

FflasFpack

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Chapter 1

FFLAS-FFPACK Documentation.

1.1 Introduction

FFLAS-FFPACK is a LGPL-2.1+ source code library for basic linear algebra operations over a finite field. It is inspired by BLAS interface (Basic Linear Algebra Subprograms) and the LAPACK library for numerical linear algebra, and shares part of their design. Yet it differs in many aspects due to the specificities of computing over a finite field:

- it is generic with respect to the finite field, so as to accomodate a large variety of field sizes and implementations;
- it is a pure source code library, to be included and compiled in the user's software. Its build system is only used for tests and benchmarks.

1.2 Goals

1.3 Design

1.4 Using FFLAS-FFPACK.

- [Copying and Licence](#).
- [Tutorial](#). This is a brief introduction to FFLAS-FFPACK capabilities.
- [Configuring and Installing FFLAS-FFPACK](#). Explains how to configure/install from sources or from the latest svn version.
- [Architecture of the library](#).. Describes how FFLAS-FFPACK is organized
- [Documentation for Users](#). If everything around is blue, then you are reading the lighter, user-oriented, documentation.
- [Documentation for Developers](#). If everything around is green, then you can get to everything (not necessarily yet) documented.

1.5 Contributing to fflas-ffpack, getting assistance.

Version

2.3.0

Chapter 2

Configuring and Installing FFLAS-FFPACK

FFLAS-FFPACK is a header-only package.

Howver configuration process can be tweaked a lot. Configure looks for BLAS routines and [Givaro](#) library which are both mandatory dependencies. See the output of `./configure -help` for information about the LAPACK/↵ BLAS discovering strategies.

Chapter 3

Copying and Licence

The FFLAS-FFPACK library is licensed under the terms of the GNU LGPL v2.1 or later.

See <https://www.gnu.org/licenses/lgpl-2.1.html>

Chapter 4

Tutorial

no doc.

Chapter 5

Architecture of the library.

no doc.

Chapter 6

Bug List

Global [DOUBLE_TO_FLOAT_CROSSOVER](#)

to be benchmarked.

Global [FFLAS::details::pack_lhs](#) (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)

this is fassign

this is fassign

Global [FFLAS::details::pack_rhs](#) (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)

this is fassign

this is fassign

Global [FFLAS::fconvert](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX, const FFLAS_ELT *Y, const size_t incY)

use cblas_(d)scal when possible

Global [FFLAS::fconvert](#) (const Field &F, const size_t n, OtherElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)

use cblas_(d)scal when possible

Global [FFLAS::finit](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global [FFLAS::finit](#) (const Field &F, const size_t n, const OtherElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)

use cblas_(d)scal when possible

Global [FFLAS::fneg](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global [FFLAS::fneg](#) (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)

use cblas_(d)scal when possible

Global [FFLAS::fnegin](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global [FFLAS::fnegin](#) (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)

use cblas_(d)scal when possible

Global [FFLAS::freduce](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::freduce** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::fscale** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, const FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)

use cblas_(d)scal when possible

Global **FFLAS::fscaln** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::fsquare** (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)

why double ?

Global **FFLAS::fswap** (const Field &F, const size_t N, typename Field::Element_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)

use cblas_dswap when double

Global **FFLAS::fswap** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)

use cblas_dswap when double

Global **FFLAS::ftrsm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)

α must be non zero.

Global **FFLAS::ftrsm** (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const FFLAS_ELT alpha, const FFLAS_ELT *A, const size_t lda, FFLAS_ELT *B, const size_t ldb)

α must be non zero.

Global **FFPACK::buildMatrix** (const Field &F, typename Field::ConstElement_ptr E, typename Field::ConstElement_ptr C, const size_t lda, const size_t *B, const size_t *T, const size_t me, const size_t mc, const size_t lambda, const size_t mu)

is this :

Global **FFPACK::invert2** (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t idx, int &nullity)

not tested.

Global **launch_fger_dispatch** (const Field &F, const size_t nn, const typename Field::Element alpha, const size_t iters, RandIter &G)

test for incx equal

test for transpo

Global **launch_MM_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename Field::Element alpha, const typename Field::Element beta, const size_t iters, RandIter &G)

test for ldX equal

test for transpo

Global **launch_MM_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename Field::Element alpha, const typename Field::Element beta, const size_t iters, const int nbw, const bool par, RandIter &G)

test for ldX equal

test for transpo

Global **printvect** (std::ostream &o, vector< T > &vect)

does not belong here

Chapter 7

Bibliography

- Global `FFLAS::Protected::TRSMBound` (const Givaro::ModularBalanced< Element > &F) .
Dumas Giorgi Pernet 06, arXiv:cs/0601133
- Global `FFPACK::LeadingSubmatrixRankProfiles` (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSn, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP) .
Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13.
- Global `FFPACK::LUdivine` (const Field &F, const `FFLAS::FFLAS_DIAG` Diag, const `FFLAS::FFLAS_TRANSPOSE` trans, const size_t M, const size_t N, typename `Field::Element_ptr` A, const size_t lda, size_t *P, size_t *Qt, const `FFPACK_LU_TAG` LuTag=FfpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE_THRESHOLD) .
Jeannerod C-P, Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013
• Pernet C, Brassel M *LUdivine, une divine factorisation LU*, 2002
- Class `ftsmLeftUpperNoTransNonUnit`< Element > .
Dumas, Giorgi, Pernet 06, arXiv:cs/0601133.
- Global `FFPACK::PLUQ` (const Field &F, const `FFLAS::FFLAS_DIAG` Diag, const size_t M, const size_t N, typename `Field::Element_ptr` A, const size_t lda, size_t *P, size_t *Q) .
Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13, 2013
- Global `FFPACK::Protected::GaussJordan` (const Field &F, const size_t M, const size_t N, typename `Field::Element_ptr` A, const size_t lda, const size_t colbeg, const size_t rowbeg, const size_t colsize, size_t *P, size_t *Q, const `FFPACK_LU_TAG` LuTag) .
Algorithm 2.8 of A. Storjohann Thesis 2000,
• Algorithm 11 of Jeannerod C-P., Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013

Chapter 8

Todo List

File `debug.h`

we should put vector printing elsewhere.

Global `FFLAS::fadd` (const Field &F, const size_t N, typename `Field::ConstElement_ptr` A, const size_t incA, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` B, const size_t incB, typename `Field::Element_ptr` C, const size_t incC)

optimise here

Global `FFLAS::fassign` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)

variant for triangular matrix

Global `FFLAS::fconvert` (const Field &F, const size_t m, const size_t n, OtherElement_ptr A, const size_t lda, typename `Field::ConstElement_ptr` B, const size_t ldb)

check if n == lda

Global `FFLAS::fneg` (const Field &F, const size_t m, const size_t n, typename `Field::ConstElement_ptr` B, const size_t ldb, typename `Field::Element_ptr` A, const size_t lda)

check if n == lda

Global `FFLAS::fnegin` (const Field &F, const size_t m, const size_t n, typename `Field::Element_ptr` A, const size_t lda)

check if n == lda

Global `FFLAS::fscal` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, const FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)

check if comparison with +/-1,0 is necessary.

Global `FFLAS::fscaln` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, FFLAS_ELT *X, const size_t incX)

check if comparison with +/-1,0 is necessary.

Global `FFLAS::Protected::igemm` (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda, const int64_t *B, size_t ldb, const int64_t beta, int64_t *C, size_t ldc)

use primitive (no `Field()`) and specialise for int64.

Global `FFLAS::Protected::MatF2MatFI_Triangular` (const Field &F, Givaro::FloatDomain::Element_ptr S, const size_t lds, typename `Field::ConstElement_ptr` const E, const size_t lde, const size_t m, const size_t n)

do finit(...,FFLAS_TRANS,FFLAS_DIAG)

do fconvert(...,FFLAS_TRANS,FFLAS_DIAG)

Global **FFPACK::LUdivine** (const Field &F, const **FFLAS::FFLAS_DIAG** Diag, const **FFLAS::FFLAS_TRANSPOSE** trans, const size_t M, const size_t N, typename **Field::Element_ptr** A, const size_t lda, size_t *P, size_t *Q, const **FFPACK::FFPACK_LU_TAG** LuTag, const size_t cutoff)
std::swap ?

Global **FFPACK::Protected::RandomKrylovPrecond** (const PolRing &PR, std::list< typename PolRing::↵
Element > &completedFactors, const size_t N, typename PolRing::Domain_t::Element_ptr A, const
size_t lda, size_t &Nb, typename PolRing::Domain_t::Element_ptr &B, size_t &ldb, typename PolRing::↵
Domain_t::RandIter &g, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)
don't assing K2 c*noc x N but only mas (c,noc) x N and store each one after the other

swap to save space ??

Module **field**

biblio

Global **launch_fger_dispatch** (const Field &F, const size_t nn, const typename **Field::Element** alpha, const
size_t iters, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Global **launch_MM_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename
Field::Element alpha, const typename **Field::Element** beta, const size_t iters, const int nbw, const bool
par, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Global **launch_MM_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename
Field::Element alpha, const typename **Field::Element** beta, const size_t iters, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Global **test_redcochelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, **FFPACK::FFPACK_LU_TAG**
LuTag, RandIter &G, bool par)

check lda

Global **test_redrowechelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, **FFPACK::FFPACK_LU_TAG**
LuTag, RandIter &G, bool par)

check lda

Module **MMalgos**

biblio

Module **simd**

biblio

Global **test_cochelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, **FFPACK::FFPACK_LU_TAG** LuTag,
RandIter &G, bool par)

check lda

Global **test_det** (Field &F, size_t n, int iter, RandIter &G)

test with stride

Global **test_rowechelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, **FFPACK::FFPACK_LU_TAG** LuTag,
RandIter &G, bool par)

check lda

Chapter 9

Module Index

9.1 Modules

Here is a list of all modules:

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| Matrix Multiplication Algorithms | 45 |
| SIMD wrapper | 46 |
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| FFLAS | 45 |
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| RNS | 47 |

Chapter 10

Namespace Index

10.1 Namespace List

Here is a list of all namespaces with brief descriptions:

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| FFLAS | 49 |
| FFLAS::BLAS3 | 196 |
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| FFLAS::CuttingStrategy | 202 |
| FFLAS::details | 203 |
| FFLAS::details_spmv | 211 |
| FFLAS::ElementCategories | 211 |
| FFLAS::FieldCategories | |
| Traits and categories will need to be placed in a proper file later | 212 |
| FFLAS::MMHelperAlgo | 212 |
| FFLAS::ModeCategories | |
| Specifies the mode of action for an algorithm w.r.t | 212 |
| FFLAS::ParSeqHelper | |
| ParSeqHelper for both fgemm and ftrsm | 213 |
| FFLAS::Protected | 213 |
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| FFLAS::StrategyParameter | 285 |
| FFLAS::StructureHelper | |
| StructureHelper for ftrsm | 285 |
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| FFPACK | |
| Finite Field PACK Set of elimination based routines for dense linear algebra | 292 |
| FFPACK::Protected | 394 |
| Givaro | 401 |
| MKL_CONFIG | 401 |
| RecInt | 401 |

Chapter 11

Hierarchical Index

11.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

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| AlgoChooser< ModeT, ParSeq > | 403 |
| AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > | 403 |
| ArbitraryPrecIntTag | 403 |
| AreEqual< X, Y > | 404 |
| AreEqual< X, X > | 404 |
| Argument | 404 |
| associatedDelayedField< Field > | 405 |
| associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > > | 405 |
| associatedDelayedField< const Givaro::Modular< T, X > > | 406 |
| associatedDelayedField< const Givaro::ModularBalanced< T > > | 406 |
| associatedDelayedField< const Givaro::ZRing< T > > | 407 |
| Auto | 407 |
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| Block | 407 |
| callLUdivine_small< Element > | 408 |
| callLUdivine_small< double > | 408 |
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| CharpolyFailed | 409 |
| Checker_Empty< Field > | 409 |
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| compatible_data_type< Field > | 418 |
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| <code>Compose< H1, H2 ></code> | 419 |
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| <code>Simd128_impl< true, true, false, 2 >::Converter</code> | 420 |
| <code>Simd128_impl< true, true, false, 4 >::Converter</code> | 421 |
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Data Structure Index

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Chapter 13

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| simd256.inl | 1050 |
| simd256_double.inl | 1050 |
| simd256_float.inl | 1051 |
| simd256_int16.inl | 1051 |
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| simd256_int64.inl | 1052 |
| simd512.inl | 1052 |
| simd512_double.inl | 1053 |
| simd512_float.inl | 1053 |
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| simd512_int64.inl | 1054 |
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| test-charpoly.C | 1057 |
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| test-fgesv.C | 1073 |
| test-finit.C | 1074 |
| test-fscal.C | 1075 |
| test-fsyr2k.C | 1076 |
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| test-ftrmm.C | 1081 |
| test-ftrmv.C | 1082 |
| test-ftrsm-check.C | 1083 |
| test-ftrsm.C | 1084 |
| test-ftrssyr2k.C | 1085 |
| test-ftrstr.C | 1086 |
| test-ftrsv.C | 1088 |
| test-ftrtri.C | 1089 |
| test-interfaces-c.c | 1090 |
| test-invert-check.C | 1090 |
| test-io.C | 1091 |
| test-lu.C | 1092 |
| test-maxdelayeddim.C | 1096 |
| test-minpoly.C | 1097 |
| test-multifile1.C | 1098 |
| test-multifile2.C | 1098 |
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| test-pluq-check.C | 1101 |
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Chapter 14

Module Documentation

14.1 CHECKER

Class CHECKER provides functions to verify computations in [FFLAS](#) and [FFPACK](#).

Class CHECKER provides functions to verify computations in [FFLAS](#) and [FFPACK](#).

14.2 FFLAS

The C-style wrapper of BLAS for finite field linear algebra.

The C-style wrapper of BLAS for finite field linear algebra.

[FFLAS](#), Finite Field Linear Algebra Subroutines, provide basic linear algebra subroutines based on the BLAS interface. Therefore, the specifications are in C style; only the field given as a template parameter requires C++.

As much as possible, these routines use [ATLAS/BLAS](#) computations and achieve therefore high efficiency.

14.3 Matrix Multiplication Algorithms

Matrix Multiplication (level 3) algorithms.

Files

- file [schedule_bini.inl](#)
Bini implementation.

14.3.1 Detailed Description

Matrix Multiplication (level 3) algorithms.

[Todo](#) biblio

14.4 SIMD wrapper

wraps SIMD functions Supportst SSE4.1, AVX, AVX2.

wraps SIMD functions Supportst SSE4.1, AVX, AVX2.

Todo biblio

14.5 FFLAS-FFPACK

the [FFLAS FFPACK](#) library

Modules

- [FFLAS](#)
The C-style wrapper of BLAS for finite field linear algebra.
- [Interfaces](#)
Intefaces for FFLAS-FFPACK.

14.5.1 Detailed Description

the [FFLAS FFPACK](#) library

C++ header library for fast exact dense linear algebra

See also

[FFLAS](#)
[FFPACK](#)

14.6 FFPACK

Class [FFPACK](#) provides functions using fflas much as Lapack uses BLAS.

Class [FFPACK](#) provides functions using fflas much as Lapack uses BLAS.

14.7 FFLAS-FFPACK fields

fields in the FFLAS-FFPACK library

Files

- file [rns-double-elt.h](#)
rns elt structure with double support
- file [rns-double.h](#)
rns structure with double support
- file [rns-integer-mod.h](#)
representation of $\mathbb{Z}/p\mathbb{Z}$ using RNS representation (note: fixed precision)
- file [rns-integer.h](#)
representation of \mathbb{Z} using RNS representation (note: fixed precision)
- file [rns.h](#)

14.7.1 Detailed Description

fields in the FFLAS-FFPACK library

Unparametric/Random elements

[Todo](#) biblio

14.8 RNS

just include them all

just include them all

14.9 Interfaces

Intefaces for FFLAS-FFPACK.

Intefaces for FFLAS-FFPACK.

C interface in folder

See also

libs

Chapter 15

Namespace Documentation

15.1 FFLAS Namespace Reference

Namespaces

- [BLAS3](#)
- [csr_hyb_details](#)
- [CuttingStrategy](#)
- [details](#)
- [details_spmv](#)
- [ElementCategories](#)
- [FieldCategories](#)

Traits and categories will need to be placed in a proper file later.

- [MMHelperAlgo](#)
- [ModeCategories](#)

Specifies the mode of action for an algorithm w.r.t.

- [ParSeqHelper](#)

ParSeqHelper for both fgemm and ftrsm.

- [Protected](#)
- [sell_details](#)
- [sparse_details](#)
- [sparse_details_impl](#)
- [StrategyParameter](#)
- [StructureHelper](#)

StructureHelper for ftrsm.

- [vectorised](#)

Data Structures

- struct [Checker_Empty](#)
- class [CheckerImplem_fgemm](#)
- class [CheckerImplem_ftrsm](#)
- struct [support_simd_add](#)
- struct [MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >](#)
- struct [MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >](#)
- struct [MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >](#)

- struct [support_simd_mod](#)
- struct [support_fast_mod](#)
- struct [support_fast_mod< float >](#)
- struct [support_fast_mod< double >](#)
- struct [support_fast_mod< int64_t >](#)
- struct [AlgoChooser](#)
- struct [AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >](#)
- struct [MMHelper](#)
- struct [MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >](#)

FGEMM Helper for Default and ConvertTo modes of operation.

- struct [MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait >](#)
- struct [TRSMHelper](#)

TRSM Helper.

- struct [support_simd](#)
- struct [Sparse< _Field, SparseMatrix_t::COO >](#)
- struct [Sparse< _Field, SparseMatrix_t::COO_ZO >](#)
- struct [Sparse< _Field, SparseMatrix_t::CSR >](#)
- struct [Sparse< _Field, SparseMatrix_t::CSR_ZO >](#)
- struct [Sparse< _Field, SparseMatrix_t::CSR_HYB >](#)
- struct [Sparse< _Field, SparseMatrix_t::ELL >](#)
- struct [Sparse< _Field, SparseMatrix_t::ELL_ZO >](#)
- struct [Sparse< _Field, SparseMatrix_t::ELL_simd >](#)
- struct [Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >](#)
- struct [Sparse< _Field, SparseMatrix_t::HYB_ZO >](#)
- struct [readMyMachineType](#)
- struct [readMyMachineType< Field, mpz_t >](#)
- struct [Sparse< _Field, SparseMatrix_t::SELL >](#)
- struct [Sparse< _Field, SparseMatrix_t::SELL_ZO >](#)
- struct [isSparseMatrix](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >](#)
- struct [isZOSparseMatrix](#)
- struct [isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >](#)
- struct [isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >](#)
- struct [isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >](#)
- struct [isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >](#)
- struct [isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >](#)
- struct [isSparseMatrixSimdFormat](#)
- struct [isSparseMatrixMKLFormat](#)
- struct [tfn_plus](#)
- struct [tfn_mul](#)
- struct [tfn_mul_eq](#)
- struct [tfn_minus](#)
- struct [tfn_plus_eq](#)

- struct [tfn_minus_eq](#)
- struct [has_plus_impl](#)
- struct [has_mul_impl](#)
- struct [has_mul_eq_impl](#)
- struct [has_plus_eq_impl](#)
- struct [has_minus_eq_impl](#)
- struct [has_minus_impl](#)
- struct [has_operation](#)
- struct [StatsMatrix](#)
- struct [Sparse](#)
- struct [HelperFlag](#)
- struct [CsrMat](#)
- struct [CooMat](#)
- struct [EiIMat](#)
- struct [SpMat](#)
- struct [ElementTraits](#)

ElementTraits.

- struct [ElementTraits< float >](#)
- struct [ElementTraits< double >](#)
- struct [ElementTraits< int8_t >](#)
- struct [ElementTraits< int16_t >](#)
- struct [ElementTraits< int32_t >](#)
- struct [ElementTraits< int64_t >](#)
- struct [ElementTraits< uint8_t >](#)
- struct [ElementTraits< uint16_t >](#)
- struct [ElementTraits< uint32_t >](#)
- struct [ElementTraits< uint64_t >](#)
- struct [ElementTraits< Givaro::Integer >](#)
- struct [ElementTraits< Reclnt::rint< K > >](#)
- struct [ElementTraits< Reclnt::ruint< K > >](#)
- struct [ElementTraits< Reclnt::rmint< K, MG > >](#)
- struct [ElementTraits< FFPACK::rns_double_elt >](#)
- struct [ModeTraits](#)

ModeTraits.

- struct [ModeTraits< Givaro::Modular< Element, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< int8_t, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< int16_t, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< int32_t, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< uint8_t, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< uint16_t, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< uint32_t, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< Givaro::Integer, Compute > >](#)
- struct [ModeTraits< Givaro::Modular< Reclnt::ruint< K >, Compute > >](#)
- struct [ModeTraits< Givaro::ModularBalanced< Element > >](#)
- struct [ModeTraits< Givaro::ModularBalanced< int8_t > >](#)
- struct [ModeTraits< Givaro::ModularBalanced< int16_t > >](#)
- struct [ModeTraits< Givaro::ModularBalanced< int32_t > >](#)
- struct [ModeTraits< Givaro::ModularBalanced< Givaro::Integer > >](#)
- struct [ModeTraits< Givaro::ZRing< Givaro::Integer > >](#)
- struct [ModeTraits< Givaro::ZRing< float > >](#)
- struct [ModeTraits< Givaro::ZRing< double > >](#)
- struct [ModeTraits< Givaro::Montgomery< T > >](#)
- struct [FieldTraits](#)

FieldTrait.

- struct [FieldTraits](#)< [Givaro::ZRing](#)< [Reclnt::ruint](#)< K > > >
- struct [FieldTraits](#)< [Givaro::Modular](#)< [Element](#) > >
- struct [FieldTraits](#)< [Givaro::ModularBalanced](#)< [Element](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [double](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [float](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [int16_t](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [uint16_t](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [int32_t](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [uint32_t](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [int64_t](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [uint64_t](#) > >
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) > >
- struct [FieldTraits](#)< [FFPACK::RNSInteger](#)< T > >
- struct [FieldTraits](#)< [FFPACK::RNSIntegerMod](#)< T > >
- struct [associatedDelayedField](#)
- struct [associatedDelayedField](#)< const [Givaro::Modular](#)< T, X > >
- struct [associatedDelayedField](#)< const [Givaro::ModularBalanced](#)< T > >
- struct [associatedDelayedField](#)< const [Givaro::ZRing](#)< T > >
- struct [associatedDelayedField](#)< const [FFPACK::RNSIntegerMod](#)< RNS > >
- struct [ForStrategy1D](#)
- struct [ForStrategy2D](#)

Typedefs

- template<class Field >
using [Checker_fgemm](#) = [FFLAS::Checker_Empty](#)< Field >
- template<class Field >
using [Checker_ftrsm](#) = [FFLAS::Checker_Empty](#)< Field >
- template<class Field >
using [ForceCheck_fgemm](#) = [CheckerImplem_fgemm](#)< Field >
- template<class Field >
using [ForceCheck_ftrsm](#) = [CheckerImplem_ftrsm](#)< Field >
- using [ZOSparseMatrix](#) = std::true_type
- using [NotZOSparseMatrix](#) = std::false_type
- using [SimdSparseMatrix](#) = std::true_type
- using [NoSimdSparseMatrix](#) = std::false_type
- using [MKLSparseMatrixFormat](#) = std::true_type
- using [NotMKLSparseMatrixFormat](#) = std::false_type
- template<class T >
using [has_plus](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, [has_plus_impl](#)< T > >::type
- template<class T >
using [has_minus](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, [has_minus_impl](#)< T > >::type
- template<class T >
using [has_equal](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, std::is_copyable_↵_assignable< T > >::type
- template<class T >
using [has_plus_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, [has_plus_eq_impl](#)< T > >::type
- template<class T >
using [has_minus_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, [has_minus_eq_impl](#)< T > >::type

- `template<class T >`
using `has_mul` = `typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_impl< T > >::type`
- `template<class T >`
using `has_mul_eq` = `typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_eq_impl< T > >::type`
- `typedef Givaro::Timer` `Timer`
- `typedef Givaro::BaseTimer` `BaseTimer`
- `typedef Givaro::UserTimer` `UserTimer`
- `typedef Givaro::SysTimer` `SysTimer`

Enumerations

- enum `FFLAS_ORDER` { `FflasRowMajor` = 101 , `FflasColMajor` = 102 }
Storage by row or col ?
- enum `FFLAS_TRANSPOSE` { `FflasNoTrans` = 111 , `FflasTrans` = 112 }
Is matrix transposed ?
- enum `FFLAS_UPLO` { `FflasUpper` = 121 , `FflasLower` = 122 }
Is triangular matrix's shape upper ?
- enum `FFLAS_DIAG` { `FflasNonUnit` = 131 , `FflasUnit` = 132 }
Is the triangular matrix implicitly unit diagonal ?
- enum `FFLAS_SIDE` { `FflasLeft` = 141 , `FflasRight` = 142 }
On what side ?
- enum `FFLAS_BASE` { `FflasDouble` = 151 , `FflasFloat` = 152 , `FflasGeneric` = 153 }
FFLAS_BASE determines the type of the element representation for Matrix Mult kernel.
- enum `number_kind` { `zero` = 0 , `one` = 1 , `mone` = -1 , `other` = 2 }
- enum class `SparseMatrix_t` {
 `CSR` , `CSR_ZO` , `CSC` , `CSC_ZO` ,
 `COO` , `COO_ZO` , `ELL` , `ELL_ZO` ,
 `SELL` , `SELL_ZO` , `ELL_simd` , `ELL_simd_ZO` ,
 `CSR_HYB` , `HYB_ZO` }
- enum `FFLAS_FORMAT` {
 `FflasAuto` = 0 , `FflasDense` = 1 , `FflasSMS` = 2 , `FflasBinary` = 3 ,
 `FflasMath` = 4 , `FflasMaple` = 5 , `FflasSageMath` = 6 }

Functions

- `Givaro::Integer` `InfNorm` (const `size_t` M, const `size_t` N, const `Givaro::Integer` *A, const `size_t` lda)
- `template<class T >`
const `T` & `min3` (const `T` &m, const `T` &n, const `T` &k)
- `template<class T >`
const `T` & `max3` (const `T` &m, const `T` &n, const `T` &k)
- `template<class T >`
const `T` & `min4` (const `T` &m, const `T` &n, const `T` &k, const `T` &l)
- `template<class T >`
const `T` & `max4` (const `T` &m, const `T` &n, const `T` &k, const `T` &l)
- `template<class Field >`
void `fadd` (const `Field` &F, const `size_t` N, `typename Field::ConstElement_ptr` A, const `size_t` inca, `typename Field::ConstElement_ptr` B, const `size_t` incb, `typename Field::Element_ptr` C, const `size_t` incc)
- `template<class Field >`
void `faddin` (const `Field` &F, const `size_t` N, `typename Field::ConstElement_ptr` B, const `size_t` incb, `typename Field::Element_ptr` C, const `size_t` incc)

- `template<class Field >`
`void fsub (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fadd : matrix addition.
- `template<class Field >`
`void fsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fsub : matrix subtraction.
- `template<class Field >`
`void faddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
faddin
- `template<class Field >`
`void fsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fsubin $C = C - B$
- `template<class Field >`
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fadd : matrix addition with scaling.
- `template<class Field >`
`void fassign (const Field &F, const size_t N, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`
fassign : $x \leftarrow y$.
- `template<> void fassign (const Givaro::Modular< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`

- `template<> void fassign (const Givaro::Modular< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<class Field >`
`void fassign (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`

$$fassign : A \leftarrow B.$$
- `template<class Field >`
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<> void faxpy (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void faxpy (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<class Field >`
`void faxpy (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t ldx, typename Field::Element_ptr Y, const size_t ldy)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DelayedTag &MT)`
- `template<> Givaro::DoubleDomain::Element fdot (const Givaro::DoubleDomain &, const size_t N, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<> Givaro::FloatDomain::Element fdot (const Givaro::FloatDomain &, const size_t N, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<class Field , class T >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::ConvertTo< T > &MT)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultBoundedTag &dbt)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, const ParSeqHelper::Sequential seq)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`

$$fdot: \text{dot product } x^T y.$$
- `template<typename RNS , typename ParSeqTrait >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >`

- >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > &H)
- template<typename RNS >
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Sequential > &H)
 - template<typename RNS, typename ParSeqTrait >
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads >, ParSeqTrait > > &H)
 - template<typename RNS, typename Cut, typename Param >
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Parallel< Cut, Param > > &H)
 - template<class ParSeq >
Givaro::Integer * fgemm (const Givaro::ZRing< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)
 - template<typename RNS, class ModeT >
RNS::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element alpha, typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd, const size_t ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential > &H)
 - template<typename RNS >
RNS::Element_ptr fgemm (const FFPACK::RNSIntegerMod< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element alpha, typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd, const size_t ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > &H)
 - Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
 - template<class ParSeq >
Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Auto, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)

- `template<size_t K1, size_t K2, class ParSeq >`
`Reclnt::ruint< K1 > * fgemm (const Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > >`
`&F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n,`
`const size_t k, const Reclnt::ruint< K1 > alpha, const Reclnt::ruint< K1 > *A, const size_t lda, const`
`Reclnt::ruint< K1 > *B, const size_t ldb, Reclnt::ruint< K1 > beta, Reclnt::ruint< K1 > *C, const size_t`
`ldc, MMHelper< Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > >, MMHelperAlgo::Classic,`
`ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`
- `template<class Field, class ModeT >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::Winograd, ModeT > &H)`
- `template<class Field, class ModeT, class Cut, class Param >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::WinogradPar, ModeT, ParSeqHelper::Parallel< Cut, Param > > &H)`
- `template<class Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper<`
`Field, MMHelperAlgo::Winograd, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >,`
`ParSeqHelper::Sequential > &H)`
- `template<typename Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, type-`
`name Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t`
`ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const`
`ParSeqHelper::Sequential seq)`
- `template<typename Field, class Cut, class Param >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, type-`
`name Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t`
`ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const`
`ParSeqHelper::Parallel< Cut, Param > par)`
- `template<typename Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const`
`typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`

fgemm: Field GENERAL Matrix Multiply.
- `template<typename Field, class ModeT, class ParSeq >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::Auto, ModeT, ParSeq > &H)`
- `template<class Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential > &H)`
- `template<class Field >`
`Field::Element_ptr fsquare (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename`

[Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc)

fsquare: Squares a matrix.

- `template<> double * fsquare (const Givaro::ModularBalanced< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::ModularBalanced< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`
- `template<> double * fsquare (const Givaro::Modular< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::Modular< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`
- `template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > > &H)`
- `template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)`
- `template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)`
- `template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE TransA, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`

finite prime Field GEneral Matrix Vector multiplication.

- `Givaro::ZRing< int64_t >::Element_ptr fgemv (const Givaro::ZRing< int64_t > &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const int64_t alpha, const int64_t *A, const size_t lda, const int64_t *X, const size_t incX, const int64_t beta, int64_t *Y, const size_t incY, MMHelper< Givaro::ZRing< int64_t >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `Givaro::DoubleDomain::Element_ptr fgemv (const Givaro::DoubleDomain &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const Givaro::DoubleDomain::Element alpha, const Givaro::DoubleDomain::ConstElement_ptr A, const size_t lda, const Givaro::DoubleDomain::ConstElement_ptr X, const size_t incX, const Givaro::DoubleDomain::Element beta, Givaro::DoubleDomain::Element_ptr Y, const size_t incY, MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H)`

- [Givaro::FloatDomain::Element_ptr fgemv](#) (const [Givaro::FloatDomain](#) &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [Givaro::FloatDomain::Element](#) alpha, const [Givaro::FloatDomain::ConstElement_ptr](#) A, const size_t lda, const [Givaro::FloatDomain::ConstElement_ptr](#) X, const size_t incX, const [Givaro::FloatDomain::Element](#) beta, [Givaro::FloatDomain::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [Givaro::FloatDomain](#), [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- template<class [Field](#) , class [Cut](#) , class [Param](#) >
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, [ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > &parH)
- template<class [Field](#) >
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, [ParSeqHelper::Sequential](#) &seqH)
- [FFPACK::rns_double::Element_ptr fgemv](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- [FFPACK::rns_double::Element_ptr fgemv](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- [Givaro::Integer * fgemv](#) (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [Givaro::Integer](#) alpha, [Givaro::Integer *A](#), const size_t lda, [Givaro::Integer *X](#), const size_t ldx, [Givaro::Integer](#) beta, [Givaro::Integer *Y](#), const size_t ldy, [MMHelper](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) > > &H)
- [Givaro::Integer * fgemv](#) (const [Givaro::Modular](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [Givaro::Integer](#) alpha, [Givaro::Integer *A](#), const size_t lda, [Givaro::Integer *X](#), const size_t ldx, [Givaro::Integer](#) beta, [Givaro::Integer *Y](#), const size_t ldy, [MMHelper](#)< [Givaro::Modular](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) > > &H)
- template<size_t K1, size_t K2, class [ParSeq](#) >
[RecInt::ruint](#)< K1 > * [fgemv](#) (const [Givaro::Modular](#)< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [RecInt::ruint](#)< K1 > alpha, const [RecInt::ruint](#)< K1 > *A, const size_t lda, const [RecInt::ruint](#)< K1 > *X, const size_t incx, [RecInt::ruint](#)< K1 > beta, [RecInt::ruint](#)< K1 > *Y, const size_t incy, [MMHelper](#)< [Givaro::Modular](#)< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) >, [ParSeq](#) > &H)
- template<class [Field](#) >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda)
fger: rank one update of a general matrix
- template<class [Field](#) >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) > > &H)
- template<class [Field](#) , class [AnyTag](#) >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [AnyTag](#) > &H)

- void `fger` (const Givaro::DoubleDomain &F, const size_t M, const size_t N, const Givaro::DoubleDomain::Element alpha, const Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, const Givaro::DoubleDomain::ConstElement_ptr y, const size_t incy, Givaro::DoubleDomain::Element_ptr A, const size_t lda, MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<class Field >
void `fger` (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, const typename Field::ConstElement_ptr x, const size_t incx, const typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H)
- void `fger` (const Givaro::FloatDomain &F, const size_t M, const size_t N, const Givaro::FloatDomain::Element alpha, const Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, const Givaro::FloatDomain::ConstElement_ptr y, const size_t incy, Givaro::FloatDomain::Element_ptr A, const size_t lda, MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<class Field >
void `fger` (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)
- template<class Field >
void `fger` (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)
- void `fger` (const Givaro::Modular< Givaro::Integer > &F, const size_t M, const size_t N, const typename Givaro::Integer alpha, typename Givaro::Integer *x, const size_t incx, typename Givaro::Integer *y, const size_t incy, typename Givaro::Integer *A, const size_t lda, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
- template<typename RNS >
void `fger` (const FFPACK::RNSInteger< RNS > &F, const size_t M, const size_t N, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::Element_ptr x, const size_t incx, typename FFPACK::RNSInteger< RNS >::Element_ptr y, const size_t incy, typename FFPACK::RNSInteger< RNS >::Element_ptr A, const size_t lda, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<typename RNS >
void `fger` (const FFPACK::RNSIntegerMod< RNS > &F, const size_t M, const size_t N, const typename FFPACK::RNSIntegerMod< RNS >::Element alpha, typename FFPACK::RNSIntegerMod< RNS >::Element_ptr x, const size_t incx, typename FFPACK::RNSIntegerMod< RNS >::Element_ptr y, const size_t incy, typename FFPACK::RNSIntegerMod< RNS >::Element_ptr A, const size_t lda, MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Classic > &H)
- template<class Field >
void `freduce` (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)
$$freduce\ x \leftarrow ymodF.$$
- template<class Field >
void `freduce` (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)
$$freduce\ x \leftarrow xmodF.$$
- template<class Field >
void `freduce_constoverride` (const Field &F, const size_t m, typename Field::ConstElement_ptr A, const size_t incX)
- template<class Field, class ConstOtherElement_ptr >
void `finit` (const Field &F, const size_t n, ConstOtherElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)
- template<class Field >
void `finit` (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)
$$finit\ \text{Initializes } X \text{ in } F\$.$$
- template<class Field >
void `freduce` (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)

- $$freduce\ A \leftarrow A \bmod F.$$
 - template<class Field >
void `pfreduce` (const `Field` &F, const size_t m, const size_t n, typename `Field::Element_ptr` A, const size_t lda, const size_t numths)
 - template<class Field >
void `freduce` (const `Field` &F, const size_t m, const size_t n, typename `Field::ConstElement_ptr` B, const size_t ldb, typename `Field::Element_ptr` A, const size_t lda)
$$freduce\ A \leftarrow B \bmod F.$$
 - template<class Field >
void `freduce_constoverride` (const `Field` &F, const size_t m, const size_t n, typename `Field::ConstElement_ptr` A, const size_t lda)
 - template<class Field, class OtherElement_ptr >
void `finit` (const `Field` &F, const size_t m, const size_t n, const OtherElement_ptr B, const size_t ldb, typename `Field::Element_ptr` A, const size_t lda)
$$finit\ A \leftarrow B \bmod F.$$
 - template<class Field >
void `finit` (const `Field` &F, const size_t m, const size_t n, typename `Field::Element_ptr` A, const size_t lda)
$$finit\ \text{Initializes } A \text{ in } F^S.$$
 - template<> void `freduce` (const `FFPACK::RNSIntegerMod`< `FFPACK::rns_double` > &F, const size_t n, `FFPACK::RNSIntegerMod`< `FFPACK::rns_double` >::Element_ptr A, size_t inc)
 - template<> void `freduce` (const `FFPACK::RNSIntegerMod`< `FFPACK::rns_double` > &F, const size_t m, const size_t n, `FFPACK::rns_double::Element_ptr` A, size_t lda)
 - template<class Field >
bool `freivalds` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size_t m, const size_t n, const size_t k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size_t lda, typename `Field::ConstElement_ptr` B, const size_t ldb, typename `Field::ConstElement_ptr` C, const size_t ldc)
$$freivalds: \text{Freivalds } \mathbf{GENERAL\ Matrix\ Multiply\ Random\ Check}.$$
 - template<class Field >
void `fscal` (const `Field` &F, const size_t n, const typename `Field::Element` alpha, typename `Field::Element_ptr` X, const size_t incX)
$$fscal\ x \leftarrow \alpha \cdot x.$$
 - template<class Field >
void `fscal` (const `Field` &F, const size_t n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` X, const size_t incX, typename `Field::Element_ptr` Y, const size_t incY)
$$fscal\ y \leftarrow \alpha \cdot x.$$
 - template<> void `fscal` (const `Givaro::DoubleDomain` &, const size_t N, const `Givaro::DoubleDomain::Element` a, `Givaro::DoubleDomain::ConstElement_ptr` x, const size_t incx, `Givaro::DoubleDomain::Element_ptr` y, const size_t incy)
 - template<> void `fscal` (const `Givaro::FloatDomain` &, const size_t N, const `Givaro::FloatDomain::Element` a, `Givaro::FloatDomain::ConstElement_ptr` x, const size_t incx, `Givaro::FloatDomain::Element_ptr` y, const size_t incy)
 - template<> void `fscal` (const `Givaro::DoubleDomain` &, const size_t N, const `Givaro::DoubleDomain::Element` a, `Givaro::DoubleDomain::Element_ptr` y, const size_t incy)
 - template<> void `fscal` (const `Givaro::FloatDomain` &, const size_t N, const `Givaro::FloatDomain::Element` a, `Givaro::FloatDomain::Element_ptr` y, const size_t incy)
 - template<class Field >
void `fscal` (const `Field` &F, const size_t m, const size_t n, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const size_t lda)
$$fscal\ A \leftarrow \alpha \cdot A.$$
 - template<class Field >
void `fscal` (const `Field` &F, const size_t m, const size_t n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size_t lda, typename `Field::Element_ptr` B, const size_t ldb)
$$fscal\ B \leftarrow \alpha \cdot A.$$
 - template<> void `fscal` (const `FFPACK::RNSInteger`< `FFPACK::rns_double` > &F, const size_t n, const `FFPACK::rns_double::Element` alpha, `FFPACK::rns_double::Element_ptr` A, const size_t inc)

- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`
- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha, typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A, const size_t inc)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<class Field >`
`Field::Element_ptr fsyr2k (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
fsyr2k: Symmetric Rank 2K update
- `template<class Field >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
fsyrk: Symmetric Rank K update
- `template<class Field >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)`
fsyrk: Symmetric Rank K update with diagonal scaling
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold)`
- `template<class Field >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const std::vector< bool > &twoBlock, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)`
fsyrk: Symmetric Rank K update with diagonal scaling
- `template<class Field >`
`void ftrmm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE`

TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)

ftmm: TRIangular Matrix Multiply.

- template<class Field >

void **ftmm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)

ftmm: TRIangular Matrix Multiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$ or $C \leftarrow \alpha B \text{op}(A) + \text{beta}C$.
- template<class Field >

void **ftsm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)
- template<class Field >

void **ftsm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Sequential &PSH)
- template<class Field, class Cut, class Param >

void **ftsm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Parallel< Cut, Param > &PSH)
- template<class Field, class ParSeqTrait = ParSeqHelper::Sequential>

void **ftsm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Recursive, ParSeqTrait > &H)
- void **ftsm** (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, Givaro::Integer *B, const size_t ldb)
- void **cblas_imptrsm** (const enum FFLAS_ORDER Order, const enum FFLAS_SIDE Side, const enum FFLAS_UPLO Uplo, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_DIAG Diag, const int M, const int N, const FFPACK::rns_double_elt alpha, FFPACK::rns_double_elt_cstptr A, const int lda, FFPACK::rns_double_elt_ptr B, const int ldb)
- template<class Field >

void **ftsv** (const Field &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, int incX)

ftsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$
- void **igemm_** (const enum FFLAS_ORDER Order, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, const size_t M, const size_t N, const size_t K, const int64_t alpha, const int64_t *A, const size_t lda, const int64_t *B, const size_t ldb, const int64_t beta, int64_t *C, const size_t ldc)
- template<class Field, class OtherElement_ptr >

void **finit** (const Field &F, const size_t n, const OtherElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)

finit $x \leftarrow y \bmod F$.
- template<class Field, class OtherElement_ptr >

void **fconvert** (const Field &F, const size_t n, OtherElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)

fconvert $x \leftarrow y \bmod F$.
- template<class Field >

void **fnegin** (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)

fnegin $x \leftarrow -x$.
- template<class Field >

void **fneg** (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)

- $f_{neg} x \leftarrow -y.$
- template<class Field >
 void **fzero** (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)
 $f_{zero} : A \leftarrow 0.$
- template<class Field , class RandIter >
 void **frand** (const Field &F, RandIter &G, const size_t n, typename Field::Element_ptr X, const size_t incX)
 $frand : A \leftarrow random.$
- template<class Field >
 bool **fiszero** (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX)
 $f_{iszero} : test X = 0.$
- template<class Field >
 bool **fequal** (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)
 $fequal : test X = Y.$
- template<class Field >
 void **faxpby** (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)
 $faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$
- template<typename Field , class Cut , class Param >
 Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY, const ParSeqHelper::Parallel< Cut, Param > par)
- template<class Field >
 void **fswap** (const Field &F, const size_t N, typename Field::Element_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)
 $f_{swap} : X \leftrightarrow Y.$
- template<class Field >
 void **fzero** (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $f_{zero} : A \leftarrow 0.$
- template<class Field , class RandIter >
 void **frand** (const Field &F, RandIter &G, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $frand : A \leftarrow random.$
- template<class Field >
 bool **fequal** (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb)
 $fequal : test A = B.$
- template<class Field >
 bool **fiszero** (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda)
 $f_{iszero} : test A = 0.$
- template<class Field >
 void **fidentity** (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda, const typename Field::Element &d)
 $creates a diagonal matrix$
- template<class Field >
 void **fidentity** (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $creates a diagonal matrix$
- template<class Field , class OtherElement_ptr >
 void **finit** (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $f_{init} Initializes A in F\$.$
- template<class Field , class OtherElement_ptr >
 void **fconvert** (const Field &F, const size_t m, const size_t n, OtherElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb)

- $fconvert\ A \leftarrow B \bmod F.$
- template<class Field >
void **fnegin** (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $fnegin\ A \leftarrow -A.$
- template<class Field >
void **fneg** (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)
 $fneg\ A \leftarrow -B.$
- template<class Field >
void **faxpby** (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t idx, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t ldy)
 $faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$
- template<class Field >
void **fmove** (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)
 $fmove : A \leftarrow B\ and\ B \leftarrow 0.$
- template<class Field >
size_t **bitsize** (const Field &F, size_t M, size_t N, const typename Field::ConstElement_ptr A, size_t lda)
bitsize: Computes the largest bitsize of the matrix' coefficients.
- template<> size_t **bitsize< Givaro::ZRing< Givaro::Integer > >** (const Givaro::ZRing< Givaro::Integer > &F, size_t M, size_t N, const Givaro::Integer *A, size_t lda)
- template<class Field >
void **ftsmv** (const Field &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, int incX)
ftsm: TRIangular Matrix Vector prodcut Computes $X \leftarrow op(A)X$
- template<class Field >
void **ftsm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)
ftsm: TRIangular System solve with Matrix.
- template<typename Field >
Field::Element_ptr **pfgemm** (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, size_t numthreads=0)
- template<class Field >
Field::Element * **pfgemm_1D_rec** (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, size_t seuil)
- template<class Field >
Field::Element * **pfgemm_2D_rec** (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, size_t seuil)
- template<class Field >
Field::Element * **pfgemm_3D_rec** (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, size_t seuil, size_t *x)
- template<class Field >
Field::Element_ptr **pfgemm_3D_rec2** (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, size_t seuil, size_t *x)

- `template<class Field , class ModeTrait , class Strat , class Param >`
`std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag`
`>>::value, typename Field::Element_ptr >::type fgemm (const Field &F, const FFLAS::FFLAS_TRANSPOSE`
`ta, const FFLAS::FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const`
`typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename`
`Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr`
`C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat,`
`Param > > &H)`
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr ftrsm (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_UPLO`
`UpLo, const FFLAS::FFLAS_TRANSPOSE TA, const FFLAS::FFLAS_DIAG Diag, const size_t m, const`
`size_t n, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename`
`Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel<`
`Cut, Param > > &H)`
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr ftrsm (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_UPLO`
`UpLo, const FFLAS::FFLAS_TRANSPOSE TA, const FFLAS::FFLAS_DIAG Diag, const size_t m, const`
`size_t n, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename`
`Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Hybrid, ParSeqHelper::Parallel< Cut,`
`Param > > &H)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::COO > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::COO_ZO > &A)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO > &A, const IndexT *row, const IndexT`
`*col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO_ZO > &A, const IndexT *row, const`
`IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_ZO > &A)`
- `template<class Field >`
`std::ostream & sparse_print (std::ostream &os, const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class IndexT >`
`void sparse_init (const Givaro::Modular< Givaro::Integer > &F, Sparse< Givaro::Modular< Givaro::Integer`
`>, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim,`
`uint64_t coldim, uint64_t nnz)`
- `template<class IndexT >`
`void sparse_init (const Givaro::ZRing< Givaro::Integer > &F, Sparse< Givaro::ZRing< Givaro::Integer > ,`
`SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim,`
`uint64_t coldim, uint64_t nnz)`
- `template<class IndexT , size_t RECINT_SIZE>`
`void sparse_init (const Givaro::ZRing< Reclnt::rmint< RECINT_SIZE >> &F, Sparse< Givaro::ZRing<`
`Reclnt::rmint< RECINT_SIZE >>, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col,`
`typename Givaro::ZRing< Reclnt::rmint< RECINT_SIZE >>::Element_ptr dat, uint64_t rowdim, uint64_t`
`coldim, uint64_t nnz)`
- `template<class IndexT , size_t RECINT_SIZE>`
`void sparse_init (const Givaro::ZRing< Reclnt::rmint< RECINT_SIZE >> &F, Sparse< Givaro::ZRing<`
`Reclnt::rmint< RECINT_SIZE >>, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, type-`
`name Givaro::ZRing< Reclnt::rmint< RECINT_SIZE >>::Element_ptr dat, uint64_t rowdim, uint64_t coldim,`
`uint64_t nnz)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT`
`*col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_HYB > &A)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_HYB > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_ZO > &A)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A)`
- `template<class Field >`
`void sparse_print (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::HYB_ZO > &A)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::HYB_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<typename _Field >`
`std::ostream & operator<< (std::ostream &os, const Sparse< _Field, SparseMatrix_t::HYB_ZO > &A)`
- `template<class Field , bool sorted = true, bool read_integer = false>`
`void readSmsFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class Field >`
`void readSprFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class T >`
`std::enable_if< std::is_integral< T >::value, int > getDataType ()`
- `template<class T >`
`std::enable_if< std::is_floating_point< T >::value, int > getDataType ()`
- `template<class T >`
`std::enable_if< std::is_same< T, mpz_t >::value, int > getDataType ()`
- `template<class T >`
`int getDataType ()`
- `template<class Field >`
`void readMachineType (const Field &F, typename Field::Element &modulo, typename Field::Element_ptr val, std::ifstream &file, const uint64_t dims, const mask_t data_type, const mask_t field_desc)`
- `template<class Field >`
`void readDnsFormat (const std::string &path, const Field &F, index_t &rowdim, index_t &coldim, typename Field::Element_ptr &val)`

- `template<class Field >`
`void writeDnsFormat (const std::string &path, const Field &F, const index_t &rowdim, const index_t &coldim,`
`typename Field::Element_ptr A, index_t lIdA)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename`
`Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL_ZO > &A)`
- `template<class Field >`
`void sparse_print (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL > &A, const IndexT *row, const In-`
`dexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz, uint64_t`
`sigma=0)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL_ZO > &A, const IndexT *row, const`
`IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class It >`
`double computeDeviation (It begin, It end)`
- `template<class Field >`
`StatsMatrix getStat (const Field &F, const index_t *row, const index_t *col, typename Field::ConstElement_ptr`
`val, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename`
`Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx,`
`const typename Field::Element &beta, typename Field::Element_ptr y, int ldy)`
- `template<> void fflas_delete (FFPACK::rns_double_elt_ptr A)`
- `template<> void fflas_delete (FFPACK::rns_double_elt_cstptr A)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSIntegerMod< FFPACK::rns_double`
`> &F, const size_t m, const Alignment align)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSIntegerMod< FFPACK::rns_double`
`> &F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS >`
`void finit_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k, const`
`Givaro::Integer *B, const size_t ldb, typename RNS::Element_ptr A)`
- `template<typename RNS >`
`void finit_trans_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k,`
`const Givaro::Integer *B, const size_t ldb, typename RNS::Element_ptr A)`
- `template<typename RNS >`
`void fconvert_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, Givaro::Integer`
`alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement_ptr A)`
- `template<typename RNS >`
`void fconvert_trans_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n,`
`Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement_ptr A)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSInteger< FFPACK::rns_double >`
`&F, const size_t m, const Alignment align)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSInteger< FFPACK::rns_double >`
`&F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS >`
`void finit_rns (const FFPACK::RNSInteger< RNS > &F, const size_t m, const size_t n, size_t k, const`
`Givaro::Integer *B, const size_t ldb, typename FFPACK::RNSInteger< RNS >::Element_ptr A)`

- template<typename RNS >
void `fconvert_rns` (const `FFPACK::RNSInteger< RNS >` &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename `FFPACK::RNSInteger< RNS >::ConstElement_ptr` A)
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, `FFLAS_ELT` *X, const size_t incX)
$$\text{freduce } x \leftarrow x \bmod F.$$
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, const `FFLAS_ELT` *Y, const size_t incY, `FFLAS_ELT` *X, const size_t incX)
$$\text{freduce } x \leftarrow y \bmod F.$$
- template `INST_OR_DECL` void `finit` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, const `FFLAS_ELT` *Y, const size_t incY, `FFLAS_ELT` *X, const size_t incX)
$$\text{finit } x \leftarrow y \bmod F.$$
- template `INST_OR_DECL` void `fconvert` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` *Y, const size_t incY)
$$\text{fconvert } x \leftarrow y \bmod F.$$
- template `INST_OR_DECL` void `fnegin` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, `FFLAS_ELT` *X, const size_t incX)
$$\text{fnegin } x \leftarrow -x.$$
- template `INST_OR_DECL` void `fneg` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, const `FFLAS_ELT` *Y, const size_t incY, `FFLAS_ELT` *X, const size_t incX)
$$\text{fneg } x \leftarrow -y.$$
- template `INST_OR_DECL` void `fzero` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, `FFLAS_ELT` *X, const size_t incX)
$$\text{fzero} : A \leftarrow 0.$$
- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, const `FFLAS_ELT` *X, const size_t incX)
$$\text{fiszero} : \text{test } X = 0.$$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, const `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` *Y, const size_t incY)
$$\text{fequal} : \text{test } X = Y.$$
- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t N, const `FFLAS_ELT` *Y, const size_t incY, `FFLAS_ELT` *X, const size_t incX)
$$\text{fassign} : x \leftarrow y.$$
- template `INST_OR_DECL` void `fscaln` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, const `FFLAS_ELT` alpha, `FFLAS_ELT` *X, const size_t incX)
$$\text{fscaln } x \leftarrow \alpha \cdot x.$$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const size_t incX, `FFLAS_ELT` *Y, const size_t incY)
$$\text{fscal } y \leftarrow \alpha \cdot x.$$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const size_t incX, `FFLAS_ELT` *Y, const size_t incY)
$$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$$
- template `INST_OR_DECL` `FFLAS_ELT` `fdot` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t N, const `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` *Y, const size_t incY)
$$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- template `INST_OR_DECL` void `fswap` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t N, `FFLAS_ELT` *X, const size_t incX, `FFLAS_ELT` *Y, const size_t incY)
$$\text{fswap} : X \leftrightarrow Y.$$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)

- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $fassign : A \leftarrow B.$
- template `INST_OR_DECL` void `fzero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
 $fzero : A \leftarrow 0.$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb)
 $fequal : test A = B.$
- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *A, const size_t lda)
 $fiszero : test A = 0.$
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` &d)
creates a diagonal matrix
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
creates a diagonal matrix
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
 $freduce A \leftarrow A \bmod F.$
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $freduce A \leftarrow B \bmod F.$
- template `INST_OR_DECL` void `finit` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $finit A \leftarrow B \bmod F.$
- template `INST_OR_DECL` void `fnegin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
 $fnegin A \leftarrow -A.$
- template `INST_OR_DECL` void `fneg` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $fneg A \leftarrow -B.$
- template `INST_OR_DECL` void `fscaln` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, `FFLAS_ELT` *A, const size_t lda)
 $fscaln A \leftarrow a \cdot A.$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)
 $fscal B \leftarrow a \cdot A.$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const size_t ldx, `FFLAS_ELT` *Y, const size_t ldy)
 $faxpy : y \leftarrow \alpha \cdot x + y.$
- template `INST_OR_DECL` void `fmove` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)
 $faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

fadd : matrix addition.

- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

fsub : matrix subtraction.

- template `INST_OR_DECL` void `fsubin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

fsubin $C = C - B$

- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

fadd : matrix addition with scaling.

- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

faddin

- template `INST_OR_DECL` `FFLAS_ELT` * `fgemv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` TransA, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` beta, `FFLAS_ELT` *Y, const size_t incY)

finite prime `FFLAS_FIELD`<`FFLAS_ELT`> *GE*neral *M*atrix *V*ector multiplication.

- template `INST_OR_DECL` void `fger` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *x, const size_t incx, const `FFLAS_ELT` *y, const size_t incy, `FFLAS_ELT` *A, const size_t lda)

fger: rank one update of a general matrix

- template `INST_OR_DECL` void `ftrsv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size_t N, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *X, int incX)

ftrsv: *TRI*angular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

- template `INST_OR_DECL` void `ftrsm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_SIDE` Side, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)

ftrsm: **TRI**angular System solve with **M**atrix.

- template `INST_OR_DECL` void `ftrmm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_SIDE` Side, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)

ftrmm: **TRI**angular **M**atrix **M**ultiply.

- template `INST_OR_DECL` `FFLAS_ELT` * `fgemm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size_t m, const size_t n, const size_t k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const size_t ldc)

fgemm: *Field* **GE**neral **M**atrix **M**ultiply.

- template `INST_OR_DECL` `FFLAS_ELT` * `fgemm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size_t m, const size_t n, const size_t k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const size_t ldc, const `ParSeqHelper::Sequential` seq)
- template `INST_OR_DECL` `FFLAS_ELT` * `fgemm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size_t m, const size_t n, const size_t k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const size_t ldc, const `ParSeqHelper::Parallel`< `CuttingStrategy::Recursive`, `StrategyParameter::TwoDAdaptive` > par)
- template `INST_OR_DECL` `FFLAS_ELT` * `fgemm` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size_t m, const size_t n, const size_t k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, const

- `FFLAS_ELT` beta, `FFLAS_ELT` *C, const `size_t` ldc, const `ParSeqHelper::Parallel`< `CuttingStrategy::Block`, `StrategyParameter::Threads` > par)
- template `INST_OR_DECL` `FFLAS_ELT` * `fsquare` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const `size_t` ldc)
- fsquare: Squares a matrix.*
- template<class Cut = `CuttingStrategy::Block`, class Strat = `StrategyParameter::Threads`>
void `BlockCuts` (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<> void `BlockCuts`< `CuttingStrategy::Single`, `StrategyParameter::Threads` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<> void `BlockCuts`< `CuttingStrategy::Row`, `StrategyParameter::Fixed` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<> void `BlockCuts`< `CuttingStrategy::Row`, `StrategyParameter::Grain` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` grainsize)
 - template<> void `BlockCuts`< `CuttingStrategy::Block`, `StrategyParameter::Grain` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` grainsize)
 - template<> void `BlockCuts`< `CuttingStrategy::Column`, `StrategyParameter::Fixed` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<> void `BlockCuts`< `CuttingStrategy::Column`, `StrategyParameter::Grain` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` grainsize)
 - template<> void `BlockCuts`< `CuttingStrategy::Block`, `StrategyParameter::Fixed` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<> void `BlockCuts`< `CuttingStrategy::Row`, `StrategyParameter::Threads` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<> void `BlockCuts`< `CuttingStrategy::Column`, `StrategyParameter::Threads` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<> void `BlockCuts`< `CuttingStrategy::Block`, `StrategyParameter::Threads` > (`size_t` &`RBLOCKSIZE`, `size_t` &`CBLOCKSIZE`, const `size_t` m, const `size_t` n, const `size_t` numthreads)
 - template<class Cut = `CuttingStrategy::Block`, class Param = `StrategyParameter::Threads`>
void `BlockCuts` (`size_t` &rowBlockSize, `size_t` &colBlockSize, `size_t` &lastRBS, `size_t` &lastCBS, `size_t` &changeRBS, `size_t` &changeCBS, `size_t` &numRowBlock, `size_t` &numColBlock, `size_t` m, `size_t` n, const `size_t` numthreads)
 - template<class Field >
void `pfzero` (const `Field` &F, `size_t` m, `size_t` n, typename `Field::Element_ptr` C, `size_t` BS=0)
 - template<class Field , class RandIter >
void `prand` (const `Field` &F, RandIter &G, `size_t` m, `size_t` n, typename `Field::Element_ptr` C, `size_t` BS=0)
 - template<class Field , class Cut , class Param >
`Field::Element` & `fdot` (const `Field` &F, const `size_t` N, typename `Field::ConstElement_ptr` x, const `size_t` incx, typename `Field::ConstElement_ptr` y, const `size_t` incy, typename `Field::Element` &d, const `ParSeqHelper::Parallel`< Cut, Param > par)
 - template<class Field , class AlgoT , class FieldTrait >
`Field::Element` * `pfgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element` *C, const `size_t` ldc, `MMHelper`< `Field`, `AlgoT`, `FieldTrait`, `ParSeqHelper::Parallel`< `CuttingStrategy::Block`, `StrategyParameter::Threads` > > &H)
 - template<class Field , class AlgoT , class FieldTrait >
`Field::Element` * `pfgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` AA, const `size_t` lda, const typename `Field::ConstElement_ptr` BB, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element` *C, const `size_t` ldc, `MMHelper`< `Field`, `AlgoT`, `FieldTrait`, `ParSeqHelper::Parallel`< `CuttingStrategy::Recursive`, `StrategyParameter::ThreeDAptive` > > &H)
 - template<class Field , class AlgoT , class FieldTrait >
`Field::Element` * `pfgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, const typename

- `Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive > > &H)`
- `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoD > > &H)`
 - `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element_ptr pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeD > > &H)`
 - `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDInPlace > > &H)`
 - `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::Threads > > &H)`
 - `template<class Field, class AlgoT, class FieldTrait, class Cut >`
`Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Row, Cut > > &H)`
 - `void parseArguments (int argc, char **argv, Argument *args, bool printDefaults=true)`
 - `std::ostream & writeCommandString (std::ostream &os, Argument *args, const char *programName=nullptr)`
writes the values of all arguments, preceded by the programName
 - `template<class Field >`
`std::ostream & WriteMatrix (std::ostream &c, const Field &F, size_t m, size_t n, typename Field::ConstElement_ptr A, size_t lda, FFLAS_FORMAT format, bool column_major)`
WriteMatrix: write a matrix to an output stream.
 - `void preamble (std::ifstream &if, FFLAS_FORMAT &format)`
 - `template<class Field >`
`Field::Element_ptr ReadMatrix (std::ifstream &if, Field &F, size_t &m, size_t &n, typename Field::Element_ptr &A, FFLAS_FORMAT format=FflasAuto)`
ReadMatrix: read a matrix from an input stream.
 - `template<class Field >`
`Field::Element_ptr ReadMatrix (const std::string &matrix_file, Field &F, size_t &m, size_t &n, typename Field::Element_ptr &A, FFLAS_FORMAT format=FflasAuto)`
ReadMatrix: read a matrix from a file.
 - `template<class Field >`
`void WriteMatrix (std::string &matrix_file, const Field &F, int m, int n, typename Field::ConstElement_ptr A, size_t lda, FFLAS_FORMAT format=FflasDense, bool column_major=false)`
WriteMatrix: write a matrix to a file.
 - `std::ostream & WritePermutation (std::ostream &c, const size_t *P, size_t N)`

WritePermutation: write a permutation matrix to an output stream.

- `template<class Element >`
`bool alignable ()`
- `template<> bool alignable< Givaro::Integer * > ()`
- `template<class Field >`
`Field::Element_ptr fflas_new (const Field &F, const size_t m, const Alignment align=Alignment::DEFAULT)`
- `template<class Field >`
`Field::Element_ptr fflas_new (const Field &F, const size_t m, const size_t n, const Alignment align=Alignment::DEFAULT)`
- `template<class Element >`
`Element * fflas_new (const size_t m, const Alignment align=Alignment::DEFAULT)`
- `template<class Ptr, class ... Args>`
`void fflas_delete (Ptr p, Args ... args)`
- `void prefetch (const int64_t *)`
- `void getTLBSize (int &tlb)`
- `void queryCacheSizes (int &l1, int &l2, int &l3)`
- `int queryL1CacheSize ()`
- `int queryTopLevelCacheSize ()`
- `uint64_t getSeed ()`

15.1.1 Typedef Documentation

15.1.1.1 Checker_fgemm

```
using Checker_fgemm = FFLAS::Checker_Empty<Field>
```

15.1.1.2 Checker_ftrsm

```
using Checker_ftrsm = FFLAS::Checker_Empty<Field>
```

15.1.1.3 ForceCheck_fgemm

```
using ForceCheck_fgemm = CheckerImplem_fgemm<Field>
```

15.1.1.4 ForceCheck_ftrsm

```
using ForceCheck_ftrsm = CheckerImplem_ftrsm<Field>
```


15.1.1.5 ZOSparseMatrix

```
using ZOSparseMatrix = std::true_type
```

15.1.1.6 NotZOSparseMatrix

```
using NotZOSparseMatrix = std::false_type
```

15.1.1.7 SimdSparseMatrix

```
using SimdSparseMatrix = std::true_type
```

15.1.1.8 NoSimdSparseMatrix

```
using NoSimdSparseMatrix = std::false_type
```

15.1.1.9 MKLSparseMatrixFormat

```
using MKLSparseMatrixFormat = std::true_type
```

15.1.1.10 NotMKLSparseMatrixFormat

```
using NotMKLSparseMatrixFormat = std::false_type
```

15.1.1.11 has_plus

```
using has_plus = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_plus_impl<T> >::type
```

15.1.1.12 has_minus

```
using has_minus = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_minus_impl<T> >::type
```

15.1.1.13 has_equal

```
using has_equal = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
std::is_copy_assignable<T> >::type
```

15.1.1.14 has_plus_eq

```
using has_plus_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_plus_eq_impl<T> >::type
```

15.1.1.15 has_minus_eq

```
using has_minus_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_minus_eq_impl<T> >::type
```

15.1.1.16 has_mul

```
using has_mul = typename std::conditional<std::is_arithmetic<T>::value, std::true_type, has_mul_impl<T>  
>::type
```

15.1.1.17 has_mul_eq

```
using has_mul_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_mul_eq_impl<T> >::type
```

15.1.1.18 Timer

```
typedef Givaro::Timer Timer
```

15.1.1.19 BaseTimer

```
typedef Givaro::BaseTimer BaseTimer
```

15.1.1.20 UserTimer

```
typedef Givaro::UserTimer UserTimer
```

15.1.1.21 SysTimer

```
typedef Givaro::SysTimer SysTimer
```

15.1.2 Enumeration Type Documentation

15.1.2.1 FFLAS_ORDER

```
enum FFLAS_ORDER
```

Storage by row or col ?

Enumerator

| | |
|---------------|-----------|
| FflasRowMajor | row major |
| FflasColMajor | col major |

15.1.2.2 FFLAS_TRANSPOSE

```
enum FFLAS_TRANSPOSE
```

Is matrix transposed ?

Enumerator

| | |
|--------------|---------------------------|
| FflasNoTrans | Matrix is not transposed. |
| FflasTrans | Matrix is transposed. |

15.1.2.3 FFLAS_UPLO

enum [FFLAS_UPLO](#)

Is triangular matrix's shape upper ?

Enumerator

| | |
|------------|--|
| FflasUpper | Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$) |
| FflasLower | Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$) |

15.1.2.4 FFLAS_DIAG

enum [FFLAS_DIAG](#)

Is the triangular matrix implicitly unit diagonal ?

Enumerator

| | |
|--------------|---|
| FflasNonUnit | Triangular matrix has an explicit arbitrary diagonal. |
| FflasUnit | Triangular matrix has an implicit unit diagonal ($T_{i,i} = 1$) |

15.1.2.5 FFLAS_SIDE

enum [FFLAS_SIDE](#)

On what side ?

Enumerator

| | |
|------------|---------------------------------|
| FflasLeft | Operator applied on the left. |
| FflasRight | Operator applied on the righth. |

15.1.2.6 FFLAS_BASE

enum [FFLAS_BASE](#)

FFLAS_BASE determines the type of the element representation for Matrix Mult kernel.

(deprecated, should not be used)

Enumerator

| | |
|--------------|--|
| FflasDouble | to use the double precision BLAS |
| FflasFloat | to use the single precision BLAS |
| FflasGeneric | for any other domain, that can not be converted to floating point integers |

15.1.2.7 number_kind

```
enum number_kind
```

Enumerator

| | |
|-------|--|
| zero | |
| one | |
| mone | |
| other | |

15.1.2.8 SparseMatrix_t

```
enum SparseMatrix_t [strong]
```

Enumerator

| | |
|-------------|--|
| CSR | |
| CSR_ZO | |
| CSC | |
| CSC_ZO | |
| COO | |
| COO_ZO | |
| ELL | |
| ELL_ZO | |
| SELL | |
| SELL_ZO | |
| ELL_simd | |
| ELL_simd_ZO | |
| CSR_HYB | |
| HYB_ZO | |

15.1.2.9 FFLAS_FORMAT

```
enum FFLAS_FORMAT
```

Enumerator

| | |
|---------------|--|
| FflasAuto | |
| FflasDense | |
| FflasSMS | |
| FflasBinary | |
| FflasMath | |
| FflasMaple | |
| FflasSageMath | |

15.1.3 Function Documentation

15.1.3.1 InfNorm()

```
Givaro::Integer FFLAS::InfNorm (
    const size_t M,
    const size_t N,
    const Givaro::Integer * A,
    const size_t lda ) [inline]
```

15.1.3.2 min3()

```
const T& FFLAS::min3 (
    const T & m,
    const T & n,
    const T & k )
```

15.1.3.3 max3()

```
const T& FFLAS::max3 (
    const T & m,
    const T & n,
    const T & k )
```

15.1.3.4 min4()

```
const T& FFLAS::min4 (
    const T & m,
    const T & n,
    const T & k,
    const T & l )
```

15.1.3.5 max4()

```
const T& FFLAS::max4 (
    const T & m,
    const T & n,
    const T & k,
    const T & l )
```

15.1.3.6 fadd() [1/8]

```
void FFLAS::fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.7 faddin() [1/4]

```
void FFLAS::faddin (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.8 fsub() [1/4]

```
void FFLAS::fsub (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.9 fsubin() [1/3]

```
void FFLAS::fsubin (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.10 fadd() [2/8]

```
void FFLAS::fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

Todo optimise here

15.1.3.11 pfadd()

```
void FFLAS::pfadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t numths )
```


15.1.3.12 pfsub()

```
void FFLAS::pfsub (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t numths )
```

15.1.3.13 pfaddin()

```
void FFLAS::pfaddin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numths )
```

15.1.3.14 pfsubin()

```
void FFLAS::pfsubin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numths )
```

15.1.3.15 fadd() [3/8]

```
void FFLAS::fadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
```

```
const size_t ldb,  
typename Field::Element_ptr C,  
const size_t ldc )
```

fadd : matrix addition.

Computes $C = A + B$.

Parameters

| | |
|------------|-----------------------------------|
| <i>F</i> | field |
| <i>M</i> | rows |
| <i>N</i> | cols |
| <i>A</i> | dense matrix of size $M \times N$ |
| <i>lda</i> | leading dimension of A |
| <i>B</i> | dense matrix of size $M \times N$ |
| <i>ldb</i> | leading dimension of B |
| <i>C</i> | dense matrix of size $M \times N$ |
| <i>ldc</i> | leading dimension of C |

15.1.3.16 fsub() [2/4]

```
void FFLAS::fsub (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )
```

fsub : matrix subtraction.

Computes $C = A - B$.

Parameters

| | |
|------------|-----------------------------------|
| <i>F</i> | field |
| <i>M</i> | rows |
| <i>N</i> | cols |
| <i>A</i> | dense matrix of size $M \times N$ |
| <i>lda</i> | leading dimension of A |
| <i>B</i> | dense matrix of size $M \times N$ |
| <i>ldb</i> | leading dimension of B |
| <i>C</i> | dense matrix of size $M \times N$ |
| <i>ldc</i> | leading dimension of C |

15.1.3.17 faddin() [2/4]

```
void FFLAS::faddin (
    const Field & F,
```

```

    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )

```

faddin

15.1.3.18 fsubin() [2/3]

```

void FFLAS::fsubin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )

```

fsubin $C = C - B$

15.1.3.19 fadd() [4/8]

```

void FFLAS::fadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )

```

fadd : matrix addition with scaling.

Computes $C = A + \text{alpha } B$.

Parameters

| | |
|--------------|--------------------------|
| <i>F</i> | field |
| <i>M</i> | rows |
| <i>N</i> | cols |
| <i>A</i> | dense matrix of size MxN |
| <i>lda</i> | leading dimension of A |
| <i>alpha</i> | some scalar |
| <i>B</i> | dense matrix of size MxN |
| <i>ldb</i> | leading dimension of B |
| <i>C</i> | dense matrix of size MxN |
| <i>ldc</i> | leading dimension of C |

15.1.3.20 fassign() [1/10]

```
void FFLAS::fassign (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX ) [inline]
```

$\text{fassign} : x \leftarrow y.$

X is preallocated

Todo variant for triangular matrix

Parameters

| | | |
|-----|--------|---------------------|
| | F | field |
| | N | size of the vectors |
| out | X | vector in F |
| | $incX$ | stride of X |
| in | Y | vector in F |
| | $incY$ | stride of Y |

15.1.3.21 fassign() [2/10]

```
void FFLAS::fassign (
    const Givaro::Modular< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX ) [inline]
```

15.1.3.22 fassign() [3/10]

```
void FFLAS::fassign (
    const Givaro::ModularBalanced< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX ) [inline]
```

15.1.3.23 fassign() [4/10]

```
void FFLAS::fassign (
    const Givaro::ZRing< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX ) [inline]
```

15.1.3.24 fassign() [5/10]

```
void FFLAS::fassign (
    const Givaro::Modular< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX ) [inline]
```

15.1.3.25 fassign() [6/10]

```
void FFLAS::fassign (
    const Givaro::ModularBalanced< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX ) [inline]
```

15.1.3.26 fassign() [7/10]

```
void FFLAS::fassign (
    const Givaro::ZRing< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX ) [inline]
```

15.1.3.27 fassign() [8/10]

```
void FFLAS::fassign (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )
```

fassign : $A \leftarrow B$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | number of rows to copy |
| n | number of cols to copy |
| A | matrix in F |
| lda | stride of A |
| B | vector in F |
| ldb | stride of B |

15.1.3.28 faxpy() [1/6]

```
void FFLAS::faxpy (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]
```

faxpy : $y \leftarrow \alpha \cdot x + y$.

Parameters

| | | |
|---------|---------|---------------------|
| | F | field |
| | N | size of the vectors |
| | $alpha$ | scalar |
| in | X | vector in F |
| | $incX$ | stride of X |
| in, out | Y | vector in F |
| | $incY$ | stride of Y |

15.1.3.29 faxpy() [2/6]

```
void FFLAS::faxpy (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy ) [inline]
```

15.1.3.30 faxpy() [3/6]

```
void FFLAS::faxpy (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy ) [inline]
```

15.1.3.31 faxpy() [4/6]

```
void FFLAS::faxpy (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t ldx,
    typename Field::Element_ptr Y,
    const size_t ldy ) [inline]
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

Parameters

| | | |
|---------|----------|--------------------------|
| | F | field |
| | m | row dimension |
| | n | column dimension |
| | α | scalar |
| in | X | vector in F |
| | ldx | leading dimension of X |
| in, out | Y | vector in F |
| | ldy | leading dimension of Y |

15.1.3.32 fdot() [1/11]

```
Field::Element FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT ) [inline]
```

15.1.3.33 fdot() [2/11]

```
Field::Element FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DelayedTag & MT ) [inline]
```

15.1.3.34 fdot() [3/11]

```
Givaro::DoubleDomain::Element FFLAS::fdot (
    const Givaro::DoubleDomain & ,
    const size_t N,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT ) [inline]
```

15.1.3.35 fdot() [4/11]

```
Givaro::FloatDomain::Element FFLAS::fdot (
    const Givaro::FloatDomain & ,
    const size_t N,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT ) [inline]
```

15.1.3.36 fdot() [5/11]

```
Field::Element FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::ConvertTo< T > & MT ) [inline]
```

15.1.3.37 fdot() [6/11]

```
Field::Element FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultBoundedTag & dbt ) [inline]
```

15.1.3.38 fdot() [7/11]

```
Field::Element FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    const ParSeqHelper::Sequential seq ) [inline]
```

15.1.3.39 fdot() [8/11]

```
Field::Element FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY ) [inline]
```

fdot: dot product $x^T y$.

Parameters

| | |
|--------|---------------------|
| F | field |
| N | size of the vectors |
| X | vector in F |
| $incX$ | stride of X |
| Y | vector in F |
| $incY$ | stride of Y |

15.1.3.40 fgemm() [1/23]

```
FFPACK::RNSInteger<RNS>::Element_ptr FFLAS::fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > & H ) [inline]
```

15.1.3.41 fgemm() [2/23]

```
FFPACK::RNSInteger<RNS>::Element_ptr FFLAS::fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Sequential > & H ) [inline]
```

15.1.3.42 fgemm() [3/23]

```
FFPACK::RNSInteger<RNS>::Element_ptr FFLAS::fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Compose< ParSeqHelper::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads
    >, ParSeqTrait > > & H ) [inline]
```

15.1.3.43 fgemm() [4/23]

```
FFPACK::RNSInteger<RNS>::Element_ptr FFLAS::fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Parallel< Cut, Param > > & H ) [inline]
```

15.1.3.44 fgemm() [5/23]

```
Givaro::Integer* FFLAS::fgemm (
    const Givaro::ZRing< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
```

```

    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]

```

15.1.3.45 fgemm() [6/23]

```

RNS::Element_ptr FFLAS::fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename RNS::Element alpha,
    typename RNS::ConstElement_ptr Ad,
    const size_t lda,
    typename RNS::ConstElement_ptr Bd,
    const size_t ldb,
    const typename RNS::Element beta,
    typename RNS::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential
> & H ) [inline]

```

15.1.3.46 fgemm() [7/23]

```

RNS::Element_ptr FFLAS::fgemm (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename RNS::Element alpha,
    typename RNS::ConstElement_ptr Ad,
    const size_t lda,
    typename RNS::ConstElement_ptr Bd,
    const size_t ldb,
    const typename RNS::Element beta,
    typename RNS::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > & H ) [inline]

```

15.1.3.47 fgemm() [8/23]

```
Givaro::Integer* FFLAS::fgemm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    const Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]
```

15.1.3.48 fgemm() [9/23]

```
Givaro::Integer* FFLAS::fgemm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    const Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Auto, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]
```

15.1.3.49 fgemm() [10/23]

```
RecInt::ruint<K1>* FFLAS::fgemm (
    const Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const RecInt::ruint< K1 > alpha,
```

```

    const RecInt::ruint< K1 > * A,
    const size_t lda,
    const RecInt::ruint< K1 > * B,
    const size_t ldb,
    RecInt::ruint< K1 > beta,
    RecInt::ruint< K1 > * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > >, MMHelperAlgo::Classic,
    ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]

```

15.1.3.50 fgemm() [11/23]

```

Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeT > & H ) [inline]

```

15.1.3.51 fgemm() [12/23]

```

Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::WinogradPar, ModeT, ParSeqHelper::Parallel< Cut,
    Param > > & H ) [inline]

```

15.1.3.52 fgemm() [13/23]

```
Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::ConvertTo< ElementCategories::MachineFl
>, ParSeqHelper::Sequential > & H ) [inline]
```

15.1.3.53 fgemm() [14/23]

```
Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Sequential seq ) [inline]
```

15.1.3.54 fgemm() [15/23]

```
Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
```



```

const size_t lda,
typename Field::ConstElement_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const ParSeqHelper::Parallel< Cut, Param > par ) [inline]

```

15.1.3.55 fgemm() [16/23]

```

Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]

```

fgemm: Field **GE**neral **M**atrix **M**ultiply.

Computes $C = \alpha \text{op}(A) \times \text{op}(B) + \beta C$ Automatically set Winograd recursion level

Parameters

| | |
|--------------|---|
| <i>F</i> | field. |
| <i>ta</i> | if $ta == \text{FflasTrans}$ then $\text{op}(A) = A^t$, else $\text{op}(A) = A$, |
| <i>tb</i> | same for matrix B |
| <i>m</i> | see A |
| <i>n</i> | see B |
| <i>k</i> | see A |
| <i>alpha</i> | scalar |
| <i>beta</i> | scalar |
| <i>A</i> | $\text{op}(A)$ is $m \times k$ |
| <i>B</i> | $\text{op}(B)$ is $k \times n$ |
| <i>C</i> | C is $m \times n$ |
| <i>lda</i> | leading dimension of A |
| <i>ldb</i> | leading dimension of B |
| <i>ldc</i> | leading dimension of C |
| <i>w</i> | recursive levels of Winograd's algorithm are used. No argument (or -1) does auto computation of w . |

Warning

α must be invertible

15.1.3.56 fgemm() [17/23]

```
Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Auto, ModeT, ParSeq > & H ) [inline]
```

15.1.3.57 fgemm() [18/23]

```
Field::Element_ptr FFLAS::fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential
> & H ) [inline]
```

15.1.3.58 fsquare() [1/6]

```
Field::Element_ptr FFLAS::fsquare (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]
```

fsquare: Squares a matrix.

compute $C \leftarrow \alpha \text{op}(A) \text{op}(A) + \beta C$ over a Field F Avoid the conversion of B

Parameters

| | |
|--------------|---|
| <i>ta</i> | if $ta == \text{FflasTrans}$, $\text{op}(A) = A^T$. |
| <i>F</i> | field |
| <i>n</i> | size of A |
| <i>alpha</i> | scalar |
| <i>beta</i> | scalar |
| <i>A</i> | dense matrix of size $n \times n$ |
| <i>lda</i> | leading dimension of A |
| <i>C</i> | dense matrix of size $n \times n$ |
| <i>ldc</i> | leading dimension of C |

Bug why double ?

15.1.3.59 fsquare() [2/6]

```
double* FFLAS::fsquare (
    const Givaro::ModularBalanced< double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double beta,
    double * C,
    const size_t ldc ) [inline]
```

15.1.3.60 fsquare() [3/6]

```
float* FFLAS::fsquare (
    const Givaro::ModularBalanced< float > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const float alpha,
    const float * A,
    const size_t lda,
    const float beta,
    float * C,
    const size_t ldc ) [inline]
```

15.1.3.61 fsquare() [4/6]

```
double* FFLAS::fsquare (
    const Givaro::Modular< double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double beta,
    double * C,
    const size_t ldc ) [inline]
```

15.1.3.62 fsquare() [5/6]

```
float* FFLAS::fsquare (
    const Givaro::Modular< float > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const float alpha,
    const float * A,
    const size_t lda,
    const float beta,
    float * C,
    const size_t ldc ) [inline]
```

15.1.3.63 fgemv() [1/19]

```
Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
```

```

    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFlo
> > & H ) [inline]

```

15.1.3.64 fgemv() [2/19]

```

Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > & H ) [inline]

```

15.1.3.65 fgemv() [3/19]

```

Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > & H ) [inline]

```

15.1.3.66 fgemv() [4/19]

```
Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > & H ) [inline]
```

15.1.3.67 fgemv() [5/19]

```
Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE TransA,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]
```

finite prime Field GEneral Matrix Vector multiplication.

Computes $Y \leftarrow \alpha \text{op}(A)X + \beta Y$.

Parameters

| | | |
|-----|---------------|---|
| | <i>F</i> | field |
| | <i>TransA</i> | if TransA==FflasTrans then $\text{op}(A) = A^t$. |
| | <i>M</i> | rows |
| | <i>N</i> | cols |
| | <i>alpha</i> | scalar |
| | <i>A</i> | dense matrix of size MxN |
| | <i>lda</i> | leading dimension of A |
| | <i>X</i> | dense vector of size N |
| | <i>incX</i> | stride of X |
| | <i>beta</i> | scalar |
| out | <i>Y</i> | dense vector of size M |
| | <i>incY</i> | stride of Y |

15.1.3.68 fgemv() [6/19]

```
Givaro::ZRing<int64_t>::Element_ptr FFLAS::fgemv (
    const Givaro::ZRing< int64_t > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const int64_t alpha,
    const int64_t * A,
    const size_t lda,
    const int64_t * X,
    const size_t incX,
    const int64_t beta,
    int64_t * Y,
    const size_t incY,
    MMHelper< Givaro::ZRing< int64_t >, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]
```

15.1.3.69 fgemv() [7/19]

```
Givaro::DoubleDomain::Element_ptr FFLAS::fgemv (
    const Givaro::DoubleDomain & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const Givaro::DoubleDomain::Element alpha,
    const Givaro::DoubleDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::DoubleDomain::ConstElement_ptr X,
    const size_t incX,
    const Givaro::DoubleDomain::Element beta,
    Givaro::DoubleDomain::Element_ptr Y,
    const size_t incY,
    MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]
```

15.1.3.70 fgemv() [8/19]

```
Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
```

```

    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > & H )
[inline]

```

15.1.3.71 fgemv() [9/19]

```

Givaro::FloatDomain::Element_ptr FFLAS::fgemv (
    const Givaro::FloatDomain & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const Givaro::FloatDomain::Element alpha,
    const Givaro::FloatDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::FloatDomain::ConstElement_ptr X,
    const size_t incX,
    const Givaro::FloatDomain::Element beta,
    Givaro::FloatDomain::Element_ptr Y,
    const size_t incY,
    MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.72 fgemv() [10/19]

```

Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    ParSeqHelper::Parallel< Cut, Param > & parH )

```


15.1.3.73 fgemv() [11/19]

```
Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    ParSeqHelper::Sequential & seqH )
```

15.1.3.74 fgemv() [12/19]

```
FFPACK::rns_double::Element_ptr FFLAS::fgemv (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::ConstElement_ptr X,
    const size_t incX,
    const FFPACK::rns_double::Element beta,
    FFPACK::rns_double::Element_ptr Y,
    const size_t incY,
    MMHelper< FFPACK::RNSInteger< FFPACK::rns_double >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > & H ) [inline]
```

15.1.3.75 fgemv() [13/19]

```
FFPACK::rns_double::Element_ptr FFLAS::fgemv (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::ConstElement_ptr X,
    const size_t incX,
    const FFPACK::rns_double::Element beta,
    FFPACK::rns_double::Element_ptr Y,
    const size_t incY,
    MMHelper< FFPACK::RNSIntegerMod< FFPACK::rns_double >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > & H ) [inline]
```

15.1.3.76 fgemv() [14/19]

```
Givaro::Integer* FFLAS::fgemv (
    const Givaro::ZRing< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const Givaro::Integer alpha,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * X,
    const size_t ldx,
    Givaro::Integer beta,
    Givaro::Integer * Y,
    const size_t ldy,
    MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]
```

15.1.3.77 fgemv() [15/19]

```
Givaro::Integer* FFLAS::fgemv (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const Givaro::Integer alpha,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * X,
    const size_t ldx,
    Givaro::Integer beta,
    Givaro::Integer * Y,
    const size_t ldy,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]
```

15.1.3.78 fgemv() [16/19]

```
RecInt::ruint<K1>* FFLAS::fgemv (
    const Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const RecInt::ruint< K1 > alpha,
    const RecInt::ruint< K1 > * A,
    const size_t lda,
    const RecInt::ruint< K1 > * X,
    const size_t incx,
    RecInt::ruint< K1 > beta,
    RecInt::ruint< K1 > * Y,
    const size_t incy,
    MMHelper< Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > >, MMHelperAlgo::Classic,
ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]
```

15.1.3.79 fger() [1/12]

```

void FFLAS::fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda ) [inline]

```

fger: rank one update of a general matrix

Computes $A \leftarrow \alpha x y^T + A$

Parameters

| | | |
|---------|----------|--|
| | F | field |
| | M | rows |
| | N | cols |
| | α | scalar |
| in, out | A | dense matrix of size MxN and leading dimension lda |
| | lda | leading dimension of A |
| | x | dense vector of size M |
| | $incx$ | stride of X |
| | y | dense vector of size N |
| | $incy$ | stride of Y |

15.1.3.80 fger() [2/12]

```

void FFLAS::fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFlo
> > & H ) [inline]

```

15.1.3.81 fger() [3/12]

```

void FFLAS::fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, AnyTag > & H ) [inline]

```

15.1.3.82 fger() [4/12]

```

void FFLAS::fger (
    const Givaro::DoubleDomain & F,
    const size_t M,
    const size_t N,
    const Givaro::DoubleDomain::Element alpha,
    const Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    const Givaro::DoubleDomain::ConstElement_ptr y,
    const size_t incy,
    Givaro::DoubleDomain::Element_ptr A,
    const size_t lda,
    MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.83 fger() [5/12]

```

void FFLAS::fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr x,
    const size_t incx,
    const typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > & H )
[inline]

```

15.1.3.84 fger() [6/12]

```

void FFLAS::fger (
    const Givaro::FloatDomain & F,
    const size_t M,
    const size_t N,
    const Givaro::FloatDomain::Element alpha,
    const Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    const Givaro::FloatDomain::ConstElement_ptr y,
    const size_t incy,
    Givaro::FloatDomain::Element_ptr A,
    const size_t lda,
    MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.85 fger() [7/12]

```

void FFLAS::fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > & H ) [inline]

```

15.1.3.86 fger() [8/12]

```

void FFLAS::fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > & H ) [inline]

```

15.1.3.87 fger() [9/12]

```

void FFLAS::fger (
    const Givaro::Modular< Givaro::Integer > & F,
    const size_t M,
    const size_t N,
    const typename Givaro::Integer alpha,
    typename Givaro::Integer * x,
    const size_t incx,
    typename Givaro::Integer * y,
    const size_t incy,
    typename Givaro::Integer * A,
    const size_t lda,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]

```

15.1.3.88 fger() [10/12]

```

void FFLAS::fger (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t M,
    const size_t N,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::Element_ptr x,
    const size_t incx,
    typename FFPACK::RNSInteger< RNS >::Element_ptr y,
    const size_t incy,
    typename FFPACK::RNSInteger< RNS >::Element_ptr A,
    const size_t lda,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.89 fger() [11/12]

```

void FFLAS::fger (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t M,
    const size_t N,
    const typename FFPACK::RNSIntegerMod< RNS >::Element alpha,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr x,
    const size_t incx,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr y,
    const size_t incy,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr A,
    const size_t lda,
    MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Classic > & H ) [inline]

```

15.1.3.90 freduce() [1/10]

```
void FFLAS::freduce (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )
```

freduce $x \leftarrow y \bmod F$.

Parameters

| | |
|--------|---------------------|
| F | field |
| n | size of the vectors |
| Y | vector of Element |
| $incY$ | stride of Y |
| X | vector in F |
| $incX$ | stride of X |

Bug use cblas_(d)scal when possible

15.1.3.91 freduce() [2/10]

```
void FFLAS::freduce (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )
```

freduce $x \leftarrow x \bmod F$.

Parameters

| | |
|--------|---------------------|
| F | field |
| n | size of the vectors |
| X | vector in F |
| $incX$ | stride of X |

Bug use cblas_(d)scal when possible

15.1.3.92 freduce_constoverride() [1/2]

```
void FFLAS::freduce_constoverride (
    const Field & F,
```

```

    const size_t m,
    typename Field::ConstElement_ptr A,
    const size_t incX )

```

15.1.3.93 finit() [1/8]

```

void FFLAS::finit (
    const Field & F,
    const size_t n,
    ConstOtherElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )

```

15.1.3.94 finit() [2/8]

```

void FFLAS::finit (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )

```

finit Initializes X in F\$.

Parameters

| | |
|--------|---------------------|
| F | field |
| n | size of the vectors |
| X | vector in F |
| $incX$ | stride of X |

15.1.3.95 freduce() [3/10]

```

void FFLAS::freduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )

```

freduce $A \leftarrow A \bmod F$.

Parameters

| | |
|-----|-------|
| F | field |
|-----|-------|

Parameters

| | |
|------------|----------------|
| <i>m</i> | number of rows |
| <i>n</i> | number of cols |
| <i>A</i> | matrix in F |
| <i>lda</i> | stride of A |

15.1.3.96 pfreduce()

```
void FFLAS::pfreduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t numths )
```

15.1.3.97 freduce() [4/10]

```
void FFLAS::freduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )
```

$\text{freduce } A \leftarrow B \bmod F.$

Parameters

| | |
|------------|-------------------|
| <i>F</i> | field |
| <i>m</i> | number of rows |
| <i>n</i> | number of cols |
| <i>A</i> | matrix in F |
| <i>lda</i> | stride of A |
| <i>B</i> | matrix in Element |
| <i>ldb</i> | stride of B |

15.1.3.98 freduce_constoverride() [2/2]

```
void FFLAS::freduce_constoverride (
    const Field & F,
```

```

const size_t m,
const size_t n,
typename Field::ConstElement_ptr A,
const size_t lda )

```

15.1.3.99 finit() [3/8]

```

void FFLAS::finit (
    const Field & F,
    const size_t m,
    const size_t n,
    const OtherElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{finit } A \leftarrow B \bmod F$.

Parameters

| | |
|-------|---------------------------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |
| B | matrix in OtherElement |
| ldb | stride of B |

15.1.3.100 finit() [4/8]

```

void FFLAS::finit (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )

```

finit Initializes A in F .

Parameters

| | |
|-------|----------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |

15.1.3.101 freduce() [5/10]

```
void FFLAS::freduce (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A,
    size_t inc ) [inline]
```

15.1.3.102 freduce() [6/10]

```
void FFLAS::freduce (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    FFPACK::rns_double::Element_ptr A,
    size_t lda ) [inline]
```

15.1.3.103 freivalds()

```
bool FFLAS::freivalds (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::ConstElement_ptr C,
    const size_t ldc ) [inline]
```

freivalds: **F**reivalds **G**eneral **M**atrix **M**ultiply **R**andom **C**heck.

Randomly Checks $C = \alpha \text{op}(A) \times \text{op}(B)$

Parameters

| | |
|--------------|---|
| <i>F</i> | field. |
| <i>ta</i> | if ta==FflasTrans then $\text{op}(A) = A^t$, else $\text{op}(A) = A$, |
| <i>tb</i> | same for matrix B |
| <i>m</i> | see A |
| <i>n</i> | see B |
| <i>k</i> | see A |
| <i>alpha</i> | scalar |

Parameters

| | |
|-------|--------------------------------|
| A | $\text{op}(A)$ is $m \times k$ |
| B | $\text{op}(B)$ is $k \times n$ |
| C | C is $m \times n$ |
| lda | leading dimension of A |
| ldb | leading dimension of B |
| ldc | leading dimension of C |

15.1.3.104 fscaln() [1/10]

```
void FFLAS::fscaln (
    const Field & F,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr X,
    const size_t incX ) [inline]
```

$\text{fscaln } x \leftarrow \alpha \cdot x.$

Parameters

| | |
|---------|---------------------|
| F | field |
| n | size of the vectors |
| $alpha$ | scalar |
| X | vector in F |
| $incX$ | stride of X |

Bug use `cblas_(d)scal` when possible

Todo check if comparison with $\pm 1, 0$ is necessary.

15.1.3.105 fscal() [1/10]

```
void FFLAS::fscal (
    const Field & F,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]
```

$\text{fscal } y \leftarrow \alpha \cdot x.$

Parameters

| | | |
|-----|----------|---------------------|
| | F | field |
| | n | size of the vectors |
| | α | scalar |
| in | X | vector in F |
| | $incX$ | stride of X |
| out | Y | vector in F |
| | $incY$ | stride of Y |

Bug use `cblas_(d)scal` when possible

Todo check if comparison with $\pm 1, 0$ is necessary.

15.1.3.106 fscal() [2/10]

```
void FFLAS::fscal (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy ) [inline]
```

15.1.3.107 fscal() [3/10]

```
void FFLAS::fscal (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy ) [inline]
```

15.1.3.108 fscaln() [2/10]

```
void FFLAS::fscaln (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy ) [inline]
```

15.1.3.109 fscaln() [3/10]

```
void FFLAS::fscaln (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy ) [inline]
```

15.1.3.110 fscaln() [4/10]

```
void FFLAS::fscaln (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda ) [inline]
```

$\text{fscaln } A \leftarrow a \cdot A.$

Parameters

| | |
|----------|------------------|
| F | field |
| m | number of rows |
| n | number of cols |
| α | homotecie scalar |
| A | matrix in F |
| lda | stride of A |

15.1.3.111 fscal() [4/10]

```
void FFLAS::fscal (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb ) [inline]
```

$\text{fscal } B \leftarrow a \cdot A.$

Parameters

| | | |
|--|-----|----------------|
| | F | field |
| | m | number of rows |

Parameters

| | | |
|-----|----------|------------------|
| | n | number of cols |
| | α | homotecie scalar |
| in | A | matrix in F |
| | lda | stride of A |
| out | B | matrix in F |
| | ldb | stride of B |

15.1.3.112 fscaln() [5/10]

```
void FFLAS::fscaln (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t inc ) [inline]
```

15.1.3.113 fscal() [5/10]

```
void FFLAS::fscal (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t Ainc,
    FFPACK::rns_double::Element_ptr B,
    const size_t Binc ) [inline]
```

15.1.3.114 fscaln() [6/10]

```
void FFLAS::fscaln (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t lda ) [inline]
```

15.1.3.115 fscal() [6/10]

```
void FFLAS::fscal (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::Element_ptr B,
    const size_t ldb ) [inline]
```

15.1.3.116 fscaln() [7/10]

```
void FFLAS::fscaln (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha,
    typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A,
    const size_t inc ) [inline]
```

15.1.3.117 fscal() [7/10]

```
void FFLAS::fscal (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t Ainc,
    FFPACK::rns_double::Element_ptr B,
    const size_t Binc ) [inline]
```

15.1.3.118 fscaln() [8/10]

```
void FFLAS::fscaln (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t lda ) [inline]
```


15.1.3.119 fscal() [8/10]

```

void FFLAS::fscal (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::Element_ptr B,
    const size_t ldb ) [inline]

```

15.1.3.120 fsyr2k()

```

Field::Element_ptr FFLAS::fsyr2k (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]

```

fsyr2k: Symmetric Rank 2K update

Computes the Lower or Upper triangular part of $C = \alpha(A \times B^T + B \times A^T) + \beta C$ or $C = \alpha(A^T \times B + B^T \times A) + \beta C$

Parameters

| | |
|--------------|--|
| <i>F</i> | field. |
| <i>UpLo</i> | whether to compute the upper or the lower triangular part of the symmetric matrix C |
| <i>trans</i> | if <code>ta==FflasNoTrans</code> then compute $C = \alpha(A \times B^T + B \times A^T) + \beta C$, else $C = \alpha(A^T \times B + B^T \times A) + \beta C$ |
| <i>n</i> | order of matrix C |
| <i>k</i> | see A |
| <i>alpha</i> | scalar |
| <i>A</i> | A is $n \times k$ (FflasNoTrans) or A is $k \times n$ (FflasTrans) |
| <i>lda</i> | leading dimension of A |
| <i>beta</i> | scalar |
| <i>C</i> | C is $n \times n$ |
| <i>ldc</i> | leading dimension of C |

Warning

α must be invertible

15.1.3.121 fsyrk() [1/5]

```
Field::Element_ptr FFLAS::fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]
```

fsyrk: Symmetric Rank K update

Computes the Lower or Upper triangular part of $C = \alpha A \times A^T + \beta C$ or $C = \alpha A^T \times A + \beta C$

Parameters

| | |
|--------------|---|
| <i>F</i> | field. |
| <i>UpLo</i> | whether to compute the upper or the lower triangular part of the symmetric matrix C |
| <i>trans</i> | if ta==FflasNoTrans then compute $C = \alpha A \times A^T + \beta C$, else $C = \alpha A^T \times A + \beta C$ |
| <i>n</i> | order of matrix C |
| <i>k</i> | see A |
| <i>alpha</i> | scalar |
| <i>A</i> | A is $n \times k$ or A is $k \times n$ |
| <i>lda</i> | leading dimension of A |
| <i>beta</i> | scalar |
| <i>C</i> | C is $n \times n$ |
| <i>ldc</i> | leading dimension of C |

Warning

α must be invertible

15.1.3.122 fsyrk() [2/5]

```
Field::Element_ptr FFLAS::fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
```

```

const FFLAS_TRANSPOSE trans,
const size_t n,
const size_t k,
const typename Field::Element alpha,
typename Field::Element_ptr A,
const size_t lda,
typename Field::ConstElement_ptr D,
const size_t incD,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const size_t threshold = __FFLASFFPACK_FSYRK_THRESHOLD ) [inline]

```

fsyrk: Symmetric Rank K update with diagonal scaling

Computes the Lower or Upper triangular part of $C = \alpha A \times D \times A^T + \beta C$ or $C = \alpha A^T \times D \times A + \beta C$ where D is a diagonal matrix. Matrix A is updated into $D \times A$ (if trans = FflasTrans) or $A \times D$ (if trans = FflasNoTrans).

Parameters

| | |
|--------------|---|
| <i>F</i> | field. |
| <i>UpLo</i> | whether to compute the upper or the lower triangular part of the symmetric matrix C |
| <i>trans</i> | if ta==FflasNoTrans then compute $C = \alpha A \times A^T + \beta C$, else $C = \alpha A^T \times A + \beta C$ |
| <i>n</i> | order of matrix C |
| <i>k</i> | see A |
| <i>alpha</i> | scalar |
| <i>A</i> | A is $n \times k$ or A is $k \times n$ |
| <i>lda</i> | leading dimension of A |
| <i>D</i> | D is $k \times k$ diagonal matrix, stored as a vector of k coefficients |
| <i>lda</i> | leading dimension of A |
| <i>beta</i> | scalar |
| <i>C</i> | C is $n \times n$ |
| <i>ldc</i> | leading dimension of C |

Warning

α must be invertible

15.1.3.123 fsyrk() [3/5]

```

Field::Element_ptr FFLAS::fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,

```

```

const size_t incD,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const ParSeqHelper::Sequential seq,
const size_t threshold ) [inline]

```

15.1.3.124 fsyrk() [4/5]

```

Field::Element_ptr FFLAS::fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Parallel< Cut, Param > par,
    const size_t threshold ) [inline]

```

15.1.3.125 fsyrk() [5/5]

```

Field::Element_ptr FFLAS::fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const std::vector< bool > & twoBlock,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t threshold = __FFLASFFPACK_FSYRK_THRESHOLD ) [inline]

```

fsyrk: Symmetric Rank K update with diagonal scaling

Computes the Lower or Upper triangular part of $C = \alpha A \times \text{Delta} D \times A^T + \beta C$ or $C = \alpha A^T \times \text{Delta} D \times A + \beta C$ where D is a diagonal matrix and Delta is a block diagonal with either 1 on the diagonal or 2x2 swap blocks Matrix A is updated into $D \times A$ (if trans = FflasTrans) or $A \times D$ (if trans = FflasNoTrans).

Parameters

| | |
|------------------|--|
| <i>F</i> | field. |
| <i>UpLo</i> | whether to compute the upper or the lower triangular part of the symmetric matrix C |
| <i>trans</i> | if <code>ta==FflasNoTrans</code> then compute $C = \alpha A \Delta D \times A^T + \beta C$, else $C = \alpha A^T \Delta D \times A + \beta C$ |
| <i>n</i> | see B |
| <i>k</i> | see A |
| <i>alpha</i> | scalar |
| <i>A</i> | <i>A</i> is $n \times k$ or <i>A</i> is $k \times n$ |
| <i>lda</i> | leading dimension of A |
| <i>D</i> | <i>D</i> is $k \times k$ diagonal matrix, stored as a vector of k coefficients |
| <i>twoBlocks</i> | a vector boolean indicating the beginning of each 2x2 blocs in Delta |
| <i>lda</i> | leading dimension of A |
| <i>beta</i> | scalar |
| <i>C</i> | <i>C</i> is $n \times n$ |
| <i>ldc</i> | leading dimension of C |

Warning

α must be invertible

15.1.3.126 ftrmm() [1/3]

```
void FFLAS::ftrmm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb ) [inline]
```

ftrmm: **TR**iangular **M**atrix **M**ultiply.

Computes $B \leftarrow \alpha \text{op}(A)B$ or $B \leftarrow \alpha B \text{op}(A)$.

Parameters

| | |
|---------------|---|
| <i>F</i> | field |
| <i>Side</i> | if <code>Side==FflasLeft</code> then $B \leftarrow \alpha \text{op}(A)B$ is computed. |
| <i>Uplo</i> | if <code>Uplo==FflasUpper</code> then A is upper triangular |
| <i>TransA</i> | if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$. |
| <i>Diag</i> | if <code>Diag==FflasUnit</code> then A is implicitly unit. |

Parameters

| | |
|----------|--|
| M | rows of B |
| N | cols of B |
| α | scalar |
| A | triangular matrix. If Side==FflasLeft then A is $N \times N$, otherwise A is $M \times M$ |
| lda | leading dim of A |
| B | matrix of size MxN |
| ldb | leading dim of B |

15.1.3.127 ftrmm() [2/3]

```

void FFLAS::ftrmm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]

```

ftrmm: **TR**iangular **M**atrix **M**ultiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \beta C$ or $C \leftarrow \alpha B \text{op}(A) + \beta C$.

Parameters

| | |
|----------|--|
| F | field |
| $Side$ | if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A)B$ is computed. |
| $Uplo$ | if Uplo==FflasUpper then A is upper triangular |
| $TransA$ | if TransA==FflasTrans then $\text{op}(A) = A^t$. |
| $Diag$ | if Diag==FflasUnit then A is implicitly unit. |
| M | rows of B |
| N | cols of B |
| α | scalar |
| A | triangular matrix. If Side==FflasLeft then A is $N \times N$, otherwise A is $M \times M$ |
| lda | leading dim of A |
| B | matrix of size MxN |
| ldb | leading dim of B |
| β | scalar |
| C | matrix of size MxN |
| ldc | leading dim of C |

15.1.3.128 ftrsm() [1/9]

```

void FFLAS::ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb ) [inline]

```

15.1.3.129 ftrsm() [2/9]

```

void FFLAS::ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const ParSeqHelper::Sequential & PSH ) [inline]

```

15.1.3.130 ftrsm() [3/9]

```

void FFLAS::ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const ParSeqHelper::Parallel< Cut, Param > & PSH ) [inline]

```

15.1.3.131 ftrsm() [4/9]

```

void FFLAS::ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Recursive, ParSeqTrait > & H ) [inline]

```

15.1.3.132 ftrsm() [5/9]

```

void FFLAS::ftrsm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * B,
    const size_t ldb ) [inline]

```

15.1.3.133 cblas_impstrsm()

```

void FFLAS::cblas_impstrsm (
    const enum FFLAS_ORDER Order,
    const enum FFLAS_SIDE Side,
    const enum FFLAS_UPLO Uplo,
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_DIAG Diag,
    const int M,
    const int N,
    const FFPACK::rns_double_elt alpha,
    FFPACK::rns_double_elt_cstptr A,
    const int lda,
    FFPACK::rns_double_elt_ptr B,
    const int ldb ) [inline]

```


15.1.3.134 ftrsv() [1/2]

```

void FFLAS::ftrsv (
    const Field & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    int incX ) [inline]

```

ftrsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

Parameters

| | |
|---------------|--|
| <i>F</i> | field |
| <i>X</i> | vector of size N on a field F |
| <i>incX</i> | stride of X |
| <i>A</i> | a matrix of leading dimension lda and size N |
| <i>lda</i> | leading dimension of A |
| <i>N</i> | number of rows or columns of A according to TransA |
| <i>TransA</i> | if TransA==FflasTrans then $\text{op}(A) = A^t$. |
| <i>Diag</i> | if Diag==FflasUnit then A is unit. |
| <i>Uplo</i> | if Uplo==FflasUpper then A is upper triangular |

15.1.3.135 igemm_()

```

void igemm_ (
    const enum FFLAS_ORDER Order,
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_TRANSPOSE TransB,
    const size_t M,
    const size_t N,
    const size_t K,
    const int64_t alpha,
    const int64_t * A,
    const size_t lda,
    const int64_t * B,
    const size_t ldb,
    const int64_t beta,
    int64_t * C,
    const size_t ldc ) [inline]

```

15.1.3.136 finit() [5/8]

```
void FFLAS::finit (
    const Field & F,
    const size_t n,
    const OtherElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )
```

$\text{finit } x \leftarrow y \bmod F.$

Parameters

| | |
|--------|------------------------|
| F | field |
| n | size of the vectors |
| Y | vector of OtherElement |
| $incY$ | stride of Y |
| X | vector in F |
| $incX$ | stride of X |

Bug use cblas_(d)scal when possible

15.1.3.137 fconvert() [1/3]

```
void FFLAS::fconvert (
    const Field & F,
    const size_t n,
    OtherElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY )
```

$\text{fconvert } x \leftarrow y \bmod F.$

Parameters

| | |
|--------|------------------------|
| F | field |
| n | size of the vectors |
| Y | vector of F |
| $incY$ | stride of Y |
| X | vector in OtherElement |
| $incX$ | stride of X |

Bug use cblas_(d)scal when possible

15.1.3.138 fnegin() [1/4]

```
void FFLAS::fnegin (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )
```

$\text{fnegin } x \leftarrow -x.$

Parameters

| | |
|---------------|---------------------|
| F | field |
| n | size of the vectors |
| X | vector in F |
| incX | stride of X |

Bug use `cblas_(d)scal` when possible

15.1.3.139 fneg() [1/4]

```
void FFLAS::fneg (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )
```

$\text{fneg } x \leftarrow -y.$

Parameters

| | |
|---------------|---------------------|
| F | field |
| n | size of the vectors |
| X | vector in F |
| incX | stride of X |
| Y | vector in F |
| incY | stride of Y |

Bug use `cblas_(d)scal` when possible

15.1.3.140 fzero() [1/4]

```
void FFLAS::fzero (
    const Field & F,
```

```

    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )

```

$\text{fzero} : A \leftarrow 0.$

Parameters

| | |
|---------------|----------------------------|
| F | field |
| n | number of elements to zero |
| X | vector in F |
| incX | stride of X |

15.1.3.141 frand() [1/2]

```

void FFLAS::frand (
    const Field & F,
    RandIter & G,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )

```

$\text{frand} : A \leftarrow \text{random}.$

Parameters

| | |
|---------------|---------------------------------|
| F | field |
| G | randomiterator |
| n | number of elements to randomize |
| X | vector in F |
| incX | stride of X |

15.1.3.142 fiszero() [1/4]

```

bool FFLAS::fiszero (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr X,
    const size_t incX )

```

$\text{fiszero} : \text{test } X = 0.$

Parameters

| | |
|---------------|------------------|
| F | field |
| n | vector dimension |
| X | vector in F |
| incX | increment of X |

15.1.3.143 fequal() [1/4]

```
bool FFLAS::fequal (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY )
```

fequal : test $X = Y$.

Parameters

| | |
|--------|------------------|
| F | field |
| n | vector dimension |
| X | vector in F |
| $incX$ | increment of X |
| Y | vector in F |
| $incY$ | increment of Y |

15.1.3.144 faxpby() [1/2]

```
void FFLAS::faxpby (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY )
```

faxpby : $y \leftarrow \alpha \cdot x + \beta \cdot y$.

Parameters

| | | |
|---------|---------|---------------------|
| | F | field |
| | N | size of the vectors |
| | $alpha$ | scalar |
| in | X | vector in F |
| | $incX$ | stride of X |
| | $beta$ | scalar |
| in, out | Y | vector in F |
| | $incY$ | stride of Y |

Note

this is a catlas function

15.1.3.145 fdot() [9/11]

```
Field::Element FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    const ParSeqHelper::Parallel< Cut, Param > par )
```

15.1.3.146 fswap() [1/2]

```
void FFLAS::fswap (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY )
```

fswap: $X \leftrightarrow Y$.

Bug use cblas_dswap when double

Parameters

| | |
|--------|---------------------|
| F | field |
| N | size of the vectors |
| X | vector in F |
| $incX$ | stride of X |
| Y | vector in F |
| $incY$ | stride of Y |

15.1.3.147 fzero() [2/4]

```
void FFLAS::fzero (
    const Field & F,
    const size_t m,
```

```

    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{fzero} : A \leftarrow 0.$

Parameters

| | |
|-------|------------------------|
| F | field |
| m | number of rows to zero |
| n | number of cols to zero |
| A | matrix in F |
| lda | stride of A |

Warning

may be buggy if Element is larger than int

15.1.3.148 frand() [2/2]

```

void FFLAS::frand (
    const Field & F,
    RandIter & G,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{frand} : A \leftarrow \text{random}.$

Parameters

| | |
|-------|-----------------------------|
| F | field |
| G | randomiterator |
| m | number of rows to randomize |
| n | number of cols to randomize |
| A | matrix in F |
| lda | stride of A |

15.1.3.149 fequal() [2/4]

```

bool FFLAS::fequal (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,

```

```

const size_t lda,
typename Field::ConstElement_ptr B,
const size_t ldb )

```

fequal : test $A = B$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | row dimension |
| n | column dimension |
| A | m x n matrix in F |
| lda | leading dimension of A |
| B | m x n matrix in F |
| ldb | leading dimension of B |

15.1.3.150 fiszero() [2/4]

```

bool FFLAS::fiszero (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda )

```

fiszero : test $A = 0$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | row dimension |
| n | column dimension |
| A | m x n matrix in F |
| lda | leading dimension of A |

15.1.3.151 fidentity() [1/4]

```

void FFLAS::fidentity (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element & d )

```

creates a diagonal matrix

15.1.3.152 fidentity() [2/4]

```
void FFLAS::fidentity (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

creates a diagonal matrix

15.1.3.153 finit() [6/8]

```
void FFLAS::finit (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

finit Initializes A in $F^{\$}$.

Parameters

| | |
|-------|----------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |

15.1.3.154 fconvert() [2/3]

```
void FFLAS::fconvert (
    const Field & F,
    const size_t m,
    const size_t n,
    OtherElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb )
```

fconvert $A \leftarrow B \bmod F$.

Parameters

| | |
|-----|----------------|
| F | field |
| m | number of rows |
| n | number of cols |

Parameters

| | |
|-------|-------------------------------------|
| A | matrix in <code>OtherElement</code> |
| lda | stride of A |
| B | matrix in F |
| ldb | stride of B |

Todo check if $n == lda$

15.1.3.155 `fnegin()` [2/4]

```
void FFLAS::fnegin (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

`fnegin` $A \leftarrow -A$.

Parameters

| | |
|-------|----------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |

Todo check if $n == lda$

15.1.3.156 `fneg()` [2/4]

```
void FFLAS::fneg (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )
```

`fneg` $A \leftarrow -B$.

Parameters

| | |
|-------|----------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |

Todo check if $n == lda$

15.1.3.157 faxpby() [2/2]

```
void FFLAS::faxpby (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t ldx,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t ldy )
```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

Parameters

| | | |
|---------|----------|--------------------------|
| | F | field |
| | m | row dimension |
| | n | column dimension |
| | α | scalar |
| in | X | vector in F |
| | ldx | leading dimension of X |
| | β | scalar |
| in, out | Y | vector in F |
| | ldy | leading dimension of Y |

Note

this is a catlas function

15.1.3.158 fmove() [1/2]

```
void FFLAS::fmove (
    const Field & F,
```

```

    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb )

```

fmove : $A \leftarrow B$ and $B \leftarrow 0$.

Parameters

| | |
|------------|------------------------|
| <i>F</i> | field |
| <i>m</i> | number of rows to copy |
| <i>n</i> | number of cols to copy |
| <i>A</i> | matrix in F |
| <i>lda</i> | stride of A |
| <i>B</i> | matrix in F |
| <i>ldb</i> | stride of B |

15.1.3.159 bitsize()

```

size_t FFLAS::bitsize (
    const Field & F,
    size_t M,
    size_t N,
    const typename Field::ConstElement_ptr A,
    size_t lda ) [inline]

```

bitsize: Computes the largest bitsize of the matrix' coefficients.

If the matrix is over a modular prime field, it returns the bitsize of the largest element (in a bsolute value)

Parameters

| | |
|-------------|--|
| <i>F</i> | field |
| <i>M</i> | rows |
| <i>N</i> | cols |
| <i>incX</i> | stride of X |
| <i>A</i> | a matrix of leading dimension lda and size MxN |
| <i>lda</i> | leading dimension of A |

15.1.3.160 bitsize< Givaro::ZRing< Givaro::Integer > >()

```

size_t FFLAS::bitsize< Givaro::ZRing< Givaro::Integer > > (
    const Givaro::ZRing< Givaro::Integer > & F,
    size_t M,

```

```

size_t N,
const Givaro::Integer * A,
size_t lda ) [inline]

```

15.1.3.161 ftrmv()

```

void FFLAS::ftrmv (
    const Field & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    int incX )

```

ftrsm: TRIangular Matrix Vector prodcut Computes $X \leftarrow \text{op}(A)X$

Parameters

| | |
|---------------|---|
| <i>F</i> | field |
| <i>X</i> | vector of size N on a field F |
| <i>incX</i> | stride of X |
| <i>A</i> | a matrix of leading dimension lda and size N |
| <i>lda</i> | leading dimension of A |
| <i>N</i> | number of rows and columns of A |
| <i>TransA</i> | if TransA==FflasTrans then $\text{op}(A) = A^T$. |
| <i>Diag</i> | if Diag==FflasUnit then A is unit diagonal. |
| <i>Uplo</i> | if Uplo==FflasUpper then A is upper triangular |

15.1.3.162 ftrsm() [6/9]

```

void FFLAS::ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb )

```

ftrsm: TRIangular System solve with Matrix.

Computes $B \leftarrow \alpha \text{op}(A^{-1})B$ or $B \leftarrow \alpha B \text{op}(A^{-1})$.

Parameters

| | |
|---------------|--|
| <i>F</i> | field |
| <i>Side</i> | if <code>Side==FflasLeft</code> then $B \leftarrow \alpha \text{op}(A^{-1})B$ is computed. |
| <i>Uplo</i> | if <code>Uplo==FflasUpper</code> then A is upper triangular |
| <i>TransA</i> | if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$. |
| <i>Diag</i> | if <code>Diag==FflasUnit</code> then A is unit. |
| <i>M</i> | rows of B |
| <i>N</i> | cols of B |
| <i>alpha</i> | scalar |
| <i>A</i> | triangular invertible matrix. If <code>Side==FflasLeft</code> then A is $N \times N$, otherwise A is $M \times M$ |
| <i>lda</i> | leading dim of A |
| <i>B</i> | matrix of size MxN |
| <i>ldb</i> | leading dim of B |

Bug α must be non zero.

15.1.3.163 `pfgemm()` [1/7]

```
Field::Element_ptr FFLAS::pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numthreads = 0 )
```

15.1.3.164 `pfgemm_1D_rec()`

```
Field::Element* FFLAS::pfgemm_1D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
```

```

const typename Field::Element_ptr A,
const size_t lda,
const typename Field::Element_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element * C,
const size_t ldc,
size_t seuil )

```

15.1.3.165 pfgemm_2D_rec()

```

Field::Element* FFLAS::pfgemm_2D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    size_t seuil )

```

15.1.3.166 pfgemm_3D_rec()

```

Field::Element* FFLAS::pfgemm_3D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t seuil,
    size_t * x )

```

15.1.3.167 pfgemm_3D_rec2()

```
Field::Element_ptr FFLAS::pfgemm_3D_rec2 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t seuil,
    size_t * x )
```

15.1.3.168 fgemm() [19/23]

```
std::enable_if<!std::is_same<ModeTrait, ModeCategories::ConvertTo<ElementCategories::RNSElementTag>
>::value, typename Field::Element_ptr>::type FFLAS::fgemm (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE ta,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat,
Param > > & H ) [inline]
```

15.1.3.169 ftrsm() [7/9]

```
Field::Element_ptr FFLAS::ftrsm (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_TRANSPOSE TA,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t m,
```



```

    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel< Cut, Param > > &
H ) [inline]

```

15.1.3.170 ftrsm() [8/9]

```

Field::Element_ptr FFLAS::ftrsm (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_TRANSPOSE TA,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Hybrid, ParSeqHelper::Parallel< Cut, Param > > & H
) [inline]

```

15.1.3.171 sparse_delete() [1/12]

```

void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::COO > & A ) [inline]

```

15.1.3.172 sparse_delete() [2/12]

```

void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A ) [inline]

```

15.1.3.173 sparse_init() [1/16]

```

void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::COO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.174 sparse_init() [2/16]

```
void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.175 sparse_delete() [3/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR > & A ) [inline]
```

15.1.3.176 sparse_delete() [4/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A ) [inline]
```

15.1.3.177 sparse_print() [1/3]

```
std::ostream& FFLAS::sparse_print (
    std::ostream & os,
    const Sparse< Field, SparseMatrix_t::CSR > & A ) [inline]
```

15.1.3.178 sparse_init() [3/16]

```
void FFLAS::sparse_init (
    const Givaro::Modular< Givaro::Integer > & F,
    Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR > & A,
    const IndexT * row,
    const IndexT * col,
    Givaro::Integer * dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.179 sparse_init() [4/16]

```

void FFLAS::sparse_init (
    const Givaro::ZRing< Givaro::Integer > & F,
    Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    Givaro::Integer * dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.180 sparse_init() [5/16]

```

void FFLAS::sparse_init (
    const Givaro::ZRing< RecInt::rmint< RECINT_SIZE >> & F,
    Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>, SparseMatrix_t::CSR_ZO >
& A,
    const IndexT * row,
    const IndexT * col,
    typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>::Element_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.181 sparse_init() [6/16]

```

void FFLAS::sparse_init (
    const Givaro::ZRing< RecInt::rmint< RECINT_SIZE >> & F,
    Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>, SparseMatrix_t::CSR > &
A,
    const IndexT * row,
    const IndexT * col,
    typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>::Element_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.182 sparse_init() [7/16]

```

void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.183 sparse_init() [8/16]

```
void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.184 sparse_delete() [5/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A ) [inline]
```

15.1.3.185 sparse_init() [9/16]

```
void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.186 sparse_delete() [6/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL > & A ) [inline]
```

15.1.3.187 sparse_delete() [7/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A ) [inline]
```

15.1.3.188 sparse_init() [10/16]

```
void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.189 sparse_init() [11/16]

```
void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.190 sparse_delete() [8/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A ) [inline]
```

15.1.3.191 sparse_delete() [9/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A ) [inline]
```

15.1.3.192 sparse_print() [2/3]

```
void FFLAS::sparse_print (
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A ) [inline]
```

15.1.3.193 sparse_init() [12/16]

```

void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.194 sparse_init() [13/16]

```

void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.195 sparse_delete() [10/12]

```

void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A ) [inline]

```

15.1.3.196 sparse_init() [14/16]

```

void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.197 operator<<()

```
std::ostream& FFLAS::operator<< (
    std::ostream & os,
    const Sparse<_Field, SparseMatrix_t::HYB_ZO > & A )
```

15.1.3.198 readSmsFormat()

```
void FFLAS::readSmsFormat (
    const std::string & path,
    const Field & f,
    index_t *& row,
    index_t *& col,
    typename Field::Element_ptr & val,
    index_t & rowdim,
    index_t & coldim,
    uint64_t & nnz )
```

15.1.3.199 readSprFormat()

```
void FFLAS::readSprFormat (
    const std::string & path,
    const Field & f,
    index_t *& row,
    index_t *& col,
    typename Field::Element_ptr & val,
    index_t & rowdim,
    index_t & coldim,
    uint64_t & nnz )
```

15.1.3.200 getDataType() [1/4]

```
std::enable_if<std::is_integral<T>::value,int> FFLAS::getDataType ( )
```

15.1.3.201 getDataType() [2/4]

```
std::enable_if<std::is_floating_point<T>::value,int> FFLAS::getDataType ( )
```

15.1.3.202 `getDataType()` [3/4]

```
std::enable_if<std::is_same<T,mpz_t>::value,int> FFLAS::getDataType ( )
```

15.1.3.203 `getDataType()` [4/4]

```
int FFLAS::getDataType ( )
```

15.1.3.204 `readMachineType()`

```
void FFLAS::readMachineType (
    const Field & F,
    typename Field::Element & modulo,
    typename Field::Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc )
```

15.1.3.205 `readDnsFormat()`

```
void FFLAS::readDnsFormat (
    const std::string & path,
    const Field & F,
    index_t & rowdim,
    index_t & coldim,
    typename Field::Element_ptr & val )
```

15.1.3.206 `writeDnsFormat()`

```
void FFLAS::writeDnsFormat (
    const std::string & path,
    const Field & F,
    const index_t & rowdim,
    const index_t & coldim,
    typename Field::Element_ptr A,
    index_t ldA )
```


15.1.3.207 fspmv() [1/2]

```
void FFLAS::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ) [inline]
```

15.1.3.208 sparse_delete() [11/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::SELL > & A ) [inline]
```

15.1.3.209 sparse_delete() [12/12]

```
void FFLAS::sparse_delete (
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A ) [inline]
```

15.1.3.210 sparse_print() [3/3]

```
void FFLAS::sparse_print (
    const Sparse< Field, SparseMatrix_t::SELL > & A ) [inline]
```

15.1.3.211 sparse_init() [15/16]

```
void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::SELL > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz,
    uint64_t sigma = 0 ) [inline]
```

15.1.3.212 sparse_init() [16/16]

```

void FFLAS::sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.213 computeDeviation()

```

double FFLAS::computeDeviation (
    It begin,
    It end )

```

15.1.3.214 getStat()

```

StatsMatrix FFLAS::getStat (
    const Field & F,
    const index_t * row,
    const index_t * col,
    typename Field::ConstElement_ptr val,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz )

```

15.1.3.215 fspmv() [2/2]

```

void FFLAS::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    const typename Field::Element & beta,
    typename Field::Element_ptr y ) [inline]

```

15.1.3.216 fspmm()

```

void FFLAS::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    const typename Field::Element & beta,
    typename Field::Element_ptr y,
    int ldy ) [inline]

```

15.1.3.217 fflas_delete() [1/3]

```

void FFLAS::fflas_delete (
    FFPACK::rns_double_elt_ptr A ) [inline]

```

15.1.3.218 fflas_delete() [2/3]

```

void FFLAS::fflas_delete (
    FFPACK::rns_double_elt_cstptr A ) [inline]

```

15.1.3.219 fflas_new() [1/7]

```

FFPACK::rns_double_elt_ptr FFLAS::fflas_new (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const Alignment align ) [inline]

```

15.1.3.220 fflas_new() [2/7]

```

FFPACK::rns_double_elt_ptr FFLAS::fflas_new (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const Alignment align ) [inline]

```

15.1.3.221 finit_rns() [1/2]

```
void FFLAS::finit_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename RNS::Element_ptr A )
```

15.1.3.222 finit_trans_rns()

```
void FFLAS::finit_trans_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename RNS::Element_ptr A )
```

15.1.3.223 fconvert_rns() [1/2]

```
void FFLAS::fconvert_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename RNS::ConstElement_ptr A )
```

15.1.3.224 fconvert_trans_rns()

```
void FFLAS::fconvert_trans_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename RNS::ConstElement_ptr A )
```

15.1.3.225 fflas_new() [3/7]

```
FFPACK::rns_double_elt_ptr FFLAS::fflas_new (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const Alignment align ) [inline]
```

15.1.3.226 fflas_new() [4/7]

```
FFPACK::rns_double_elt_ptr FFLAS::fflas_new (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const Alignment align ) [inline]
```

15.1.3.227 finit_rns() [2/2]

```
void FFLAS::finit_rns (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename FFPACK::RNSInteger< RNS >::Element_ptr A )
```

15.1.3.228 fconvert_rns() [2/2]

```
void FFLAS::fconvert_rns (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr A )
```

15.1.3.229 freduce() [7/10]

```
template INST_OR_DECL void FFLAS::freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX )
```

$\text{freduce } x \leftarrow x \bmod F.$

Parameters

| | |
|--------|---------------------|
| F | field |
| n | size of the vectors |
| X | vector in F |
| $incX$ | stride of X |

Bug use `cblas_(d)scal` when possible

15.1.3.230 `freduce()` [8/10]

```
template INST_OR_DECL void FFLAS::freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

`freduce` $x \leftarrow y \bmod F$.

Parameters

| | |
|--------|---------------------|
| F | field |
| n | size of the vectors |
| Y | vector of Element |
| $incY$ | stride of Y |
| X | vector in F |
| $incX$ | stride of X |

Bug use `cblas_(d)scal` when possible

15.1.3.231 `finit()` [7/8]

```
template INST_OR_DECL void FFLAS::finit (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

`finit` $x \leftarrow y \bmod F$.

Parameters

| | |
|--------|------------------------|
| F | field |
| n | size of the vectors |
| Y | vector of OtherElement |
| $incY$ | stride of Y |
| X | vector in F |
| $incX$ | stride of X |

Bug use `cblas_(d)scal` when possible

15.1.3.232 `fconvert()` [3/3]

```
template INST_OR_DECL void FFLAS::fconvert (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY )
```

`fconvert` $x \leftarrow y \bmod F$.

Parameters

| | |
|--------|------------------------|
| F | field |
| n | size of the vectors |
| Y | vector of F |
| $incY$ | stride of Y |
| X | vector in OtherElement |
| $incX$ | stride of X |

Bug use `cblas_(d)scal` when possible

15.1.3.233 `fnegin()` [3/4]

```
template INST_OR_DECL void FFLAS::fnegin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX )
```

`fnegin` $x \leftarrow -x$.

Parameters

| | |
|--------|---------------------|
| F | field |
| n | size of the vectors |
| X | vector in F |
| $incX$ | stride of X |

Bug use `cblas_(d)scal` when possible

15.1.3.234 `fneg()` [3/4]

```
template INST_OR_DECL void FFLAS::fneg (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

`fneg` $x \leftarrow -y$.

Parameters

| | |
|--------|---------------------|
| F | field |
| n | size of the vectors |
| X | vector in F |
| $incX$ | stride of X |
| Y | vector in F |
| $incY$ | stride of Y |

Bug use `cblas_(d)scal` when possible

15.1.3.235 `fzero()` [3/4]

```
template INST_OR_DECL void FFLAS::fzero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX )
```

`fzero` : $A \leftarrow 0$.

Parameters

| | |
|--------|----------------------------|
| F | field |
| n | number of elements to zero |
| X | vector in F |
| $incX$ | stride of X |

15.1.3.236 fiszero() [3/4]

```
template INST_OR_DECL bool FFLAS::fiszero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * X,
    const size_t incX )
```

fiszero : test $X = 0$.

Parameters

| | |
|--------|------------------|
| F | field |
| n | vector dimension |
| X | vector in F |
| $incX$ | increment of X |

15.1.3.237 fequal() [3/4]

```
template INST_OR_DECL bool FFLAS::fequal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY )
```

fequal : test $X = Y$.

Parameters

| | |
|--------|------------------|
| F | field |
| n | vector dimension |
| X | vector in F |
| $incX$ | increment of X |
| Y | vector in F |
| $incY$ | increment of Y |

15.1.3.238 fassign() [9/10]

```
template INST_OR_DECL void FFLAS::fassign (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

fassign : $x \leftarrow y$.

X is preallocated

Todo variant for triagular matrix

Parameters

| | | |
|-----|--------|---------------------|
| | F | field |
| | N | size of the vectors |
| out | X | vector in F |
| | $incX$ | stride of X |
| in | Y | vector in F |
| | $incY$ | stride of Y |

15.1.3.239 fscaln() [9/10]

```
template INST_OR_DECL void FFLAS::fscaln (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT alpha,
    FFLAS_ELT * X,
    const size_t incX )
```

fscaln $x \leftarrow \alpha \cdot x$.

Parameters

| | |
|---------|---------------------|
| F | field |
| n | size of the vectors |
| $alpha$ | scalar |
| X | vector in F |
| $incX$ | stride of X |

Bug use cblas_(d)scal when possible

Todo check if comparison with +/-1,0 is necessary.

15.1.3.240 fscal() [9/10]

```
template INST_OR_DECL void FFLAS::fscal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t incX,
    FFLAS_ELT * Y,
    const size_t incY )
```

$\text{fscal } y \leftarrow \alpha \cdot x.$

Parameters

| | | |
|-----|---------------|---------------------|
| | F | field |
| | n | size of the vectors |
| | α | scalar |
| in | X | vector in F |
| | incX | stride of X |
| out | Y | vector in F |
| | incY | stride of Y |

Bug use cblas_(d)scal when possible

Todo check if comparison with +/-1,0 is necessary.

15.1.3.241 faxpy() [5/6]

```
template INST_OR_DECL void FFLAS::faxpy (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t incX,
    FFLAS_ELT * Y,
    const size_t incY )
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

Parameters

| | | |
|---------|---------------|---------------------|
| | F | field |
| | N | size of the vectors |
| | α | scalar |
| in | X | vector in F |
| | incX | stride of X |
| in, out | Y | vector in F |
| | incY | stride of Y |

15.1.3.242 fdot() [10/11]

```
template INST_OR_DECL FFLAS_ELT FFLAS::fdot (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY )
```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

Parameters

| | | |
|---------|---------------|---------------------|
| | F | field |
| | N | size of the vectors |
| | α | scalar |
| in | X | vector in F |
| | incX | stride of X |
| | β | scalar |
| in, out | Y | vector in F |
| | incY | stride of Y |

Note

this is a catlas function

fdot: dot product $x^T y$.

Parameters

| | |
|---------------|---------------------|
| F | field |
| N | size of the vectors |
| X | vector in F |
| incX | stride of X |
| Y | vector in F |
| incY | stride of Y |

15.1.3.243 fswap() [2/2]

```
template INST_OR_DECL void FFLAS::fswap (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    FFLAS_ELT * X,
    const size_t incX,
```

```

FFLAS_ELT * Y,
const size_t incY )

```

fswap: $X \leftrightarrow Y$.

Bug use cblas_dswap when double

Parameters

| | |
|-------------|---------------------|
| <i>F</i> | field |
| <i>N</i> | size of the vectors |
| <i>X</i> | vector in F |
| <i>incX</i> | stride of X |
| <i>Y</i> | vector in F |
| <i>incY</i> | stride of Y |

15.1.3.244 fadd() [5/8]

```

template INST_OR_DECL void FFLAS::fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )

```

15.1.3.245 fsub() [3/4]

```

template INST_OR_DECL void FFLAS::fsub (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )

```

15.1.3.246 faddin() [3/4]

```
template INST_OR_DECL void FFLAS::faddin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )
```

15.1.3.247 fadd() [6/8]

```
template INST_OR_DECL void FFLAS::fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )
```

15.1.3.248 fassign() [10/10]

```
template INST_OR_DECL void FFLAS::fassign (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

fassign : $A \leftarrow B$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | number of rows to copy |
| n | number of cols to copy |
| A | matrix in F |
| lda | stride of A |
| B | vector in F |
| ldb | stride of B |

15.1.3.249 fzero() [4/4]

```
template INST_OR_DECL void FFLAS::fzero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

fzero : $A \leftarrow 0$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | number of rows to zero |
| n | number of cols to zero |
| A | matrix in F |
| lda | stride of A |

Warning

may be buggy if Element is larger than int

15.1.3.250 fequal() [4/4]

```
template INST_OR_DECL bool FFLAS::fequal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb )
```

fequal : test $A = B$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | row dimension |
| n | column dimension |
| A | m x n matrix in F |
| lda | leading dimension of A |
| B | m x n matrix in F |
| ldb | leading dimension of B |

15.1.3.251 fiszero() [4/4]

```
template INST_OR_DECL bool FFLAS::fiszero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * A,
    const size_t lda )
```

fiszero : test $A = 0$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | row dimension |
| n | column dimension |
| A | m x n matrix in F |
| lda | leading dimension of A |

15.1.3.252 fidentity() [3/4]

```
template INST_OR_DECL void FFLAS::fidentity (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT & d )
```

creates a diagonal matrix

15.1.3.253 fidentity() [4/4]

```
template INST_OR_DECL void FFLAS::fidentity (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

creates a diagonal matrix

15.1.3.254 freduce() [9/10]

```
template INST_OR_DECL void FFLAS::freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

freduce $A \leftarrow A \bmod F$.

Parameters

| | |
|-------|----------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |

15.1.3.255 freduce() [10/10]

```
template INST_OR_DECL void FFLAS::freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

freduce $A \leftarrow B \bmod F$.

Parameters

| | |
|-------|-------------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |
| B | matrix in Element |
| ldb | stride of B |

15.1.3.256 finit() [8/8]

```
template INST_OR_DECL void FFLAS::finit (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

finit $A \leftarrow B \bmod F$.

Parameters

| | |
|-----|-------|
| F | field |
|-----|-------|

Parameters

| | |
|-------|----------------|
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |
| B | matrix in F |
| ldb | stride of B |

15.1.3.257 fnegin() [4/4]

```
template INST_OR_DECL void FFLAS::fnegin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

fnegin $A \leftarrow -A$.

Parameters

| | |
|-------|----------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |

15.1.3.258 fneg() [4/4]

```
template INST_OR_DECL void FFLAS::fneg (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

fneg $A \leftarrow -B$.

Parameters

| | |
|-------|----------------|
| F | field |
| m | number of rows |
| n | number of cols |
| A | matrix in F |
| lda | stride of A |

15.1.3.259 fscaln() [10/10]

```
template INST_OR_DECL void FFLAS::fscaln (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    FFLAS_ELT * A,
    const size_t lda )
```

$\text{fscaln } A \leftarrow a \cdot A.$

Parameters

| | |
|----------|------------------|
| F | field |
| m | number of rows |
| n | number of cols |
| α | homotecie scalar |
| A | matrix in F |
| lda | stride of A |

15.1.3.260 fscl() [10/10]

```
template INST_OR_DECL void FFLAS::fscl (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

$\text{fscl } B \leftarrow a \cdot A.$

Parameters

| | | |
|-----|----------|------------------|
| | F | field |
| | m | number of rows |
| | n | number of cols |
| | α | homotecie scalar |
| in | A | matrix in F |
| | lda | stride of A |
| out | B | matrix in F |
| | ldb | stride of B |

15.1.3.261 faxpy() [6/6]

```
template INST_OR_DECL void FFLAS::faxpy (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t ldx,
    FFLAS_ELT * Y,
    const size_t ldy )
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

Parameters

| | | |
|---------|----------|--------------------------|
| | F | field |
| | m | row dimension |
| | n | column dimension |
| | α | scalar |
| in | X | vector in F |
| | ldx | leading dimension of X |
| in, out | Y | vector in F |
| | ldy | leading dimension of Y |

15.1.3.262 fmove() [2/2]

```
template INST_OR_DECL void FFLAS::fmove (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

Parameters

| | | |
|---------|----------|--------------------------|
| | F | field |
| | m | row dimension |
| | n | column dimension |
| | α | scalar |
| in | X | vector in F |
| | ldx | leading dimension of X |
| | β | scalar |
| in, out | Y | vector in F |
| | ldy | leading dimension of Y |

Note

this is a catlas function

fmove : $A \leftarrow B$ and $B \leftarrow 0$.

Parameters

| | |
|-------|------------------------|
| F | field |
| m | number of rows to copy |
| n | number of cols to copy |
| A | matrix in F |
| lda | stride of A |
| B | vector in F |
| ldb | stride of B |

15.1.3.263 fadd() [7/8]

```
template INST_OR_DECL void FFLAS::fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )
```

fadd : matrix addition.

Computes $C = A + B$.

Parameters

| | |
|-------|-----------------------------------|
| F | field |
| M | rows |
| N | cols |
| A | dense matrix of size $M \times N$ |
| lda | leading dimension of A |
| B | dense matrix of size $M \times N$ |
| ldb | leading dimension of B |
| C | dense matrix of size $M \times N$ |
| ldc | leading dimension of C |

15.1.3.264 fsub() [4/4]

```
template INST_OR_DECL void FFLAS::fsub (
```

```

    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )

```

fsub : matrix subtraction.

Computes $C = A - B$.

Parameters

| | |
|------------|--------------------------|
| <i>F</i> | field |
| <i>M</i> | rows |
| <i>N</i> | cols |
| <i>A</i> | dense matrix of size MxN |
| <i>lda</i> | leading dimension of A |
| <i>B</i> | dense matrix of size MxN |
| <i>ldb</i> | leading dimension of B |
| <i>C</i> | dense matrix of size MxN |
| <i>ldc</i> | leading dimension of C |

15.1.3.265 fsubin() [3/3]

```

template INST_OR_DECL void FFLAS::fsubin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )

```

fsubin $C = C - B$

15.1.3.266 fadd() [8/8]

```

template INST_OR_DECL void FFLAS::fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT alpha,

```

```

const FFLAS_ELT * B,
const size_t ldb,
FFLAS_ELT * C,
const size_t ldc )

```

fadd : matrix addition with scaling.

Computes $C = A + \alpha B$.

Parameters

| | |
|--------------|--------------------------|
| <i>F</i> | field |
| <i>M</i> | rows |
| <i>N</i> | cols |
| <i>A</i> | dense matrix of size MxN |
| <i>lda</i> | leading dimension of A |
| <i>alpha</i> | some scalar |
| <i>B</i> | dense matrix of size MxN |
| <i>ldb</i> | leading dimension of B |
| <i>C</i> | dense matrix of size MxN |
| <i>ldc</i> | leading dimension of C |

15.1.3.267 faddin() [4/4]

```

template INST_OR_DECL void FFLAS::faddin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )

```

faddin

15.1.3.268 fgemv() [17/19]

```

template INST_OR_DECL FFLAS_ELT* FFLAS::fgemv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE TransA,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT beta,

```

```
FFLAS_ELT * Y,  
const size_t incY )
```

finite prime FFLAS_FIELD<FFLAS_ELT> GEneral Matrix Vector multiplication.

Computes $Y \leftarrow \alpha \text{op}(A)X + \beta Y$.

Parameters

| | | |
|-----|---------------|--|
| | <i>F</i> | field |
| | <i>TransA</i> | if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$. |
| | <i>M</i> | rows |
| | <i>N</i> | cols |
| | <i>alpha</i> | scalar |
| | <i>A</i> | dense matrix of size MxN |
| | <i>lda</i> | leading dimension of A |
| | <i>X</i> | dense vector of size N |
| | <i>incX</i> | stride of X |
| | <i>beta</i> | scalar |
| out | <i>Y</i> | dense vector of size M |
| | <i>incY</i> | stride of Y |

15.1.3.269 fger() [12/12]

```
template INST_OR_DECL void FFLAS::fger (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * x,
    const size_t incx,
    const FFLAS_ELT * y,
    const size_t incy,
    FFLAS_ELT * A,
    const size_t lda )
```

fger: rank one update of a general matrix

Computes $A \leftarrow \alpha x y^T + A$

Parameters

| | | |
|---------|--------------|--|
| | <i>F</i> | field |
| | <i>M</i> | rows |
| | <i>N</i> | cols |
| | <i>alpha</i> | scalar |
| in, out | <i>A</i> | dense matrix of size MxN and leading dimension lda |
| | <i>lda</i> | leading dimension of A |
| | <i>x</i> | dense vector of size M |
| | <i>incx</i> | stride of X |
| | <i>y</i> | dense vector of size N |
| | <i>incy</i> | stride of Y |

15.1.3.270 ftrsv() [2/2]

```
template INST_OR_DECL void FFLAS::ftrsv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    int incX )
```

ftrsv: **TR**iangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

Parameters

| | |
|---------------|--|
| <i>F</i> | field |
| <i>X</i> | vector of size N on a field F |
| <i>incX</i> | stride of X |
| <i>A</i> | a matrix of leading dimension lda and size N |
| <i>lda</i> | leading dimension of A |
| <i>N</i> | number of rows or columns of A according to TransA |
| <i>TransA</i> | if TransA==FflasTrans then $\text{op}(A) = A^t$. |
| <i>Diag</i> | if Diag==FflasUnit then A is unit. |
| <i>Uplo</i> | if Uplo==FflasUpper then A is upper triangular |

15.1.3.271 ftrsm() [9/9]

```
template INST_OR_DECL void FFLAS::ftrsm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

ftrsm: **TR**iangular System solve with **M**atrix.

Computes $B \leftarrow \alpha \text{op}(A^{-1})B$ or $B \leftarrow \alpha B \text{op}(A^{-1})$.

Parameters

| | |
|-------------|---|
| <i>F</i> | field |
| <i>Side</i> | if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A^{-1})B$ is computed. |

Parameters

| | |
|---------------|--|
| <i>Uplo</i> | if <code>Uplo==FflasUpper</code> then A is upper triangular |
| <i>TransA</i> | if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$. |
| <i>Diag</i> | if <code>Diag==FflasUnit</code> then A is unit. |
| <i>M</i> | rows of B |
| <i>N</i> | cols of B |
| <i>alpha</i> | scalar |
| <i>A</i> | triangular invertible matrix. If <code>Side==FflasLeft</code> then A is $N \times N$, otherwise A is $M \times M$ |
| <i>lda</i> | leading dim of A |
| <i>B</i> | matrix of size MxN |
| <i>ldb</i> | leading dim of B |

Bug α must be non zero.

15.1.3.272 ftrmm() [3/3]

```
template INST_OR_DECL void FFLAS::ftrmm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

ftrmm: **TR**iangular **M**atrix **M**ultiply.

Computes $B \leftarrow \alpha \text{op}(A)B$ or $B \leftarrow \alpha B \text{op}(A)$.

Parameters

| | |
|---------------|---|
| <i>F</i> | field |
| <i>Side</i> | if <code>Side==FflasLeft</code> then $B \leftarrow \alpha \text{op}(A)B$ is computed. |
| <i>Uplo</i> | if <code>Uplo==FflasUpper</code> then A is upper triangular |
| <i>TransA</i> | if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$. |
| <i>Diag</i> | if <code>Diag==FflasUnit</code> then A is implicitly unit. |
| <i>M</i> | rows of B |
| <i>N</i> | cols of B |
| <i>alpha</i> | scalar |
| <i>A</i> | triangular matrix. If <code>Side==FflasLeft</code> then A is $N \times N$, otherwise A is $M \times M$ |
| <i>lda</i> | leading dim of A |
| <i>B</i> | matrix of size MxN |
| <i>ldb</i> | leading dim of B |

15.1.3.273 fgemm() [20/23]

```
template INST_OR_DECL FFLAS_ELT* FFLAS::fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc )
```

fgemm: **F**ield **G**eneral **M**atrix **M**ultiply.

Computes $C = \alpha \text{op}(A) \times \text{op}(B) + \beta C$ Automatically set Winograd recursion level

Parameters

| | |
|--------------|---|
| <i>F</i> | field. |
| <i>ta</i> | if <code>ta==FflasTrans</code> then $\text{op}(A) = A^t$, else $\text{op}(A) = A$, |
| <i>tb</i> | same for matrix B |
| <i>m</i> | see A |
| <i>n</i> | see B |
| <i>k</i> | see A |
| <i>alpha</i> | scalar |
| <i>beta</i> | scalar |
| <i>A</i> | $\text{op}(A)$ is $m \times k$ |
| <i>B</i> | $\text{op}(B)$ is $k \times n$ |
| <i>C</i> | C is $m \times n$ |
| <i>lda</i> | leading dimension of A |
| <i>ldb</i> | leading dimension of B |
| <i>ldc</i> | leading dimension of C |
| <i>w</i> | recursive levels of Winograd's algorithm are used. No argument (or -1) does auto computation of w . |

Warning

α must be invertible

15.1.3.274 fgemm() [21/23]

```
template INST_OR_DECL FFLAS_ELT* FFLAS::fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
```

```

const FFLAS_TRANSPOSE ta,
const FFLAS_TRANSPOSE tb,
const size_t m,
const size_t n,
const size_t k,
const FFLAS_ELT alpha,
const FFLAS_ELT * A,
const size_t lda,
const FFLAS_ELT * B,
const size_t ldb,
const FFLAS_ELT beta,
FFLAS_ELT * C,
const size_t ldc,
const ParSeqHelper::Sequential seq )

```

15.1.3.275 fgemm() [22/23]

```

template INST_OR_DECL FFLAS_ELT* FFLAS::fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc,
    const ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive
> par )

```

15.1.3.276 fgemm() [23/23]

```

template INST_OR_DECL FFLAS_ELT* FFLAS::fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,

```

```

        const size_t ldc,
        const ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads
> par )

```

15.1.3.277 fsquare() [6/6]

```

template INST_OR_DECL FFLAS_ELT* FFLAS::fsquare (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc )

```

fsquare: Squares a matrix.

compute $C \leftarrow \alpha \text{op}(A) \text{op}(A) + \beta C$ over a FFLAS_FIELD <FFLAS_ELT> F Avoid the conversion of B

Parameters

| | |
|--------------|---|
| <i>ta</i> | if ta==FflasTrans, $\text{op}(A) = A^T$. |
| <i>F</i> | field |
| <i>n</i> | size of A |
| <i>alpha</i> | scalar |
| <i>beta</i> | scalar |
| <i>A</i> | dense matrix of size $n \times n$ |
| <i>lda</i> | leading dimension of A |
| <i>C</i> | dense matrix of size $n \times n$ |
| <i>ldc</i> | leading dimension of C |

15.1.3.278 BlockCuts() [1/2]

```

void FFLAS::BlockCuts (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]

```

15.1.3.279 BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >()

```
void FFLAS::BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.280 BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >()

```
void FFLAS::BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.281 BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >()

```
void FFLAS::BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize ) [inline]
```

15.1.3.282 BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >()

```
void FFLAS::BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize ) [inline]
```

15.1.3.283 BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >()

```
void FFLAS::BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.284 BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >()

```
void FFLAS::BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize ) [inline]
```

15.1.3.285 BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >()

```
void FFLAS::BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.286 BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >()

```
void FFLAS::BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.287 BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >()

```
void FFLAS::BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.288 BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >()

```
void FFLAS::BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```


15.1.3.289 BlockCuts() [2/2]

```
void FFLAS::BlockCuts (
    size_t & rowBlockSize,
    size_t & colBlockSize,
    size_t & lastRBS,
    size_t & lastCBS,
    size_t & changeRBS,
    size_t & changeCBS,
    size_t & numRowsBlock,
    size_t & numColBlock,
    size_t m,
    size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.290 pfzero()

```
void FFLAS::pfzero (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr C,
    size_t BS = 0 )
```

15.1.3.291 pfrand()

```
void FFLAS::pfrand (
    const Field & F,
    RandIter & G,
    size_t m,
    size_t n,
    typename Field::Element_ptr C,
    size_t BS = 0 )
```

15.1.3.292 fdot() [11/11]

```
Field::Element& FFLAS::fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element & d,
    const ParSeqHelper::Parallel< Cut, Param > par ) [inline]
```

15.1.3.293 pfgemm() [2/7]

```
Field::Element* FFLAS::pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Block,
StrategyParameter::Threads > > & H )
```

15.1.3.294 pfgemm() [3/7]

```
Field::Element* FFLAS::pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeDAdaptive > > & H )
```

15.1.3.295 pfgemm() [4/7]

```
Field::Element* FFLAS::pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
```

```

    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::TwoDAdaptive > > & H )

```

15.1.3.296 pfgemm() [5/7]

```

Field::Element* FFLAS::pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::TwoD > > & H )

```

15.1.3.297 pfgemm() [6/7]

```

Field::Element_ptr FFLAS::pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeD > > & H )

```

15.1.3.298 pfgemm() [7/7]

```
Field::Element* FFLAS::pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeDInPlace > > & H )
```

15.1.3.299 fgemv() [18/19]

```
Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::Threads > > & H )
```

15.1.3.300 fgemv() [19/19]

```
Field::Element_ptr FFLAS::fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
```

```

    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Row,
Cut > > & H )

```

15.1.3.301 parseArguments()

```

void parseArguments (
    int argc,
    char ** argv,
    Argument * args,
    bool printDefaults = true )

```

15.1.3.302 writeCommandString()

```

std::ostream& FFLAS::writeCommandString (
    std::ostream & os,
    Argument * args,
    const char * programName = nullptr )

```

writes the values of all arguments, preceded by the programName

15.1.3.303 WriteMatrix() [1/2]

```

std::ostream& FFLAS::WriteMatrix (
    std::ostream & c,
    const Field & F,
    size_t m,
    size_t n,
    typename Field::ConstElement_ptr A,
    size_t lda,
    FFLAS_FORMAT format,
    bool column_major )

```

WriteMatrix: write a matrix to an output stream.

Parameters

| | |
|---------------------|--|
| <i>c</i> | output stream |
| <i>F</i> | base field |
| <i>m</i> | row dimension |
| <i>n</i> | column dimension |
| <i>A</i> | matrix |
| <i>format</i> | input format (FflasAuto, FflasDense, FflasSMS, FflasBinary) |
| <i>column_major</i> | whether the matrix is stored in column or row major (row by default) |

15.1.3.304 preamble()

```
void FFLAS::preamble (
    std::ifstream & ifs,
    FFLAS_FORMAT & format ) [inline]
```

15.1.3.305 ReadMatrix() [1/2]

```
Field::Element_ptr FFLAS::ReadMatrix (
    std::ifstream & ifs,
    Field & F,
    size_t & m,
    size_t & n,
    typename Field::Element_ptr & A,
    FFLAS_FORMAT format = FflasAuto )
```

ReadMatrix: read a matrix from an input stream.

Parameters

| | | |
|-----|---------------|---|
| | <i>ifs</i> | input stream |
| | <i>F</i> | base field |
| out | <i>m</i> | row dimension |
| out | <i>n</i> | column dimension |
| out | <i>A</i> | output matrix |
| | <i>format</i> | input format (FflasAuto, FflasDense, FflasSMS, FflasBinary) |

15.1.3.306 ReadMatrix() [2/2]

```
Field::Element_ptr FFLAS::ReadMatrix (
    const std::string & matrix_file,
    Field & F,
    size_t & m,
    size_t & n,
    typename Field::Element_ptr & A,
    FFLAS_FORMAT format = FflasAuto ) [inline]
```

ReadMatrix: read a matrix from a file.

Parameters

| | | |
|-----|--------------------|---|
| | <i>matrix_file</i> | filename |
| | <i>F</i> | base field |
| out | <i>m</i> | row dimension |
| out | <i>n</i> | column dimension |
| out | <i>A</i> | output matrix |
| | <i>format</i> | input format (FflasAuto, FflasDense, FflasSMS, FflasBinary) |

15.1.3.307 WriteMatrix() [2/2]

```

void FFLAS::WriteMatrix (
    std::string & matrix_file,
    const Field & F,
    int m,
    int n,
    typename Field::ConstElement_ptr A,
    size_t lda,
    FFLAS_FORMAT format = FflasDense,
    bool column_major = false )

```

WriteMatrix: write a matrix to a file.

Parameters

| | |
|---------------------|--|
| <i>matrix_file</i> | file name |
| <i>F</i> | base field |
| <i>m</i> | row dimension |
| <i>n</i> | column dimension |
| <i>A</i> | matrix |
| <i>format</i> | input format (FflasAuto, FflasDense, FflasSMS, FflasBinary) |
| <i>column_major</i> | whether the matrix is stored in column or row major (row by default) |

15.1.3.308 WritePermutation()

```

std::ostream& FFLAS::WritePermutation (
    std::ostream & c,
    const size_t * P,
    size_t N ) [inline]

```

WritePermutation: write a permutation matrix to an output stream.

Parameters

| | |
|----------|-------------------------|
| <i>c</i> | output stream |
| <i>P</i> | permutation |
| <i>N</i> | size of the permutation |

15.1.3.309 alignable()

```

bool FFLAS::alignable ( ) [inline]

```

15.1.3.310 alignable< Givaro::Integer * >()

```
bool FFLAS::alignable< Givaro::Integer * > ( ) [inline]
```

15.1.3.311 fflas_new() [5/7]

```
Field::Element_ptr FFLAS::fflas_new (
    const Field & F,
    const size_t m,
    const Alignment align = Alignment::DEFAULT ) [inline]
```

15.1.3.312 fflas_new() [6/7]

```
Field::Element_ptr FFLAS::fflas_new (
    const Field & F,
    const size_t m,
    const size_t n,
    const Alignment align = Alignment::DEFAULT ) [inline]
```

15.1.3.313 fflas_new() [7/7]

```
Element* FFLAS::fflas_new (
    const size_t m,
    const Alignment align = Alignment::DEFAULT ) [inline]
```

15.1.3.314 fflas_delete() [3/3]

```
void FFLAS::fflas_delete (
    Ptr p,
    Args ... args ) [inline]
```

15.1.3.315 prefetch()

```
void FFLAS::prefetch (
    const int64_t * ) [inline]
```


15.1.3.316 getTLBSize()

```
void FFLAS::getTLBSize (
    int & tlb ) [inline]
```

15.1.3.317 queryCacheSizes()

```
void FFLAS::queryCacheSizes (
    int & l1,
    int & l2,
    int & l3 ) [inline]
```

Queries and returns the cache sizes in Bytes of the L1, L2, and L3 data caches respectively

15.1.3.318 queryL1CacheSize()

```
int FFLAS::queryL1CacheSize ( ) [inline]
```

Returns

the size in Bytes of the L1 data cache

15.1.3.319 queryTopLevelCacheSize()

```
int FFLAS::queryTopLevelCacheSize ( ) [inline]
```

Returns

the size in Bytes of the L2 or L3 cache if this later is present

15.1.3.320 getSeed()

```
uint64_t FFLAS::getSeed ( )
```

15.2 FFLAS::BLAS3 Namespace Reference

Functions

- `template<class Field >`
`void Bini (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, const size_t kmax, const size_t w, const FFLAS_BASE base, const size_t rec_level)`
- `template<class Field , class FieldTrait , class Strat , class Param >`
`Field::Element_ptr WinoPar (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel< Strat, Param > > &WH)`
- `template<class Field , class FieldTrait >`
`void Winograd (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_3_23 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_3_21 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_2_24 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_2_27 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_LR (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`

- `template<class Field , class FieldTrait >`
`void WinogradAcc_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void Winograd_LR_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void Winograd_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void Winograd_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`

15.2.1 Function Documentation

15.2.1.1 Bini()

```
void FFLAS::BLAS3::Bini (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t kmax,
    const size_t w,
    const FFLAS_BASE base,
    const size_t rec_level ) [inline]
```

15.2.1.2 WinoPar()

```
Field::Element_ptr FFLAS::BLAS3::WinoPar (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel<
Strat, Param > > & WH ) [inline]
```

15.2.1.3 Winograd()

```
void FFLAS::BLAS3::Winograd (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.2.1.4 WinogradAcc_3_23()

```
void FFLAS::BLAS3::WinogradAcc_3_23 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
```

```

const size_t lda,
typename Field::ConstElement_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.5 WinogradAcc_3_21()

```

void FFLAS::BLAS3::WinogradAcc_3_21 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.6 WinogradAcc_2_24()

```

void FFLAS::BLAS3::WinogradAcc_2_24 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.7 WinogradAcc_2_27()

```
void FFLAS::BLAS3::WinogradAcc_2_27 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.2.1.8 WinogradAcc_LR()

```
void FFLAS::BLAS3::WinogradAcc_LR (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.2.1.9 WinogradAcc_R_S()

```
void FFLAS::BLAS3::WinogradAcc_R_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
```

```

typename Field::Element_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.10 WinogradAcc_L_S()

```

void FFLAS::BLAS3::WinogradAcc_L_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.11 Winograd_LR_S()

```

void FFLAS::BLAS3::Winograd_LR_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.12 Winograd_L_S()

```
void FFLAS::BLAS3::Winograd_L_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.2.1.13 Winograd_R_S()

```
void FFLAS::BLAS3::Winograd_R_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.3 FFLAS::csr_hyb_details Namespace Reference

Data Structures

- struct [Info](#)
- struct [Coo](#)

15.4 FFLAS::CuttingStrategy Namespace Reference

Data Structures

- struct [Single](#)
- struct [Row](#)
- struct [Column](#)
- struct [Block](#)
- struct [Recursive](#)

Typedefs

- typedef [Row](#) [RNSModulus](#)

15.4.1 Typedef Documentation

15.4.1.1 RNSModulus

```
typedef Row RNSModulus
```

15.5 FFLAS::details Namespace Reference

Functions

- template<class Field, bool ADD>
std::enable_if< [FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::ModularTag](#))
- template<class Field, bool ADD>
std::enable_if<![FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::ModularTag](#))
- template<class Field, bool ADD>
void [fadd](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, type-
name [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::GenericTag](#))
- template<class Field, bool ADD>
std::enable_if<![FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::UnparametricTag](#))
- template<class Field, bool ADD>
std::enable_if< [FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::UnparametricTag](#))
- template<class Field >
std::enable_if< [FFLAS::support_fast_mod](#)< typename [Field::Element](#) >::value, void >::type [freduce](#) (const [Field](#) &F, const size_t m, typename [Field::Element_ptr](#) A, const size_t incX, [FieldCategories::ModularTag](#))
- template<class Field >
std::enable_if< [FFLAS::support_fast_mod](#)< typename [Field::Element](#) >::value, void >::type [freduce](#)
(const [Field](#) &F, const size_t m, typename [Field::ConstElement_ptr](#) B, const size_t incY, typename [Field::Element_ptr](#) A, const size_t incX, [FieldCategories::ModularTag](#))
- template<class Field, class FC >
void [freduce](#) (const [Field](#) &F, const size_t m, typename [Field::Element_ptr](#) A, const size_t incX, FC)
- template<class Field, class FC >
void [freduce](#) (const [Field](#) &F, const size_t m, typename [Field::ConstElement_ptr](#) B, const size_t incY, type-
name [Field::Element_ptr](#) A, const size_t incX, FC)

- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type fscalin (const Field &F, const size_t N, const typename Field::Element a, typename Field::Element_ptr X, const size_t incX, FieldCategories::ModularTag)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type fscal (const Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, FieldCategories::ModularTag)`
- `template<class Field, class FC >`
`void fscalin (const Field &F, const size_t n, const typename Field::Element a, typename Field::Element_ptr X, const size_t incX, FC)`
- `template<class Field, class FC >`
`void fscal (const Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, FC)`
- `template<enum number_kind K>`
`void igebb44 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb24 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb14 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb41 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb21 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb11 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebp (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *blockA, size_t lda, const int64_t *blockB, size_t ldb, int64_t *C, size_t ldc)`
- `template<size_t k, bool transpose>`
`void pack_lhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `template<size_t k, bool transpose>`
`void pack_rhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `void gebp (size_t rows, size_t cols, size_t depth, int64_t *C, size_t ldc, const int64_t *blockA, size_t lda, const int64_t *BlockB, size_t ldb, int64_t *BlockW)`
- `void BlockingFactor (size_t &m, size_t &n, size_t &k)`

15.5.1 Function Documentation

15.5.1.1 fadd() [1/5]

```
std::enable_if<FFLAS::support_simd_add<typename Field::Element>::value, void>::type FFLAS::details::fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
```

```

    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::ModularTag )

```

15.5.1.2 fadd() [2/5]

```

std::enable_if<!FFLAS::support_simd_add<typename Field::Element>::value, void>::type FFLAS↵
::details::fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::ModularTag )

```

15.5.1.3 fadd() [3/5]

```

void FFLAS::details::fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::GenericTag )

```

15.5.1.4 fadd() [4/5]

```

std::enable_if<!FFLAS::support_simd_add<typename Field::Element>::value, void>::type FFLAS↵
::details::fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::UnparametricTag ) [inline]

```

15.5.1.5 fadd() [5/5]

```

std::enable_if<FFLAS::support_simd_add<typename Field::Element>::value, void>::type FFLAS↵
::details::fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::UnparametricTag ) [inline]

```

15.5.1.6 freduce() [1/4]

```

std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value , void>::type FFLAS↵
::details::freduce (
    const Field & F,
    const size_t m,
    typename Field::Element_ptr A,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]

```

15.5.1.7 freduce() [2/4]

```

std::enable_if< FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↵
::details::freduce (
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr B,
    const size_t incY,
    typename Field::Element_ptr A,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]

```

15.5.1.8 freduce() [3/4]

```

void FFLAS::details::freduce (
    const Field & F,
    const size_t m,
    typename Field::Element_ptr A,
    const size_t incX,
    FC ) [inline]

```

15.5.1.9 freduce() [4/4]

```
void FFLAS::details::freduce (
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr B,
    const size_t incY,
    typename Field::Element_ptr A,
    const size_t incX,
    FC ) [inline]
```

15.5.1.10 fscaln() [1/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔
::details::fscaln (
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::Element_ptr X,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]
```

15.5.1.11 fscal() [1/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔
::details::fscal (
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FieldCategories::ModularTag ) [inline]
```

15.5.1.12 fscaln() [2/2]

```
void FFLAS::details::fscaln (
    const Field & F,
    const size_t n,
    const typename Field::Element a,
    typename Field::Element_ptr X,
    const size_t incX,
    FC ) [inline]
```

15.5.1.13 fscal() [2/2]

```
void FFLAS::details::fscal (
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FC ) [inline]
```

15.5.1.14 igebb44()

```
void igebb44 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.15 igebb24()

```
void igebb24 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.16 igebb14()

```
void igebb14 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.17 igebb41()

```
void igebb41 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

bug ,B_0 dans VEC_MADD_32 ?

bug ,B_0 dans VEC_MADD_32 ?

15.5.1.18 igebb21()

```
void igebb21 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.19 igebb11()

```
void igebb11 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.20 igebp()

```
void igebp (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * blockA,
    size_t lda,
    const int64_t * blockB,
    size_t ldb,
    int64_t * C,
    size_t ldc )
```

15.5.1.21 pack_lhs()

```
void pack_lhs (
    int64_t * XX,
    const int64_t * X,
    size_t ldx,
    size_t rows,
    size_t cols )
```

Bug this is fassign

Bug this is fassign

Bug this is fassign

Bug this is fassign

15.5.1.22 pack_rhs()

```
void pack_rhs (
    int64_t * XX,
    const int64_t * X,
    size_t ldx,
    size_t rows,
    size_t cols )
```

Bug this is fassign

Bug this is fassign

Bug this is fassign

Bug this is fassign

15.5.1.23 gebp()

```
void FFLAS::details::gebp (
    size_t rows,
    size_t cols,
    size_t depth,
    int64_t * C,
    size_t ldc,
    const int64_t * blockA,
    size_t lda,
    const int64_t * BlockB,
    size_t ldb,
    int64_t * BlockW )
```

15.5.1.24 BlockingFactor()

```
void BlockingFactor (
    size_t & m,
    size_t & n,
    size_t & k ) [inline]
```

15.6 FFLAS::details_spmv Namespace Reference

Data Structures

- struct [Coo](#)

15.7 FFLAS::ElementCategories Namespace Reference

Data Structures

- struct [GenericTag](#)
default is generic
- struct [MachineFloatTag](#)
float or double
- struct [MachineIntTag](#)
short, int, long, long long, and unsigned variants
- struct [FixedPrecIntTag](#)
Fixed precision integers above machine precision: Givaro::reclnt.
- struct [ArbitraryPrecIntTag](#)
Arbitrary precision integers: GMP.
- struct [RNSElementTag](#)
Representation in a Residue Number System.

15.8 FFLAS::FieldCategories Namespace Reference

Traits and categories will need to be placed in a proper file later.

Data Structures

- struct [GenericTag](#)
generic ring.
- struct [ModularTag](#)
This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`
- struct [UnparametricTag](#)
If the field uses a representation with infix operators.

15.8.1 Detailed Description

Traits and categories will need to be placed in a proper file later.

15.9 FFLAS::MMHelperAlgo Namespace Reference

Data Structures

- struct [Auto](#)
- struct [Classic](#)
- struct [Winograd](#)
- struct [WinogradPar](#)
- struct [Bini](#)

15.10 FFLAS::ModeCategories Namespace Reference

Specifies the mode of action for an algorithm w.r.t.

Data Structures

- struct [DefaultTag](#)
No specific mode of action: use standard field operations.
- struct [DefaultBoundedTag](#)
Use standard field operations, but keeps track of bounds on input and output.
- struct [ConvertTo](#)
Force conversion to appropriate element type of `ElementCategory T`.
- struct [DelayedTag](#)
Performs field operations with delayed mod reductions. Ensures result is reduced.
- struct [LazyTag](#)
Performs field operations with delayed mod only when necessary. Result may not be reduced.

15.10.1 Detailed Description

Specifies the mode of action for an algorithm w.r.t.

its field

15.11 FFLAS::ParSeqHelper Namespace Reference

[ParSeqHelper](#) for both fgemm and ftrsm.

Data Structures

- struct [Parallel](#)
- struct [Sequential](#)
- struct [Compose](#)

15.11.1 Detailed Description

[ParSeqHelper](#) for both fgemm and ftrsm.

[ParSeqHelper](#) for both fgemm and ftrsm

15.12 FFLAS::Protected Namespace Reference

Data Structures

- class [AreEqual](#)
 - class [AreEqual< X, X >](#)
 - class [ftrsmLeftUpperNoTransNonUnit](#)
- Computes the maximal size for delaying the modular reduction in a triangular system resolution.*
- class [ftrsmLeftUpperNoTransUnit](#)
 - class [ftrsmLeftUpperTransNonUnit](#)
 - class [ftrsmLeftUpperTransUnit](#)
 - class [ftrsmLeftLowerNoTransNonUnit](#)
 - class [ftrsmLeftLowerNoTransUnit](#)
 - class [ftrsmLeftLowerTransNonUnit](#)
 - class [ftrsmLeftLowerTransUnit](#)
 - class [ftrsmRightUpperNoTransNonUnit](#)
 - class [ftrsmRightUpperNoTransUnit](#)
 - class [ftrsmRightUpperTransNonUnit](#)
 - class [ftrsmRightUpperTransUnit](#)
 - class [ftrsmRightLowerNoTransNonUnit](#)
 - class [ftrsmRightLowerNoTransUnit](#)
 - class [ftrsmRightLowerTransNonUnit](#)
 - class [ftrsmRightLowerTransUnit](#)
 - class [ftrmmLeftUpperNoTransNonUnit](#)
 - class [ftrmmLeftUpperNoTransUnit](#)

- class [ftrmmLeftUpperTransNonUnit](#)
- class [ftrmmLeftUpperTransUnit](#)
- class [ftrmmLeftLowerNoTransNonUnit](#)
- class [ftrmmLeftLowerNoTransUnit](#)
- class [ftrmmLeftLowerTransNonUnit](#)
- class [ftrmmLeftLowerTransUnit](#)
- class [ftrmmRightUpperNoTransNonUnit](#)
- class [ftrmmRightUpperNoTransUnit](#)
- class [ftrmmRightUpperTransNonUnit](#)
- class [ftrmmRightUpperTransUnit](#)
- class [ftrmmRightLowerNoTransNonUnit](#)
- class [ftrmmRightLowerNoTransUnit](#)
- class [ftrmmRightLowerTransNonUnit](#)
- class [ftrmmRightLowerTransUnit](#)

Functions

- template<class Field >
double [computeFactorClassic](#) (const [Field](#) &F)
- template<> double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< double > &F)
- template<> double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< float > &F)
- template<class Field >
size_t [DotProdBoundClassic](#) (const [Field](#) &F, const typename [Field::Element](#) &beta)
- template<class Field >
size_t [TRSMBound](#) (const [Field](#) &)
TRSMBound.
- template<class Element >
size_t [TRSMBound](#) (const [Givaro::Modular](#)< Element > &F)
Specialization for positive modular representation over float.
- template<class Element >
size_t [TRSMBound](#) (const [Givaro::ModularBalanced](#)< Element > &F)
Specialization for balanced modular representation over double.
- template<class Field >
int [WinogradThreshold](#) (const [Field](#) &F)
Computes the number of recursive levels to perform.
- template<> int [WinogradThreshold](#) (const [Givaro::Modular](#)< float > &F)
- template<> int [WinogradThreshold](#) (const [Givaro::ModularBalanced](#)< double > &F)
- template<> int [WinogradThreshold](#) (const [Givaro::ModularBalanced](#)< float > &F)
- template<class Field >
int [WinogradSteps](#) (const [Field](#) &F, const size_t &m)
Computes the number of recursive levels to perform.
- template<class Field , class FieldMode >
void [DynamicPeeling](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), FieldMode > &H, const typename [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), FieldMode >::DelayedField::Element Cmin, const typename [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), FieldMode >::DelayedField::Element Cmax)

- `template<class Field , class FieldMode >`
`void DynamicPeeling2 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmin, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmax)`
- `template<class Field , class FieldMode >`
`void WinogradCalc (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H)`
- `template<class NewField , class Field , class FieldMode >`
`Field::Element_ptr fgemm_convert (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H)`
- `template<class Field , class Element , class AlgoT , class ParSeqTrait >`
`bool NeedPreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field , class Element , class AlgoT , class ModeT , class ParSeqTrait >`
`bool NeedPreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field , class Element , class AlgoT , class ParSeqTrait >`
`bool NeedPreSubReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field , class Element , class AlgoT , class ModeT , class ParSeqTrait >`
`bool NeedPreSubReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field , class Element , class AlgoT , class ParSeqTrait >`
`bool NeedDoublePreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field , class Element , class AlgoT , class ModeT , class ParSeqTrait >`
`bool NeedDoublePreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field , class AlgoT , class ParSeqTrait >`
`void ScalAndReduce (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr X, const size_t incX, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)`
- `template<class Field , class AlgoT , class ParSeqTrait >`
`void ScalAndReduce (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)`
- `template<class Field >`
`Field::Element_ptr fsquareCommon (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
- `template<typename FloatElement , class Field >`
`Field::Element_ptr fgemv_convert (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda,`

- typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY)
- `template<class FloatElement, class Field >`
`void fger_convert (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha,`
`typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t`
`incy, typename Field::Element_ptr A, const size_t lda)`
 - `template<class DFE >`
`size_t min_types (const DFE &k)`
 - `template<> size_t min_types (const Reclnt::rint< 6 > &k)`
 - `template<> size_t min_types (const Reclnt::rint< 7 > &k)`
 - `template<> size_t min_types (const Reclnt::rint< 8 > &k)`
 - `template<> size_t min_types (const Reclnt::rint< 9 > &k)`
 - `template<> size_t min_types (const Reclnt::rint< 10 > &k)`
 - `template<> size_t min_types (const Givaro::Integer &k)`
 - `template<class T >`
`bool unfit (T x)`
 - `template<> bool unfit (int64_t x)`
 - `template<size_t K>`
`bool unfit (Reclnt::rint< K > x)`
 - `template<> bool unfit (Reclnt::rint< 6 > x)`
 - `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB>`
`void igemm_colmajor (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda,`
`const int64_t *B, size_t ldb, int64_t *C, size_t ldc)`
 - `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB, enum number_kind alpha_kind>`
`void igemm_colmajor (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda,`
`const int64_t *B, size_t ldb, int64_t *C, size_t ldc)`
 - `void igemm (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t`
`rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda, const int64_t *B, size_t ldb,`
`const int64_t beta, int64_t *C, size_t ldc)`
 - `template<class Field >`
`void MatF2MatD_Triangular (const Field &F, Givaro::DoubleDomain::Element_ptr S, const size_t lds, type-`
`name Field::ConstElement_ptr const E, const size_t lde, const size_t m, const size_t n)`
 - `template<class Field >`
`void MatF2MatFI_Triangular (const Field &F, Givaro::FloatDomain::Element_ptr S, const size_t lds, typename`
`Field::ConstElement_ptr const E, const size_t lde, const size_t m, const size_t n)`

15.12.1 Function Documentation

15.12.1.1 computeFactorClassic() [1/3]

```
double FFLAS::Protected::computeFactorClassic (
    const Field & F ) [inline]
```

15.12.1.2 computeFactorClassic() [2/3]

```
double FFLAS::Protected::computeFactorClassic (
    const Givaro::ModularBalanced< double > & F ) [inline]
```

15.12.1.3 computeFactorClassic() [3/3]

```
double FFLAS::Protected::computeFactorClassic (
    const Givaro::ModularBalanced< float > & F ) [inline]
```

15.12.1.4 DotProdBoundClassic()

```
size_t FFLAS::Protected::DotProdBoundClassic (
    const Field & F,
    const typename Field::Element & beta ) [inline]
```

15.12.1.5 TRSMBound() [1/3]

```
size_t FFLAS::Protected::TRSMBound (
    const Field & ) [inline]
```

TRSMBound.

computes the maximal size for delaying the modular reduction in a triangular system resolution

This is the default version over an arbitrary field. It is currently never used (the recursive algorithm is run until $n=1$ in this case)

Parameters

| | |
|-----|--------------------------------------|
| F | Finite Field/Ring of the computation |
|-----|--------------------------------------|

15.12.1.6 TRSMBound() [2/3]

```
size_t FFLAS::Protected::TRSMBound (
    const Givaro::Modular< Element > & F ) [inline]
```

Specialization for positive modular representation over float.

Computes n_{\max} s.t. $(p-1)/2 * (p^{\{n_{\max}-1\}} + (p-2)^{\{n_{\max}-1\}}) < 2^{24}$ @pbi See [Dumas Giorgi Pernet 06, arXiv:cs/0601133]

15.12.1.7 TRSMBound() [3/3]

```
size_t FFLAS::Protected::TRSMBound (
    const Givaro::ModularBalanced< Element > & F ) [inline]
```

Specialization for balanced modular representation over double.

Computes n_{\max} s.t. $(p-1)/2 * (((p+1)/2)^{\{n_{\max}-1\}}) < 2^{53}$

Bibliography • Dumas Giorgi Pernet 06, arXiv:cs/0601133

15.12.1.8 WinogradThreshold() [1/4]

```
int FFLAS::Protected::WinogradThreshold (
    const Field & F ) [inline]
```

Computes the number of recursive levels to perform.

Parameters

| | |
|----------|---|
| <i>m</i> | the common dimension in the product AxB |
|----------|---|

15.12.1.9 WinogradThreshold() [2/4]

```
int FFLAS::Protected::WinogradThreshold (
    const Givaro::Modular< float > & F ) [inline]
```

15.12.1.10 WinogradThreshold() [3/4]

```
int FFLAS::Protected::WinogradThreshold (
    const Givaro::ModularBalanced< double > & F ) [inline]
```

15.12.1.11 WinogradThreshold() [4/4]

```
int FFLAS::Protected::WinogradThreshold (
    const Givaro::ModularBalanced< float > & F ) [inline]
```

15.12.1.12 WinogradSteps()

```
int FFLAS::Protected::WinogradSteps (
    const Field & F,
    const size_t & m ) [inline]
```

Computes the number of recursive levels to perform.

Parameters

| | |
|----------|---|
| <i>m</i> | the common dimension in the product AxB |
|----------|---|

15.12.1.13 DynamicPeeling()

```

void FFLAS::Protected::DynamicPeeling (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmin,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmax ) [inline]

```

15.12.1.14 DynamicPeeling2()

```

void FFLAS::Protected::DynamicPeeling2 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmin,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
Field::Element Cmax ) [inline]

```

15.12.1.15 WinogradCalc()

```

void FFLAS::Protected::WinogradCalc (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H ) [inline]

```

15.12.1.16 fgemv_convert()

```

Field::Element_ptr FFLAS::Protected::fgemv_convert (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H ) [inline]

```

15.12.1.17 NeedPreAddReduction() [1/2]

```

bool FFLAS::Protected::NeedPreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH ) [inline]

```

15.12.1.18 NeedPreAddReduction() [2/2]

```
bool FFLAS::Protected::NeedPreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH ) [inline]
```

15.12.1.19 NeedPreSubReduction() [1/2]

```
bool FFLAS::Protected::NeedPreSubReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH ) [inline]
```

15.12.1.20 NeedPreSubReduction() [2/2]

```
bool FFLAS::Protected::NeedPreSubReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH ) [inline]
```

15.12.1.21 NeedDoublePreAddReduction() [1/2]

```
bool FFLAS::Protected::NeedDoublePreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    Element beta,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH ) [inline]
```

15.12.1.22 NeedDoublePreAddReduction() [2/2]

```
bool FFLAS::Protected::NeedDoublePreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    Element beta,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH ) [inline]
```

15.12.1.23 ScalAndReduce() [1/2]

```
void FFLAS::Protected::ScalAndReduce (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr X,
    const size_t incX,
    const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & H ) [inline]
```

15.12.1.24 ScalAndReduce() [2/2]

```
void FFLAS::Protected::ScalAndReduce (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & H ) [inline]
```

15.12.1.25 fsquareCommon()

```
Field::Element_ptr FFLAS::Protected::fsquareCommon (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]
```

15.12.1.26 fgemv_convert()

```
Field::Element_ptr FFLAS::Protected::fgemv_convert (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]
```

15.12.1.27 fger_convert()

```
void FFLAS::Protected::fger_convert (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda ) [inline]
```

15.12.1.28 min_types() [1/7]

```
size_t FFLAS::Protected::min_types (
    const DFE & k ) [inline]
```

15.12.1.29 min_types() [2/7]

```
size_t FFLAS::Protected::min_types (
    const RecInt::rint< 6 > & k ) [inline]
```

15.12.1.30 min_types() [3/7]

```
size_t FFLAS::Protected::min_types (
    const RecInt::rint< 7 > & k ) [inline]
```

15.12.1.31 min_types() [4/7]

```
size_t FFLAS::Protected::min_types (
    const RecInt::rint< 8 > & k ) [inline]
```

15.12.1.32 min_types() [5/7]

```
size_t FFLAS::Protected::min_types (
    const RecInt::rint< 9 > & k ) [inline]
```

15.12.1.33 min_types() [6/7]

```
size_t FFLAS::Protected::min_types (
    const RecInt::rint< 10 > & k ) [inline]
```

15.12.1.34 min_types() [7/7]

```
size_t FFLAS::Protected::min_types (
    const Givaro::Integer & k ) [inline]
```

15.12.1.35 unfit() [1/4]

```
bool FFLAS::Protected::unfit (
    T x ) [inline]
```

15.12.1.36 unfit() [2/4]

```
bool FFLAS::Protected::unfit (
    int64_t x ) [inline]
```

15.12.1.37 unfit() [3/4]

```
bool FFLAS::Protected::unfit (
    RecInt::rint< K > x ) [inline]
```

15.12.1.38 unfit() [4/4]

```
bool FFLAS::Protected::unfit (
    RecInt::rint< 6 > x ) [inline]
```

15.12.1.39 igemm_colmajor() [1/2]

```
void igemm_colmajor (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    int64_t * C,
    size_t ldc )
```

15.12.1.40 igemm_colmajor() [2/2]

```
void igemm_colmajor (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    int64_t * C,
    size_t ldc )
```

15.12.1.41 igemm()

```
void igemm (
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_TRANSPOSE TransB,
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    const int64_t beta,
    int64_t * C,
    size_t ldc ) [inline]
```

Todo use primitive (no [Field\(\)](#)) and specialise for int64.

Todo use primitive (no [Field\(\)](#)) and specialise for int64.

15.12.1.42 MatF2MatD_Triangular()

```
void FFLAS::Protected::MatF2MatD_Triangular (
    const Field & F,
    Givaro::DoubleDomain::Element\_ptr S,
    const size_t lds,
    typename Field::ConstElement\_ptr const E,
    const size_t lde,
    const size_t m,
    const size_t n )
```

15.12.1.43 MatF2MatFI_Triangular()

```
void FFLAS::Protected::MatF2MatFI_Triangular (
    const Field & F,
    Givaro::FloatDomain::Element\_ptr S,
    const size_t lds,
    typename Field::ConstElement\_ptr const E,
    const size_t lde,
    const size_t m,
    const size_t n )
```

Todo do finit(...,FFLAS_TRANS,FFLAS_DIAG)
do fconvert(...,FFLAS_TRANS,FFLAS_DIAG)

15.13 FFLAS::sell_details Namespace Reference

Data Structures

- struct [Info](#)
- struct [Coo](#)

15.14 FFLAS::sparse_details Namespace Reference

Functions

- `template<class Field >`
`void init_y (const Field &F, const size_t m, const typename Field::Element b, typename Field::Element_ptr y)`
- `template<class Field >`
`void init_y (const Field &F, const size_t m, const size_t n, const typename Field::Element b, typename Field::Element_ptr y, const int ldy)`
- `template<class Field , class SM , class FC , class MZO >`
`std::enable_if< !(std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmv_dispatch (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FC fc, MZO mzo)`
- `template<class Field , class SM , class FC , class MZO >`
`std::enable_if< std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmv_dispatch (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FC fc, MZO mzo)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< !(std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`

- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloa`
`>::value||std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag`
`>::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr`
`x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx,`
`typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx,`
`typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx,`
`typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< !(std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloa`
`>::value)||std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag`
`>::value)>::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename`
`Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloa`
`>::value||std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag`
`>::value >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename`
`Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx,`
`typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const`
`SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const`

- SM &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x, int ldx, typename [Field::Element_ptr](#) y, int ldy, [FieldCategories::UnparametricTag](#), [NotZOSparseMatrix](#))
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if<!support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if<!support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::false_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::false_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::false_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::true_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::true_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
 - `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typename Field::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typename Field::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typename Field::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`

15.14.1 Function Documentation

15.14.1.1 init_y() [1/2]

```
void FFLAS::sparse_details::init_y (
    const Field & F,
    const size_t m,
    const typename Field::Element b,
    typename Field::Element_ptr y ) [inline]
```

15.14.1.2 init_y() [2/2]

```
void FFLAS::sparse_details::init_y (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element b,
    typename Field::Element_ptr y,
    const int ldy ) [inline]
```

15.14.1.3 fspmv_dispatch() [1/2]

```
std::enable_if< !(std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineInt1>::value || std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineInt1>::value)>::type FFLAS::sparse_details::fspmv_dispatch (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FC fC,
    MZO mzo ) [inline]
```

15.14.1.4 fspmv_dispatch() [2/2]

```
std::enable_if< std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineInt1>::value || std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineInt1>::value>::type FFLAS::sparse_details::fspmv_dispatch (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FC fC,
    MZO mzo ) [inline]
```

15.14.1.5 fspmv() [1/12]

```
void FFLAS::sparse_details::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.6 fspmv() [2/12]

```
std::enable_if<!isSparseMatrixSimdFormat<Field, SM>::value>::type FFLAS::sparse_details←
::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.7 fspmv() [3/12]

```
std::enable_if<isSparseMatrixSimdFormat<Field, SM>::value>::type FFLAS::sparse_details::fspmv
(
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.8 fspmv() [4/12]

```
std::enable_if<!isSparseMatrixSimdFormat<Field, SM>::value>::type FFLAS::sparse_details←
::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.9 fspmv() [5/12]

```
std::enable_if<isSparseMatrixSimdFormat<Field, SM>::value>::type FFLAS::sparse_details::fspmv
(
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.10 fspmv() [6/12]

```
void FFLAS::sparse_details::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.11 fspmv() [7/12]

```
std::enable_if<!isSparseMatrixSimdFormat<Field, SM>::value>::type FFLAS::sparse_details↵
::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.12 fspmv() [8/12]

```
std::enable_if<isSparseMatrixSimdFormat<Field, SM>::value>::type FFLAS::sparse_details::fspmv
(
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.13 fspmv() [9/12]

```
void FFLAS::sparse_details::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::true_type ) [inline]
```

15.14.1.14 fspmm_dispatch() [1/2]

```
std::enable_if< !(std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineIntT>::value || std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineIntT>::value)>::type FFLAS::sparse_details::fspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

15.14.1.15 fspmm_dispatch() [2/2]

```
std::enable_if< std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineIntT>::value || std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineIntT>::value>::type FFLAS::sparse_details::fspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

15.14.1.16 fspmm() [1/9]

```

void FFLAS::sparse_details::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.17 fspmm() [2/9]

```

std::enable_if<support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.18 fspmm() [3/9]

```

std::enable_if<!support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```


15.14.1.19 fspmm() [4/9]

```
std::enable_if<support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.20 fspmm() [5/9]

```
std::enable_if<!support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.21 fspmm() [6/9]

```
void FFLAS::sparse_details::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.22 fspmm() [7/9]

```

std::enable_if<support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]

```

15.14.1.23 fspmm() [8/9]

```

std::enable_if<!support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]

```

15.14.1.24 fspmm() [9/9]

```

void FFLAS::sparse_details::fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    ZOSparseMatrix ) [inline]

```

15.14.1.25 pfspmm_dispatch() [1/2]

```
std::enable_if< !(std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineInt1
::value || std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineInt1
::value)>::type FFLAS::sparse_details::pfspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

15.14.1.26 pfspmm_dispatch() [2/2]

```
std::enable_if< std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::Mach
::value || std::is_same<typename ElementTraits<typename Field::Element>::value, ElementCategories::MachineInt1
::value)>::type FFLAS::sparse_details::pfspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]
```

15.14.1.27 pfspmm() [1/9]

```
void FFLAS::sparse_details::pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.28 pfspmm() [2/9]

```
std::enable_if<support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.29 pfspmm() [3/9]

```
std::enable_if<!support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.30 pfspmm() [4/9]

```
std::enable_if<support_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.31 pfspmm() [5/9]

```
std::enable_if<!support\_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement\_ptr x,
    int ldx,
    typename Field::Element\_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.32 pfspmm() [6/9]

```
void FFLAS::sparse_details::pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement\_ptr x,
    int ldx,
    typename Field::Element\_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.33 pfspmm() [7/9]

```
std::enable_if<support\_simd<typename Field::Element>::value>::type FFLAS::sparse_details←
::pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement\_ptr x,
    int ldx,
    typename Field::Element\_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.34 pfsppmm() [8/9]

```
std::enable_if<!support\_simd<typename Field::Element>::value>::type FFLAS::sparse\_details<↵
::pfsppmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement\_ptr x,
    int ldx,
    typename Field::Element\_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.35 pfsppmm() [9/9]

```
void FFLAS::sparse\_details::pfsppmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement\_ptr x,
    int ldx,
    typename Field::Element\_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.36 pfsppmv() [1/6]

```
void FFLAS::sparse\_details::pfsppmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement\_ptr x,
    typename Field::Element\_ptr y,
    FieldCategories::GenericTag ,
    std::false_type ) [inline]
```

15.14.1.37 pfsppmv() [2/6]

```
void FFLAS::sparse\_details::pfsppmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement\_ptr x,
    typename Field::Element\_ptr y,
    FieldCategories::UnparametricTag ,
    std::false_type ) [inline]
```

15.14.1.38 pfspmv() [3/6]

```
void FFLAS::sparse_details::pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::false_type ) [inline]
```

15.14.1.39 pfspmv() [4/6]

```
void FFLAS::sparse_details::pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    std::true_type ) [inline]
```

15.14.1.40 pfspmv() [5/6]

```
void FFLAS::sparse_details::pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    std::true_type ) [inline]
```

15.14.1.41 pfspmv() [6/6]

```
void FFLAS::sparse_details::pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::true_type ) [inline]
```

15.14.1.42 fspmv() [10/12]

```
std::enable_if<isSparseMatrixSimdFormat<Field, SM>::value && support_simd<typename Field::Element>>↵
::value >::type FFLAS::sparse_details::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.43 fspmv() [11/12]

```
std::enable_if<isSparseMatrixSimdFormat<Field, SM>::value && support_simd<typename Field::Element>>↵
::value >::type FFLAS::sparse_details::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.44 fspmv() [12/12]

```
std::enable_if<isSparseMatrixSimdFormat<Field, SM>::value && support_simd<typename Field::Element>>↵
::value >::type FFLAS::sparse_details::fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.15 FFLAS::sparse_details_impl Namespace Reference**Functions**

- template<class Field >
void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)
- template<class Field >
void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)
- template<class Field >
void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)

- template<class Field >
void [fspmm_simd_aligned](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)
- template<class Field >
void [fspmm_simd_unaligned](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)
- template<class Field >
void [fspmm_one](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)
- template<class Field >
void [fspmm_mone](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)
- template<class Field >
void [fspmm_one_simd_aligned](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)
- template<class Field >
void [fspmm_one_simd_unaligned](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)
- template<class Field >
void [fspmm_mone_simd_aligned](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)
- template<class Field >
void [fspmm_mone_simd_unaligned](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)
- template<class Field >
void [fspmv](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)
- template<class Field >
void [fspmv](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)
- template<class Field >
void [fspmv](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)
- template<class Field >
void [fspmv_one](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)
- template<class Field >
void [fspmv_mone](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)
- template<class Field >
void [fspmv_one](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)
- template<class Field >
void [fspmv_mone](#) (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)
- template<class Field >
void [pfspmm](#) (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)

- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_task (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const index_t iStart, const index_t iStop, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, index_t blockSize, typename Field::ConstElement_ptr x_, index_t ldx, typename Field::Element_ptr y_, index_t ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

- `template<class Field >`
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`

- `template<class Field , class Func >`
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x, typename Field::Element_ptr y, Func &&func)`
- `template<class Field , class Func >`
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, Func &&func)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`

- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- [illegible]

- template<class Field >
void `fspmv_one` (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)
- template<class Field >
void `fspmv_mone` (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)

15.15.1 Function Documentation

15.15.1.1 fspmm() [1/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.2 fspmm() [2/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.3 fspmm() [3/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax ) [inline]
```

15.15.1.4 fspmm_simd_aligned() [1/2]

```
void FFLAS::sparse_details_impl::fspmm_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    const int64_t kmax ) [inline]
```

15.15.1.5 fspmm_simd_unaligned() [1/2]

```
void FFLAS::sparse_details_impl::fspmm_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    const int64_t kmax ) [inline]
```

15.15.1.6 fspmm_one() [1/4]

```
void FFLAS::sparse_details_impl::fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.7 fspmm_mone() [1/4]

```
void FFLAS::sparse_details_impl::fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.8 fspmm_one_simd_aligned() [1/3]

```
void FFLAS::sparse_details_impl::fspmm_one_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.9 fspmm_one_simd_unaligned() [1/3]

```
void FFLAS::sparse_details_impl::fspmm_one_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.10 fspmm_mone_simd_aligned() [1/3]

```
void FFLAS::sparse_details_impl::fspmm_mone_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.11 fspmm_mone_simd_unaligned() [1/3]

```
void FFLAS::sparse_details_impl::fspmm_mone_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.12 fspmv() [1/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.13 fspmv() [2/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.14 fspmv() [3/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]
```

15.15.1.15 fspmv_one() [1/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.16 fspmv_mone() [1/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.17 fspmv_one() [2/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.18 fspmv_mone() [2/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.19 pfspmm() [1/18]

```
void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.20 pfspmm() [2/18]

```
void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.21 pfsppmm() [3/18]

```
void FFLAS::sparse_details_impl::pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax ) [inline]
```

15.15.1.22 pfsppmm_one() [1/2]

```
void FFLAS::sparse_details_impl::pfsppmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.23 pfsppmm_mone() [1/2]

```
void FFLAS::sparse_details_impl::pfsppmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.24 pfsppmm_one() [2/2]

```
void FFLAS::sparse_details_impl::pfsppmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.25 pfsppmm_mone() [2/2]

```

void FFLAS::sparse_details_impl::pfsppmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.26 pfsppmv() [1/18]

```

void FFLAS::sparse_details_impl::pfsppmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.27 pfsppmv_task()

```

void FFLAS::sparse_details_impl::pfsppmv_task (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const index_t iStart,
    const index_t iStop,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.28 pfsppmv() [2/18]

```

void FFLAS::sparse_details_impl::pfsppmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.29 pfspmv() [3/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax ) [inline]
```

15.15.1.30 pfspmv_one() [1/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.31 pfspmv_mone() [1/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.32 pfspmv_one() [2/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.33 pfspmv_mone() [2/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```


15.15.134 fspmm() [4/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.135 fspmm() [5/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    index_t blockSize,
    typename Field::ConstElement_ptr x_,
    index_t ldx,
    typename Field::Element_ptr y_,
    index_t ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.136 fspmm_simd_aligned() [2/2]

```
void FFLAS::sparse_details_impl::fspmm_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.137 fspmm_simd_unaligned() [2/2]

```
void FFLAS::sparse_details_impl::fspmm_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.38 fspmm() [6/15]

```

void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    const int64_t kmax ) [inline]

```

15.15.1.39 fspmm_one() [2/4]

```

void FFLAS::sparse_details_impl::fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.40 fspmm_mone() [2/4]

```

void FFLAS::sparse_details_impl::fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.41 fspmm_one_simd_aligned() [2/3]

```

void FFLAS::sparse_details_impl::fspmm_one_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.142 fspmm_one_simd_unaligned() [2/3]

```
void FFLAS::sparse_details_impl::fspmm_one_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.143 fspmm_mone_simd_aligned() [2/3]

```
void FFLAS::sparse_details_impl::fspmm_mone_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.144 fspmm_mone_simd_unaligned() [2/3]

```
void FFLAS::sparse_details_impl::fspmm_mone_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.145 fspmv() [4/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.46 fspmv() [5/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.47 fspmv() [6/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax ) [inline]
```

15.15.1.48 fspmv_one() [3/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.49 fspmv_mone() [3/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.50 fspmv_one() [4/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.151 fspmv_mone() [4/10]

```

void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.152 pfspmm() [4/18]

```

void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]

```

15.15.153 pfspmm() [5/18]

```

void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

15.15.154 pfspmm() [6/18]

```

void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.55 pfsppmm() [7/18]

```

void FFLAS::sparse_details_impl::pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.56 pfsppmm() [8/18]

```

void FFLAS::sparse_details_impl::pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    const int64_t kmax ) [inline]

```

15.15.1.57 pfsppmm() [9/18]

```

void FFLAS::sparse_details_impl::pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    const int64_t kmax ) [inline]

```

15.15.1.58 pfsppmv() [4/18]

```

void FFLAS::sparse_details_impl::pfsppmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.59 pfspmv() [5/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.60 pfspmv() [6/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax ) [inline]
```

15.15.1.61 fspmm() [7/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.62 fspmm() [8/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.63 fspmm() [9/15]

```

void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    const int64_t kmax ) [inline]

```

15.15.1.64 fspmv() [7/21]

```

void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.65 fspmv() [8/21]

```

void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.66 fspmv() [9/21]

```

void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]

```


15.15.1.67 pfspmm() [10/18]

```

void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.68 pfspmm() [11/18]

```

void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.69 pfspmm() [12/18]

```

void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.70 pfspmm() [13/18]

```

void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.71 pfsppmm() [14/18]

```
void FFLAS::sparse_details_impl::pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    const int64_t kmax ) [inline]
```

15.15.1.72 pfsppmm() [15/18]

```
void FFLAS::sparse_details_impl::pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    const int64_t kmax ) [inline]
```

15.15.1.73 pfsppmm_zo() [1/2]

```
void FFLAS::sparse_details_impl::pfsppmm_zo (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    Func && func ) [inline]
```

15.15.1.74 pfsppmm_zo() [2/2]

```
void FFLAS::sparse_details_impl::pfsppmm_zo (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    Func && func ) [inline]
```

15.15.1.75 pfspmv() [7/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.76 pfspmv() [8/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.77 pfspmv() [9/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax ) [inline]
```

15.15.1.78 pfspmv_one() [3/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.79 pfspmv_mone() [3/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.80 pfspmv_one() [4/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.81 pfspmv_mone() [4/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.82 fspmm() [10/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.83 fspmm() [11/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.84 fspmm() [12/15]

```
void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    const int64_t kmax ) [inline]
```

15.15.1.85 fspmm_mone() [3/4]

```
void FFLAS::sparse_details_impl::fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.86 fspmm_one() [3/4]

```
void FFLAS::sparse_details_impl::fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.87 fspmm_mone() [4/4]

```
void FFLAS::sparse_details_impl::fspmm_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldY,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.88 fspmm_one() [4/4]

```

void FFLAS::sparse_details_impl::fspmm_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.89 fspmm_one_simd_aligned() [3/3]

```

void FFLAS::sparse_details_impl::fspmm_one_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.90 fspmm_one_simd_unaligned() [3/3]

```

void FFLAS::sparse_details_impl::fspmm_one_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.91 fspmm_mone_simd_aligned() [3/3]

```

void FFLAS::sparse_details_impl::fspmm_mone_simd_aligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.92 fspmm_mone_simd_unaligned() [3/3]

```

void FFLAS::sparse_details_impl::fspmm_mone_simd_unaligned (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x_,
    int ldx,
    typename Field::Element_ptr y_,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.93 fspmv() [10/21]

```

void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.94 fspmv() [11/21]

```

void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.95 fspmv() [12/21]

```

void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]

```

15.15.1.96 fspmv_one() [5/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.97 fspmv_mone() [5/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.98 fspmv_one() [6/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.99 fspmv_mone() [6/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.100 pfspmv() [10/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```


15.15.1.101 pfspmv() [11/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.102 pfspmv() [12/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]
```

15.15.1.103 pfspmv_one() [5/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.104 pfspmv_mone() [5/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.105 pfspmv_one() [6/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.106 pfspmv_mone() [6/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.107 fspmv() [13/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.108 fspmv_simd() [1/4]

```
void FFLAS::sparse_details_impl::fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.109 fspmv() [14/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.110 fspmv_simd() [2/4]

```
void FFLAS::sparse_details_impl::fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]
```

15.15.1.111 fspmv() [15/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]
```

15.15.1.112 fspmv_one() [7/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.113 fspmv_mone() [7/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.114 fspmv_one() [8/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.115 fspmv_mone() [8/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.116 fspmv_one_simd() [1/2]

```
void FFLAS::sparse_details_impl::fspmv_one_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.117 fspmv_mone_simd() [1/2]

```
void FFLAS::sparse_details_impl::fspmv_mone_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.118 pfspmm() [16/18]

```
void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.119 pfspmm() [17/18]

```
void FFLAS::sparse_details_impl::pfspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.120 pfsppmm() [18/18]

```

void FFLAS::sparse_details_impl::pfsppmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    uint64_t kmax ) [inline]

```

15.15.1.121 pfsppmv() [13/18]

```

void FFLAS::sparse_details_impl::pfsppmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.122 pfsppmv() [14/18]

```

void FFLAS::sparse_details_impl::pfsppmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.123 pfsppmv() [15/18]

```

void FFLAS::sparse_details_impl::pfsppmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    uint64_t kmax ) [inline]

```

15.15.1.124 fspmm() [13/15]

```

void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.125 fspmm() [14/15]

```

void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ) [inline]

```

15.15.1.126 fspmm() [15/15]

```

void FFLAS::sparse_details_impl::fspmm (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    uint64_t kmax ) [inline]

```

15.15.1.127 fspmv() [16/21]

```

void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ) [inline]

```

15.15.1.128 fspmv() [17/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.129 fspmv() [18/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    uint64_t kmax ) [inline]
```

15.15.1.130 pfspmv() [16/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.131 pfspmv() [17/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.132 pfspmv() [18/18]

```
void FFLAS::sparse_details_impl::pfspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const int64_t kmax ) [inline]
```

15.15.1.133 pfspmv_one() [7/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.134 pfspmv_mone() [7/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.135 pfspmv_one() [8/8]

```
void FFLAS::sparse_details_impl::pfspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.136 pfspmv_mone() [8/8]

```
void FFLAS::sparse_details_impl::pfspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.137 fspmv() [19/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```


15.15.1.138 fspmv_simd() [3/4]

```
void FFLAS::sparse_details_impl::fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.139 fspmv() [20/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.140 fspmv_simd() [4/4]

```
void FFLAS::sparse_details_impl::fspmv_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]
```

15.15.1.141 fspmv() [21/21]

```
void FFLAS::sparse_details_impl::fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    const uint64_t kmax ) [inline]
```

15.15.1.142 fspmv_one() [9/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.143 fspmv_mone() [9/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::GenericTag ) [inline]
```

15.15.1.144 fspmv_one_simd() [2/2]

```
void FFLAS::sparse_details_impl::fspmv_one_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.145 fspmv_mone_simd() [2/2]

```
void FFLAS::sparse_details_impl::fspmv_mone_simd (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.146 fspmv_one() [10/10]

```
void FFLAS::sparse_details_impl::fspmv_one (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.15.1.147 fspmv_mone() [10/10]

```
void FFLAS::sparse_details_impl::fspmv_mone (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x_,
    typename Field::Element_ptr y_,
    FieldCategories::UnparametricTag ) [inline]
```

15.16 FFLAS::StrategyParameter Namespace Reference

Data Structures

- struct [Fixed](#)
- struct [Threads](#)
- struct [Grain](#)
- struct [TwoD](#)
- struct [TwoDAdaptive](#)
- struct [ThreeD](#)
- struct [ThreeDInPlace](#)
- struct [ThreeDAdaptive](#)

15.17 FFLAS::StructureHelper Namespace Reference

[StructureHelper](#) for ftrsm.

Data Structures

- struct [Recursive](#)
- struct [Iterative](#)
- struct [Hybrid](#)

15.17.1 Detailed Description

[StructureHelper](#) for ftrsm.

15.18 FFLAS::vectorised Namespace Reference

Namespaces

- [unswitch](#)

Data Structures

- struct [HelperMod](#)
- struct [HelperMod](#)< Field, ElementCategories::MachineIntTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::MachineFloatTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::FixedPrecIntTag >

Functions

- `template<class SimdT , class Element , bool positive>`
`std::enable_if< is_simd< SimdT >::value, void >::type VEC_ADD (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)`
- `template<bool positive, class Element , class T1 , class T2 >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type addp (Element *T, const Element *TA, const Element *TB, size_t n, Element p, T1 min_, T2 max_)`
- `template<class SimdT , class Element , bool positive>`
`std::enable_if< is_simd< SimdT >::value, void >::type VEC_SUB (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)`
- `template<bool positive, class Element , class T1 , class T2 >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type subp (Element *T, const Element *TA, const Element *TB, const size_t n, const Element p, const T1 min_, const T2 max_)`
- `template<class Element >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type add (Element *T, const Element *TA, const Element *TB, size_t n)`
- `template<class Element >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type sub (Element *T, const Element *TA, const Element *TB, size_t n)`
- `template<class T >`
`std::enable_if< ! std::is_integral< T >::value, T >::type reduce (T A, T B)`
- `template<class T >`
`std::enable_if< std::is_integral< T >::value, T >::type reduce (T A, T B)`
- `template<> Givaro::Integer reduce (Givaro::Integer A, Givaro::Integer B)`
- `float reduce (float A, float B, float invB, float min, float max)`
- `double reduce (double A, double B, double invB, double min, double max)`
- `int64_t reduce (int64_t A, int64_t p, double invp, double min, double max, int64_t pow50rem)`
- `template<class Field >`
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::MachineIntTag > &H)`
- `template<class Field >`
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::MachineFloatTag > &H)`
- `template<class Field >`
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::ArbitraryPrecIntTag > &H)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, typename Field::Element_ptr T)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, const size_t &incX, typename Field::Element_ptr T)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n, const size_t &incX)`

15.18.1 Function Documentation

15.18.1.1 VEC_ADD()

```
std::enable_if<is_simd<SimdT>::value, void>::type FFLAS::vectorised::VEC_ADD (
    SimdT & C,
    SimdT & A,
    SimdT & B,
    SimdT & Q,
    SimdT & T,
    SimdT & P,
    SimdT & NEGP,
    SimdT & MIN,
    SimdT & MAX ) [inline]
```

15.18.1.2 addp()

```
std::enable_if<FFLAS::support_simd_add<Element>::value, void>::type FFLAS::vectorised::addp (
    Element * T,
    const Element * TA,
    const Element * TB,
    size_t n,
    Element p,
    T1 min_,
    T2 max_ ) [inline]
```

15.18.1.3 VEC_SUB()

```
std::enable_if<is_simd<SimdT>::value, void>::type FFLAS::vectorised::VEC_SUB (
    SimdT & C,
    SimdT & A,
    SimdT & B,
    SimdT & Q,
    SimdT & T,
    SimdT & P,
    SimdT & NEGP,
    SimdT & MIN,
    SimdT & MAX ) [inline]
```

15.18.1.4 subp()

```
std::enable_if<FFLAS::support_simd_add<Element>::value, void>::type FFLAS::vectorised::subp (
    Element * T,
    const Element * TA,
    const Element * TB,
    const size_t n,
    const Element p,
    const T1 min_,
    const T2 max_ ) [inline]
```

15.18.1.5 add()

```
std::enable_if<FFLAS::support_simd_add<Element>::value, void>::type FFLAS::vectorised::add (
    Element * T,
    const Element * TA,
    const Element * TB,
    size_t n ) [inline]
```

15.18.1.6 sub()

```
std::enable_if<FFLAS::support_simd_add<Element>::value, void>::type FFLAS::vectorised::sub (
    Element * T,
    const Element * TA,
    const Element * TB,
    size_t n ) [inline]
```

15.18.1.7 reduce() [1/9]

```
std::enable_if< ! std::is_integral<T>::value, T>::type FFLAS::vectorised::reduce (
    T A,
    T B ) [inline]
```

15.18.1.8 reduce() [2/9]

```
std::enable_if< std::is_integral<T>::value, T>::type FFLAS::vectorised::reduce (
    T A,
    T B ) [inline]
```

15.18.1.9 reduce() [3/9]

```
Givaro::Integer FFLAS::vectorised::reduce (
    Givaro::Integer A,
    Givaro::Integer B ) [inline]
```

15.18.1.10 reduce() [4/9]

```
float FFLAS::vectorised::reduce (
    float A,
    float B,
    float invB,
    float min,
    float max ) [inline]
```

15.18.1.11 reduce() [5/9]

```
double FFLAS::vectorised::reduce (
    double A,
    double B,
    double invB,
    double min,
    double max ) [inline]
```

15.18.1.12 reduce() [6/9]

```
int64_t FFLAS::vectorised::reduce (
    int64_t A,
    int64_t p,
    double invp,
    double min,
    double max,
    int64_t pow50rem ) [inline]
```

15.18.1.13 reduce() [7/9]

```
Field::Element FFLAS::vectorised::reduce (
    typename Field::Element A,
    HelperMod< Field, ElementCategories::MachineIntTag > & H ) [inline]
```

15.18.1.14 reduce() [8/9]

```
Field::Element FFLAS::vectorised::reduce (
    typename Field::Element A,
    HelperMod< Field, ElementCategories::MachineFloatTag > & H ) [inline]
```

15.18.1.15 reduce() [9/9]

```
Field::Element FFLAS::vectorised::reduce (
    typename Field::Element A,
    HelperMod< Field, ElementCategories::ArbitraryPrecIntTag > & H ) [inline]
```

15.18.1.16 modp() [1/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔
::vectorised::modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    typename Field::Element_ptr T ) [inline]
```

15.18.1.17 modp() [2/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔
::vectorised::modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    const size_t & incX,
    typename Field::Element_ptr T ) [inline]
```

15.18.1.18 scalp() [1/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔
::vectorised::scalp (
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n ) [inline]
```

15.18.1.19 scalp() [2/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔
::vectorised::scalp (
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    const size_t & incX ) [inline]
```


15.19 FFLAS::vectorised::unswitch Namespace Reference

Functions

- `template<class Field >`
`std::enable_if<!FFLAS::support_simd_mod< typename Field::Element >::value &&FFLAS::support_fast_mod<`
`typename Field::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U,`
`const size_t &n, typename Field::Element_ptr T, HelperMod< Field > &H)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type modp`
`(const Field &F, typename Field::ConstElement_ptr U, const size_t &n, const size_t &incX, typename`
`Field::Element_ptr T, HelperMod< Field > &H)`
- `template<class Field >`
`std::enable_if<!FFLAS::support_simd_mod< typename Field::Element >::value &&FFLAS::support_fast_mod<`
`typename Field::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const`
`typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n, HelperMod< Field >`
`&H)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type scalp`
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr U, const size_t n, const size_t &incX, HelperMod< Field > &H)`

15.19.1 Function Documentation

15.19.1.1 modp() [1/2]

```
std::enable_if<!FFLAS::support_simd_mod<typename Field::Element>::value && FFLAS::support_fast_mod<typename
Field::Element>::value, void>::type FFLAS::vectorised::unswitch::modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    typename Field::Element_ptr T,
    HelperMod< Field > & H ) [inline]
```

15.19.1.2 modp() [2/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔
::vectorised::unswitch::modp (
    const Field & F,
    typename Field::ConstElement_ptr U,
    const size_t & n,
    const size_t & incX,
    typename Field::Element_ptr T,
    HelperMod< Field > & H ) [inline]
```

15.19.1.3 `scalp()` [1/2]

```
std::enable_if<!FFLAS::support_simd_mod<typename Field::Element>::value && FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS::vectorised::unswitch::scalp (
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    HelperMod< Field > & H ) [inline]
```

15.19.1.4 `scalp()` [2/2]

```
std::enable_if<FFLAS::support_fast_mod<typename Field::Element>::value, void>::type FFLAS↔::vectorised::unswitch::scalp (
    const Field & F,
    typename Field::Element_ptr T,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr U,
    const size_t n,
    const size_t & incX,
    HelperMod< Field > & H ) [inline]
```

15.20 FFPACK Namespace Reference

Finite Field **PACK** Set of elimination based routines for dense linear algebra.

Namespaces

- [Protected](#)

Data Structures

- class [CheckerImplem_charpoly](#)
- class [CheckerImplem_Det](#)
- class [CheckerImplem_invert](#)
- class [CheckerImplem_PLUQ](#)
- class [CharpolyFailed](#)
- class [callLUdivine_small](#)
- class [callLUdivine_small< double >](#)
- class [callLUdivine_small< float >](#)
- class [RNSInteger](#)
- class [RNSIntegerMod](#)
- struct [rns_double_elt](#)
- struct [rns_double_elt_ptr](#)
- struct [rns_double_elt_cstptr](#)
- struct [rns_double](#)
- struct [rns_double_extended](#)
- class [rnsRandIter](#)
- class [Failure](#)

A precondition failed.

Typedefs

- template<class Field >
using [Checker_PLUQ](#) = FFLAS::Checker_Empty< Field >
- template<class Field >
using [Checker_Det](#) = FFLAS::Checker_Empty< Field >
- template<class Field >
using [Checker_invert](#) = FFLAS::Checker_Empty< Field >
- template<class Field , class Polynomial >
using [Checker_charpoly](#) = FFLAS::Checker_Empty< Field >
- template<class Field >
using [ForceCheck_PLUQ](#) = CheckerImplem_PLUQ< Field >
- template<class Field >
using [ForceCheck_Det](#) = CheckerImplem_Det< Field >
- template<class Field >
using [ForceCheck_invert](#) = CheckerImplem_invert< Field >
- template<class Field , class Polynomial >
using [ForceCheck_charpoly](#) = CheckerImplem_charpoly< Field, Polynomial >

Functions

- void [LAPACKPerm2MathPerm](#) (size_t *MathP, const size_t *LapackP, const size_t N)
Conversion of a permutation from LAPACK format to Math format.
- void [MathPerm2LAPACKPerm](#) (size_t *LapackP, const size_t *MathP, const size_t N)
Conversion of a permutation from Maths format to LAPACK format.
- template<class Field >
void [applyP](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P)
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.
- template<class Field >
void [applyP](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Sequential seq)
- template<class Field , class Cut , class Param >
void [applyP](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)
- template<class Field >
void [MonotonicApplyP](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t R)
Apply a R-monotonically increasing permutation P, to the matrix A.
- template<class Field >
void [fgetrs](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename Field::Element_ptr B, const size_t ldb, int *info)
Solve the system $AX = B$ or $XA = B$.
- template<class Field >
[Field::Element_ptr fgetrs](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)
Solve the system $AX = B$ or $XA = B$.

- `template<class Field >`
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, int *info)`
Square system solver.
- `template<class Field >`
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`
Rectangular system solver.
- `template<class Field >`
`void ftrtri (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FTRTRI_THRESHOLD)`
Compute the inverse of a triangular matrix.
- `template<class Field >`
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldl, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field >`
`void ftrtrm (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda)`
Compute the product of two triangular matrices of opposite shape.
- `template<class Field >`
`void ftrstr (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const FFLAS::FFLAS_DIAG diagB, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSTR_THRESHOLD)`
Solve a triangular system with a triangular right hand side of the same shape.
- `template<class Field >`
`void ftrssyr2k (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldx, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)`
Solve a triangular system in a symmetric sum: find B upper/lower triangular such that $A^T B + B^T A = C$ where C is symmetric.
- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
Triangular factorization of symmetric matrices.
- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field , class Cut , class Param >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field >`
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr D, const size_t incD, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
Triangular factorization of symmetric matrices.
- `template<class Field >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`
Compute a PLUQ factorization of the given matrix.
- `template<class Field >`
`size_t pPLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`

- `template<class Field >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, type-`
`name Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Sequential`
`&PSHelper, size_t BCThreshold=__FFLASFFPACK_PLUQ_THRESHOLD)`
- `template<class Field , class Cut , class Param >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< Cut,`
`Param > &PSHelper)`
- `template<class Field >`
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans,`
`const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt,`
`const FFPACK_LU_TAG LuTag=FfpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE↵`
`_THRESHOLD)`

Compute the CUP or PLE factorization of the given matrix.
- `template<class Field >`
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`
`A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, const FFPACK_LU_TAG Lu↵`
`Tag=FfpackSlabRecursive)`

Compute the Column Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG`
`LuTag=FfpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper`
`&psH)`
- `template<class Field >`
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`
`A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG Lu↵`
`Tag=FfpackSlabRecursive)`

Compute the Row Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_↵`
`LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper`
`&psH)`
- `template<class Field >`
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_↵`
`LU_TAG LuTag=FfpackSlabRecursive)`

Compute the Reduced Column Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0,`
`const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU↵`
`_TAG LuTag, const PSHelper &psH)`
- `template<class Field >`
`size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`
`A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG Lu↵`
`Tag=FfpackSlabRecursive)`

Compute the Reduced Row Echelon form of the input matrix in-place.

- `template<class Field >`
`size_t pReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`
`A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_`
`__LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`
`A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK__LU_TAG LuTag, const`
`PSHelper &psH)`
- `template<class Field >`
`Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, int`
`&nullity)`

Invert the given matrix in place or computes its nullity if it is singular.
- `template<class Field >`
`Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::ConstElement_ptr A, const size_t`
`lda, typename Field::Element_ptr X, const size_t ldx, int &nullity)`

Invert the given matrix or computes its nullity if it is singular.
- `template<class Field >`
`Field::Element_ptr Invert2 (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda,`
`typename Field::Element_ptr X, const size_t ldx, int &nullity)`

Invert the given matrix or computes its nullity if it is singular.
- `template<class PolRing >`
`std::list< typename PolRing::Element > & CharPoly (const PolRing &R, std::list< typename PolRing::`
`Element > &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, typename`
`PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t`
`degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`

Compute the characteristic polynomial of the matrix A.
- `template<class PolRing >`
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, type-`
`name PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::RandIter &G, const`
`FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`

Compute the characteristic polynomial of the matrix A.
- `template<class PolRing >`
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N,`
`typename PolRing::Domain_t::Element_ptr A, const size_t lda, const FFPACK_CHARPOLY_TAG Charp`
`Tag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`

Compute the characteristic polynomial of the matrix A.
- `template<class Field , class Polynomial >`
`Polynomial & MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr`
`A, const size_t lda)`

Compute the minimal polynomial of the matrix A.
- `template<class Field , class Polynomial , class RandIter >`
`Polynomial & MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr`
`A, const size_t lda, RandIter &G)`

Compute the minimal polynomial of the matrix A.
- `template<class Field , class Polynomial >`
`Polynomial & MatVecMinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr`
`A, const size_t lda, typename Field::ConstElement_ptr v, const size_t incv)`

Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis $(v, Av, \dots, A^N v)$.
- `template<class Field >`
`size_t Rank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda)`

Computes the rank of the given matrix using a PLUQ factorization.
- `template<class Field >`
`size_t pRank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda,`
`size_t numthreads=0)`

- `template<class Field , class PSHelper >`
`size_t Rank` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, const PSHelper &psH)
- `template<class Field >`
`bool IsSingular` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda)
Returns true if the given matrix is singular.
- `template<class Field >`
`Field::Element & Det` (const `Field` &F, typename `Field::Element` &det, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P=NULL, `size_t` *Q=NULL)
Returns the determinant of the given square matrix.
- `template<class Field >`
`Field::Element & pDet` (const `Field` &F, typename `Field::Element` &det, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` numthreads=0, `size_t` *P=NULL, `size_t` *Q=NULL)
- `template<class Field , class PSHelper >`
`Field::Element & Det` (const `Field` &F, typename `Field::Element` &det, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, const PSHelper &psH, `size_t` *P=NULL, `size_t` *Q=NULL)
- `template<class Field >`
`Field::Element_ptr Solve` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` x, const `int` incx, typename `Field::ConstElement_ptr` b, const `int` incb)
Solves a linear system $AX = b$ using PLUQ factorization.
- `template<class Field , class PSHelper >`
`Field::Element_ptr Solve` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` x, const `int` incx, typename `Field::ConstElement_ptr` b, const `int` incb, PSHelper &psH)
- `template<class Field >`
`Field::Element_ptr pSolve` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` x, const `int` incx, typename `Field::ConstElement_ptr` b, const `int` incb, `size_t` numthreads=0)
- `template<class Field >`
`*void RandomNullSpaceVector` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` incX)
Solve $LX = B$ or $XL = B$ in place.
- `template<class Field >`
`size_t NullSpaceBasis` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` &NS, `size_t` &ldn, `size_t` &NSdim)
Computes a basis of the Left/Right nullspace of the matrix A.
- `template<class Field >`
`size_t RowRankProfile` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *&rkprofile, const FFPACK_LU_TAG LuTag=`FfpackSlabRecursive`)
Computes the row rank profile of A.
- `template<class Field >`
`size_t pRowRankProfile` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *&rkprofile, `size_t` numthreads=0, const FFPACK_LU_TAG LuTag=`FfpackTileRecursive`)
- `template<class Field , class PSHelper >`
`size_t RowRankProfile` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *&rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)
- `template<class Field >`
`size_t ColumnRankProfile` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *&rkprofile, const FFPACK_LU_TAG LuTag=`FfpackSlabRecursive`)
Computes the column rank profile of A.
- `template<class Field >`
`size_t pColumnRankProfile` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *&rkprofile, `size_t` numthreads=0, const FFPACK_LU_TAG LuTag=`FfpackTileRecursive`)

- `template<class Field, class PSHelper>`
`size_t ColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)`
- `void RankProfileFromLU (const size_t *P, const size_t N, const size_t R, size_t *rkprofile, const FFPACK_LU_TAG LuTag)`
Recovers the column/row rank profile from the permutation of an LU decomposition.
- `size_t LeadingSubmatrixRankProfiles (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSn, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP)`
Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.
- `template<class Field>`
`size_t RowRankProfileSubmatrixIndices (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rowindices, size_t *colindices, size_t &R)`
RowRankProfileSubmatrixIndices.
- `template<class Field>`
`size_t ColRankProfileSubmatrixIndices (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rowindices, size_t *colindices, size_t &R)`
Computes the indices of the submatrix $r \times r$ X of A whose columns correspond to the column rank profile of A .
- `template<class Field>`
`size_t RowRankProfileSubmatrix (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &X, size_t &R)`
Computes the $r \times r$ submatrix X of A , by picking the row rank profile rows of A .
- `template<class Field>`
`size_t ColRankProfileSubmatrix (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &X, size_t &R)`
Compute the $r \times r$ submatrix X of A , by picking the row rank profile rows of A .
- `template<class Field>`
`void getTriangular (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false)`
Extracts a triangular matrix from a compact storage $A=L|U$ of rank R .
- `template<class Field>`
`void getTriangular (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr A, const size_t lda)`
Cleans up a compact storage $A=L|U$ to reveal a triangular matrix of rank R .
- `template<class Field>`
`void getEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`
Extracts a matrix in echelon form from a compact storage $A=L|U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.
- `template<class Field>`
`void getEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t lda, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`
Cleans up a compact storage $A=L|U$ obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R .
- `template<class Field>`
`void getEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`
Extracts a transformation matrix to echelon form from a compact storage $A=L|U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.

- `template<class Field >`
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.
- `template<class Field >`
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t lda, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Cleans up a compact storage $A=L\backslash U$ of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.
- `template<class Field >`
`void getReducedEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.
- `void PLUQtoEchelonPermutation (const size_t N, const size_t R, const size_t *P, size_t *outPerm)`
Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.
- `template<class Field >`
`Field::Element_ptr LQUptInverseOfFullRankMinor (const Field &F, const size_t rank, typename Field::Element_ptr A_factors, const size_t lda, const size_t *QtPointer, typename Field::Element_ptr X, const size_t ldx)`
LQUptInverseOfFullRankMinor.
- `template<class Field >`
`void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t incX)`
Solve $LX = B$ or $XL = B$ in place.
- `template<class Field >`
`void solveLB (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field >`
`void solveLB2 (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field, class Polynomial >`
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda)`
- `template<class Field >`
`Field::Element_ptr buildMatrix (const Field &F, typename Field::ConstElement_ptr E, typename Field::ConstElement_ptr C, const size_t lda, const size_t *B, const size_t *T, const size_t me, const size_t mc, const size_t lambda, const size_t mu)`
- `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr CharPoly (const FFPACK::RNSInteger< FFPACK::rns_double > &F, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr charp, const size_t N, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A, const size_t lda, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag, size_t degree)`
- `template<> Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & CharPoly (const Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > &R, Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element &charp, const size_t N, Givaro::Integer *A, const size_t lda, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag, size_t degree)`
- `template<class PSHelper >`
`FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & Det (const FFPACK::RNSInteger<`

- `FFPACK::rns_double > &F, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr &det, const size_t N, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A, const size_t lda, const PSHelper &psH)`
- `template<class PSHelper >`
`Givaro::Integer & Det (const Givaro::ZRing< Givaro::Integer > &F, Givaro::Integer &det, const size_t N, Givaro::Integer *A, const size_t lda, const PSHelper &psH, size_t *P, size_t *Q)`
 - `template<class Field >`
`bool fsytrf_BC_Crout (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
 - `template<class Field >`
`size_t fsytrf_BC_RL (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
 - `template<class Field >`
`size_t fsytrf_UP_RPM_BC_RL (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
 - `template<class Field >`
`size_t fsytrf_LOW_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
 - `template<class Field >`
`size_t fsytrf_UP_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
 - `template<class Field >`
`size_t fsytrf_UP_RPM (const Field &Fi, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P, size_t BCThreshold)`
 - `template<class Field >`
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, FFLAS::ParSeqHelper::Sequential seq, size_t threshold)`
 - `template<class Field, class Cut, class Param >`
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, FFLAS::ParSeqHelper::Parallel< Cut, Param > par, size_t threshold)`
 - `template<class Field >`
`size_t fsytrf_RPM (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t threshold)`
 - `template<class Field >`
`void getTridiagonal (const Field &F, const size_t N, const size_t R, typename Field::ConstElement_ptr A, const size_t lda, size_t *P, typename Field::Element_ptr T, const size_t ldt)`
 - `template<class Field >`
`size_t LUdivine_gauss (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)`
 - `template<class Field >`
`size_t LUdivine_small (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)`
 - `template<class Field >`
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag, const size_t cutoff)`
 - `template<> size_t LUdivine (const Givaro::Modular< Givaro::Integer > &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag, const size_t cutoff)`
 - `template<class Field >`
`void MonotonicCompress (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`

- `template<class Field >`
`void MonotonicCompressMorePivots (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, type-`
`name Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const`
`size_t rowstomove, const size_t lenP)`
- `template<class Field >`
`void MonotonicCompressCycles (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename`
`Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t lenP)`
- `template<class Field >`
`void MonotonicExpand (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename`
`Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t`
`maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`
- `template<class Field >`
`void applyP_block (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE`
`Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda,`
`const size_t *P)`
- `template<class Field >`
`void doApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr`
`tmp, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const`
`size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t ↵`
`t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const`
`FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field , class Cut , class Param >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t ↵`
`t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const`
`FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T >`
`void PermApplyS (T *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t`
`R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void doApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr`
`tmp, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const`
`size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t ↵`
`t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const`
`FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field , class Cut , class Param >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t ↵`
`t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const`
`FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T >`
`void PermApplyT (T *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t`
`R2, const size_t R3, const size_t R4)`
- `void composePermutationsLLL (size_t *P1, const size_t *P2, const size_t R, const size_t N)`
Computes $P1 \times Diag(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.
- `void composePermutationsLLM (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const`
`size_t N)`
Computes $P1 \times Diag(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $MathP$ as a MathPermutation format.
- `void composePermutationsMLM (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)`

Computes MathP1 x Diag (I_R, P2) where MathP1 is a MathPermutation and P2 a LAPACK permutation and store the result in MathP1 as a MathPermutation format.

- void [cyclic_shift_mathPerm](#) (size_t *P, const size_t s)
- template<class Field >
void [cyclic_shift_row_col](#) (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)
- template<class Field >
void [cyclic_shift_row](#) (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)
- template<typename T >
void [cyclic_shift_row](#) (const RNSIntegerMod< T > &F, typename T::Element_ptr A, size_t m, size_t n, size_t lda)
- template<class Field >
void [cyclic_shift_col](#) (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)
- template<typename T >
void [cyclic_shift_col](#) (const RNSIntegerMod< T > &F, typename T::Element_ptr A, size_t m, size_t n, size_t lda)
- template<class Field >
size_t [PLUQ_basecaseV3](#) (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element *A, const size_t lda, size_t *P, size_t *Q)
- template<class Field >
size_t [PLUQ_basecaseV2](#) (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element *A, const size_t lda, size_t *P, size_t *Q)
- template<class Field >
size_t [PLUQ_basecaseCrout](#) (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)
- template<class Field >
size_t [_PLUQ](#) (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, size_t BCThreshold)
- template<class Cut, class Param >
size_t [PLUQ](#) (const Givaro::Modular< Givaro::Integer > &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, size_t BCThreshold, FFLAS::ParSeqHelper::Parallel< Cut, Param > &PSHelper)
- template<class Field >
void [threads_fgemm](#) (const size_t m, const size_t n, const size_t r, int nbthreads, size_t *W1, size_t *W2, size_t *W3, size_t gamma)
- template<class Field >
void [threads_ftrsm](#) (const size_t m, const size_t n, int nbthreads, size_t *t1, size_t *t2)
- template<class Field >
size_t [PLUQ](#) (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter::Threads > &PSHelper)
- template<> [rns_double_elt_ptr fflas_const_cast](#) (rns_double_elt_cstptr x)
- template<> [rns_double_elt_cstptr fflas_const_cast](#) (rns_double_elt_ptr x)
- template<typename Base_t >
void [cyclic_shift_row_col](#) (Base_t *A, size_t m, size_t n, size_t lda)
- template [INST_OR_DECL](#) void [cyclic_shift_row](#) (const FFLAS_FIELD< FFLAS_ELT > &F, FFLAS_ELT *A, size_t m, size_t n, size_t lda)
- template [INST_OR_DECL](#) void [cyclic_shift_col](#) (const FFLAS_FIELD< FFLAS_ELT > &F, FFLAS_ELT *A, size_t m, size_t n, size_t lda)
- template [INST_OR_DECL](#) void [applyP](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, FFLAS_ELT *A, const size_t lda, const size_t *P)
- template [INST_OR_DECL](#) void [fgetrs](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, FFLAS_ELT *A, const size_t lda, const size_t *P, const size_t *Q, FFLAS_ELT *B, const size_t ldb, int *info)
- template [INST_OR_DECL](#) FFLAS_ELT * [fgetrs](#) (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, FFLAS_ELT *A, const size_t lda, const size_t *P, const size_t *Q, FFLAS_ELT *X, const size_t ldx, const FFLAS_ELT *B, const size_t ldb, int *info)

- template [INST_OR_DECL](#) [size_t fgesv](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) Side, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [FFLAS_ELT](#) *B, const [size_t](#) ldb, int *info)
- template [INST_OR_DECL](#) [size_t fgesv](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) Side, const [size_t](#) M, const [size_t](#) N, const [size_t](#) NRHS, [FFLAS_ELT](#) *A, const [size_t](#) lda, [FFLAS_ELT](#) *X, const [size_t](#) ldx, const [FFLAS_ELT](#) *B, const [size_t](#) ldb, int *info)
- template [INST_OR_DECL](#) void [ftrtri](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) Diag, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, const [size_t](#) threshold)
- template [INST_OR_DECL](#) void [trinv_left](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) N, const [FFLAS_ELT](#) *L, const [size_t](#) ldl, [FFLAS_ELT](#) *X, const [size_t](#) ldx)
- template [INST_OR_DECL](#) void [ftrtrm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_DIAG](#) diag, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda)
- template [INST_OR_DECL](#) [size_t PLUQ](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Q)
- template [INST_OR_DECL](#) [size_t LUdivine](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Qt, const [FFPACK_LU_TAG](#) LuTag, const [size_t](#) cutoff)
- template [INST_OR_DECL](#) [size_t LUdivine_small](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Q, const [FFPACK_LU_TAG](#) LuTag)
- template [INST_OR_DECL](#) [size_t LUdivine_gauss](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Q, const [FFPACK_LU_TAG](#) LuTag)
- template [INST_OR_DECL](#) [size_t RowEchelonForm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Qt, const bool transform, const [FFPACK_LU_TAG](#) LuTag)
- template [INST_OR_DECL](#) [size_t ReducedRowEchelonForm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Qt, const bool transform, const [FFPACK_LU_TAG](#) LuTag)
- template [INST_OR_DECL](#) [size_t ColumnEchelonForm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Qt, const bool transform, const [FFPACK_LU_TAG](#) LuTag)
- template [INST_OR_DECL](#) [size_t ReducedColumnEchelonForm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) M, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Qt, const bool transform, const [FFPACK_LU_TAG](#) LuTag)
- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [Invert](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) M, [FFLAS_ELT](#) *A, const [size_t](#) lda, int &nullity)
- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [Invert](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) M, const [FFLAS_ELT](#) *A, const [size_t](#) lda, [FFLAS_ELT](#) *X, const [size_t](#) ldx, int &nullity)
- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [Invert2](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [size_t](#) M, [FFLAS_ELT](#) *A, const [size_t](#) lda, [FFLAS_ELT](#) *X, const [size_t](#) ldx, int &nullity)
- template [INST_OR_DECL](#) std::list< Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > >::Element > &CharPoly (const Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > > &R, std::list< Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > >::Element > &charp, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [FFLAS_FIELD](#)< [FFLAS_ELT](#) >::RandIter &G, const [FFPACK_CHARPOLY_TAG](#) CharpTag, const [size_t](#) degree)
- template [INST_OR_DECL](#) Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > >::Element &CharPoly (const Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > > &R, Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > >::Element &charp, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, [FFLAS_FIELD](#)< [FFLAS_ELT](#) >::RandIter &G, const [FFPACK_CHARPOLY_TAG](#) CharpTag, const [size_t](#) degree)
- template [INST_OR_DECL](#) Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > >::Element &CharPoly (const Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > > &R, Givaro::Poly1Dom< [FFLAS_FIELD](#)< [FFLAS_ELT](#) > >::Element &charp, const [size_t](#) N, [FFLAS_ELT](#) *A, const [size_t](#) lda, const [FFPACK_CHARPOLY_TAG](#) CharpTag, const [size_t](#) degree)
- template [INST_OR_DECL](#) std::vector< [FFLAS_ELT](#) > &MinPoly (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, std::vector< [FFLAS_ELT](#) > &minP, const [size_t](#) N, const [FFLAS_ELT](#) *A, const [size_t](#) lda, [FFLAS_FIELD](#)< [FFLAS_ELT](#) >::RandIter &G)

- template [INST_OR_DECL](#) [std::vector< FFLAS_ELT > & MinPoly](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), [std::vector< FFLAS_ELT > &minP](#), const [size_t N](#), const [FFLAS_ELT *A](#), const [size_t lda](#))
- template [INST_OR_DECL](#) [std::vector< FFLAS_ELT > & MatVecMinPoly](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), [std::vector< FFLAS_ELT > &minP](#), const [size_t N](#), const [FFLAS_ELT *A](#), const [size_t lda](#), const [FFLAS_ELT *V](#), const [size_t incv](#))
- template [INST_OR_DECL](#) [size_t KrylovElim](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [size_t *P](#), [size_t *Q](#), const [size_t deg](#), [size_t *iterates](#), [size_t *inviterates](#), const [size_t maxit](#), [size_t virt](#))
- template [INST_OR_DECL](#) [size_t SpecRankProfile](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), const [size_t deg](#), [size_t *rankProfile](#))
- template [INST_OR_DECL](#) [size_t Rank](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#))
- template [INST_OR_DECL](#) [bool IsSingular](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#))
- template [INST_OR_DECL](#) [FFLAS_ELT & Det](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), [FFLAS_ELT &det](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [size_t *P](#), [size_t *Q](#))
- template [INST_OR_DECL](#) [FFLAS_ELT & Det](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), [FFLAS_ELT &det](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), const [FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter::Threads > &parH](#), [size_t *P](#), [size_t *Q](#))
- template [INST_OR_DECL](#) [FFLAS_ELT * Solve](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), [FFLAS_ELT *A](#), const [size_t lda](#), [FFLAS_ELT *x](#), const [int incx](#), const [FFLAS_ELT *b](#), const [int incb](#))
- template [INST_OR_DECL](#) [void solveLB](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [FFLAS::FFLAS_SIDE Side](#), const [size_t M](#), const [size_t N](#), const [size_t R](#), [FFLAS_ELT *L](#), const [size_t ldl](#), const [size_t *Q](#), [FFLAS_ELT *B](#), const [size_t ldb](#))
- template [INST_OR_DECL](#) [void solveLB2](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [FFLAS::FFLAS_SIDE Side](#), const [size_t M](#), const [size_t N](#), const [size_t R](#), [FFLAS_ELT *L](#), const [size_t ldl](#), const [size_t *Q](#), [FFLAS_ELT *B](#), const [size_t ldb](#))
- template [INST_OR_DECL](#) [void RandomNullSpaceVector](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [FFLAS::FFLAS_SIDE Side](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [FFLAS_ELT *X](#), const [size_t incX](#))
- template [INST_OR_DECL](#) [size_t NullSpaceBasis](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [FFLAS::FFLAS_SIDE Side](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [FFLAS_ELT *&NS](#), [size_t &ldn](#), [size_t &NSdim](#))
- template [INST_OR_DECL](#) [size_t RowRankProfile](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [size_t *rkprofile](#), const [FFPACK_LU_TAG LuTag](#))
- template [INST_OR_DECL](#) [size_t ColumnRankProfile](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [size_t *rkprofile](#), const [FFPACK_LU_TAG LuTag](#))
- template [INST_OR_DECL](#) [size_t RowRankProfileSubmatrixIndices](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [size_t *&rowindices](#), [size_t *&colindices](#), [size_t &R](#))
- template [INST_OR_DECL](#) [size_t ColRankProfileSubmatrixIndices](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [size_t *&rowindices](#), [size_t *&colindices](#), [size_t &R](#))
- template [INST_OR_DECL](#) [size_t RowRankProfileSubmatrix](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [FFLAS_ELT *&X](#), [size_t &R](#))
- template [INST_OR_DECL](#) [size_t ColRankProfileSubmatrix](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [size_t M](#), const [size_t N](#), [FFLAS_ELT *A](#), const [size_t lda](#), [FFLAS_ELT *&X](#), [size_t &R](#))
- template [INST_OR_DECL](#) [void getTriangular< FFLAS_FIELD< FFLAS_ELT > >](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [FFLAS::FFLAS_UPLO Uplo](#), const [FFLAS::FFLAS_DIAG diag](#), const [size_t M](#), const [size_t N](#), const [size_t R](#), const [FFLAS_ELT *A](#), const [size_t lda](#), [FFLAS_ELT *T](#), const [size_t ldt](#), const [bool OnlyNonZeroVectors](#))
- template [INST_OR_DECL](#) [void getTriangular< FFLAS_FIELD< FFLAS_ELT > >](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [FFLAS::FFLAS_UPLO Uplo](#), const [FFLAS::FFLAS_DIAG diag](#), const [size_t M](#), const [size_t N](#), const [size_t R](#), [FFLAS_ELT *A](#), const [size_t lda](#))
- template [INST_OR_DECL](#) [void getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >](#) (const [FFLAS_FIELD< FFLAS_ELT > &F](#), const [FFLAS::FFLAS_UPLO Uplo](#), const [FFLAS::FFLAS_DIAG diag](#), const [size_t M](#), const [size_t N](#), const [size_t R](#), const [size_t *P](#), const [FFLAS_ELT *A](#), const [size_t lda](#), [FFLAS_ELT *T](#), const [size_t ldt](#), const [bool OnlyNonZeroVectors](#), const [FFPACK_LU_TAG LuTag](#))

- template `INST_OR_DECL` void `getEchelonForm`< `FFLAS_FIELD`< `FFLAS_ELT` > > (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const size_t M, const size_t N, const size_t R, const size_t *P, `FFLAS_ELT` *A, const size_t Ida, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getEchelonTransform`< `FFLAS_FIELD`< `FFLAS_ELT` > > (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const `FFLAS_ELT` *A, const size_t Ida, `FFLAS_ELT` *T, const size_t Idt, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonForm`< `FFLAS_FIELD`< `FFLAS_ELT` > > (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const `FFLAS_ELT` *A, const size_t Ida, `FFLAS_ELT` *T, const size_t Idt, const bool OnlyNonZeroVectors, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonForm`< `FFLAS_FIELD`< `FFLAS_ELT` > > (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, `FFLAS_ELT` *A, const size_t Ida, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonTransform`< `FFLAS_FIELD`< `FFLAS_ELT` > > (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS::FFLAS_UPLO` Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const `FFLAS_ELT` *A, const size_t Ida, `FFLAS_ELT` *T, const size_t Idt, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `FFLAS_ELT` * `LQUPtoInverseOfFullRankMinor` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t rank, `FFLAS_ELT` *A_factors, const size_t Ida, const size_t *QtPointer, `FFLAS_ELT` *X, const size_t Idx)
- template<class T, class CT = const T>
T `fflas_const_cast` (CT x)
- `Failure` & `failure` ()
- template<class T >
bool `isOdd` (const T &a)
- bool `isOdd` (const float &a)
- bool `isOdd` (const double &a)
- template<class Field, class RandIter >
`Field::Element_ptr` `NonZeroRandomMatrix` (const `Field` &F, size_t m, size_t n, typename `Field::Element_ptr` A, size_t Ida, RandIter &G)
Random non-zero Matrix.
- template<class Field, class RandIter >
`Field::Element_ptr` `NonZeroRandomMatrix` (const `Field` &F, size_t m, size_t n, typename `Field::Element_ptr` A, size_t Ida)
Random non-zero Matrix.
- template<class Field, class RandIter >
`Field::Element_ptr` `RandomMatrix` (const `Field` &F, size_t m, size_t n, typename `Field::Element_ptr` A, size_t Ida, RandIter &G)
Random Matrix.
- template<class Field >
`Field::Element_ptr` `RandomMatrix` (const `Field` &F, size_t m, size_t n, typename `Field::Element_ptr` A, size_t Ida)
Random Matrix.
- template<class Field, class RandIter >
`Field::Element_ptr` `RandomTriangularMatrix` (const `Field` &F, size_t m, size_t n, const `FFLAS::FFLAS_UPLO` UpLo, const `FFLAS::FFLAS_DIAG` Diag, bool nonsingular, typename `Field::Element_ptr` A, size_t Ida, RandIter &G)
Random Triangular Matrix.
- template<class Field >
`Field::Element_ptr` `RandomTriangularMatrix` (const `Field` &F, size_t m, size_t n, const `FFLAS::FFLAS_UPLO` UpLo, const `FFLAS::FFLAS_DIAG` Diag, bool nonsingular, typename `Field::Element_ptr` A, size_t Ida)
Random Triangular Matrix.
- size_t `RandInt` (size_t a, size_t b)

- `template<class Field , class Randlter >`
`Field::Element_ptr RandomSymmetricMatrix` (const `Field` &F, size_t n, bool nonsingular, typename `Field::Element_ptr` A, size_t lda, Randlter &G)
Random Symmetric Matrix.
- `template<class Field , class Randlter >`
`Field::Element_ptr RandomMatrixWithRank` (const `Field` &F, size_t m, size_t n, size_t r, typename `Field::Element_ptr` A, size_t lda, Randlter &G)
Random Matrix with prescribed rank.
- `template<class Field >`
`Field::Element_ptr RandomMatrixWithRank` (const `Field` &F, size_t m, size_t n, size_t r, typename `Field::Element_ptr` A, size_t lda)
Random Matrix with prescribed rank.
- `size_t * RandomIndexSubset` (size_t N, size_t R, size_t *P)
Pick uniformly at random a sequence of R distinct elements from the set $\{0, \dots, N - 1\}$ using Knuth's shuffle.
- `size_t * RandomPermutation` (size_t N, size_t *P)
Pick uniformly at random a permutation of size N stored in LAPACK format using Knuth's shuffle.
- `void RandomRankProfileMatrix` (size_t M, size_t N, size_t R, size_t *rows, size_t *cols)
Pick uniformly at random an R -subpermutation of dimension $M \times N$: a matrix with only R non-zeros equal to one, in a random rook placement.
- `void swapval` (size_t k, size_t N, size_t *P, size_t val)
- `void RandomSymmetricRankProfileMatrix` (size_t N, size_t R, size_t *rows, size_t *cols)
Pick uniformly at random a symmetric R -subpermutation of dimension $N \times N$: a symmetric matrix with only R non-zeros, all equal to one, in a random rook placement.
- `template<class Field , class Randlter >`
`Field::Element_ptr RandomMatrixWithRankandRPM` (const `Field` &F, size_t M, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, const size_t *RRP, const size_t *CRP, Randlter &G)
Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .
- `template<class Field >`
`Field::Element_ptr RandomMatrixWithRankandRPM` (const `Field` &F, size_t M, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, const size_t *RRP, const size_t *CRP)
Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .
- `template<class Field , class Randlter >`
`Field::Element_ptr RandomSymmetricMatrixWithRankandRPM` (const `Field` &F, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, const size_t *RRP, const size_t *CRP, Randlter &G)
Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .
- `template<class Field >`
`Field::Element_ptr RandomSymmetricMatrixWithRankandRPM` (const `Field` &F, size_t M, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, const size_t *RRP, const size_t *CRP)
Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .
- `template<class Field , class Randlter >`
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size_t M, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, Randlter &G)
Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.
- `template<class Field >`
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size_t M, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda)
Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.
- `template<class Field , class Randlter >`
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, Randlter &G)

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

- `template<class Field >`
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM (const Field &F, size_t N, size_t R,`
`typename Field::Element_ptr A, size_t lda)`
Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.
- `template<class Field >`
`Field::Element_ptr RandomMatrixWithDet (const Field &F, size_t n, const typename Field::Element d, type-`
`name Field::Element_ptr A, size_t lda)`
Random Matrix with prescribed det.
- `template<class Field , class RandIter >`
`Field::Element_ptr RandomMatrixWithDet (const Field &F, size_t n, const typename Field::Element d, type-`
`name Field::Element_ptr A, size_t lda, RandIter &G)`
Random Matrix with prescribed det.
- `template<typename Field >`
`Givaro::Integer maxFieldElt ()`
- `template<> Givaro::Integer maxFieldElt< Givaro::ZRing< Givaro::Integer > > ()`
- `template<typename Field >`
`Field * chooseField (Givaro::Integer q, uint64_t b, uint64_t seed)`
- `template<> Givaro::ZRing< int32_t > * chooseField< Givaro::ZRing< int32_t > > (Givaro::Integer q,`
`uint64_t b, uint64_t seed)`
- `template<> Givaro::ZRing< int64_t > * chooseField< Givaro::ZRing< int64_t > > (Givaro::Integer q,`
`uint64_t b, uint64_t seed)`
- `template<> Givaro::ZRing< float > * chooseField< Givaro::ZRing< float > > (Givaro::Integer q, uint64_t`
`b, uint64_t seed)`
- `template<> Givaro::ZRing< double > * chooseField< Givaro::ZRing< double > > (Givaro::Integer q,`
`uint64_t b, uint64_t seed)`

15.20.1 Detailed Description

Finite Field PACK Set of elimination based routines for dense linear algebra.

This namespace enlarges the set of BLAS routines of the class **FFLAS**, with higher level routines based on elimination.

15.20.2 Typedef Documentation

15.20.2.1 Checker_PLUQ

```
using Checker_PLUQ = FFLAS::Checker_Empty<Field>
```

15.20.2.2 Checker_Det

```
using Checker_Det = FFLAS::Checker_Empty<Field>
```

15.20.2.3 Checker_invert

```
using Checker_invert = FFLAS::Checker_Empty<Field>
```

15.20.2.4 Checker_charpoly

```
using Checker_charpoly = FFLAS::Checker_Empty<Field>
```

15.20.2.5 ForceCheck_PLUQ

```
using ForceCheck_PLUQ = CheckerImplem_PLUQ<Field>
```

15.20.2.6 ForceCheck_Det

```
using ForceCheck_Det = CheckerImplem_Det<Field>
```

15.20.2.7 ForceCheck_invert

```
using ForceCheck_invert = CheckerImplem_invert<Field>
```

15.20.2.8 ForceCheck_charpoly

```
using ForceCheck_charpoly = CheckerImplem_charpoly<Field, Polynomial>
```

15.20.3 Function Documentation**15.20.3.1 LAPACKPerm2MathPerm()**

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N ) [inline]
```

Conversion of a permutation from LAPACK format to Math format.

15.20.3.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N ) [inline]
```

Conversion of a permutation from Maths format to LAPACK format.

15.20.3.3 applyP() [1/4]

```
void FFPACK::applyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P )
```

Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.

Parameters

| | | |
|---------|------|----------------------------------|
| in, out | $P1$ | a LAPACK permutation of size N |
| | $P2$ | a LAPACK permutation of size N-R |

Applies a permutation P to the matrix A . Apply a permutation P , stored in the LAPACK format (a sequence of transpositions) between indices $ibeg$ and $iend$ of P to $(iend-ibeg)$ vectors of size M stored in A (as column for NoTrans and rows for Trans). $Side == \text{FFLAS::FflasLeft}$ for row permutation $Side == \text{FFLAS::FflasRight}$ for a column permutation $Trans == \text{FFLAS::FflasTrans}$ for the inverse permutation of P

Parameters

| | |
|---------|---|
| F | base field |
| $Side$ | decides if rows (FflasLeft) or columns (FflasRight) are permuted |
| $Trans$ | decides if the matrix is seen as columns (FflasTrans) or rows (FflasNoTrans) |
| M | size of the elements to permute |
| $ibeg$ | first index to consider in P |
| $iend$ | last index to consider in P |
| A | input matrix |
| lda | leading dimension of A |
| P | permutation in LAPACK format |
| psh | (optional): a sequential or parallel helper, to choose between sequential or parallel execution |

Warning

not sure the submatrix is still a permutation and the one we expect in all cases... examples for iend=2, ibeg=1 and P=[2,2,2]

15.20.3.4 applyP() [2/4]

```
void FFPACK::applyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t m,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const FFLAS::ParSeqHelper::Sequential seq )
```

15.20.3.5 applyP() [3/4]

```
void FFPACK::applyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t m,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > par )
```

15.20.3.6 MonotonicApplyP()

```
void FFPACK::MonotonicApplyP (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const size_t R )
```

Apply a R-monotonically increasing permutation P, to the matrix A.

MonotonicApplyP Apply a permutation defined by the first R entries of the vector P (the pivots).

The permutation represented by P is defined as follows:

- the first R values of P is a LAPACK representation (a sequence of transpositions)
- the remaining $iend-ibeg-R$ values of the permutation are in a monotonically increasing progression $Side==FflasLeft$ for row permutation $Side==FflasRight$ for a column permutation $Trans==FflasTrans$ for the inverse permutation of P

Parameters

| | |
|--------------|---|
| <i>F</i> | base field |
| <i>Side</i> | selects if it is a row (FflasLeft) or column (FflasRight) permutation |
| <i>Trans</i> | inverse permutation (FflasTrans/NoTrans) |
| <i>M</i> | |
| <i>ibeg</i> | |
| <i>iend</i> | |
| <i>A</i> | input matrix |
| <i>lda</i> | leading dimension of <i>A</i> |
| <i>P</i> | LAPACK permuation |
| <i>R</i> | first values of P |

The non pivot elements, are located in montonically increasing order.

15.20.3.7 fgetrs() [1/4]

```
void FFPACK::fgetrs (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    typename Field::Element_ptr B,
    const size_t ldb,
    int * info )
```

Solve the system $AX = B$ or $XA = B$.

Solving using the PLUQ decomposition of A already computed inplace with PLUQ ([FFLAS::FflasNonUnit](#)). Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

Parameters

| | |
|-------------|--|
| <i>F</i> | base field |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking. |
| <i>M</i> | row dimension of B |
| <i>N</i> | col dimension of B |
| <i>R</i> | rank of A |
| <i>A</i> | input matrix |
| <i>lda</i> | leading dimension of A |

Parameters

| | |
|-------------|---|
| <i>P</i> | row permutation of the PLUQ decomposition of A |
| <i>Q</i> | column permutation of the PLUQ decomposition of A |
| <i>B</i> | Right/Left hand side matrix. Initially stores B, finally stores the solution X. |
| <i>ldb</i> | leading dimension of B |
| <i>info</i> | Success of the computation: 0 if successfull, >0 if system is inconsistent |

15.20.3.8 fgetrs() [2/4]

```
Field::Element_ptr FFPACK::fgetrs (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    const size_t R,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    typename Field::Element_ptr X,
    const size_t ldx,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    int * info )
```

Solve the system $A X = B$ or $X A = B$.

Solving using the PLUQ decomposition of A already computed inplace with PLUQ(FFLAS::FflasNonUnit). Version for A rectangular. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

Parameters

| | |
|-------------|---|
| <i>F</i> | base field |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking. |
| <i>M</i> | row dimension of A |
| <i>N</i> | col dimension of A |
| <i>NRHS</i> | number of columns (if Side = FFLAS::FflasLeft) or row (if Side = FFLAS::FflasRight) of the matrices X and B |
| <i>R</i> | rank of A |
| <i>A</i> | input matrix |
| <i>lda</i> | leading dimension of A |
| <i>P</i> | row permutation of the PLUQ decomposition of A |
| <i>Q</i> | column permutation of the PLUQ decomposition of A |
| <i>X</i> | solution matrix |
| <i>ldx</i> | leading dimension of X |
| <i>B</i> | Right/Left hand side matrix. |
| <i>ldb</i> | leading dimension of B |
| <i>info</i> | Succes of the computation: 0 if successfull, >0 if system is inconsistent |

15.20.3.9 fgesv() [1/4]

```
size_t FFPACK::fgesv (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    int * info )
```

Square system solver.

Parameters

| | |
|-------------|---|
| <i>F</i> | The computation domain |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking |
| <i>M</i> | row dimension of B |
| <i>N</i> | col dimension of B |
| <i>A</i> | input matrix |
| <i>lda</i> | leading dimension of A |
| <i>B</i> | Right/Left hand side matrix. Initially contains B, finally contains the solution X. |
| <i>ldb</i> | leading dimension of B |
| <i>info</i> | Success of the computation: 0 if successfull, >0 if system is inconsistent |

Returns

the rank of the system

Solve the system $A X = B$ or $X A = B$. Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

15.20.3.10 fgesv() [2/4]

```
size_t FFPACK::fgesv (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldX,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    int * info )
```

Rectangular system solver.

Parameters

| | |
|-------------|---|
| <i>F</i> | The computation domain |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking |
| <i>M</i> | row dimension of A |
| <i>N</i> | col dimension of A |
| <i>NRHS</i> | number of columns (if Side = FFLAS::FflasLeft) or row (if Side = FFLAS::FflasRight) of the matrices X and B |
| <i>A</i> | input matrix |
| <i>lda</i> | leading dimension of A |
| <i>B</i> | Right/Left hand side matrix. Initially contains B, finally contains the solution X. |
| <i>ldb</i> | leading dimension of B |
| <i>X</i> | |
| <i>ldx</i> | |
| <i>info</i> | Success of the computation: 0 if successfull, >0 if system is inconsistent |

Returns

the rank of the system

Solve the system $A X = B$ or $X A = B$. Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

15.20.3.11 `fttrtri()` [1/2]

```
void FFPACK::fttrtri (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t threshold = __FFLASFFPACK_FTRTRI_THRESHOLD )
```

Compute the inverse of a triangular matrix.

Parameters

| | |
|-------------|--|
| <i>F</i> | base field |
| <i>Uplo</i> | whether the matrix is upper or lower triangular |
| <i>Diag</i> | whether the matrix is unit diagonal (FflasUnit/NoUnit) |
| <i>N</i> | input matrix order |
| <i>A</i> | the input matrix |
| <i>lda</i> | leading dimension of A |

15.20.3.12 `trinv_left()` [1/2]

```
void FFPACK::trinv_left (
```



```

const Field & F,
const size_t N,
typename Field::ConstElement_ptr L,
const size_t ldl,
typename Field::Element_ptr X,
const size_t ldx )

```

15.20.3.13 ftrtrm() [1/2]

```

void FFPACK::ftrtrm (
    const Field & F,
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_DIAG diag,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )

```

Compute the product of two triangular matrices of opposite shape.

Product UL or LU of the upper, resp lower triangular matrices U and L stored one above the other in the square matrix A.

Parameters

| | |
|-------------|--|
| <i>F</i> | base field |
| <i>Side</i> | set to FflasLeft to compute the product UL, FflasRight to compute LU |
| <i>diag</i> | whether the matrix U is unit diagonal (FflasUnit/NoUnit) |
| <i>N</i> | input matrix order |
| <i>A</i> | the input matrix |
| <i>lda</i> | leading dimension of A |

15.20.3.14 ftrstr()

```

void FFPACK::ftrstr (
    const Field & F,
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diagA,
    const FFLAS::FFLAS_DIAG diagB,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const size_t threshold = __FFLASFFPACK_FTRSTR_THRESHOLD )

```

Solve a triangular system with a triangular right hand side of the same shape.

Parameters

| | |
|--------------|---|
| <i>F</i> | base field |
| <i>Side</i> | set to FflasLeft to compute $U1^{-1} * U2$ or $L1^{-1} * L2$, FflasRight to compute $U1 * U2^{-1}$ or $L1 * L2^{-1}$ |
| <i>Uplo</i> | whether the matrix A is upper or lower triangular |
| <i>diag1</i> | whether the matrix U1 or L2 is unit diagonal (FflasUnit/NoUnit) |
| <i>diag2</i> | whether the matrix U2 or L2 is unit diagonal (FflasUnit/NoUnit) |
| <i>N</i> | order of the input matrices |
| <i>A</i> | the input matrix to be inverted (U1 or L1) |
| <i>lda</i> | leading dimension of A |
| <i>B</i> | the input right hand side (U2 or L2) |
| <i>ldb</i> | leading dimension of B |

15.20.3.15 ftrssyr2k()

```
void FFPACK::ftrssyr2k (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diagA,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const size_t threshold = __FFLASFFPACK_FTRSSYR2K_THRESHOLD )
```

Solve a triangular system in a symmetric sum: find B upper/lower triangular such that $A^T B + B^T A = C$ where C is symmetric.

C is overwritten by B.

Parameters

| | | |
|----------------|--------------|---|
| | <i>F</i> | base field |
| | <i>Side</i> | set to FflasLeft to compute $U1^{-1} * U2$ or $L1^{-1} * L2$, FflasRight to compute $U1 * U2^{-1}$ or $L1 * L2^{-1}$ |
| | <i>Uplo</i> | whether the matrix A is upper or lower triangular |
| | <i>diagA</i> | whether the matrix A is unit diagonal (FflasUnit/NoUnit) |
| | <i>N</i> | order of the input matrices |
| | <i>A</i> | the input matrix |
| | <i>lda</i> | leading dimension of A |
| <i>in, out</i> | <i>B</i> | the input right hand side where the output is written |
| | <i>ldb</i> | leading dimension of B |

15.20.3.16 fsytrf() [1/3]

```
bool FFPACK::fsytrf (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD )
```

Triangular factorization of symmetric matrices.

Parameters

| | | |
|----------------|-------------|--|
| | <i>F</i> | The computation domain |
| | <i>UpLo</i> | Determine wheter to store the upper (FflasUpper) or lower (FflasLower) triangular factor |
| | <i>N</i> | order of the matrix A |
| <i>in, out</i> | <i>A</i> | input matrix |
| | <i>lda</i> | leading dimension of A |

Returns

false if the A does not have generic rank profile, making the computation fail.

Compute the a triangular factorization of the matrix A: $A = L \times D \times L^T$ if UpLo = FflasLower or $A = U^T \times D \times U$ otherwise. D is a diagonal matrix. The matrices L and U are unit diagonal lower (resp. upper) triangular and overwrite the input matrix A. The matrix D is stored on the diagonal of A, as the diagonal of L or U is known to be all ones. If A does not have generic rank profile, the LDLT or UTDU factorizations is not defined, and the algorithm returns false.

15.20.3.17 fsytrf() [2/3]

```
bool FFPACK::fsytrf (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFLAS::ParSeqHelper::Sequential seq,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD )
```

15.20.3.18 fsytrf() [3/3]

```
bool FFPACK::fsytrf (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > par,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD )
```

15.20.3.19 fsytrf_nonunit() [1/3]

```
bool FFPACK::fsytrf_nonunit (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr D,
    const size_t incD,
    const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD )
```

Triangular factorization of symmetric matrices.

Parameters

| | | |
|---------|--------|--|
| | F | The computation domain |
| | $UpLo$ | Determine wheter to store the upper (FflasUpper) or lower (FflasLower) triangular factor |
| | N | order of the matrix A |
| in, out | A | input matrix |
| in, out | D | |
| | lda | leading dimension of A |

Returns

false if the A does not have generic rank profile, making the computation fail.

Compute the a triangular factorization of the matrix A: $A = L \times D_{inv} \times L^T$ if UpLo = FflasLower or $A = U^T \times D \times U$ otherwise. D is a diagonal matrix. The matrices L and U are lower (resp. upper) triangular and overwrite the input matrix A. The matrix D need to be stored separately, as the diagonal of L or U are not unit. If A does not have generic rank profile, the LDLT or UTDU factorizations is not defined, and the algorithm returns false.

15.20.3.20 PLUQ() [1/6]

```
size_t FFPACK::PLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q )
```

Compute a PLUQ factorization of the given matrix.

Return its rank. The permutations P and Q are represented using LAPACK's convention.

Parameters

| | |
|--------|--|
| F | base field |
| $Diag$ | whether U should have a unit diagonal (FflasUnit) or not (FflasNoUnit) |
| M | matrix row dimension |

Parameters

| | |
|-------|--------------------------|
| N | matrix column dimension |
| A | input matrix |
| lda | leading dimension of A |
| P | the row permutation |
| Q | the column permutation |

Returns

the rank of A

- Bibliography** • Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13, 2013

15.20.3.21 pPLUQ()

```
size_t FFPACK::pPLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q )
```

15.20.3.22 PLUQ() [2/6]

```
size_t FFPACK::PLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFLAS::ParSeqHelper::Sequential & PSHelper,
    size_t BCThreshold = __FFLASFFPACK_PLUQ_THRESHOLD )
```

15.20.3.23 PLUQ() [3/6]

```

size_t FFPACK::PLUQ (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > & PSHelper )

```

15.20.3.24 LUdivine() [1/4]

```

size_t FFPACK::LUdivine (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive,
    const size_t cutoff = __FFLASFFPACK_LUDIVINE_THRESHOLD )

```

Compute the CUP or PLE factorization of the given matrix.

Using a block algorithm and return its rank. The permutations P and Q are represented using LAPACK's convention.

Parameters

| | |
|---------------|---|
| <i>F</i> | base field |
| <i>Diag</i> | whether the transformation matrix (U of the CUP, L of the PLE) should have a unit diagonal (FflasUnit) or not (FflasNoUnit) |
| <i>trans</i> | whether to compute the CUP decomposition (FflasNoTrans) or the PLE decomposition (FflasTrans) |
| <i>M</i> | matrix row dimension |
| <i>N</i> | matrix column dimension |
| <i>A</i> | input matrix |
| <i>lda</i> | leading dimension of A |
| <i>P</i> | the factor of CUP or PLE |
| <i>Q</i> | a permutation indicating the pivot position in the echelon form C or E in its first r positions |
| <i>LuTag</i> | flag for setting the earling termination if the matrix is singular |
| <i>cutoff</i> | threshold to basecase |

Returns

the rank of A

Bibliography

- Jeannerod C-P, Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013
- Pernet C, Brassel M *LUdivine, une divine factorisation LU*, 2002

15.20.3.25 ColumnEchelonForm() [1/3]

```
size_t ColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive ) [inline]
```

Compute the Column Echelon form of the input matrix in-place.

If $LuTag == FfpackTileRecursive$, then after the computation $A = [M \setminus V]$ such that $AU = C$ is a column echelon decomposition of A , with $U = P^T [V]$ and $C = M + Q [I_r] [0 \text{ } I_{n-r}] [0]$ If $LuTag == FfpackTileRecursive$ then $A = [N \setminus V]$ such that the same holds with $M = Q N$

$Qt = Q^T$ If $transform=false$, the matrix V is not computed. See also test-colechelon for an example of use

Parameters

| | | |
|----|-------------|---|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix |
| | lda | leading dimension of A |
| | P | the column permutation |
| | Qt | the row position of the pivots in the echelon form |
| | $transform$ | decides whether V is computed |
| | $LuTag$ | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

15.20.3.26 pColumnEchelonForm()

```
size_t pColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
```

```

size_t * Qt,
bool transform = false,
size_t numthreads = 0,
const FFPACK_LU_TAG LuTag = FfpackTileRecursive ) [inline]

```

15.20.3.27 ColumnEchelonForm() [2/3]

```

size_t ColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag,
    const PSHelper & psH ) [inline]

```

15.20.3.28 RowEchelonForm() [1/3]

```

size_t RowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive ) [inline]

```

Compute the Row Echelon form of the input matrix in-place.

If $\text{LuTag} == \text{FfpackTileRecursive}$, then after the computation $A = [L \setminus M]$ such that $XA = R$ is a row echelon decomposition of A , with $X = [L \ 0] P$ and $R = M + [I \ 0] Q^T [In-r]$ If $\text{LuTag} == \text{FfpackTileRecursive}$ then $A = [L \setminus N]$ such that the same holds with $M = N Q^T Q^T = Q^T$ If $\text{transform} = \text{false}$, the matrix L is not computed. See also `test-rowechelon` for an example of use

Parameters

| | | |
|----|-------------|---|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | the input matrix |
| | lda | leading dimension of A |
| | P | the row permutation |
| | Qt | the column position of the pivots in the echelon form |
| | $transform$ | decides whether L is computed |
| | $LuTag$ | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

15.20.3.29 pRowEchelonForm()

```

size_t pRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive ) [inline]

```

15.20.3.30 RowEchelonForm() [2/3]

```

size_t RowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag,
    const PSHelper & psH ) [inline]

```

15.20.3.31 ReducedColumnEchelonForm() [1/3]

```

size_t ReducedColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive ) [inline]

```

Compute the Reduced Column Echelon form of the input matrix in-place.

After the computation $A = [V]$ such that $AX = R$ is a reduced col echelon $[M \ 0]$ decomposition of A , where $X = P^T [V]$ and $R = Q [I_r] [0 \ I_{n-r}] [M \ 0] Qt = Q^T$ If transform=false, the matrix X is not computed and the matrix $A = R$

Parameters

| | | |
|----|-------------|---|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix |
| | lda | leading dimension of A |
| | P | the column permutation |
| | Qt | the row position of the pivots in the echelon form |
| | $transform$ | decides whether X is computed |
| | $LuTag$ | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

15.20.3.32 pReducedColumnEchelonForm()

```

size_t pReducedColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive ) [inline]

```

15.20.3.33 ReducedColumnEchelonForm() [2/3]

```

size_t ReducedColumnEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag,
    const PSHelper & psH ) [inline]

```

15.20.3.34 ReducedRowEchelonForm() [1/3]

```

size_t ReducedRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive ) [inline]

```

Compute the Reduced Row Echelon form of the input matrix in-place.

After the computation $A = [V1 \ M]$ such that $X A = R$ is a reduced row echelon $[V2 \ 0]$ decomposition of A , where $X = [V1 \ 0] P$ and $R = [I_r \ M] Q^T [V2 \ In-r] [0] Qt = Q^T$ If transform=false, the matrix X is not computed and the matrix $A = R$

Parameters

| | | |
|----|-------------|---|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix |
| | lda | leading dimension of A |
| | P | the row permutation |
| | Qt | the column position of the pivots in the echelon form |
| | $transform$ | decides whether X is computed |
| | $LuTag$ | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

15.20.3.35 pReducedRowEchelonForm()

```

size_t pReducedRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform = false,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive ) [inline]

```

15.20.3.36 ReducedRowEchelonForm() [2/3]

```

size_t ReducedRowEchelonForm (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag,
    const PSHelper & psH ) [inline]

```

15.20.3.37 Invert() [1/4]

```

Field::Element_ptr FFPACK::Invert (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    int & nullity )

```

Invert the given matrix in place or computes its nullity if it is singular.

An inplace $2n^3$ algorithm is used.

Parameters

| | | |
|---------|-----------|-------------------------------|
| | F | The computation domain |
| | M | order of the matrix |
| in, out | A | input matrix ($M \times M$) |
| | lda | leading dimension of A |
| | $nullity$ | dimension of the kernel of A |

Returns

pointer to A and $A \leftarrow A^{-1}$

15.20.3.38 Invert() [2/4]

```

Field::Element_ptr FFPACK::Invert (
    const Field & F,
    const size_t M,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    int & nullity )

```

Invert the given matrix or computes its nullity if it is singular.

Precondition

X is preallocated and should be large enough to store the $m \times m$ matrix A .

Parameters

| | | |
|-----|-----------|---|
| | F | The computation domain |
| | M | order of the matrix |
| in | A | input matrix ($M \times M$) |
| | lda | leading dimension of A |
| out | X | this is the inverse of A if A is invertible (non <code>NULL</code> and <code>nullity = 0</code>). It is untouched otherwise. |
| | ldx | leading dimension of X |
| | $nullity$ | dimension of the kernel of A |

Returns

pointer to $X = A^{-1}$

15.20.3.39 Invert2() [1/2]

```
Field::Element_ptr FFPACK::Invert2 (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    int & nullity )
```

Invert the given matrix or computes its nullity if it is singular.

An $2n^3f$ algorithm is used. This routine can be % faster than `FFPACK::Invert` but is not totally inplace.

Precondition

X is preallocated and should be large enough to store the $m \times m$ matrix A .

Warning

A is overwritten here !

Bug not tested.

Parameters

| | | |
|----------------------|-------|---|
| | F | the computation domain |
| | M | order of the matrix |
| in, out | A | input matrix ($M \times M$). On output, A is modified and represents a "psychological" factorisation LU. |
| Generated by Doxygen | lda | leading dimension of A |
| out | X | this is the inverse of A if A is invertible (non <code>NULL</code> and <code>nullity = 0</code>). It is untouched otherwise. |
| | ldx | leading dimension of X |

Returns

pointer to $X = A^{-1}$

Todo this init is not all necessary (done after ftrtri)

15.20.3.40 CharPoly() [1/8]

```
std::list< typename PolRing::Element > & CharPoly (
    const PolRing & R,
    std::list< typename PolRing::Element > & charp,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    typename PolRing::Domain_t::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD ) [inline]
```

Compute the characteristic polynomial of the matrix A.

Parameters

| | | |
|-----|-----------------|---|
| | <i>R</i> | the polynomial ring of charp (contains the base field) |
| out | <i>charp</i> | the characteristic polynomial of as a list of factors |
| | <i>N</i> | order of the matrix A |
| in | <i>A</i> | the input matrix ($N \times N$) (could be overwritten in some algorithmic variants) |
| | <i>lda</i> | leading dimension of A |
| | <i>CharpTag</i> | the algorithmic variant |
| | <i>G</i> | a random iterator (required for the randomized variants LUKrylov and ArithProg) |

15.20.3.41 CharPoly() [2/8]

```
PolRing::Element & CharPoly (
    const PolRing & R,
    typename PolRing::Element & charp,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    typename PolRing::Domain_t::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD ) [inline]
```

Compute the characteristic polynomial of the matrix A.

Parameters

| | | |
|--|----------|--|
| | <i>R</i> | the polynomial ring of charp (contains the base field) |
|--|----------|--|

Parameters

| | | |
|-----|-----------------|---|
| out | <i>charp</i> | the characteristic polynomial of <i>as</i> a single polynomial |
| | <i>N</i> | order of the matrix <i>A</i> |
| in | <i>A</i> | the input matrix ($N \times N$) (could be overwritten in some algorithmic variants) |
| | <i>lda</i> | leading dimension of <i>A</i> |
| | <i>CharpTag</i> | the algorithmic variant |
| | <i>G</i> | a random iterator (required for the randomized variants LUKrylov and ArithProg) |

15.20.3.42 CharPoly() [3/8]

```
PolRing::Element& FFPACK::CharPoly (
    const PolRing & R,
    typename PolRing::Element & charp,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD ) [inline]
```

Compute the characteristic polynomial of the matrix *A*.

Parameters

| | | |
|-----|-----------------|---|
| | <i>R</i> | the polynomial ring of <i>charp</i> (contains the base field) |
| out | <i>charp</i> | the characteristic polynomial of <i>as</i> a single polynomial |
| | <i>N</i> | order of the matrix <i>A</i> |
| in | <i>A</i> | the input matrix ($N \times N$) (could be overwritten in some algorithmic variants) |
| | <i>lda</i> | leading dimension of <i>A</i> |
| | <i>CharpTag</i> | the algorithmic variant |

15.20.3.43 MinPoly() [1/4]

```
Polynomial& FFPACK::MinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda )
```

Compute the minimal polynomial of the matrix *A*.

The algorithm is randomized probabilistic, and computes the minimal polynomial of the Krylov iterates of a random vector: (*v*, *Av*, ..., *A*^{*k*}*v*)

Parameters

| | | |
|-----|--------|-----------------------------------|
| | F | the base field |
| out | $minP$ | the minimal polynomial of A |
| | N | order of the matrix A |
| in | A | the input matrix ($N \times N$) |
| | lda | leading dimension of A |

15.20.3.44 MinPoly() [2/4]

```
Polynomial& FFPACK::MinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    RandIter & G )
```

Compute the minimal polynomial of the matrix A .

The algorithm is randomized probabilistic, and computes the minimal polynomial of the Krylov iterates of a random vector: $(v, Av, \dots, A^k v)$

Parameters

| | | |
|-----|--------|-----------------------------------|
| | F | the base field |
| out | $minP$ | the minimal polynomial of A |
| | N | order of the matrix A |
| in | A | the input matrix ($N \times N$) |
| | lda | leading dimension of A |
| | G | a random iterator |

15.20.3.45 MatVecMinPoly() [1/2]

```
Polynomial& FFPACK::MatVecMinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr v,
    const size_t incv )
```

Compute the minimal polynomial of the matrix A and a vector v , namely the first linear dependency relation in the Krylov basis $(v, Av, \dots, A^N v)$.

Parameters

| | | |
|-----|--------|---|
| | F | the base field |
| out | $minP$ | the minimal polynomial of A and v |
| | N | order of the matrix A |
| in | A | the input matrix ($N \times N$) |
| | lda | leading dimension of A |
| | K | an $N \times (N + 1)$ matrix containing the vector v on its first row |
| | ldk | leading dimension of K |
| | P | [out] (optional) the permutation used in the elimination of the Krylov matrix K |

15.20.3.46 Rank() [1/3]

```
size_t FFPACK::Rank (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )
```

Computes the rank of the given matrix using a PLUQ factorization.

The input matrix is modified.

Parameters

| | | |
|----|-------|---|
| | F | base field |
| | M | row dimension of the matrix |
| | N | column dimension of the matrix |
| in | A | input matrix |
| | lda | leading dimension of A |
| | psH | (optional) a ParSeqHelper to choose between sequential and parallel execution |

15.20.3.47 pRank()

```
size_t FFPACK::pRank (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t numthreads = 0 )
```

15.20.3.48 Rank() [2/3]

```
size_t FFPACK::Rank (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const PSHelper & pSH )
```

15.20.3.49 IsSingular() [1/2]

```
bool FFPACK::IsSingular (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )
```

Returns true if the given matrix is singular.

The method is a block elimination with early termination

using LQUP factorization with early termination. If $M \neq N$, then the matrix is virtually padded with zeros to make it square and its determinant is zero.

Warning

The input matrix is modified.

Parameters

| | | |
|---------|-------|---------------------------------|
| | F | base field |
| | M | row dimension of the matrix |
| | N | column dimension of the matrix. |
| in, out | A | input matrix |
| | lda | leading dimension of A |

15.20.3.50 Det() [1/6]

```
Field::Element& FFPACK::Det (
    const Field & F,
    typename Field::Element & det,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
```

```
size_t * P = NULL,
size_t * Q = NULL )
```

Returns the determinant of the given square matrix.

The method is a block elimination using PLUQ factorization. The input matrix A is overwritten.

Warning

The input matrix is modified.

Parameters

| | | |
|---------|------------|---|
| | <i>F</i> | base field |
| out | <i>det</i> | the determinant of A |
| | <i>N</i> | the order of the square matrix A. |
| in, out | <i>A</i> | input matrix |
| | <i>lda</i> | leading dimension of A |
| | <i>psH</i> | (optional) a ParSeqHelper to choose between sequential and parallel execution |
| | <i>P,Q</i> | (optional) row and column permutations to be used by the PLUQ factorization. randomized checkers (see cherckes/checker_det.inl) need them for certification |

15.20.3.51 pDet()

```
Field::Element& FFPACK::pDet (
    const Field & F,
    typename Field::Element & det,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t numthreads = 0,
    size_t * P = NULL,
    size_t * Q = NULL )
```

15.20.3.52 Det() [2/6]

```
Field::Element& FFPACK::Det (
    const Field & F,
    typename Field::Element & det,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const PSHelper & psH,
    size_t * P = NULL,
    size_t * Q = NULL )
```

15.20.3.53 Solve() [1/3]

```
Field::Element_ptr FFPACK::Solve (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr x,
    const int incx,
    typename Field::ConstElement_ptr b,
    const int incb )
```

Solves a linear system $AX = b$ using PLUQ factorization.

@oaram F base field @oaram M matrix order

Parameters

| | | |
|-----|-------------|-------------------------------------|
| in | <i>A</i> | input matrix |
| | <i>lda</i> | leading dimension of A |
| out | <i>x</i> | output solution vector |
| | <i>incx</i> | increment of x |
| | <i>b</i> | input right hand side of the system |
| | <i>incb</i> | increment of b |

15.20.3.54 Solve() [2/3]

```
Field::Element_ptr FFPACK::Solve (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr x,
    const int incx,
    typename Field::ConstElement_ptr b,
    const int incb,
    PSHelper & psH )
```

15.20.3.55 pSolve()

```
Field::Element_ptr FFPACK::pSolve (
    const Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr x,
    const int incx,
    typename Field::ConstElement_ptr b,
    const int incb,
    size_t numthreads = 0 )
```

15.20.3.56 RandomNullSpaceVector() [1/3]

```
* void FFPACK::RandomNullSpaceVector (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t incX )
```

Solve $LX = B$ or $XL = B$ in place.

L is $M \times M$ if Side == FFLAS::FflasLeft and $N \times N$ if Side == FFLAS::FflasRight, B is $M \times N$. Only the R non trivial column of L are stored in the $M \times R$ matrix L Requirement : so that L could be expanded in-place Computes a vector of the Left/Right nullspace of the matrix A.

Parameters

| | | |
|---------|-------------|--|
| | <i>F</i> | The computation domain |
| | <i>Side</i> | decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace |
| | <i>M</i> | number of rows |
| | <i>N</i> | number of columns |
| in, out | <i>A</i> | input matrix of dimension $M \times N$, A is modified to its LU version |
| | <i>lda</i> | leading dimension of A |
| out | <i>X</i> | output vector |
| | <i>incX</i> | increment of X |

15.20.3.57 NullSpaceBasis() [1/2]

```
size_t FFPACK::NullSpaceBasis (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr & NS,
    size_t & ldn,
    size_t & NSdim )
```

Computes a basis of the Left/Right nullspace of the matrix A.

return the dimension of the nullspace.

Parameters

| | | |
|--|-------------|--|
| | <i>F</i> | The computation domain |
| | <i>Side</i> | decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace |
| | <i>M</i> | number of rows |

Parameters

| | | |
|---------|---------|--|
| | N | number of columns |
| in, out | A | input matrix of dimension $M \times N$, A is modified |
| | lda | leading dimension of A |
| out | NS | output matrix of dimension $N \times NSdim$ (allocated here) |
| out | ldn | leading dimension of NS |
| out | $NSdim$ | the dimension of the Nullspace ($N - rank(A)$) |

15.20.3.58 RowRankProfile() [1/3]

```
size_t FFPACK::RowRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *& rkprofile,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )
```

Computes the row rank profile of A .

Parameters

| | | |
|-----|-------------|---|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix of dimension $M \times N$ |
| | lda | leading dimension of A |
| out | $rkprofile$ | return the rank profile as an array of row indexes, of dimension $r = rank(A)$ |
| | $LuTag$ | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

A is modified $rkprofile$ is allocated during the computation.

Returns

R

15.20.3.59 pRowRankProfile()

```
size_t FFPACK::pRowRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
```

```

const size_t lda,
size_t *rkprofile,
size_t numthreads = 0,
const FFPACK_LU_TAG LuTag = FfpackTileRecursive )

```

15.20.3.60 RowRankProfile() [2/3]

```

size_t FFPACK::RowRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    const FFPACK_LU_TAG LuTag,
    PSHelper & psH )

```

15.20.3.61 ColumnRankProfile() [1/3]

```

size_t FFPACK::ColumnRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )

```

Computes the column rank profile of A.

Parameters

| | | |
|-----|-------------|---|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix of dimension |
| | lda | leading dimension of A |
| out | $rkprofile$ | return the rank profile as an array of row indexes, of dimension $r=\text{rank}(A)$ |
| | $LuTag$ | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

A is modified rkprofile is allocated during the computation.

Returns

R

15.20.3.62 pColumnRankProfile()

```

size_t FFPACK::pColumnRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    size_t numthreads = 0,
    const FFPACK_LU_TAG LuTag = FfpackTileRecursive )

```

15.20.3.63 ColumnRankProfile() [2/3]

```

size_t FFPACK::ColumnRankProfile (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *rkprofile,
    const FFPACK_LU_TAG LuTag,
    PSHelper & psH )

```

15.20.3.64 RankProfileFromLU()

```

void RankProfileFromLU (
    const size_t * P,
    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const FFPACK_LU_TAG LuTag ) [inline]

```

Recovers the column/row rank profile from the permutation of an LU decomposition.

Works with both the CUP/PLE decompositions (obtained by LUdivine) or the PLUQ decomposition. Assumes that the output vector containing the rank profile is already allocated.

Parameters

| | | |
|-----|------------------|---|
| | <i>P</i> | the permutation carrying the rank profile information |
| | <i>N</i> | the row/col dimension for a row/column rank profile |
| | <i>R</i> | the rank of the matrix |
| out | <i>rkprofile</i> | return the rank profile as an array of indices |
| | <i>LuTag</i> | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

15.20.3.65 LeadingSubmatrixRankProfiles()

```
size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP ) [inline]
```

Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.

Only works with the PLUQ decomposition Assumes that the output vectors containing the rank profiles are already allocated.

Parameters

| | |
|------------|--|
| <i>P</i> | the permutation carrying the rank profile information |
| <i>M</i> | the row dimension of the initial matrix |
| <i>N</i> | the column dimension of the initial matrix |
| <i>R</i> | the rank of the initial matrix |
| <i>LSm</i> | the row dimension of the leading submatrix considered |
| <i>LSn</i> | the column dimension of the leading submatrix considered |
| <i>P</i> | the row permutation of the PLUQ decomposition |
| <i>Q</i> | the column permutation of the PLUQ decomposition |
| <i>RRP</i> | return the row rank profile of the leading submatrix |

Returns

the rank of the LSm x LSn leading submatrix

A is modified

Bibliography • Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13.

15.20.3.66 RowRankProfileSubmatrixIndices() [1/2]

```
size_t FFPACK::RowRankProfileSubmatrixIndices (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *& rowindices,
    size_t *& colindices,
    size_t & R )
```

RowRankProfileSubmatrixIndices.

Computes the indices of the submatrix $r \times r$ X of A whose rows correspond to the row rank profile of A.

Parameters

| | | |
|-----|-------------------|------------------------------------|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix of dimension |
| | <i>rowindices</i> | array of the row indices of X in A |
| | <i>colindices</i> | array of the col indices of X in A |
| | <i>lda</i> | leading dimension of A |
| out | R | list of indices |

rowindices and colindices are allocated during the computation. A is modified

Returns

R

15.20.3.67 ColRankProfileSubmatrixIndices() [1/2]

```
size_t FFPACK::ColRankProfileSubmatrixIndices (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t *& rowindices,
    size_t *& colindices,
    size_t & R )
```

Computes the indices of the submatrix $r \times r$ X of A whose columns correspond to the column rank profile of A.

Parameters

| | | |
|-----|-------------------|------------------------------------|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix of dimension |
| | <i>rowindices</i> | array of the row indices of X in A |
| | <i>colindices</i> | array of the col indices of X in A |
| | <i>lda</i> | leading dimension of A |
| out | R | list of indices |

rowindices and colindices are allocated during the computation.

Warning

A is modified

Returns

R

15.20.3.68 RowRankProfileSubmatrix() [1/2]

```
size_t FFPACK::RowRankProfileSubmatrix (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr & X,
    size_t & R )
```

Computes the $r \times r$ submatrix X of A , by picking the row rank profile rows of A .

Parameters

| | | |
|-----|-------|--|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix of dimension $M \times N$ |
| | lda | leading dimension of A |
| out | X | the output matrix |
| out | R | list of indices |

A is not modified X is allocated during the computation.

Returns

R

15.20.3.69 ColRankProfileSubmatrix() [1/2]

```
size_t FFPACK::ColRankProfileSubmatrix (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr & X,
    size_t & R )
```

Compute the $r \times r$ submatrix X of A , by picking the row rank profile rows of A .

Parameters

| | | |
|-----|-------|--|
| | F | base field |
| | M | number of rows |
| | N | number of columns |
| in | A | input matrix of dimension $M \times N$ |
| | lda | leading dimension of A |
| out | X | the output matrix |
| out | R | list of indices |

A is not modified X is allocated during the computation.

Returns

R

15.20.3.70 getTriangular() [1/2]

```
void FFPACK::getTriangular (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const bool OnlyNonZeroVectors = false )
```

Extracts a triangular matrix from a compact storage $A=L\backslash U$ of rank R .

if `OnlyNonZeroVectors` is false, then T and A have the same dimensions Otherwise, T is $R \times N$ if `UpLo` = `FflasUpper`, else T is $M \times R$

Parameters

| | | |
|-----|---------------------------------|---|
| | F | base field |
| | $UpLo$ | selects if the upper (<code>FflasUpper</code>) or lower (<code>FflasLower</code>) triangular matrix is returned |
| | $diag$ | selects if the triangular matrix unit-diagonal (<code>FflasUnit/NoUnit</code>) |
| | M | row dimension of T |
| | N | column dimension of T |
| | R | rank of the triangular matrix (how many rows/columns need to be copied) |
| in | A | input matrix |
| | lda | leading dimension of A |
| out | T | output matrix |
| | ldt | leading dimension of T |
| | <code>OnlyNonZeroVectors</code> | decides whether the last zero rows/columns should be ignored |

Todo just one triangular fzero+fassign ?

15.20.3.71 getTriangular() [2/2]

```
void FFPACK::getTriangular (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::Element_ptr A,
    const size_t lda )
```

Cleans up a compact storage $A=LU$ to reveal a triangular matrix of rank R .

Parameters

| | | |
|---------|-------------|---|
| | <i>F</i> | base field |
| | <i>UpLo</i> | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is revealed |
| | <i>diag</i> | selects if the triangular matrix unit-diagonal (FflasUnit/NoUnit) |
| | <i>M</i> | row dimension of A |
| | <i>N</i> | column dimension of A |
| | <i>R</i> | rank of the triangular matrix |
| in, out | <i>A</i> | input/output matrix |
| | <i>lda</i> | leading dimension of A |

Todo just one triangular fzero+fassign ?

15.20.3.72 getEchelonForm() [1/2]

```
void FFPACK::getEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const bool OnlyNonZeroVectors = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )
```

Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.

Either L or U is in Echelon form (depending on Uplo) The echelon structure is defined by the first R values of the array P . row and column dimension of T are greater or equal to that of A

Parameters

| | | |
|-----|---------------------------|---|
| | F | base field |
| | $UpLo$ | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned |
| | $diag$ | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit) |
| | M | row dimension of T |
| | N | column dimension of T |
| | R | rank of the triangular matrix (how many rows/columns need to be copied) |
| | P | positions of the R pivots |
| in | A | input matrix |
| | lda | leading dimension of A |
| out | T | output matrix |
| | ldt | leading dimension of T |
| | <i>OnlyNonZeroVectors</i> | decides whether the last zero rows/columns should be ignored |
| | $LuTag$ | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive) |

15.20.3.73 getEchelonForm() [2/2]

```
void FFPACK::getEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )
```

Cleans up a compact storage $A=L\backslash U$ obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R .

Either L or U is in Echelon form (depending on Uplo) The echelon structure is defined by the first R values of the array P .

Parameters

| | | |
|--|--------|---|
| | F | base field |
| | $UpLo$ | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned |
| | $diag$ | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit) |
| | M | row dimension of A |
| | N | column dimension of A |

Parameters

| | | |
|---------|---------|---|
| | R | rank of the triangular matrix (how many rows/columns need to be copied) |
| | P | positions of the R pivots |
| in, out | A | input/output matrix |
| | lda | leading dimension of A |
| | $LuTag$ | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive) |

15.20.3.74 getEchelonTransform()

```

void FFPACK::getEchelonTransform (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )

```

Extracts a transformation matrix to echelon form from a compact storage $A=LU$ of rank R obtained by Row↔EchelonForm or ColumnEchelonForm.

If Uplo == FflasLower: T is $N \times N$ (already allocated) such that $A T = C$ is a transformation of A in Column echelon form Else T is $M \times M$ (already allocated) such that $T A = E$ is a transformation of A in Row Echelon form

Parameters

| | | |
|-----|---------|---|
| | F | base field |
| | $UpLo$ | Lower (FflasLower) means Transformation to Column Echelon Form, Upper (FflasUpper), to Row Echelon Form |
| | $diag$ | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit) |
| | M | row dimension of A |
| | N | column dimension of A |
| | R | rank of the triangular matrix |
| | P | permutation matrix |
| in | A | input matrix |
| | lda | leading dimension of A |
| out | T | output matrix |
| | ldt | leading dimension of T |
| | $LuTag$ | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive) |

15.20.3.75 `getReducedEchelonForm()` [1/2]

```

void FFPACK::getReducedEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const bool OnlyNonZeroVectors = false,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )

```

Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

Either L or U is in Echelon form (depending on `Uplo`) The echelon structure is defined by the first R values of the array `P`. row and column dimension of `T` are greater or equal to that of `A`

Parameters

| | | |
|----|---------------------------|---|
| | <i>F</i> | base field |
| | <i>UpLo</i> | selects if the upper (<code>FflasUpper</code>) or lower (<code>FflasLower</code>) triangular matrix is returned |
| | <i>diag</i> | selects if the echelon matrix has unit pivots (<code>FflasUnit/NoUnit</code>) |
| | <i>M</i> | row dimension of <code>T</code> |
| | <i>N</i> | column dimension of <code>T</code> |
| | <i>R</i> | rank of the triangular matrix (how many rows/columns need to be copied) |
| | <i>P</i> | positions of the R pivots |
| in | <i>A</i> | input matrix |
| | <i>lda</i> | leading dimension of <code>A</code> |
| | <i>ldt</i> | leading dimension of <code>T</code> |
| | <i>LuTag</i> | which factorized form (CUP/PLE if <code>FfpackSlabRecursive</code> , PLUQ if <code>FfpackTileRecursive</code>) |
| | <i>OnlyNonZeroVectors</i> | decides whether the last zero rows/columns should be ignored |

15.20.3.76 `getReducedEchelonForm()` [2/2]

```

void FFPACK::getReducedEchelonForm (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    typename Field::Element_ptr A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )

```


Cleans up a compact storage $A=L\backslash U$ of rank R obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

Either L or U is in Echelon form (depending on `Uplo`) The echelon structure is defined by the first R values of the array P .

Parameters

| | | |
|-----------|---------|--|
| | F | base field |
| | $UpLo$ | selects if the upper (<code>FflasUpper</code>) or lower (<code>FflasLower</code>) triangular matrix is returned |
| | $diag$ | selects if the echelon matrix has unit pivots (<code>FflasUnit/NoUnit</code>) |
| | M | row dimension of A |
| | N | column dimension of A |
| | R | rank of the triangular matrix (how many rows/columns need to be copied) |
| | P | positions of the R pivots |
| in, out | A | input/output matrix |
| | lda | leading dimension of A |
| | $LuTag$ | which factorized form (<code>CUP/PLE</code> if <code>FfpackSlabRecursive</code> , <code>PLUQ</code> if <code>FfpackTileRecursive</code>) |

15.20.3.77 getReducedEchelonTransform()

```
void FFPACK::getReducedEchelonTransform (
    const Field & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr T,
    const size_t ldt,
    const FFPACK_LU_TAG LuTag = FfpackSlabRecursive )
```

Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by `RowEchelonForm` or `ColumnEchelonForm`.

If `Uplo == FflasLower`: T is $N \times N$ (already allocated) such that $A T = C$ is a transformation of A in Column echelon form Else T is $M \times M$ (already allocated) such that $T A = E$ is a transformation of A in Row Echelon form

Parameters

| | | |
|--|--------|---|
| | F | base field |
| | $UpLo$ | selects Col (<code>FflasLower</code>) or Row (<code>FflasUpper</code>) Echelon Form |
| | $diag$ | selects if the echelon matrix has unit pivots (<code>FflasUnit/NoUnit</code>) |
| | M | row dimension of A |
| | N | column dimension of A |
| | R | rank of the triangular matrix |
| | P | permutation matrix |

Parameters

| | | |
|-----|--------------|---|
| in | <i>A</i> | input matrix |
| | <i>lda</i> | leading dimension of A |
| out | <i>T</i> | output matrix |
| | <i>ldt</i> | leading dimension of T |
| | <i>LuTag</i> | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive) |

15.20.3.78 PLUQtoEchelonPermutation()

```
void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
    const size_t * P,
    size_t * outPerm ) [inline]
```

Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.

15.20.3.79 LQUPtoInverseOfFullRankMinor() [1/2]

```
Field::Element_ptr FFPACK::LQUPtoInverseOfFullRankMinor (
    const Field & F,
    const size_t rank,
    typename Field::Element_ptr A_factors,
    const size_t lda,
    const size_t * QtPointer,
    typename Field::Element_ptr X,
    const size_t ldx )
```

LQUPtoInverseOfFullRankMinor.

Suppose A has been factorized as L.Q.U.P, with rank r. Then Qt.A.Pt has an invertible leading principal r x r submatrix This procedure efficiently computes the inverse of this minor and puts it into X.

Note

It changes the lower entries of A_factors in the process (NB: unless A was nonsingular and square)

Parameters

| | |
|------------------|--|
| <i>F</i> | base field |
| <i>rank</i> | rank of the matrix. |
| <i>A_factors</i> | matrix containing the L and U entries of the factorization |
| <i>lda</i> | leading dimension of A |
| <i>QtPointer</i> | theLQUP->getQ()->getPointer() (note: getQ returns Qt!) |
| <i>X</i> | desired location for output |
| <i>ldx</i> | leading dimension of X |

15.20.3.80 RandomNullSpaceVector() [2/3]

```
void FFPACK::RandomNullSpaceVector (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t incX )
```

Solve $LX = B$ or $XL = B$ in place.

L is $M \times M$ if `Side == FFLAS::FflasLeft` and $N \times N$ if `Side == FFLAS::FflasRight`, B is $M \times N$. Only the R non trivial column of L are stored in the $M \times R$ matrix L Requirement : so that L could be expanded in-place Computes a vector of the Left/Right nullspace of the matrix A.

Parameters

| | | |
|---------|-------------|--|
| | <i>F</i> | The computation domain |
| | <i>Side</i> | decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace |
| | <i>M</i> | number of rows |
| | <i>N</i> | number of columns |
| in, out | <i>A</i> | input matrix of dimension $M \times N$, A is modified to its LU version |
| | <i>lda</i> | leading dimension of A |
| out | <i>X</i> | output vector |
| | <i>incX</i> | increment of X |

15.20.3.81 solveLB() [1/2]

```
void FFPACK::solveLB (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::Element_ptr L,
    const size_t ldl,
    const size_t * Q,
    typename Field::Element_ptr B,
    const size_t ldb )
```

15.20.3.82 solveLB2() [1/2]

```
void FFPACK::solveLB2 (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    typename Field::Element_ptr L,
    const size_t ldl,
    const size_t * Q,
    typename Field::Element_ptr B,
    const size_t ldb )
```

15.20.3.83 Danilevski()

```
std::list<Polynomial>& FFPACK::Danilevski (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )
```

15.20.3.84 buildMatrix()

```
Field::Element_ptr FFPACK::buildMatrix (
    const Field & F,
    typename Field::ConstElement_ptr E,
    typename Field::ConstElement_ptr C,
    const size_t lda,
    const size_t * B,
    const size_t * T,
    const size_t me,
    const size_t mc,
    const size_t lambda,
    const size_t mu )
```

Bug is this :

15.20.3.85 CharPoly() [4/8]

```
FFPACK::RNSInteger<FFPACK::rns_double>::Element_ptr FFPACK::CharPoly (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr charp,
    const size_t N,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A,
    const size_t lda,
    Givaro::ZRing< Givaro::Integer >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    size_t degree ) [inline]
```

15.20.3.86 CharPoly() [5/8]

```
Givaro::Poly1Dom<Givaro::ZRing<Givaro::Integer> >::Element& FFPACK::CharPoly (
    const Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > & R,
    Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & charp,
    const size_t N,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::ZRing< Givaro::Integer >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    size_t degree ) [inline]
```

15.20.3.87 Det() [3/6]

```
FFPACK::RNSInteger<FFPACK::rns_double>::Element_ptr& FFPACK::Det (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & det,
    const size_t N,
    typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A,
    const size_t lda,
    const PSHelper & psH ) [inline]
```

15.20.3.88 Det() [4/6]

```
Givaro::Integer& FFPACK::Det (
    const Givaro::ZRing< Givaro::Integer > & F,
    Givaro::Integer & det,
    const size_t N,
    Givaro::Integer * A,
    const size_t lda,
    const PSHelper & psH,
    size_t * P,
    size_t * Q ) [inline]
```

15.20.3.89 fsytrf_BC_Crout()

```
bool FFPACK::fsytrf_BC_Crout (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv ) [inline]
```

15.20.3.90 fsytrf_BC_RL()

```

size_t FFPACK::fsytrf_BC_RL (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv ) [inline]

```

15.20.3.91 fsytrf_UP_RPM_BC_RL()

```

size_t FFPACK::fsytrf_UP_RPM_BC_RL (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P ) [inline]

```

15.20.3.92 fsytrf_LOW_RPM_BC_Crout()

```

size_t FFPACK::fsytrf_LOW_RPM_BC_Crout (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P ) [inline]

```

15.20.3.93 fsytrf_UP_RPM_BC_Crout()

```

size_t FFPACK::fsytrf_UP_RPM_BC_Crout (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P ) [inline]

```

15.20.3.94 fsytrf_UP_RPM()

```
size_t FFPACK::fsytrf_UP_RPM (
    const Field & Fi,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    size_t * P,
    size_t BCThreshold ) [inline]
```

$$\text{MathP} < - \left[\begin{array}{c|c} I & P1 \end{array} \right] \left[\begin{array}{c|c} L & (N1+R2) \end{array} \right] \left[\begin{array}{c|c} P2^T & \end{array} \right] \left[\begin{array}{c|c} & P3^T \end{array} \right] \left[\begin{array}{c|c} \text{-----} & \text{---} \end{array} \right] \left[\begin{array}{c|c} & Q2^T \end{array} \right]$$

Changing $\begin{bmatrix} U1 & V1 & | & E1 & E21 & E22 \end{bmatrix}$ into $\begin{bmatrix} U1 & E11 & E12 & V1 & E* & E* \end{bmatrix} \begin{bmatrix} 0 & | & L2 \setminus U2 & V21 & V22 \end{bmatrix} \begin{bmatrix} U4 & V41 & 0 & V42 & V43 \end{bmatrix} \begin{bmatrix} 0 & | & M2 & 0 & 0 \end{bmatrix} \begin{bmatrix} U3 & 0 & 0 & V3 \end{bmatrix} \begin{bmatrix} \text{---} & | & \text{-----} \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & | & H1 & H21 & H22 \end{bmatrix} \begin{bmatrix} 0 & | & U3 & V3 \end{bmatrix} \begin{bmatrix} 0 & | & 0 \end{bmatrix}$ where $U4$ is the $2R2 \times 2R2$ matrix formed by interleaving $U2$, $L2^T$ and $H1$

15.20.3.95 fsytrf_nonunit() [2/3]

```
bool FFPACK::fsytrf_nonunit (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    FFLAS::ParSeqHelper::Sequential seq,
    size_t threshold ) [inline]
```

15.20.3.96 fsytrf_nonunit() [3/3]

```
bool FFPACK::fsytrf_nonunit (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr Dinv,
    const size_t incDinv,
    FFLAS::ParSeqHelper::Parallel< Cut, Param > par,
    size_t threshold ) [inline]
```

15.20.3.97 fsytrf_RPM()

```
size_t FFPACK::fsytrf_RPM (
    const Field & F,
    const FFLAS::FFLAS_UPLO UpLo,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t threshold ) [inline]
```

15.20.3.98 getTridiagonal()

```
void FFPACK::getTridiagonal (
    const Field & F,
    const size_t N,
    const size_t R,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    size_t * P,
    typename Field::Element_ptr T,
    const size_t ldt ) [inline]
```

15.20.3.99 LUdivine_gauss() [1/2]

```
size_t FFPACK::LUdivine_gauss (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```

15.20.3.100 LUdivine_small() [1/2]

```
size_t FFPACK::LUdivine_small (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```


15.20.3.101 LUdivine() [2/4]

```

size_t FFPACK::LUdivine (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag,
    const size_t cutoff ) [inline]

```

Todo std::swap ?

15.20.3.102 LUdivine() [3/4]

```

size_t FFPACK::LUdivine (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Givaro::Integer * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag,
    const size_t cutoff ) [inline]

```

15.20.3.103 MonotonicCompress()

```

void FFPACK::MonotonicCompress (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t R,
    const size_t maxpiv,
    const size_t rowstomove,
    const std::vector< bool > & ispiv ) [inline]

```

15.20.3.104 MonotonicCompressMorePivots()

```

void FFPACK::MonotonicCompressMorePivots (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t R,
    const size_t rowstomove,
    const size_t lenP ) [inline]

```

15.20.3.105 MonotonicCompressCycles()

```

void FFPACK::MonotonicCompressCycles (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t lenP ) [inline]

```

15.20.3.106 MonotonicExpand()

```

void FFPACK::MonotonicExpand (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t incA,
    const size_t * MathP,
    const size_t R,
    const size_t maxpiv,
    const size_t rowstomove,
    const std::vector< bool > & ispiv )

```

15.20.3.107 applyP_block()

```
void FFPACK::applyP_block (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t * P ) [inline]
```

15.20.3.108 doApplyS()

```
void FFPACK::doApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 ) [inline]
```

15.20.3.109 MatrixApplyS() [1/3]

```
void FFPACK::MatrixApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 ) [inline]
```

15.20.3.110 MatrixApplyS() [2/3]

```

void FFPACK::MatrixApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    const FFLAS::ParSeqHelper::Sequential seq ) [inline]

```

15.20.3.111 MatrixApplyS() [3/3]

```

void FFPACK::MatrixApplyS (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > par ) [inline]

```

15.20.3.112 PermApplyS()

```

void FFPACK::PermApplyS (
    T * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 ) [inline]

```

15.20.3.113 doApplyT()

```
void FFPACK::doApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 ) [inline]
```

15.20.3.114 MatrixApplyT() [1/3]

```
void FFPACK::MatrixApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 ) [inline]
```

15.20.3.115 MatrixApplyT() [2/3]

```
void FFPACK::MatrixApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    const FFLAS::ParSeqHelper::Sequential seq ) [inline]
```

15.20.3.116 MatrixApplyT() [3/3]

```

void FFPACK::MatrixApplyT (
    const Field & F,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    const FFLAS::ParSeqHelper::Parallel< Cut, Param > par ) [inline]

```

15.20.3.117 PermApplyT()

```

void FFPACK::PermApplyT (
    T * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 ) [inline]

```

15.20.3.118 composePermutationsLLL()

```

void composePermutationsLLL (
    size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N ) [inline]

```

Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.

Parameters

| | | |
|---------|------|----------------------------------|
| in, out | $P1$ | a LAPACK permutation of size N |
| | $P2$ | a LAPACK permutation of size N-R |

15.20.3.119 composePermutationsLLM()

```

void composePermutationsLLM (
    size_t * MathP,

```

```

const size_t * P1,
const size_t * P2,
const size_t R,
const size_t N ) [inline]

```

Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in MathP as a MathPermutation format.

Parameters

| | | |
|-----|--|--|
| out | | |
|-----|--|--|

15.20.3.120 composePermutationsMLM()

```

void composePermutationsMLM (
    size_t * MathP1,
    const size_t * P2,
    const size_t R,
    const size_t N ) [inline]

```

Computes $\text{MathP1} \times \text{Diag}(I_R, P2)$ where MathP1 is a MathPermutation and $P2$ a LAPACK permutation and store the result in MathP1 as a MathPermutation format.

Parameters

| | | |
|---------|---------------|--|
| in, out | <i>MathP1</i> | a MathPermutation of size N |
| | <i>P2</i> | a LAPACK permutation of size $N-R$ |

15.20.3.121 cyclic_shift_mathPerm()

```

void cyclic_shift_mathPerm (
    size_t * P,
    const size_t s ) [inline]

```

15.20.3.122 cyclic_shift_row_col() [1/2]

```

void FFPACK::cyclic_shift_row_col (
    const Field & F,
    typename Field::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda ) [inline]

```

15.20.3.123 cyclic_shift_row() [1/3]

```
void FFPACK::cyclic_shift_row (
    const Field & F,
    typename Field::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda ) [inline]
```

15.20.3.124 cyclic_shift_row() [2/3]

```
void FFPACK::cyclic_shift_row (
    const RNSIntegerMod< T > & F,
    typename T::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda ) [inline]
```

15.20.3.125 cyclic_shift_col() [1/3]

```
void FFPACK::cyclic_shift_col (
    const Field & F,
    typename Field::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda ) [inline]
```

15.20.3.126 cyclic_shift_col() [2/3]

```
void FFPACK::cyclic_shift_col (
    const RNSIntegerMod< T > & F,
    typename T::Element_ptr A,
    size_t m,
    size_t n,
    size_t lda ) [inline]
```

15.20.3.127 PLUQ_basecaseV3()

```
size_t FFPACK::PLUQ_basecaseV3 (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element * A,
    const size_t lda,
    size_t * P,
    size_t * Q ) [inline]
```


15.20.3.128 PLUQ_basecaseV2()

```
size_t FFPACK::PLUQ_basecaseV2 (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element * A,
    const size_t lda,
    size_t * P,
    size_t * Q ) [inline]
```

15.20.3.129 PLUQ_basecaseCrout()

```
size_t FFPACK::PLUQ_basecaseCrout (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q ) [inline]
```

15.20.3.130 _PLUQ()

```
size_t FFPACK::_PLUQ (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    size_t BCThreshold ) [inline]
```

15.20.3.131 PLUQ() [4/6]

```
size_t FFPACK::PLUQ (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Givaro::Integer * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    size_t BCThreshold,
    FFLAS::ParSeqHelper::Parallel< Cut, Param > & PSHelper ) [inline]
```

15.20.3.132 threads_fgemm()

```
void FFPACK::threads_fgemm (
    const size_t m,
    const size_t n,
    const size_t r,
    int nbthreads,
    size_t * W1,
    size_t * W2,
    size_t * W3,
    size_t gamma )
```

15.20.3.133 threads_ftrsm()

```
void FFPACK::threads_ftrsm (
    const size_t m,
    const size_t n,
    int nbthreads,
    size_t * t1,
    size_t * t2 )
```

15.20.3.134 PLUQ() [5/6]

```
size_t FFPACK::PLUQ (
    const Field & Fi,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter
> & PSHelper ) [inline]
```

15.20.3.135 fflas_const_cast() [1/3]

```
rns_double_elt_ptr FFPACK::fflas_const_cast (
    rns_double_elt_cstp_ptr x ) [inline]
```

15.20.3.136 fflas_const_cast() [2/3]

```
rns_double_elt_cstp_ptr FFPACK::fflas_const_cast (
    rns_double_elt_ptr x ) [inline]
```

15.20.3.137 cyclic_shift_row_col() [2/2]

```
void FFPACK::cyclic_shift_row_col (
    Base_t * A,
    size_t m,
    size_t n,
    size_t lda )
```

15.20.3.138 cyclic_shift_row() [3/3]

```
template INST_OR_DECL void FFPACK::cyclic_shift_row (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT * A,
    size_t m,
    size_t n,
    size_t lda )
```

15.20.3.139 cyclic_shift_col() [3/3]

```
template INST_OR_DECL void FFPACK::cyclic_shift_col (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT * A,
    size_t m,
    size_t n,
    size_t lda )
```

15.20.3.140 applyP() [4/4]

```
template INST_OR_DECL void FFPACK::applyP (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t * P )
```

15.20.3.141 fgetrs() [3/4]

```
template INST_OR_DECL void FFPACK::fgetrs (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    FFLAS_ELT * B,
    const size_t ldb,
    int * info )
```

15.20.3.142 fgetrs() [4/4]

```
template INST_OR_DECL FFLAS_ELT* FFPACK::fgetrs (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    const size_t R,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    FFLAS_ELT * X,
    const size_t ldX,
    const FFLAS_ELT * B,
    const size_t ldb,
    int * info )
```

15.20.3.143 fgesv() [3/4]

```
template INST_OR_DECL size_t FFPACK::fgesv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb,
    int * info )
```

15.20.3.144 fgesv() [4/4]

```
template INST_OR_DECL size_t FFPACK::fgesv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t ldx,
    const FFLAS_ELT * B,
    const size_t ldb,
    int * info )
```

15.20.3.145 ftrtri() [2/2]

```
template INST_OR_DECL void FFPACK::ftrtri (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t threshold )
```

15.20.3.146 trinv_left() [2/2]

```
template INST_OR_DECL void FFPACK::trinv_left (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * L,
    const size_t ldl,
    FFLAS_ELT * X,
    const size_t ldx )
```

15.20.3.147 ftrtrm() [2/2]

```
template INST_OR_DECL void FFPACK::ftrtrm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_DIAG diag,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda )
```

15.20.3.148 PLUQ() [6/6]

```
template INST_OR_DECL size_t FFPACK::PLUQ (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q )
```

15.20.3.149 LUdivine() [4/4]

```
template INST_OR_DECL size_t FFPACK::LUdivine (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const FFPACK_LU_TAG LuTag,
    const size_t cutoff )
```

15.20.3.150 LUdivine_small() [2/2]

```
template INST_OR_DECL size_t FFPACK::LUdivine_small (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.151 LUdivine_gauss() [2/2]

```
template INST_OR_DECL size_t FFPACK::LUdivine_gauss (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.152 RowEchelonForm() [3/3]

```
template INST_OR_DECL size_t FFPACK::RowEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.153 ReducedRowEchelonForm() [3/3]

```
template INST_OR_DECL size_t FFPACK::ReducedRowEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.154 ColumnEchelonForm() [3/3]

```
template INST_OR_DECL size_t FFPACK::ColumnEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.155 ReducedColumnEchelonForm() [3/3]

```
template INST_OR_DECL size_t FFPACK::ReducedColumnEchelonForm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.156 Invert() [3/4]

```
template INST_OR_DECL FFLAS_ELT* FFPACK::Invert (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    FFLAS_ELT * A,
    const size_t lda,
    int & nullity )
```

15.20.3.157 Invert() [4/4]

```
template INST_OR_DECL FFLAS_ELT* FFPACK::Invert (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t ldx,
    int & nullity )
```

15.20.3.158 Invert2() [2/2]

```
template INST_OR_DECL FFLAS_ELT* FFPACK::Invert2 (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t ldx,
    int & nullity )
```


15.20.3.159 CharPoly() [6/8]

```
template INST_OR_DECL std::list<Givaro::Poly1Dom<FFLAS_FIELD<FFLAS_ELT> >::Element>& FFPACK←
::CharPoly (
    const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
    std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > & charp,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_FIELD< FFLAS_ELT >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    const size_t degree )
```

15.20.3.160 CharPoly() [7/8]

```
template INST_OR_DECL Givaro::Poly1Dom<FFLAS_FIELD<FFLAS_ELT> >::Element& FFPACK::CharPoly (
    const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
    Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & charp,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_FIELD< FFLAS_ELT >::RandIter & G,
    const FFPACK_CHARPOLY_TAG CharpTag,
    const size_t degree )
```

15.20.3.161 CharPoly() [8/8]

```
template INST_OR_DECL Givaro::Poly1Dom<FFLAS_FIELD<FFLAS_ELT> >::Element& FFPACK::CharPoly (
    const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
    Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & charp,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const FFPACK_CHARPOLY_TAG CharpTag,
    const size_t degree )
```

15.20.3.162 MinPoly() [3/4]

```
template INST_OR_DECL std::vector<FFLAS_ELT>& FFPACK::MinPoly (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    std::vector< FFLAS_ELT > & minP,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_FIELD< FFLAS_ELT >::RandIter & G )
```

15.20.3.163 MinPoly() [4/4]

```
template INST_OR_DECL std::vector<FFLAS_ELT>& FFPACK::MinPoly (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    std::vector< FFLAS_ELT > & minP,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda )
```

15.20.3.164 MatVecMinPoly() [2/2]

```
template INST_OR_DECL std::vector<FFLAS_ELT>& FFPACK::MatVecMinPoly (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    std::vector< FFLAS_ELT > & minP,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * V,
    const size_t incv )
```

15.20.3.165 KrylovElim()

```
template INST_OR_DECL size_t FFPACK::KrylovElim (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const size_t deg,
    size_t * iterates,
    size_t * inviterates,
    const size_t maxit,
    size_t virt )
```

15.20.3.166 SpecRankProfile()

```
template INST_OR_DECL size_t FFPACK::SpecRankProfile (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const size_t deg,
    size_t * rankProfile )
```

15.20.3.167 Rank() [3/3]

```
template INST_OR_DECL size_t FFPACK::Rank (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda )
```

15.20.3.168 IsSingular() [2/2]

```
template INST_OR_DECL bool FFPACK::IsSingular (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda )
```

15.20.3.169 Det() [5/6]

```
template INST_OR_DECL FFLAS_ELT& FFPACK::Det (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT & det,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t * P,
    size_t * Q )
```

15.20.3.170 Det() [6/6]

```
template INST_OR_DECL FFLAS_ELT& FFPACK::Det (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    FFLAS_ELT & det,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter
> & parH,
    size_t * P,
    size_t * Q )
```

15.20.3.171 Solve() [3/3]

```
template INST_OR_DECL FFLAS_ELT* FFPACK::Solve (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * x,
    const int incx,
    const FFLAS_ELT * b,
    const int incb )
```

15.20.3.172 solveLB() [2/2]

```
template INST_OR_DECL void FFPACK::solveLB (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * L,
    const size_t ldl,
    const size_t * Q,
    FFLAS_ELT * B,
    const size_t ldb )
```

15.20.3.173 solveLB2() [2/2]

```
template INST_OR_DECL void FFPACK::solveLB2 (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * L,
    const size_t ldl,
    const size_t * Q,
    FFLAS_ELT * B,
    const size_t ldb )
```

15.20.3.174 RandomNullSpaceVector() [3/3]

```
template INST_OR_DECL void FFPACK::RandomNullSpaceVector (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    const size_t incX )
```

15.20.3.175 NullSpaceBasis() [2/2]

```
template INST_OR_DECL size_t FFPACK::NullSpaceBasis (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT *& NS,
    size_t & ldn,
    size_t & NSdim )
```

15.20.3.176 RowRankProfile() [3/3]

```
template INST_OR_DECL size_t FFPACK::RowRankProfile (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rkprofile,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.177 ColumnRankProfile() [3/3]

```
template INST_OR_DECL size_t FFPACK::ColumnRankProfile (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rkprofile,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.178 RowRankProfileSubmatrixIndices() [2/2]

```
template INST_OR_DECL size_t FFPACK::RowRankProfileSubmatrixIndices (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rowindices,
    size_t *& colindices,
    size_t & R )
```

15.20.3.179 ColRankProfileSubmatrixIndices() [2/2]

```
template INST_OR_DECL size_t FFPACK::ColRankProfileSubmatrixIndices (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    size_t *& rowindices,
    size_t *& colindices,
    size_t & R )
```

15.20.3.180 RowRankProfileSubmatrix() [2/2]

```
template INST_OR_DECL size_t FFPACK::RowRankProfileSubmatrix (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT *& X,
    size_t & R )
```

15.20.3.181 ColRankProfileSubmatrix() [2/2]

```
template INST_OR_DECL size_t FFPACK::ColRankProfileSubmatrix (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT *& X,
    size_t & R )
```

15.20.3.182 getTriangular< FFLAS_FIELD< FFLAS_ELT > >() [1/2]

```
template INST_OR_DECL void FFPACK::getTriangular< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors )
```

15.20.3.183 `getTriangular< FFLAS_FIELD< FFLAS_ELT > >()` [2/2]

```
template INST_OR_DECL void FFPACK::getTriangular< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    FFLAS_ELT * A,
    const size_t lda )
```

15.20.3.184 `getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >()` [1/2]

```
template INST_OR_DECL void FFPACK::getEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.185 `getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >()` [2/2]

```
template INST_OR_DECL void FFPACK::getEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    FFLAS_ELT * A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.186 getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >()

```
template INST_OR_DECL void FFPACK::getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const FFLAS::FFLAS_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.187 getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [1/2]

```
template INST_OR_DECL void FFPACK::getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.188 getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [2/2]

```
template INST_OR_DECL void FFPACK::getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    FFLAS_ELT * A,
    const size_t lda,
    const FFPACK_LU_TAG LuTag )
```


15.20.3.189 getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >()

```
template INST_OR_DECL void FFPACK::getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > > (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * T,
    const size_t ldt,
    const FFPACK_LU_TAG LuTag )
```

15.20.3.190 LQUPToInverseOfFullRankMinor() [2/2]

```
template INST_OR_DECL FFLAS_ELT* FFPACK::LQUPToInverseOfFullRankMinor (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t rank,
    FFLAS_ELT * A_factors,
    const size_t lda,
    const size_t * QtPointer,
    FFLAS_ELT * X,
    const size_t ldx )
```

15.20.3.191 fflas_const_cast() [3/3]

```
T FFPACK::fflas_const_cast (
    CT x )
```

15.20.3.192 failure()

```
Failure& FFPACK::failure ( ) [inline]
```

15.20.3.193 isOdd() [1/3]

```
bool FFPACK::isOdd (
    const T & a ) [inline]
```

15.20.3.194 isOdd() [2/3]

```
bool FFPACK::isOdd (
    const float & a ) [inline]
```

15.20.3.195 isOdd() [3/3]

```
bool FFPACK::isOdd (
    const double & a ) [inline]
```

15.20.3.196 NonZeroRandomMatrix() [1/2]

```
Field::Element_ptr FFPACK::NonZeroRandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]
```

Random non-zero Matrix.

Creates a $m \times n$ matrix with random entries, and at least one of them is non zero.

Parameters

| | | |
|-----|-------|---|
| | F | field |
| | m | number of rows in A |
| | n | number of cols in A |
| out | A | the matrix (preallocated to at least $m \times lda$ field elements) |
| | lda | leading dimension of A |
| | G | a random iterator |

Returns

A.

15.20.3.197 NonZeroRandomMatrix() [2/2]

```
Field::Element_ptr FFPACK::NonZeroRandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
```

```

typename Field::Element_ptr A,
size_t lda ) [inline]

```

Random non-zero Matrix.

Creates a $m \times n$ matrix with random entries, and at least one of them is non zero.

Parameters

| | | |
|-----|------------|---|
| | <i>F</i> | field |
| | <i>m</i> | number of rows in A |
| | <i>n</i> | number of cols in A |
| out | <i>A</i> | the matrix (preallocated to at least $m \times lda$ field elements) |
| | <i>lda</i> | leading dimension of A |

Returns

A.

15.20.3.198 RandomMatrix() [1/2]

```

Field::Element_ptr FFPACK::RandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]

```

Random Matrix.

Creates a $m \times n$ matrix with random entries.

Parameters

| | | |
|-----|------------|---|
| | <i>F</i> | field |
| | <i>m</i> | number of rows in A |
| | <i>n</i> | number of cols in A |
| out | <i>A</i> | the matrix (preallocated to at least $m \times lda$ field elements) |
| | <i>lda</i> | leading dimension of A |
| | <i>G</i> | a random iterator |

Returns

A.

15.20.3.199 RandomMatrix() [2/2]

```
Field::Element_ptr FFPACK::RandomMatrix (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr A,
    size_t lda ) [inline]
```

Random Matrix.

Creates a $m \times n$ matrix with random entries.

Parameters

| | | |
|-----|-------|---|
| | F | field |
| | m | number of rows in A |
| | n | number of cols in A |
| out | A | the matrix (preallocated to at least $m \times lda$ field elements) |
| | lda | leading dimension of A |

Returns

A .

15.20.3.200 RandomTriangularMatrix() [1/2]

```
Field::Element_ptr FFPACK::RandomTriangularMatrix (
    const Field & F,
    size_t m,
    size_t n,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_DIAG Diag,
    bool nonsingular,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]
```

Random Triangular Matrix.

Creates a $m \times n$ triangular matrix with random entries. The `UpLo` parameter defines whether it is upper or lower triangular.

Parameters

| | | |
|-----|--------|---|
| | F | field |
| | m | number of rows in A |
| | n | number of cols in A |
| | $UpLo$ | whether A is upper or lower triangular |
| out | A | the matrix (preallocated to at least $m \times lda$ field elements) |
| | lda | leading dimension of A |
| | G | a random iterator |

Returns

A .

15.20.3.201 RandomTriangularMatrix() [2/2]

```
Field::Element_ptr FFPACK::RandomTriangularMatrix (
    const Field & F,
    size_t m,
    size_t n,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_DIAG Diag,
    bool nonsingular,
    typename Field::Element_ptr A,
    size_t lda ) [inline]
```

Random Triangular Matrix.

Creates a $m \times n$ triangular matrix with random entries. The `UpLo` parameter defines whether it is upper or lower triangular.

Parameters

| | | |
|-----|--------|---|
| | F | field |
| | m | number of rows in A |
| | n | number of cols in A |
| | $UpLo$ | whether A is upper or lower triangular |
| out | A | the matrix (preallocated to at least $m \times lda$ field elements) |
| | lda | leading dimension of A |

Returns

A .

15.20.3.202 RandInt()

```
size_t FFPACK::RandInt (
    size_t a,
    size_t b ) [inline]
```

15.20.3.203 RandomSymmetricMatrix()

```
Field::Element_ptr FFPACK::RandomSymmetricMatrix (
    const Field & F,
    size_t n,
    bool nonsingular,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]
```

Random Symmetric Matrix.

Creates a $m \times n$ triangular matrix with random entries. The `UpLo` parameter defines whether it is upper or lower triangular.

Parameters

| | | |
|-----|-------|---|
| | F | field |
| | n | order of A |
| out | A | the matrix (preallocated to at least $n \times lda$ field elements) |
| | lda | leading dimension of A |
| | G | a random iterator |

Returns

A .

15.20.3.204 RandomMatrixWithRank() [1/2]

```
Field::Element_ptr FFPACK::RandomMatrixWithRank (
    const Field & F,
    size_t m,
    size_t n,
    size_t r,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]
```

Random Matrix with prescribed rank.

Creates an $m \times n$ matrix with random entries and rank r .

Parameters

| | |
|-------|---|
| F | field |
| m | number of rows in A |
| n | number of cols in A |
| r | rank of the matrix to build |
| A | the matrix (preallocated to at least $m \times lda$ field elements) |
| lda | leading dimension of A |
| G | a random iterator |

Returns

A .

15.20.3.205 RandomMatrixWithRank() [2/2]

```
Field::Element_ptr FFPACK::RandomMatrixWithRank (
    const Field & F,
    size_t m,
    size_t n,
    size_t r,
    typename Field::Element_ptr A,
    size_t lda ) [inline]
```

Random Matrix with prescribed rank.

Creates an $m \times n$ matrix with random entries and rank r .

Parameters

| | | |
|-----|-------|---|
| | F | field |
| | m | number of rows in A |
| | n | number of cols in A |
| | r | rank of the matrix to build |
| out | A | the matrix (preallocated to at least $m \times lda$ field elements) |
| | lda | leading dimension of A |

Returns

A .

15.20.3.206 RandomIndexSubset()

```
size_t* FFPACK::RandomIndexSubset (
    size_t N,
    size_t R,
    size_t * P ) [inline]
```

Pick uniformly at random a sequence of R distinct elements from the set $\{0, \dots, N - 1\}$ using Knuth's shuffle.

Parameters

| | | |
|-----|-----|---|
| | N | the cardinality of the sampling set |
| | R | the number of elements to sample |
| out | P | the output sequence (pre-allocated to at least R indices) |

15.20.3.207 RandomPermutation()

```
size_t* FFPACK::RandomPermutation (
    size_t N,
    size_t * P ) [inline]
```

Pick uniformly at random a permutation of size N stored in LAPACK format using Knuth's shuffle.

Parameters

| | | |
|-----|-----|--|
| | N | the length of the permutation |
| out | P | the output permutation (pre-allocated to at least N indices) |

15.20.3.208 RandomRankProfileMatrix()

```
void FFPACK::RandomRankProfileMatrix (
    size_t M,
    size_t N,
    size_t R,
    size_t * rows,
    size_t * cols ) [inline]
```

Pick uniformly at random an R -subpermutation of dimension $M \times N$: a matrix with only R non-zeros equal to one, in a random rook placement.

Parameters

| | | |
|-----|--------|--|
| | M | row dimension |
| | N | column dimension |
| out | $rows$ | the row position of each non zero element (pre-allocated) |
| out | $cols$ | the column position of each non zero element (pre-allocated) |

15.20.3.209 swapval()

```
void FFPACK::swapval (
    size_t k,
    size_t N,
    size_t * P,
    size_t val ) [inline]
```


15.20.3.210 RandomSymmetricRankProfileMatrix()

```
void FFPACK::RandomSymmetricRankProfileMatrix (
    size_t N,
    size_t R,
    size_t * rows,
    size_t * cols ) [inline]
```

Pick uniformly at random a symmetric R-subpermutation of dimension $N \times N$: a symmetric matrix with only R non-zeros, all equal to one, in a random rook placement.

Parameters

| | | |
|-----|-------------|--|
| | <i>N</i> | matrix order |
| out | <i>rows</i> | the row position of each non zero element (pre-allocated) |
| out | <i>cols</i> | the column position of each non zero element (pre-allocated) |

15.20.3.211 RandomMatrixWithRankandRPM() [1/2]

```
Field::Element_ptr FFPACK::RandomMatrixWithRankandRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP,
    RandIter & G ) [inline]
```

Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .

Parameters

| | |
|------------|--|
| <i>F</i> | field |
| <i>m</i> | number of rows in A |
| <i>n</i> | number of cols in A |
| <i>r</i> | rank of the matrix to build |
| <i>A</i> | the matrix (preallocated to at least $m \times lda$ field elements) |
| <i>lda</i> | leading dimension of A |
| <i>RRP</i> | the R dimensional array with row positions of the rank profile matrix' pivots |
| <i>CRP</i> | the R dimensional array with column positions of the rank profile matrix' pivots |
| <i>G</i> | a random iterator |

Returns

A.

15.20.3.212 RandomMatrixWithRankandRPM() [2/2]

```
Field::Element_ptr FFPACK::RandomMatrixWithRankandRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP ) [inline]
```

Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .

Parameters

| | |
|-------|--|
| F | field |
| m | number of rows in A |
| n | number of cols in A |
| r | rank of the matrix to build |
| A | the matrix (preallocated to at least $m \times lda$ field elements) |
| lda | leading dimension of A |
| RRP | the R dimensional array with row positions of the rank profile matrix' pivots |
| CRP | the R dimensional array with column positions of the rank profile matrix' pivots |

Returns

A.

15.20.3.213 RandomSymmetricMatrixWithRankandRPM() [1/2]

```
Field::Element_ptr FFPACK::RandomSymmetricMatrixWithRankandRPM (
    const Field & F,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP,
    RandIter & G ) [inline]
```

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .

Parameters

| | |
|-----|---|
| F | field |
| n | order of A |
| r | rank of A |
| A | the matrix (preallocated to at least $n \times lda$ field elements) |

Parameters

| | |
|------------|--|
| <i>lda</i> | leading dimension of A |
| <i>RRP</i> | the R dimensional array with row positions of the rank profile matrix' pivots |
| <i>CRP</i> | the R dimensional array with column positions of the rank profile matrix' pivots |
| <i>G</i> | a random iterator |

Returns

A .

15.20.3.214 RandomSymmetricMatrixWithRankandRPM() [2/2]

```
Field::Element_ptr FFPACK::RandomSymmetricMatrixWithRankandRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    const size_t * RRP,
    const size_t * CRP ) [inline]
```

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .

Parameters

| | |
|------------|--|
| <i>F</i> | field |
| <i>n</i> | order of A |
| <i>r</i> | rank of A |
| <i>A</i> | the matrix (preallocated to at least $n \times lda$ field elements) |
| <i>lda</i> | leading dimension of A |
| <i>RRP</i> | the R dimensional array with row positions of the rank profile matrix' pivots |
| <i>CRP</i> | the R dimensional array with column positions of the rank profile matrix' pivots |

Returns

A .

15.20.3.215 RandomMatrixWithRankandRandomRPM() [1/2]

```
Field::Element_ptr FFPACK::RandomMatrixWithRankandRandomRPM (
    const Field & F,
    size_t M,
```

```

    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]

```

Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

Parameters

| | |
|-------|---|
| F | field |
| m | number of rows in A |
| n | number of cols in A |
| r | rank of the matrix to build |
| A | the matrix (preallocated to at least $m \times lda$ field elements) |
| lda | leading dimension of A |
| G | a random iterator |

Returns

A .

15.20.3.216 RandomMatrixWithRankandRandomRPM() [2/2]

```

Field::Element_ptr FFPACK::RandomMatrixWithRankandRandomRPM (
    const Field & F,
    size_t M,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda ) [inline]

```

Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

Parameters

| | |
|-------|---|
| F | field |
| m | number of rows in A |
| n | number of cols in A |
| r | rank of the matrix to build |
| A | the matrix (preallocated to at least $m \times lda$ field elements) |
| lda | leading dimension of A |

Returns

A .

15.20.3.217 RandomSymmetricMatrixWithRankandRandomRPM() [1/2]

```
Field::Element_ptr FFPACK::RandomSymmetricMatrixWithRankandRandomRPM (
    const Field & F,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]
```

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

Parameters

| | |
|-------|---|
| F | field |
| n | order of A |
| r | rank of A |
| A | the matrix (preallocated to at least $n \times lda$ field elements) |
| lda | leading dimension of A |
| G | a random iterator |

Returns

A .

15.20.3.218 RandomSymmetricMatrixWithRankandRandomRPM() [2/2]

```
Field::Element_ptr FFPACK::RandomSymmetricMatrixWithRankandRandomRPM (
    const Field & F,
    size_t N,
    size_t R,
    typename Field::Element_ptr A,
    size_t lda ) [inline]
```

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

Parameters

| | |
|-------|---|
| F | field |
| n | order of A |
| r | rank of A |
| A | the matrix (preallocated to at least $n \times lda$ field elements) |
| lda | leading dimension of A |

Returns

A .

15.20.3.219 RandomMatrixWithDet() [1/2]

```
Field::Element_ptr FFPACK::RandomMatrixWithDet (
    const Field & F,
    size_t n,
    const typename Field::Element d,
    typename Field::Element_ptr A,
    size_t lda ) [inline]
```

Random Matrix with prescribed det.

Creates a $m \times n$ matrix with random entries and rank r .

Parameters

| | |
|-------|---|
| F | field |
| d | the prescribed value for the determinant of A |
| n | number of cols in A |
| A | the matrix to be generated (preallocated to at least $n \times lda$ field elements) |
| lda | leading dimension of A |

Returns

A.

15.20.3.220 RandomMatrixWithDet() [2/2]

```
Field::Element_ptr FFPACK::RandomMatrixWithDet (
    const Field & F,
    size_t n,
    const typename Field::Element d,
    typename Field::Element_ptr A,
    size_t lda,
    RandIter & G ) [inline]
```

Random Matrix with prescribed det.

Creates a $m \times n$ matrix with random entries and rank r .

Parameters

| | |
|-------|---|
| F | field |
| d | the prescribed value for the determinant of A |
| n | number of cols in A |
| A | the matrix to be generated (preallocated to at least $n \times lda$ field elements) |
| lda | leading dimension of A |

Returns

A.

15.20.3.221 maxFieldElt()

```
Givaro::Integer FFPACK::maxFieldElt ( )
```

15.20.3.222 maxFieldElt< Givaro::ZRing< Givaro::Integer > >()

```
Givaro::Integer FFPACK::maxFieldElt< Givaro::ZRing< Givaro::Integer > > ( )
```

15.20.3.223 chooseField()

```
Field* FFPACK::chooseField (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed )
```

15.20.3.224 chooseField< Givaro::ZRing< int32_t > >()

```
Givaro::ZRing<int32_t>* FFPACK::chooseField< Givaro::ZRing< int32_t > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed )
```

15.20.3.225 chooseField< Givaro::ZRing< int64_t > >()

```
Givaro::ZRing<int64_t>* FFPACK::chooseField< Givaro::ZRing< int64_t > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed )
```

15.20.3.226 chooseField< Givaro::ZRing< float > >()

```
Givaro::ZRing<float>* FFPACK::chooseField< Givaro::ZRing< float > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed )
```

15.20.3.227 chooseField< Givaro::ZRing< double > >()

```
Givaro::ZRing<double>* FFPACK::chooseField< Givaro::ZRing< double > > (
    Givaro::Integer q,
    uint64_t b,
    uint64_t seed )
```

15.21 FFPACK::Protected Namespace Reference

Functions

- template<class Field >
size_t LUdivine_construct (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::Element_ptr u, const size_t incu, size_t *P, bool computeX, const FFPACK_MINPOLY_TAG MinTag=FFpackDense, const size_t kg_mc=0, const size_t kg_mb=0, const size_t kg_j=0)
- template<class Field >
size_t GaussJordan (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t colbeg, const size_t rowbeg, const size_t colsize, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)
Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.
- template<class Field , class Polynomial >
std::list< Polynomial > & KellerGehrig (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::ConstElement_ptr A, const size_t lda)
- template<class Field , class Polynomial >
int KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *kg_mc, size_t *kg_mb, size_t *kg_j)
- template<class Field , class Polynomial >
std::list< Polynomial > & KGFast_generalized (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda)
- template<class Field >
void fgemv_kgf (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, const size_t kg_mc, const size_t kg_mb, const size_t kg_j)
- template<class Field , class Polynomial , class RandIter >
std::list< Polynomial > & LUKrylov (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr U, const size_t ldu, RandIter &G)
- template<class Field , class Polynomial >
std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda)
- template<class PolRing >
void RandomKrylovPrecond (const PolRing &PR, std::list< typename PolRing::Element > &completedFactors, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, size_t &Nb, typename PolRing::Domain_t::Element_ptr &B, size_t &ldb, typename PolRing::Domain_t::RandIter &g, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)

- `template<class PolRing >`
`std::list< typename PolRing::Element > & ArithProg (const PolRing &PR, std::list< typename PolRing::Element > &frobeniusForm, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, const size_t degree)`
- `template<class Field , class Polynomial >`
`std::list< Polynomial > & LUKrylov_KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field , class Polynomial >`
`Polynomial & MatVecMinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr v, const size_t incv, typename Field::Element_ptr K, const size_t ldk, size_t *P)`
- `template<class Field , class Polynomial >`
`Polynomial & Hybrid_KGF_LUK_MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, size_t *P, const FFPACK_MINPOLY_TAG MinTag=FFPACK::FfpackDense, const size_t kg_mc=0, const size_t kg_mb=0, const size_t kg_j=0)`
- `template<class Field >`
`size_t updatedD (const Field &F, size_t *d, size_t k, std::vector< std::vector< typename Field::Element > > &minpt)`
- `template<class Field >`
`size_t newD (const Field &F, size_t *d, bool &KeepOn, const size_t l, const size_t N, typename Field::Element_ptr X, const size_t *Q, std::vector< std::vector< typename Field::Element > > &minpt)`
- `template<class Field >`
`void CompressRows (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`
`void CompressRowsQK (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)`
- `template<class Field >`
`void DeCompressRows (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`
`void DeCompressRowsQK (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)`
- `template<class Field >`
`void CompressRowsQA (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`
`void DeCompressRowsQA (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`
`size_t LUdivine_construct (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::Element_ptr u, const size_t incu, size_t *P, bool computeX, const FFPACK::FFPACK_MINPOLY_TAG MinTag, const size_t kg_mc, const size_t kg_mb, const size_t kg_j)`

15.21.1 Function Documentation

15.21.1.1 LUdivine_construct() [1/2]

```
size_t FFPACK::Protected::LUdivine_construct (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    typename Field::Element_ptr u,
    const size_t incu,
    size_t * P,
    bool computeX,
    const FFPACK_MINPOLY_TAG MinTag = FfpackDense,
    const size_t kg_mc = 0,
    const size_t kg_mb = 0,
    const size_t kg_j = 0 )
```

15.21.1.2 GaussJordan()

```
size_t GaussJordan (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t colbeg,
    const size_t rowbeg,
    const size_t colsize,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```

Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.

Bibliography

- Algorithm 2.8 of A. Storjohann Thesis 2000,
- Algorithm 11 of Jeannerod C-P., Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013

Parameters

| | | |
|---------|--------------|--|
| | <i>M</i> | row dimension of A |
| | <i>N</i> | column dimension of A |
| in, out | <i>A</i> | an m x n matrix |
| | <i>lda</i> | leading dimension of A |
| | <i>P</i> | row permutation |
| | <i>Q</i> | column permutation |
| | <i>LuTag</i> | set the base case to a Tile (FfpackGaussJordanTile) or Slab (FfpackGaussJordanSlab) recursive RedEchelon |

$$\begin{bmatrix} | & A11 & A12 & | & \text{---} & \text{---} & \text{---} & \text{---} & | & I & * & A22 & | & | & 0 & 0 & A22 & | & \text{---} & \text{---} & \text{---} & \text{---} & | & 0 & A32 & | & \text{---} & \text{---} & \text{---} & \text{---} \\ \hline \end{bmatrix}$$
 where the transformation matrix is stored at the pivot column position

15.21.1.3 KellerGehrig()

```
std::list<Polynomial>& FFPACK::Protected::KellerGehrig (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda )
```

15.21.1.4 KGFast()

```
int FFPACK::Protected::KGFast (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * kg_mc,
    size_t * kg_mb,
    size_t * kg_j )
```

15.21.1.5 KGFast_generalized()

```
std::list<Polynomial>& FFPACK::Protected::KGFast_generalized (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )
```

15.21.1.6 fgemv_kgf()

```
void FFPACK::Protected::fgemv_kgf (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    const size_t kg_mc,
    const size_t kg_mb,
    const size_t kg_j )
```

15.21.1.7 LUKrylov()

```
std::list<Polynomial>& FFPACK::Protected::LUKrylov (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
```

```

typename Field::Element_ptr A,
const size_t lda,
typename Field::Element_ptr U,
const size_t ldu,
RandIter & G )

```

15.21.1.8 Danilevski()

```

std::list<Polynomial>& FFPACK::Protected::Danilevski (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )

```

15.21.1.9 RandomKrylovPrecond()

```

void RandomKrylovPrecond (
    const PolRing & PR,
    std::list< typename PolRing::Element > & completedFactors,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    size_t & Nb,
    typename PolRing::Domain_t::Element_ptr & B,
    size_t & ldb,
    typename PolRing::Domain_t::RandIter & g,
    const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD ) [inline]

```

Todo swap to save space ??

Todo don't assing K2 c*noc x N but only mas (c,noc) x N and store each one after the other

Todo swap to save space ??

Todo don't assing K2 c*noc x N but only mas (c,noc) x N and store each one after the other

15.21.1.10 ArithProg()

```

std::list< typename PolRing::Element > & ArithProg (
    const PolRing & PR,
    std::list< typename PolRing::Element > & frobeniusForm,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    const size_t degree ) [inline]

```

15.21.1.11 LUKrylov_KGFast()

```

std::list<Polynomial>& FFPACK::Protected::LUKrylov_KGFast (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,

```

```

typename Field::Element_ptr A,
const size_t lda,
typename Field::Element_ptr X,
const size_t ldX )

```

15.21.1.12 MatVecMinPoly()

```

Polynomial& FFPACK::Protected::MatVecMinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr v,
    const size_t incv,
    typename Field::Element_ptr K,
    const size_t ldK,
    size_t * P )

```

15.21.1.13 Hybrid_KGF_LUK_MinPoly()

```

Polynomial& FFPACK::Protected::Hybrid_KGF_LUK_MinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldX,
    size_t * P,
    const FFPACK_MINPOLY_TAG MinTag = FFPACK::FfpackDense,
    const size_t kg_mc = 0,
    const size_t kg_mb = 0,
    const size_t kg_j = 0 )

```

15.21.1.14 updateD()

```

size_t FFPACK::Protected::updateD (
    const Field & F,
    size_t * d,
    size_t k,
    std::vector< std::vector< typename Field::Element > > & minpt )

```

15.21.1.15 newD()

```

size_t FFPACK::Protected::newD (
    const Field & F,
    size_t * d,
    bool & KeepOn,
    const size_t l,
    const size_t N,
    typename Field::Element_ptr X,
    const size_t * Q,
    std::vector< std::vector< typename Field::Element > > & minpt )

```

15.21.1.16 CompressRows()

```
void FFPACK::Protected::CompressRows (
    Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs ) [inline]
```

15.21.1.17 CompressRowsQK()

```
void FFPACK::Protected::CompressRowsQK (
    Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t deg,
    const size_t nb_blocs ) [inline]
```

15.21.1.18 DeCompressRows()

```
void FFPACK::Protected::DeCompressRows (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs ) [inline]
```

15.21.1.19 DeCompressRowsQK()

```
void FFPACK::Protected::DeCompressRowsQK (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t deg,
    const size_t nb_blocs ) [inline]
```

15.21.1.20 CompressRowsQA()

```
void FFPACK::Protected::CompressRowsQA (
    Field & F,
```

```

const size_t M,
typename Field::Element_ptr A,
const size_t lda,
typename Field::Element_ptr tmp,
const size_t ldtmp,
const size_t * d,
const size_t nb_blocs ) [inline]

```

15.21.1.21 DeCompressRowsQA()

```

void FFPACK::Protected::DeCompressRowsQA (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs ) [inline]

```

15.21.1.22 LUdivine_construct() [2/2]

```

size_t FFPACK::Protected::LUdivine_construct (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldX,
    typename Field::Element_ptr u,
    const size_t incu,
    size_t * P,
    bool computeX,
    const FFPACK::FFPACK_MINPOLY_TAG MinTag,
    const size_t kg_mc,
    const size_t kg_mb,
    const size_t kg_j )

```

15.22 Givaro Namespace Reference

Data Structures

- class [ModularBalanced](#)
- class [Montgomery](#)

15.23 MKL_CONFIG Namespace Reference

15.24 Reclnt Namespace Reference

Data Structures

- class [rint](#)

- class [ruint](#)

Chapter 16

Data Structure Documentation

16.1 AlgoChooser< ModeT, ParSeq > Struct Template Reference

Public Types

- typedef [MMHelperAlgo::Winograd value](#)

16.1.1 Member Typedef Documentation

16.1.1.1 value

typedef [MMHelperAlgo::Winograd value](#)

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.2 AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > Struct Template Reference

Public Types

- typedef [MMHelperAlgo::Classic value](#)

16.2.1 Member Typedef Documentation

16.2.1.1 value

typedef [MMHelperAlgo::Classic value](#)

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.3 ArbitraryPrecIntTag Struct Reference

Arbitrary precision integers: GMP.

```
#include <field-traits.h>
```

16.3.1 Detailed Description

Arbitrary precision integers: GMP.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.4 AreEqual< X, Y > Class Template Reference

```
#include <fflas_enum.h>
```

Static Public Attributes

- static const bool [value](#) = false

16.4.1 Field Documentation

16.4.1.1 value

```
const bool value = false [static]
```

The documentation for this class was generated from the following file:

- [fflas_enum.h](#)

16.5 AreEqual< X, X > Class Template Reference

```
#include <fflas_enum.h>
```

Static Public Attributes

- static const bool [value](#) = true

16.5.1 Field Documentation

16.5.1.1 value

```
const bool value = true [static]
```

The documentation for this class was generated from the following file:

- [fflas_enum.h](#)

16.6 Argument Struct Reference

```
#include <args-parser.h>
```

Data Fields

- char [c](#)
- const char * [example](#)
- const char * [helpString](#)
- [ArgumentType](#) type
- void * [data](#)

16.6.1 Field Documentation

16.6.1.1 c

char c

16.6.1.2 example

const char* example

16.6.1.3 helpString

const char* helpString

16.6.1.4 type

[ArgumentType](#) type

16.6.1.5 data

void* data

The documentation for this struct was generated from the following file:

- [args-parser.h](#)

16.7 associatedDelayedField< Field > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [Field](#) field
- typedef [Field](#) & [type](#)

16.7.1 Member Typedef Documentation

16.7.1.1 field

typedef [Field](#) field

16.7.1.2 type

typedef [Field](#)& [type](#)

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.8 associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FFPACK::RNSInteger< RNS >](#) [field](#)
- typedef [FFPACK::RNSInteger< RNS >](#) [type](#)

16.8.1 Member Typedef Documentation

16.8.1.1 field

```
typedef FFPACK::RNSInteger<RNS> field
```

16.8.1.2 type

```
typedef FFPACK::RNSInteger<RNS> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.9 associatedDelayedField< const Givaro::Modular< T, X > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef Givaro::ZRing< T > [field](#)
- typedef Givaro::ZRing< T > [type](#)

16.9.1 Member Typedef Documentation

16.9.1.1 field

```
typedef Givaro::ZRing<T> field
```

16.9.1.2 type

```
typedef Givaro::ZRing<T> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.10 associatedDelayedField< const Givaro::ModularBalanced< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef Givaro::ZRing< T > [field](#)
- typedef Givaro::ZRing< T > [type](#)

16.10.1 Member Typedef Documentation

16.10.1.1 field

```
typedef Givaro::ZRing<T> field
```

16.10.1.2 type

```
typedef Givaro::ZRing<T> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.11 associatedDelayedField< const Givaro::ZRing< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef Givaro::ZRing< T > [field](#)
- typedef Givaro::ZRing< T > [type](#)

16.11.1 Member Typedef Documentation

16.11.1.1 field

```
typedef Givaro::ZRing<T> field
```

16.11.1.2 type

```
typedef Givaro::ZRing<T> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.12 Auto Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.13 Bini Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.14 Block Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.15 callLUdivine_small< Element > Class Template Reference

Public Member Functions

- `template<class Field >`
`size_t operator()` (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const `size_t` M, const `size_t` N, typename [Field::Element_ptr](#) A, const `size_t` lda, `size_t` *P, `size_t` *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag)

16.15.1 Member Function Documentation

16.15.1.1 operator>()()

```
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS\_DIAG Diag,
    const FFLAS::FFLAS\_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element\_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK\_LU\_TAG LuTag ) [inline]
```

The documentation for this class was generated from the following file:

- [ffpack_ludivine.inl](#)

16.16 callLUdivine_small< double > Class Reference

Public Member Functions

- `template<class Field >`
`size_t operator()` (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const `size_t` M, const `size_t` N, typename [Field::Element_ptr](#) A, const `size_t` lda, `size_t` *P, `size_t` *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag)

16.16.1 Member Function Documentation

16.16.1.1 operator>()()

```
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS\_DIAG Diag,
    const FFLAS::FFLAS\_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element\_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK\_LU\_TAG LuTag ) [inline]
```

The documentation for this class was generated from the following file:

- [ffpack_ludivine.inl](#)

16.17 callLUdivine_small< float > Class Reference

Public Member Functions

- `template<class Field >`
`size_t operator() (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)`

16.17.1 Member Function Documentation

16.17.1.1 operator>()()

```
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```

The documentation for this class was generated from the following file:

- [ffpack_ludivine.inl](#)

16.18 CharpolyFailed Class Reference

```
#include <ffpack.h>
```

The documentation for this class was generated from the following file:

- [ffpack.h](#)

16.19 Checker_Empty< Field > Struct Template Reference

```
#include <checker_empty.h>
```

Public Member Functions

- `template<typename... Params>`
`Checker_Empty (Params... parameters)`
- `template<typename... Params>`
`bool check (Params... parameters)`

16.19.1 Constructor & Destructor Documentation

16.19.1.1 Checker_Empty()

```
Checker_Empty (
    Params... parameters ) [inline]
```

16.19.2 Member Function Documentation

16.19.2.1 check()

```
bool check (
    Params... parameters ) [inline]
```

The documentation for this struct was generated from the following file:

- [checker_empty.h](#)

16.20 CheckerImplem_charpoly< Field, Polynomial > Class Template Reference

Public Member Functions

- [CheckerImplem_charpoly](#) (const [Field](#) &F_, const size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda_)
- [CheckerImplem_charpoly](#) (typename [Field::RandIter](#) &G, const size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda_)
- [~CheckerImplem_charpoly](#) ()
- bool [check](#) (Polynomial &g)

16.20.1 Constructor & Destructor Documentation

16.20.1.1 CheckerImplem_charpoly() [1/2]

```
CheckerImplem_charpoly (
    const Field & F_,
    const size_t n_,
    typename Field::ConstElement\_ptr A,
    size_t lda_ ) [inline]
```

16.20.1.2 CheckerImplem_charpoly() [2/2]

```
CheckerImplem_charpoly (
    typename Field::RandIter & G,
    const size_t n_,
    typename Field::ConstElement\_ptr A,
    size_t lda_ ) [inline]
```

16.20.1.3 ~CheckerImplem_charpoly()

```
~CheckerImplem_charpoly ( ) [inline]
```

16.20.2 Member Function Documentation

16.20.2.1 check()

```
bool check (
    Polynomial & g ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_charpoly.inl](#)

16.21 CheckerImplem_Det< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_Det](#) (const [Field](#) &F_, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [CheckerImplem_Det](#) (typename [Field::RandIter](#) &G, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [~CheckerImplem_Det](#) ()
- bool [check](#) (const typename [Field::Element](#) &det, typename [Field::ConstElement_ptr](#) LU, size_t lda, size_t *P, size_t *Q) const

check if the Det factorization is correct.

16.21.1 Constructor & Destructor Documentation

16.21.1.1 CheckerImplem_Det() [1/2]

```
CheckerImplem_Det (
    const Field & F_,
    size_t n_,
    typename Field::ConstElement\_ptr A,
    size_t lda ) [inline]
```

16.21.1.2 CheckerImplem_Det() [2/2]

```
CheckerImplem_Det (
    typename Field::RandIter & G,
    size_t n_,
    typename Field::ConstElement\_ptr A,
    size_t lda ) [inline]
```

16.21.1.3 ~CheckerImplem_Det()

```
~CheckerImplem_Det ( ) [inline]
```

16.21.2 Member Function Documentation

16.21.2.1 check()

```
bool check (
    const typename Field::Element & det,
    typename Field::ConstElement\_ptr LU,
    size_t lda,
    size_t * P,
    size_t * Q ) const [inline]
```

check if the Det factorization is correct.

Needs matrix in LU form

Parameters

| | |
|-------------------|-------------|
| <i>LU,storage</i> | for L and U |
|-------------------|-------------|

Parameters

| | |
|------------|--|
| <i>det</i> | |
| <i>P</i> | |
| <i>Q</i> | |

The documentation for this class was generated from the following file:

- [checker_det.inl](#)

16.22 CheckerImplem_fgemm< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_fgemm](#) (const [Field](#) &F_, const size_t m_, const size_t n_, const size_t k_, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc_)
- [CheckerImplem_fgemm](#) (typename [Field::RandIter](#) &G, const size_t m_, const size_t n_, const size_t k_, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc_)
- [~CheckerImplem_fgemm](#) ()
- bool [check](#) (const [FFLAS::FFLAS_TRANSPOSE](#) ta, const [FFLAS::FFLAS_TRANSPOSE](#) tb, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::ConstElement_ptr](#) C)

16.22.1 Constructor & Destructor Documentation

16.22.1.1 CheckerImplem_fgemm() [1/2]

```
CheckerImplem_fgemm (
    const Field & F_,
    const size_t m_,
    const size_t n_,
    const size_t k_,
    const typename Field::Element beta,
    typename Field::Element\_ptr C,
    const size_t ldc_ ) [inline]
```

16.22.1.2 CheckerImplem_fgemm() [2/2]

```
CheckerImplem_fgemm (
    typename Field::RandIter & G,
    const size_t m_,
    const size_t n_,
    const size_t k_,
    const typename Field::Element beta,
    typename Field::Element\_ptr C,
    const size_t ldc_ ) [inline]
```

16.22.1.3 ~CheckerImplem_fgemm()

```
~CheckerImplem_fgemm ( ) [inline]
```

16.22.2 Member Function Documentation

16.22.2.1 check()

```
bool check (
    const FFLAS::FFLAS_TRANSPOSE ta,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::ConstElement_ptr C ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_fgemm.inl](#)

16.23 CheckerImplem_ftrsm< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_ftrsm](#) (const [Field](#) &F_, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) B, const size_t ldb)
- [CheckerImplem_ftrsm](#) (typename [Field::RandIter](#) &G, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) B, const size_t ldb)
- [~CheckerImplem_ftrsm](#) ()
- bool [check](#) (const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_UPLO](#) uplo, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const [FFLAS::FFLAS_DIAG](#) diag, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, size_t lda, const typename [Field::ConstElement_ptr](#) X, size_t ldx)

16.23.1 Constructor & Destructor Documentation

16.23.1.1 CheckerImplem_ftrsm() [1/2]

```
CheckerImplem_ftrsm (
    const Field & F_,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr B,
    const size_t ldb ) [inline]
```

16.23.1.2 CheckerImplem_ftrsm() [2/2]

```
CheckerImplem_ftrsm (
    typename Field::RandIter & G,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr B,
    const size_t ldb ) [inline]
```

16.23.1.3 ~CheckerImplem_ftrsm()

```
~CheckerImplem_ftrsm ( ) [inline]
```

16.23.2 Member Function Documentation

16.23.2.1 check()

```
bool check (
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_UPLO uplo,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const FFLAS::FFLAS_DIAG diag,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    const typename Field::ConstElement_ptr X,
    size_t ldx ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_ftsm.inl](#)

16.24 CheckerImplem_invert< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_invert](#) (const [Field](#) &F_, const size_t m_, typename [Field::ConstElement_ptr](#) A, const size_t lda_)
- [CheckerImplem_invert](#) (typename [Field::RandIter](#) &G, const size_t m_, typename [Field::ConstElement_ptr](#) A, const size_t lda_)
- [~CheckerImplem_invert](#) ()
- bool [check](#) (typename [Field::ConstElement_ptr](#) A, int nullity)

16.24.1 Constructor & Destructor Documentation

16.24.1.1 CheckerImplem_invert() [1/2]

```
CheckerImplem_invert (
    const Field & F_,
    const size_t m_,
    typename Field::ConstElement_ptr A,
    const size_t lda_ ) [inline]
```

16.24.1.2 CheckerImplem_invert() [2/2]

```
CheckerImplem_invert (
    typename Field::RandIter & G,
    const size_t m_,
    typename Field::ConstElement_ptr A,
    const size_t lda_ ) [inline]
```

16.24.1.3 ~CheckerImplem_invert()

```
~CheckerImplem_invert ( ) [inline]
```

16.24.2 Member Function Documentation

16.24.2.1 check()

```
bool check (
    typename Field::ConstElement_ptr A,
    int nullity ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_invert.inl](#)

16.25 CheckerImplem_PLUQ< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_PLUQ](#) (const [Field](#) &F_, size_t m_, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [CheckerImplem_PLUQ](#) (typename [Field::RandIter](#) &G, size_t m_, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [~CheckerImplem_PLUQ](#) ()
- bool [check](#) (typename [Field::ConstElement_ptr](#) A, size_t lda, const [FFLAS::FFLAS_DIAG](#) Diag, size_t r, size_t *P, size_t *Q) const
check if the PLUQ factorization is correct.

16.25.1 Constructor & Destructor Documentation

16.25.1.1 CheckerImplem_PLUQ() [1/2]

```
CheckerImplem_PLUQ (
    const Field & F_,
    size_t m_,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda ) [inline]
```

16.25.1.2 CheckerImplem_PLUQ() [2/2]

```
CheckerImplem_PLUQ (
    typename Field::RandIter & G,
    size_t m_,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda ) [inline]
```

16.25.1.3 ~CheckerImplem_PLUQ()

```
~CheckerImplem_PLUQ ( ) [inline]
```

16.25.2 Member Function Documentation

16.25.2.1 check()

```
bool check (
    typename Field::ConstElement_ptr A,
    size_t lda,
    const FFLAS::FFLAS_DIAG Diag,
    size_t r,
    size_t * P,
    size_t * Q ) const [inline]
```

check if the PLUQ factorization is correct.

Returns true if $w - P(L(U(Q.v))) == 0$

Parameters

| | |
|-----|--|
| A | |
| r | |
| P | |
| Q | |

The documentation for this class was generated from the following file:

- [checker_pluq.inl](#)

16.26 Classic Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.27 Column Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.28 CompactElement< Element > Struct Template Reference

Public Types

- typedef Element [type](#)

16.28.1 Member Typedef Documentation

16.28.1.1 type

```
typedef Element type
```

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.29 CompactElement< double > Struct Reference

Public Types

- typedef [int32_t](#) [type](#)

16.29.1 Member Typedef Documentation

16.29.1.1 type

typedef [int32_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.30 CompactElement< float > Struct Reference

Public Types

- typedef [int16_t](#) type

16.30.1 Member Typedef Documentation

16.30.1.1 type

typedef [int16_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.31 CompactElement< int16_t > Struct Reference

Public Types

- typedef [int8_t](#) type

16.31.1 Member Typedef Documentation

16.31.1.1 type

typedef [int8_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.32 CompactElement< int32_t > Struct Reference

Public Types

- typedef [int16_t](#) type

16.32.1 Member Typedef Documentation

16.32.1.1 type

typedef [int16_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.33 CompactElement< int64_t > Struct Reference

Public Types

- typedef [int32_t](#) [type](#)

16.33.1 Member Typedef Documentation

16.33.1.1 type

typedef [int32_t](#) [type](#)

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.34 compatible_data_type< Field > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = true

16.34.1 Field Documentation

16.34.1.1 value

constexpr bool [value](#) = true [static], [constexpr]

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.35 compatible_data_type< Givaro::ZRing< double > > Struct Reference

Static Public Attributes

- static constexpr bool [value](#) = false

16.35.1 Field Documentation

16.35.1.1 value

constexpr bool [value](#) = false [static], [constexpr]

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.36 compatible_data_type< Givaro::ZRing< float > > Struct Reference

Static Public Attributes

- static constexpr bool [value](#) = false

16.36.1 Field Documentation

16.36.1.1 value

constexpr bool value = false [static], [constexpr]

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.37 Compose< H1, H2 > Struct Template Reference

Public Member Functions

- [Compose](#) ()
- [Compose](#) (const [Compose](#) &other)
- [Compose](#) (const [Sequential](#) &S)
- [Compose](#) (size_t th1, size_t th2)
- [Compose](#) (const H1 &o1, const H2 &o2)
- H1 [first_component](#) () const
- H2 [second_component](#) () const

Friends

- std::ostream & [operator<<](#) (std::ostream &o, const [Compose](#) &c)

16.37.1 Constructor & Destructor Documentation

16.37.1.1 Compose() [1/5]

```
Compose ( ) [inline]
```

16.37.1.2 Compose() [2/5]

```
Compose (
    const Compose< H1, H2 > & other ) [inline]
```

16.37.1.3 Compose() [3/5]

```
Compose (
    const Sequential & S ) [inline]
```

16.37.1.4 Compose() [4/5]

```
Compose (
    size_t th1,
    size_t th2 ) [inline]
```

16.37.1.5 Compose() [5/5]

```
Compose (
    const H1 & o1,
    const H2 & o2 ) [inline]
```

16.37.2 Member Function Documentation

16.37.2.1 first_component()

```
H1 first_component ( ) const [inline]
```

16.37.2.2 second_component()

```
H2 second_component ( ) const [inline]
```

16.37.3 Friends And Related Function Documentation

16.37.3.1 operator<<

```
std::ostream& operator<< (
    std::ostream & o,
    const Compose< H1, H2 > & c ) [friend]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.38 Const_int_t< n > Class Template Reference

```
#include <instrset.h>
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.39 Const_uint_t< n > Class Template Reference

```
#include <instrset.h>
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.40 Simd128_impl< true, true, false, 2 >::Converter Union Reference

Data Fields

- [vect_t](#) v
- [scalar_t](#) t [vect_size]

16.40.1 Field Documentation

16.40.1.1 v

```
vect\_t v
```

16.40.1.2 t

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd128_int16.inl](#)

16.41 Simd128_impl< true, true, false, 4 >::Converter Union Reference**Data Fields**

- [vect_t v](#)
- [scalar_t t\[vect_size\]](#)

16.41.1 Field Documentation**16.41.1.1 v**

`vect_t v`

16.41.1.2 t

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd128_int32.inl](#)

16.42 Simd128_impl< true, true, false, 8 >::Converter Union Reference**Data Fields**

- [vect_t v](#)
- [scalar_t t\[vect_size\]](#)

16.42.1 Field Documentation**16.42.1.1 v**

`vect_t v`

16.42.1.2 t

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd128_int64.inl](#)

16.43 Simd128_impl< true, true, true, 2 >::Converter Union Reference**Data Fields**

- [vect_t v](#)
- [scalar_t t\[vect_size\]](#)

16.43.1 Field Documentation

16.43.1.1 v

[vect_t](#) v

16.43.1.2 t

[scalar_t](#) t[[vect_size](#)]

The documentation for this union was generated from the following file:

- [simd128_int16.inl](#)

16.44 Simd128_impl< true, true, true, 4 >::Converter Union Reference

Data Fields

- [vect_t](#) v
- [scalar_t](#) t[[vect_size](#)]

16.44.1 Field Documentation

16.44.1.1 v

[vect_t](#) v

16.44.1.2 t

[scalar_t](#) t[[vect_size](#)]

The documentation for this union was generated from the following file:

- [simd128_int32.inl](#)

16.45 Simd128_impl< true, true, true, 8 >::Converter Union Reference

Data Fields

- [vect_t](#) v
- [scalar_t](#) t[[vect_size](#)]

16.45.1 Field Documentation

16.45.1.1 v

[vect_t](#) v

16.45.1.2 t

[scalar_t](#) t[[vect_size](#)]

The documentation for this union was generated from the following file:

- [simd128_int64.inl](#)

16.46 Simd256_impl< true, true, false, 2 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.46.1 Field Documentation

16.46.1.1 v

[vect_t v](#)

16.46.1.2 t

[scalar_t t \[vect_size\]](#)

The documentation for this union was generated from the following file:

- [simd256_int16.inl](#)

16.47 Simd256_impl< true, true, false, 4 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.47.1 Field Documentation

16.47.1.1 v

[vect_t v](#)

16.47.1.2 t

[scalar_t t](#)

The documentation for this union was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.48 Simd256_impl< true, true, false, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.48.1 Field Documentation

16.48.1.1 v

`vect_t` v

16.48.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd256_int64.inl](#)

16.49 Simd256_impl< true, true, true, 2 >::Converter Union Reference**Data Fields**

- [vect_t](#) v
- [scalar_t](#) t[`vect_size`]

16.49.1 Field Documentation**16.49.1.1 v**

`vect_t` v

16.49.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd256_int16.inl](#)

16.50 Simd256_impl< true, true, true, 4 >::Converter Union Reference**Data Fields**

- [vect_t](#) v
- [scalar_t](#) t[`vect_size`]

16.50.1 Field Documentation**16.50.1.1 v**

`vect_t` v

16.50.1.2 t

`scalar_t` t

The documentation for this union was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.51 Simd256_impl< true, true, true, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.51.1 Field Documentation

16.51.1.1 v

[vect_t v](#)

16.51.1.2 t

[scalar_t t \[vect_size\]](#)

The documentation for this union was generated from the following file:

- [simd256_int64.inl](#)

16.52 Simd512_impl< true, true, false, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.52.1 Field Documentation

16.52.1.1 v

[vect_t v](#)

16.52.1.2 t

[scalar_t t \[vect_size\]](#)

The documentation for this union was generated from the following file:

- [simd512_int64.inl](#)

16.53 Simd512_impl< true, true, true, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.53.1 Field Documentation

16.53.1.1 v

`vect_t` [v](#)

16.53.1.2 t

`scalar_t` [t](#)[`vect_size`]

The documentation for this union was generated from the following file:

- [simd512_int64.inl](#)

16.54 ConvertTo< T > Struct Template Reference

Force conversion to appropriate element type of ElementCategory T.

`#include <field-traits.h>`

16.54.1 Detailed Description

`template<class T>`

`struct FFLAS::ModeCategories::ConvertTo< T >`

Force conversion to appropriate element type of ElementCategory T.

e.g.

- `ConvertTo<ElementCategories::MachineFloatTag>` tries conversion of `Modular<int>` to `Modular<double>`
- `ConvertTo<ElementCategories::FixedPrecIntTag>` tries conversion of `Modular<Integer>` to `Modular<RecInt<K>>`
- `ConvertTo<ElementCategories::ArbitraryPrecIntTag>` tries conversion of `Modular<Integer>` to `RNSInteger`

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.55 Coo< ValT, IdxT > Struct Template Reference**Public Types**

- using `Self` = `Coo< ValT, IdxT >`

Public Member Functions

- `Coo` (`ValT` v, `IdxT` r, `IdxT` c)
- `Coo` ()=default
- `Coo` (const `Self` &)=default
- `Coo` (`Self` &&)=default
- `Self` & `operator=` (const `Self` &)=default
- `Self` & `operator=` (`Self` &&)=default

Data Fields

- `ValT` `val` = 0
- `IdxT` `row` = 0
- `IdxT` `col` = 0

16.55.1 Member Typedef Documentation

16.55.1.1 Self

```
using Self = Coo<ValT, IdxT>
```

16.55.2 Constructor & Destructor Documentation

16.55.2.1 `Coo()` [1/4]

```
Coo (
    ValT v,
    IdxT r,
    IdxT c ) [inline]
```

16.55.2.2 `Coo()` [2/4]

```
Coo ( ) [default]
```

16.55.2.3 `Coo()` [3/4]

```
Coo (
    const Self & ) [default]
```

16.55.2.4 `Coo()` [4/4]

```
Coo (
    Self && ) [default]
```

16.55.3 Member Function Documentation

16.55.3.1 `operator=()` [1/2]

```
Self& operator= (
    const Self & ) [default]
```

16.55.3.2 `operator=()` [2/2]

```
Self& operator= (
    Self && ) [default]
```

16.55.4 Field Documentation

16.55.4.1 `val`

```
ValT val = 0
```

16.55.4.2 `row`

```
IdxT row = 0
```

16.55.4.3 col

```
IdxT col = 0
```

The documentation for this struct was generated from the following file:

- [csr_hyb_utils.inl](#)

16.56 **Coo**< **Field** > Struct Template Reference

```
#include <read_sparse.h>
```

Public Member Functions

- **Coo** ()=default
- **Coo** (typename [Field::Element](#) v, [index_t](#) r, [index_t](#) c)
- **Coo** (const [Self](#) &)=default
- **Coo** ([Self](#) &&)=default
- [Self](#) & **operator=** (const [Self](#) &)=default
- [Self](#) & **operator=** ([Self](#) &&)=default

Data Fields

- [Field::Element](#) val = 0
- [index_t](#) col = 0
- [index_t](#) row = 0
- bool [deleted](#) = false

16.56.1 Constructor & Destructor Documentation

16.56.1.1 **Coo**() [1/4]

```
Coo ( ) [default]
```

16.56.1.2 **Coo**() [2/4]

```
Coo (
    typename Field::Element v,
    index\_t r,
    index\_t c ) [inline]
```

16.56.1.3 **Coo**() [3/4]

```
Coo (
    const Self & ) [default]
```

16.56.1.4 **Coo**() [4/4]

```
Coo (
    Self && ) [default]
```

16.56.2 Member Function Documentation

16.56.2.1 `operator=()` [1/2]

```
Self& operator= (
    const Self & ) [default]
```

16.56.2.2 `operator=()` [2/2]

```
Self& operator= (
    Self && ) [default]
```

16.56.3 Field Documentation**16.56.3.1 `val`**

```
Field::Element val = 0
```

16.56.3.2 `col`

```
index_t col = 0
```

16.56.3.3 `row`

```
index_t row = 0
```

16.56.3.4 `deleted`

```
bool deleted = false
```

The documentation for this struct was generated from the following file:

- [read_sparse.h](#)

16.57 `Coo< ValT, IdxT >` Struct Template Reference**Public Types**

- using `Self` = `Coo< ValT, IdxT >`

Public Member Functions

- `Coo` (`ValT` v, `IdxT` r, `IdxT` c)
- `Coo` ()=default
- `Coo` (const `Self` &)=default
- `Coo` (`Self` &&)=default
- `Self` & `operator=` (const `Self` &)=default
- `Self` & `operator=` (`Self` &&)=default

Data Fields

- `ValT` `val` = 0
- `IdxT` `row` = 0
- `IdxT` `col` = 0

16.57.1 Member Typedef Documentation

16.57.1.1 Self

```
using Self = Coo<ValT, IdxT>
```

16.57.2 Constructor & Destructor Documentation

16.57.2.1 Coo() [1/4]

```
Coo (
    ValT v,
    IdxT r,
    IdxT c ) [inline]
```

16.57.2.2 Coo() [2/4]

```
Coo ( ) [default]
```

16.57.2.3 Coo() [3/4]

```
Coo (
    const Self & ) [default]
```

16.57.2.4 Coo() [4/4]

```
Coo (
    Self && ) [default]
```

16.57.3 Member Function Documentation

16.57.3.1 operator=() [1/2]

```
Self& operator= (
    const Self & ) [default]
```

16.57.3.2 operator=() [2/2]

```
Self& operator= (
    Self && ) [default]
```

16.57.4 Field Documentation

16.57.4.1 val

```
ValT val = 0
```

16.57.4.2 row

```
IdxT row = 0
```

16.57.4.3 col

```
IdxT col = 0
```

The documentation for this struct was generated from the following file:

- [sell_utils.inl](#)

16.58 CooMat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::Sparse< Field, SparseMatrix_t::COO, int16_t > * _coo16](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO, int32_t > * _coo32](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO, int64_t > * _coo64](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO_ZO, int16_t > * _coo16_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO_ZO, int32_t > * _coo32_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO_ZO, int64_t > * _coo64_zo](#) = nullptr

16.58.1 Field Documentation**16.58.1.1 _coo16**

```
FFLAS::Sparse<Field, SparseMatrix_t::COO, int16_t>* _coo16 = nullptr
```

16.58.1.2 _coo32

```
FFLAS::Sparse<Field, SparseMatrix_t::COO, int32_t>* _coo32 = nullptr
```

16.58.1.3 _coo64

```
FFLAS::Sparse<Field, SparseMatrix_t::COO, int64_t>* _coo64 = nullptr
```

16.58.1.4 _coo16_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int16_t>* _coo16_zo = nullptr
```

16.58.1.5 _coo32_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int32_t>* _coo32_zo = nullptr
```

16.58.1.6 _coo64_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int64_t>* _coo64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.59 CsrMat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::Sparse< Field, SparseMatrix_t::CSR, int16_t > * _csr16](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR, int32_t > * _csr32](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR, int64_t > * _csr64](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR_ZO, int16_t > * _csr16_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR_ZO, int32_t > * _csr32_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR_ZO, int64_t > * _csr64_zo](#) = nullptr

16.59.1 Field Documentation

16.59.1.1 _csr16

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int16_t>* _csr16 = nullptr
```

16.59.1.2 _csr32

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int32_t>* _csr32 = nullptr
```

16.59.1.3 _csr64

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int64_t>* _csr64 = nullptr
```

16.59.1.4 _csr16_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int16_t>* _csr16_zo = nullptr
```

16.59.1.5 _csr32_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int32_t>* _csr32_zo = nullptr
```

16.59.1.6 _csr64_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int64_t>* _csr64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.60 DefaultBoundedTag Struct Reference

Use standard field operations, but keeps track of bounds on input and output.

```
#include <field-traits.h>
```

16.60.1 Detailed Description

Use standard field operations, but keeps track of bounds on input and output.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.61 DefaultTag Struct Reference

No specific mode of action: use standard field operations.

```
#include <field-traits.h>
```

16.61.1 Detailed Description

No specific mode of action: use standard field operations.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.62 DelayedTag Struct Reference

Performs field operations with delayed mod reductions. Ensures result is reduced.

```
#include <field-traits.h>
```

16.62.1 Detailed Description

Performs field operations with delayed mod reductions. Ensures result is reduced.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.63 ElementTraits< Element > Struct Template Reference

[ElementTraits](#).

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::GenericTag](#) value

16.63.1 Detailed Description

```
template<class Element>
```

```
struct FFLAS::ElementTraits< Element >
```

[ElementTraits](#).

16.63.2 Member Typedef Documentation

16.63.2.1 value

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.64 ElementTraits< double > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineFloatTag](#) value

16.64.1 Member Typedef Documentation

16.64.1.1 value

typedef [ElementCategories::MachineFloatTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.65 ElementTraits< FFPACK::rns_double_elt > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::RNSElementTag](#) value

16.65.1 Member Typedef Documentation

16.65.1.1 value

typedef [ElementCategories::RNSElementTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.66 ElementTraits< float > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineFloatTag](#) value

16.66.1 Member Typedef Documentation

16.66.1.1 value

typedef [ElementCategories::MachineFloatTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.67 ElementTraits< Givaro::Integer > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::ArbitraryPrecIntTag](#) value

16.67.1 Member Typedef Documentation

16.67.1.1 value

typedef [ElementCategories::ArbitraryPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.68 ElementTraits< int16_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.68.1 Member Typedef Documentation

16.68.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.69 ElementTraits< int32_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.69.1 Member Typedef Documentation

16.69.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.70 ElementTraits< int64_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.70.1 Member Typedef Documentation

16.70.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.71 ElementTraits< int8_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.71.1 Member Typedef Documentation

16.71.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.72 ElementTraits< RecInt::rint< K > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::FixedPrecIntTag](#) value

16.72.1 Member Typedef Documentation

16.72.1.1 value

typedef [ElementCategories::FixedPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.73 ElementTraits< RecInt::rmint< K, MG > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::FixedPrecIntTag](#) value

16.73.1 Member Typedef Documentation

16.73.1.1 value

typedef [ElementCategories::FixedPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.74 ElementTraits< RecInt::ruint< K > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::FixedPrecIntTag](#) value

16.74.1 Member Typedef Documentation

16.74.1.1 value

typedef [ElementCategories::FixedPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.75 ElementTraits< uint16_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.75.1 Member Typedef Documentation

16.75.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.76 ElementTraits< uint32_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.76.1 Member Typedef Documentation

16.76.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.77 ElementTraits< uint64_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.77.1 Member Typedef Documentation

16.77.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.78 ElementTraits< uint8_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.78.1 Member Typedef Documentation

16.78.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.79 EII Mat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL](#), [int16_t](#) > * [_ell16](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL](#), [int32_t](#) > * [_ell32](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL](#), [int64_t](#) > * [_ell64](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL_ZO](#), [int16_t](#) > * [_ell16_zo](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL_ZO](#), [int32_t](#) > * [_ell32_zo](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL_ZO](#), [int64_t](#) > * [_ell64_zo](#) = nullptr

16.79.1 Field Documentation

16.79.1.1 [_ell16](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL, int16_t>* _ell16 = nullptr
```

16.79.1.2 [_ell32](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL, int32_t>* _ell32 = nullptr
```

16.79.1.3 [_ell64](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL, int64_t>* _ell64 = nullptr
```

16.79.1.4 [_ell16_zo](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL_ZO, int16_t>* _ell16_zo = nullptr
```

16.79.1.5 [_ell32_zo](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL_ZO, int32_t>* _ell32_zo = nullptr
```

16.79.1.6 [_ell64_zo](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL_ZO, int64_t>* _ell64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.80 Failure Class Reference

A precondition failed.

```
#include <debug.h>
```

Public Member Functions

- [Failure](#) ()
- void [operator\(\)](#) (const char *function, int line, const char *check)
- void [operator\(\)](#) (const char *function, const char *file, int line, const char *check)
- void [setErrorStream](#) (std::ostream &stream)
- std::ostream & [print](#) (std::ostream &o) const

Protected Attributes

- `std::ostream * _errorStream`

16.80.1 Detailed Description

A precondition failed.

The `throw` mechanism is usually used here as in

```
if (!check)
    failure(__func__, __LINE__, "this check just failed");
```

The parameters of the constructor help debugging.

16.80.2 Constructor & Destructor Documentation

16.80.2.1 Failure()

```
Failure ( ) [inline]
```

16.80.3 Member Function Documentation

16.80.3.1 operator>() [1/2]

```
void operator() (
    const char * function,
    int line,
    const char * check ) [inline]
```

A precondition failed.

Parameters

| | |
|-----------------|---|
| <i>function</i> | usually func , the function that threw the error |
| <i>line</i> | usually LINE , the line where it happened |
| <i>check</i> | a string telling what failed. |

16.80.3.2 operator>() [2/2]

```
void operator() (
    const char * function,
    const char * file,
    int line,
    const char * check ) [inline]
```

A precondition failed. The parameter help debugging. This is not much different from the previous except we can digg faster in the file where the exception was triggered.

Parameters

| | |
|-----------------|---|
| <i>function</i> | usually func , the function that threw the error |
| <i>file</i> | usually FILE , the file where this function is |
| <i>line</i> | usually LINE , the line where it happened |
| <i>check</i> | a string telling what failed. |

16.80.3.3 setErrorMessage()

```
void setErrorMessage (
    std::ostream & stream )
```

16.80.3.4 print()

```
std::ostream& print (
    std::ostream & o ) const [inline]
```

overload the virtual print of LinboxError.

Parameters

| | |
|----------|---------------|
| <i>o</i> | output stream |
|----------|---------------|

16.80.4 Field Documentation**16.80.4.1 _errorMessage**

```
std::ostream* _errorMessage [protected]
```

The documentation for this class was generated from the following file:

- [debug.h](#)

16.81 FailureCharpolyCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.82 FailureDetCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.83 FailureFgemmCheck Class Reference

```
#include <checkers_fflas.h>
```

The documentation for this class was generated from the following file:

- [checkers_fflas.h](#)

16.84 FailureInvertCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.85 FailurePLUQCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.86 FailureTrsmCheck Class Reference

```
#include <checkers_fflas.h>
```

The documentation for this class was generated from the following file:

- [checkers_fflas.h](#)

16.87 FieldSimd< _Field > Class Template Reference

Public Types

- using [Field](#) = [_Field](#)
- using [Element](#) = typename [Field::Element](#)
- using [simd](#) = [Simd](#)< typename [_Field::Element](#) >
- using [vect_t](#) = typename [simd::vect_t](#)
- using [scalar_t](#) = typename [simd::scalar_t](#)

Public Member Functions

- [FieldSimd](#) (const [Field](#) &f)
- [FieldSimd](#) (const [Self](#) &)=default
- [FieldSimd](#) ([Self](#) &&)=default
- [Self](#) & operator= (const [Self](#) &)=default
- [Self](#) & operator= ([Self](#) &&)=default
- [INLINE vect_t init](#) ([vect_t](#) &x, const [vect_t](#) a) const
- [INLINE vect_t init](#) (const [vect_t](#) a) const
- [INLINE vect_t add](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t add](#) (const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t addin](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t add_r](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t add_r](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t addin_r](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t sub](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t sub](#) (const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t subin](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t sub_r](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t sub_r](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t subin_r](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t zero](#) ([vect_t](#) &x) const
- [INLINE vect_t zero](#) () const
- [INLINE vect_t mod](#) ([vect_t](#) &c) const
- [INLINE vect_t mul](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t mul](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t mulin](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t mul_r](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t mul_r](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t axpy](#) ([vect_t](#) &r, const [vect_t](#) a, const [vect_t](#) b, const [vect_t](#) c) const
- [INLINE vect_t axpy](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t axpyin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const

- `INLINE vect_t axpy_r (vect_t &r, const vect_t a, const vect_t b, const vect_t c) const`
- `INLINE vect_t axpy_r (const vect_t c, const vect_t a, const vect_t b) const`
- `INLINE vect_t axpyin_r (vect_t &c, const vect_t a, const vect_t b) const`
- `INLINE vect_t maxpy (vect_t &r, const vect_t a, const vect_t b, const vect_t c) const`
- `INLINE vect_t maxpy (const vect_t c, const vect_t a, const vect_t b) const`
- `INLINE vect_t maxpyin (vect_t &c, const vect_t a, const vect_t b) const`

Static Public Attributes

- static constexpr const size_t `vect_size` = `simd::vect_size`
- static constexpr const size_t `alignment` = `simd::alignment`

16.87.1 Member Typedef Documentation

16.87.1.1 Field

using `Field` = `_Field`

16.87.1.2 Element

using `Element` = `typename Field::Element`

16.87.1.3 simd

using `simd` = `Simd<typename _Field::Element>`

16.87.1.4 vect_t

using `vect_t` = `typename simd::vect_t`

16.87.1.5 scalar_t

using `scalar_t` = `typename simd::scalar_t`

16.87.2 Constructor & Destructor Documentation

16.87.2.1 FieldSimd() [1/3]

```
FieldSimd (
    const Field & f ) [inline]
```

16.87.2.2 FieldSimd() [2/3]

```
FieldSimd (
    const Self & ) [default]
```

16.87.2.3 FieldSimd() [3/3]

```
FieldSimd (
    Self && ) [default]
```

16.87.3 Member Function Documentation

16.87.3.1 operator=() [1/2]

```
Self& operator= (
    const Self & ) [default]
```

16.87.3.2 operator=() [2/2]

```
Self& operator= (
    Self && ) [default]
```

16.87.3.3 init() [1/2]

```
INLINE vect_t init (
    vect_t & x,
    const vect_t a ) const [inline]
```

16.87.3.4 init() [2/2]

```
INLINE vect_t init (
    const vect_t a ) const [inline]
```

16.87.3.5 add() [1/2]

```
INLINE vect_t add (
    vect_t & c,
    const vect_t a,
    const vect_t b ) [inline]
```

16.87.3.6 add() [2/2]

```
INLINE vect_t add (
    const vect_t a,
    const vect_t b ) [inline]
```

16.87.3.7 addin()

```
INLINE vect_t addin (
    vect_t & a,
    const vect_t b ) const [inline]
```

16.87.3.8 add_r() [1/2]

```
INLINE vect_t add_r (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.9 add_r() [2/2]

```
INLINE vect_t add_r (  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.10 addin_r()

```
INLINE vect_t addin_r (  
    vect_t & a,  
    const vect_t b ) const [inline]
```

16.87.3.11 sub() [1/2]

```
INLINE vect_t sub (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline]
```

16.87.3.12 sub() [2/2]

```
INLINE vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline]
```

16.87.3.13 subin()

```
INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) const [inline]
```

16.87.3.14 sub_r() [1/2]

```
INLINE vect_t sub_r (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.15 sub_r() [2/2]

```
INLINE vect_t sub_r (  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.16 subin_r()

```
INLINE vect_t subin_r (  
    vect_t & a,  
    const vect_t b ) const [inline]
```

16.87.3.17 zero() [1/2]

```
INLINE vect_t zero (
    vect_t & x ) const [inline]
```

16.87.3.18 zero() [2/2]

```
INLINE vect_t zero ( ) const [inline]
```

16.87.3.19 mod()

```
INLINE vect_t mod (
    vect_t & c ) const [inline]
```

16.87.3.20 mul() [1/2]

```
INLINE vect_t mul (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.21 mul() [2/2]

```
INLINE vect_t mul (
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.22 mulin()

```
INLINE vect_t mulin (
    vect_t & a,
    const vect_t b ) const [inline]
```

16.87.3.23 mul_r() [1/2]

```
INLINE vect_t mul_r (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.24 mul_r() [2/2]

```
INLINE vect_t mul_r (
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.25 axpy() [1/2]

```
INLINE vect_t axpy (
    vect_t & r,
    const vect_t a,
```

```
const vect_t b,  
const vect_t c ) const [inline]
```

16.87.3.26 axpy() [2/2]

```
INLINE vect_t axpy (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.27 axpyin()

```
INLINE vect_t axpyin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.28 axpy_r() [1/2]

```
INLINE vect_t axpy_r (  
    vect_t & r,  
    const vect_t a,  
    const vect_t b,  
    const vect_t c ) const [inline]
```

16.87.3.29 axpy_r() [2/2]

```
INLINE vect_t axpy_r (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.30 axpyin_r()

```
INLINE vect_t axpyin_r (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.31 maxpy() [1/2]

```
INLINE vect_t maxpy (  
    vect_t & r,  
    const vect_t a,  
    const vect_t b,  
    const vect_t c ) const [inline]
```

16.87.3.32 maxpy() [2/2]

```
INLINE vect_t maxpy (  
    const vect_t c,
```

```
const vect_t a,
const vect_t b ) const [inline]
```

16.87.3.33 maxpyin()

```
INLINE vect_t maxpyin (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.4 Field Documentation

16.87.4.1 vect_size

```
constexpr const size_t vect_size = simd::vect_size [static], [constexpr]
```

16.87.4.2 alignment

```
constexpr const size_t alignment = simd::alignment [static], [constexpr]
```

The documentation for this class was generated from the following file:

- [simd_modular.inl](#)

16.88 FieldTraits< Field > Struct Template Reference

FieldTrait.

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::GenericTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.88.1 Detailed Description

```
template<class Field>
struct FFLAS::FieldTraits< Field >
```

FieldTrait.

16.88.2 Member Typedef Documentation

16.88.2.1 category

```
typedef FieldCategories::GenericTag category
```

16.88.3 Field Documentation

16.88.3.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.89 FieldTraits< FFPACK::RNSInteger< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.89.1 Member Typedef Documentation

16.89.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.89.2 Field Documentation

16.89.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.90 FieldTraits< FFPACK::RNSIntegerMod< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::ModularTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.90.1 Member Typedef Documentation

16.90.1.1 category

```
typedef FieldCategories::ModularTag category
```

16.90.2 Field Documentation**16.90.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.91 FieldTraits< Givaro::Modular< Element > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::ModularTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.91.1 Member Typedef Documentation**16.91.1.1 category**

```
typedef FieldCategories::ModularTag category
```

16.91.2 Field Documentation**16.91.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.92 FieldTraits< Givaro::ModularBalanced< Element > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::ModularTag](#) category

Static Public Attributes

- static const bool [balanced](#) = true

16.92.1 Member Typedef Documentation

16.92.1.1 category

```
typedef FieldCategories::ModularTag category
```

16.92.2 Field Documentation

16.92.2.1 balanced

```
const bool balanced = true [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.93 FieldTraits< Givaro::ZRing< double > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.93.1 Member Typedef Documentation

16.93.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.93.2 Field Documentation

16.93.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.94 FieldTraits< Givaro::ZRing< float > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.94.1 Member Typedef Documentation

16.94.1.1 category

typedef [FieldCategories::UnparametricTag](#) category

16.94.2 Field Documentation

16.94.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.95 FieldTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.95.1 Member Typedef Documentation

16.95.1.1 category

typedef [FieldCategories::UnparametricTag](#) category

16.95.2 Field Documentation

16.95.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.96 FieldTraits< Givaro::ZRing< int16_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.96.1 Member Typedef Documentation

16.96.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.96.2 Field Documentation

16.96.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.97 FieldTraits< Givaro::ZRing< int32_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.97.1 Member Typedef Documentation

16.97.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.97.2 Field Documentation

16.97.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.98 FieldTraits< Givaro::ZRing< int64_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.98.1 Member Typedef Documentation**16.98.1.1 category**

```
typedef FieldCategories::UnparametricTag category
```

16.98.2 Field Documentation**16.98.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.99 FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.99.1 Member Typedef Documentation**16.99.1.1 category**

```
typedef FieldCategories::UnparametricTag category
```

16.99.2 Field Documentation

16.99.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.100 FieldTraits< Givaro::ZRing< uint16_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.100.1 Member Typedef Documentation

16.100.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.100.2 Field Documentation

16.100.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.101 FieldTraits< Givaro::ZRing< uint32_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.101.1 Member Typedef Documentation

16.101.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.101.2 Field Documentation**16.101.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.102 FieldTraits< Givaro::ZRing< uint64_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.102.1 Member Typedef Documentation**16.102.1.1 category**

```
typedef FieldCategories::UnparametricTag category
```

16.102.2 Field Documentation**16.102.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.103 Fixed Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.104 FixedPrecIntTag Struct Reference

Fixed precision integers above machine precision: Givaro::reclnt.

```
#include <field-traits.h>
```

16.104.1 Detailed Description

Fixed precision integers above machine precision: Givaro::reclnt.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.105 ForStrategy1D< blocksize_t, Cut, Param > Struct Template Reference

Public Member Functions

- [ForStrategy1D](#) (const blocksize_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- [ForStrategy1D](#) (const blocksize_t b, const blocksize_t e, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- void [build](#) (const blocksize_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- blocksize_t [initialize](#) ()
- bool [isTerminated](#) () const
- blocksize_t [begin](#) () const
- blocksize_t [end](#) () const
- blocksize_t [numblocks](#) () const
- blocksize_t [blockindex](#) () const
- blocksize_t [operator++](#) ()

Protected Attributes

- blocksize_t [ibeg](#)
- blocksize_t [iend](#)
- blocksize_t [current](#)
- blocksize_t [firstBlockSize](#)
- blocksize_t [lastBlockSize](#)
- blocksize_t [changeBS](#)
- blocksize_t [numBlock](#)

16.105.1 Constructor & Destructor Documentation

16.105.1.1 ForStrategy1D() [1/2]

```
ForStrategy1D (
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.105.1.2 ForStrategy1D() [2/2]

```
ForStrategy1D (
    const blocksize_t b,
    const blocksize_t e,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.105.2 Member Function Documentation

16.105.2.1 build()

```
void build (
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.105.2.2 initialize()

```
blocksize_t initialize ( ) [inline]
```

16.105.2.3 isTerminated()

```
bool isTerminated ( ) const [inline]
```

16.105.2.4 begin()

```
blocksize_t begin ( ) const [inline]
```

16.105.2.5 end()

```
blocksize_t end ( ) const [inline]
```

16.105.2.6 numblocks()

```
blocksize_t numblocks ( ) const [inline]
```

16.105.2.7 blockindex()

```
blocksize_t blockindex ( ) const [inline]
```

16.105.2.8 operator++()

```
blocksize_t operator++ ( ) [inline]
```

16.105.3 Field Documentation

16.105.3.1 ibeg

```
blocksize_t ibeg [protected]
```

16.105.3.2 iend

```
blocksize_t iend [protected]
```

16.105.3.3 current

```
blocksize_t current [protected]
```


16.105.3.4 firstBlockSize

```
blocksize_t firstBlockSize [protected]
```

16.105.3.5 lastBlockSize

```
blocksize_t lastBlockSize [protected]
```

16.105.3.6 changeBS

```
blocksize_t changeBS [protected]
```

16.105.3.7 numBlock

```
blocksize_t numBlock [protected]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.106 ForStrategy2D< blocksize_t, Cut, Param > Struct Template Reference

Public Member Functions

- [ForStrategy2D](#) (const blocksize_t m, const blocksize_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- blocksize_t [initialize](#) ()
- bool [isTerminated](#) () const
- blocksize_t [ibegin](#) () const
- blocksize_t [jbegin](#) () const
- blocksize_t [iend](#) () const
- blocksize_t [jend](#) () const
- blocksize_t [operator++](#) ()
- blocksize_t [rownumblocks](#) () const
- blocksize_t [colnumblocks](#) () const
- blocksize_t [blockindex](#) () const
- blocksize_t [rowblockindex](#) () const
- blocksize_t [colblockindex](#) () const

Protected Attributes

- blocksize_t [_ibeg](#)
- blocksize_t [_iend](#)
- blocksize_t [_jbeg](#)
- blocksize_t [_jend](#)
- blocksize_t [rowBlockSize](#)
- blocksize_t [colBlockSize](#)
- blocksize_t [current](#)
- blocksize_t [lastRBS](#)
- blocksize_t [lastCBS](#)
- blocksize_t [changeRBS](#)
- blocksize_t [changeCBS](#)
- blocksize_t [numRowBlock](#)
- blocksize_t [numColBlock](#)
- blocksize_t [BLOCKS](#)

Friends

- `std::ostream & operator<< (std::ostream &out, const ForStrategy2D &FS2D)`

16.106.1 Constructor & Destructor Documentation

16.106.1.1 ForStrategy2D()

```
ForStrategy2D (
    const blocksize_t m,
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.106.2 Member Function Documentation

16.106.2.1 initialize()

```
blocksize_t initialize ( ) [inline]
```

16.106.2.2 isTerminated()

```
bool isTerminated ( ) const [inline]
```

16.106.2.3 ibegin()

```
blocksize_t ibegin ( ) const [inline]
```

16.106.2.4 jbegin()

```
blocksize_t jbegin ( ) const [inline]
```

16.106.2.5 iend()

```
blocksize_t iend ( ) const [inline]
```

16.106.2.6 jend()

```
blocksize_t jend ( ) const [inline]
```

16.106.2.7 operator++()

```
blocksize_t operator++ ( ) [inline]
```

16.106.2.8 rownumblocks()

```
blocksize_t rownumblocks ( ) const [inline]
```

16.106.2.9 colnumblocks()

```
blocksize_t colnumblocks ( ) const [inline]
```

16.106.2.10 blockindex()

```
blocksize_t blockindex ( ) const [inline]
```

16.106.2.11 rowblockindex()

```
blocksize_t rowblockindex ( ) const [inline]
```

16.106.2.12 colblockindex()

```
blocksize_t colblockindex ( ) const [inline]
```

16.106.3 Friends And Related Function Documentation

16.106.3.1 operator<<

```
std::ostream& operator<< (
    std::ostream & out,
    const ForStrategy2D< blocksize_t, Cut, Param > & FS2D ) [friend]
```

16.106.4 Field Documentation

16.106.4.1 _ibeg

```
blocksize_t _ibeg [protected]
```

16.106.4.2 _iend

```
blocksize_t _iend [protected]
```

16.106.4.3 _jbeg

```
blocksize_t _jbeg [protected]
```

16.106.4.4 _jend

```
blocksize_t _jend [protected]
```

16.106.4.5 rowBlockSize

```
blocksize_t rowBlockSize [protected]
```

16.106.4.6 colBlockSize

blocksize_t colBlockSize [protected]

16.106.4.7 current

blocksize_t current [protected]

16.106.4.8 lastRBS

blocksize_t lastRBS [protected]

16.106.4.9 lastCBS

blocksize_t lastCBS [protected]

16.106.4.10 changeRBS

blocksize_t changeRBS [protected]

16.106.4.11 changeCBS

blocksize_t changeCBS [protected]

16.106.4.12 numRowsBlock

blocksize_t numRowsBlock [protected]

16.106.4.13 numColBlock

blocksize_t numColBlock [protected]

16.106.4.14 BLOCKS

blocksize_t BLOCKS [protected]

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.107 ftrmmLeftLowerNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.108 ftrmmLeftLowerNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.109 ftrmmLeftLowerTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.110 ftrmmLeftLowerTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.111 ftrmmLeftUpperNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.112 ftrmmLeftUpperNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.113 ftrmmLeftUpperTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.114 ftrmmLeftUpperTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.115 ftrmmRightLowerNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.116 ftrmmRightLowerNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.117 **ftrmmRightLowerTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.118 **ftrmmRightLowerTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.119 **ftrmmRightUpperNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.120 **ftrmmRightUpperNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.121 **ftrmmRightUpperTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.122 **ftrmmRightUpperTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.123 **ftrsmLeftLowerNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.124 **ftrsmLeftLowerNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.125 ftrsmLeftLowerTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.126 ftrsmLeftLowerTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.127 ftrsmLeftUpperNoTransNonUnit< Element > Class Template Reference

Computes the maximal size for delaying the modular reduction in a triangular system resolution.

16.127.1 Detailed Description

```
template<class Element>
class FFLAS::Protected::ftrsmLeftUpperNoTransNonUnit< Element >
```

Computes the maximal size for delaying the modular reduction in a triangular system resolution.
Compute the maximal dimension k , such that a unit diagonal triangular system of dimension k can be solved over \mathbb{Z} without overflow of the underlying floating point representation.

Bibliography • Dumas, Giorgi, Pernet 06, arXiv:cs/0601133.

Parameters

| | |
|-----|--------------------------------------|
| F | Finite Field/Ring of the computation |
|-----|--------------------------------------|

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.128 ftrsmLeftUpperNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.129 ftrsmLeftUpperTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.130 ftrsmLeftUpperTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.131 **ftrsmRightLowerNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.132 **ftrsmRightLowerNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.133 **ftrsmRightLowerTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.134 **ftrsmRightLowerTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.135 **ftrsmRightUpperNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.136 **ftrsmRightUpperNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.137 **ftrsmRightUpperTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.138 **ftrsmRightUpperTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.139 GenericTag Struct Reference

default is generic

```
#include <field-traits.h>
```

16.139.1 Detailed Description

default is generic

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.140 GenericTag Struct Reference

generic ring.

```
#include <field-traits.h>
```

16.140.1 Detailed Description

generic ring.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.141 Grain Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.142 has_minus_eq_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.142.1 Field Documentation

16.142.1.1 value

```
constexpr bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.143 has_minus_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.143.1 Field Documentation

16.143.1.1 value

`constexpr bool value = type::value [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.144 has_mul_eq_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.144.1 Field Documentation

16.144.1.1 value

`constexpr bool value = type::value [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.145 has_mul_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.145.1 Field Documentation

16.145.1.1 value

`constexpr bool value = type::value [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.146 has_operation< T > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#)

16.146.1 Field Documentation

16.146.1.1 value

constexpr bool value [static], [constexpr]

Initial value:

```
= (has_plus<T>::value && has_minus<T>::value && has_equal<T>::value &&
    has_plus_eq<T>::value && has_minus_eq<T>::value && has_mul<T>::value
    && has_mul_eq<T>::value)
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.147 has_plus_eq_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.147.1 Field Documentation

16.147.1.1 value

constexpr bool value = type::value [static], [constexpr]

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.148 has_plus_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.148.1 Field Documentation

16.148.1.1 value

constexpr bool value = type::value [static], [constexpr]

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.149 HelperFlag Struct Reference

```
#include <fflas_sparse.h>
```

Static Public Attributes

- static constexpr [uint64_t none](#) = 0_ui64
- static constexpr [uint64_t coo](#) = 1_ui64
- static constexpr [uint64_t csr](#) = 1_ui64 << 1
- static constexpr [uint64_t ell](#) = 1_ui64 << 2
- static constexpr [uint64_t aut](#) = 1_ui64 << 32
- static constexpr [uint64_t pm1](#) = 1_ui64 << 33

16.149.1 Field Documentation

16.149.1.1 none

constexpr [uint64_t none](#) = 0_ui64 [static], [constexpr]

16.149.1.2 coo

constexpr [uint64_t coo](#) = 1_ui64 [static], [constexpr]

16.149.1.3 csr

constexpr [uint64_t csr](#) = 1_ui64 << 1 [static], [constexpr]

16.149.1.4 ell

constexpr [uint64_t ell](#) = 1_ui64 << 2 [static], [constexpr]

16.149.1.5 aut

constexpr [uint64_t aut](#) = 1_ui64 << 32 [static], [constexpr]

16.149.1.6 pm1

constexpr [uint64_t pm1](#) = 1_ui64 << 33 [static], [constexpr]

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.150 HelperMod< Field, ElementTraits > Struct Template Reference

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.151 HelperMod< Field, ElementCategories::MachineIntTag > Struct Template Reference

Public Member Functions

- [HelperMod](#) ()
- [HelperMod](#) (const [Field](#) &F)

Data Fields

- [Field::Element p](#)
- double [invp](#)
- double [min](#)
- double [max](#)
- [int64_t pow50rem](#)

16.151.1 Constructor & Destructor Documentation

16.151.1.1 HelperMod() [1/2]

```
HelperMod ( ) [inline]
```

16.151.1.2 HelperMod() [2/2]

```
HelperMod (
    const Field & F ) [inline]
```

16.151.2 Field Documentation

16.151.2.1 p

```
Field::Element p
```

16.151.2.2 invp

```
double invp
```

16.151.2.3 min

```
double min
```

16.151.2.4 max

```
double max
```

16.151.2.5 pow50rem

```
int64\_t pow50rem
```

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.152 HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag > Struct Template Reference

Public Member Functions

- [HelperMod\(\)](#)
- [HelperMod\(const Field &F\)](#)

Data Fields

- [Field::Element p](#)

16.152.1 Constructor & Destructor Documentation

16.152.1.1 HelperMod() [1/2]

[HelperMod](#) () [inline]

16.152.1.2 HelperMod() [2/2]

[HelperMod](#) (
 const [Field](#) & F) [inline]

16.152.2 Field Documentation

16.152.2.1 p

[Field::Element](#) p

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.153 HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag > Struct Template Reference

Public Member Functions

- [HelperMod\(\)](#)
- [HelperMod\(const Field &F\)](#)

Data Fields

- [Field::Element p](#)

16.153.1 Constructor & Destructor Documentation

16.153.1.1 HelperMod() [1/2]

[HelperMod](#) () [inline]

16.153.1.2 HelperMod() [2/2]

```
HelperMod (
    const Field & F ) [inline]
```

16.153.2 Field Documentation**16.153.2.1 p**

Field::Element p

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.154 HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag > Struct Template Reference

Public Member Functions

- [HelperMod\(\)](#)
- [HelperMod](#) (const [Field](#) &F)

Data Fields

- [Field::Element](#) p
- [Field::Element](#) invp
- [Field::Element](#) min
- [Field::Element](#) max

16.154.1 Constructor & Destructor Documentation**16.154.1.1 HelperMod()** [1/2]

```
HelperMod ( ) [inline]
```

16.154.1.2 HelperMod() [2/2]

```
HelperMod (
    const Field & F ) [inline]
```

16.154.2 Field Documentation**16.154.2.1 p**

Field::Element p

16.154.2.2 invp

Field::Element invp

16.154.2.3 min

`Field::Element` min

16.154.2.4 max

`Field::Element` max

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.155 Hybrid Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.156 Info Struct Reference**Public Member Functions**

- [Info](#) ([uint64_t](#) it, [uint64_t](#) s, [uint64_t](#) p)
- [Info](#) ()=default
- [Info](#) (const [Info](#) &)=default
- [Info](#) ([Info](#) &&)=default
- [Info](#) & [operator=](#) (const [Info](#) &)=default
- [Info](#) & [operator=](#) ([Info](#) &&)=default

Data Fields

- [uint64_t](#) size = 0
- [uint64_t](#) perm = 0
- [uint64_t](#) begin = 0

16.156.1 Constructor & Destructor Documentation**16.156.1.1 Info() [1/4]**

```
Info (
    uint64_t it,
    uint64_t s,
    uint64_t p ) [inline]
```

16.156.1.2 Info() [2/4]

```
Info ( ) [default]
```

16.156.1.3 Info() [3/4]

```
Info (
    const Info & ) [default]
```


16.156.1.4 Info() [4/4]

```
Info (
    Info && ) [default]
```

16.156.2 Member Function Documentation

16.156.2.1 operator=() [1/2]

```
Info& operator= (
    const Info & ) [default]
```

16.156.2.2 operator=() [2/2]

```
Info& operator= (
    Info && ) [default]
```

16.156.3 Field Documentation

16.156.3.1 size

```
uint64_t size = 0
```

16.156.3.2 perm

```
uint64_t perm = 0
```

16.156.3.3 begin

```
uint64_t begin = 0
```

The documentation for this struct was generated from the following file:

- [csr_hyb_utils.inl](#)

16.157 Info Struct Reference

Public Member Functions

- [Info](#) (uint64_t it, uint64_t s, uint64_t p)
- [Info](#) ()=default
- [Info](#) (const [Info](#) &)=default
- [Info](#) ([Info](#) &&)=default
- [Info](#) & [operator=](#) (const [Info](#) &)=default
- [Info](#) & [operator=](#) ([Info](#) &&)=default

Data Fields

- [uint64_t](#) size = 0
- [uint64_t](#) perm = 0
- [uint64_t](#) begin = 0

16.157.1 Constructor & Destructor Documentation

16.157.1.1 Info() [1/4]

```
Info (
    uint64_t it,
    uint64_t s,
    uint64_t p ) [inline]
```

16.157.1.2 Info() [2/4]

```
Info ( ) [default]
```

16.157.1.3 Info() [3/4]

```
Info (
    const Info & ) [default]
```

16.157.1.4 Info() [4/4]

```
Info (
    Info && ) [default]
```

16.157.2 Member Function Documentation

16.157.2.1 operator=() [1/2]

```
Info& operator= (
    const Info & ) [default]
```

16.157.2.2 operator=() [2/2]

```
Info& operator= (
    Info && ) [default]
```

16.157.3 Field Documentation

16.157.3.1 size

```
uint64_t size = 0
```

16.157.3.2 perm

```
uint64_t perm = 0
```

16.157.3.3 begin

```
uint64_t begin = 0
```

The documentation for this struct was generated from the following file:

- [sell_utils.inl](#)

16.158 is_simd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [type](#) = std::integral_constant< bool, false >

Static Public Attributes

- static constexpr const bool [value](#) = false

16.158.1 Member Typedef Documentation**16.158.1.1 type**

```
using type = std::integral_constant<bool, false>
```

16.158.2 Field Documentation**16.158.2.1 value**

```
constexpr const bool value = false [static], [constexpr]
```

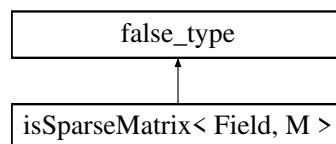
The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.159 isSparseMatrix< Field, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, M >:



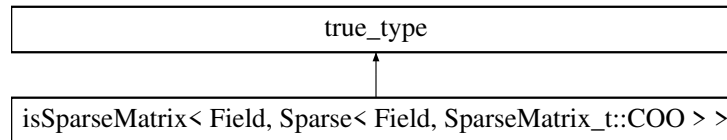
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.160 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >`:



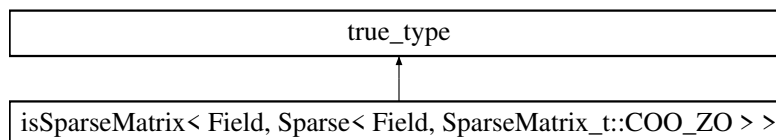
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.161 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >`:



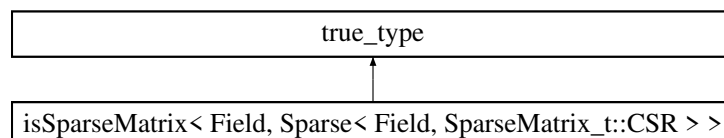
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.162 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >`:



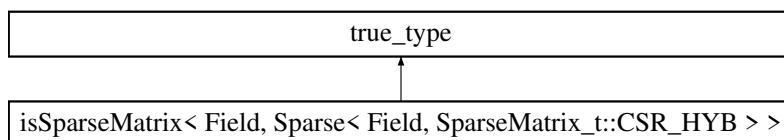
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.163 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >`:



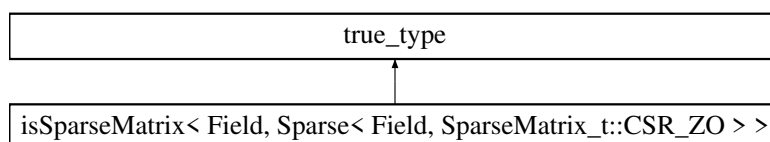
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.164 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >:



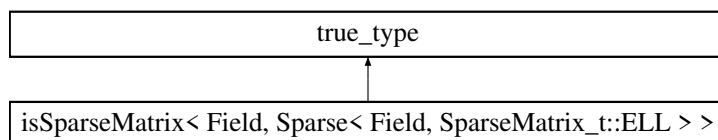
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.165 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >:



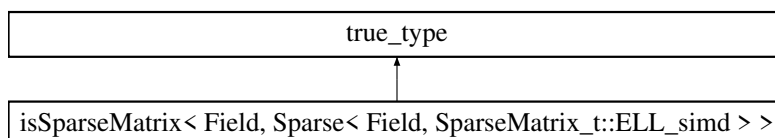
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.166 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >:



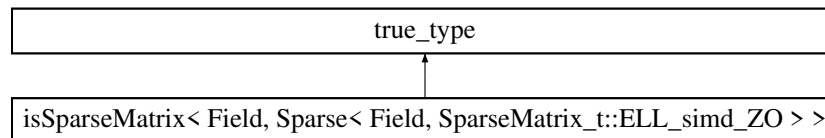
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.167 **isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference**

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >:



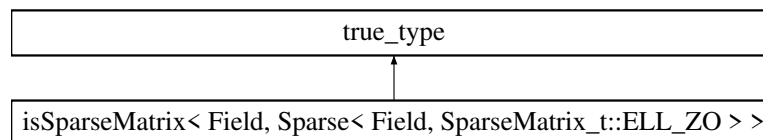
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.168 **isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference**

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >:



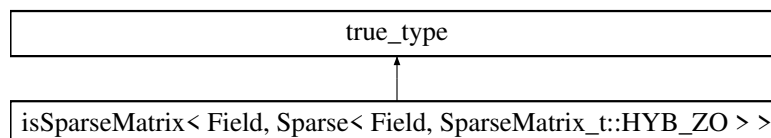
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.169 **isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > > Struct Template Reference**

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >:



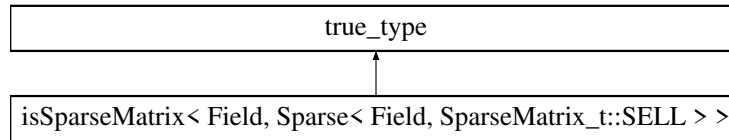
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.170 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >:



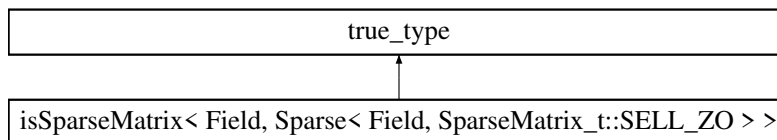
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.171 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >:



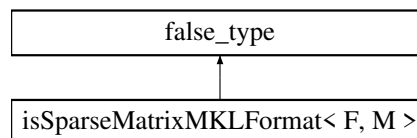
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.172 isSparseMatrixMKLFormat< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrixMKLFormat< F, M >:



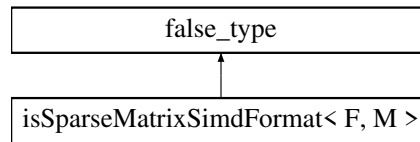
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.173 isSparseMatrixSimdFormat< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrixSimdFormat< F, M >:



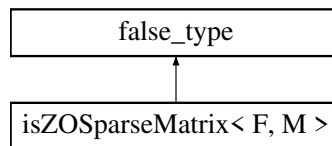
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.174 isZOSparseMatrix< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< F, M >:



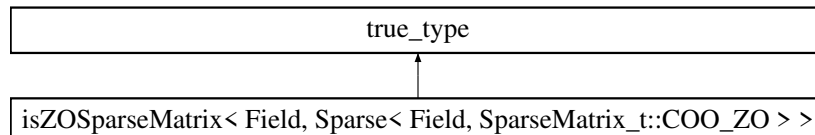
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.175 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >:



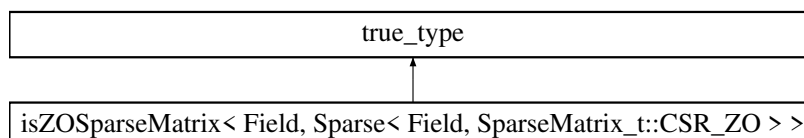
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.176 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >:



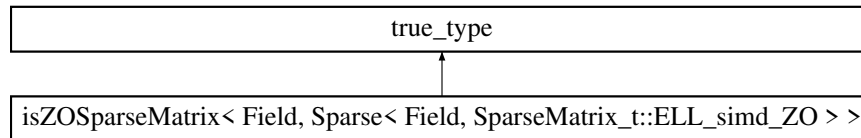
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.177 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >:



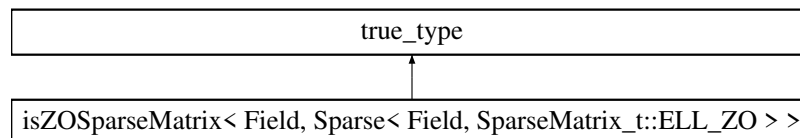
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.178 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >:



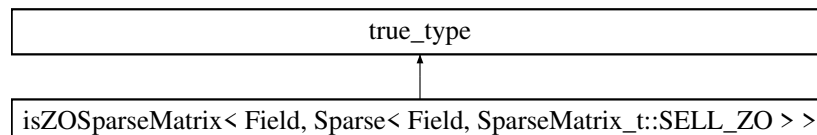
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.179 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >:



The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.180 Iterative Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.181 LazyTag Struct Reference

Performs field operations with delayed mod only when necessary. Result may not be reduced.

```
#include <field-traits.h>
```

16.181.1 Detailed Description

Performs field operations with delayed mod only when necessary. Result may not be reduced.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.182 limits< T > Struct Template Reference

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.183 limits< char > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef char [T](#)

Static Public Member Functions

- constexpr static char [max](#) () noexcept
- constexpr static char [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.183.1 Member Typedef Documentation

16.183.1.1 T

```
typedef char T
```

16.183.2 Member Function Documentation

16.183.2.1 max()

```
constexpr static char max ( ) [inline], [static], [constexpr], [noexcept]
```

16.183.2.2 min()

```
constexpr static char min ( ) [inline], [static], [constexpr], [noexcept]
```

16.183.2.3 digits()

```
constexpr static int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.184 limits< double > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef double [T](#)

Static Public Member Functions

- constexpr static [int64_t max](#) () noexcept
- constexpr static [int64_t min](#) () noexcept
- constexpr static [int32_t digits](#) () noexcept

16.184.1 Member Typedef Documentation

16.184.1.1 T

```
typedef double T
```

16.184.2 Member Function Documentation

16.184.2.1 max()

```
constexpr static int64\_t max ( ) [inline], [static], [constexpr], [noexcept]
```

16.184.2.2 min()

```
constexpr static int64\_t min ( ) [inline], [static], [constexpr], [noexcept]
```

16.184.2.3 digits()

```
constexpr static int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.185 limits< float > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef float [T](#)

Static Public Member Functions

- constexpr static [int32_t max](#) () noexcept
- constexpr static [int32_t min](#) () noexcept
- constexpr static [int32_t digits](#) () noexcept

16.185.1 Member Typedef Documentation

16.185.1.1 T

```
typedef float T
```

16.185.2 Member Function Documentation

16.185.2.1 max()

```
constexpr static int32_t max ( ) [inline], [static], [constexpr], [noexcept]
```

16.185.2.2 min()

```
constexpr static int32_t min ( ) [inline], [static], [constexpr], [noexcept]
```

16.185.2.3 digits()

```
constexpr static int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.186 limits< Givaro::Integer > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef Givaro::Integer T

Static Public Member Functions

- constexpr static int [max](#) () noexcept
- constexpr static int [min](#) () noexcept

16.186.1 Member Typedef Documentation

16.186.1.1 T

```
typedef Givaro::Integer T
```

16.186.2 Member Function Documentation

16.186.2.1 max()

```
constexpr static int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.186.2.2 min()

```
constexpr static int min ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.187 limits< int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef int [T](#)

Static Public Member Functions

- constexpr static int [max](#) () noexcept
- constexpr static int [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.187.1 Member Typedef Documentation

16.187.1.1 T

```
typedef int T
```

16.187.2 Member Function Documentation

16.187.2.1 max()

```
constexpr static int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.187.2.2 min()

```
constexpr static int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.187.2.3 digits()

```
constexpr static int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.188 limits< long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef long [T](#)

Static Public Member Functions

- constexpr static long [max](#) () noexcept
- constexpr static long [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.188.1 Member Typedef Documentation

16.188.1.1 T

```
typedef long T
```

16.188.2 Member Function Documentation

16.188.2.1 max()

```
constexpr static long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.188.2.2 min()

```
constexpr static long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.188.2.3 digits()

```
constexpr static int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.189 limits< long long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef long long [T](#)

Static Public Member Functions

- constexpr static long long [max](#) () noexcept
- constexpr static long long [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.189.1 Member Typedef Documentation

16.189.1.1 T

```
typedef long long T
```

16.189.2 Member Function Documentation

16.189.2.1 max()

```
constexpr static long long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.189.2.2 min()

```
constexpr static long long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.189.2.3 digits()

```
constexpr static int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.190 limits< RecInt::rint< K > > Struct Template Reference

```
#include <flimits.h>
```

Public Types

- typedef [RecInt::ruint](#)< K > [T](#)

Static Public Member Functions

- constexpr static [RecInt::rint](#)< K > [max](#) () noexcept
- constexpr static [RecInt::rint](#)< K > [min](#) () noexcept

16.190.1 Member Typedef Documentation

16.190.1.1 T

```
typedef RecInt::ruint<K> T
```

16.190.2 Member Function Documentation

16.190.2.1 max()

```
constexpr static RecInt::rint<K> max ( ) [inline], [static], [constexpr], [noexcept]
```

16.190.2.2 min()

```
constexpr static RecInt::rint<K> min ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.191 limits< RecInt::ruint< K > > Struct Template Reference

```
#include <flimits.h>
```

Public Types

- typedef [RecInt::ruint](#)< K > [T](#)

Static Public Member Functions

- constexpr static [RecInt::ruint](#)< K > [max](#) () noexcept
- constexpr static [RecInt::ruint](#)< K > [min](#) () noexcept

16.191.1 Member Typedef Documentation

16.191.1.1 T

```
typedef RecInt::ruint<K> T
```

16.191.2 Member Function Documentation

16.191.2.1 max()

```
constexpr static RecInt::ruint<K> max ( ) [inline], [static], [constexpr], [noexcept]
```

16.191.2.2 min()

```
constexpr static RecInt::ruint<K> min ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.192 limits< short int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef short int [T](#)

Static Public Member Functions

- constexpr static short int [max](#) () noexcept
- constexpr static short int [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.192.1 Member Typedef Documentation

16.192.1.1 T

```
typedef short int T
```


16.192.2 Member Function Documentation

16.192.2.1 max()

```
constexpr static short int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.192.2.2 min()

```
constexpr static short int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.192.2.3 digits()

```
constexpr static int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.193 limits< signed char > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef signed char [T](#)

Static Public Member Functions

- constexpr static signed char [max](#) () noexcept
- constexpr static signed char [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.193.1 Member Typedef Documentation

16.193.1.1 T

```
typedef signed char T
```

16.193.2 Member Function Documentation

16.193.2.1 max()

```
constexpr static signed char max ( ) [inline], [static], [constexpr], [noexcept]
```

16.193.2.2 min()

```
constexpr static signed char min ( ) [inline], [static], [constexpr], [noexcept]
```

16.193.2.3 digits()

```
constexpr static int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.194 limits< unsigned char > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned char [T](#)

Static Public Member Functions

- constexpr static unsigned char [max](#) () noexcept
- constexpr static unsigned char [min](#) () noexcept
- constexpr static [int32_t digits](#) () noexcept

16.194.1 Member Typedef Documentation

16.194.1.1 T

```
typedef unsigned char T
```

16.194.2 Member Function Documentation

16.194.2.1 max()

```
constexpr static unsigned char max ( ) [inline], [static], [constexpr], [noexcept]
```

16.194.2.2 min()

```
constexpr static unsigned char min ( ) [inline], [static], [constexpr], [noexcept]
```

16.194.2.3 digits()

```
constexpr static int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.195 limits< unsigned int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned int [T](#)

Static Public Member Functions

- constexpr static unsigned int [max](#) () noexcept
- constexpr static unsigned int [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.195.1 Member Typedef Documentation

16.195.1.1 T

```
typedef unsigned int T
```

16.195.2 Member Function Documentation

16.195.2.1 max()

```
constexpr static unsigned int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.195.2.2 min()

```
constexpr static unsigned int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.195.2.3 digits()

```
constexpr static int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.196 limits< unsigned long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned long [T](#)

Static Public Member Functions

- constexpr static unsigned long [max](#) () noexcept
- constexpr static unsigned long [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.196.1 Member Typedef Documentation

16.196.1.1 T

```
typedef unsigned long T
```

16.196.2 Member Function Documentation

16.196.2.1 max()

```
constexpr static unsigned long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.196.2.2 min()

```
constexpr static unsigned long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.196.2.3 digits()

```
constexpr static int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.197 limits< unsigned long long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned long long [T](#)

Static Public Member Functions

- constexpr static unsigned long long [max](#) () noexcept
- constexpr static unsigned long long [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.197.1 Member Typedef Documentation

16.197.1.1 T

```
typedef unsigned long long T
```

16.197.2 Member Function Documentation

16.197.2.1 max()

```
constexpr static unsigned long long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.197.2.2 min()

```
constexpr static unsigned long long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.197.2.3 digits()

```
constexpr static int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.198 limits< unsigned short int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned short int [T](#)

Static Public Member Functions

- constexpr static unsigned short int [max](#) () noexcept
- constexpr static unsigned short int [min](#) () noexcept
- constexpr static [int32_t](#) [digits](#) () noexcept

16.198.1 Member Typedef Documentation

16.198.1.1 T

```
typedef unsigned short int T
```

16.198.2 Member Function Documentation

16.198.2.1 max()

```
constexpr static unsigned short int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.198.2.2 min()

```
constexpr static unsigned short int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.198.2.3 digits()

```
constexpr static int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.199 MachineFloatTag Struct Reference

float or double

```
#include <field-traits.h>
```

16.199.1 Detailed Description

float or double

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.200 MachineIntTag Struct Reference

short, int, long, long long, and unsigned variants

```
#include <field-traits.h>
```

16.200.1 Detailed Description

short, int, long, long long, and unsigned variants

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.201 MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeTrait](#), [ParSeqTrait](#) > [Self_t](#)
- typedef [associatedDelayedField](#)< const [Field](#) >::type [DelayedField_t](#)
- typedef [associatedDelayedField](#)< const [Field](#) >::field [DelayedField](#)
- typedef [DelayedField::Element](#) [DFElt](#)

Public Member Functions

- void [initC](#) ()
- void [initA](#) ()
- void [initB](#) ()
- void [initOut](#) ()
- [size_t](#) [MaxDelayedDim](#) ([DFElt](#) beta)
- bool [Aunfit](#) ()
- bool [Bunfit](#) ()
- void [setOutBounds](#) (const [size_t](#) k, const [DFElt](#) alpha, const [DFElt](#) beta)
- bool [checkA](#) (const [Field](#) &F, const [FFLAS::FFLAS_TRANSPOSE](#) ta, const [size_t](#) M, const [size_t](#) N, typename [Field::ConstElement_ptr](#) A, const [size_t](#) lda)
- bool [checkB](#) (const [Field](#) &F, const [FFLAS::FFLAS_TRANSPOSE](#) tb, const [size_t](#) M, const [size_t](#) N, typename [Field::ConstElement_ptr](#) B, const [size_t](#) ldb)
- bool [checkOut](#) (const [Field](#) &F, const [size_t](#) M, const [size_t](#) N, typename [Field::ConstElement_ptr](#) A, const [size_t](#) lda)
- [MMHelper](#) ()
- [MMHelper](#) (const [Field](#) &F, [size_t](#) m, [size_t](#) k, [size_t](#) n, [ParSeqTrait](#) _PS)
- [MMHelper](#) (const [Field](#) &F, int w, [ParSeqTrait](#) _PS=[ParSeqTrait](#)())
- template<class F2, typename AlgoT2, typename FT2, typename PS2 >
 [MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)
- [MMHelper](#) (const [Field](#) &F, int w, [DFElt](#) _Amin, [DFElt](#) _Amax, [DFElt](#) _Bmin, [DFElt](#) _Bmax, [DFElt](#) _Cmin, [DFElt](#) _Cmax, [ParSeqTrait](#) _PS=[ParSeqTrait](#)())

Data Fields

- int [recLevel](#)
- [DFelt](#) FieldMin
- [DFelt](#) FieldMax
- [DFelt](#) Amin
- [DFelt](#) Amax
- [DFelt](#) Bmin
- [DFelt](#) Bmax
- [DFelt](#) Cmin
- [DFelt](#) Cmax
- [DFelt](#) Outmin
- [DFelt](#) Outmax
- [DFelt](#) MaxStorableValue
- const [DelayedField_t](#) [delayedField](#)
- [ParSeqTrait](#) [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.201.1 Member Typedef Documentation

16.201.1.1 Self_t

```
typedef MMHelper<Field,AlgoTrait,ModeTrait,ParSeqTrait> Self_t
```

16.201.1.2 DelayedField_t

```
typedef associatedDelayedField<const Field>::type DelayedField_t
```

16.201.1.3 DelayedField

```
typedef associatedDelayedField<const Field>::field DelayedField
```

16.201.1.4 DFElt

```
typedef DelayedField::Element DFElt
```

16.201.2 Constructor & Destructor Documentation

16.201.2.1 MMHelper() [1/5]

```
MMHelper ( ) [inline]
```

16.201.2.2 MMHelper() [2/5]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait _PS ) [inline]
```

16.201.2.3 MMHelper() [3/5]

```
MMHelper (
    const Field & F,
    int w,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.201.2.4 MMHelper() [4/5]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.201.2.5 MMHelper() [5/5]

```
MMHelper (
    const Field & F,
    int w,
    DFelt _Amin,
    DFelt _Amax,
    DFelt _Bmin,
    DFelt _Bmax,
    DFelt _Cmin,
    DFelt _Cmax,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.201.3 Member Function Documentation**16.201.3.1 initC()**

```
void initC ( ) [inline]
```

16.201.3.2 initA()

```
void initA ( ) [inline]
```

16.201.3.3 initB()

```
void initB ( ) [inline]
```

16.201.3.4 initOut()

```
void initOut ( ) [inline]
```


16.201.3.5 MaxDelayedDim()

```
size_t MaxDelayedDim (
    DFelt beta ) [inline]
```

16.201.3.6 Aunfit()

```
bool Aunfit ( ) [inline]
```

16.201.3.7 Bunfit()

```
bool Bunfit ( ) [inline]
```

16.201.3.8 setOutBounds()

```
void setOutBounds (
    const size_t k,
    const DFelt alpha,
    const DFelt beta ) [inline]
```

16.201.3.9 checkA()

```
bool checkA (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda ) [inline]
```

16.201.3.10 checkB()

```
bool checkB (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb ) [inline]
```

16.201.3.11 checkOut()

```
bool checkOut (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda ) [inline]
```

16.201.4 Friends And Related Function Documentation

16.201.4.1 operator<<

```
std::ostream& operator<< (  
    std::ostream & out,  
    const Self_t & M ) [friend]
```

16.201.5 Field Documentation**16.201.5.1 recLevel**

```
int recLevel
```

16.201.5.2 FieldMin

```
DFElt FieldMin
```

16.201.5.3 FieldMax

```
DFElt FieldMax
```

16.201.5.4 Amin

```
DFElt Amin
```

16.201.5.5 Amax

```
DFElt Amax
```

16.201.5.6 Bmin

```
DFElt Bmin
```

16.201.5.7 Bmax

```
DFElt Bmax
```

16.201.5.8 Cmin

```
DFElt Cmin
```

16.201.5.9 Cmax

```
DFElt Cmax
```

16.201.5.10 Outmin

```
DFElt Outmin
```

16.201.5.11 Outmax

[DFelt](#) Outmax

16.201.5.12 MaxStorableValue

[DFelt](#) MaxStorableValue

16.201.5.13 delayedField

const [DelayedField_t](#) delayedField

16.201.5.14 parseq

[ParSeqTrait](#) parseq

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.202 MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [FFPACK::RNSInteger](#)< E >, [AlgoTrait](#), [ModeCategories::DefaultTag](#), [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (Givaro::Integer [Amax](#), Givaro::Integer [Bmax](#))
- [MMHelper](#) (const [FFPACK::RNSInteger](#)< E > &F, size_t m, size_t n, size_t k, [ParSeqTrait](#) PS=[ParSeqTrait](#)())
- [MMHelper](#) (const [FFPACK::RNSInteger](#)< E > &F, int wino, [ParSeqTrait](#) PS=[ParSeqTrait](#)())
- template<class F2 , class A2 , class M2 , class PS2 > [MMHelper](#) ([MMHelper](#)< F2, A2, M2, PS2 > H2)
- void [setNorm](#) (Givaro::Integer p)

Data Fields

- Givaro::Integer [normA](#)
- Givaro::Integer [normB](#)
- int [recLevel](#)
- [ParSeqTrait](#) [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.202.1 Member Typedef Documentation

16.202.1.1 Self_t

```
typedef MMHelper<FFPACK::RNSInteger<E>, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait>
Self_t
```

16.202.2 Constructor & Destructor Documentation**16.202.2.1 MMHelper() [1/5]**

```
MMHelper ( ) [inline]
```

16.202.2.2 MMHelper() [2/5]

```
MMHelper (
    Givaro::Integer Amax,
    Givaro::Integer Bmax ) [inline]
```

16.202.2.3 MMHelper() [3/5]

```
MMHelper (
    const FFPACK::RNSInteger< E > & F,
    size_t m,
    size_t n,
    size_t k,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.202.2.4 MMHelper() [4/5]

```
MMHelper (
    const FFPACK::RNSInteger< E > & F,
    int wino,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.202.2.5 MMHelper() [5/5]

```
MMHelper (
    MMHelper< F2, A2, M2, PS2 > H2 ) [inline]
```

16.202.3 Member Function Documentation**16.202.3.1 setNorm()**

```
void setNorm (
    Givaro::Integer p ) [inline]
```

16.202.4 Friends And Related Function Documentation

16.202.4.1 operator<<

```
std::ostream& operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.202.5 Field Documentation

16.202.5.1 normA

Givaro::Integer normA

16.202.5.2 normB

Givaro::Integer normB

16.202.5.3 recLevel

int recLevel

16.202.5.4 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fgemm_classical_mp.inl](#)

16.203 MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference

Public Types

- typedef MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, [ModeCategories::DefaultTag](#), ParSeqTrait > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (Givaro::Integer [Amax](#), Givaro::Integer [Bmax](#))
- [MMHelper](#) (const [FFPACK::RNSIntegerMod](#)< E > &F, size_t m, size_t n, size_t k, ParSeqTrait PS=[ParSeqTrait](#)())
- [MMHelper](#) (const [FFPACK::RNSIntegerMod](#)< E > &F, int wino, ParSeqTrait PS=[ParSeqTrait](#)())
- template<class F2, typename AlgoT2, typename FT2, typename PS2 >
[MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)
- void [setNorm](#) (Givaro::Integer p)

Data Fields

- Givaro::Integer [normA](#)
- Givaro::Integer [normB](#)
- int [recLevel](#)
- ParSeqTrait [parseq](#)

Friends

- `std::ostream & operator<< (std::ostream &out, const Self_t &M)`

16.203.1 Member Typedef Documentation

16.203.1.1 Self_t

```
typedef MMHelper<FFPACK::RNSIntegerMod<E>, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait>
Self_t
```

16.203.2 Constructor & Destructor Documentation

16.203.2.1 MMHelper() [1/5]

```
MMHelper ( ) [inline]
```

16.203.2.2 MMHelper() [2/5]

```
MMHelper (
    Givaro::Integer Amax,
    Givaro::Integer Bmax ) [inline]
```

16.203.2.3 MMHelper() [3/5]

```
MMHelper (
    const FFPACK::RNSIntegerMod< E > & F,
    size_t m,
    size_t n,
    size_t k,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.203.2.4 MMHelper() [4/5]

```
MMHelper (
    const FFPACK::RNSIntegerMod< E > & F,
    int wino,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.203.2.5 MMHelper() [5/5]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.203.3 Member Function Documentation

16.203.3.1 setNorm()

```
void setNorm (
    Givaro::Integer p ) [inline]
```

16.203.4 Friends And Related Function Documentation

16.203.4.1 operator<<

```
std::ostream& operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.203.5 Field Documentation

16.203.5.1 normA

Givaro::Integer normA

16.203.5.2 normB

Givaro::Integer normB

16.203.5.3 recLevel

int recLevel

16.203.5.4 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fgemm_classical_mp.inl](#)

16.204 MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::ConvertTo](#)< Dest >, [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (const [Field](#) &F, size_t m, size_t k, size_t n, [ParSeqTrait](#) _PS)
- [MMHelper](#) (const [Field](#) &F, int w, [ParSeqTrait](#) _PS=[ParSeqTrait](#)())
- template<class F2 , typename AlgoT2 , typename FT2 , typename PS2 >
[MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)

Data Fields

- int [recLevel](#)
- [ParSeqTrait](#) [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.204.1 Member Typedef Documentation

16.204.1.1 Self_t

```
typedef MMHelper<Field,AlgoTrait, ModeCategories::ConvertTo<Dest>,ParSeqTrait> Self_t
```

16.204.2 Constructor & Destructor Documentation

16.204.2.1 MMHelper() [1/4]

```
MMHelper ( ) [inline]
```

16.204.2.2 MMHelper() [2/4]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait _PS ) [inline]
```

16.204.2.3 MMHelper() [3/4]

```
MMHelper (
    const Field & F,
    int w,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.204.2.4 MMHelper() [4/4]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.204.3 Friends And Related Function Documentation

16.204.3.1 operator<<

```
std::ostream& operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.204.4 Field Documentation

16.204.4.1 recLevel

```
int recLevel
```


16.204.4.2 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.205 MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- template<class F2 , class A2 , class M2 , class PS2 >
[MMHelper](#) ([MMHelper](#)< F2, A2, M2, PS2 > H2)
- [MMHelper](#) (Givaro::Integer [Amax](#), Givaro::Integer [Bmax](#))
- [MMHelper](#) (const [Field](#) &F, size_t m, size_t n, size_t k, ParSeqTrait PS=ParSeqTrait())
- [MMHelper](#) (const [Field](#) &F, int wino, ParSeqTrait PS=ParSeqTrait())
- void [setNorm](#) (Givaro::Integer p)

Data Fields

- Givaro::Integer [normA](#)
- Givaro::Integer [normB](#)
- int [recLevel](#)
- ParSeqTrait [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.205.1 Member Typedef Documentation

16.205.1.1 Self_t

```
typedef MMHelper<Field, AlgoTrait,ModeCategories::ConvertTo<ElementCategories::RNSElementTag>,  
ParSeqTrait> Self\_t
```

16.205.2 Constructor & Destructor Documentation

16.205.2.1 MMHelper() [1/5]

```
MMHelper ( ) [inline]
```

16.205.2.2 MMHelper() [2/5]

```
MMHelper (
    MMHelper< F2, A2, M2, PS2 > H2 ) [inline]
```

16.205.2.3 MMHelper() [3/5]

```
MMHelper (
    Givaro::Integer Amax,
    Givaro::Integer Bmax ) [inline]
```

16.205.2.4 MMHelper() [4/5]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t n,
    size_t k,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.205.2.5 MMHelper() [5/5]

```
MMHelper (
    const Field & F,
    int wino,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.205.3 Member Function Documentation**16.205.3.1 setNorm()**

```
void setNorm (
    Givaro::Integer p ) [inline]
```

16.205.4 Friends And Related Function Documentation**16.205.4.1 operator<<**

```
std::ostream& operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.205.5 Field Documentation**16.205.5.1 normA**

```
Givaro::Integer normA
```

16.205.5.2 normB

Givaro::Integer normB

16.205.5.3 recLevel

int recLevel

16.205.5.4 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fgemm_classical_mp.inl](#)

16.206 MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference

FGEMM Helper for Default and ConvertTo modes of operation.

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::DefaultTag](#), [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (const [Field](#) &F, size_t m, size_t k, size_t n, [ParSeqTrait](#) _PS)
- [MMHelper](#) (const [Field](#) &F, int w, [ParSeqTrait](#) _PS=[ParSeqTrait](#)())
- template<class F2 , typename AlgoT2 , typename FT2 , typename PS2 >
[MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)

Data Fields

- int [recLevel](#)
- [ParSeqTrait](#) [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.206.1 Detailed Description

```
template<class Field, typename AlgoTrait, typename ParSeqTrait>
struct FFLAS::MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >
```

FGEMM Helper for Default and ConvertTo modes of operation.

16.206.2 Member Typedef Documentation

16.206.2.1 Self_t

```
typedef MMHelper<Field,AlgoTrait, ModeCategories::DefaultTag,ParSeqTrait> Self\_t
```

16.206.3 Constructor & Destructor Documentation

16.206.3.1 MMHelper() [1/4]

```
MMHelper ( ) [inline]
```

16.206.3.2 MMHelper() [2/4]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait _PS ) [inline]
```

16.206.3.3 MMHelper() [3/4]

```
MMHelper (
    const Field & F,
    int w,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.206.3.4 MMHelper() [4/4]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.206.4 Friends And Related Function Documentation

16.206.4.1 operator<<

```
std::ostream& operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.206.5 Field Documentation

16.206.5.1 recLevel

```
int recLevel
```

16.206.5.2 parseq

```
ParSeqTrait parseq
```

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.207 ModeTraits< Field > Struct Template Reference

[ModeTraits.](#)

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultTag](#) value

16.207.1 Detailed Description

```
template<class Field>
```

```
struct FFLAS::ModeTraits< Field >
```

[ModeTraits.](#)

16.207.2 Member Typedef Documentation

16.207.2.1 value

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.208 ModeTraits< Givaro::Modular< Element, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DelayedTag](#) value

16.208.1 Member Typedef Documentation

16.208.1.1 value

```
typedef ModeCategories::DelayedTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.209 ModeTraits< Givaro::Modular< Givaro::Integer, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value

16.209.1 Member Typedef Documentation

16.209.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.210 ModeTraits< Givaro::Modular< int16_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.210.1 Member Typedef Documentation

16.210.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.211 ModeTraits< Givaro::Modular< int32_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.211.1 Member Typedef Documentation

16.211.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.212 ModeTraits< Givaro::Modular< int8_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.212.1 Member Typedef Documentation

16.212.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value](#)

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.213 ModeTraits< Givaro::Modular< RecInt::ruint< K >, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag > value](#)

16.213.1 Member Typedef Documentation

16.213.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::RNSElementTag> value](#)

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.214 ModeTraits< Givaro::Modular< uint16_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.214.1 Member Typedef Documentation

16.214.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value](#)

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.215 ModeTraits< Givaro::Modular< uint32_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.215.1 Member Typedef Documentation

16.215.1.1 value

```
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.216 ModeTraits< Givaro::Modular< uint8_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.216.1 Member Typedef Documentation

16.216.1.1 value

```
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.217 ModeTraits< Givaro::ModularBalanced< Element > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DelayedTag value](#)

16.217.1 Member Typedef Documentation

16.217.1.1 value

```
typedef ModeCategories::DelayedTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.218 ModeTraits< Givaro::ModularBalanced< Givaro::Integer > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag > value](#)

16.218.1 Member Typedef Documentation**16.218.1.1 value**

```
typedef ModeCategories::ConvertTo<ElementCategories::RNSElementTag> value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.219 ModeTraits< Givaro::ModularBalanced< int16_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.219.1 Member Typedef Documentation**16.219.1.1 value**

```
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.220 ModeTraits< Givaro::ModularBalanced< int32_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.220.1 Member Typedef Documentation

16.220.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.221 ModeTraits< Givaro::ModularBalanced< int8_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.221.1 Member Typedef Documentation

16.221.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.222 ModeTraits< Givaro::Montgomery< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value

16.222.1 Member Typedef Documentation

16.222.1.1 value

typedef [ModeCategories::DefaultBoundedTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.223 ModeTraits< Givaro::ZRing< double > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value

16.223.1 Member Typedef Documentation

16.223.1.1 value

typedef [ModeCategories::DefaultBoundedTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.224 ModeTraits< Givaro::ZRing< float > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value

16.224.1 Member Typedef Documentation

16.224.1.1 value

typedef [ModeCategories::DefaultBoundedTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.225 ModeTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value

16.225.1 Member Typedef Documentation

16.225.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.226 ModularBalanced< T > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.227 ModularTag Struct Reference

This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`
`#include <field-traits.h>`

16.227.1 Detailed Description

This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`
 The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.228 Montgomery< T > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.229 need_field_characteristic< Field > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = false

16.229.1 Field Documentation

16.229.1.1 value

```
constexpr bool value = false [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.230 need_field_characteristic< Givaro::Modular< Field > > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = true

16.230.1 Field Documentation

16.230.1.1 value

```
constexpr bool value = true [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.231 need_field_characteristic< Givaro::ModularBalanced< Field > > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = true

16.231.1 Field Documentation

16.231.1.1 value

`constexpr bool value = true [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.232 NoSimd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [vect_t](#) = T *
- using [scalar_t](#) = T

Static Public Member Functions

- static const std::string [type_string](#) ()
- template<class TT >
static constexpr bool [valid](#) (TT p)
- template<class TT >
static constexpr bool [compliant](#) (TT n)

Static Public Attributes

- static constexpr const size_t [vect_size](#) = 1

16.232.1 Member Typedef Documentation

16.232.1.1 vect_t

```
using vect\_t = T*
```

16.232.1.2 scalar_t

```
using scalar\_t = T
```

16.232.2 Member Function Documentation

16.232.2.1 type_string()

```
static const std::string type_string ( ) [inline], [static]
```

16.232.2.2 valid()

```
static constexpr bool valid (
    TT p ) [inline], [static], [constexpr]
```

16.232.2.3 compliant()

```
static constexpr bool compliant (
    TT n ) [inline], [static], [constexpr]
```

16.232.3 Field Documentation

16.232.3.1 vect_size

```
constexpr const size_t vect_size = 1 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.233 Parallel< C, P > Struct Template Reference

Public Types

- typedef C [Cut](#)
- typedef P [Param](#)

Public Member Functions

- [Parallel](#) (size_t n=[NUM_THREADS](#))
- size_t [numthreads](#) () const
- size_t & [set_numthreads](#) (size_t n)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Parallel](#) &p)

16.233.1 Member Typedef Documentation

16.233.1.1 Cut

```
typedef C Cut
```

16.233.1.2 Param

```
typedef P Param
```

16.233.2 Constructor & Destructor Documentation

16.233.2.1 Parallel()

```
Parallel (
    size_t n = NUM\_THREADS ) [inline]
```

16.233.3 Member Function Documentation

16.233.3.1 numthreads()

```
size_t numthreads ( ) const [inline]
```

16.233.3.2 set_numthreads()

```
size_t& set_numthreads (
    size_t n ) [inline]
```

16.233.4 Friends And Related Function Documentation

16.233.4.1 operator<<

```
std::ostream& operator<< (
    std::ostream & out,
    const Parallel< C, P > & p ) [friend]
```

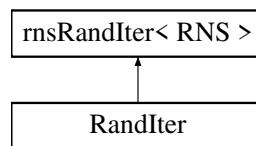
The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.234 RNSInteger< RNS >::RandIter Class Reference

```
#include <rns-integer.h>
```

Inheritance diagram for RNSInteger< RNS >::RandIter:



Public Member Functions

- [RandIter](#) (const [RNSInteger< RNS >](#) &F, size_t size=0, uint64_t seed=0)
- [RNS::Element & random](#) (typename [RNS::Element](#) &elt) const
RNS ring Element random assignement.
- [RNS::Element random](#) () const
- [RNS::Element & operator\(\)](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element operator\(\)](#) () const
- const [RNS](#) & [ring](#) () const

16.234.1 Constructor & Destructor Documentation

16.234.1.1 RandIter()

```
RandIter (
    const RNSInteger< RNS > & F,
    size_t size = 0,
    uint64_t seed = 0 ) [inline]
```

16.234.2 Member Function Documentation

16.234.2.1 random() [1/2]

```
RNS::Element& random (
    typename RNS::Element & elt ) const [inline], [inherited]
```

RNS ring Element random assignment.

Element is supposed to be initialized

Returns

random ring Element

16.234.2.2 random() [2/2]

```
RNS::Element random ( ) const [inline], [inherited]
```

16.234.2.3 operator>() [1/2]

```
RNS::Element& operator() (
    typename RNS::Element & elt ) const [inline], [inherited]
```

16.234.2.4 operator>() [2/2]

```
RNS::Element operator() ( ) const [inline], [inherited]
```

16.234.2.5 ring()

```
const RNS& ring ( ) const [inline], [inherited]
```

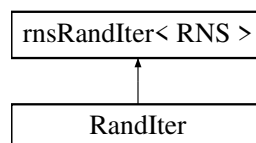
The documentation for this class was generated from the following file:

- [rns-integer.h](#)

16.235 RNSIntegerMod< RNS >::RandIter Class Reference

```
#include <rns-integer-mod.h>
```

Inheritance diagram for RNSIntegerMod< RNS >::RandIter:

**Public Member Functions**

- [RandIter](#) (const [RNSIntegerMod< RNS >](#) &F, [size_t](#) size=0, [uint64_t](#) seed=0)
- [RNS::Element & random](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element random](#) () const
- [RNS::Element & operator\(\)](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element operator\(\)](#) () const
- const [RNS](#) & [ring](#) () const

16.235.1 Constructor & Destructor Documentation

16.235.1.1 RandIter()

```
RandIter (
    const RNSIntegerMod< RNS > & F,
    size_t size = 0,
    uint64_t seed = 0 ) [inline]
```

16.235.2 Member Function Documentation**16.235.2.1 random() [1/2]**

```
RNS::Element& random (
    typename RNS::Element & elt ) const [inline]
```

16.235.2.2 random() [2/2]

```
RNS::Element random ( ) const [inline], [inherited]
```

16.235.2.3 operator>() [1/2]

```
RNS::Element& operator() (
    typename RNS::Element & elt ) const [inline], [inherited]
```

16.235.2.4 operator>() [2/2]

```
RNS::Element operator() ( ) const [inline], [inherited]
```

16.235.2.5 ring()

```
const RNS& ring ( ) const [inline], [inherited]
```

The documentation for this class was generated from the following file:

- [rns-integer-mod.h](#)

16.236 readMyMachineType< Field, T > Struct Template Reference

```
#include <read_sparse.h>
```

Public Types

- typedef [Field::Element](#) Element
- typedef [Field::Element_ptr](#) Element_ptr

Public Member Functions

- void [operator\(\)](#) (const [Field](#) &F, [Element](#) &modulo, [Element_ptr](#) val, std::ifstream &file, const [uint64_t](#) dims, const [mask_t](#) data_type, const [mask_t](#) field_desc)

16.236.1 Member Typedef Documentation

16.236.1.1 Element

```
typedef Field::Element Element
```

16.236.1.2 Element_ptr

```
typedef Field::Element_ptr Element_ptr
```

16.236.2 Member Function Documentation

16.236.2.1 operator>()

```
void operator() (
    const Field & F,
    Element & modulo,
    Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc )
```

The documentation for this struct was generated from the following file:

- [read_sparse.h](#)

16.237 readMyMachineType< Field, mpz_t > Struct Template Reference

```
#include <read_sparse.h>
```

Public Types

- typedef [Field::Element](#) [Element](#)
- typedef [Field::Element_ptr](#) [Element_ptr](#)

Public Member Functions

- void [operator\(\)](#) (const [Field](#) &F, [Element](#) &modulo, [Element_ptr](#) val, std::ifstream &file, const [uint64_t](#) dims, const [mask_t](#) data_type, const [mask_t](#) field_desc)

16.237.1 Member Typedef Documentation

16.237.1.1 Element

```
typedef Field::Element Element
```

16.237.1.2 Element_ptr

```
typedef Field::Element_ptr Element_ptr
```

16.237.2 Member Function Documentation

16.237.2.1 operator()()

```
void operator() (
    const Field & F,
    typename Field::Element & modulo,
    typename Field::Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc )
```

The documentation for this struct was generated from the following file:

- [read_sparse.h](#)

16.238 Recursive Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.239 Recursive Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.240 rint< K > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.241 rns_double Struct Reference

```
#include <rns-double.h>
```

Public Types

- typedef Givaro::Integer [integer](#)
- typedef Givaro::Modular< double > [ModField](#)
- typedef double [BasisElement](#)
- typedef [rns_double_elt](#) [Element](#)
- typedef [rns_double_elt_ptr](#) [Element_ptr](#)
- typedef [rns_double_elt_cstptr](#) [ConstElement_ptr](#)

Public Member Functions

- [rns_double](#) (const [integer](#) &bound, size_t pbits, bool rnsmod=false, long seed=time(NULL))
- [rns_double](#) (size_t pbits, size_t size, long seed=time(NULL))
- template<typename Vect >
 [rns_double](#) (const Vect &basis, bool rnsmod=false, long seed=time(NULL))
- [rns_double](#) (const [RNSIntegerMod](#)< [rns_double](#) > &basis, bool rnsmod=false, long seed=time(NULL))
- void [precompute_cst](#) (size_t K=0)
- template<typename T >
 void [init](#) (size_t m, size_t n, double *Arns, size_t rda, const T *A, size_t lda, const [integer](#) &maxA, bool RNS_MAJOR=false) const

- void `init` (size_t m, size_t n, double *Arns, size_t rda, const integer *A, size_t lda, size_t k, bool RNS_MAJOR=false) const
- void `init_transpose` (size_t m, size_t n, double *Arns, size_t rda, const integer *A, size_t lda, size_t k, bool RNS_MAJOR=false) const
- void `convert` (size_t m, size_t n, integer gamma, integer *A, size_t lda, const double *Arns, size_t rda, bool RNS_MAJOR=false) const
- void `convert_transpose` (size_t m, size_t n, integer gamma, integer *A, size_t lda, const double *Arns, size_t rda, bool RNS_MAJOR=false) const
- void `reduce` (size_t n, double *Arns, size_t rda, bool RNS_MAJOR=false) const
- template<size_t K>
void `init` (size_t m, size_t n, double *Arns, size_t rda, const Reclnt::ruint< K > *A, size_t lda, size_t k, bool RNS_MAJOR=false) const
- template<size_t K>
void `convert` (size_t m, size_t n, integer gamma, Reclnt::ruint< K > *A, size_t lda, const double *Arns, size_t rda, integer p=0, bool RNS_MAJOR=false) const

Data Fields

- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_basis`
- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_basisMax`
- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_negbasis`
- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_invbasis`
- std::vector< ModField > `_field_rns`
- integer `_M`
- std::vector< integer > `_Mi`
- std::vector< double > `_MMi`
- std::vector< double > `_crt_in`
- std::vector< double > `_crt_out`
- size_t `_size`
- size_t `_pbits`
- size_t `_ldm`
- integer `_mi_sum`

16.241.1 Member Typedef Documentation

16.241.1.1 integer

```
typedef Givaro::Integer integer
```

16.241.1.2 ModField

```
typedef Givaro::Modular<double> ModField
```

16.241.1.3 BasisElement

```
typedef double BasisElement
```

16.241.1.4 Element

```
typedef rns_double_elt Element
```

16.241.1.5 Element_ptr

```
typedef rns_double_elt_ptr Element_ptr
```

16.241.1.6 ConstElement_ptr

```
typedef rns_double_elt_cstptr ConstElement_ptr
```

16.241.2 Constructor & Destructor Documentation

16.241.2.1 rns_double() [1/4]

```
rns_double (
    const integer & bound,
    size_t pbits,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.241.2.2 rns_double() [2/4]

```
rns_double (
    size_t pbits,
    size_t size,
    long seed = time(NULL) ) [inline]
```

16.241.2.3 rns_double() [3/4]

```
rns_double (
    const Vect & basis,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.241.2.4 rns_double() [4/4]

```
rns_double (
    const RNSIntegerMod< rns_double > & basis,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.241.3 Member Function Documentation

16.241.3.1 precompute_cst()

```
void precompute_cst (
    size_t K = 0 ) [inline]
```

16.241.3.2 init() [1/3]

```
void init (
    size_t m,
    size_t n,
```

```

double * Arns,
size_t rda,
const T * A,
size_t lda,
const integer & maxA,
bool RNS_MAJOR = false ) const [inline]

```

16.241.3.3 init() [2/3]

```

void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false ) const [inline]

```

16.241.3.4 init_transpose()

```

void init_transpose (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false ) const [inline]

```

16.241.3.5 convert() [1/2]

```

void convert (
    size_t m,
    size_t n,
    integer gamma,
    integer * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) const [inline]

```

16.241.3.6 convert_transpose()

```

void convert_transpose (
    size_t m,
    size_t n,
    integer gamma,
    integer * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) const [inline]

```

16.241.3.7 reduce()

```
void reduce (
    size_t n,
    double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) const [inline]
```

16.241.3.8 init() [3/3]

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const RecInt::ruint< K > * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false ) const [inline]
```

16.241.3.9 convert() [2/2]

```
void convert (
    size_t m,
    size_t n,
    integer gamma,
    RecInt::ruint< K > * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    integer p = 0,
    bool RNS_MAJOR = false ) const [inline]
```

16.241.4 Field Documentation**16.241.4.1 _basis**

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basis
```

16.241.4.2 _basisMax

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basisMax
```

16.241.4.3 _negbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _negbasis
```

16.241.4.4 _invbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _invbasis
```

16.241.4.5 `_field_rns`

```
std::vector<ModField> _field_rns
```

16.241.4.6 `_M`

```
integer _M
```

16.241.4.7 `_Mi`

```
std::vector<integer> _Mi
```

16.241.4.8 `_MMi`

```
std::vector<double> _MMi
```

16.241.4.9 `_crt_in`

```
std::vector<double> _crt_in
```

16.241.4.10 `_crt_out`

```
std::vector<double> _crt_out
```

16.241.4.11 `_size`

```
size_t _size
```

16.241.4.12 `_pbits`

```
size_t _pbits
```

16.241.4.13 `_ldm`

```
size_t _ldm
```

16.241.4.14 `_mi_sum`

```
integer _mi_sum
```

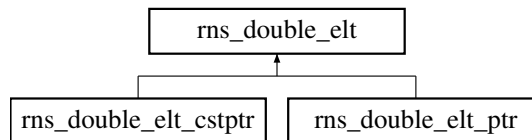
The documentation for this struct was generated from the following files:

- [rns-double.h](#)
- [rns-double-recint.inl](#)
- [rns-double.inl](#)

16.242 `rns_double_elt` Struct Reference

```
#include <rns-double-elt.h>
```

Inheritance diagram for `rns_double_elt`:



Public Member Functions

- [rns_double_elt](#) ()
- [~rns_double_elt](#) ()
- [rns_double_elt](#) (double *p, size_t r, size_t a=false)
- [rns_double_elt_ptr](#) operator& ()
- [rns_double_elt_cstptr](#) operator& () const
- [rns_double_elt](#) (const [rns_double_elt](#) &x)

Data Fields

- double * [_ptr](#)
- size_t [_stride](#)
- bool [_alloc](#)

16.242.1 Constructor & Destructor Documentation

16.242.1.1 [rns_double_elt](#)() [1/3]

```
rns\_double\_elt ( ) [inline]
```

16.242.1.2 [~rns_double_elt](#)()

```
~rns\_double\_elt ( ) [inline]
```

16.242.1.3 [rns_double_elt](#)() [2/3]

```
rns\_double\_elt (
    double * p,
    size_t r,
    size_t a = false ) [inline]
```

16.242.1.4 [rns_double_elt](#)() [3/3]

```
rns\_double\_elt (
    const rns\_double\_elt & x ) [inline]
```

16.242.2 Member Function Documentation

16.242.2.1 [operator&\(\)](#) [1/2]

```
rns\_double\_elt\_ptr operator& ( ) [inline]
```

16.242.2.2 operator&() [2/2]

```
rns_double_elt_cstptr operator& ( ) const [inline]
```

16.242.3 Field Documentation

16.242.3.1 _ptr

```
double* _ptr
```

16.242.3.2 _stride

```
size_t _stride
```

16.242.3.3 _alloc

```
bool _alloc
```

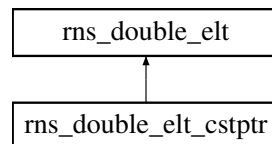
The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

16.243 rns_double_elt_cstptr Struct Reference

```
#include <rns-double-elt.h>
```

Inheritance diagram for rns_double_elt_cstptr:



Public Member Functions

- [rns_double_elt_cstptr](#) ()
- [rns_double_elt_cstptr](#) (double *p, size_t r)
- [rns_double_elt_cstptr](#) (const [rns_double_elt_ptr](#) &x)
- [rns_double_elt_cstptr](#) (const [rns_double_elt_cstptr](#) &x)
- [rns_double_elt_cstptr](#) ([rns_double_elt_cstptr](#) &&)=default
- [rns_double_elt_cstptr](#) * [operator&](#) ()
- [rns_double_elt](#) & [operator*](#) () const
- [rns_double_elt](#) [operator\[\]](#) (size_t i) const
- [rns_double_elt](#) & [operator\[\]](#) (size_t i)
- [rns_double_elt_cstptr](#) [operator++](#) ()
- [rns_double_elt_cstptr](#) [operator--](#) ()
- [rns_double_elt_cstptr](#) [operator+](#) (size_t inc) const
- [rns_double_elt_cstptr](#) [operator-](#) (size_t inc) const
- [rns_double_elt_cstptr](#) & [operator+=](#) (size_t inc)
- [rns_double_elt_cstptr](#) & [operator-=](#) (size_t inc)
- [rns_double_elt_cstptr](#) & [operator=](#) (const [rns_double_elt_cstptr](#) &x)
- bool [operator<](#) (const [rns_double_elt_cstptr](#) &x)
- bool [operator!=](#) (const [rns_double_elt_cstptr](#) &x)
- [rns_double_elt_cstptr](#) [operator&](#) () const

Data Fields

- [rns_double_elt](#) other
- double * [_ptr](#)
- size_t [_stride](#)
- bool [_alloc](#)

16.243.1 Constructor & Destructor Documentation

16.243.1.1 rns_double_elt_cstptr() [1/5]

```
rns_double_elt_cstptr ( ) [inline]
```

16.243.1.2 rns_double_elt_cstptr() [2/5]

```
rns_double_elt_cstptr (
    double * p,
    size_t r ) [inline]
```

16.243.1.3 rns_double_elt_cstptr() [3/5]

```
rns_double_elt_cstptr (
    const rns_double_elt_ptr & x ) [inline]
```

16.243.1.4 rns_double_elt_cstptr() [4/5]

```
rns_double_elt_cstptr (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.1.5 rns_double_elt_cstptr() [5/5]

```
rns_double_elt_cstptr (
    rns_double_elt_cstptr && ) [default]
```

16.243.2 Member Function Documentation

16.243.2.1 operator&() [1/2]

```
rns_double_elt_cstptr* operator& ( ) [inline]
```

16.243.2.2 operator*()

```
rns_double_elt& operator* ( ) const [inline]
```

16.243.2.3 operator[]() [1/2]

```
rns_double_elt operator[] (
    size_t i ) const [inline]
```

16.243.2.4 operator[]() [2/2]

```
rns_double_elt& operator[] (
    size_t i ) [inline]
```

16.243.2.5 operator++()

```
rns_double_elt_cstptr operator++ ( ) [inline]
```

16.243.2.6 operator--()

```
rns_double_elt_cstptr operator-- ( ) [inline]
```

16.243.2.7 operator+()

```
rns_double_elt_cstptr operator+ (
    size_t inc ) const [inline]
```

16.243.2.8 operator-()

```
rns_double_elt_cstptr operator- (
    size_t inc ) const [inline]
```

16.243.2.9 operator+=()

```
rns_double_elt_cstptr& operator+= (
    size_t inc ) [inline]
```

16.243.2.10 operator-=()

```
rns_double_elt_cstptr& operator-= (
    size_t inc ) [inline]
```

16.243.2.11 operator=()

```
rns_double_elt_cstptr & operator= (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.2.12 operator<()

```
bool operator< (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.2.13 operator"!="()

```
bool operator!= (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.2.14 operator&() [2/2]

```
rns_double_elt_cstptr operator& ( ) const [inline], [inherited]
```

16.243.3 Field Documentation

16.243.3.1 other

`rns_double_elt` other

16.243.3.2 _ptr

`double* _ptr` [inherited]

16.243.3.3 _stride

`size_t _stride` [inherited]

16.243.3.4 _alloc

`bool _alloc` [inherited]

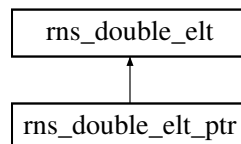
The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

16.244 rns_double_elt_ptr Struct Reference

```
#include <rns-double-elt.h>
```

Inheritance diagram for `rns_double_elt_ptr`:



Public Member Functions

- [rns_double_elt_ptr](#) ()
- [rns_double_elt_ptr](#) (double *p, size_t r)
- [rns_double_elt_ptr](#) (const [rns_double_elt_ptr](#) &x)
- [rns_double_elt_ptr](#) (const [rns_double_elt_cstptr](#) &x)
- [rns_double_elt_ptr](#) ([rns_double_elt_ptr](#) &&)=default
- [rns_double_elt_ptr](#) * [operator&](#) ()
- [rns_double_elt](#) & [operator*](#) ()
- [rns_double_elt](#) [operator\[\]](#) (size_t i) const
- [rns_double_elt](#) & [operator\[\]](#) (size_t i)
- [rns_double_elt_ptr](#) [operator++](#) ()
- [rns_double_elt_ptr](#) [operator--](#) ()
- [rns_double_elt_ptr](#) [operator+](#) (size_t inc)
- [rns_double_elt_ptr](#) [operator-](#) (size_t inc)
- [rns_double_elt_ptr](#) & [operator+=](#) (size_t inc)
- [rns_double_elt_ptr](#) & [operator-=](#) (size_t inc)
- [rns_double_elt_ptr](#) & [operator=](#) (const [rns_double_elt_ptr](#) &x)
- `bool` [operator<](#) (const [rns_double_elt_ptr](#) &x)
- `bool` [operator!=](#) (const [rns_double_elt_ptr](#) &x)
- [rns_double_elt_cstptr](#) [operator&](#) () const

Data Fields

- [rns_double_elt](#) other
- double * [_ptr](#)
- size_t [_stride](#)
- bool [_alloc](#)

16.244.1 Constructor & Destructor Documentation

16.244.1.1 [rns_double_elt_ptr\(\)](#) [1/5]

```
rns\_double\_elt\_ptr ( ) [inline]
```

16.244.1.2 [rns_double_elt_ptr\(\)](#) [2/5]

```
rns\_double\_elt\_ptr (
    double * p,
    size_t r ) [inline]
```

16.244.1.3 [rns_double_elt_ptr\(\)](#) [3/5]

```
rns\_double\_elt\_ptr (
    const rns\_double\_elt\_ptr & x ) [inline]
```

16.244.1.4 [rns_double_elt_ptr\(\)](#) [4/5]

```
rns\_double\_elt\_ptr (
    const rns\_double\_elt\_cstptr & x ) [inline]
```

16.244.1.5 [rns_double_elt_ptr\(\)](#) [5/5]

```
rns\_double\_elt\_ptr (
    rns\_double\_elt\_ptr && ) [default]
```

16.244.2 Member Function Documentation

16.244.2.1 [operator&\(\)](#) [1/2]

```
rns\_double\_elt\_ptr* operator& ( ) [inline]
```

16.244.2.2 [operator*\(\)](#)

```
rns\_double\_elt& operator\* ( ) [inline]
```

16.244.2.3 [operator\[\]\(\)](#) [1/2]

```
rns\_double\_elt operator\[\] (
    size_t i ) const [inline]
```

16.244.2.4 operator[]() [2/2]

```
rns_double_elt& operator[] (
    size_t i ) [inline]
```

16.244.2.5 operator++()

```
rns_double_elt_ptr operator++ ( ) [inline]
```

16.244.2.6 operator--()

```
rns_double_elt_ptr operator-- ( ) [inline]
```

16.244.2.7 operator+()

```
rns_double_elt_ptr operator+ (
    size_t inc ) [inline]
```

16.244.2.8 operator-()

```
rns_double_elt_ptr operator- (
    size_t inc ) [inline]
```

16.244.2.9 operator+=()

```
rns_double_elt_ptr& operator+= (
    size_t inc ) [inline]
```

16.244.2.10 operator-=()

```
rns_double_elt_ptr& operator-= (
    size_t inc ) [inline]
```

16.244.2.11 operator=()

```
rns_double_elt_ptr & operator= (
    const rns_double_elt_ptr & x ) [inline]
```

16.244.2.12 operator<()

```
bool operator< (
    const rns_double_elt_ptr & x ) [inline]
```

16.244.2.13 operator"!="()

```
bool operator!= (
    const rns_double_elt_ptr & x ) [inline]
```

16.244.2.14 operator&() [2/2]

```
rns_double_elt_cstptr operator& ( ) const [inline], [inherited]
```

16.244.3 Field Documentation

16.244.3.1 other

`rns_double_elt` other

16.244.3.2 _ptr

`double* _ptr` [inherited]

16.244.3.3 _stride

`size_t _stride` [inherited]

16.244.3.4 _alloc

`bool _alloc` [inherited]

The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

16.245 rns_double_extended Struct Reference

```
#include <rns-double.h>
```

Public Types

- typedef Givaro::Integer [integer](#)
- typedef Givaro::ModularExtended< double > [ModField](#)
- typedef double [BasisElement](#)
- typedef [rns_double_elt](#) [Element](#)
- typedef [rns_double_elt_ptr](#) [Element_ptr](#)
- typedef [rns_double_elt_cstptr](#) [ConstElement_ptr](#)

Public Member Functions

- [rns_double_extended](#) (const [integer](#) &bound, size_t pbits, bool rnsmod=false, long seed=time(NULL))
- [rns_double_extended](#) (size_t pbits, size_t size, long seed=time(NULL))
- template<typename Vect >
 [rns_double_extended](#) (const Vect &basis, bool rnsmod=false, long seed=time(NULL))
- void [precompute_cst](#) ()
- void [init](#) (size_t m, size_t n, double *Arns, size_t rda, const [integer](#) *A, size_t lda, const [integer](#) &maxA, bool RNS_MAJOR=false) const
- void [init](#) (size_t m, size_t n, double *Arns, size_t rda, const [integer](#) *A, size_t lda, size_t k, bool RNS_↔MAJOR=false)
- void [convert](#) (size_t m, size_t n, [integer](#) gamma, [integer](#) *A, size_t lda, const double *Arns, size_t rda, bool RNS_MAJOR=false)
- void [init](#) (size_t m, double *Arns, const [integer](#) *A, size_t lda) const
- void [convert](#) (size_t m, [integer](#) *A, const double *Arns) const
- void [reduce](#) (size_t n, double *Arns, size_t rda, bool RNS_MAJOR=false) const

Data Fields

- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _basis`
- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _basisMax`
- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _negbasis`
- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _invbasis`
- `std::vector< ModField > _field_rns`
- `integer _M`
- `std::vector< integer > _Mi`
- `std::vector< double > _MMi`
- `std::vector< double > _crt_in`
- `std::vector< double > _crt_out`
- `size_t _size`
- `size_t _pbits`
- `size_t _ldm`

16.245.1 Member Typedef Documentation

16.245.1.1 integer

```
typedef Givaro::Integer integer
```

16.245.1.2 ModField

```
typedef Givaro::ModularExtended<double> ModField
```

16.245.1.3 BasisElement

```
typedef double BasisElement
```

16.245.1.4 Element

```
typedef rns\_double\_elt Element
```

16.245.1.5 Element_ptr

```
typedef rns\_double\_elt\_ptr Element\_ptr
```

16.245.1.6 ConstElement_ptr

```
typedef rns\_double\_elt\_cstptr ConstElement\_ptr
```

16.245.2 Constructor & Destructor Documentation

16.245.2.1 rns_double_extended() [1/3]

```
rns_double_extended (
    const integer & bound,
    size_t pbits,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.245.2.2 rns_double_extended() [2/3]

```
rns_double_extended (
    size_t pbits,
    size_t size,
    long seed = time(NULL) ) [inline]
```

16.245.2.3 rns_double_extended() [3/3]

```
rns_double_extended (
    const Vect & basis,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.245.3 Member Function Documentation**16.245.3.1 precompute_cst()**

```
void precompute_cst ( ) [inline]
```

16.245.3.2 init() [1/3]

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    const integer & maxA,
    bool RNS_MAJOR = false ) const [inline]
```

16.245.3.3 init() [2/3]

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false ) [inline]
```

16.245.3.4 convert() [1/2]

```
void convert (
    size_t m,
    size_t n,
    integer gamma,
    integer * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) [inline]
```

16.245.3.5 init() [3/3]

```
void init (
    size_t m,
    double * Arns,
    const integer * A,
    size_t lda ) const [inline]
```

16.245.3.6 convert() [2/2]

```
void convert (
    size_t m,
    integer * A,
    const double * Arns ) const [inline]
```

16.245.3.7 reduce()

```
void reduce (
    size_t n,
    double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) const [inline]
```

16.245.4 Field Documentation**16.245.4.1 _basis**

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basis
```

16.245.4.2 _basisMax

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basisMax
```

16.245.4.3 _negbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _negbasis
```

16.245.4.4 `_invbasis`

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _invbasis
```

16.245.4.5 `_field_rns`

```
std::vector<ModField> _field_rns
```

16.245.4.6 `_M`

```
integer _M
```

16.245.4.7 `_Mi`

```
std::vector<integer> _Mi
```

16.245.4.8 `_MMi`

```
std::vector<double> _MMi
```

16.245.4.9 `_crt_in`

```
std::vector<double> _crt_in
```

16.245.4.10 `_crt_out`

```
std::vector<double> _crt_out
```

16.245.4.11 `_size`

```
size_t _size
```

16.245.4.12 `_pbits`

```
size_t _pbits
```

16.245.4.13 `_ldm`

```
size_t _ldm
```

The documentation for this struct was generated from the following files:

- [rns-double.h](#)
- [rns-double.inl](#)

16.246 RNSElementTag Struct Reference

Representation in a Residue Number System.

```
#include <field-traits.h>
```

16.246.1 Detailed Description

Representation in a Residue Number System.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.247 RNSInteger< RNS > Class Template Reference

```
#include <rns-integer.h>
```

Data Structures

- class [RandIter](#)

Public Types

- typedef [RNS::Element](#) [Element](#)
- typedef [RNS::Element_ptr](#) [Element_ptr](#)
- typedef [RNS::ConstElement_ptr](#) [ConstElement_ptr](#)

Public Member Functions

- [RNSInteger](#) (const [RNS](#) &myrns)
- template<typename T >
 [RNSInteger](#) (const T &F)
- const [RNS](#) & [rns](#) () const
- size_t [size](#) () const
- bool [isOne](#) (const [Element](#) &x) const
- bool [isMOne](#) (const [Element](#) &x) const
- bool [isZero](#) (const [Element](#) &x) const
- integer [characteristic](#) ([integer](#) &p) const
- integer [cardinality](#) ([integer](#) &p) const
- [Element](#) & [init](#) ([Element](#) &x) const
- [Element](#) & [init](#) ([Element](#) &x, const Givaro::Integer &y) const
- [Element](#) & [reduce](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) & [reduce](#) ([Element](#) &x) const
- Givaro::Integer [convert](#) (Givaro::Integer &x, const [Element](#) &y) const
- [Element](#) & [assign](#) ([Element](#) &x, const [Element](#) &y) const
- std::ostream & [write](#) (std::ostream &os, const [Element](#) &y) const
- std::ostream & [write](#) (std::ostream &os) const

Data Fields

- [Element](#) [one](#)
- [Element](#) [mOne](#)
- [Element](#) [zero](#)

Protected Types

- typedef [RNS::BasisElement](#) [BasisElement](#)
- typedef Givaro::Integer [integer](#)

Protected Attributes

- const [RNS](#) * [_rns](#)

16.247.1 Member Typedef Documentation

16.247.1.1 BasisElement

```
typedef RNS::BasisElement BasisElement [protected]
```

16.247.1.2 integer

```
typedef Givaro::Integer integer [protected]
```

16.247.1.3 Element

```
typedef RNS::Element Element
```

16.247.1.4 Element_ptr

```
typedef RNS::Element_ptr Element_ptr
```

16.247.1.5 ConstElement_ptr

```
typedef RNS::ConstElement_ptr ConstElement_ptr
```

16.247.2 Constructor & Destructor Documentation

16.247.2.1 RNSInteger() [1/2]

```
RNSInteger (
    const RNS & myrns ) [inline]
```

16.247.2.2 RNSInteger() [2/2]

```
RNSInteger (
    const T & F ) [inline]
```

16.247.3 Member Function Documentation

16.247.3.1 rns()

```
const RNS& rns ( ) const [inline]
```

16.247.3.2 size()

```
size_t size ( ) const [inline]
```

16.247.3.3 isOne()

```
bool isOne (
    const Element & x ) const [inline]
```

16.247.3.4 isMOne()

```
bool isMOne (
    const Element & x ) const [inline]
```

16.247.3.5 isZero()

```
bool isZero (
    const Element & x ) const [inline]
```

16.247.3.6 characteristic()

```
integer characteristic (
    integer & p ) const [inline]
```

16.247.3.7 cardinality()

```
integer cardinality (
    integer & p ) const [inline]
```

16.247.3.8 init() [1/2]

```
Element& init (
    Element & x ) const [inline]
```

16.247.3.9 init() [2/2]

```
Element& init (
    Element & x,
    const Givaro::Integer & y ) const [inline]
```

16.247.3.10 reduce() [1/2]

```
Element& reduce (
    Element & x,
    const Element & y ) const [inline]
```

16.247.3.11 reduce() [2/2]

```
Element& reduce (
    Element & x ) const [inline]
```

16.247.3.12 convert()

```
Givaro::Integer convert (
    Givaro::Integer & x,
    const Element & y ) const [inline]
```

16.247.3.13 assign()

```
Element& assign (
    Element & x,
    const Element & y ) const [inline]
```

16.247.3.14 write() [1/2]

```
std::ostream& write (
    std::ostream & os,
    const Element & y ) const [inline]
```

16.247.3.15 write() [2/2]

```
std::ostream& write (
    std::ostream & os ) const [inline]
```

16.247.4 Field Documentation**16.247.4.1 _rns**

```
const RNS* _rns [protected]
```

16.247.4.2 one

```
Element one
```

16.247.4.3 mOne

```
Element mOne
```

16.247.4.4 zero

```
Element zero
```

The documentation for this class was generated from the following files:

- [field-traits.h](#)
- [rns-integer.h](#)

16.248 RNSIntegerMod< RNS > Class Template Reference

```
#include <rns-integer-mod.h>
```

Data Structures

- class [RandIter](#)

Public Types

- typedef [RNS::Element](#) [Element](#)
- typedef [RNS::Element_ptr](#) [Element_ptr](#)
- typedef [RNS::ConstElement_ptr](#) [ConstElement_ptr](#)

Public Member Functions

- [RNSIntegerMod](#) (const [integer](#) &p, const [RNS](#) &myrns)
- const [rns_double](#) &[rns](#) () const
- const [RNSInteger](#)< [RNS](#) > &[delayed](#) () const
- [size_t](#) [size](#) () const
- bool [isOne](#) (const [Element](#) &x) const
- bool [isMOne](#) (const [Element](#) &x) const
- bool [isZero](#) (const [Element](#) &x) const
- [integer](#) &[characteristic](#) ([integer](#) &p) const
- [integer](#) [characteristic](#) () const
- [integer](#) &[cardinality](#) ([integer](#) &p) const
- [integer](#) [cardinality](#) () const
- [integer](#) [minElement](#) () const
- [integer](#) [maxElement](#) () const
- [Element](#) &[init](#) ([Element](#) &x) const
- [Element](#) &[init](#) ([Element](#) &x, const Givaro::Integer &y) const
- [Element](#) &[reduce](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) &[reduce](#) ([Element](#) &x) const
- [Element](#) &[init](#) ([Element](#) &x, const [Element](#) &y) const
- Givaro::Integer [convert](#) (Givaro::Integer &x, const [Element](#) &y) const
- [Element](#) &[assign](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) &[add](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[sub](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[neg](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) &[mul](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[axpyin](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[inv](#) ([Element](#) &x, const [Element](#) &y) const
- bool [areEqual](#) (const [Element](#) &x, const [Element](#) &y) const
- std::ostream &[write](#) (std::ostream &os, const [Element](#) &y) const
- std::ostream &[write](#) (std::ostream &os) const
- void [reduce_modp](#) ([size_t](#) n, [Element_ptr](#) B) const
- std::ostream &[write_matrix](#) (std::ostream &c, const double *E, int n, int m, int lda) const
- std::ostream &[write_matrix_long](#) (std::ostream &c, const double *E, int n, int m, int lda) const
- void [reduce_modp](#) ([size_t](#) m, [size_t](#) n, [Element_ptr](#) B, [size_t](#) lda) const
- void [reduce_modp_rnsmajor](#) ([size_t](#) n, [Element_ptr](#) B) const

Data Fields

- [Element](#) [one](#)
- [Element](#) [mOne](#)
- [Element](#) [zero](#)

Protected Types

- typedef [RNS::BasisElement](#) [BasisElement](#)
- typedef Givaro::Modular< [BasisElement](#) > [ModField](#)
- typedef Givaro::Integer [integer](#)

Protected Attributes

- `integer _p`
- `std::vector< BasisElement, AlignedAllocator< BasisElement, Alignment::CACHE_LINE > > _Mi_modp_rns`
- `std::vector< BasisElement, AlignedAllocator< BasisElement, Alignment::CACHE_LINE > > _iM_modp_rns`
- `const RNS * _rns`
- `Givaro::Modular< Givaro::Integer > _F`
- `RNSInteger< RNS > _RNSdelayed`

16.248.1 Member Typedef Documentation

16.248.1.1 Element

```
typedef RNS::Element Element
```

16.248.1.2 Element_ptr

```
typedef RNS::Element\_ptr Element_ptr
```

16.248.1.3 ConstElement_ptr

```
typedef RNS::ConstElement\_ptr ConstElement_ptr
```

16.248.1.4 BasisElement

```
typedef RNS::BasisElement BasisElement [protected]
```

16.248.1.5 ModField

```
typedef Givaro::Modular<BasisElement> ModField [protected]
```

16.248.1.6 integer

```
typedef Givaro::Integer integer [protected]
```

16.248.2 Constructor & Destructor Documentation

16.248.2.1 RNSIntegerMod()

```
RNSIntegerMod (
    const integer & p,
    const RNS & myrns ) [inline]
```

16.248.3 Member Function Documentation

16.248.3.1 rns()

```
const rns\_double& rns ( ) const [inline]
```

16.248.3.2 delayed()

```
const RNSInteger<RNS>& delayed ( ) const [inline]
```

16.248.3.3 size()

```
size_t size ( ) const [inline]
```

16.248.3.4 isOne()

```
bool isOne (
    const Element & x ) const [inline]
```

16.248.3.5 isMOne()

```
bool isMOne (
    const Element & x ) const [inline]
```

16.248.3.6 isZero()

```
bool isZero (
    const Element & x ) const [inline]
```

16.248.3.7 characteristic() [1/2]

```
integer& characteristic (
    integer & p ) const [inline]
```

16.248.3.8 characteristic() [2/2]

```
integer characteristic ( ) const [inline]
```

16.248.3.9 cardinality() [1/2]

```
integer& cardinality (
    integer & p ) const [inline]
```

16.248.3.10 cardinality() [2/2]

```
integer cardinality ( ) const [inline]
```

16.248.3.11 minElement()

```
integer minElement ( ) const [inline]
```

16.248.3.12 maxElement()

```
integer maxElement ( ) const [inline]
```

16.248.3.13 init() [1/3]

```
Element& init (
    Element & x ) const [inline]
```

16.248.3.14 init() [2/3]

```
Element& init (
    Element & x,
    const Givaro::Integer & y ) const [inline]
```

16.248.3.15 reduce() [1/2]

```
Element& reduce (
    Element & x,
    const Element & y ) const [inline]
```

16.248.3.16 reduce() [2/2]

```
Element& reduce (
    Element & x ) const [inline]
```

16.248.3.17 init() [3/3]

```
Element& init (
    Element & x,
    const Element & y ) const [inline]
```

16.248.3.18 convert()

```
Givaro::Integer convert (
    Givaro::Integer & x,
    const Element & y ) const [inline]
```

16.248.3.19 assign()

```
Element& assign (
    Element & x,
    const Element & y ) const [inline]
```

16.248.3.20 add()

```
Element& add (
    Element & x,
    const Element & y,
    const Element & z ) const [inline]
```

16.248.3.21 sub()

```
Element& sub (
    Element & x,
```

```
const Element & y,  
const Element & z ) const [inline]
```

16.248.3.22 neg()

```
Element& neg (  
    Element & x,  
    const Element & y ) const [inline]
```

16.248.3.23 mul()

```
Element& mul (  
    Element & x,  
    const Element & y,  
    const Element & z ) const [inline]
```

16.248.3.24 axpyin()

```
Element& axpyin (  
    Element & x,  
    const Element & y,  
    const Element & z ) const [inline]
```

16.248.3.25 inv()

```
Element& inv (  
    Element & x,  
    const Element & y ) const [inline]
```

16.248.3.26 areEqual()

```
bool areEqual (  
    const Element & x,  
    const Element & y ) const [inline]
```

16.248.3.27 write() [1/2]

```
std::ostream& write (  
    std::ostream & os,  
    const Element & y ) const [inline]
```

16.248.3.28 write() [2/2]

```
std::ostream& write (  
    std::ostream & os ) const [inline]
```

16.248.3.29 reduce_modp() [1/2]

```
void reduce_modp (  
    size_t n,  
    Element_ptr B ) const [inline]
```

16.248.3.30 write_matrix()

```
std::ostream& write_matrix (
    std::ostream & c,
    const double * E,
    int n,
    int m,
    int lda ) const [inline]
```

16.248.3.31 write_matrix_long()

```
std::ostream& write_matrix_long (
    std::ostream & c,
    const double * E,
    int n,
    int m,
    int lda ) const [inline]
```

16.248.3.32 reduce_modp() [2/2]

```
void reduce_modp (
    size_t m,
    size_t n,
    Element_ptr B,
    size_t lda ) const [inline]
```

16.248.3.33 reduce_modp_rnsmajor()

```
void reduce_modp_rnsmajor (
    size_t n,
    Element_ptr B ) const [inline]
```

16.248.4 Field Documentation**16.248.4.1 _p**

```
integer _p [protected]
```

16.248.4.2 _Mi_modp_rns

```
std::vector<BasisElement, AlignedAllocator<BasisElement, Alignment::CACHE_LINE> > _Mi_modp_↵
rns [protected]
```

16.248.4.3 _iM_modp_rns

```
std::vector<BasisElement, AlignedAllocator<BasisElement, Alignment::CACHE_LINE> > _iM_modp_↵
rns [protected]
```

16.248.4.4 _rns

```
const RNS* _rns [protected]
```

16.248.4.5 `_F`

```
Givaro::Modular<Givaro::Integer> _F [protected]
```

16.248.4.6 `_RNSdelayed`

```
RNSInteger<RNS> _RNSdelayed [protected]
```

16.248.4.7 `one`

```
Element one
```

16.248.4.8 `mOne`

```
Element mOne
```

16.248.4.9 `zero`

```
Element zero
```

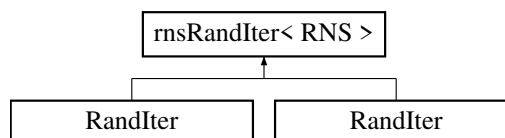
The documentation for this class was generated from the following files:

- [field-traits.h](#)
- [rns-integer-mod.h](#)

16.249 `rnsRandIter< RNS >` Class Template Reference

```
#include <rns-double.h>
```

Inheritance diagram for `rnsRandIter< RNS >`:



Public Member Functions

- `rnsRandIter` (const [RNS](#) &R, `size_t` size=0, `uint64_t` seed=0)
- `RNS::Element & random` (typename [RNS::Element](#) &elt) const
RNS ring Element random assignement.
- `RNS::Element & operator()` (typename [RNS::Element](#) &elt) const
- `RNS::Element operator()` () const
- `RNS::Element random` () const
- const [RNS](#) & `ring` () const

16.249.1 Constructor & Destructor Documentation

16.249.1.1 `rnsRandIter()`

```
rnsRandIter (
    const RNS & R,
    size_t size = 0,
    uint64_t seed = 0 ) [inline]
```

16.249.2 Member Function Documentation

16.249.2.1 random() [1/2]

```
RNS::Element& random (
    typename RNS::Element & elt ) const [inline]
```

RNS ring Element random assignment.

Element is supposed to be initialized

Returns

random ring Element

16.249.2.2 operator>() [1/2]

```
RNS::Element& operator() (
    typename RNS::Element & elt ) const [inline]
```

16.249.2.3 operator>() [2/2]

```
RNS::Element operator() ( ) const [inline]
```

16.249.2.4 random() [2/2]

```
RNS::Element random ( ) const [inline]
```

16.249.2.5 ring()

```
const RNS& ring ( ) const [inline]
```

The documentation for this class was generated from the following file:

- [rns-double.h](#)

16.250 Row Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.251 ruint< K > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.252 ScalFunctions< Element, Enable > Struct Template Reference

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

16.253 ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type > Struct Template Reference

Static Public Member Functions

- static Element [zero](#) ()
- static Element [vand](#) (Element x1, Element x2)
- static Element [vor](#) (Element x1, Element x2)
- static Element [vxor](#) (Element x1, Element x2)
- static Element [vandnot](#) (Element x1, Element x2)
- static Element [ceil](#) (Element x)
- static Element [floor](#) (Element x)
- static Element [round](#) (Element x)
- static Element [add](#) (Element x1, Element x2)
- static Element [addin](#) (Element &x1, Element x2)
- static Element [sub](#) (Element x1, Element x2)
- static Element [subin](#) (Element &x1, Element x2)
- static Element [mul](#) (Element x1, Element x2)
- static Element [mulin](#) (Element &x1, Element x2)
- static Element [div](#) (Element x1, Element x2)
- static Element [fmadd](#) (Element x1, Element x2, Element x3)
- static Element [fmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [fmsub](#) (Element x1, Element x2, Element x3)
- static Element [fmsubin](#) (Element &x1, Element x2, Element x3)
- static Element [fnmadd](#) (Element x1, Element x2, Element x3)
- static Element [fnmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [lesser](#) (Element x1, Element x2)
- static Element [lesser_eq](#) (Element x1, Element x2)
- static Element [greater](#) (Element x1, Element x2)
- static Element [greater_eq](#) (Element x1, Element x2)
- static Element [eq](#) (Element x1, Element x2)

16.253.1 Member Function Documentation

16.253.1.1 zero()

```
static Element zero ( ) [inline], [static]
```

16.253.1.2 vand()

```
static Element vand (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.3 vor()

```
static Element vor (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.4 vxor()

```
static Element vxor (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.5 vandnot()

```
static Element vandnot (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.6 ceil()

```
static Element ceil (  
    Element x ) [inline], [static]
```

16.253.1.7 floor()

```
static Element floor (  
    Element x ) [inline], [static]
```

16.253.1.8 round()

```
static Element round (  
    Element x ) [inline], [static]
```

16.253.1.9 add()

```
static Element add (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.10 addin()

```
static Element addin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.253.1.11 sub()

```
static Element sub (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.12 subin()

```
static Element subin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.253.1.13 mul()

```
static Element mul (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.14 mulin()

```
static Element mulin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.253.1.15 div()

```
static Element div (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.16 fmadd()

```
static Element fmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.17 fmaddin()

```
static Element fmaddin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.18 fmsub()

```
static Element fmsub (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.19 fmsubin()

```
static Element fmsubin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.20 fnmadd()

```
static Element fnmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.21 fnmaddin()

```
static Element fnmaddin (
    Element & x1,
    Element x2,
    Element x3 ) [inline], [static]
```

16.253.1.22 lesser()

```
static Element lesser (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.23 lesser_eq()

```
static Element lesser_eq (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.24 greater()

```
static Element greater (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.25 greater_eq()

```
static Element greater_eq (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.26 eq()

```
static Element eq (
    Element x1,
    Element x2 ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

16.254 ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type > Struct Template Reference

Static Public Member Functions

- static Element [zero](#) ()
- static Element [round](#) (Element x)
- static Element [vand](#) (Element x1, Element x2)
- static Element [vor](#) (Element x1, Element x2)
- static Element [vxor](#) (Element x1, Element x2)
- static Element [vandnot](#) (Element x1, Element x2)
- static Element [add](#) (Element x1, Element x2)
- static Element [addin](#) (Element &x1, Element x2)

- static Element [sub](#) (Element x1, Element x2)
- static Element [subin](#) (Element &x1, Element x2)
- static Element [mul](#) (Element x1, Element x2)
- static Element [mullo](#) (Element x1, Element x2)
- static Element [mulhi](#) (Element x1, Element x2)
- static Element [mulx](#) (Element x1, Element x2)
- static Element [fmadd](#) (Element x1, Element x2, Element x3)
- static Element [fmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [fmaddx](#) (Element x1, Element x2, Element x3)
- static Element [fmaddxin](#) (Element &x1, Element x2, Element x3)
- static Element [fmsub](#) (Element x1, Element x2, Element x3)
- static Element [fmsubin](#) (Element &x1, Element x2, Element x3)
- static Element [fmsubx](#) (Element x1, Element x2, Element x3)
- static Element [fmsubxin](#) (Element &x1, Element x2, Element x3)
- static Element [fnmadd](#) (Element x1, Element x2, Element x3)
- static Element [fnmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [fnmaddx](#) (Element x1, Element x2, Element x3)
- static Element [fnmaddxin](#) (Element &x1, Element x2, Element x3)
- template<int s, bool EnableTrue = true>
static enable_if<lis_signed< Element >::value &&EnableTrue, Element >::type [sra](#) (Element x1)
- template<int s, bool EnableTrue = true>
static enable_if< is_signed< Element >::value &&EnableTrue, Element >::type [sra](#) (Element x1)
- template<int s>
static Element [srl](#) (Element x1)
- template<int s>
static Element [sll](#) (Element x1)
- static Element [lesser](#) (Element x1, Element x2)
- static Element [lesser_eq](#) (Element x1, Element x2)
- static Element [greater](#) (Element x1, Element x2)
- static Element [greater_eq](#) (Element x1, Element x2)
- static Element [eq](#) (Element x1, Element x2)

16.254.1 Member Function Documentation

16.254.1.1 zero()

```
static Element zero ( ) [inline], [static]
```

16.254.1.2 round()

```
static Element round (  
    Element x ) [inline], [static]
```

16.254.1.3 vand()

```
static Element vand (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.4 vor()

```
static Element vor (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.5 vxor()

```
static Element vxor (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.6 vandnot()

```
static Element vandnot (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.7 add()

```
static Element add (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.8 addin()

```
static Element addin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.254.1.9 sub()

```
static Element sub (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.10 subin()

```
static Element subin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.254.1.11 mul()

```
static Element mul (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.12 mullo()

```
static Element mullo (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.13 mulhi()

```
static Element mulhi (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.14 mulx()

```
static Element mulx (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.15 fmadd()

```
static Element fmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.16 fmaddin()

```
static Element fmaddin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.17 fmaddx()

```
static Element fmaddx (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.18 fmaddxin()

```
static Element fmaddxin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.19 fmsub()

```
static Element fmsub (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.20 fmsubin()

```
static Element fmsubin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.21 fmsubx()

```
static Element fmsubx (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.22 fmsubxin()

```
static Element fmsubxin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.23 fnmadd()

```
static Element fnmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.24 fnmaddin()

```
static Element fnmaddin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.25 fnmaddx()

```
static Element fnmaddx (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.26 fnmaddxin()

```
static Element fnmaddxin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.27 sra() [1/2]

```
static enable_if<!is_signed<Element>::value && EnableTrue, Element>::type sra (  
    Element x1 ) [inline], [static]
```


16.254.1.28 sra() [2/2]

```
static enable_if<is_signed<Element>::value && EnableTrue, Element>::type sra (  
    Element x1 ) [inline], [static]
```

16.254.1.29 srl()

```
static Element srl (  
    Element x1 ) [inline], [static]
```

16.254.1.30 sll()

```
static Element sll (  
    Element x1 ) [inline], [static]
```

16.254.1.31 lesser()

```
static Element lesser (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.32 lesser_eq()

```
static Element lesser_eq (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.33 greater()

```
static Element greater (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.34 greater_eq()

```
static Element greater_eq (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.35 eq()

```
static Element eq (  
    Element x1,  
    Element x2 ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

16.255 Sequential Struct Reference

Public Member Functions

- [Sequential](#) ()
- [Sequential](#) (size_t nth)
- template<class Cut, class Param >
[Sequential](#) ([Parallel](#)< Cut, Param > &)
- size_t [numthreads](#) () const

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Sequential](#) &)

16.255.1 Constructor & Destructor Documentation

16.255.1.1 Sequential() [1/3]

```
Sequential ( ) [inline]
```

16.255.1.2 Sequential() [2/3]

```
Sequential (
    size_t nth ) [inline]
```

16.255.1.3 Sequential() [3/3]

```
Sequential (
    Parallel< Cut, Param > & ) [inline]
```

16.255.2 Member Function Documentation

16.255.2.1 numthreads()

```
size_t numthreads ( ) const [inline]
```

16.255.3 Friends And Related Function Documentation

16.255.3.1 operator<<

```
std::ostream& operator<< (
    std::ostream & out,
    const Sequential & ) [friend]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

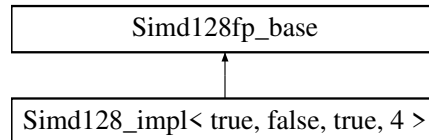
16.256 Simd128_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

16.257 Simd128_impl< true, false, true, 4 > Struct Reference

Inheritance diagram for Simd128_impl< true, false, true, 4 >:



Static Public Member Functions

- static const std::string [type_string](#) ()

16.257.1 Member Function Documentation

16.257.1.1 type_string()

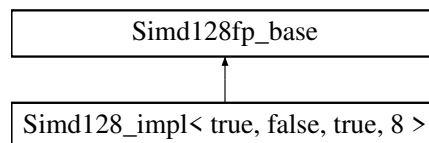
```
static const std::string type_string ( ) [inline], [static], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_float.inl](#)

16.258 Simd128_impl< true, false, true, 8 > Struct Reference

Inheritance diagram for Simd128_impl< true, false, true, 8 >:



Static Public Member Functions

- static const std::string [type_string](#) ()

16.258.1 Member Function Documentation

16.258.1.1 type_string()

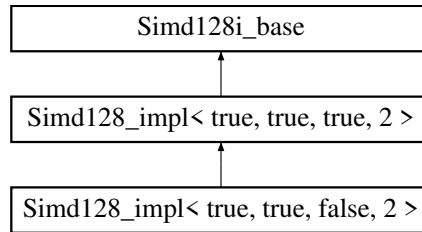
```
static const std::string type_string ( ) [inline], [static], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_double.inl](#)

16.259 Simd128_impl< true, true, false, 2 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, false, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint16_t](#)
- using [vect_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulx](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmsubx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmsubxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST scalar_t hadd_to_scal](#) (const [vect_t](#) a)
- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)

- `template<uint32_t s>`
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `__m64` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- `template<uint8_t s>`
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- `template<uint8_t s>`
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static constexpr const size_t `vect_size` = 8
- static constexpr const size_t `alignment` = 16

16.259.1 Member Typedef Documentation

16.259.1.1 scalar_t

```
using scalar_t = uint16_t
```

16.259.1.2 vect_t

```
using vect_t = __m128i [inherited]
```

16.259.2 Member Function Documentation

16.259.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.259.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.259.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.259.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.259.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.259.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.259.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.259.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.259.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.259.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.259.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.259.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.14 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.259.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.259.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.259.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.259.2.25 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```


16.259.2.26 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.27 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.28 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.29 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.30 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.31 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.32 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.33 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.34 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.35 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.36 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.37 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.38 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.39 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.40 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.41 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.42 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.43 eq()

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.44 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.45 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const __m64 & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static], [inherited]
```

16.259.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.259.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.259.2.48 sll128()

```
static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.49 srl128()

```
static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.50 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.51 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.52 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.3 Field Documentation**16.259.3.1 vect_size**

```
constexpr const size_t vect_size = 8 [static], [constexpr], [inherited]
```

16.259.3.2 alignment

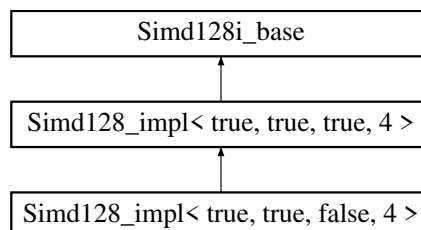
```
constexpr const size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_int16.inl](#)

16.260 Simd128_impl< true, true, false, 4 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, false, 4 >:

**Data Structures**

- union [Converter](#)

Public Types

- using [scalar_t](#) = uint32_t
- using [vect_t](#) = __m128i

Static Public Member Functions

- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3)
- template<class T >
 - static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
 - static `INLINE CONST vect_t sra` (const `vect_t` a)
- static `INLINE CONST vect_t greater` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t lesser` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
 - static constexpr bool `valid` (T *p)
- template<class T >
 - static constexpr bool `compliant` (T n)
- template<int s>
 - static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
 - static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
 - static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
 - static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)

- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- template<uint8_t s>
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static constexpr const size_t `vect_size` = 4
- static constexpr const size_t `alignment` = 16

16.260.1 Member Typedef Documentation

16.260.1.1 scalar_t

```
using scalar_t = uint32_t
```

16.260.1.2 vect_t

```
using vect_t = __m128i [inherited]
```

16.260.2 Member Function Documentation

16.260.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.260.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3 ) [inline], [static]
```

16.260.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.260.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.260.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.260.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.260.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.260.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.260.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.260.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.260.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.260.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.14 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.260.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.260.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.260.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.260.2.25 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.26 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.27 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.28 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.29 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.30 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.31 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.32 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.33 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.34 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.35 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.36 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.37 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.38 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.39 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.40 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.41 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.42 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.43 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.45 mod()

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const vect_t & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,  
    vect_t & Q,  
    vect_t & T ) [inline], [static], [inherited]
```

16.260.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.260.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.260.2.48 sll128()

```
static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.49 srl128()

```
static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.50 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.51 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.52 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.260.3 Field Documentation

16.260.3.1 vect_size

```
constexpr const size_t vect_size = 4 [static], [constexpr], [inherited]
```

16.260.3.2 alignment

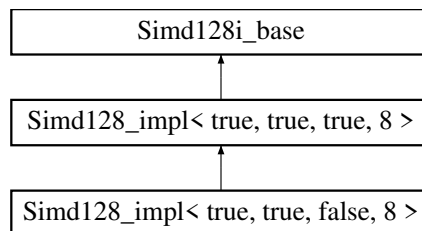
```
constexpr const size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_int32.inl](#)

16.261 Simd128_impl< true, true, false, 8 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, false, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint64_t](#)
- using [vect_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mullo](#) (const [vect_t](#) x0, const [vect_t](#) x1)
- static [INLINE CONST vect_t mulx](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmsubx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmsubxin](#) ([vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST scalar_t hadd_to_scal](#) (const [vect_t](#) a)
- template<class T >
static constexpr bool [valid](#) (T *p)

- `template<class T >`
`static constexpr bool compliant (T n)`
- `template<int idx>`
`static INLINE CONST scalar_t get (vect_t v)`
- `template<int s>`
`static INLINE CONST vect_t sll (const vect_t a)`
- `template<int s>`
`static INLINE CONST vect_t srl (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `template<uint8_t s>`
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE CONST vect_t mask_high ()`
- `static INLINE CONST vect_t mulhi_fast (vect_t x, vect_t y)`
- `static INLINE vect_t mod (vect_t &C, const __m128d &P, const __m128d &INVP, const __m128d &NEGP, const vect_t &POW50REM, const __m128d &MIN, const __m128d &MAX, __m128d &Q, __m128d &T)`
- `static const std::string type_string ()`
- `static INLINE CONST vect_t zero ()`
- `template<uint8_t s>`
`static INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t srl128 (const vect_t a)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- `static constexpr const size_t vect_size = 2`
- `static constexpr const size_t alignment = 16`

Static Protected Member Functions

- `static INLINE CONST vect_t signbits (const vect_t x)`

16.261.1 Member Typedef Documentation

16.261.1.1 scalar_t

```
using scalar_t = uint64_t
```

16.261.1.2 vect_t

```
using vect_t = __m128i [inherited]
```

16.261.2 Member Function Documentation

16.261.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.261.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1 ) [inline], [static]
```

16.261.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.261.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.261.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.261.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.261.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.261.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.261.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.261.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.261.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.261.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.14 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t x0,  
    const vect_t x1 ) [inline], [static]
```

16.261.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,
```



```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.261.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.21 fmsubxin() [1/2]

```
static INLINE CONST vect_t fmsubxin (  
    vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.261.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.261.2.24 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr], [inherited]
```

16.261.2.25 get()

```
static INLINE CONST scalar_t get (
    vect_t v ) [inline], [static], [inherited]
```

16.261.2.26 sll()

```
static INLINE CONST vect_t sll (
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.27 srl()

```
static INLINE CONST vect_t srl (
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.28 shuffle()

```
static INLINE CONST vect_t shuffle (
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.29 unpacklo()

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.30 unpackhi()

```
static INLINE CONST vect_t unpackhi (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.31 blend()

```
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.32 add()

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.33 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.34 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.35 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.36 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.37 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.38 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.39 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.40 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.41 fmsub()

```
static INLINE CONST vect_t fmsub (
    const vect_t c,
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.42 fmsubin()

```
static INLINE vect_t fmsubin (
    vect_t & c,
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.43 fmsubxin() [2/2]

```
static INLINE vect_t fmsubxin (
    vect_t & c,
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.44 eq()

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.45 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.46 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static], [inherited]
```

16.261.2.47 mulhi_fast()

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static], [inherited]
```

16.261.2.48 mod()

```
INLINE vect_t mod (
    vect_t & C,
    const __m128d & P,
    const __m128d & INVP,
    const __m128d & NEGP,
    const vect_t & POW50REM,
    const __m128d & MIN,
    const __m128d & MAX,
```

```
__m128d & Q,  
__m128d & T ) [static], [inherited]
```

16.261.2.49 signbits()

```
static INLINE CONST vect_t signbits (  
    const vect_t x ) [inline], [static], [protected], [inherited]
```

16.261.2.50 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.261.2.51 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.261.2.52 sll128()

```
static INLINE CONST vect_t sll128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.53 srl128()

```
static INLINE CONST vect_t srl128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.54 vand()

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.55 vor()

```
static INLINE CONST vect_t vor (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.56 vxor()

```
static INLINE CONST vect_t vxor (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.57 vandnot()

```
static INLINE CONST vect_t vandnot (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.3 Field Documentation

16.261.3.1 vect_size

```
constexpr const size_t vect_size = 2 [static], [constexpr], [inherited]
```

16.261.3.2 alignment

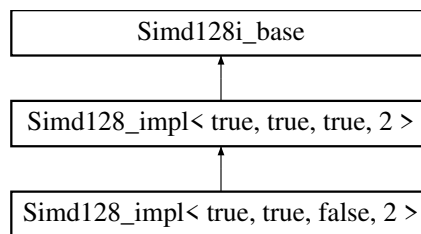
```
constexpr const size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_int64.inl](#)

16.262 Simd128_impl< true, true, true, 2 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, true, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m128i
- using [scalar_t](#) = int16_t

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE](#) void [store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)

- `template<int s>`
`static INLINE CONST vect_t sra (const vect_t a)`
- `template<uint32_t s>`
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `template<uint8_t s>`
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulhi (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulx (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsubx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST scalar_t hadd_to_scal (const vect_t a)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE vect_t mod (vect_t &C, const vect_t &P, const __m64 &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- `static const std::string type_string ()`
- `static INLINE CONST vect_t zero ()`
- `template<uint8_t s>`
`static INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t srl128 (const vect_t a)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- `static constexpr const size_t vect_size = 8`
- `static constexpr const size_t alignment = 16`

16.262.1 Member Typedef Documentation

16.262.1.1 vect_t

```
using vect_t = __m128i
```

16.262.1.2 scalar_t

```
using scalar_t = int16_t
```

16.262.2 Member Function Documentation

16.262.2.1 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr]
```

16.262.2.2 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr]
```

16.262.2.3 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.262.2.4 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.262.2.5 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.262.2.6 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```


16.262.2.7 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.262.2.8 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.262.2.9 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.262.2.10 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.262.2.11 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.262.2.12 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.262.2.13 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.262.2.14 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.262.2.15 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.16 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.17 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.18 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.19 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.262.2.20 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.21 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.262.2.22 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.23 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.24 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.25 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.26 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.27 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.28 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.29 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.30 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.31 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.32 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.33 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.34 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.35 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.36 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.37 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.38 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.39 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.40 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.41 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.42 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.43 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.262.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.262.2.45 mod()

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const __m64 & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,  
    vect_t & Q,  
    vect_t & T ) [inline], [static]
```

16.262.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.262.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.262.2.48 sll128()

```
static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.262.2.49 srl128()

```
static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.262.2.50 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.2.51 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.2.52 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.3 Field Documentation**16.262.3.1 vect_size**

```
constexpr const size_t vect_size = 8 [static], [constexpr]
```

16.262.3.2 alignment

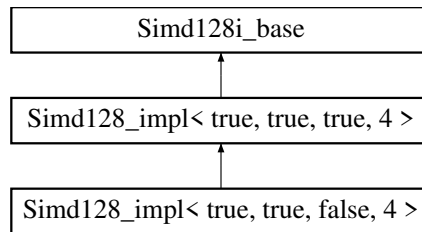
```
constexpr const size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128_int16.inl](#)

16.263 Simd128_impl< true, true, true, 4 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, true, 4 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m128i
- using [scalar_t](#) = int32_t

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- template<uint8_t s>
static [INLINE CONST vect_t shuffle](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t unpacklo](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpackhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- template<uint8_t s>
static [INLINE CONST vect_t blend](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t add](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t addin](#) ([vect_t](#) &a, const [vect_t](#) b)
- static [INLINE CONST vect_t sub](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t subin](#) ([vect_t](#) &a, const [vect_t](#) b)
- static [INLINE CONST vect_t mullo](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mul](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulhi](#) (const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- template<uint8_t s>
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static constexpr const size_t `vect_size` = 4
- static constexpr const size_t `alignment` = 16

16.263.1 Member Typedef Documentation

16.263.1.1 `vect_t`

```
using vect_t = __m128i
```

16.263.1.2 `scalar_t`

```
using scalar_t = int32_t
```

16.263.2 Member Function Documentation

16.263.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.263.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.263.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.263.2.4 set()

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3 ) [inline], [static]
```

16.263.2.5 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.263.2.6 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p ) [inline], [static]
```

16.263.2.7 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p ) [inline], [static]
```

16.263.2.8 store()

```
static INLINE void store (
    scalar_t * p,
    vect_t v ) [inline], [static]
```

16.263.2.9 storeu()

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v ) [inline], [static]
```

16.263.2.10 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.263.2.11 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.263.2.12 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.263.2.13 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.263.2.14 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.263.2.15 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.16 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.17 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.18 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.19 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.263.2.20 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.21 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.263.2.22 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.23 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.24 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.25 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.26 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.27 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.28 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.29 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.30 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.31 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.32 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.33 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.34 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.263.2.35 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.36 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.37 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.38 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.39 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.40 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.41 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.42 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.43 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.263.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.263.2.45 mod()

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const vect_t & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,  
    vect_t & Q,  
    vect_t & T ) [inline], [static]
```

16.263.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.263.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.263.2.48 sll128()

```
static INLINE CONST vect_t sll128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.263.2.49 srl128()

```
static INLINE CONST vect_t srl128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.263.2.50 vand()

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.263.2.51 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.263.2.52 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.263.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.263.3 Field Documentation**16.263.3.1 vect_size**

```
constexpr const size_t vect_size = 4 [static], [constexpr]
```

16.263.3.2 alignment

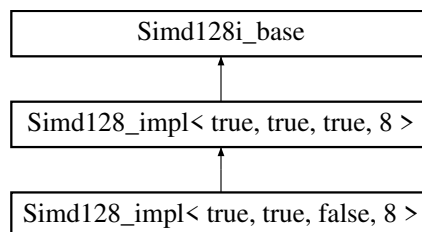
```
constexpr const size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128_int32.inl](#)

16.264 Simd128_impl< true, true, true, 8 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, true, 8 >:

**Data Structures**

- union [Converter](#)

Public Types

- using [vect_t](#) = __m128i
- using [scalar_t](#) = int64_t

Static Public Member Functions

- `template<class T >`
`static constexpr bool valid (T *p)`
- `template<class T >`
`static constexpr bool compliant (T n)`
- `static INLINE CONST vect_t set1 (const scalar_t x)`
- `static INLINE CONST vect_t set (const scalar_t x0, const scalar_t x1)`
- `template<class T >`
`static INLINE PURE vect_t gather (const scalar_t *const p, const T *const idx)`
- `template<int idx>`
`static INLINE CONST scalar_t get (vect_t v)`
- `static INLINE PURE vect_t load (const scalar_t *const p)`
- `static INLINE PURE vect_t loadu (const scalar_t *const p)`
- `static INLINE void store (scalar_t *p, vect_t v)`
- `static INLINE void storeu (scalar_t *p, vect_t v)`
- `static INLINE void stream (scalar_t *p, const vect_t v)`
- `template<int s>`
`static INLINE CONST vect_t sll (const vect_t a)`
- `template<int s>`
`static INLINE CONST vect_t srl (const vect_t a)`
- `template<int s>`
`static INLINE CONST vect_t sra (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `template<uint8_t s>`
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t x0, const vect_t x1)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulx (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmaddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsubx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST scalar_t hadd_to_scal (const vect_t a)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE CONST vect_t mask_high ()`

- static `INLINE CONST vect_t mulhi_fast (vect_t x, vect_t y)`
- static `INLINE vect_t mod (vect_t &C, const __m128d &P, const __m128d &INVP, const __m128d &NEGP, const vect_t &POW50REM, const __m128d &MIN, const __m128d &MAX, __m128d &Q, __m128d &T)`
- static const std::string `type_string ()`
- static `INLINE CONST vect_t zero ()`
- `template<uint8_t s>`
static `INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`
static `INLINE CONST vect_t srl128 (const vect_t a)`
- static `INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- static constexpr const size_t `vect_size` = 2
- static constexpr const size_t `alignment` = 16

Static Protected Member Functions

- static `INLINE CONST vect_t signbits (const vect_t x)`

16.264.1 Member Typedef Documentation

16.264.1.1 vect_t

```
using vect_t = __m128i
```

16.264.1.2 scalar_t

```
using scalar_t = int64_t
```

16.264.2 Member Function Documentation

16.264.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.264.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.264.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.264.2.4 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1 ) [inline], [static]
```

16.264.2.5 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.264.2.6 get()

```
static INLINE CONST scalar_t get (  
    vect_t v ) [inline], [static]
```

16.264.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.264.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.264.2.9 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.264.2.10 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.264.2.11 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.264.2.12 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.264.2.13 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.264.2.14 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.264.2.15 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.264.2.16 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.17 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.18 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.19 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.20 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.264.2.21 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.22 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.264.2.23 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t x0,  
    const vect_t x1 ) [inline], [static]
```

16.264.2.24 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.25 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.26 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.27 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.28 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.29 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.30 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.31 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.32 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.33 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.34 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.35 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.36 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.37 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,
```

```
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.38 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.39 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.40 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.41 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.42 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.43 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.264.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.264.2.45 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static]
```

16.264.2.46 mulhi_fast()

```

INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static]

```

16.264.2.47 mod()

```

INLINE vect_t mod (
    vect_t & C,
    const __m128d & P,
    const __m128d & INVP,
    const __m128d & NEGP,
    const vect_t & POW50REM,
    const __m128d & MIN,
    const __m128d & MAX,
    __m128d & Q,
    __m128d & T ) [static]

```

16.264.2.48 signbits()

```

static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected]

```

16.264.2.49 type_string()

```

static const std::string type_string ( ) [inline], [static], [inherited]

```

16.264.2.50 zero()

```

static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]

```

16.264.2.51 sll128()

```

static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static], [inherited]

```

16.264.2.52 srl128()

```

static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static], [inherited]

```

16.264.2.53 vand()

```

static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```

16.264.2.54 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.264.2.55 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.264.2.56 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.264.3 Field Documentation**16.264.3.1 vect_size**

```
constexpr const size_t vect_size = 2 [static], [constexpr]
```

16.264.3.2 alignment

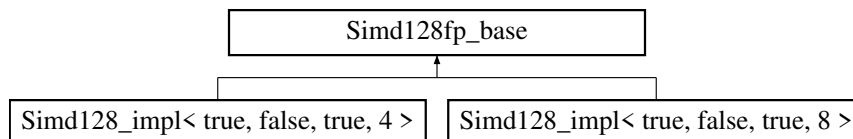
```
constexpr const size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128_int64.inl](#)

16.265 Simd128fp_base Struct Reference

Inheritance diagram for Simd128fp_base:

**Static Public Member Functions**

- static const std::string [type_string](#) ()

16.265.1 Member Function Documentation**16.265.1.1 type_string()**

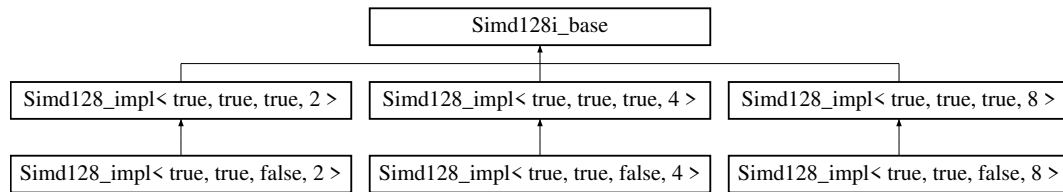
```
static const std::string type_string ( ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

16.266 Simd128i_base Struct Reference

Inheritance diagram for Simd128i_base:



Public Types

- using `vect_t` = `__m128i`

Static Public Member Functions

- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- template<uint8_t s>
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

16.266.1 Member Typedef Documentation

16.266.1.1 vect_t

using `vect_t` = `__m128i`

16.266.2 Member Function Documentation

16.266.2.1 type_string()

```
static const std::string type_string ( ) [inline], [static]
```

16.266.2.2 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.266.2.3 sll128()

```
static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static]
```

16.266.2.4 srl128()

```
static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static]
```

16.266.2.5 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.266.2.6 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.266.2.7 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.266.2.8 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

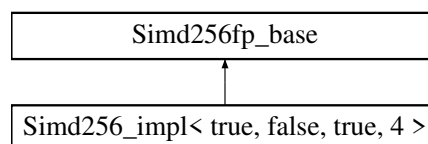
16.267 Simd256_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd256.inl](#)

16.268 Simd256_impl< true, false, true, 4 > Struct Reference

Inheritance diagram for Simd256_impl< true, false, true, 4 >:

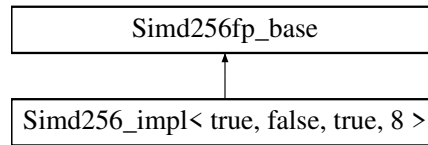


The documentation for this struct was generated from the following file:

- [simd256_float.inl](#)

16.269 Simd256_impl< true, false, true, 8 > Struct Reference

Inheritance diagram for Simd256_impl< true, false, true, 8 >:



Public Types

- using `vect_t` = `__m256d`
- using `scalar_t` = `double`

Static Public Member Functions

- `template<class T >`
static constexpr bool `valid` (T *p)
- `template<class T >`
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4)
- `template<class T >`
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void storeu` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void stream` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t blendv` (const `vect_t` a, const `vect_t` b, const `vect_t` mask)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t div` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t floor` (const `vect_t` a)
- static `INLINE CONST vect_t ceil` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t hadd` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)

Static Public Attributes

- static constexpr const size_t `vect_size` = 4
- static constexpr const size_t `alignment` = 32

16.269.1 Member Typedef Documentation

16.269.1.1 vect_t

```
using vect_t = __m256d
```

16.269.1.2 scalar_t

```
using scalar_t = double
```

16.269.2 Member Function Documentation

16.269.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.269.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.269.2.3 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.269.2.4 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.269.2.5 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4 ) [inline], [static]
```

16.269.2.6 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.269.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.269.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.269.2.9 store()

```
static INLINE void store (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.269.2.10 storeu()

```
static INLINE void storeu (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.269.2.11 stream()

```
static INLINE void stream (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.269.2.12 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.13 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.14 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.15 blendv()

```
static INLINE CONST vect_t blendv (  
    const vect_t a,  
    const vect_t b,  
    const vect_t mask ) [inline], [static]
```

16.269.2.16 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.17 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.269.2.18 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.19 subin()

```
static INLINE CONST vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.269.2.20 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.21 mulin()

```
static INLINE CONST vect_t mulin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.269.2.22 div()

```
static INLINE CONST vect_t div (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.23 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.24 fmaddin()

```
static INLINE CONST vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.25 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.26 fnmaddin()

```
static INLINE CONST vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.27 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.28 fmsubin()

```
static INLINE CONST vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.29 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.30 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.31 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.32 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.33 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.34 vand()

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.35 vor()

```
static INLINE CONST vect_t vor (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.36 vxor()

```
static INLINE CONST vect_t vxor (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.269.2.37 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.269.2.38 floor()

```
static INLINE CONST vect_t floor (
    const vect_t a ) [inline], [static]
```

16.269.2.39 ceil()

```
static INLINE CONST vect_t ceil (
    const vect_t a ) [inline], [static]
```

16.269.2.40 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.269.2.41 hadd()

```
static INLINE CONST vect_t hadd (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.269.2.42 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a ) [inline], [static]
```

16.269.2.43 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.269.3 Field Documentation**16.269.3.1 vect_size**

```
constexpr const size_t vect_size = 4 [static], [constexpr]
```

16.269.3.2 alignment

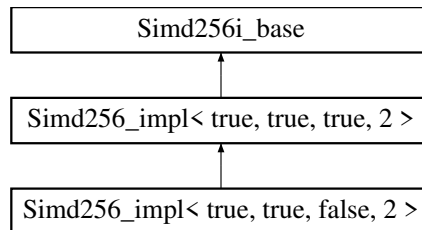
```
constexpr const size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd256_double.inl](#)

16.270 Simd256_impl< true, true, false, 2 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, false, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint16_t](#)
- using [simdHalf](#) = [Simd128](#)< [scalar_t](#) >
- using [vect_t](#) = [__m256i](#)
- using [half_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7, const [scalar_t](#) x8, const [scalar_t](#) x9, const [scalar_t](#) x10, const [scalar_t](#) x11, const [scalar_t](#) x12, const [scalar_t](#) x13, const [scalar_t](#) x14, const [scalar_t](#) x15)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulx](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint64_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static constexpr const size_t `vect_size` = 16
- static constexpr const size_t `alignment` = 32

16.270.1 Member Typedef Documentation

16.270.1.1 scalar_t

```
using scalar_t = uint16_t
```

16.270.1.2 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.270.1.3 vect_t

```
using vect_t = __m256i [inherited]
```

16.270.1.4 half_t

```
using half_t = __m128i [inherited]
```

16.270.2 Member Function Documentation

16.270.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.270.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7,  
    const scalar_t x8,  
    const scalar_t x9,  
    const scalar_t x10,  
    const scalar_t x11,  
    const scalar_t x12,  
    const scalar_t x13,  
    const scalar_t x14,  
    const scalar_t x15 ) [inline], [static]
```

16.270.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.270.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.270.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.270.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.270.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.270.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.270.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.270.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.270.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.270.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.14 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.270.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.270.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.270.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.270.2.25 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.26 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.27 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.28 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.29 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.30 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.31 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.32 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.33 blend_twice()

```
static INLINE CONST vect_t blend_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.34 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.35 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.36 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.37 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.38 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```


16.270.2.39 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.40 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.41 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.42 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.43 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.44 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.45 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.46 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.47 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.48 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static], [inherited]
```

16.270.2.49 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.270.2.50 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.270.3 Field Documentation**16.270.3.1 vect_size**

```
constexpr const size_t vect_size = 16 [static], [constexpr], [inherited]
```

16.270.3.2 alignment

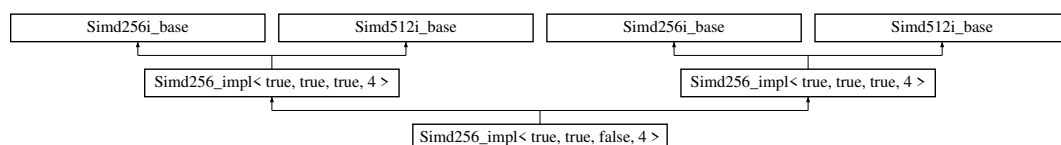
```
constexpr const size_t alignment = 32 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd256_int16.inl](#)

16.271 Simd256_impl< true, true, false, 4 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, false, 4 >:

**Data Structures**

- union [Converter](#)

Public Types

- using `scalar_t` = `uint32_t`
- using `simdHalf` = `Simd128< scalar_t >`
- using `scalar_t` = `uint32_t`
- using `simdHalf` = `Simd128< scalar_t >`
- using `vect_t` = `__m256i`
- using `vect_t` = `__m512i`
- using `half_t` = `__m128i`
- using `half_t` = `__m256i`

Static Public Member Functions

- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
static `INLINE CONST vect_t sra` (const `vect_t` a)
- static `INLINE CONST vect_t greater` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t lesser` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
static `INLINE CONST vect_t sra` (const `vect_t` a)
- static `INLINE CONST vect_t greater` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t lesser` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)

- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- template<class T >
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7, const `scalar_t` x8, const `scalar_t` x9, const `scalar_t` x10, const `scalar_t` x11, const `scalar_t` x12, const `scalar_t` x13, const `scalar_t` x14, const `scalar_t` x15)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- template<uint32_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- template<uint64_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)

- static `INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t round (const vect_t a)`
- static `INLINE CONST vect_t round (const vect_t a)`
- static `INLINE vect_t mod (vect_t &C, const vect_t &P, const vect_t &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- static `INLINE vect_t mod (vect_t &C, const vect_t &P, const vect_t &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- static const std::string `type_string ()`
- static const std::string `type_string ()`
- static `INLINE CONST vect_t zero ()`
- static `INLINE CONST vect_t zero ()`
- static `INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- static constexpr const size_t `vect_size` = 8
- static constexpr const size_t `alignment` = 32

16.271.1 Member Typedef Documentation

16.271.1.1 scalar_t [1/2]

```
using scalar_t = uint32_t
```

16.271.1.2 simdHalf [1/2]

```
using simdHalf = Simd128<scalar_t>
```

16.271.1.3 scalar_t [2/2]

```
using scalar_t = uint32_t
```

16.271.1.4 simdHalf [2/2]

```
using simdHalf = Simd128<scalar_t>
```

16.271.1.5 vect_t [1/2]

```
using vect_t = __m256i [inherited]
```

16.271.1.6 vect_t [2/2]

```
using vect_t = __m512i [inherited]
```

16.271.1.7 half_t [1/2]

```
using half_t = __m128i [inherited]
```

16.271.1.8 half_t [2/2]

```
using half_t = __m256i [inherited]
```

16.271.2 Member Function Documentation**16.271.2.1 set1() [1/2]**

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.271.2.2 set() [1/3]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.271.2.3 gather() [1/2]

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.271.2.4 load() [1/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.271.2.5 loadu() [1/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.271.2.6 store() [1/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.7 storeu() [1/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.8 stream() [1/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.271.2.9 sra() [1/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.271.2.10 greater() [1/2]

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.11 lesser() [1/2]

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.12 greater_eq() [1/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.13 lesser_eq() [1/2]

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.14 mulhi() [1/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.15 mulx() [1/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.16 fmaddx() [1/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.17 fmaddxin() [1/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.18 fnmaddx() [1/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.19 fnmaddxin() [1/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.20 fmsubx() [1/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.21 fmsubxin() [1/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.271.2.22 hadd_to_scal() [1/2]

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.271.2.23 set1() [2/2]

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.271.2.24 set() [2/3]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.271.2.25 gather() [2/2]

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.271.2.26 load() [2/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.271.2.27 loadu() [2/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.271.2.28 store() [2/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.29 storeu() [2/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.30 stream() [2/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.271.2.31 sra() [2/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.271.2.32 greater() [2/2]

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.33 lesser() [2/2]

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.34 greater_eq() [2/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.35 lesser_eq() [2/2]

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.36 mulhi() [2/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.37 mulx() [2/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.38 fmaddx() [2/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.271.2.39 fmaddxin() [2/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.40 fnmaddx() [2/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.41 fnmaddxin() [2/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.42 fmsubx() [2/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.43 fmsubxin() [2/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.44 hadd_to_scal() [2/2]

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.271.2.45 valid() [1/2]

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.271.2.46 valid() [2/2]

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.271.2.47 compliant() [1/2]

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.271.2.48 compliant() [2/2]

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.271.2.49 set() [3/3]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7,  
    const scalar_t x8,  
    const scalar_t x9,  
    const scalar_t x10,  
    const scalar_t x11,  
    const scalar_t x12,  
    const scalar_t x13,  
    const scalar_t x14,  
    const scalar_t x15 ) [inline], [static], [inherited]
```

16.271.2.50 sll() [1/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.51 sll() [2/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.52 srl() [1/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.53 srl() [2/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.54 shuffle_twice() [1/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.55 shuffle_twice() [2/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.56 shuffle() [1/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.57 shuffle() [2/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.58 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.59 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.60 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.61 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.62 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.63 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.64 add() [1/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.65 add() [2/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.66 addin() [1/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.67 addin() [2/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.68 sub() [1/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.69 sub() [2/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.70 subin() [1/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.71 subin() [2/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.72 mullo() [1/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.73 mullo() [2/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.74 mul() [1/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.75 mul() [2/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.76 fmadd() [1/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.77 fmadd() [2/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.78 fmaddin() [1/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.79 fmaddin() [2/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.80 fnmadd() [1/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.81 fnmadd() [2/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.82 fnmaddin() [1/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.83 fnmaddin() [2/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.84 fmsub() [1/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.85 fmsub() [2/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,
```



```
const vect_t a,
const vect_t b ) [inline], [static], [inherited]
```

16.271.2.86 fmsubin() [1/2]

```
static INLINE vect_t fmsubin (
    vect_t & c,
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.87 fmsubin() [2/2]

```
static INLINE vect_t fmsubin (
    vect_t & c,
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.88 eq() [1/2]

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.89 eq() [2/2]

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.90 round() [1/2]

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.91 round() [2/2]

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.92 mod() [1/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static], [inherited]
```

16.271.2.93 mod() [2/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static], [inherited]
```

16.271.2.94 type_string() [1/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.271.2.95 type_string() [2/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.271.2.96 zero() [1/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.271.2.97 zero() [2/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.271.2.98 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.99 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.100 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.101 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.3 Field Documentation

16.271.3.1 vect_size

```
static constexpr const size_t vect_size = 8 [static], [constexpr], [inherited]
```

16.271.3.2 alignment

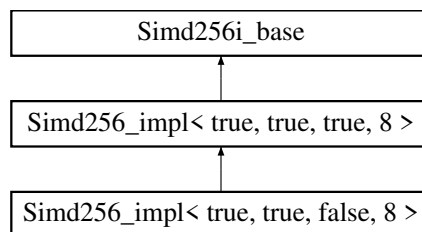
```
static constexpr const size_t alignment = 32 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.272 Simd256_impl< true, true, false, 8 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, false, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint64_t](#)
- using [simdHalf](#) = [Simd128](#)< [scalar_t](#) >
- using [vect_t](#) = [__m256i](#)
- using [half_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- template<int idx>
static `INLINE CONST scalar_t get` (`vect_t` v)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &l, `vect_t` &h, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const __m256d &P, const __m256d &INVP, const __m256d &NEGP, const `vect_t` &POW50REM, const __m256d &MIN, const __m256d &MAX, __m256d &Q, __m256d &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static constexpr const size_t `vect_size` = 4
- static constexpr const size_t `alignment` = 32

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.272.1 Member Typedef Documentation

16.272.1.1 scalar_t

```
using scalar_t = uint64_t
```

16.272.1.2 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.272.1.3 vect_t

```
using vect_t = __m256i [inherited]
```

16.272.1.4 half_t

```
using half_t = __m128i [inherited]
```

16.272.2 Member Function Documentation

16.272.2.1 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.272.2.2 set()

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3 ) [inline], [static]
```

16.272.2.3 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.272.2.4 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p ) [inline], [static]
```

16.272.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.272.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.272.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.272.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.272.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.272.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.272.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.272.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.14 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.272.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.272.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.272.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.272.2.25 get()

```
static INLINE CONST scalar_t get (  
    vect_t v ) [inline], [static], [inherited]
```

16.272.2.26 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.27 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.28 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.29 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.30 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```


16.272.2.31 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.32 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.33 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.34 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.35 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.36 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.37 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.38 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.39 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.40 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.41 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.42 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.43 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.44 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.45 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.46 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.47 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.48 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static], [inherited]
```

16.272.2.49 mulhi_fast()

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static], [inherited]
```

16.272.2.50 mod()

```
INLINE vect_t mod (
    vect_t & C,
    const __m256d & P,
    const __m256d & INV_P,
    const __m256d & NEG_P,
    const vect_t & POW50REM,
    const __m256d & MIN,
    const __m256d & MAX,
    __m256d & Q,
    __m256d & T ) [static], [inherited]
```

16.272.2.51 signbits()

```
static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected], [inherited]
```

16.272.2.52 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.272.2.53 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.272.3 Field Documentation**16.272.3.1 vect_size**

```
constexpr const size_t vect_size = 4 [static], [constexpr], [inherited]
```

16.272.3.2 alignment

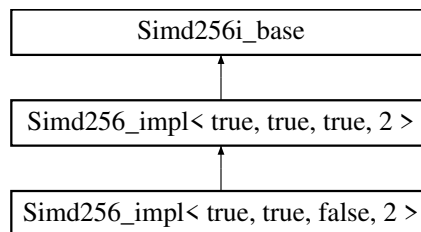
```
constexpr const size_t alignment = 32 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd256_int64.inl](#)

16.273 Simd256_impl< true, true, true, 2 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, true, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m256i
- using [half_t](#) = __m128i
- using [scalar_t](#) = [int16_t](#)
- using [simdHalf](#) = [Simd128](#)< [scalar_t](#) >

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST](#) [vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST](#) [vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7, const [scalar_t](#) x8, const [scalar_t](#) x9, const [scalar_t](#) x10, const [scalar_t](#) x11, const [scalar_t](#) x12, const [scalar_t](#) x13, const [scalar_t](#) x14, const [scalar_t](#) x15)
- template<class T >
static [INLINE PURE](#) [vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE](#) [vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE](#) [vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE](#) void [store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST](#) [vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST](#) [vect_t srl](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST](#) [vect_t sra](#) (const [vect_t](#) a)
- template<uint64_t s>
static [INLINE CONST](#) [vect_t shuffle](#) (const [vect_t](#) a)

- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
 - static `INLINE CONST vect_t blend_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmadxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static constexpr const size_t `vect_size` = 16
- static constexpr const size_t `alignment` = 32

16.273.1 Member Typedef Documentation

16.273.1.1 vect_t

```
using vect_t = __m256i
```

16.273.1.2 half_t

```
using half_t = __m128i
```

16.273.1.3 scalar_t

```
using scalar_t = int16_t
```

16.273.1.4 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.273.2 Member Function Documentation**16.273.2.1 valid()**

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.273.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.273.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.273.2.4 set()

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7,
    const scalar_t x8,
    const scalar_t x9,
    const scalar_t x10,
    const scalar_t x11,
    const scalar_t x12,
    const scalar_t x13,
    const scalar_t x14,
    const scalar_t x15 ) [inline], [static]
```

16.273.2.5 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.273.2.6 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.273.2.7 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.273.2.8 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.273.2.9 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.273.2.10 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.273.2.11 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.273.2.12 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.273.2.13 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.273.2.14 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.273.2.15 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.16 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.17 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.18 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.19 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.20 blend_twice()

```
static INLINE CONST vect_t blend_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.21 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.22 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```


16.273.2.23 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.24 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.273.2.25 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.26 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.27 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.28 mulx()

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.273.2.29 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.30 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.31 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.32 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.33 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.34 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.35 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.36 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.37 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.38 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.273.2.39 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.40 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.41 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.42 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.43 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.44 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.45 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.46 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.273.2.47 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.273.2.48 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.273.2.49 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.273.2.50 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.273.3 Field Documentation**16.273.3.1 vect_size**

```
constexpr const size_t vect_size = 16 [static], [constexpr]
```

16.273.3.2 alignment

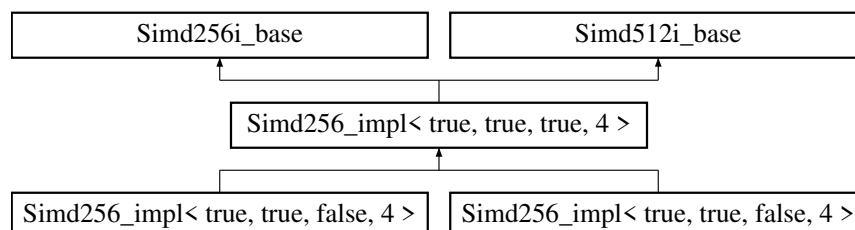
```
constexpr const size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd256_int16.inl](#)

16.274 Simd256_impl< true, true, true, 4 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, true, 4 >:

**Data Structures**

- union [Converter](#)

Public Types

- using `vect_t` = `__m256i`
- using `half_t` = `__m128i`
- using `scalar_t` = `int32_t`
- using `simdHalf` = `Simd128`< `scalar_t` >
- using `vect_t` = `__m512i`
- using `half_t` = `__m256i`
- using `scalar_t` = `int32_t`
- using `simdHalf` = `Simd256`< `scalar_t` >

Static Public Member Functions

- `template<class T >`
static constexpr bool `valid` (T *p)
- `template<class T >`
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- `template<class T >`
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- `template<int s>`
static `INLINE CONST vect_t sll` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t srl` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t sra` (const `vect_t` a)
- `template<uint8_t s>`
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- `template<uint32_t s>`
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7, const `scalar_t` x8, const `scalar_t` x9, const `scalar_t` x10, const `scalar_t` x11, const `scalar_t` x12, const `scalar_t` x13, const `scalar_t` x14, const `scalar_t` x15)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t sra` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- template<uint64_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static constexpr const size_t `vect_size` = 8
- static constexpr const size_t `alignment` = 32

16.274.1 Member Typedef Documentation

16.274.1.1 `vect_t` [1/2]

```
using vect_t = __m256i
```

16.274.1.2 `half_t` [1/2]

```
using half_t = __m128i
```

16.274.1.3 `scalar_t` [1/2]

```
using scalar_t = int32_t
```

16.274.1.4 `simdHalf` [1/2]

```
using simdHalf = Simd128<scalar_t>
```

16.274.1.5 vect_t [2/2]

```
using vect_t = __m512i
```

16.274.1.6 half_t [2/2]

```
using half_t = __m256i
```

16.274.1.7 scalar_t [2/2]

```
using scalar_t = int32_t
```

16.274.1.8 simdHalf [2/2]

```
using simdHalf = Simd256<scalar_t>
```

16.274.2 Member Function Documentation**16.274.2.1 valid() [1/2]**

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.274.2.2 compliant() [1/2]

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.274.2.3 set1() [1/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.274.2.4 set() [1/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7 ) [inline], [static]
```

16.274.2.5 gather() [1/2]

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```


16.274.2.6 load() [1/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.7 loadu() [1/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.8 store() [1/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.9 storeu() [1/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.10 stream() [1/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.274.2.11 sll() [1/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.274.2.12 srl() [1/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.274.2.13 sra() [1/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.274.2.14 shuffle_twice() [1/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static]
```

16.274.2.15 shuffle() [1/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.274.2.16 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.17 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.18 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.19 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.20 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.21 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.22 add() [1/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.23 addin() [1/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.24 sub() [1/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.25 subin() [1/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.26 mullo() [1/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.27 mul() [1/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.28 mulhi() [1/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.29 mulx() [1/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.274.2.30 fmadd() [1/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.31 fmaddin() [1/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.32 fmaddx() [1/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.33 fmaddxin() [1/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.34 fnmadd() [1/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.35 fnmaddin() [1/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.36 fnmaddx() [1/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.37 fnmaddxin() [1/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.38 fmsub() [1/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.274.2.39 fmsubin() [1/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.40 fmsubx() [1/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.41 fmsubxin() [1/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.42 eq() [1/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.43 greater() [1/2]

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.44 lesser() [1/2]

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.45 greater_eq() [1/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.46 lesser_eq() [1/2]

```
static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.47 hadd_to_scal() [1/2]

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a ) [inline], [static]
```

16.274.2.48 round() [1/2]

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.274.2.49 mod() [1/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.274.2.50 valid() [2/2]

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.274.2.51 compliant() [2/2]

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.274.2.52 set1() [2/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.274.2.53 set() [2/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
```

```
const scalar_t x7,  
const scalar_t x8,  
const scalar_t x9,  
const scalar_t x10,  
const scalar_t x11,  
const scalar_t x12,  
const scalar_t x13,  
const scalar_t x14,  
const scalar_t x15 ) [inline], [static]
```

16.274.2.54 gather() [2/2]

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.274.2.55 load() [2/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.56 loadu() [2/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.57 store() [2/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.58 storeu() [2/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.59 stream() [2/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.274.2.60 sll() [2/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.274.2.61 srl() [2/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.274.2.62 sra() [2/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.274.2.63 shuffle_twice() [2/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static]
```

16.274.2.64 shuffle() [2/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.274.2.65 add() [2/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.66 addin() [2/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.67 sub() [2/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.68 subin() [2/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.69 mullo() [2/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.274.2.70 mul() [2/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.71 mulhi() [2/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.72 mulx() [2/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.274.2.73 fmadd() [2/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.74 fmaddin() [2/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.75 fmaddx() [2/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.76 fmaddxin() [2/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.77 fnmadd() [2/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.78 fnmaddin() [2/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.79 fnmaddx() [2/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.80 fnmaddxin() [2/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.81 fmsub() [2/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.82 fmsubin() [2/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.83 fmsubx() [2/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.84 fmsubxin() [2/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.85 eq() [2/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,
```

```
const vect_t b ) [inline], [static]
```

16.274.2.86 greater() [2/2]

```
static INLINE CONST vect_t greater (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.87 lesser() [2/2]

```
static INLINE CONST vect_t lesser (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.88 greater_eq() [2/2]

```
static INLINE CONST vect_t greater_eq (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.89 lesser_eq() [2/2]

```
static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.90 hadd_to_scal() [2/2]

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a ) [inline], [static]
```

16.274.2.91 round() [2/2]

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.274.2.92 mod() [2/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.274.2.93 type_string() [1/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.274.2.94 zero() [1/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.274.2.95 type_string() [2/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.274.2.96 zero() [2/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.274.2.97 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.2.98 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.2.99 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.2.100 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.3 Field Documentation**16.274.3.1 vect_size**

```
static constexpr const size_t vect_size = 8 [static], [constexpr]
```

16.274.3.2 alignment

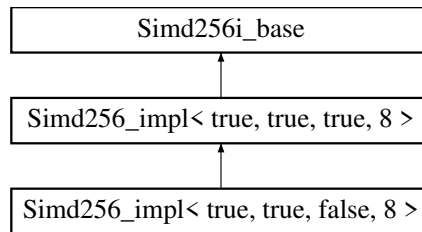
```
static constexpr const size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.275 Simd256_impl< true, true, true, 8 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, true, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m256i
- using [half_t](#) = __m128i
- using [scalar_t](#) = int64_t
- using [simdHalf](#) = Simd128< [scalar_t](#) >

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- template<int idx>
static [INLINE CONST scalar_t get](#) ([vect_t](#) v)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE](#) void [store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- template<uint8_t s>
static [INLINE CONST vect_t shuffle](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t unpacklo_twice](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpackhi_twice](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpacklo](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpackhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE](#) void [unpacklohi](#) ([vect_t](#) &l, [vect_t](#) &h, const [vect_t](#) a, const [vect_t](#) b)
- template<uint8_t s>
static [INLINE CONST vect_t blend](#) (const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const `__m256d` &P, const `__m256d` &INVP, const `__m256d` &NEGP, const `vect_t` &POW50REM, const `__m256d` &MIN, const `__m256d` &MAX, `__m256d` &Q, `__m256d` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static constexpr const size_t `vect_size` = 4
- static constexpr const size_t `alignment` = 32

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.275.1 Member Typedef Documentation

16.275.1.1 `vect_t`

```
using vect_t = __m256i
```

16.275.1.2 `half_t`

```
using half_t = __m128i
```

16.275.1.3 scalar_t

```
using scalar_t = int64_t
```

16.275.1.4 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.275.2 Member Function Documentation

16.275.2.1 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr]
```

16.275.2.2 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr]
```

16.275.2.3 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.275.2.4 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3 ) [inline], [static]
```

16.275.2.5 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.275.2.6 get()

```
static INLINE CONST scalar_t get (  
    vect_t v ) [inline], [static]
```

16.275.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.275.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.275.2.9 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.275.2.10 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.275.2.11 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.275.2.12 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.275.2.13 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.275.2.14 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.275.2.15 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.275.2.16 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.275.2.17 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.18 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.19 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.20 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.21 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.22 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.23 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.275.2.24 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.25 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.275.2.26 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.275.2.27 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.28 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.29 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.30 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.31 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.32 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.33 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.34 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.35 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.36 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.37 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.38 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.39 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.40 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.275.2.41 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.42 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.43 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.44 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.45 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.46 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.275.2.47 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.275.2.48 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static]
```

16.275.2.49 mulhi_fast()

```

INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static]

```

16.275.2.50 mod()

```

INLINE vect_t mod (
    vect_t & C,
    const __m256d & P,
    const __m256d & INV_P,
    const __m256d & NEG_P,
    const vect_t & POW50REM,
    const __m256d & MIN,
    const __m256d & MAX,
    __m256d & Q,
    __m256d & T ) [static]

```

16.275.2.51 signbits()

```

static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected]

```

16.275.2.52 type_string()

```

static const std::string type_string ( ) [inline], [static], [inherited]

```

16.275.2.53 zero()

```

static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]

```

16.275.3 Field Documentation**16.275.3.1 vect_size**

```

constexpr const size_t vect_size = 4 [static], [constexpr]

```

16.275.3.2 alignment

```

constexpr const size_t alignment = 32 [static], [constexpr]

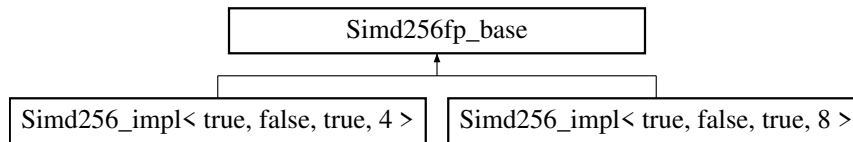
```

The documentation for this struct was generated from the following file:

- [simd256_int64.inl](#)

16.276 Simd256fp_base Struct Reference

Inheritance diagram for Simd256fp_base:

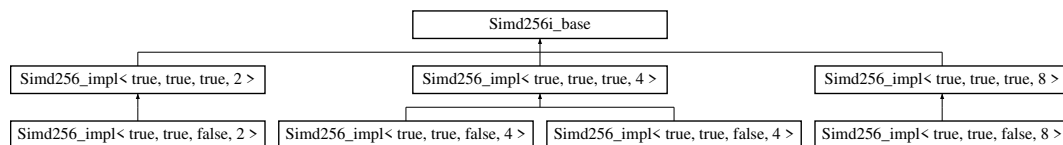


The documentation for this struct was generated from the following file:

- [simd256.inl](#)

16.277 Simd256i_base Struct Reference

Inheritance diagram for Simd256i_base:



Public Types

- using [vect_t](#) = __m256i

Static Public Member Functions

- static const std::string [type_string](#) ()
- static [INLINE CONST vect_t zero](#) ()

16.277.1 Member Typedef Documentation

16.277.1.1 vect_t

using [vect_t](#) = __m256i

16.277.2 Member Function Documentation

16.277.2.1 type_string()

```
static const std::string type_string ( ) [inline], [static]
```

16.277.2.2 zero()

```
static INLINE CONST vect\_t zero ( ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd256.inl](#)

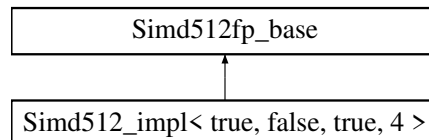
16.278 Simd512_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

16.279 Simd512_impl< true, false, true, 4 > Struct Reference

Inheritance diagram for Simd512_impl< true, false, true, 4 >:



Static Public Member Functions

- static const std::string [type_string](#) ()

16.279.1 Member Function Documentation

16.279.1.1 type_string()

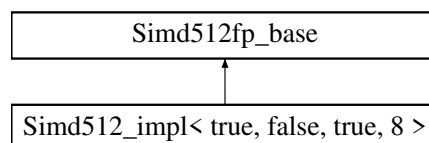
```
static const std::string type_string ( ) [inline], [static], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd512_float.inl](#)

16.280 Simd512_impl< true, false, true, 8 > Struct Reference

Inheritance diagram for Simd512_impl< true, false, true, 8 >:



Public Types

- using [vect_t](#) = __m512d
- using [scalar_t](#) = double

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t zero](#) ()
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)

- static `INLINE CONST vect_t set` (const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7, const `scalar_t` x8)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void storeu` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void stream` (const `scalar_t` *p, const `vect_t` v)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t blendv` (const `vect_t` a, const `vect_t` b, const `vect_t` mask)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t div` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t floor` (const `vect_t` a)
- static `INLINE CONST vect_t ceil` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t hadd` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static const std::string `type_string` ()

Static Public Attributes

- static constexpr const size_t `vect_size` = 8
- static constexpr const size_t `alignment` = 64

16.280.1 Member Typedef Documentation

16.280.1.1 vect_t

using `vect_t` = __m512d

16.280.1.2 scalar_t

using scalar_t = double

16.280.2 Member Function Documentation

16.280.2.1 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr]
```

16.280.2.2 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr]
```

16.280.2.3 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.280.2.4 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.280.2.5 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7,  
    const scalar_t x8 ) [inline], [static]
```

16.280.2.6 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.280.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.280.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.280.2.9 store()

```
static INLINE void store (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.280.2.10 storeu()

```
static INLINE void storeu (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.280.2.11 stream()

```
static INLINE void stream (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.280.2.12 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.280.2.13 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.14 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.15 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.16 blendv()

```
static INLINE CONST vect_t blendv (  
    const vect_t a,  
    const vect_t b,  
    const vect_t mask ) [inline], [static]
```

16.280.2.17 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.18 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.280.2.19 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.20 subin()

```
static INLINE CONST vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.280.2.21 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.22 mulin()

```
static INLINE CONST vect_t mulin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.280.2.23 div()

```
static INLINE CONST vect_t div (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.24 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.25 fmaddin()

```
static INLINE CONST vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.26 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.27 fnmaddin()

```
static INLINE CONST vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.28 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.29 fmsubin()

```
static INLINE CONST vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.30 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.31 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.32 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.33 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.34 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.35 floor()

```
static INLINE CONST vect_t floor (  
    const vect_t a ) [inline], [static]
```

16.280.2.36 ceil()

```
static INLINE CONST vect_t ceil (  
    const vect_t a ) [inline], [static]
```

16.280.2.37 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.280.2.38 hadd()

```
static INLINE CONST vect_t hadd (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.39 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.280.2.40 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.280.3 Field Documentation**16.280.3.1 vect_size**

```
constexpr const size_t vect_size = 8 [static], [constexpr]
```

16.280.3.2 alignment

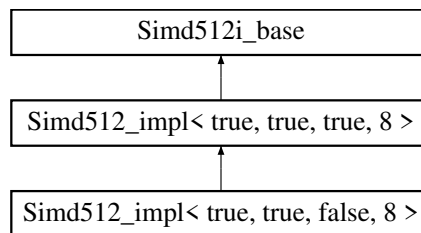
```
constexpr const size_t alignment = 64 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd512_double.inl](#)

16.281 Simd512_impl< true, true, false, 8 > Struct Reference

Inheritance diagram for Simd512_impl< true, true, false, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint64_t](#)
- using [simdHalf](#) = [Simd256](#)< [scalar_t](#) >
- using [vect_t](#) = [__m512i](#)
- using [half_t](#) = [__m256i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- template<uint8_t k>
static [INLINE void maskstore](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mullo](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t mulx](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &l, `vect_t` &h, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmadin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const __m512d &P, const __m512d &INVP, const __m512d &NEGP, const `vect_t` &POW50REM, const __m512d &MIN, const __m512d &MAX, __m512d &Q, __m512d &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static constexpr const size_t `vect_size` = 8
- static constexpr const size_t `alignment` = 64

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.281.1 Member Typedef Documentation

16.281.1.1 scalar_t

```
using scalar_t = uint64_t
```

16.281.1.2 simdHalf

```
using simdHalf = Simd256<scalar_t>
```

16.281.1.3 vect_t

```
using vect_t = __m512i [inherited]
```

16.281.1.4 half_t

```
using half_t = __m256i [inherited]
```

16.281.2 Member Function Documentation

16.281.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.281.2.2 set() [1/2]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.281.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.281.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```


16.281.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.281.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.281.2.7 maskstore()

```
static INLINE void maskstore (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.281.2.8 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.281.2.9 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.281.2.10 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.281.2.11 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.281.2.12 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.281.2.13 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.14 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.15 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.281.2.16 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.17 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.18 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.19 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.20 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.21 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.22 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.23 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.281.2.24 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.281.2.25 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.281.2.26 set() [2/2]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3 ) [inline], [static], [inherited]
```

16.281.2.27 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.28 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.29 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.30 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.31 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.32 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.33 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.34 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.35 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.36 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.37 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.38 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.39 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.40 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.41 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.42 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.43 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.44 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.45 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.46 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.47 eq()

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.48 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.49 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static], [inherited]
```

16.281.2.50 mulhi_fast()

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static], [inherited]
```

16.281.2.51 mod()

```
INLINE vect_t mod (
    vect_t & C,
    const __m512d & P,
    const __m512d & INV_P,
    const __m512d & NEG_P,
    const vect_t & POW50REM,
    const __m512d & MIN,
    const __m512d & MAX,
    __m512d & Q,
    __m512d & T ) [static], [inherited]
```

16.281.2.52 signbits()

```
static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected], [inherited]
```

16.281.2.53 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.281.2.54 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.281.2.55 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.56 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.57 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.58 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.3 Field Documentation**16.281.3.1 vect_size**

```
constexpr const size_t vect_size = 8 [static], [constexpr], [inherited]
```

16.281.3.2 alignment

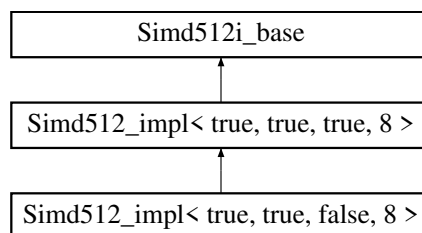
```
constexpr const size_t alignment = 64 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd512_int64.inl](#)

16.282 Simd512_impl< true, true, true, 8 > Struct Reference

Inheritance diagram for Simd512_impl< true, true, true, 8 >:

**Data Structures**

- union [Converter](#)

Public Types

- using `vect_t` = `__m512i`
- using `half_t` = `__m256i`
- using `scalar_t` = `int64_t`
- using `simdHalf` = `Simd256< scalar_t >`

Static Public Member Functions

- `template<class T >`
static constexpr bool `valid` (T *p)
- `template<class T >`
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3)
- `template<class T >`
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- `template<uint8_t k>`
static `INLINE void maskstore` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- `template<int s>`
static `INLINE CONST vect_t sll` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t srl` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t sra` (const `vect_t` a)
- `template<uint8_t s>`
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &l, `vect_t` &h, const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const `__m512d` &P, const `__m512d` &INVP, const `__m512d` &NEGP, const `vect_t` &POW50REM, const `__m512d` &MIN, const `__m512d` &MAX, `__m512d` &Q, `__m512d` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static constexpr const size_t `vect_size` = 8
- static constexpr const size_t `alignment` = 64

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.282.1 Member Typedef Documentation

16.282.1.1 vect_t

```
using vect_t = __m512i
```

16.282.1.2 half_t

```
using half_t = __m256i
```

16.282.1.3 scalar_t

```
using scalar_t = int64_t
```

16.282.1.4 simdHalf

```
using simdHalf = Simd256<scalar_t>
```

16.282.2 Member Function Documentation

16.282.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.282.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.282.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.282.2.4 set() [1/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7 ) [inline], [static]
```

16.282.2.5 set() [2/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3 ) [inline], [static]
```

16.282.2.6 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.282.2.7 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p ) [inline], [static]
```

16.282.2.8 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p ) [inline], [static]
```

16.282.2.9 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.282.2.10 maskstore()

```
static INLINE void maskstore (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.282.2.11 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.282.2.12 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.282.2.13 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.282.2.14 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.282.2.15 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.282.2.16 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.282.2.17 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.18 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.19 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.20 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.21 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.22 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.23 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.24 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.282.2.25 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.26 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.282.2.27 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.282.2.28 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.29 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.30 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.31 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.32 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.33 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.34 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.35 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.36 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.37 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.38 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.39 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.40 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.41 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.282.2.42 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.43 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.44 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.45 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.46 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.47 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.282.2.48 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.282.2.49 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static]
```

16.282.2.50 mulhi_fast()

```

INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static]

```

16.282.2.51 mod()

```

INLINE vect_t mod (
    vect_t & C,
    const __m512d & P,
    const __m512d & INV_P,
    const __m512d & NEG_P,
    const vect_t & POW50REM,
    const __m512d & MIN,
    const __m512d & MAX,
    __m512d & Q,
    __m512d & T ) [static]

```

16.282.2.52 signbits()

```

static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected]

```

16.282.2.53 type_string()

```

static const std::string type_string ( ) [inline], [static], [inherited]

```

16.282.2.54 zero()

```

static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]

```

16.282.2.55 vor()

```

static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```

16.282.2.56 vxor()

```

static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```

16.282.2.57 vand()

```

static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```


16.282.2.58 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.282.3 Field Documentation**16.282.3.1 vect_size**

```
constexpr const size_t vect_size = 8 [static], [constexpr]
```

16.282.3.2 alignment

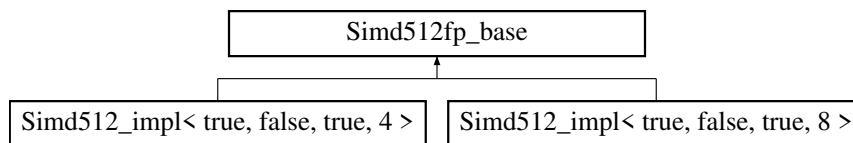
```
constexpr const size_t alignment = 64 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd512_int64.inl](#)

16.283 Simd512fp_base Struct Reference

Inheritance diagram for Simd512fp_base:

**Static Public Member Functions**

- static const std::string [type_string](#) ()

16.283.1 Member Function Documentation**16.283.1.1 type_string()**

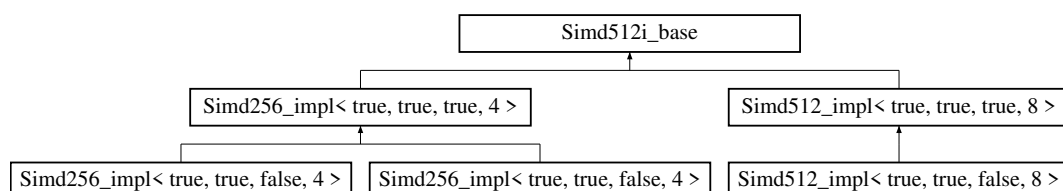
```
static const std::string type_string ( ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

16.284 Simd512i_base Struct Reference

Inheritance diagram for Simd512i_base:



Public Types

- using `vect_t` = `__m512i`

Static Public Member Functions

- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

16.284.1 Member Typedef Documentation

16.284.1.1 `vect_t`

using `vect_t` = `__m512i`

16.284.2 Member Function Documentation

16.284.2.1 `type_string()`

```
static const std::string type_string ( ) [inline], [static]
```

16.284.2.2 `zero()`

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.284.2.3 `vor()`

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.284.2.4 `vxor()`

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.284.2.5 `vand()`

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.284.2.6 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

16.285 SimdChooser< T, bool, bool > Struct Template Reference

```
#include <fflas_simd.h>
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.286 SimdChooser< T, false, b > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [value](#) = [NoSimd](#)< T >

16.286.1 Member Typedef Documentation**16.286.1.1 value**

```
using value = NoSimd<T>
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.287 SimdChooser< T, true, false > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [value](#) = [NoSimd](#)< T >

16.287.1 Member Typedef Documentation**16.287.1.1 value**

```
using value = NoSimd<T>
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.288 SimdChooser< T, true, true > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [value](#) = [NoSimd](#)< T >

16.288.1 Member Typedef Documentation

16.288.1.1 value

using [value](#) = [NoSimd](#)<T>

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.289 [simdToType](#)< T > Struct Template Reference

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.290 Single Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.291 [Sparse](#)< [Field](#), [SparseMatrix_t](#), [IdxT](#), [PtrT](#) > Struct Template Reference

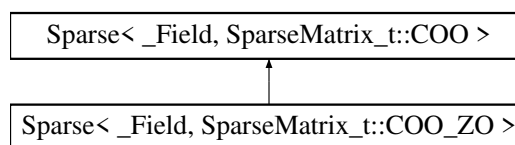
The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.292 [Sparse](#)< [_Field](#), [SparseMatrix_t::COO](#) > Struct Template Reference

```
#include <coo.h>
```

Inheritance diagram for [Sparse](#)< [_Field](#), [SparseMatrix_t::COO](#) >:



Public Types

- using [Field](#) = [_Field](#)

Data Fields

- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [row](#) = nullptr
- [_Field::Element_ptr](#) dat

- bool `delayed` = false
- `uint64_t` `kmax` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `uint64_t` `maxrow` = 0

16.292.1 Member Typedef Documentation

16.292.1.1 Field

using `Field` = `_Field`

16.292.2 Field Documentation

16.292.2.1 col

`index_t*` `col` = `nullptr`

16.292.2.2 row

`index_t*` `row` = `nullptr`

16.292.2.3 dat

`_Field::Element_ptr` `dat`

16.292.2.4 delayed

bool `delayed` = false

16.292.2.5 kmax

`uint64_t` `kmax` = 0

16.292.2.6 m

`index_t` `m` = 0

16.292.2.7 n

`index_t` `n` = 0

16.292.2.8 nnz

`uint64_t` `nnz` = 0

16.292.2.9 nElements

```
uint64_t nElements = 0
```

16.292.2.10 maxrow

```
uint64_t maxrow = 0
```

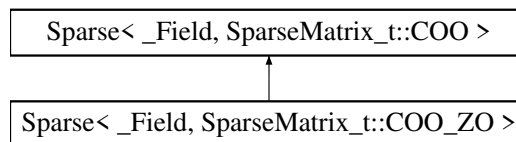
The documentation for this struct was generated from the following file:

- [coo.h](#)

16.293 Sparse<_Field, SparseMatrix_t::COO_ZO > Struct Template Reference

```
#include <coo.h>
```

Inheritance diagram for Sparse<_Field, SparseMatrix_t::COO_ZO >:



Public Types

- using [Field](#) = _Field

Data Fields

- _Field::Element [cst](#) = 1
- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [row](#) = nullptr
- _Field::Element_ptr [dat](#)
- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0

16.293.1 Member Typedef Documentation

16.293.1.1 Field

```
using Field = _Field
```

16.293.2 Field Documentation

16.293.2.1 cst

```
_Field::Element cst = 1
```

16.293.2.2 col

```
index_t* col = nullptr [inherited]
```

16.293.2.3 row

```
index_t* row = nullptr [inherited]
```

16.293.2.4 dat

```
_Field::Element_ptr dat [inherited]
```

16.293.2.5 delayed

```
bool delayed = false [inherited]
```

16.293.2.6 kmax

```
uint64_t kmax = 0 [inherited]
```

16.293.2.7 m

```
index_t m = 0 [inherited]
```

16.293.2.8 n

```
index_t n = 0 [inherited]
```

16.293.2.9 nnz

```
uint64_t nnz = 0 [inherited]
```

16.293.2.10 nElements

```
uint64_t nElements = 0 [inherited]
```

16.293.2.11 maxrow

```
uint64_t maxrow = 0 [inherited]
```

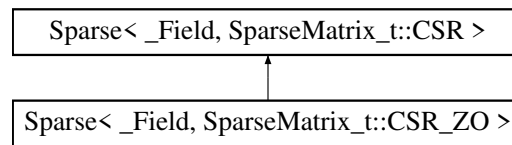
The documentation for this struct was generated from the following file:

- [coo.h](#)

16.294 Sparse< _Field, SparseMatrix_t::CSR > Struct Template Reference

```
#include <csr.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::CSR >:



Public Types

- using `Field` = `_Field`

Data Fields

- bool `delayed` = false
- `uint64_t` `kmax` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `uint64_t` `maxrow` = 0
- `index_t` * `col` = nullptr
- `index_t` * `st` = nullptr
- `index_t` * `stend` = nullptr
- `_Field::Element_ptr` `dat`

16.294.1 Member Typedef Documentation

16.294.1.1 Field

using `Field` = `_Field`

16.294.2 Field Documentation

16.294.2.1 delayed

bool `delayed` = false

16.294.2.2 kmax

`uint64_t` `kmax` = 0

16.294.2.3 m

`index_t` `m` = 0

16.294.2.4 n

`index_t` `n` = 0

16.294.2.5 nnz

```
uint64_t nnz = 0
```

16.294.2.6 nElements

```
uint64_t nElements = 0
```

16.294.2.7 maxrow

```
uint64_t maxrow = 0
```

16.294.2.8 col

```
index_t* col = nullptr
```

16.294.2.9 st

```
index_t* st = nullptr
```

16.294.2.10 stend

```
index_t* stend = nullptr
```

16.294.2.11 dat

```
_Field::Element_ptr dat
```

The documentation for this struct was generated from the following file:

- [csr.h](#)

16.295 Sparse< _Field, SparseMatrix_t::CSR_HYB > Struct Template Reference

```
#include <csr_hyb.h>
```

Public Types

- using [Field](#) = _Field

Data Fields

- bool [delayed](#) = false
- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [st](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0

- `uint64_t nOnes = 0`
- `uint64_t nMOnes = 0`
- `uint64_t nOthers = 0`

16.295.1 Member Typedef Documentation

16.295.1.1 Field

```
using Field = _Field
```

16.295.2 Field Documentation

16.295.2.1 delayed

```
bool delayed = false
```

16.295.2.2 col

```
index_t* col = nullptr
```

16.295.2.3 st

```
index_t* st = nullptr
```

16.295.2.4 dat

```
_Field::Element_ptr dat
```

16.295.2.5 kmax

```
uint64_t kmax = 0
```

16.295.2.6 m

```
index_t m = 0
```

16.295.2.7 n

```
index_t n = 0
```

16.295.2.8 nnz

```
uint64_t nnz = 0
```

16.295.2.9 nElements

```
uint64_t nElements = 0
```

16.295.2.10 maxrow

```
uint64_t maxrow = 0
```

16.295.2.11 nOnes

```
uint64_t nOnes = 0
```

16.295.2.12 nMOnes

```
uint64_t nMOnes = 0
```

16.295.2.13 nOthers

```
uint64_t nOthers = 0
```

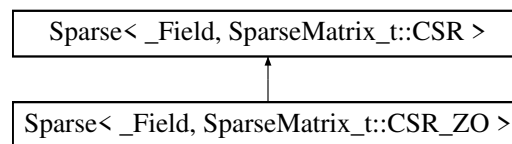
The documentation for this struct was generated from the following file:

- [csr_hyb.h](#)

16.296 Sparse<_Field, SparseMatrix_t::CSR_ZO > Struct Template Reference

```
#include <csr.h>
```

Inheritance diagram for Sparse<_Field, SparseMatrix_t::CSR_ZO >:

**Public Types**

- using [Field](#) = _Field

Data Fields

- [int64_t](#) [cst](#) = 1
- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0
- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [st](#) = nullptr
- [index_t](#) * [stend](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)

16.296.1 Member Typedef Documentation

16.296.1.1 Field

```
using Field = _Field
```

16.296.2 Field Documentation

16.296.2.1 cst

```
int64_t cst = 1
```

16.296.2.2 delayed

```
bool delayed = false
```

16.296.2.3 kmax

```
uint64_t kmax = 0 [inherited]
```

16.296.2.4 m

```
index_t m = 0 [inherited]
```

16.296.2.5 n

```
index_t n = 0 [inherited]
```

16.296.2.6 nnz

```
uint64_t nnz = 0 [inherited]
```

16.296.2.7 nElements

```
uint64_t nElements = 0 [inherited]
```

16.296.2.8 maxrow

```
uint64_t maxrow = 0 [inherited]
```

16.296.2.9 col

```
index_t* col = nullptr [inherited]
```

16.296.2.10 st

```
index_t* st = nullptr [inherited]
```

16.296.2.11 stend

```
index_t* stend = nullptr [inherited]
```

16.296.2.12 dat

```
_Field::Element_ptr dat [inherited]
```

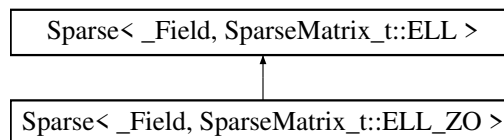
The documentation for this struct was generated from the following file:

- [csr.h](#)

16.297 Sparse< _Field, SparseMatrix_t::ELL > Struct Template Reference

```
#include <ell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::ELL >:

**Public Types**

- using [Field](#) = _Field

Data Fields

- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [ld](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0
- [index_t](#)* [col](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)

16.297.1 Member Typedef Documentation**16.297.1.1 Field**

```
using Field = _Field
```

16.297.2 Field Documentation**16.297.2.1 delayed**

```
bool delayed = false
```

16.297.2.2 kmax

```
uint64_t kmax = 0
```

16.297.2.3 m

```
index_t m = 0
```

16.297.2.4 n

```
index_t n = 0
```

16.297.2.5 ld

```
index_t ld = 0
```

16.297.2.6 nnz

```
uint64_t nnz = 0
```

16.297.2.7 nElements

```
uint64_t nElements = 0
```

16.297.2.8 maxrow

```
uint64_t maxrow = 0
```

16.297.2.9 col

```
index_t* col = nullptr
```

16.297.2.10 dat

```
_Field::Element_ptr dat
```

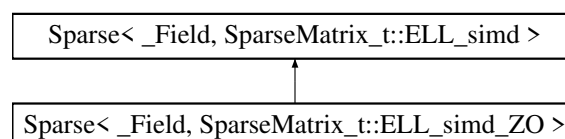
The documentation for this struct was generated from the following file:

- [ell.h](#)

16.298 Sparse<_Field, SparseMatrix_t::ELL_simd > Struct Template Reference

```
#include <ell_simd.h>
```

Inheritance diagram for Sparse<_Field, SparseMatrix_t::ELL_simd >:



Data Fields

- bool `delayed` = false
- int `chunk` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `index_t` `ld` = 0
- `uint64_t` `kmax` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `uint64_t` `maxrow` = 0
- `uint64_t` `nChunks` = 0
- `index_t` * `col` = nullptr
- `_Field::Element_ptr` `dat`

16.298.1 Field Documentation

16.298.1.1 `delayed`

```
bool delayed = false
```

16.298.1.2 `chunk`

```
int chunk = 0
```

16.298.1.3 `m`

```
index_t m = 0
```

16.298.1.4 `n`

```
index_t n = 0
```

16.298.1.5 `ld`

```
index_t ld = 0
```

16.298.1.6 `kmax`

```
uint64_t kmax = 0
```

16.298.1.7 `nnz`

```
uint64_t nnz = 0
```

16.298.1.8 `nElements`

```
uint64_t nElements = 0
```

16.298.1.9 maxrow

```
uint64_t maxrow = 0
```

16.298.1.10 nChunks

```
uint64_t nChunks = 0
```

16.298.1.11 col

```
index_t* col = nullptr
```

16.298.1.12 dat

```
_Field::Element_ptr dat
```

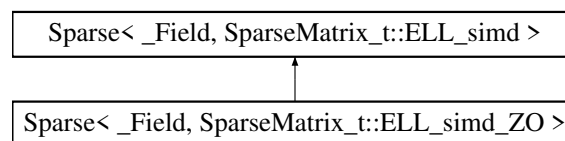
The documentation for this struct was generated from the following file:

- [ell_simd.h](#)

16.299 Sparse< _Field, SparseMatrix_t::ELL_simd_ZO > Struct Template Reference

```
#include <ell_simd.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >:

**Data Fields**

- _Field::Element [cst](#) = 1
- bool [delayed](#) = false
- int [chunk](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [ld](#) = 0
- [uint64_t](#) [kmax](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0
- [uint64_t](#) [nChunks](#) = 0
- [index_t](#) * [col](#) = nullptr
- _Field::Element_ptr [dat](#)

16.299.1 Field Documentation**16.299.1.1 cst**

```
_Field::Element cst = 1
```


16.299.1.2 delayed

```
bool delayed = false [inherited]
```

16.299.1.3 chunk

```
int chunk = 0 [inherited]
```

16.299.1.4 m

```
index_t m = 0 [inherited]
```

16.299.1.5 n

```
index_t n = 0 [inherited]
```

16.299.1.6 ld

```
index_t ld = 0 [inherited]
```

16.299.1.7 kmax

```
uint64_t kmax = 0 [inherited]
```

16.299.1.8 nnz

```
uint64_t nnz = 0 [inherited]
```

16.299.1.9 nElements

```
uint64_t nElements = 0 [inherited]
```

16.299.1.10 maxrow

```
uint64_t maxrow = 0 [inherited]
```

16.299.1.11 nChunks

```
uint64_t nChunks = 0 [inherited]
```

16.299.1.12 col

```
index_t* col = nullptr [inherited]
```

16.299.1.13 dat

```
_Field::Element_ptr dat [inherited]
```

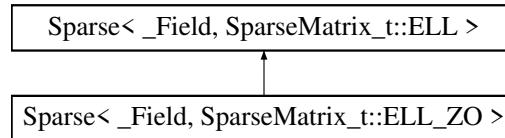
The documentation for this struct was generated from the following file:

- [ell_simd.h](#)

16.300 Sparse< _Field, SparseMatrix_t::ELL_ZO > Struct Template Reference

```
#include <ell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::ELL_ZO >:



Public Types

- using [Field](#) = `_Field`

Data Fields

- `_Field::Element` [cst](#) = 1
- `bool` [delayed](#) = false
- `uint64_t` [kmax](#) = 0
- `index_t` [m](#) = 0
- `index_t` [n](#) = 0
- `index_t` [ld](#) = 0
- `uint64_t` [nnz](#) = 0
- `uint64_t` [nElements](#) = 0
- `uint64_t` [maxrow](#) = 0
- `index_t * col` = nullptr
- `_Field::Element_ptr` [dat](#)

16.300.1 Member Typedef Documentation

16.300.1.1 Field

```
using Field = _Field
```

16.300.2 Field Documentation

16.300.2.1 cst

```
_Field::Element cst = 1
```

16.300.2.2 delayed

```
bool delayed = false [inherited]
```

16.300.2.3 kmax

```
uint64_t kmax = 0 [inherited]
```

16.300.2.4 m

```
index_t m = 0 [inherited]
```

16.300.2.5 n

```
index_t n = 0 [inherited]
```

16.300.2.6 ld

```
index_t ld = 0 [inherited]
```

16.300.2.7 nnz

```
uint64_t nnz = 0 [inherited]
```

16.300.2.8 nElements

```
uint64_t nElements = 0 [inherited]
```

16.300.2.9 maxrow

```
uint64_t maxrow = 0 [inherited]
```

16.300.2.10 col

```
index_t* col = nullptr [inherited]
```

16.300.2.11 dat

```
_Field::Element_ptr dat [inherited]
```

The documentation for this struct was generated from the following file:

- [ell.h](#)

16.301 Sparse< _Field, SparseMatrix_t::HYB_ZO > Struct Template Reference

```
#include <hyb_zo.h>
```

Public Types

- using [Field](#) = [_Field](#)
- typedef [Sparse](#)< [_Field](#), [SparseMatrix_t::HYB_ZO](#) > [Self_t](#)

Data Fields

- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0

- `uint64_t nnz = 0`
- `uint64_t maxrow = 0`
- `uint64_t nElements = 0`
- `Sparse<_Field, SparseMatrix_t::CSR> * dat = nullptr`
- `Sparse<_Field, SparseMatrix_t::CSR_ZO> * one = nullptr`
- `Sparse<_Field, SparseMatrix_t::CSR_ZO> * mone = nullptr`

16.301.1 Member Typedef Documentation

16.301.1.1 Field

using `Field` = `_Field`

16.301.1.2 Self_t

typedef `Sparse<_Field, SparseMatrix_t::HYB_ZO>` `Self_t`

16.301.2 Field Documentation

16.301.2.1 delayed

`bool delayed = false`

16.301.2.2 kmax

`uint64_t kmax = 0`

16.301.2.3 m

`index_t m = 0`

16.301.2.4 n

`index_t n = 0`

16.301.2.5 nnz

`uint64_t nnz = 0`

16.301.2.6 maxrow

`uint64_t maxrow = 0`

16.301.2.7 nElements

`uint64_t nElements = 0`

16.301.2.8 dat

```
Sparse<_Field, SparseMatrix_t::CSR>* dat = nullptr
```

16.301.2.9 one

```
Sparse<_Field, SparseMatrix_t::CSR_ZO>* one = nullptr
```

16.301.2.10 mone

```
Sparse<_Field, SparseMatrix_t::CSR_ZO>* mone = nullptr
```

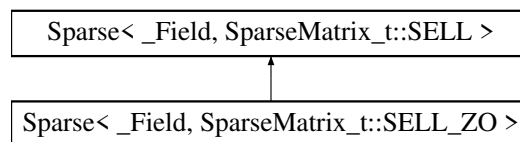
The documentation for this struct was generated from the following file:

- [hyb_zo.h](#)

16.302 Sparse< _Field, SparseMatrix_t::SELL > Struct Template Reference

```
#include <sell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::SELL >:

**Public Types**

- using [Field](#) = [_Field](#)

Data Fields

- bool [delayed](#) = false
- int [chunk](#) = 0
- [index_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [maxrow](#) = 0
- [index_t](#) [sigma](#) = 0
- [index_t](#) [nChunks](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [index_t](#) * [perm](#) = nullptr
- [uint64_t](#) * [st](#) = nullptr
- [index_t](#) * [chunkSize](#) = nullptr
- [index_t](#) * [col](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)

16.302.1 Member Typedef Documentation

16.302.1.1 Field

```
using Field = _Field
```

16.302.2 Field Documentation

16.302.2.1 delayed

```
bool delayed = false
```

16.302.2.2 chunk

```
int chunk = 0
```

16.302.2.3 kmax

```
index_t kmax = 0
```

16.302.2.4 m

```
index_t m = 0
```

16.302.2.5 n

```
index_t n = 0
```

16.302.2.6 maxrow

```
index_t maxrow = 0
```

16.302.2.7 sigma

```
index_t sigma = 0
```

16.302.2.8 nChunks

```
index_t nChunks = 0
```

16.302.2.9 nnz

```
uint64_t nnz = 0
```

16.302.2.10 nElements

```
uint64_t nElements = 0
```

16.302.2.11 perm

```
index_t* perm = nullptr
```

16.302.2.12 st

```
uint64_t* st = nullptr
```

16.302.2.13 chunkSize

```
index_t* chunkSize = nullptr
```

16.302.2.14 col

```
index_t* col = nullptr
```

16.302.2.15 dat

```
_Field::Element_ptr dat
```

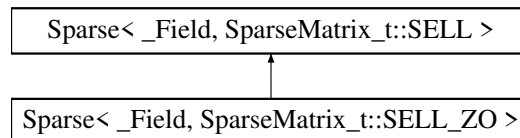
The documentation for this struct was generated from the following file:

- [sell.h](#)

16.303 Sparse< _Field, SparseMatrix_t::SELL_ZO > Struct Template Reference

```
#include <sell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::SELL_ZO >:

**Public Types**

- using [Field](#) = _Field

Data Fields

- _Field::Element [cst](#) = 1
- bool [delayed](#) = false
- int [chunk](#) = 0
- [index_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [maxrow](#) = 0
- [index_t](#) [sigma](#) = 0
- [index_t](#) [nChunks](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [index_t](#) * [perm](#) = nullptr

- `uint64_t * st = nullptr`
- `index_t * chunkSize = nullptr`
- `index_t * col = nullptr`
- `_Field::Element_ptr dat`

16.303.1 Member Typedef Documentation

16.303.1.1 Field

```
using Field = _Field
```

16.303.2 Field Documentation

16.303.2.1 cst

```
_Field::Element cst = 1
```

16.303.2.2 delayed

```
bool delayed = false [inherited]
```

16.303.2.3 chunk

```
int chunk = 0 [inherited]
```

16.303.2.4 kmax

```
index_t kmax = 0 [inherited]
```

16.303.2.5 m

```
index_t m = 0 [inherited]
```

16.303.2.6 n

```
index_t n = 0 [inherited]
```

16.303.2.7 maxrow

```
index_t maxrow = 0 [inherited]
```

16.303.2.8 sigma

```
index_t sigma = 0 [inherited]
```


16.303.2.9 nChunks

```
index_t nChunks = 0 [inherited]
```

16.303.2.10 nnz

```
uint64_t nnz = 0 [inherited]
```

16.303.2.11 nElements

```
uint64_t nElements = 0 [inherited]
```

16.303.2.12 perm

```
index_t* perm = nullptr [inherited]
```

16.303.2.13 st

```
uint64_t* st = nullptr [inherited]
```

16.303.2.14 chunkSize

```
index_t* chunkSize = nullptr [inherited]
```

16.303.2.15 col

```
index_t* col = nullptr [inherited]
```

16.303.2.16 dat

```
_Field::Element_ptr dat [inherited]
```

The documentation for this struct was generated from the following file:

- [sell.h](#)

16.304 SpMat< Field, flag > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::CooMat< Field > * _coo](#) = nullptr
- [FFLAS::CsrMat< Field > * _csr](#) = nullptr
- [FFLAS::EliMat< Field > * _eli](#) = nullptr

16.304.1 Field Documentation**16.304.1.1 _coo**

```
FFLAS::CooMat<Field>* _coo = nullptr
```

16.304.1.2 CSR

```
FFLAS::CsrMat<Field>* _csr = nullptr
```

16.304.1.3 ELL

```
FFLAS::EllMat<Field>* _ell = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.305 Static_error_check< bool > Class Template Reference

```
#include <instrset.h>
```

Public Member Functions

- [Static_error_check\(\)](#)

16.305.1 Constructor & Destructor Documentation**16.305.1.1 Static_error_check()**

```
Static_error_check ( ) [inline]
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.306 Static_error_check< false > Class Reference

```
#include <instrset.h>
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.307 StatsMatrix Struct Reference

```
#include <utils.h>
```

Data Fields

- [uint64_t rowdim](#) = 0
- [uint64_t coldim](#) = 0
- [uint64_t nOnes](#) = 0
- [uint64_t nMOnes](#) = 0
- [uint64_t nOthers](#) = 0
- [uint64_t nnz](#) = 0
- [uint64_t maxRow](#) = 0
- [uint64_t minRow](#) = 0
- [uint64_t averageRow](#) = 0
- [uint64_t deviationRow](#) = 0
- [uint64_t maxCol](#) = 0
- [uint64_t minCol](#) = 0
- [uint64_t averageCol](#) = 0

- `uint64_t` `deviationCol` = 0
- `uint64_t` `minColDifference` = 0
- `uint64_t` `maxColDifference` = 0
- `uint64_t` `averageColDifference` = 0
- `uint64_t` `deviationColDifference` = 0
- `uint64_t` `minRowDifference` = 0
- `uint64_t` `maxRowDifference` = 0
- `uint64_t` `averageRowDifference` = 0
- `uint64_t` `deviationRowDifference` = 0
- `uint64_t` `nDenseRows` = 0
- `uint64_t` `nDenseCols` = 0
- `uint64_t` `nEmptyRows` = 0
- `uint64_t` `nEmptyCols` = 0
- `uint64_t` `nEmptyColsEnd` = 0
- `std::vector< uint64_t >` `denseRows`
- `std::vector< uint64_t >` `denseCols`

16.307.1 Field Documentation

16.307.1.1 rowdim

`uint64_t` `rowdim` = 0

16.307.1.2 coldim

`uint64_t` `coldim` = 0

16.307.1.3 nOnes

`uint64_t` `nOnes` = 0

16.307.1.4 nMOnes

`uint64_t` `nMOnes` = 0

16.307.1.5 nOthers

`uint64_t` `nOthers` = 0

16.307.1.6 nnz

`uint64_t` `nnz` = 0

16.307.1.7 maxRow

`uint64_t` `maxRow` = 0

16.307.1.8 minRow

```
uint64_t minRow = 0
```

16.307.1.9 averageRow

```
uint64_t averageRow = 0
```

16.307.1.10 deviationRow

```
uint64_t deviationRow = 0
```

16.307.1.11 maxCol

```
uint64_t maxCol = 0
```

16.307.1.12 minCol

```
uint64_t minCol = 0
```

16.307.1.13 averageCol

```
uint64_t averageCol = 0
```

16.307.1.14 deviationCol

```
uint64_t deviationCol = 0
```

16.307.1.15 minColDifference

```
uint64_t minColDifference = 0
```

16.307.1.16 maxColDifference

```
uint64_t maxColDifference = 0
```

16.307.1.17 averageColDifference

```
uint64_t averageColDifference = 0
```

16.307.1.18 deviationColDifference

```
uint64_t deviationColDifference = 0
```

16.307.1.19 minRowDifference

```
uint64_t minRowDifference = 0
```

16.307.1.20 maxRowDifference

```
uint64_t maxRowDifference = 0
```

16.307.1.21 averageRowDifference

```
uint64_t averageRowDifference = 0
```

16.307.1.22 deviationRowDifference

```
uint64_t deviationRowDifference = 0
```

16.307.1.23 nDenseRows

```
uint64_t nDenseRows = 0
```

16.307.1.24 nDenseCols

```
uint64_t nDenseCols = 0
```

16.307.1.25 nEmptyRows

```
uint64_t nEmptyRows = 0
```

16.307.1.26 nEmptyCols

```
uint64_t nEmptyCols = 0
```

16.307.1.27 nEmptyColsEnd

```
uint64_t nEmptyColsEnd = 0
```

16.307.1.28 denseRows

```
std::vector<uint64_t> denseRows
```

16.307.1.29 denseCols

```
std::vector<uint64_t> denseCols
```

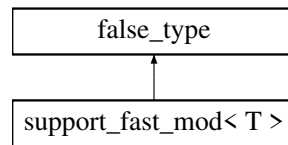
The documentation for this struct was generated from the following file:

- [utils.h](#)

16.308 support_fast_mod< T > Struct Template Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< T >:



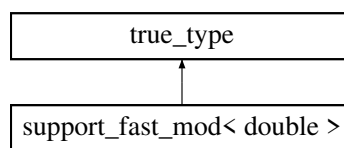
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.309 support_fast_mod< double > Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< double >:



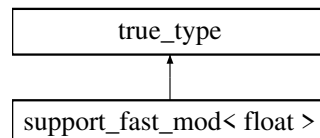
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.310 support_fast_mod< float > Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< float >:



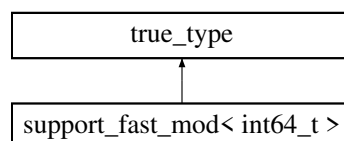
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.311 support_fast_mod< int64_t > Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< int64_t >:



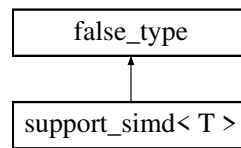
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.312 support_simd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

Inheritance diagram for support_simd< T >:



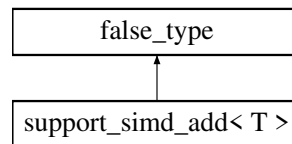
The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.313 support_simd_add< T > Struct Template Reference

```
#include <fflas_fadd.h>
```

Inheritance diagram for support_simd_add< T >:



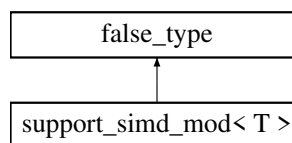
The documentation for this struct was generated from the following file:

- [fflas_fadd.h](#)

16.314 support_simd_mod< T > Struct Template Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_simd_mod< T >:



The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.315 tfn_minus Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\)(Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.315.1 Member Function Documentation

16.315.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.316 tfn_minus_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.316.1 Member Function Documentation

16.316.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.317 tfn_mul Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.317.1 Member Function Documentation

16.317.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.318 tfn_mul_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.318.1 Member Function Documentation

16.318.1.1 `operator>()()`

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.319 tfn_plus Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.319.1 Member Function Documentation

16.319.1.1 `operator>()()`

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.320 tfn_plus_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.320.1 Member Function Documentation

16.320.1.1 operator>()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.321 Threads Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.322 ThreeD Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.323 ThreeDAdaptive Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.324 ThreeDInPlace Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.325 TRSMHelper< ReclterTrait, ParSeqTrait > Struct Template Reference

TRSM Helper.

Public Member Functions

- `template<class Cut , class Param >`
[TRSMHelper](#) ([ParSeqHelper::Parallel](#)< Cut, Param > _PS)
- `TRSMHelper` ([ParSeqHelper::Sequential](#) _PS)
- `template<typename RIT , typename PST >`
[TRSMHelper](#) ([TRSMHelper](#)< RIT, PST > &_TH)
- `template<class Dom , class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS::ModeTraits<Dom>::value>`
[FFLAS::MMHelper](#)< Dom, Algo, ModeT, ParSeqTrait > [pMMH](#) (Dom &D, size_t m, size_t k, size_t n, ParSeqTrait p) const
- `template<class Dom , class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS::ModeTraits<Dom>::value>`
[FFLAS::MMHelper](#)< Dom, Algo, ModeT, ParSeqTrait > [pMMH](#) (Dom &D, size_t m, size_t k, size_t n) const

Data Fields

- ParSeqTrait [parseq](#)

16.325.1 Detailed Description

```
template<typename ReclterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeqHelper::Sequential>
struct FFLAS::TRSMHelper< ReclterTrait, ParSeqTrait >
```

TRSM Helper.

16.325.2 Constructor & Destructor Documentation

16.325.2.1 TRSMHelper() [1/3]

```
TRSMHelper (
    ParSeqHelper::Parallel< Cut, Param > _PS ) [inline]
```

16.325.2.2 TRSMHelper() [2/3]

```
TRSMHelper (
    ParSeqHelper::Sequential _PS ) [inline]
```

16.325.2.3 TRSMHelper() [3/3]

```
TRSMHelper (
    TRSMHelper< RIT, PST > & _TH ) [inline]
```

16.325.3 Member Function Documentation

16.325.3.1 pMMH() [1/2]

```
FFLAS::MMHelper<Dom, Algo, ModeT, ParSeqTrait> pMMH (
    Dom & D,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait p ) const [inline]
```

16.325.3.2 pMMH() [2/2]

```
FFLAS::MMHelper<Dom, Algo, ModeT, ParSeqTrait> pMMH (
    Dom & D,
    size_t m,
    size_t k,
    size_t n ) const [inline]
```

16.325.4 Field Documentation

16.325.4.1 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.326 TwoD Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.327 TwoDAdaptive Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.328 UnparametricTag Struct Reference

If the field uses a representation with infix operators.

```
#include <field-traits.h>
```

16.328.1 Detailed Description

If the field uses a representation with infix operators.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.329 Winograd Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.330 WinogradPar Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

Chapter 17

File Documentation

17.1 101-fgemm.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/modular-balanced.h>
#include <fflas-ffpack/fflas/fflas.h>
#include <fflas-ffpack/utils/timer.h>
#include <fflas-ffpack/utils/fflas_io.h>
#include <fflas-ffpack/utils/args-parser.h>
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.1.1 Function Documentation

17.1.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.2 2x2-fgemm.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/modular-balanced.h>
#include <fflas-ffpack/fflas/fflas.h>
#include <fflas-ffpack/utils/timer.h>
#include <fflas-ffpack/utils/fflas_io.h>
#include <fflas-ffpack/utils/args-parser.h>
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.2.1 Function Documentation

17.2.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.3 2x2-fftrsv.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/modular-balanced.h>
#include <fflas-ffpack/fflas/fflas.h>
#include <fflas-ffpack/utils/timer.h>
#include <fflas-ffpack/utils/fflas_io.h>
#include <fflas-ffpack/utils/args-parser.h>
#include <iostream>
#include <array>
```

Functions

- int [main](#) (int argc, char **argv)

17.3.1 Function Documentation

17.3.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.4 2x2-pluq.C File Reference

```
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int [main](#) (int argc, char **argv)

17.4.1 Function Documentation

17.4.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.5 align-allocator.h File Reference

```
#include "fflas-ffpack/config.h"
```

17.6 args-parser.h File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/givinteger.h>
#include <givaro/givprint.h>
#include <iostream>
#include <fstream>
#include <vector>
#include <string>
#include <cstring>
#include <list>
#include <stdlib.h>
```

Data Structures

- struct [Argument](#)

Namespaces

- [FFLAS](#)

Macros

- #define [TYPE_BOOL](#) [TYPE_NONE](#)
- #define [END_OF_ARGUMENTS](#) { '\0', "\0", "\0", [TYPE_NONE](#), NULL }
- #define [type_integer](#) long int

Enumerations

- enum [ArgumentType](#) {
[TYPE_NONE](#) , [TYPE_INT](#) , [TYPE_UINT64](#) , [TYPE_LONGLONG](#) ,
[TYPE_INTEGER](#) , [TYPE_DOUBLE](#) , [TYPE_INTLIST](#) , [TYPE_STR](#) }

Functions

- void [parseArguments](#) (int argc, char **argv, [Argument](#) *args, bool printDefaults=true)
- void [printHelpMessage](#) (const char *program, [Argument](#) *args, bool printDefaults=false)
- [Argument](#) * [findArgument](#) ([Argument](#) *args, char c)
- int [getListArgs](#) (std::list< int > &outlist, std::string &instring)
transforms a string list of ints to a list of int string "12,13,15" is turned into list of ints {12,13,15}
- std::ostream & [writeCommandString](#) (std::ostream &os, [Argument](#) *args, const char *programName=nullptr)
writes the values of all arguments, preceded by the programName

17.6.1 Macro Definition Documentation

17.6.1.1 TYPE_BOOL

```
#define TYPE_BOOL TYPE\_NONE
```

17.6.1.2 END_OF_ARGUMENTS

```
#define END_OF_ARGUMENTS { '\0', "\0", "\0", TYPE_NONE, NULL }
```

17.6.1.3 type_integer

```
#define type_integer long int
```

17.6.2 Enumeration Type Documentation

17.6.2.1 ArgumentType

```
enum ArgumentType
```

Enumerator

| | |
|---------------|--|
| TYPE_NONE | |
| TYPE_INT | |
| TYPE_UINT64 | |
| TYPE_LONGLONG | |
| TYPE_INTEGER | |
| TYPE_DOUBLE | |
| TYPE_INTLIST | |
| TYPE_STR | |

17.6.3 Function Documentation

17.6.3.1 printHelpMessage()

```
void printHelpMessage (
    const char * program,
    Argument * args,
    bool printDefaults = false )
```

17.6.3.2 findArgument()

```
Argument* findArgument (
    Argument * args,
    char c )
```

17.6.3.3 getListArgs()

```
int getListArgs (
    std::list< int > & outlist,
    std::string & instring )
```

transforms a string list of ints to a list of int string "12,13,15" is turned into list of ints {12,13,15}

Parameters

| | |
|----------------|---------------------|
| <i>outlist</i> | list once converted |
|----------------|---------------------|

Parameters

| | |
|-----------------|----------------------|
| <i>instring</i> | list to be converted |
|-----------------|----------------------|

Returns

status message.

17.7 arithprog.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))
- #define [GFOPS](#)(m, n, r, t) (2.7*CUBE(double(n)/1000.0))/t

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- int [main](#) (int argc, char **argv)

17.7.1 Macro Definition Documentation

17.7.1.1 CUBE

```
#define CUBE(
    x )  ((x)*(x)*(x))
```

17.7.1.2 GFOPS

```
#define GFOPS(
    m,
    n,
    r,
    t )  (2.7*CUBE(double(n)/1000.0))/t
```

17.7.2 Typedef Documentation

17.7.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.7.3 Function Documentation

17.7.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.8 benchmark-charpoly-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/Matio.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_FORCE_SEQ`

Functions

- `int main (int argc, char **argv)`

17.8.1 Macro Definition Documentation

17.8.1.1 [__FFLASFFPACK_FORCE_SEQ](#)

```
#define \_\_FFLASFFPACK\_FORCE\_SEQ
```

17.8.2 Function Documentation

17.8.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.9 benchmark-charpoly.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include <givaro/givpoly1.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

```
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `template<class Field >`
`void run_with_field (int q, size_t bits, size_t n, size_t d, size_t iter, std::string file, int variant)`
- `int main (int argc, char **argv)`

17.9.1 Macro Definition Documentation

17.9.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.9.2 Function Documentation

17.9.2.1 run_with_field()

```
void run_with_field (
    int q,
    size_t bits,
    size_t n,
    size_t d,
    size_t iter,
    std::string file,
    int variant )
```

17.9.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.10 benchmark-checkers.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/checkers/checkers_fflas.h"
#include "fflas-ffpack/checkers/checkers_ffpack.h"
#include <fstream>
```

Macros

- `#define ENABLE_ALL_CHECKINGS 1`
- `#define _NR_TESTS 5`
- `#define _MAX_SIZE_MATRICES 1000`
- `#define CUBE(x) ((x)*(x)*(x))`

Functions

- `int main (int argc, char **argv)`

17.10.1 Macro Definition Documentation

17.10.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.10.1.2 _NR_TESTS

```
#define _NR_TESTS 5
```

17.10.1.3 _MAX_SIZE_MATRICES

```
#define _MAX_SIZE_MATRICES 1000
```

17.10.1.4 CUBE

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```

17.10.2 Function Documentation

17.10.2.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.11 benchmark-dgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular.h>  
#include "fflas-ffpack/config-blas.h"  
#include "fflas-ffpack/fflas/fflas.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CBLAS_GEMM](#) `cblas_dgemm`

Typedefs

- typedef [FFLAS::Timer](#) `TTimer`
- typedef double [Floats](#)

Functions

- int [main](#) (int argc, char **argv)

17.11.1 Macro Definition Documentation

17.11.1.1 CBLAS_GEMM

```
#define CBLAS_GEMM cblas_dgemm
```

17.11.2 Typedef Documentation

17.11.2.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.11.2.2 Floats

```
typedef double Floats
```

17.11.3 Function Documentation

17.11.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.12 benchmark-dgetrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [__FFLASFFPACK_HAVE_DGETRF](#) 1

Typedefs

- typedef [FFLAS::Timer](#) TTimer

Functions

- int [main](#) (int argc, char **argv)

17.12.1 Macro Definition Documentation

17.12.1.1 __FFLASFFPACK_HAVE_DGETRF

```
#define __FFLASFFPACK_HAVE_DGETRF 1
```

17.12.2 Typedef Documentation

17.12.2.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.12.3 Function Documentation

17.12.3.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.13 benchmark-dgetri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <vector>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

Typedefs

- typedef [FFLAS::Timer](#) TTimer

Functions

- int [main](#) (int argc, char **argv)

17.13.1 Typedef Documentation

17.13.1.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.13.2 Function Documentation

17.13.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.14 benchmark-dsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define EFFGFF(*n*, *t*, *i*) ((double(*n*)/1000.*double(*n*)/1000.*double(*n*)/1000.0) / double(*t*) * double(*i*) / 3.)

Typedefs

- typedef FFLAS::Timer TTimer

Functions

- int main (int argc, char **argv)

17.14.1 Macro Definition Documentation

17.14.1.1 EFFGFF

```
#define EFFGFF(
    n,
    t,
    i ) ( (double(n)/1000.*double(n)/1000.*double(n)/1000.0) / double(t) * double(i)
/ 3.)
```

17.14.2 Typedef Documentation

17.14.2.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.14.3 Function Documentation

17.14.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.15 benchmark-dtrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Typedefs

- typedef [FFLAS::Timer](#) TTimer

Functions

- int [main](#) (int argc, char **argv)

17.15.1 Typedef Documentation

17.15.1.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.15.2 Function Documentation

17.15.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.16 benchmark-dtrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```


Macros

- `#define __FFLASFFPACK_HAVE_DTRTRI 1`

Typedefs

- `typedef FFLAS::Timer TTimer`

Functions

- `int main (int argc, char **argv)`

17.16.1 Macro Definition Documentation

17.16.1.1 __FFLASFFPACK_HAVE_DTRTRI

```
#define __FFLASFFPACK_HAVE_DTRTRI 1
```

17.16.2 Typedef Documentation

17.16.2.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.16.3 Function Documentation

17.16.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.17 benchmark-fadd-lvl2.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.17.1 Macro Definition Documentation

17.17.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.17.2 Function Documentation

17.17.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.18 benchmark-fdot.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include <givaro/givrational.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `template<class Field >`
[Field::Element run_with_field](#) (int q, size_t iter, size_t N, const size_t BS, const size_t p, const size_t threads)
- `int main` (int argc, char **argv)

17.18.1 Macro Definition Documentation

17.18.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.18.2 Function Documentation

17.18.2.1 run_with_field()

```
Field::Element run_with_field (
    int q,
    size_t iter,
    size_t N,
    const size_t BS,
    const size_t p,
    const size_t threads )
```

17.18.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.19 benchmark-fgemm-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <typeinfo>
#include <vector>
#include <string>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
#include "fflas-ffpack/paladin/parallel.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `template<typename Ints >`
`int tmain ()`
- `int main (int argc, char **argv)`

17.19.1 Macro Definition Documentation

17.19.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.19.2 Function Documentation

17.19.2.1 tmain()

```
int tmain ( )
```

17.19.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.20 benchmark-fgemm-rns.C File Reference

```
#include "fflas-ffpack/fflas/fflas.h"
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Typedefs

- typedef `FFPACK::rns_double` `RNS`
- typedef `FFPACK::RNSInteger< RNS >` `Field`
- typedef `Field::Element_ptr` `Element_ptr`
- typedef `Field::ConstElement_ptr` `ConstElement_ptr`
- typedef `StrategyParameter::Threads` `THREADS`
- typedef `StrategyParameter::Grain` `GRAIN`
- typedef `StrategyParameter::TwoD` `TWOD`
- typedef `StrategyParameter::TwoDAdaptive` `TWODA`
- typedef `StrategyParameter::ThreeD` `THREED`
- typedef `StrategyParameter::ThreeDAdaptive` `THREEDA`
- typedef `StrategyParameter::ThreeDInPlace` `THREEDIP`
- typedef `ParSeqHelper::Sequential` `PSeq`

Functions

- int `main` (int argc, char *argv[])

17.20.1 Macro Definition Documentation

17.20.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.20.2 Typedef Documentation

17.20.2.1 RNS

```
typedef FFPACK::rns_double RNS
```

17.20.2.2 Field

```
typedef FFPACK::RNSInteger<RNS> Field
```

17.20.2.3 Element_ptr

```
typedef Field::Element_ptr Element_ptr
```

17.20.2.4 ConstElement_ptr

```
typedef Field::ConstElement_ptr ConstElement_ptr
```

17.20.2.5 THREADS

```
typedef StrategyParameter::Threads THREADS
```

17.20.2.6 GRAIN

```
typedef StrategyParameter::Grain GRAIN
```

17.20.2.7 TWOD

```
typedef StrategyParameter::TwoD TWOD
```

17.20.2.8 TWODA

```
typedef StrategyParameter::TwoDAdaptive TWODA
```

17.20.2.9 THREED

```
typedef StrategyParameter::ThreeD THREED
```

17.20.2.10 THREEDA

```
typedef StrategyParameter::ThreeDAdaptive THREEDA
```

17.20.2.11 THREEDIP

```
typedef StrategyParameter::ThreeDInPlace THREEDIP
```

17.20.2.12 PSeq

```
typedef ParSeqHelper::Sequential PSeq
```

17.20.3 Function Documentation

17.20.3.1 main()

```
int main (  
    int argc,  
    char * argv[] )
```

17.21 benchmark-fgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CLASSIC_HYBRID](#)

Functions

- int [main](#) (int argc, char **argv)

17.21.1 Macro Definition Documentation

17.21.1.1 CLASSIC_HYBRID

```
#define CLASSIC_HYBRID
```

17.21.2 Function Documentation

17.21.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.22 benchmark-fgemv-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <typeinfo>
#include <vector>
#include <string>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
#include "fflas-ffpack/paladin/parallel.h"
```

Macros

- #define [__FFLASFFPACK_OPENBLAS_NT_ALREADY_SET](#) 1

Functions

- `template<typename T>`
`std::ostream & write_matrix (std::ostream &out, Givaro::Integer p, size_t m, size_t n, T *C, size_t ldc)`

17.22.1 Macro Definition Documentation

17.22.1.1 `__FFLASFFPACK_OPENBLAS_NT_ALREADY_SET`

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.22.2 Function Documentation

17.22.2.1 `write_matrix()`

```
std::ostream& write_matrix (
    std::ostream & out,
    Givaro::Integer p,
    size_t m,
    size_t n,
    T * C,
    size_t ldc )
```

17.23 benchmark-fgemv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
```

Data Structures

- struct [need_field_characteristic](#)< Field >
- struct [need_field_characteristic](#)< Givaro::Modular< Field > >
- struct [need_field_characteristic](#)< Givaro::ModularBalanced< Field > >
- struct [compatible_data_type](#)< Field >
- struct [compatible_data_type](#)< Givaro::ZRing< float > >
- struct [compatible_data_type](#)< Givaro::ZRing< double > >

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `template<class Field , class RandIter , class Matrix , class Vector >`
`void fill_value (Field &F, RandIter &Rand, Matrix &A, Vector &X, Vector &Y, size_t m, size_t k, size_t incX, size_t incY, size_t lda, int NBK)`
- `template<class Field , class Matrix , class Vector >`
`void genData (Field &F, Matrix &A, Vector &X, Vector &Y, size_t m, size_t k, size_t incX, size_t incY, size_t lda, int NBK, int bitsize, uint64_t seed)`
- `template<class Field , class Matrix , class Vector >`
`bool check_result (Field &F, size_t m, size_t lda, Matrix &A, Vector &X, size_t incX, Vector &Y, size_t incY)`
- `template<class Field , class Matrix , class Vector >`
`bool benchmark_with_timer (Field &F, int p, Matrix &A, Vector &X, Vector &Y, size_t m, size_t k, size_t incX, size_t incY, size_t lda, size_t iters, int t, double &time, size_t GrainSize)`
- `template<class Field , class arg >`
`void benchmark_disp (Field &F, bool pass, double &time, size_t iters, int p, size_t m, size_t k, arg &as)`
- `template<class Field , class arg >`
`void benchmark_in_Field (Field &F, int p, size_t m, size_t k, int NBK, int bitsize, uint64_t seed, size_t iters, int t, arg &as, size_t GrainSize)`
- `template<class Field , class arg >`
`void benchmark_with_field (int p, size_t m, size_t k, int NBK, int bitsize, uint64_t seed, size_t iters, int t, arg &as, size_t GrainSize)`
- `template<class Field , class arg >`
`void benchmark_with_field (const Givaro::Integer &q, int p, size_t m, size_t k, int NBK, int bitsize, uint64_t seed, size_t iters, int t, arg &as, size_t GrainSize)`
- `int main (int argc, char **argv)`

17.23.1 Macro Definition Documentation

17.23.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.23.2 Function Documentation

17.23.2.1 fill_value()

```
void fill_value (
    Field & F,
    RandIter & Rand,
    Matrix & A,
    Vector & X,
    Vector & Y,
    size_t m,
    size_t k,
    size_t incX,
    size_t incY,
    size_t lda,
    int NBK )
```

17.23.2.2 genData()

```
void genData (
    Field & F,
    Matrix & A,
```



```
Vector & X,  
Vector & Y,  
size_t m,  
size_t k,  
size_t incX,  
size_t incY,  
size_t lda,  
int NBK,  
int bitsize,  
uint64_t seed )
```

17.23.2.3 check_result()

```
bool check_result (   
    Field & F,  
    size_t m,  
    size_t lda,  
    Matrix & A,  
    Vector & X,  
    size_t incX,  
    Vector & Y,  
    size_t incY )
```

17.23.2.4 benchmark_with_timer()

```
bool benchmark_with_timer (   
    Field & F,  
    int p,  
    Matrix & A,  
    Vector & X,  
    Vector & Y,  
    size_t m,  
    size_t k,  
    size_t incX,  
    size_t incY,  
    size_t lda,  
    size_t iters,  
    int t,  
    double & time,  
    size_t GrainSize )
```

17.23.2.5 benchmark_disp()

```
void benchmark_disp (   
    Field & F,  
    bool pass,  
    double & time,  
    size_t iters,  
    int p,  
    size_t m,  
    size_t k,  
    arg & as )
```

17.23.2.6 benchmark_in_Field()

```
void benchmark_in_Field (
    Field & F,
    int p,
    size_t m,
    size_t k,
    int NBK,
    int bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize )
```

17.23.2.7 benchmark_with_field() [1/2]

```
void benchmark_with_field (
    int p,
    size_t m,
    size_t k,
    int NBK,
    int bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize )
```

17.23.2.8 benchmark_with_field() [2/2]

```
void benchmark_with_field (
    const Givaro::Integer & q,
    int p,
    size_t m,
    size_t k,
    int NBK,
    int bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize )
```

17.23.2.9 main()

```
int main (
    int argc,
    char ** argv )
```

17.24 benchmark-fgesv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
```

```
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.24.1 Macro Definition Documentation

17.24.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.24.2 Function Documentation

17.24.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.25 benchmark-fsyrc.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define CUBE(x) ((x)*(x)*(x))`

Functions

- `int main (int argc, char **argv)`

17.25.1 Macro Definition Documentation

17.25.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.25.1.2 CUBE

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```

17.25.2 Function Documentation**17.25.2.1 main()**

```
int main (  
    int argc,  
    char ** argv )
```

17.26 benchmark-fsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- [#define __FFPACK_FSYTRF_BC_CROUT](#)
- [#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1](#)
- [#define CUBE\(x\) \(\(x\)*\(x\)*\(x\)\)](#)

Functions

- int [main](#) (int argc, char **argv)

17.26.1 Macro Definition Documentation**17.26.1.1 __FFPACK_FSYTRF_BC_CROUT**

```
#define __FFPACK_FSYTRF_BC_CROUT
```

17.26.1.2 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.26.1.3 CUBE

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```

17.26.2 Function Documentation

17.26.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.27 benchmark-fftrsm-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <string>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.27.1 Macro Definition Documentation

17.27.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.27.2 Function Documentation

17.27.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.28 benchmark-fftrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.28.1 Macro Definition Documentation

17.28.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.28.2 Function Documentation

17.28.2.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.29 benchmark-fftrsv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.29.1 Macro Definition Documentation

17.29.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.29.2 Function Documentation

17.29.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.30 benchmark-fftrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define CUBE(x) ((x)*(x)*(x))`

Functions

- int `main` (int argc, char **argv)

17.30.1 Macro Definition Documentation**17.30.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET**

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.30.1.2 CUBE

```
#define CUBE(
    x ) ( (x)*(x)*(x) )
```

17.30.2 Function Documentation**17.30.2.1 main()**

```
int main (
    int argc,
    char ** argv )
```

17.31 benchmark-inverse.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
```

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define CUBE(x) ((x)*(x)*(x))`

Functions

- `int main (int argc, char **argv)`

17.31.1 Macro Definition Documentation

17.31.1.1 CUBE

```
#define CUBE(  
    x )  ( (x)*(x)*(x) )
```

17.31.2 Function Documentation

17.31.2.1 main()

```
int main (  
    int  argc,  
    char ** argv )
```

17.32 benchmark-lqup-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <vector>  
#include <string>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "fflas-ffpack/utils/args-parser.h"  
#include "givaro/modular-integer.h"
```

Functions

- `int main (int argc, char **argv)`

17.32.1 Function Documentation

17.32.1.1 main()

```
int main (  
    int  argc,  
    char ** argv )
```


17.33 benchmark-lqup.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))

Functions

- int [main](#) (int argc, char **argv)

17.33.1 Macro Definition Documentation

17.33.1.1 CUBE

```
#define CUBE(
    x )  ((x)*(x)*(x))
```

17.33.2 Function Documentation

17.33.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.34 benchmark-pluq.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular.h>
#include <givaro/givranditer.h>
#include <iostream>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Macros

- #define [__FFLASFFPACK_OPENBLAS_NT_ALREADY_SET](#) 1
- #define [CUBE](#)(x) ((x)*(x)*(x))

Typedefs

- typedef [Givaro::ModularBalanced](#)< double > [Field](#)

Functions

- void [verification_PLUQ](#) (const [Field](#) &F, typename [Field::Element](#) *B, typename [Field::Element](#) *A, size_t *P, size_t *Q, size_t m, size_t n, size_t R)
- void [Rec_Initialize](#) ([Field](#) &F, [Field::Element](#) *C, size_t m, size_t n, size_t ldc)
- int [main](#) (int argc, char **argv)

17.34.1 Macro Definition Documentation

17.34.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.34.1.2 CUBE

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```

17.34.2 Typedef Documentation

17.34.2.1 Field

```
typedef Givaro::ModularBalanced<double> Field
```

17.34.3 Function Documentation

17.34.3.1 verification_PLUQ()

```
void verification_PLUQ (  
    const Field & F,  
    typename Field::Element * B,  
    typename Field::Element * A,  
    size_t * P,  
    size_t * Q,  
    size_t m,  
    size_t n,  
    size_t R )
```

17.34.3.2 Rec_Initialize()

```
void Rec_Initialize (  
    Field & F,  
    Field::Element * C,  
    size_t m,  
    size_t n,  
    size_t ldc )
```

17.34.3.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.35 benchmark-wino.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <fstream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))

Functions

- template<class Field >
void [launch_wino](#) (const [Field](#) &F, const size_t &n, const size_t &NB, const size_t &wino, const bool &asmax, const size_t &seed, const bool compare)
- int [main](#) (int argc, char **argv)

17.35.1 Macro Definition Documentation

17.35.1.1 CUBE

```
#define CUBE(
    x ) ((x)*(x)*(x))
```

17.35.2 Function Documentation

17.35.2.1 launch_wino()

```
void launch_wino (
    const Field & F,
    const size_t & n,
    const size_t & NB,
    const size_t & wino,
    const bool & asmax,
    const size_t & seed,
    const bool compare )
```

17.35.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.36 bit_manipulation.h File Reference

```
#include <givaro/udl.h>
#include "fflas-ffpack/fflas-ffpack-config.h"
```

Macros

- `#define __has_builtin(x) 0`

Functions

- `int32_t clz (uint64_t val)`
- `int32_t clz (uint32_t val)`
- `int32_t ctz (uint32_t val)`
- `int32_t ctz (uint64_t val)`

17.36.1 Macro Definition Documentation

17.36.1.1 __has_builtin

```
#define __has_builtin(  
    x ) 0
```

17.36.2 Function Documentation

17.36.2.1 clz() [1/2]

```
int32_t clz (  
    uint64_t val ) [inline]
```

17.36.2.2 clz() [2/2]

```
int32_t clz (  
    uint32_t val ) [inline]
```

17.36.2.3 ctz() [1/2]

```
int32_t ctz (  
    uint32_t val ) [inline]
```

17.36.2.4 ctz() [2/2]

```
int32_t ctz (  
    uint64_t val ) [inline]
```

17.37 blockcuts.inl File Reference

```
#include <fflas-ffpack/fflas/fflas_enum.h>
#include <math.h>
#include <cassert>
```

Data Structures

- struct [Single](#)
- struct [Row](#)
- struct [Column](#)
- struct [Block](#)
- struct [Recursive](#)
- struct [Fixed](#)
- struct [Threads](#)
- struct [Grain](#)
- struct [TwoD](#)
- struct [TwoDAdaptive](#)
- struct [ThreeD](#)
- struct [ThreeDInPlace](#)
- struct [ThreeDAdaptive](#)
- struct [Parallel< C, P >](#)
- struct [Sequential](#)
- struct [Compose< H1, H2 >](#)
- struct [ForStrategy1D< blocksize_t, Cut, Param >](#)
- struct [ForStrategy2D< blocksize_t, Cut, Param >](#)

Namespaces

- [FFLAS](#)
- [FFLAS::CuttingStrategy](#)
- [FFLAS::StrategyParameter](#)
- [FFLAS::ParSeqHelper](#)

ParSeqHelper for both *fgemm* and *ftrsm*.

Macros

- `#define __FFLASFFPACK_fflas_blockcuts_INL`
- `#define __FFLASFFPACK_MINBLOCKCUTS ((size_t)256)`

Typedefs

- typedef Row [RNSModulus](#)

Functions

- `template<class Cut = CuttingStrategy::Block, class Strat = StrategyParameter::Threads>
void BlockCuts (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`

- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<class Cut = CuttingStrategy::Block, class Param = StrategyParameter::Threads>
void BlockCuts (size_t &rowBlockSize, size_t &colBlockSize, size_t &lastRBS, size_t &lastCBS, size_t &changeRBS, size_t &changeCBS, size_t &numRowBlock, size_t &numColBlock, size_t m, size_t n, const size_t numthreads)`

17.37.1 Macro Definition Documentation

17.37.1.1 `__FFLASFFPACK_fflas_blockcuts_INL`

```
#define __FFLASFFPACK_fflas_blockcuts_INL
```

17.37.1.2 `__FFLASFFPACK_MINBLOCKCUTS`

```
#define __FFLASFFPACK_MINBLOCKCUTS ((size_t)256)
```

17.38 `cast.h` File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- `template<class T, class CT = const T>
T fflas_const_cast (CT x)`

17.39 `cblas.C` File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- `#define __FFLASFFPACK_CONFIGURATION`
- `#define __FFLASFFPACK_HAVE_CBLAS 1`

Functions

- `int main ()`

17.39.1 Macro Definition Documentation

17.39.1.1 `__FFLASFFPACK_CONFIGURATION`

```
#define __FFLASFFPACK_CONFIGURATION
```

17.39.1.2 __FFLASFFPACK_HAVE_CBLAS

```
#define __FFLASFFPACK_HAVE_CBLAS 1
```

17.39.2 Function Documentation

17.39.2.1 main()

```
int main (
    void )
```

17.40 charpoly.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))
- #define [GFOPS](#)(m, n, r, t) (2.7*CUBE(double(n)/1000.0))/t

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- int [main](#) ()

17.40.1 Macro Definition Documentation

17.40.1.1 CUBE

```
#define CUBE(
    x ) ( (x) * (x) * (x) )
```

17.40.1.2 GFOPS

```
#define GFOPS(
    m,
    n,
    r,
    t ) (2.7*CUBE(double(n)/1000.0))/t
```

17.40.2 Typedef Documentation

17.40.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.40.3 Function Documentation

17.40.3.1 main()

```
int main (
    void )
```

17.41 charpoly.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example computes the characteristic polynomial of a matrix over a defined finite field.

17.41.1 Function Documentation

17.41.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example computes the characteristic polynomial of a matrix over a defined finite field.
Outputs the characteristic polynomial.

17.42 checker_charpoly.inl File Reference

```
#include "fflas-ffpack/ffpack/ffpack.h"
```

Data Structures

- class [CheckerImplem_charpoly](#)< Field, Polynomial >

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_checker_charpoly_INL](#)

17.42.1 Macro Definition Documentation

17.42.1.1 __FFLASFFPACK_checker_charpoly_INL

```
#define __FFLASFFPACK_checker_charpoly_INL
```

17.43 checker_det.inl File Reference

```
#include "fflas-ffpack/ffpack/ffpack.h"
```

Data Structures

- class [CheckerImplem_Det< Field >](#)

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_checker_det_INL](#)

17.43.1 Macro Definition Documentation

17.43.1.1 __FFLASFFPACK_checker_det_INL

```
#define __FFLASFFPACK_checker_det_INL
```

17.44 checker_empty.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
```

Data Structures

- struct [Checker_Empty< Field >](#)

Namespaces

- [FFLAS](#)

17.45 checker_fgemm.inl File Reference

Data Structures

- class [CheckerImplem_fgemm< Field >](#)

Namespaces

- [FFLAS](#)

Macros

- #define [__FFLASFFPACK_checker_fgemm_INL](#)

17.45.1 Macro Definition Documentation

17.45.1.1 __FFLASFFPACK_checker_fgemm_INL

```
#define __FFLASFFPACK_checker_fgemm_INL
```

17.46 checker_ftrsm.inl File Reference

Data Structures

- class [CheckerImplem_ftrsm< Field >](#)

Namespaces

- [FFLAS](#)

Macros

- #define [__FFLASFFPACK_checker_ftrsm_INL](#)

17.46.1 Macro Definition Documentation

17.46.1.1 __FFLASFFPACK_checker_ftrsm_INL

```
#define __FFLASFFPACK_checker_ftrsm_INL
```

17.47 checker_invert.inl File Reference

Data Structures

- class [CheckerImplem_invert< Field >](#)

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_checker_invert_INL](#)

17.47.1 Macro Definition Documentation

17.47.1.1 __FFLASFFPACK_checker_invert_INL

```
#define __FFLASFFPACK_checker_invert_INL
```

17.48 checker_pluq.inl File Reference

```
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Data Structures

- class [CheckerImplem_PLUQ< Field >](#)

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define` [__FFLASFFPACK_checker_pluq_INL](#)

17.48.1 Macro Definition Documentation

17.48.1.1 [__FFLASFFPACK_checker_pluq_INL](#)

```
#define __FFLASFFPACK_checker_pluq_INL
```

17.49 checkers.doxy File Reference

17.50 checkers_fflas.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "checker_empty.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_enum.h"
#include "fflas-ffpack/fflas/fflas_memory.h"
```

Data Structures

- class [FailureFgemmCheck](#)
- class [FailureTrsmCheck](#)

Namespaces

- [FFLAS](#)

Typedefs

- `template<class Field >`
using [Checker_fgemm](#) = [FFLAS::Checker_Empty< Field >](#)
- `template<class Field >`
using [Checker_ftrsm](#) = [FFLAS::Checker_Empty< Field >](#)

17.51 checkers_fflas.inl File Reference

```
#include "checker_fgemm.inl"
#include "checker_ftrsm.inl"
```

Namespaces

- [FFLAS](#)

Macros

- `#define FFLASFFPACK_checkers_fflas_inl_H`

Typedefs

- `template<class Field >`
`using ForceCheck_fgemm = CheckerImplem_fgemm< Field >`
- `template<class Field >`
`using ForceCheck_ftrsm = CheckerImplem_ftrsm< Field >`

17.51.1 Macro Definition Documentation

17.51.1.1 FFLASFFPACK_checkers_fflas_inl_H

```
#define FFLASFFPACK_checkers_fflas_inl_H
```

17.52 checkers_ffpack.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "checker_empty.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Data Structures

- class [FailurePLUQCheck](#)
- class [FailureDetCheck](#)
- class [FailureInvertCheck](#)
- class [FailureCharpolyCheck](#)

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Typedefs

- `template<class Field >`
`using Checker_PLUQ = FFLAS::Checker_Empty< Field >`
- `template<class Field >`
`using Checker_Det = FFLAS::Checker_Empty< Field >`
- `template<class Field >`
`using Checker_invert = FFLAS::Checker_Empty< Field >`
- `template<class Field , class Polynomial >`
`using Checker_charpoly = FFLAS::Checker_Empty< Field >`

17.53 checkers_ffpack.inl File Reference

```
#include "checker_pluq.inl"
#include "checker_det.inl"
#include "checker_invert.inl"
#include "checker_charpoly.inl"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define FFLASFFPACK_checkers_ffpack_inl_H`

Typedefs

- `template<class Field >`
`using ForceCheck_PLUQ = CheckerImplem_PLUQ< Field >`
- `template<class Field >`
`using ForceCheck_Det = CheckerImplem_Det< Field >`
- `template<class Field >`
`using ForceCheck_invert = CheckerImplem_invert< Field >`
- `template<class Field , class Polynomial >`
`using ForceCheck_charpoly = CheckerImplem_charpoly< Field, Polynomial >`

17.53.1 Macro Definition Documentation

17.53.1.1 FFLASFFPACK_checkers_ffpack_inl_H

```
#define FFLASFFPACK_checkers_ffpack_inl_H
```

17.54 clapack.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- `#define __FFLASFFPACK_CONFIGURATION`
- `#define __FFLASFFPACK_HAVE_LAPACK 1`
- `#define __FFLASFFPACK_HAVE_CLAPACK 1`

Functions

- `int main ()`

17.54.1 Macro Definition Documentation

17.54.1.1 __FFLASFFPACK_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

17.54.1.2 __FFLASFFPACK_HAVE_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

17.54.1.3 __FFLASFFPACK_HAVE_CLAPACK

```
#define __FFLASFFPACK_HAVE_CLAPACK 1
```

17.54.2 Function Documentation

17.54.2.1 main()

```
int main (
    void )
```

17.55 config-blas.h File Reference

Macros

- #define [CBLAS_INT](#) int
- #define [CBLAS_ENUM_DEFINED_H](#)
- #define [CBLAS_EXTERNALS](#)
- #define [blas_enum](#) enum

Enumerations

- enum [CBLAS_ORDER](#) { [CblasRowMajor](#) =101 , [CblasColMajor](#) =102 }
- enum [CBLAS_TRANSPOSE](#) { [CblasNoTrans](#) =111 , [CblasTrans](#) =112 , [CblasConjTrans](#) =113 , [AtlasConj](#) =114 }
- enum [CBLAS_UPLO](#) { [CblasUpper](#) =121 , [CblasLower](#) =122 }
- enum [CBLAS_DIAG](#) { [CblasNonUnit](#) =131 , [CblasUnit](#) =132 }
- enum [CBLAS_SIDE](#) { [CblasLeft](#) =141 , [CblasRight](#) =142 }

Functions

- void [daxpy_](#) (const int *, const double *, const double *, const int *, double *, const int *)
- void [saxpy_](#) (const int *, const float *, const float *, const int *, float *, const int *)
- double [ddot_](#) (const int *, const double *, const int *, const double *, const int *)
- float [sdot_](#) (const int *, const float *, const int *, const float *, const int *)
- double [dasum_](#) (const int *, const double *, const int *)
- int [idamax_](#) (const int *, const double *, const int *)
- double [dnrm2_](#) (const int *, const double *, const int *)
- void [dgemv_](#) (const char *, const int *, const int *, const double *, const double *, const int *, const double *, const int *, const double *, double *, const int *)
- void [sgemv_](#) (const char *, const int *, const int *, const float *, const float *, const int *, const float *, const int *, const float *, float *, const int *)
- void [dger_](#) (const int *, const int *, const double *, const double *, const int *, const double *, const int *, double *, const int *)
- void [sger_](#) (const int *, const int *, const float *, const float *, const int *, const float *, const int *, float *, const int *)
- void [dcopy_](#) (const int *, const double *, const int *, double *, const int *)
- void [scopy_](#) (const int *, const float *, const int *, float *, const int *)
- void [dscal_](#) (const int *, const double *, double *, const int *)
- void [sscal_](#) (const int *, const float *, float *, const int *)
- void [dtrsm_](#) (const char *, const char *, const char *, const char *, const int *, const int *, const double *, const double *, const int *, double *, const int *)
- void [strsm_](#) (const char *, const char *, const char *, const char *, const int *, const int *, const float *, const float *, const int *, float *, const int *)

- void [dtrmm_](#) (const char *, const char *, const char *, const char *, const int *, const int *, const double *, const double *, const int *, double *, const int *)
- void [strmm_](#) (const char *, const char *, const char *, const char *, const int *, const int *, const float *, const float *, const int *, float *, const int *)
- void [sgemm_](#) (const char *, const char *, const int *, const int *, const int *, const float *, const float *, const int *, const float *, const int *, const float *, float *, const int *)
- void [dgemm_](#) (const char *, const char *, const int *, const int *, const int *, const double *, const double *, const int *, const double *, const int *, const double *, double *, const int *)

17.55.1 Macro Definition Documentation

17.55.1.1 CBLAS_INT

```
#define CBLAS_INT int
```

17.55.1.2 CBLAS_ENUM_DEFINED_H

```
#define CBLAS_ENUM_DEFINED_H
```

17.55.1.3 CBLAS_EXTERNALS

```
#define CBLAS_EXTERNALS
```

17.55.1.4 blas_enum

```
#define blas_enum enum
```

17.55.2 Enumeration Type Documentation

17.55.2.1 CBLAS_ORDER

```
enum CBLAS\_ORDER
```

Enumerator

| | |
|---------------|--|
| CblasRowMajor | |
| CblasColMajor | |

17.55.2.2 CBLAS_TRANSPOSE

```
enum CBLAS\_TRANSPOSE
```

Enumerator

| | |
|----------------|--|
| CblasNoTrans | |
| CblasTrans | |
| CblasConjTrans | |
| AtlasConj | |

17.55.2.3 CBLAS_UPLO

enum [CBLAS_UPLO](#)

Enumerator

| | |
|------------|--|
| CblasUpper | |
| CblasLower | |

17.55.2.4 CBLAS_DIAG

enum [CBLAS_DIAG](#)

Enumerator

| | |
|--------------|--|
| CblasNonUnit | |
| CblasUnit | |

17.55.2.5 CBLAS_SIDE

enum [CBLAS_SIDE](#)

Enumerator

| | |
|------------|--|
| CblasLeft | |
| CblasRight | |

17.55.3 Function Documentation

17.55.3.1 daxpy_()

```
void daxpy_ (
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    double * ,
    const int * )
```

17.55.3.2 saxpy_()

```
void saxpy_ (
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    float * ,
    const int * )
```


17.55.3.3 ddot_()

```
double ddot_ (
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    const int * )
```

17.55.3.4 sdot_()

```
float sdot_ (
    const int * ,
    const float * ,
    const int * ,
    const float * ,
    const int * )
```

17.55.3.5 dasum_()

```
double dasum_ (
    const int * ,
    const double * ,
    const int * )
```

17.55.3.6 idamax_()

```
int idamax_ (
    const int * ,
    const double * ,
    const int * )
```

17.55.3.7 dnorm2_()

```
double dnorm2_ (
    const int * ,
    const double * ,
    const int * )
```

17.55.3.8 dgemv_()

```
void dgemv_ (
    const char * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    const double * ,
    const int * ,
    const double * ,
```

```
double * ,  
const int * )
```

17.55.3.9 sgemv_()

```
void sgemv_ (  
    const char * ,  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    float * ,  
    const int * )
```

17.55.3.10 dger_()

```
void dger_ (  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

17.55.3.11 sger_()

```
void sger_ (  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

17.55.3.12 dcopy_()

```
void dcopy_ (  
    const int * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

17.55.3.13 scopy_()

```
void scopy_ (
    const int * ,
    const float * ,
    const int * ,
    float * ,
    const int * )
```

17.55.3.14 dscal_()

```
void dscal_ (
    const int * ,
    const double * ,
    double * ,
    const int * )
```

17.55.3.15 sscal_()

```
void sscal_ (
    const int * ,
    const float * ,
    float * ,
    const int * )
```

17.55.3.16 dtrsm_()

```
void dtrsm_ (
    const char * ,
    const char * ,
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    double * ,
    const int * )
```

17.55.3.17 strsm_()

```
void strsm_ (
    const char * ,
    const char * ,
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    float * ,
    const int * )
```

17.55.3.18 dtrmm_()

```
void dtrmm_ (
    const char * ,
    const char * ,
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    double * ,
    const int * )
```

17.55.3.19 strmm_()

```
void strmm_ (
    const char * ,
    const char * ,
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    float * ,
    const int * )
```

17.55.3.20 sgemm_()

```
void sgemm_ (
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    const float * ,
    const int * ,
    const float * ,
    float * ,
    const int * )
```

17.55.3.21 dgemm_()

```
void dgemm_ (
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const int * ,
    const double * ,
```

```

const double * ,
const int * ,
const double * ,
const int * ,
const double * ,
double * ,
const int * )

```

17.56 config.h File Reference

Macros

- #define [HAVE_BLAS](#) 1
- #define [HAVE_CBLAS](#) 1
- #define [HAVE_CXX11](#) 1
- #define [HAVE_DLFCN_H](#) 1
- #define [HAVE_FLOAT_H](#) 1
- #define [HAVE_INTPYPES_H](#) 1
- #define [HAVE_LAPACK](#) 1
- #define [HAVE_LIMITS_H](#) 1
- #define [HAVE_LITTLE_ENDIAN](#) 1
- #define [HAVE_PTHREAD_H](#) 1
- #define [HAVE_STDDEF_H](#) 1
- #define [HAVE_STDINT_H](#) 1
- #define [HAVE_STDIO_H](#) 1
- #define [HAVE_STDLIB_H](#) 1
- #define [HAVE_STRINGS_H](#) 1
- #define [HAVE_STRING_H](#) 1
- #define [HAVE_SYS_STAT_H](#) 1
- #define [HAVE_SYS_TIME_H](#) 1
- #define [HAVE_SYS_TYPES_H](#) 1
- #define [HAVE_UNISTD_H](#) 1
- #define [LT_OBJDIR](#) ".libs/"
- #define [OPENBLAS_NUM_THREADS](#) 1
- #define [PACKAGE](#) "fflas-ffpack"
- #define [PACKAGE_BUGREPORT](#) "ffpack-devel@googlegroups.com"
- #define [PACKAGE_NAME](#) "FFLAS-FFPACK"
- #define [PACKAGE_STRING](#) "FFLAS-FFPACK 2.4.3"
- #define [PACKAGE_TARNAME](#) "fflas-ffpack"
- #define [PACKAGE_URL](#) "https://github.com/linbox-team/fflas-ffpack"
- #define [PACKAGE_VERSION](#) "2.4.3"
- #define [SIZEOF_CHAR](#) 1
- #define [SIZEOF_INT](#) 4
- #define [SIZEOF_LONG](#) 4
- #define [SIZEOF_LONG_LONG](#) 8
- #define [SIZEOF_SHORT](#) 2
- #define [SIZEOF___INT64](#) 0
- #define [STDC_HEADERS](#) 1
- #define [USE_OPENMP](#) 1
- #define [VERSION](#) "2.4.3"

17.56.1 Macro Definition Documentation

17.56.1.1 HAVE_BLAS

```
#define HAVE_BLAS 1
```

17.56.1.2 HAVE_CBLAS

```
#define HAVE_CBLAS 1
```

17.56.1.3 HAVE_CXX11

```
#define HAVE_CXX11 1
```

17.56.1.4 HAVE_DLFCN_H

```
#define HAVE_DLFCN_H 1
```

17.56.1.5 HAVE_FLOAT_H

```
#define HAVE_FLOAT_H 1
```

17.56.1.6 HAVE_INTTYPES_H

```
#define HAVE_INTTYPES_H 1
```

17.56.1.7 HAVE_LAPACK

```
#define HAVE_LAPACK 1
```

17.56.1.8 HAVE_LIMITS_H

```
#define HAVE_LIMITS_H 1
```

17.56.1.9 HAVE_LITTLE_ENDIAN

```
#define HAVE_LITTLE_ENDIAN 1
```

17.56.1.10 HAVE_PTHREAD_H

```
#define HAVE_PTHREAD_H 1
```

17.56.1.11 HAVE_STDDEF_H

```
#define HAVE_STDDEF_H 1
```

17.56.1.12 HAVE_STDINT_H

```
#define HAVE_STDINT_H 1
```

17.56.1.13 HAVE_STDIO_H

```
#define HAVE_STDIO_H 1
```

17.56.1.14 HAVE_STDLIB_H

```
#define HAVE_STDLIB_H 1
```

17.56.1.15 HAVE_STRINGS_H

```
#define HAVE_STRINGS_H 1
```

17.56.1.16 HAVE_STRING_H

```
#define HAVE_STRING_H 1
```

17.56.1.17 HAVE_SYS_STAT_H

```
#define HAVE_SYS_STAT_H 1
```

17.56.1.18 HAVE_SYS_TIME_H

```
#define HAVE_SYS_TIME_H 1
```

17.56.1.19 HAVE_SYS_TYPES_H

```
#define HAVE_SYS_TYPES_H 1
```

17.56.1.20 HAVE_UNISTD_H

```
#define HAVE_UNISTD_H 1
```

17.56.1.21 LT_OBJDIR

```
#define LT_OBJDIR ".libs/"
```

17.56.1.22 OPENBLAS_NUM_THREADS

```
#define OPENBLAS_NUM_THREADS 1
```

17.56.1.23 PACKAGE

```
#define PACKAGE "fflas-ffpack"
```

17.56.1.24 PACKAGE_BUGREPORT

```
#define PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"
```

17.56.1.25 PACKAGE_NAME

```
#define PACKAGE_NAME "FFLAS-FFPACK"
```

17.56.1.26 PACKAGE_STRING

```
#define PACKAGE_STRING "FFLAS-FFPACK 2.4.3"
```

17.56.1.27 PACKAGE_TARNAME

```
#define PACKAGE_TARNAME "fflas-ffpack"
```

17.56.1.28 PACKAGE_URL

```
#define PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"
```

17.56.1.29 PACKAGE_VERSION

```
#define PACKAGE_VERSION "2.4.3"
```

17.56.1.30 SIZEOF_CHAR

```
#define SIZEOF_CHAR 1
```

17.56.1.31 SIZEOF_INT

```
#define SIZEOF_INT 4
```

17.56.1.32 SIZEOF_LONG

```
#define SIZEOF_LONG 4
```

17.56.1.33 SIZEOF_LONG_LONG

```
#define SIZEOF_LONG_LONG 8
```

17.56.1.34 SIZEOF_SHORT

```
#define SIZEOF_SHORT 2
```

17.56.1.35 SIZEOF__INT64

```
#define SIZEOF__INT64 0
```

17.56.1.36 STDC_HEADERS

```
#define STDC_HEADERS 1
```


17.56.1.37 USE_OPENMP

```
#define USE_OPENMP 1
```

17.56.1.38 VERSION

```
#define VERSION "2.4.3"
```

17.57 config.h File Reference**Macros**

- [#define __FFLASFFPACK_HAVE_BLAS 1](#)
- [#define __FFLASFFPACK_HAVE_CBLAS 1](#)
- [#define __FFLASFFPACK_HAVE_CXX11 1](#)
- [#define __FFLASFFPACK_HAVE_DLFCN_H 1](#)
- [#define __FFLASFFPACK_HAVE_FLOAT_H 1](#)
- [#define __FFLASFFPACK_HAVE_INTTYPES_H 1](#)
- [#define __FFLASFFPACK_HAVE_LAPACK 1](#)
- [#define __FFLASFFPACK_HAVE_LIMITS_H 1](#)
- [#define __FFLASFFPACK_HAVE_LITTLE_ENDIAN 1](#)
- [#define __FFLASFFPACK_HAVE_PTHREAD_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDDEF_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDINT_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDIO_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDLIB_H 1](#)
- [#define __FFLASFFPACK_HAVE_STRINGS_H 1](#)
- [#define __FFLASFFPACK_HAVE_STRING_H 1](#)
- [#define __FFLASFFPACK_HAVE_SYS_STAT_H 1](#)
- [#define __FFLASFFPACK_HAVE_SYS_TIME_H 1](#)
- [#define __FFLASFFPACK_HAVE_SYS_TYPES_H 1](#)
- [#define __FFLASFFPACK_HAVE_UNISTD_H 1](#)
- [#define __FFLASFFPACK_LT_OBJDIR ".libs/"](#)
- [#define __FFLASFFPACK_OPENBLAS_NUM_THREADS 1](#)
- [#define __FFLASFFPACK_PACKAGE "fflas-ffpack"](#)
- [#define __FFLASFFPACK_PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"](#)
- [#define __FFLASFFPACK_PACKAGE_NAME "FFLAS-FFPACK"](#)
- [#define __FFLASFFPACK_PACKAGE_STRING "FFLAS-FFPACK 2.4.3"](#)
- [#define __FFLASFFPACK_PACKAGE_TARNAME "fflas-ffpack"](#)
- [#define __FFLASFFPACK_PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"](#)
- [#define __FFLASFFPACK_PACKAGE_VERSION "2.4.3"](#)
- [#define __FFLASFFPACK_SIZEOF_CHAR 1](#)
- [#define __FFLASFFPACK_SIZEOF_INT 4](#)
- [#define __FFLASFFPACK_SIZEOF_LONG 4](#)
- [#define __FFLASFFPACK_SIZEOF_LONG_LONG 8](#)
- [#define __FFLASFFPACK_SIZEOF_SHORT 2](#)
- [#define __FFLASFFPACK_SIZEOF___INT64 0](#)
- [#define __FFLASFFPACK_STDC_HEADERS 1](#)
- [#define __FFLASFFPACK_USE_OPENMP 1](#)
- [#define __FFLASFFPACK_VERSION "2.4.3"](#)

17.57.1 Macro Definition Documentation

17.57.1.1 __FFLASFFPACK_HAVE_BLAS

```
#define __FFLASFFPACK_HAVE_BLAS 1
```

17.57.1.2 __FFLASFFPACK_HAVE_CBLAS

```
#define __FFLASFFPACK_HAVE_CBLAS 1
```

17.57.1.3 __FFLASFFPACK_HAVE_CXX11

```
#define __FFLASFFPACK_HAVE_CXX11 1
```

17.57.1.4 __FFLASFFPACK_HAVE_DLFCN_H

```
#define __FFLASFFPACK_HAVE_DLFCN_H 1
```

17.57.1.5 __FFLASFFPACK_HAVE_FLOAT_H

```
#define __FFLASFFPACK_HAVE_FLOAT_H 1
```

17.57.1.6 __FFLASFFPACK_HAVE_INTTYPES_H

```
#define __FFLASFFPACK_HAVE_INTTYPES_H 1
```

17.57.1.7 __FFLASFFPACK_HAVE_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

17.57.1.8 __FFLASFFPACK_HAVE_LIMITS_H

```
#define __FFLASFFPACK_HAVE_LIMITS_H 1
```

17.57.1.9 __FFLASFFPACK_HAVE_LITTLE_ENDIAN

```
#define __FFLASFFPACK_HAVE_LITTLE_ENDIAN 1
```

17.57.1.10 __FFLASFFPACK_HAVE_PTHREAD_H

```
#define __FFLASFFPACK_HAVE_PTHREAD_H 1
```

17.57.1.11 __FFLASFFPACK_HAVE_STDDEF_H

```
#define __FFLASFFPACK_HAVE_STDDEF_H 1
```

17.57.1.12 __FFLASFFPACK_HAVE_STDINT_H

```
#define __FFLASFFPACK_HAVE_STDINT_H 1
```

17.57.1.13 __FFLASFFPACK_HAVE_STDIO_H

```
#define __FFLASFFPACK_HAVE_STDIO_H 1
```

17.57.1.14 __FFLASFFPACK_HAVE_STDLIB_H

```
#define __FFLASFFPACK_HAVE_STDLIB_H 1
```

17.57.1.15 __FFLASFFPACK_HAVE_STRINGS_H

```
#define __FFLASFFPACK_HAVE_STRINGS_H 1
```

17.57.1.16 __FFLASFFPACK_HAVE_STRING_H

```
#define __FFLASFFPACK_HAVE_STRING_H 1
```

17.57.1.17 __FFLASFFPACK_HAVE_SYS_STAT_H

```
#define __FFLASFFPACK_HAVE_SYS_STAT_H 1
```

17.57.1.18 __FFLASFFPACK_HAVE_SYS_TIME_H

```
#define __FFLASFFPACK_HAVE_SYS_TIME_H 1
```

17.57.1.19 __FFLASFFPACK_HAVE_SYS_TYPES_H

```
#define __FFLASFFPACK_HAVE_SYS_TYPES_H 1
```

17.57.1.20 __FFLASFFPACK_HAVE_UNISTD_H

```
#define __FFLASFFPACK_HAVE_UNISTD_H 1
```

17.57.1.21 __FFLASFFPACK_LT_OBJDIR

```
#define __FFLASFFPACK_LT_OBJDIR ".libs/"
```

17.57.1.22 __FFLASFFPACK_OPENBLAS_NUM_THREADS

```
#define __FFLASFFPACK_OPENBLAS_NUM_THREADS 1
```

17.57.1.23 __FFLASFFPACK_PACKAGE

```
#define __FFLASFFPACK_PACKAGE "fflas-ffpack"
```

17.57.1.24 __FFLASFFPACK_PACKAGE_BUGREPORT

```
#define __FFLASFFPACK_PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"
```

17.57.1.25 __FFLASFFPACK_PACKAGE_NAME

```
#define __FFLASFFPACK_PACKAGE_NAME "FFLAS-FFPACK"
```

17.57.1.26 __FFLASFFPACK_PACKAGE_STRING

```
#define __FFLASFFPACK_PACKAGE_STRING "FFLAS-FFPACK 2.4.3"
```

17.57.1.27 __FFLASFFPACK_PACKAGE_TARNAME

```
#define __FFLASFFPACK_PACKAGE_TARNAME "fflas-ffpack"
```

17.57.1.28 __FFLASFFPACK_PACKAGE_URL

```
#define __FFLASFFPACK_PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"
```

17.57.1.29 __FFLASFFPACK_PACKAGE_VERSION

```
#define __FFLASFFPACK_PACKAGE_VERSION "2.4.3"
```

17.57.1.30 __FFLASFFPACK_SIZEOF_CHAR

```
#define __FFLASFFPACK_SIZEOF_CHAR 1
```

17.57.1.31 __FFLASFFPACK_SIZEOF_INT

```
#define __FFLASFFPACK_SIZEOF_INT 4
```

17.57.1.32 __FFLASFFPACK_SIZEOF_LONG

```
#define __FFLASFFPACK_SIZEOF_LONG 4
```

17.57.1.33 __FFLASFFPACK_SIZEOF_LONG_LONG

```
#define __FFLASFFPACK_SIZEOF_LONG_LONG 8
```

17.57.1.34 __FFLASFFPACK_SIZEOF_SHORT

```
#define __FFLASFFPACK_SIZEOF_SHORT 2
```

17.57.1.35 __FFLASFFPACK_SIZEOF__INT64

```
#define __FFLASFFPACK_SIZEOF__INT64 0
```

17.57.1.36 __FFLASFFPACK_STDC_HEADERS

```
#define __FFLASFFPACK_STDC_HEADERS 1
```

17.57.1.37 __FFLASFFPACK_USE_OPENMP

```
#define __FFLASFFPACK_USE_OPENMP 1
```

17.57.1.38 __FFLASFFPACK_VERSION

```
#define __FFLASFFPACK_VERSION "2.4.3"
```

17.58 coo.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_spmv.inl"
```

Data Structures

- struct [Sparse<_Field, SparseMatrix_t::COO>](#)
- struct [Sparse<_Field, SparseMatrix_t::COO_ZO>](#)

Namespaces

- [FFLAS](#)

Functions

- template<class Field, class IndexT>
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::COO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field, class IndexT>
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field>
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::COO > &A)
- template<class Field>
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A)

17.59 coo_spmv.inl File Reference**Namespaces**

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_coo_spmv_INL](#)

Functions

- template<class Field>
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x_, int ldx, typename [Field::Element_ptr](#) y_, int ldy, FieldCategories::GenericTag)
- template<class Field>
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x_, int ldx, typename [Field::Element_ptr](#) y_, int ldy, FieldCategories::UnparametricTag)

- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

17.59.1 Macro Definition Documentation

17.59.1.1 __FFLASFFPACK_fflas_sparse_coo_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_spmv_INL
```

17.60 coo_spmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_coo_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.60.1 Macro Definition Documentation

17.60.1.1 __FflasFFPACK_fflas_sparse_coo_spmv_INL

```
#define __FflasFFPACK_fflas_sparse_coo_spmv_INL
```

17.61 coo_utils.inl File Reference

Namespaces

- [Fflas](#)

Macros

- `#define __FflasFFPACK_fflas_sparse_coo_utils_INL`

Functions

- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::COO > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::COO_ZO > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::COO_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.61.1 Macro Definition Documentation

17.61.1.1 __FFLASFFPACK_fflas_sparse_coo_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_utils_INL
```

17.62 csr.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_spmv.inl"
```

Data Structures

- struct [Sparse<_Field, SparseMatrix_t::CSR>](#)
- struct [Sparse<_Field, SparseMatrix_t::CSR_ZO>](#)

Namespaces

- [FFLAS](#)

Functions

- template<class Field, class IndexT>
void [sparse_init](#) (const [Field](#) &F, [Sparse<Field, SparseMatrix_t::CSR>](#) &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field, class IndexT>
void [sparse_init](#) (const [Field](#) &F, [Sparse<Field, SparseMatrix_t::CSR_ZO>](#) &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field>
void [sparse_delete](#) (const [Sparse<Field, SparseMatrix_t::CSR>](#) &A)
- template<class Field>
void [sparse_delete](#) (const [Sparse<Field, SparseMatrix_t::CSR_ZO>](#) &A)

17.63 csr_hyb.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_spmv.inl"
```

Data Structures

- struct [Sparse<_Field, SparseMatrix_t::CSR_HYB>](#)

Namespaces

- [FFLAS](#)

Functions

- template<class Field>
void [sparse_delete](#) (const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A)
- template<class Field, class IndexT>
void [sparse_init](#) (const [Field](#) &F, [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.64 csr_hyb_pspmm.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL`

Functions

- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::↵`
`UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, typename Field::Element_ptr y, const int64_t kmax)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`

17.64.1 Macro Definition Documentation

17.64.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL
```

17.65 csr_hyb_pspmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`

17.65.1 Macro Definition Documentation

17.65.1.1 __FflasFFPACK_fflas_sparse_CSR_HYB_pspmv_INL

```
#define __FflasFFPACK_fflas_sparse_CSR_HYB_pspmv_INL
```

17.66 csr_hyb_spmv.inl File Reference

Namespaces

- [Fflas](#)
- [Fflas::sparse_details_impl](#)

Macros

- `#define __FflasFFPACK_fflas_sparse_CSR_HYB_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`

17.66.1 Macro Definition Documentation

17.66.1.1 __FflasFFPACK_fflas_sparse_CSR_HYB_spmv_INL

```
#define __FflasFFPACK_fflas_sparse_CSR_HYB_spmv_INL
```

17.67 csr_hyb_spmv.inl File Reference

Namespaces

- [Fflas](#)
- [Fflas::sparse_details_impl](#)

Macros

- `#define __FflasFFPACK_fflas_sparse_CSR_HYB_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`

17.67.1 Macro Definition Documentation

17.67.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL
```

17.68 csr_hyb_utils.inl File Reference

Data Structures

- struct [Info](#)
- struct [Coo< ValT, IdxT >](#)

Namespaces

- [FFLAS](#)
- [FFLAS::csr_hyb_details](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL`

Functions

- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_HYB > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_HYB > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.68.1 Macro Definition Documentation

17.68.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL
```

17.69 csr_pspmm.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL`

Functions

- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

17.69.1 Macro Definition Documentation

17.69.1.1 __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL
```

17.70 csr_pspmv.inl File Reference

```
#include <thread>
```

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_task (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const index_t iStart, const index_t iStop, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.70.1 Macro Definition Documentation

17.70.1.1 __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL
```

17.71 csr_spmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, index_t blockSize, typename Field::ConstElement_ptr x_, index_t ldx, typename Field::Element_ptr y_, index_t ldy, FieldCategories::↵ UnparametricTag)`

- `template<class Field >`
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, Field↵`
`Categories::UnparametricTag)`
- `template<class Field >`
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, Field↵`
`Categories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::↵`
`GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::↵`
`GenericTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_↵`
`_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, Field↵`
`Categories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`

17.71.1 Macro Definition Documentation

17.71.1.1 __FFLASFFPACK_fflas_sparse_CSR_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL
```

17.72 csr_spmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.72.1 Macro Definition Documentation

17.72.1.1 __FFLASFFPACK_fflas_sparse_CSR_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL
```

17.73 csr_utils.inl File Reference

Namespaces

- [FFLAS](#)

Functions

- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_ZO > &A)`
- `template<class Field >`
`std::ostream & sparse_print (std::ostream &os, const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class IndexT >`
`void sparse_init (const Givaro::Modular< Givaro::Integer > &F, Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT >`
`void sparse_init (const Givaro::ZRing< Givaro::Integer > &F, Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`
`void sparse_init (const Givaro::ZRing< Reclnt::rmint< RECINT_SIZE >> &F, Sparse< Givaro::ZRing< Reclnt::rmint< RECINT_SIZE >>, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col,`

```
typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>::Element_ptr dat, uint64_t rowdim, uint64_t
coldim, uint64_t nnz)
```

- template<class IndexT , size_t RECINT_SIZE>
void [sparse_init](#) (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE >> &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, type-
name Givaro::ZRing< RecInt::rmint< RECINT_SIZE >>::Element_ptr dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.74 cuda.C File Reference

```
#include <stdio.h>
#include <cuda_runtime.h>
#include <cusparse.h>
```

Functions

- int [main](#) ()

17.74.1 Function Documentation

17.74.1.1 main()

```
int main (
    void )
```

17.75 debug.h File Reference

Various utilities for debugging.

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <iostream>
#include <sstream>
#include <cmath>
#include <stdexcept>
```

Data Structures

- class [Failure](#)
A precondition failed.

Namespaces

- [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.

Macros

- #define `FFLASFFPACK_check`(check)
- #define `FFLASFFPACK_abort`(msg)

Functions

- Failure & `failure` ()
- template<class T >
bool `isOdd` (const T &a)
- bool `isOdd` (const float &a)
- bool `isOdd` (const double &a)

17.75.1 Detailed Description

Various utilities for debugging.

Todo we should put vector printing elsewhere.

17.75.2 Macro Definition Documentation

17.75.2.1 FFLASFFPACK_check

```
#define FFLASFFPACK_check(  
    check )
```

Value:

```
if (!(check)) {\n    FFPACK::failure() (__func__, __FILE__, __LINE__, #check); \n    throw std::runtime_error(#check); \n}
```

17.75.2.2 FFLASFFPACK_abort

```
#define FFLASFFPACK_abort(  
    msg )
```

Value:

```
{\n    FFPACK::failure() (__func__, __FILE__, __LINE__, msg); \n    throw std::runtime_error(msg); \n}
```

17.76 det.C File Reference

```
#include <givaro/modular.h>\n#include <iostream>\n#include "fflas-ffpack/fflas-ffpack-config.h"\n#include "fflas-ffpack/fflas-ffpack.h"\n#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int `main` (int argc, char **argv)

This example computes the determinant of a matrix over a defined finite field.

17.76.1 Function Documentation

17.76.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example computes the determinant of a matrix over a defined finite field.
Outputs the determinant.

17.77 ell.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_spmmm.inl"
```

Data Structures

- struct [Sparse< _Field, SparseMatrix_t::ELL >](#)
- struct [Sparse< _Field, SparseMatrix_t::ELL_ZO >](#)

Namespaces

- [FFLAS](#)

Functions

- template<class Field , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class Field >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL > &A)
- template<class Field >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL_ZO > &A)

17.78 ell_pspmm.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_ELL_pspmm_INL](#)

Functions

- template<class Field >
void [pffspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::GenericTag)
- template<class Field >
void [pffspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x, int ldx, typename [Field::Element_ptr](#) y, int ldy, FieldCategories::GenericTag)

- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, const int64_t kmax)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`
- `template<class Field, class Func >`
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, Func &&func)`
- `template<class Field, class Func >`
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, Func &&func)`

17.78.1 Macro Definition Documentation

17.78.1.1 __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL
```

17.79 ell_pspmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.79.1 Macro Definition Documentation

17.79.1.1 __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL
```

17.80 ell_simd.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd/ell_simd_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd/ell_simd_spmv.inl"
```

Data Structures

- struct [Sparse< _Field, SparseMatrix_t::ELL_simd >](#)
- struct [Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >](#)

Namespaces

- [FFLAS](#)

Functions

- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A)`

17.81 ell_simd_pspmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.81.1 Macro Definition Documentation

17.81.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL
```

17.82 ell_simd_spmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.82.1 Macro Definition Documentation

17.82.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL
```

17.83 ell_simd_utils.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL`

Functions

- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A)`
- `template<class Field >`
`void sparse_print (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.83.1 Macro Definition Documentation

17.83.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL
```

17.84 ell_spmmm.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_spmmm_INL`

Functions

- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

17.84.1 Macro Definition Documentation

17.84.1.1 __FFLASFFPACK_fflas_sparse_ELL_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL
```

17.85 ell_spmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- [#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL](#)

Functions

- [template<class Field >
void fspmv \(const \[Field\]\(#\) &F, const Sparse< \[Field\]\(#\), SparseMatrix_t::ELL > &A, typename \[Field::ConstElement_ptr\]\(#\) x_, typename \[Field::Element_ptr\]\(#\) y_, FieldCategories::GenericTag\)](#)
- [template<class Field >
void fspmv \(const \[Field\]\(#\) &F, const Sparse< \[Field\]\(#\), SparseMatrix_t::ELL > &A, typename \[Field::ConstElement_ptr\]\(#\) x_, typename \[Field::Element_ptr\]\(#\) y_, FieldCategories::UnparametricTag\)](#)
- [template<class Field >
void fspmv \(const \[Field\]\(#\) &F, const Sparse< \[Field\]\(#\), SparseMatrix_t::ELL > &A, typename \[Field::ConstElement_ptr\]\(#\) x_, typename \[Field::Element_ptr\]\(#\) y_, const \[uint64_t\]\(#\) kmax\)](#)
- [template<class Field >
void fspmv_one \(const \[Field\]\(#\) &F, const Sparse< \[Field\]\(#\), SparseMatrix_t::ELL_ZO > &A, typename \[Field::ConstElement_ptr\]\(#\) x_, typename \[Field::Element_ptr\]\(#\) y_, FieldCategories::GenericTag\)](#)
- [template<class Field >
void fspmv_mone \(const \[Field\]\(#\) &F, const Sparse< \[Field\]\(#\), SparseMatrix_t::ELL_ZO > &A, typename \[Field::ConstElement_ptr\]\(#\) x_, typename \[Field::Element_ptr\]\(#\) y_, FieldCategories::GenericTag\)](#)
- [template<class Field >
void fspmv_one \(const \[Field\]\(#\) &F, const Sparse< \[Field\]\(#\), SparseMatrix_t::ELL_ZO > &A, typename \[Field::ConstElement_ptr\]\(#\) x_, typename \[Field::Element_ptr\]\(#\) y_, FieldCategories::UnparametricTag\)](#)
- [template<class Field >
void fspmv_mone \(const \[Field\]\(#\) &F, const Sparse< \[Field\]\(#\), SparseMatrix_t::ELL_ZO > &A, typename \[Field::ConstElement_ptr\]\(#\) x_, typename \[Field::Element_ptr\]\(#\) y_, FieldCategories::UnparametricTag\)](#)

17.85.1 Macro Definition Documentation

17.85.1.1 __FFLASFFPACK_fflas_sparse_ELL_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL
```

17.86 ell_utils.inl File Reference

```
#include <vector>
```

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_utils_INL`

Functions

- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_ZO > &A)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field , class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.86.1 Macro Definition Documentation

17.86.1.1 __FFLASFFPACK_fflas_sparse_ELL_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_utils_INL
```

17.87 fblas.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- `#define __FFLASFFPACK_CONFIGURATION`

Functions

- `void dgemm_ (const char *, const char *, const int *, const int *, const int *, const double *, const double *, const int *, const double *, const int *, const double *, double *, const int *)`
- `int main ()`

17.87.1 Macro Definition Documentation

17.87.1.1 __FFLASFFPACK_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

17.87.2 Function Documentation

17.87.2.1 dgemm_()

```
void dgemm_ (
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    double * ,
    const int * )
```

17.87.2.2 main()

```
int main (
    void )
```

17.88 fflas-101_1.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.88.1 Function Documentation**17.88.1.1 main()**

```
int main (
    int argc,
    char ** argv )
```

17.89 fflas-101_3.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.89.1 Function Documentation

17.89.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.90 fflas-ffpack-config.h File Reference

Defaults for optimised values.

```
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/fflas-ffpack-thresholds.h"
#include "fflas-ffpack/fflas-ffpack-default-thresholds.h"
#include "givaro/givconfig.h"
```

Macros

- #define [GCC_VERSION](#) (__GNUC__ * 10000 + __GNUC_MINOR__ * 100 + __GNUC_PATCHLEVEL__)

17.90.1 Detailed Description

Defaults for optimised values.

While `fflas-ffpack-optimize.h` is created by `configure` script, (either left blank or filled by optimiser), this file produces the defaults for the optimised values. If `fflas-ffpack-optimize.h` is not empty, then its values preceeds the defaults here.

17.90.2 Macro Definition Documentation

17.90.2.1 GCC_VERSION

```
#define GCC_VERSION (__GNUC__ * 10000 + __GNUC_MINOR__ * 100 + __GNUC_PATCHLEVEL__)
```

17.91 fflas-ffpack-default-thresholds.h File Reference

Macros

- #define [__FFLASFFPACK_WINOTHRESHOLD](#) 1000
- #define [__FFLASFFPACK_WINOTHRESHOLD_FLT](#) 2000
- #define [__FFLASFFPACK_WINOTHRESHOLD_BAL](#) 1000
- #define [__FFLASFFPACK_WINOTHRESHOLD_BAL_FLT](#) 2000
- #define [__FFLASFFPACK_PLUQ_THRESHOLD](#) 256
- #define [__FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD](#) 1000
- #define [__FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD](#) 16
- #define [__FFLASFFPACK_ARITHPROG_THRESHOLD](#) 30
- #define [__FFLASFFPACK_FTRTRI_THRESHOLD](#) 32
- #define [__FFLASFFPACK_FSYTRF_THRESHOLD](#) 64
- #define [__FFLASFFPACK_FSYRK_THRESHOLD](#) 3000

17.91.1 Macro Definition Documentation

17.91.1.1 `__FFLASFFPACK_WINOTHRESHOLD`

```
#define __FFLASFFPACK_WINOTHRESHOLD 1000
```

17.91.1.2 `__FFLASFFPACK_WINOTHRESHOLD_FLT`

```
#define __FFLASFFPACK_WINOTHRESHOLD_FLT 2000
```

17.91.1.3 `__FFLASFFPACK_WINOTHRESHOLD_BAL`

```
#define __FFLASFFPACK_WINOTHRESHOLD_BAL 1000
```

17.91.1.4 `__FFLASFFPACK_WINOTHRESHOLD_BAL_FLT`

```
#define __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT 2000
```

17.91.1.5 `__FFLASFFPACK_PLUQ_THRESHOLD`

```
#define __FFLASFFPACK_PLUQ_THRESHOLD 256
```

17.91.1.6 `__FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD`

```
#define __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD 1000
```

17.91.1.7 `__FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD`

```
#define __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD 16
```

17.91.1.8 `__FFLASFFPACK_ARITHPROG_THRESHOLD`

```
#define __FFLASFFPACK_ARITHPROG_THRESHOLD 30
```

17.91.1.9 `__FFLASFFPACK_FTRTRI_THRESHOLD`

```
#define __FFLASFFPACK_FTRTRI_THRESHOLD 32
```

17.91.1.10 `__FFLASFFPACK_FSYTRF_THRESHOLD`

```
#define __FFLASFFPACK_FSYTRF_THRESHOLD 64
```

17.91.1.11 `__FFLASFFPACK_FSYRK_THRESHOLD`

```
#define __FFLASFFPACK_FSYRK_THRESHOLD 3000
```

17.92 fflas-ffpack-thresholds.h File Reference

17.93 fflas-ffpack.doxy File Reference

17.94 fflas-ffpack.h File Reference

Includes [FFLAS](#) and [FFPACK](#).

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas/fflas.h"
#include "ffpack/ffpack.h"
```

17.94.1 Detailed Description

Includes [FFLAS](#) and [FFPACK](#).

17.95 fflas.doxy File Reference

17.96 fflas.h File Reference

Finite Field Linear Algebra Subroutines

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/config-blas.h"
#include <cmath>
#include <cstring>
#include <float.h>
#include <algorithm>
#include "fflas_enum.h"
#include "fflas-ffpack/utis/fflas_memory.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas_level1.inl"
#include "fflas_level2.inl"
#include "fflas_level3.inl"
#include "fflas-ffpack/checkers/checkers_fflas.h"
#include "fflas_freduce.h"
#include "fflas_fadd.h"
#include "fflas_fscal.h"
#include "fflas_fassign.h"
#include "fflas_fgemm.inl"
#include "fflas_pfgemm.inl"
#include "fflas_fgemv.inl"
#include "fflas-ffpack/paladin/pfgemv.inl"
#include "fflas_freivalds.inl"
#include "fflas_fger.inl"
#include "fflas_fsyrk.inl"
#include "fflas_fsyr2k.inl"
#include "fflas_ftrsm.inl"
#include "fflas_pfttrsm.inl"
#include "fflas_ftrmm.inl"
#include "fflas_ftrsv.inl"
#include "fflas_faxpy.inl"
#include "fflas_fdot.inl"
#include "fflas-ffpack/field/rns.h"
#include "fflas_fscal_mp.inl"
#include "fflas_freduce_mp.inl"
```

```
#include "fflas-ffpack/fflas/fflas_fger_mp.inl"
#include "fflas_fgemm/fgemm_classical_mp.inl"
#include "fflas_ftrsm_mp.inl"
#include "fflas_fgmv_mp.inl"
#include "fflas-ffpack/field/rns.inl"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include "fflas_sparse.h"
#include "fflas-ffpack/checkers/checkers_fflas.inl"
```

Macros

- `#define WINOTHRESHOLD __FFLASFFPACK_WINOTHRESHOLD`
- `#define DOUBLE_TO_FLOAT_CROSSOVER 800`

Thresholds determining which floating point representation to use, depending on the cardinality of the finite field.

17.96.1 Detailed Description

Finite Field Linear Algebra Subroutines

Author

Clément Pernet.

17.96.2 Macro Definition Documentation

17.96.2.1 WINOTHRESHOLD

```
#define WINOTHRESHOLD __FFLASFFPACK_WINOTHRESHOLD
```

17.96.2.2 DOUBLE_TO_FLOAT_CROSSOVER

```
#define DOUBLE_TO_FLOAT_CROSSOVER 800
```

Thresholds determining which floating point representation to use, depending on the cardinality of the finite field. This is only used when the element representation is not a floating point type.

Bug to be benchmarked.

17.97 fflas_101.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <iostream>
```

Functions

- `int main (int argc, char **argv)`

17.97.1 Function Documentation

17.97.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.98 fflas_101_lvl1.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <iostream>
#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int [main](#) (int argc, char **argv)

17.98.1 Function Documentation

17.98.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.99 fflas_bounds.inl File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/flimits.h"
#include <givaro/udl.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Macros

- `#define` [__FFLASFFPACK_fflas_bounds_INL](#)
- `#define` [FFLAS_INT_TYPE](#) `uint64_t`

Functions

- `template<class Field >`
double [computeFactorClassic](#) (const [Field](#) &F)
- `template<>` double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< double > &F)
- `template<>` double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< float > &F)
- `template<class Field >`
size_t [DotProdBoundClassic](#) (const [Field](#) &F, const typename [Field::Element](#) &beta)
- `Givaro::Integer` [InfNorm](#) (const size_t M, const size_t N, const `Givaro::Integer` *A, const size_t lda)

- template<class Field >
size_t [TRSMBound](#) (const [Field](#) &)
TRSMBound.
- template<class Element >
size_t [TRSMBound](#) (const Givaro::Modular< Element > &F)
Specialization for positive modular representation over float.
- template<class Element >
size_t [TRSMBound](#) (const [Givaro::ModularBalanced](#)< Element > &F)
Specialization for balanced modular representation over double.

17.99.1 Macro Definition Documentation

17.99.1.1 [__FFLASFFPACK_fflas_bounds_INL](#)

```
#define __FFLASFFPACK_fflas_bounds_INL
```

17.99.1.2 [FFLAS_INT_TYPE](#)

```
#define FFLAS_INT_TYPE uint64\_t
```

17.100 [fflas_c.h](#) File Reference

```
#include <stdbool.h>
#include <stdlib.h>
#include <inttypes.h>
```

Macros

- #define [FFLAS_COMPILED](#)

Enumerations

- enum [FFLAS_C_ORDER](#) { [FflasRowMajor](#) = 101 , [FflasColMajor](#) = 102 , [FflasRowMajor](#) = 101 , [FflasColMajor](#) = 102 }
Storage by row or col ?
- enum [FFLAS_C_TRANSPOSE](#) { [FflasNoTrans](#) = 111 , [FflasTrans](#) = 112 , [FflasNoTrans](#) = 111 , [FflasTrans](#) = 112 }
Is matrix transposed ?
- enum [FFLAS_C_UPLO](#) { [FflasUpper](#) = 121 , [FflasLower](#) = 122 , [FflasUpper](#) = 121 , [FflasLower](#) = 122 }
Is triangular matrix's shape upper ?
- enum [FFLAS_C_DIAG](#) { [FflasNonUnit](#) = 131 , [FflasUnit](#) = 132 , [FflasNonUnit](#) = 131 , [FflasUnit](#) = 132 }
Is the triangular matrix implicitly unit diagonal ?
- enum [FFLAS_C_SIDE](#) { [FflasLeft](#) = 141 , [FflasRight](#) = 142 , [FflasLeft](#) = 141 , [FflasRight](#) = 142 }
On what side ?
- enum [FFLAS_C_BASE](#) { [FflasDouble](#) = 151 , [FflasFloat](#) = 152 , [FflasGeneric](#) = 153 }
FFLAS_C_BASE determines the type of the element representation for Matrix Mult kernel.

Functions

- void [freducein_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- void [freduce_1_modular_double](#) (const double F, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fnegin_1_modular_double](#) (const double F, const size_t n, double *X, const size_t incX, bool positive)
- void [fneg_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fzero_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- bool [fiszero_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, bool positive)
- bool [fequal_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void [fassign_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fscal_1_modular_double](#) (const double p, const size_t n, const double alpha, double *X, const size_t incX, bool positive)
- void [fscal_1_modular_double](#) (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void [faxpy_1_modular_double](#) (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- double [fdot_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void [fswap_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void [fadd_1_modular_double](#) (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [fsub_1_modular_double](#) (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [faddin_1_modular_double](#) (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [fsubin_1_modular_double](#) (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [fassign_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t incB, double *A, const size_t incA, bool positive)
- void [fzero_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t incA, bool positive)
- bool [fequal_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, bool positive)
- bool [fiszero_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t incA, bool positive)
- void [fidentity_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t incA, const double d, bool positive)
- void [freducein_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t incA, bool positive)
- void [freduce_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t incB, double *A, const size_t incA, bool positive)
- void [fnegin_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t incA, bool positive)
- void [fneg_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t incB, double *A, const size_t incA, bool positive)
- void [fscal_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, double *A, const size_t incA, bool positive)
- void [fscal_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *A, const size_t incA, double *B, const size_t incB, bool positive)
- void [faxpy_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)

- void [fmove_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t ldA, double *B, const size_t ldB, bool positive)
- void [fadd_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t ldA, const double *B, const size_t ldB, double *C, const size_t ldC, bool positive)
- void [fsub_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t ldA, const double *B, const size_t ldB, double *C, const size_t ldC, bool positive)
- void [fsubin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t ldB, double *C, const size_t ldC, bool positive)
- void [faddin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t ldB, double *C, const size_t ldC, bool positive)
- double * [fgemv_2_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) TransA, const size_t m, const size_t n, const double alpha, const double *A, const size_t ldA, const double *X, const size_t incX, const double beta, double *Y, const size_t incY, bool positive)
- void [fger_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *x, const size_t incX, const double *y, const size_t incY, double *A, const size_t ldA, bool positive)
- void [ftrsv_2_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) TransA, const enum [FFLAS_C_DIAG](#) Diag, const size_t n, const double *A, const size_t ldA, double *X, int incX, bool positive)
- void [ftrsm_3_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) TransA, const enum [FFLAS_C_DIAG](#) Diag, const size_t m, const size_t n, const double alpha, const double *A, const size_t ldA, double *B, const size_t ldB, bool positive)
- void [ftrmm_3_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) TransA, const enum [FFLAS_C_DIAG](#) Diag, const size_t m, const size_t n, const double alpha, double *A, const size_t ldA, double *B, const size_t ldB, bool positive)
- double * [fgemm_3_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) tA, const enum [FFLAS_C_TRANSPOSE](#) tB, const size_t m, const size_t n, const size_t k, const double alpha, const double *A, const size_t ldA, const double *B, const size_t ldB, const double beta, double *C, const size_t ldC, bool positive)
- double * [fsquare_3_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) tA, const size_t n, const double alpha, const double *A, const size_t ldA, const double beta, double *C, const size_t ldC, bool positive)

17.100.1 Macro Definition Documentation

17.100.1.1 FFLAS_COMPILED

```
#define FFLAS_COMPILED
```

17.100.2 Enumeration Type Documentation

17.100.2.1 FFLAS_C_ORDER

```
enum FFLAS\_C\_ORDER
```

Storage by row or col ?

Enumerator

| | |
|---------------|-----------|
| FflasRowMajor | row major |
| FflasColMajor | col major |
| FflasRowMajor | |
| FflasColMajor | |

17.100.2.2 FFLAS_C_TRANSPOSEenum [FFLAS_C_TRANSPOSE](#)

Is matrix transposed ?

Enumerator

| | |
|--------------|---------------------------|
| FflasNoTrans | Matrix is not transposed. |
| FflasTrans | Matrix is transposed. |
| FflasNoTrans | |
| FflasTrans | |

17.100.2.3 FFLAS_C_UPLOenum [FFLAS_C_UPLO](#)

Is triangular matrix's shape upper ?

Enumerator

| | |
|------------|--|
| FflasUpper | Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$) |
| FflasLower | Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$) |
| FflasUpper | |
| FflasLower | |

17.100.2.4 FFLAS_C_DIAGenum [FFLAS_C_DIAG](#)

Is the triangular matrix implicitly unit diagonal ?

Enumerator

| | |
|--------------|---|
| FflasNonUnit | Triangular matrix has an explicit arbitrary diagonal. |
| FflasUnit | Triangular matrix has an implicit unit diagonal ($T_{i,i} = 1$) |
| FflasNonUnit | |
| FflasUnit | |

17.100.2.5 FFLAS_C_SIDEenum [FFLAS_C_SIDE](#)

On what side ?

Enumerator

| | |
|------------|---------------------------------|
| FflasLeft | Operator applied on the left. |
| FflasRight | Operator applied on the righth. |
| FflasLeft | |
| FflasRight | |

17.100.2.6 FFLAS_C_BASE

enum [FFLAS_C_BASE](#)

FFLAS_C_BASE determines the type of the element representation for Matrix Mult kernel.
(deprecated, should not be used)

Enumerator

| | |
|--------------|--|
| FflasDouble | to use the double precision BLAS |
| FflasFloat | to use the single precison BLAS |
| FflasGeneric | for any other domain, that can not be converted to floating point integers |

17.100.3 Function Documentation

17.100.3.1 freducein_1_modular_double()

```
void freducein_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.100.3.2 freduce_1_modular_double()

```
void freduce_1_modular_double (
    const double F,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive )
```

17.100.3.3 fnegin_1_modular_double()

```
void fnegin_1_modular_double (
    const double F,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.100.3.4 fneg_1_modular_double()

```
void fneg_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
```

```
double * X,  
const size_t incX,  
bool positive )
```

17.100.3.5 fzero_1_modular_double()

```
void fzero_1_modular_double (   
    const double p,  
    const size_t n,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.100.3.6 fiszero_1_modular_double()

```
bool fiszero_1_modular_double (   
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    bool positive )
```

17.100.3.7 fequal_1_modular_double()

```
bool fequal_1_modular_double (   
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    const double * Y,  
    const size_t incY,  
    bool positive )
```

17.100.3.8 fassign_1_modular_double()

```
void fassign_1_modular_double (   
    const double p,  
    const size_t n,  
    const double * Y,  
    const size_t incY,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.100.3.9 fscaln_1_modular_double()

```
void fscaln_1_modular_double (   
    const double p,  
    const size_t n,  
    const double alpha,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.100.3.10 fscal_1_modular_double()

```
void fscal_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive )
```

17.100.3.11 faxpy_1_modular_double()

```
void faxpy_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive )
```

17.100.3.12 fdot_1_modular_double()

```
double fdot_1_modular_double (
    const double p,
    const size_t n,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    bool positive )
```

17.100.3.13 fswap_1_modular_double()

```
void fswap_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive )
```

17.100.3.14 fadd_1_modular_double()

```
void fadd_1_modular_double (
    const double p,
    const size_t n,
    const double * A,
    const size_t incA,
    const double * B,
    const size_t incB,
```

```
double * C,  
const size_t incC,  
bool positive )
```

17.100.3.15 fsub_1_modular_double()

```
void fsub_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * A,  
    const size_t incA,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive )
```

17.100.3.16 faddin_1_modular_double()

```
void faddin_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive )
```

17.100.3.17 fsubin_1_modular_double()

```
void fsubin_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive )
```

17.100.3.18 fassign_2_modular_double()

```
void fassign_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.100.3.19 fzero_2_modular_double()

```
void fzero_2_modular_double (  

```

```
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t ldA,
    bool positive )
```

17.100.3.20 fequal_2_modular_double()

```
bool fequal_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    bool positive )
```

17.100.3.21 fiszero_2_modular_double()

```
bool fiszero_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t ldA,
    bool positive )
```

17.100.3.22 fidentity_2_modular_double()

```
void fidentity_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t ldA,
    const double d,
    bool positive )
```

17.100.3.23 freducein_2_modular_double()

```
void freducein_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t ldA,
    bool positive )
```

17.100.3.24 freduce_2_modular_double()

```
void freduce_2_modular_double (
    const double p,
```



```
const size_t m,  
const size_t n,  
const double * B,  
const size_t ldB,  
double * A,  
const size_t ldA,  
bool positive )
```

17.100.3.25 fnegin_2_modular_double()

```
void fnegin_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.100.3.26 fneg_2_modular_double()

```
void fneg_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.100.3.27 fscaln_2_modular_double()

```
void fscaln_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.100.3.28 fscal_2_modular_double()

```
void fscal_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.100.3.29 faxpy_2_modular_double()

```
void faxpy_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t ldX,
    double * Y,
    const size_t ldY,
    bool positive )
```

17.100.3.30 fmove_2_modular_double()

```
void fmove_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t ldA,
    double * B,
    const size_t ldB,
    bool positive )
```

17.100.3.31 fadd_2_modular_double()

```
void fadd_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive )
```

17.100.3.32 fsub_2_modular_double()

```
void fsub_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive )
```

17.100.3.33 fsubin_2_modular_double()

```
void fsubin_2_modular_double (
```

```
const double p,  
const size_t m,  
const size_t n,  
const double * B,  
const size_t ldB,  
double * C,  
const size_t ldC,  
bool positive )
```

17.100.3.34 faddin_2_modular_double()

```
void faddin_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * C,  
    const size_t ldC,  
    bool positive )
```

17.100.3.35 fgemv_2_modular_double()

```
double* fgemv_2_modular_double (  
    const double p,  
    const enum FFLAS_C_TRANSPOSE TransA,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    const double * X,  
    const size_t incX,  
    const double betA,  
    double * Y,  
    const size_t incY,  
    bool positive )
```

17.100.3.36 fger_2_modular_double()

```
void fger_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * x,  
    const size_t incX,  
    const double * y,  
    const size_t incY,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.100.3.37 ftrsv_2_modular_double()

```
void ftrsv_2_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_TRANSPOSE TransA,
    const enum FFLAS_C_DIAG Diag,
    const size_t n,
    const double * A,
    const size_t ldA,
    double * X,
    int incX,
    bool positive )
```

17.100.3.38 ftrsm_3_modular_double()

```
void ftrsm_3_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_TRANSPOSE TransA,
    const enum FFLAS_C_DIAG Diag,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    double * B,
    const size_t ldB,
    bool positive )
```

17.100.3.39 ftrmm_3_modular_double()

```
void ftrmm_3_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_TRANSPOSE TransA,
    const enum FFLAS_C_DIAG Diag,
    const size_t m,
    const size_t n,
    const double alpha,
    double * A,
    const size_t ldA,
    double * B,
    const size_t ldB,
    bool positive )
```

17.100.3.40 fgemm_3_modular_double()

```
double* fgemm_3_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE tA,
    const enum FFLAS_C_TRANSPOSE tB,
    const size_t m,
    const size_t n,
```

```

    const size_t k,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive )

```

17.100.3.41 fsquare_3_modular_double()

```

double* fsquare_3_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE tA,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive )

```

17.101 fflas_enum.h File Reference

```
#include <algorithm>
```

Data Structures

- class [AreEqual< X, Y >](#)
- class [AreEqual< X, X >](#)

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Enumerations

- enum [FFLAS_ORDER](#) { [FflasRowMajor](#) = 101 , [FflasColMajor](#) = 102 }
- Storage by row or col ?*
- enum [FFLAS_TRANSPOSE](#) { [FflasNoTrans](#) = 111 , [FflasTrans](#) = 112 }
- Is matrix transposed ?*
- enum [FFLAS_UPLO](#) { [FflasUpper](#) = 121 , [FflasLower](#) = 122 }
- Is triangular matrix's shape upper ?*
- enum [FFLAS_DIAG](#) { [FflasNonUnit](#) = 131 , [FflasUnit](#) = 132 }
- Is the triangular matrix implicitly unit diagonal ?*
- enum [FFLAS_SIDE](#) { [FflasLeft](#) = 141 , [FflasRight](#) = 142 }
- On what side ?*
- enum [FFLAS_BASE](#) { [FflasDouble](#) = 151 , [FflasFloat](#) = 152 , [FflasGeneric](#) = 153 }
- FFLAS_BASE determines the type of the element representation for Matrix Mult kernel.*

Functions

- `template<class T >`
`const T & min3 (const T &m, const T &n, const T &k)`
- `template<class T >`
`const T & max3 (const T &m, const T &n, const T &k)`
- `template<class T >`
`const T & min4 (const T &m, const T &n, const T &k, const T &l)`
- `template<class T >`
`const T & max4 (const T &m, const T &n, const T &k, const T &l)`

17.102 fflas_fadd.h File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas_fadd.inl"
```

Data Structures

- struct [support_simd_add< T >](#)

Namespaces

- [FFLAS](#)

Functions

- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void faddin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsub (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`

- `template<class Field >`
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fadd : matrix addition.
- `template<class Field >`
`void fsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fsub : matrix subtraction.
- `template<class Field >`
`void faddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
faddin
- `template<class Field >`
`void fsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fsubin $C = C - B$
- `template<class Field >`
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fadd : matrix addition with scaling.

17.103 fflas_fadd.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
```

Namespaces

- [FFLAS](#)
- [FFLAS::vectorised](#)
- [FFLAS::details](#)

Macros

- `#define __FFLASFFPACK_fadd_INL`

Functions

- `template<class SimdT , class Element , bool positive>`
`std::enable_if< is_simd< SimdT >::value, void >::type VEC_ADD (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)`
- `template<bool positive, class Element , class T1 , class T2 >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type addp (Element *T, const Element *TA, const Element *TB, size_t n, Element p, T1 min_, T2 max_)`
- `template<class SimdT , class Element , bool positive>`
`std::enable_if< is_simd< SimdT >::value, void >::type VEC_SUB (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)`
- `template<bool positive, class Element , class T1 , class T2 >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type subp (Element *T, const Element *TA, const Element *TB, const size_t n, const Element p, const T1 min_, const T2 max_)`
- `template<class Element >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type add (Element *T, const Element *TA, const Element *TB, size_t n)`

- `template<class Element >`
`std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type sub` (`Element *T`, `const Element *TA`, `const Element *TB`, `size_t n`)
- `template<class Field , bool ADD>`
`std::enable_if< FFLAS::support_simd_add< typename Field::Element >::value, void >::type fadd` (`const Field &F`, `const size_t N`, `typename Field::ConstElement_ptr A`, `const size_t inca`, `typename Field::ConstElement_ptr B`, `const size_t incb`, `typename Field::Element_ptr C`, `const size_t incc`, `Field`↵
`Categories::ModularTag`)
- `template<class Field , bool ADD>`
`std::enable_if<!FFLAS::support_simd_add< typename Field::Element >::value, void >::type fadd` (`const Field &F`, `const size_t N`, `typename Field::ConstElement_ptr A`, `const size_t inca`, `typename Field::ConstElement_ptr B`, `const size_t incb`, `typename Field::Element_ptr C`, `const size_t incc`, `Field`↵
`Categories::ModularTag`)
- `template<class Field , bool ADD>`
`void fadd` (`const Field &F`, `const size_t N`, `typename Field::ConstElement_ptr A`, `const size_t inca`, `typename Field::ConstElement_ptr B`, `const size_t incb`, `typename Field::Element_ptr C`, `const size_t incc`, `Field`↵
`Categories::GenericTag`)
- `template<class Field , bool ADD>`
`std::enable_if<!FFLAS::support_simd_add< typename Field::Element >::value, void >::type fadd` (`const Field &F`, `const size_t N`, `typename Field::ConstElement_ptr A`, `const size_t inca`, `typename Field::ConstElement_ptr B`, `const size_t incb`, `typename Field::Element_ptr C`, `const size_t incc`, `Field`↵
`Categories::UnparametricTag`)
- `template<class Field , bool ADD>`
`std::enable_if< FFLAS::support_simd_add< typename Field::Element >::value, void >::type fadd` (`const Field &F`, `const size_t N`, `typename Field::ConstElement_ptr A`, `const size_t inca`, `typename Field::ConstElement_ptr B`, `const size_t incb`, `typename Field::Element_ptr C`, `const size_t incc`, `Field`↵
`Categories::UnparametricTag`)

17.103.1 Macro Definition Documentation

17.103.1.1 __FFLASFFPACK_fadd_INL

```
#define __FFLASFFPACK_fadd_INL
```

17.104 fflas_fassign.h File Reference

```
#include "fflas_fassign.inl"
```

17.105 fflas_fassign.inl File Reference

```
#include <string.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <givaro/zring.h>
#include "fflas-ffpack/utils/debug.h"
```

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fassign_INL`

Functions

- `template<class Field >`
`void fassign (const Field &F, const size_t N, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`

$$fassign : x \leftarrow y.$$
- `template<> void fassign (const Givaro::Modular< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::Modular< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<class Field >`
`void fassign (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`

$$fassign : A \leftarrow B.$$

17.105.1 Macro Definition Documentation

17.105.1.1 __FFLASFFPACK_fassign_INL

```
#define __FFLASFFPACK_fassign_INL
```

17.106 fflas_faxpy.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_faxpy_INL`

Functions

- `template<class Field >`
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<> void faxpy (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::ConstElement a, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void faxpy (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<class Field >`
`void faxpy (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t ldx, typename Field::Element_ptr Y, const size_t ldy)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$

17.106.1 Macro Definition Documentation

17.106.1.1 __FFLASFFPACK_faxpy_INL

```
#define __FFLASFFPACK_faxpy_INL
```

17.107 fflas_fdot.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_helpers.inl"
```

Namespaces

- [FFLAS](#)

Macros

- `#define` [__FFLASFFPACK_fdot_INL](#)

Functions

- `template<class Field >`
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultTag &MT)
- `template<class Field >`
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DelayedTag &MT)
- `template<>` [Givaro::DoubleDomain::Element](#) [fdot](#) (const [Givaro::DoubleDomain](#) &, const size_t N, [Givaro::DoubleDomain::ConstElement_ptr](#) x, const size_t incx, [Givaro::DoubleDomain::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultTag &MT)
- `template<>` [Givaro::FloatDomain::Element](#) [fdot](#) (const [Givaro::FloatDomain](#) &, const size_t N, [Givaro::FloatDomain::ConstElement_ptr](#) x, const size_t incx, [Givaro::FloatDomain::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultTag &MT)
- `template<class Field, class T >`
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::ConvertTo< T > &MT)
- `template<class Field >`
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultBoundedTag &dbt)
- `template<class Field >`
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, const [ParSeqHelper::Sequential](#) seq)
- `template<class Field >`
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY)
fdot: dot product $x^T y$.

17.107.1 Macro Definition Documentation

17.107.1.1 __FFLASFFPACK_fdot_INL

```
#define __FFLASFFPACK_fdot_INL
```

17.108 fflas_fgemm.inl File Reference

```
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/debug.h"
#include "fflas_fgemm/fgemm_classical.inl"
#include "fflas_fgemm/fgemm_winograd.inl"
```

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Macros

- [#define __FFLASFFPACK_fgemm_INL](#)

Functions

- [template<class NewField , class Field , class FieldMode >](#)
[Field::Element_ptr fgemm_convert](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode > &H)
- [template<class Field , class Element , class AlgoT , class ParSeqTrait >](#)
[bool NeedPreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)
- [template<class Field , class Element , class AlgoT , class ModeT , class ParSeqTrait >](#)
[bool NeedPreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- [template<class Field , class Element , class AlgoT , class ParSeqTrait >](#)
[bool NeedPreSubReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)
- [template<class Field , class Element , class AlgoT , class ModeT , class ParSeqTrait >](#)
[bool NeedPreSubReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- [template<class Field , class Element , class AlgoT , class ParSeqTrait >](#)
[bool NeedDoublePreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)
- [template<class Field , class Element , class AlgoT , class ModeT , class ParSeqTrait >](#)
[bool NeedDoublePreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- [template<class Field , class AlgoT , class ParSeqTrait >](#)
[void ScalAndReduce](#) (const [Field](#) &F, const size_t N, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) X, const size_t incX, const MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)
- [template<class Field , class AlgoT , class ParSeqTrait >](#)
[void ScalAndReduce](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, const MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)

- `template<class Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `ModeCategories::ConvertTo`< `ElementCategories::MachineFloatTag` >, `ParSeqHelper::Sequential` > &H)
- `template<typename Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Sequential` seq)
- `template<typename Field , class Cut , class Param >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Parallel`< `Cut`, `Param` > par)
- `template<typename Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc)
fgemm: Field GENERAL Matrix Multiply.
- `template<typename Field , class ModeT , class ParSeq >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Auto`, `ModeT`, `ParSeq` > &H)
- `template<class Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `ModeCategories::DelayedTag`, `ParSeqHelper::Sequential` > &H)
- `template<class Field >`
`Field::Element_ptr fsquare` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc)
fsquare: Squares a matrix.
- `template<class Field >`
`Field::Element_ptr fsquareCommon` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc)
- `template<> double * fsquare` (const `Givaro::ModularBalanced`< `double` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `double` alpha, const `double` *A, const `size_t` lda, const `double` beta, `double` *C, const `size_t` ldc)
- `template<> float * fsquare` (const `Givaro::ModularBalanced`< `float` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `float` alpha, const `float` *A, const `size_t` lda, const `float` beta, `float` *C, const `size_t` ldc)
- `template<> double * fsquare` (const `Givaro::Modular`< `double` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `double` alpha, const `double` *A, const `size_t` lda, const `double` beta, `double` *C, const `size_t` ldc)
- `template<> float * fsquare` (const `Givaro::Modular`< `float` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `float` alpha, const `float` *A, const `size_t` lda, const `float` beta, `float` *C, const `size_t` ldc)

17.108.1 Macro Definition Documentation

17.108.1.1 __FFLASFFPACK_fgemm_INL

```
#define __FFLASFFPACK_fgemm_INL
```

17.109 fflas_fgemv.inl File Reference

```
#include <givaro/zring.h>
```

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Macros

- [#define __FFLASFFPACK_fgemv_INL](#)

Functions

- [template<typename FloatElement , class Field >](#)
[Field::Element_ptr fgemv_convert](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY)
- [template<class Field >](#)
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), MMHelperAlgo::Classic, ModeCategories::↵ ConvertTo< ElementCategories::MachineFloatTag > > &H)
- [template<class Field >](#)
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), MMHelperAlgo::Classic, ModeCategories::↵ DelayedTag > &H)
- [template<class Field >](#)
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), MMHelperAlgo::Classic, ModeCategories::↵ DefaultTag > &H)
- [template<class Field >](#)
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), MMHelperAlgo::Classic, ModeCategories::↵ LazyTag > &H)
- [template<class Field >](#)
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE TransA, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY)

finite prime Field GEneral Matrix Vector multiplication.

- `Givaro::ZRing< int64_t >::Element_ptr fgemv` (const `Givaro::ZRing< int64_t > &F`, const `FFLAS_TRANSPOSE ta`, const `size_t M`, const `size_t N`, const `int64_t alpha`, const `int64_t *A`, const `size_t lda`, const `int64_t *X`, const `size_t incX`, const `int64_t beta`, `int64_t *Y`, const `size_t incY`, `MMHelper< Givaro::ZRing< int64_t >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H`)
- `Givaro::DoubleDomain::Element_ptr fgemv` (const `Givaro::DoubleDomain &F`, const `FFLAS_TRANSPOSE ta`, const `size_t M`, const `size_t N`, const `Givaro::DoubleDomain::Element alpha`, const `Givaro::DoubleDomain::ConstElement_ptr A`, const `size_t lda`, const `Givaro::DoubleDomain::ConstElement_ptr X`, const `size_t incX`, const `Givaro::DoubleDomain::Element beta`, `Givaro::DoubleDomain::Element_ptr Y`, const `size_t incY`, `MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H`)
- `template<class Field >`
`Field::Element_ptr fgemv` (const `Field &F`, const `FFLAS_TRANSPOSE ta`, const `size_t M`, const `size_t N`, const `typename Field::Element alpha`, const `typename Field::ConstElement_ptr A`, const `size_t lda`, const `typename Field::ConstElement_ptr X`, const `size_t incX`, const `typename Field::Element beta`, `typename Field::Element_ptr Y`, const `size_t incY`, `MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H`)
- `Givaro::FloatDomain::Element_ptr fgemv` (const `Givaro::FloatDomain &F`, const `FFLAS_TRANSPOSE ta`, const `size_t M`, const `size_t N`, const `Givaro::FloatDomain::Element alpha`, const `Givaro::FloatDomain::ConstElement_ptr A`, const `size_t lda`, const `Givaro::FloatDomain::ConstElement_ptr X`, const `size_t incX`, const `Givaro::FloatDomain::Element beta`, `Givaro::FloatDomain::Element_ptr Y`, const `size_t incY`, `MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H`)
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr fgemv` (const `Field &F`, const `FFLAS_TRANSPOSE ta`, const `size_t m`, const `size_t n`, const `typename Field::Element alpha`, const `typename Field::ConstElement_ptr A`, const `size_t lda`, const `typename Field::ConstElement_ptr X`, const `size_t incX`, const `typename Field::Element beta`, `typename Field::Element_ptr Y`, const `size_t incY`, `ParSeqHelper::Parallel< Cut, Param > &parH`)
- `template<class Field >`
`Field::Element_ptr fgemv` (const `Field &F`, const `FFLAS_TRANSPOSE ta`, const `size_t m`, const `size_t n`, const `typename Field::Element alpha`, const `typename Field::ConstElement_ptr A`, const `size_t lda`, const `typename Field::ConstElement_ptr X`, const `size_t incX`, const `typename Field::Element beta`, `typename Field::Element_ptr Y`, const `size_t incY`, `ParSeqHelper::Sequential &seqH`)

17.109.1 Macro Definition Documentation

17.109.1.1 __FFLASFFPACK_fgemv_INL

```
#define __FFLASFFPACK_fgemv_INL
```

17.110 fflas_fgemv_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
```

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fgemv_mp_INL`

Functions

- `FFPACK::rns_double::Element_ptr fgemv` (const `FFPACK::RNSInteger< FFPACK::rns_double > &F`, const `FFLAS_TRANSPOSE ta`, const `size_t M`, const `size_t N`, const `FFPACK::rns_double::Element alpha`,

- [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, MMHelper< [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- [FFPACK::rns_double::Element_ptr](#) fgemv (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, MMHelper< [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
 - Givaro::Integer * [fgemv](#) (const Givaro::ZRing< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const Givaro::Integer alpha, Givaro::Integer *A, const size_t lda, Givaro::Integer *X, const size_t ldx, Givaro::Integer beta, Givaro::Integer *Y, const size_t ldy, MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
 - Givaro::Integer * [fgemv](#) (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const Givaro::Integer alpha, Givaro::Integer *A, const size_t lda, Givaro::Integer *X, const size_t ldx, Givaro::Integer beta, Givaro::Integer *Y, const size_t ldy, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
 - template<size_t K1, size_t K2, class ParSeq >
[RecInt::ruint](#)< K1 > * [fgemv](#) (const Givaro::Modular< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > > &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const [RecInt::ruint](#)< K1 > alpha, const [RecInt::ruint](#)< K1 > *A, const size_t lda, const [RecInt::ruint](#)< K1 > *X, const size_t incx, [RecInt::ruint](#)< K1 > beta, [RecInt::ruint](#)< K1 > *Y, const size_t incy, MMHelper< Givaro::Modular< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)

17.110.1 Macro Definition Documentation

17.110.1.1 __FFLASFFPACK_fgemv_mp_INL

```
#define __FFLASFFPACK_fgemv_mp_INL
```

17.111 fflas_fger.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Macros

- #define [__FFLASFFPACK_fger_INL](#)

Functions

- template<class Field >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda)
fger: rank one update of a general matrix
- template<class FloatElement, class Field >
void [fger_convert](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda)

- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > > &H)`
- `template<class Field, class AnyTag >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, AnyTag > &H)`
- `void fger (const Givaro::DoubleDomain &F, const size_t M, const size_t N, const Givaro::DoubleDomain::Element alpha, const Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, const Givaro::DoubleDomain::ConstElement_ptr y, const size_t incy, Givaro::DoubleDomain::Element_ptr A, const size_t lda, MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, const typename Field::ConstElement_ptr x, const size_t incx, const typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H)`
- `void fger (const Givaro::FloatDomain &F, const size_t M, const size_t N, const Givaro::FloatDomain::Element alpha, const Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, const Givaro::FloatDomain::ConstElement_ptr y, const size_t incy, Givaro::FloatDomain::Element_ptr A, const size_t lda, MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)`
- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)`

17.111.1 Macro Definition Documentation

17.111.1.1 __FFLASFFPACK_fger_INL

```
#define __FFLASFFPACK_fger_INL
```

17.112 fflas_fger_mp.inl File Reference

```
#include <givaro/modular-integer.h>
#include <givaro/zring.h>
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas-ffpack/fflas/fflas_fgemm/fgemm_classical_mp.inl"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/field/rns-integer-mod.h"
```

Namespaces

- [FFLAS](#)

Macros

- `#define __FFPACK_fger_mp_INL`

Functions

- void [fger](#) (const Givaro::Modular< Givaro::Integer > &F, const size_t M, const size_t N, const typename Givaro::Integer alpha, typename Givaro::Integer *x, const size_t incx, typename Givaro::Integer *y, const size_t incy, typename Givaro::Integer *A, const size_t lda, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
- template<typename RNS >
void [fger](#) (const [FFPACK::RNSInteger](#)< [RNS](#) > &F, const size_t M, const size_t N, const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element alpha, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr x, const size_t incx, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr y, const size_t incy, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr A, const size_t lda, MMHelper< [FFPACK::RNSInteger](#)< [RNS](#) >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<typename RNS >
void [fger](#) (const [FFPACK::RNSIntegerMod](#)< [RNS](#) > &F, const size_t M, const size_t N, const typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element alpha, typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element_ptr x, const size_t incx, typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element_ptr y, const size_t incy, typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element_ptr A, const size_t lda, MMHelper< [FFPACK::RNSIntegerMod](#)< [RNS](#) >, MMHelperAlgo::Classic > &H)

17.112.1 Macro Definition Documentation

17.112.1.1 __FFPACK_fger_mp_INL

```
#define __FFPACK_fger_mp_INL
```

17.113 fflas_freduce.h File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/utils/cast.h"
#include "fflas-ffpack/fflas/fflas_freduce.inl"
```

Data Structures

- struct [support_simd_mod](#)< T >
- struct [support_fast_mod](#)< T >
- struct [support_fast_mod](#)< float >
- struct [support_fast_mod](#)< double >
- struct [support_fast_mod](#)< int64_t >

Namespaces

- [FFLAS](#)

Functions

- template<class Field >
void [freduce](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) Y, const size_t incY, typename [Field::Element_ptr](#) X, const size_t incX)
$$\text{freduce } x \leftarrow y \bmod F.$$
- template<class Field >
void [freduce](#) (const [Field](#) &F, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)
$$\text{freduce } x \leftarrow x \bmod F.$$

- `template<class Field >`
`void freduce_constoverride (const Field &F, const size_t m, typename Field::ConstElement_ptr A, const size_t incX)`
- `template<class Field, class ConstOtherElement_ptr >`
`void finit (const Field &F, const size_t n, ConstOtherElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`
- `template<class Field >`
`void finit (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`
fini initializes X in F .
- `template<class Field >`
`void freduce (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)`
freduce $A \leftarrow A \bmod F$.
- `template<class Field >`
`void pfreduce (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda, const size_t numths)`
- `template<class Field >`
`void freduce (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`
freduce $A \leftarrow B \bmod F$.
- `template<class Field >`
`void freduce_constoverride (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda)`
- `template<class Field, class OtherElement_ptr >`
`void finit (const Field &F, const size_t m, const size_t n, const OtherElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`
fini $A \leftarrow B \bmod F$.
- `template<class Field >`
`void finit (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)`
fini initializes A in F .

17.114 fflas_freduce.inl File Reference

```
#include <givaro/udl.h>
#include "fflas-ffpack/fflas/fflas_fassign.h"
```

Data Structures

- struct [HelperMod< Field, ElementCategories::MachineIntTag >](#)
- struct [HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >](#)
- struct [HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >](#)
- struct [HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >](#)

Namespaces

- [FFLAS](#)
- [FFLAS::vectorised](#)
- [FFLAS::vectorised::unswitch](#)
- [FFLAS::details](#)

Macros

- `#define __FFLASFFPACK_fflas_freduce_INL`
- `#define FFLASFFPACK_COPY_REDUCE 32 /* TODO TO BENCHMARK LATER */`

Functions

- `template<class T >`
`std::enable_if< ! std::is_integral< T >::value, T >::type` `reduce` (T A, T B)
- `template<class T >`
`std::enable_if< std::is_integral< T >::value, T >::type` `reduce` (T A, T B)
- `template<>` `Givaro::Integer` `reduce` (Givaro::Integer A, Givaro::Integer B)
- `float` `reduce` (float A, float B, float invB, float min, float max)
- `double` `reduce` (double A, double B, double invB, double min, double max)
- `int64_t` `reduce` (`int64_t` A, `int64_t` p, double invp, double min, double max, `int64_t` pow50rem)
- `template<class Field >`
`Field::Element` `reduce` (typename `Field::Element` A, HelperMod< `Field`, ElementCategories::MachineIntTag > &H)
- `template<class Field >`
`Field::Element` `reduce` (typename `Field::Element` A, HelperMod< `Field`, ElementCategories::MachineFloatTag > &H)
- `template<class Field >`
`Field::Element` `reduce` (typename `Field::Element` A, HelperMod< `Field`, ElementCategories::ArbitraryPrecIntTag > &H)
- `template<class Field >`
`std::enable_if< ! FFLAS::support_simd_mod< typename Field::Element >::value && FFLAS::support_fast_mod< typename Field::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const `size_t` &n, typename `Field::Element_ptr` T, HelperMod< `Field` > &H)
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const `size_t` &n, const `size_t` &incX, typename `Field::Element_ptr` T, HelperMod< `Field` > &H)
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const `size_t` &n, const `size_t` &incX, typename `Field::Element_ptr` T)
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type` `modp` (const `Field` &F, typename `Field::ConstElement_ptr` U, const `size_t` &n, const `size_t` &incX, typename `Field::Element_ptr` T)
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type` `freduce` (const `Field` &F, const `size_t` m, typename `Field::Element_ptr` A, const `size_t` incX, FieldCategories::ModularTag)
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type` `freduce` (const `Field` &F, const `size_t` m, typename `Field::ConstElement_ptr` B, const `size_t` incY, typename `Field::Element_ptr` A, const `size_t` incX, FieldCategories::ModularTag)
- `template<class Field, class FC >`
`void` `freduce` (const `Field` &F, const `size_t` m, typename `Field::Element_ptr` A, const `size_t` incX, FC)
- `template<class Field, class FC >`
`void` `freduce` (const `Field` &F, const `size_t` m, typename `Field::ConstElement_ptr` B, const `size_t` incY, typename `Field::Element_ptr` A, const `size_t` incX, FC)

17.114.1 Macro Definition Documentation

17.114.1.1 __FFLASFFPACK_fflas_freduce_INL

```
#define __FFLASFFPACK_fflas_freduce_INL
```

17.114.1.2 FFLASFFPACK_COPY_REDUCE

```
#define FFLASFFPACK_COPY_REDUCE 32 /* TODO TO BENCHMARK LATER */
```

17.115 fflas_freduce_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
```

Namespaces

- [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_freduce_mp_INL](#)

Functions

- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t n, [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >::Element_ptr A, size_t inc)
- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t m, const size_t n, [FFPACK::rns_double::Element_ptr](#) A, size_t lda)

17.115.1 Macro Definition Documentation

17.115.1.1 __FFLASFFPACK_fflas_freduce_mp_INL

```
#define __FFLASFFPACK_fflas_freduce_mp_INL
```

17.116 fflas_freivalds.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- #define [__FFLASFFPACK_freivalds_INL](#)

Functions

- template<class Field >
bool [freivalds](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::ConstElement_ptr](#) C, const size_t ldc)

*freivalds: Freivalds **GE**neral **M**atrix **M**ultiply **R**andom **C**heck.*

17.116.1 Macro Definition Documentation

17.116.1.1 __FFLASFFPACK_freivalds_INL

```
#define __FFLASFFPACK_freivalds_INL
```

17.117 fflas_fscal.h File Reference

```
#include "fflas_fscal.inl"
```

17.118 fflas_fscal.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::vectorised](#)
- [FFLAS::vectorised::unswitch](#)
- [FFLAS::details](#)

Macros

- `#define __FFLASFFPACK_fscal_INL`

Functions

- `template<class Field >`
`std::enable_if<!FFLAS::support_simd_mod< typename Field::Element >::value &&FFLAS::support_fast_mod<`
`typename Field::Element >::value, void >::type scalp (const Field &F, typename Field::Element_ptr T, const`
`typename Field::Element alpha, typename Field::ConstElement_ptr U, const size_t n, HelperMod< Field >`
`&H)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type scalp`
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr U, const size_t n, const size_t &incX, HelperMod< Field > &H)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type scalp`
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr U, const size_t n)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type scalp`
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr U, const size_t n, const size_t &incX)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type fscaln (const`
`Field &F, const size_t N, const typename Field::Element a, typename Field::Element_ptr X, const size_t incX,`
`FieldCategories::ModularTag)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typename Field::Element >::value, void >::type fscal (const`
`Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr X, const size_t`
`incX, typename Field::Element_ptr Y, const size_t incY, FieldCategories::ModularTag)`
- `template<class Field, class FC >`
`void fscaln (const Field &F, const size_t n, const typename Field::Element a, typename Field::Element_ptr X,`
`const size_t incX, FC)`
- `template<class Field, class FC >`
`void fscal (const Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr`
`X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, FC)`
- `template<class Field >`
`void fscaln (const Field &F, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr`
`X, const size_t incX)`

$$fscaln\ x \leftarrow \alpha \cdot x.$$

- `template<class Field >`
`void fscal (const Field &F, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`

$$fscal\ y \leftarrow \alpha \cdot x.$$
- `template<> void fscal (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void fscal (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<> void fscaln (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void fscaln (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<class Field >`
`void fscaln (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda)`

$$fscaln\ A \leftarrow a \cdot A.$$
- `template<class Field >`
`void fscal (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`

$$fscal\ B \leftarrow a \cdot A.$$

17.118.1 Macro Definition Documentation

17.118.1.1 __FFLASFFPACK_fscal_INL

```
#define __FFLASFFPACK_fscal_INL
```

17.119 fflas_fscal_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas_fscal.h"
#include "fflas_fgemm.inl"
#include "fflas-ffpack/fflas/fflas_freduce_mp.inl"
```

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fscal_mp_INL`

Functions

- `template<> void fscaln (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t inc)`
- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`

- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha, typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A, const size_t inc)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`

17.119.1 Macro Definition Documentation

17.119.1.1 __FFLASFFPACK_fscal_mp_INL

```
#define __FFLASFFPACK_fscal_mp_INL
```

17.120 fflas_fsyr2k.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_fsyr2k_INL`

Functions

- `template<class Field > Field::Element_ptr fsyr2k (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`

fsyr2k: Symmetric Rank 2K update

17.120.1 Macro Definition Documentation

17.120.1.1 __FFLASFFPACK_fflas_fsyr2k_INL

```
#define __FFLASFFPACK_fflas_fsyr2k_INL
```

17.121 fflas_fsyrk.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_fsyk_INL`

Functions

- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc)
fsyrk: Symmetric Rank K update
- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` D, const `size_t` incD, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `size_t` threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling
- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` D, const `size_t` incD, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Sequential` seq, const `size_t` threshold)
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` N, const `size_t` K, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` D, const `size_t` incD, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Parallel`< Cut, Param > par, const `size_t` threshold)
- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const `FFLAS_UPLO` UpLo, const `FFLAS_TRANSPOSE` trans, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` D, const `size_t` incD, const `std::vector< bool >` &two←Block, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `size_t` threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling

17.121.1 Macro Definition Documentation

17.121.1.1 __FFLASFFPACK_fflas_fsyk_INL

```
#define __FFLASFFPACK_fflas_fsyk_INL
```

17.122 fflas_ftrmm.inl File Reference

Namespaces

- `FFLAS`

Macros

- `#define __FFLASFFPACK_ftrmm_INL`

Functions

- `template<class Field >`
`void ftrmm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`
*ftrmm: **TR**angular **M**atrix **M**ultiply.*
- `template<class Field >`
`void ftrmm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
*ftrmm: **TR**angular **M**atrix **M**ultiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$ or $C \leftarrow \alpha B \text{op}(A) + \text{beta}C$.*

17.122.1 Macro Definition Documentation

17.122.1.1 __FFLASFFPACK_ftrmm_INL

```
#define __FFLASFFPACK_ftrmm_INL
```

17.123 fflas_ftrsm.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_ftrsm_INL`

Functions

- `template<class Field >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Sequential &PSH)`
- `template<class Field , class Cut , class Param >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Parallel< Cut, Param > &PSH)`
- `template<class Field , class ParSeqTrait = ParSeqHelper::Sequential>`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Recursive, ParSeqTrait > &H)`

17.123.1 Macro Definition Documentation

17.123.1.1 __FFLASFFPACK_ftrsm_INL

```
#define __FFLASFFPACK_ftrsm_INL
```

17.124 fflas_ftrsm_mp.inl File Reference

triangular system with matrix right hand side over multiprecision domain (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)

```
#include <cmath>
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include "fflas-ffpack/fflas/fflas_bounds.inl"
#include "fflas-ffpack/fflas/fflas_level3.inl"
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
```

Namespaces

- [FFLAS](#)

Macros

- `#define __FFPACK_ftrsm_mp_INL`

Functions

- void [ftrsm](#) (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, Givaro::Integer *B, const size_t ldb)
- void [cblas_imptrsm](#) (const enum FFLAS_ORDER Order, const enum FFLAS_SIDE Side, const enum FFLAS_UPLO Uplo, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_DIAG Diag, const int M, const int N, const [FFPACK::rns_double_elt](#) alpha, [FFPACK::rns_double_elt_cstptr](#) A, const int lda, [FFPACK::rns_double_elt_ptr](#) B, const int ldb)

17.124.1 Detailed Description

triangular system with matrix right hand side over multiprecision domain (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)

17.124.2 Macro Definition Documentation

17.124.2.1 __FFPACK_ftrsm_mp_INL

```
#define __FFPACK_ftrsm_mp_INL
```

17.125 fflas_ftrsv.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_ftrsv_INL`

Functions

- template<class Field >
void [ftrsv](#) (const [Field](#) &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, int incX)

ftrsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

17.125.1 Macro Definition Documentation

17.125.1.1 __FFLASFFPACK_ftrsv_INL

```
#define __FFLASFFPACK_ftrsv_INL
```

17.126 fflas_helpers.inl File Reference

```
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/utils/flimits.h"
#include <algorithm>
```

Data Structures

- struct [Auto](#)
 - struct [Classic](#)
 - struct [Winograd](#)
 - struct [WinogradPar](#)
 - struct [Bini](#)
 - struct [AlgoChooser](#)< [ModeT](#), [ParSeq](#) >
 - struct [AlgoChooser](#)< [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeq](#) >
 - struct [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::DefaultTag](#), [ParSeqTrait](#) >
- FGEMM Helper for Default and ConvertTo modes of operation.*
- struct [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::ConvertTo](#)< [Dest](#) >, [ParSeqTrait](#) >
 - struct [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeTrait](#), [ParSeqTrait](#) >
 - struct [Recursive](#)
 - struct [Iterative](#)
 - struct [Hybrid](#)
 - struct [TRSMHelper](#)< [ReclterTrait](#), [ParSeqTrait](#) >

TRSM Helper.

Namespaces

- [FFLAS](#)
 - [FFLAS::Protected](#)
 - [FFLAS::MMHelperAlgo](#)
 - [FFLAS::StructureHelper](#)
- StructureHelper for ftrsm.*

Macros

- #define [__FFLASFFPACK_fflas_fflas_mmhelper_INL](#)

Functions

- `template<class Field >`
`int WinogradSteps (const Field &F, const size_t &m)`
Computes the number of recursive levels to perform.
- `template<class DFE >`
`size_t min_types (const DFE &k)`
- `template<> size_t min_types (const RecInt::rint< 6 > &k)`
- `template<> size_t min_types (const RecInt::rint< 7 > &k)`
- `template<> size_t min_types (const RecInt::rint< 8 > &k)`
- `template<> size_t min_types (const RecInt::rint< 9 > &k)`
- `template<> size_t min_types (const RecInt::rint< 10 > &k)`
- `template<> size_t min_types (const Givaro::Integer &k)`
- `template<class T >`
`bool unfit (T x)`
- `template<> bool unfit (int64_t x)`
- `template<size_t K>`
`bool unfit (RecInt::rint< K > x)`
- `template<> bool unfit (RecInt::rint< 6 > x)`

17.126.1 Macro Definition Documentation

17.126.1.1 __FFLASFFPACK_fflas_fflas_mmhelper_INL

```
#define __FFLASFFPACK_fflas_fflas_mmhelper_INL
```

17.127 fflas_intrinsic.h File Reference

17.128 fflas_io.h File Reference

```
#include <cstring>
#include <stdio.h>
#include <stdlib.h>
#include <fstream>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas_memory.h"
```

Namespaces

- [FFLAS](#)

Enumerations

- `enum FFLAS_FORMAT {`
`FflasAuto = 0 , FflasDense = 1 , FflasSMS = 2 , FflasBinary = 3 ,`
`FflasMath = 4 , FflasMaple = 5 , FflasSageMath = 6 }`

Functions

- `template<class Field >`
`std::ostream & WriteMatrix (std::ostream &c, const Field &F, size_t m, size_t n, typename Field::ConstElement_ptr A, size_t lda, FFLAS_FORMAT format, bool column_major)`
WriteMatrix: write a matrix to an output stream.

- void [preamble](#) (std::ifstream &ifs, FFLAS_FORMAT &format)
- template<class Field >
[Field::Element_ptr ReadMatrix](#) (std::ifstream &ifs, [Field](#) &F, size_t &m, size_t &n, typename [Field::Element_ptr](#) &A, FFLAS_FORMAT format=FFlasAuto)
ReadMatrix: read a matrix from an input stream.
- template<class Field >
[Field::Element_ptr ReadMatrix](#) (const std::string &matrix_file, [Field](#) &F, size_t &m, size_t &n, typename [Field::Element_ptr](#) &A, FFLAS_FORMAT format=FFlasAuto)
ReadMatrix: read a matrix from a file.
- template<class Field >
void [WriteMatrix](#) (std::string &matrix_file, const [Field](#) &F, int m, int n, typename [Field::ConstElement_ptr](#) A, size_t lda, FFLAS_FORMAT format=FFlasDense, bool column_major=false)
WriteMatrix: write a matrix to a file.
- std::ostream & [WritePermutation](#) (std::ostream &c, const size_t *P, size_t N)
WritePermutation: write a permutation matrix to an output stream.

17.129 fflas_L1_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L1_inst_implem.inl"
```

Macros

- #define [__FFLAS_L1_INST_C](#)
- #define [INST_OR_DECL](#)
- #define [FFLAS_FIELD](#) [Givaro::ModularBalanced](#)
- #define [FFLAS_ELT](#) double
- #define [FFLAS_ELT](#) float
- #define [FFLAS_ELT](#) int64_t
- #define [FFLAS_FIELD](#) [Givaro::Modular](#)
- #define [FFLAS_ELT](#) double
- #define [FFLAS_ELT](#) float
- #define [FFLAS_ELT](#) int64_t

17.129.1 Macro Definition Documentation

17.129.1.1 [__FFLAS_L1_INST_C](#)

```
#define \_\_FFLAS\_L1\_INST\_C
```

17.129.1.2 [INST_OR_DECL](#)

```
#define INST\_OR\_DECL
```

17.129.1.3 [FFLAS_FIELD](#) [1/2]

```
#define FFLAS\_FIELD Givaro::ModularBalanced
```

17.129.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.129.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.129.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.129.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.129.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.129.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.129.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.130 fflas_L1_inst.h File Reference

```
#include "givaro/modular.h"  
#include "givaro/modular-balanced.h"  
#include "fflas-ffpack/fflas/fflas.h"  
#include "fflas-ffpack/fflas/fflas_helpers.inl"  
#include "fflas_L1_inst_implem.inl"
```

Macros

- `#define INST_OR_DECL <>`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.130.1 Macro Definition Documentation

17.130.1.1 INST_OR_DECL

```
#define INST_OR_DECL <>
```

17.130.1.2 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.130.1.3 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.130.1.4 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.130.1.5 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.130.1.6 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.130.1.7 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.130.1.8 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.130.1.9 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.131 fflas_L1_inst_implem.inl File Reference**Namespaces**

- [FFLAS](#)

Functions

- template [INST_OR_DECL](#) void [freduce](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, [FFLAS_ELT](#) *X, const size_t incX)

$$\text{freduce } x \leftarrow x \bmod F.$$
- template [INST_OR_DECL](#) void [freduce](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, const [FFLAS_ELT](#) *Y, const size_t incY, [FFLAS_ELT](#) *X, const size_t incX)

$$\text{freduce } x \leftarrow y \bmod F.$$

- template `INST_OR_DECL` void `finit` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` *Y, const `size_t` incY, `FFLAS_ELT` *X, const `size_t` incX)

$$\text{finit } x \leftarrow y \bmod F.$$
- template `INST_OR_DECL` void `fconvert` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, `FFLAS_ELT` *X, const `size_t` incX, const `FFLAS_ELT` *Y, const `size_t` incY)

$$\text{fconvert } x \leftarrow y \bmod F.$$
- template `INST_OR_DECL` void `fnegin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, `FFLAS_ELT` *X, const `size_t` incX)

$$\text{fnegin } x \leftarrow -x.$$
- template `INST_OR_DECL` void `fneg` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` *Y, const `size_t` incY, `FFLAS_ELT` *X, const `size_t` incX)

$$\text{fneg } x \leftarrow -y.$$
- template `INST_OR_DECL` void `fzero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, `FFLAS_ELT` *X, const `size_t` incX)

$$\text{fzero} : A \leftarrow 0.$$
- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` *X, const `size_t` incX)

$$\text{fiszero} : \text{test } X = 0.$$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` *X, const `size_t` incX, const `FFLAS_ELT` *Y, const `size_t` incY)

$$\text{fequal} : \text{test } X = Y.$$
- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` *Y, const `size_t` incY, `FFLAS_ELT` *X, const `size_t` incX)

$$\text{fassign} : x \leftarrow y.$$
- template `INST_OR_DECL` void `fscaln` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` alpha, `FFLAS_ELT` *X, const `size_t` incX)

$$\text{fscaln } x \leftarrow \alpha \cdot x.$$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const `size_t` incX, `FFLAS_ELT` *Y, const `size_t` incY)

$$\text{fscal } y \leftarrow \alpha \cdot x.$$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const `size_t` incX, `FFLAS_ELT` *Y, const `size_t` incY)

$$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$$
- template `INST_OR_DECL` `FFLAS_ELT` `fdot` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` *X, const `size_t` incX, const `FFLAS_ELT` *Y, const `size_t` incY)

$$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- template `INST_OR_DECL` void `fswap` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, `FFLAS_ELT` *X, const `size_t` incX, `FFLAS_ELT` *Y, const `size_t` incY)

$$\text{fswap} : X \leftrightarrow Y.$$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` inca, const `FFLAS_ELT` *B, const `size_t` incb, `FFLAS_ELT` *C, const `size_t` incc)
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` inca, const `FFLAS_ELT` *B, const `size_t` incb, `FFLAS_ELT` *C, const `size_t` incc)
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` *B, const `size_t` incb, `FFLAS_ELT` *C, const `size_t` incc)
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` inca, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const `size_t` incb, `FFLAS_ELT` *C, const `size_t` incc)

17.132 fflas_L2_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L2_inst_implem.inl"
```

Macros

- `#define __FFLAS_L2_INST_C`
- `#define INST_OR_DECL`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.132.1 Macro Definition Documentation

17.132.1.1 __FFLAS_L2_INST_C

```
#define __FFLAS_L2_INST_C
```

17.132.1.2 INST_OR_DECL

```
#define INST_OR_DECL
```

17.132.1.3 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.132.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.132.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.132.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.132.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.132.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.132.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.132.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.133 fflas_L2_inst.h File Reference

```
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L2_inst_implem.inl"
```

Macros

- #define [INST_OR_DECL](#) <>
- #define [FFLAS_FIELD](#) Givaro::ModularBalanced
- #define [FFLAS_ELT](#) double
- #define [FFLAS_ELT](#) float
- #define [FFLAS_ELT](#) int64_t
- #define [FFLAS_FIELD](#) Givaro::Modular
- #define [FFLAS_ELT](#) double
- #define [FFLAS_ELT](#) float
- #define [FFLAS_ELT](#) int64_t

17.133.1 Macro Definition Documentation**17.133.1.1 INST_OR_DECL**

```
#define INST_OR_DECL <>
```

17.133.1.2 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.133.1.3 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.133.1.4 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.133.1.5 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.133.1.6 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.133.1.7 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.133.1.8 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.133.1.9 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.134 fflas_L2_inst_implem.inl File Reference**Namespaces**

- [FFLAS](#)

Functions

- template [INST_OR_DECL](#) void [fassign](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *B, const size_t ldb, [FFLAS_ELT](#) *A, const size_t lda)
fassign : $A \leftarrow B$.
- template [INST_OR_DECL](#) void [fzero](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda)
fzero : $A \leftarrow 0$.
- template [INST_OR_DECL](#) bool [fequal](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) *B, const size_t ldb)
fequal : test $A = B$.
- template [INST_OR_DECL](#) bool [fiszero](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *A, const size_t lda)
fiszero : test $A = 0$.
- template [INST_OR_DECL](#) void [fidentity](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) &d)
creates a diagonal matrix
- template [INST_OR_DECL](#) void [fidentity](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda)
creates a diagonal matrix
- template [INST_OR_DECL](#) void [freduce](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda)

- freduce* $A \leftarrow A \bmod F$.
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
- freduce* $A \leftarrow B \bmod F$.
- template `INST_OR_DECL` void `finit` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
- finit* $A \leftarrow B \bmod F$.
- template `INST_OR_DECL` void `fnegin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
- fnegin* $A \leftarrow -A$.
- template `INST_OR_DECL` void `fneg` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
- fneg* $A \leftarrow -B$.
- template `INST_OR_DECL` void `fscaln` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, `FFLAS_ELT` *A, const size_t lda)
- fscaln* $A \leftarrow a \cdot A$.
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)
- fscal* $B \leftarrow a \cdot A$.
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const size_t ldx, `FFLAS_ELT` *Y, const size_t ldy)
- faxpy* : $y \leftarrow \alpha \cdot x + y$.
- template `INST_OR_DECL` void `fmove` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)
- faxpy* : $y \leftarrow \alpha \cdot x + \beta \cdot y$.
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
- fadd* : matrix addition.
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
- fsub* : matrix subtraction.
- template `INST_OR_DECL` void `fsubin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
- fsubin* $C = C - B$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
- fadd* : matrix addition with scaling.
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
- faddin*
- template `INST_OR_DECL` `FFLAS_ELT` * `fgemv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` TransA, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` beta, `FFLAS_ELT` *Y, const size_t incY)
- finite prime* `FFLAS_FIELD`<`FFLAS_ELT`> *GEneral Matrix Vector multiplication.*
- template `INST_OR_DECL` void `fger` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *x, const size_t incx, const `FFLAS_ELT` *y, const size_t incy, `FFLAS_ELT` *A, const size_t lda)
- fger*: rank one update of a general matrix

- template [INST_OR_DECL](#) void [ftrsv](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, const [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *X, int incX)

ftrsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

17.135 fflas_L3_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L3_inst_implem.inl"
```

Macros

- [#define __FFLAS_L3_INST_C](#)
- [#define INST_OR_DECL](#)
- [#define FFLAS_FIELD Givaro::ModularBalanced](#)
- [#define FFLAS_ELT double](#)
- [#define FFLAS_ELT float](#)
- [#define FFLAS_ELT int64_t](#)
- [#define FFLAS_FIELD Givaro::Modular](#)
- [#define FFLAS_ELT double](#)
- [#define FFLAS_ELT float](#)
- [#define FFLAS_ELT int64_t](#)

17.135.1 Macro Definition Documentation

17.135.1.1 __FFLAS_L3_INST_C

```
#define __FFLAS_L3_INST_C
```

17.135.1.2 INST_OR_DECL

```
#define INST_OR_DECL
```

17.135.1.3 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.135.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.135.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.135.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.135.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.135.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.135.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.135.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.136 fflas_L3_inst.h File Reference

```
#include "givaro/modular.h"  
#include "givaro/modular-balanced.h"  
#include "fflas-ffpack/fflas/fflas.h"  
#include "fflas-ffpack/fflas/fflas_helpers.inl"  
#include "fflas_L3_inst_implem.inl"
```

Macros

- #define INST_OR_DECL <>
- #define FFLAS_FIELD Givaro::ModularBalanced
- #define FFLAS_ELT double
- #define FFLAS_ELT float
- #define FFLAS_ELT int64_t
- #define FFLAS_FIELD Givaro::Modular
- #define FFLAS_ELT double
- #define FFLAS_ELT float
- #define FFLAS_ELT int64_t

17.136.1 Macro Definition Documentation

17.136.1.1 INST_OR_DECL

```
#define INST_OR_DECL <>
```

17.136.1.2 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.136.1.3 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.136.1.4 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.136.1.5 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.136.1.6 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.136.1.7 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.136.1.8 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.136.1.9 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.137 fflas_L3_inst_implem.inl File Reference**Namespaces**

- [FFLAS](#)

Macros

- `#define __FFLAS__TRSM_READONLY`

Functions

- template [INST_OR_DECL](#) void [ftrsm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *B, const size_t ldb)

ftrsm: **TRI**angular **S**ystem solve with **M**atrix.

- template [INST_OR_DECL](#) void [ftrmm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *B, const size_t ldb)

ftrmm: **TRI**angular **M**atrix **M**ultiply.

- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` *B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const `size_t` ldc)

*fgemm: Field **GE**neral **M**atrix **M**ultiply.*

- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` *B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const `size_t` ldc, const `ParSeqHelper::Sequential` seq)
- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` *B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const `size_t` ldc, const `ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive >` par)
- template `INST_OR_DECL FFLAS_ELT * fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` *B, const `size_t` ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const `size_t` ldc, const `ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads >` par)
- template `INST_OR_DECL FFLAS_ELT * fsquare` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const `size_t` ldc)

fsquare: Squares a matrix.

17.137.1 Macro Definition Documentation

17.137.1.1 __FFLAS_TRSM_READONLY

```
#define __FFLAS_TRSM_READONLY
```

17.138 fflas_level1.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- #define [__FFLASFPACK_fflas_fflas_level1_INL](#)

Functions

- template<class Field >
void [freduce](#) (const [Field](#) &F, const `size_t` n, typename [Field::Element_ptr](#) X, const `size_t` incX)
freduce $x \leftarrow x \bmod F$.
- template<class Field >
void [freduce](#) (const [Field](#) &F, const `size_t` n, typename [Field::ConstElement_ptr](#) Y, const `size_t` incY, typename [Field::Element_ptr](#) X, const `size_t` incX)
freduce $x \leftarrow y \bmod F$.
- template<class Field, class OtherElement_ptr >
void [finit](#) (const [Field](#) &F, const `size_t` n, const `OtherElement_ptr` Y, const `size_t` incY, typename [Field::Element_ptr](#) X, const `size_t` incX)
finit $x \leftarrow y \bmod F$.

- `template<class Field >`
`void finit (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`
finit Initializes X in F .
- `template<class Field, class OtherElement_ptr >`
`void fconvert (const Field &F, const size_t n, OtherElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`
fconvert $x \leftarrow y \bmod F$.
- `template<class Field >`
`void fnegin (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`
fnegin $x \leftarrow -x$.
- `template<class Field >`
`void fneg (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`
fneg $x \leftarrow -y$.
- `template<class Field >`
`void fzero (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`
fzero : $A \leftarrow 0$.
- `template<class Field, class RandIter >`
`void frand (const Field &F, RandIter &G, const size_t n, typename Field::Element_ptr X, const size_t incX)`
frand : $A \leftarrow random$.
- `template<class Field >`
`bool fiszero (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX)`
fiszero : test $X = 0$.
- `template<class Field >`
`bool fequal (const Field &F, const size_t n, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`
fequal : test $X = Y$.
- `template<class Field >`
`void fassign (const Field &F, const size_t N, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`
fassign : $x \leftarrow y$.
- `template<class Field >`
`void fscaln (const Field &F, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr X, const size_t incX)`
fscaln $x \leftarrow \alpha \cdot x$.
- `template<class Field >`
`void fscal (const Field &F, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`
fscal $y \leftarrow \alpha \cdot x$.
- `template<class Field >`
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`
faxpy : $y \leftarrow \alpha \cdot x + y$.
- `template<class Field >`
`void faxpby (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`
faxpby : $y \leftarrow \alpha \cdot x + \beta \cdot y$.
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`
fdot: dot product $x^T y$.
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, const ParSeqHelper::Sequential seq)`

- `template<typename Field , class Cut , class Param >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX,`
`typename Field::ConstElement_ptr Y, const size_t incY, const ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class Field >`
`void fswap (const Field &F, const size_t N, typename Field::Element_ptr X, const size_t incX, typename`
`Field::Element_ptr Y, const size_t incY)`

$$fswap: X \leftrightarrow Y.$$
- `template<class Field >`
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t`
`lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc,`
`const size_t numths)`
- `template<class Field >`
`void pfsb (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t`
`lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc,`
`const size_t numths)`
- `template<class Field >`
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const`
`size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const`
`size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename`
`Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsub (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename`
`Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void faddin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename`
`Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename`
`Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const`
`typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t incb, typename`
`Field::Element_ptr C, const size_t incc)`

17.138.1 Macro Definition Documentation

17.138.1.1 __FFLASFFPACK_fflas_fflas_level1_INL

```
#define __FFLASFFPACK_fflas_fflas_level1_INL
```

17.139 fflas_level2.inl File Reference

```
#include "givaro/zring.h"
```

Namespaces

- [FFLAS](#)

Macros

- #define `__FFLASFFPACK_fflas_fflas_level2_INL`

Functions

- template<class Field >
void `fassign` (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)
 $fassign : A \leftarrow B.$
- template<class Field >
void `fzero` (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $fzero : A \leftarrow 0.$
- template<class Field , class RandIter >
void `frand` (const Field &F, RandIter &G, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $frand : A \leftarrow random.$
- template<class Field >
bool `fequal` (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb)
 $fequal : test A = B.$
- template<class Field >
bool `fiszero` (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr A, const size_t lda)
 $fiszero : test A = 0.$
- template<class Field >
void `fidentity` (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda, const typename Field::Element &d)
creates a diagonal matrix
- template<class Field >
void `fidentity` (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
creates a diagonal matrix
- template<class Field >
void `freduce` (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $freduce A \leftarrow A mod F.$
- template<class Field >
void `freduce` (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)
 $freduce A \leftarrow B mod F.$
- template<class Field , class OtherElement_ptr >
void `finit` (const Field &F, const size_t m, const size_t n, const OtherElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)
 $finit A \leftarrow B mod F.$
- template<class Field , class OtherElement_ptr >
void `finit` (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
finit initializes A in F^S .
- template<class Field , class OtherElement_ptr >
void `fconvert` (const Field &F, const size_t m, const size_t n, OtherElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb)
 $fconvert A \leftarrow B mod F.$
- template<class Field >
void `fnegin` (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda)
 $fnegin A \leftarrow -A.$

- template<class Field >
void **fneg** (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)
$$\text{fneg } A \leftarrow -B.$$
- template<class Field >
void **fscaln** (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda)
$$\text{fscaln } A \leftarrow a \cdot A.$$
- template<class Field >
void **fscal** (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)
$$\text{fscal } B \leftarrow a \cdot A.$$
- template<class Field >
void **faxpy** (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t ldx, typename Field::Element_ptr Y, const size_t ldy)
$$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$$
- template<class Field >
void **faxpby** (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t ldx, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t ldy)
$$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- template<class Field >
void **fmove** (const Field &F, const size_t m, const size_t n, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)
$$\text{fmove} : A \leftarrow B \text{ and } B \leftarrow 0.$$
- template<class Field >
void **fadd** (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)
$$\text{fadd} : \text{matrix addition.}$$
- template<class Field >
void **fsub** (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)
$$\text{fsub} : \text{matrix subtraction.}$$
- template<class Field >
void **fsubin** (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)
$$\text{fsubin } C = C - B$$
- template<class Field >
void **fadd** (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)
$$\text{fadd} : \text{matrix addition with scaling.}$$
- template<class Field >
void **faddin** (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, const size_t ldx, typename Field::Element_ptr C, const size_t ldc)
$$\text{faddin}$$
- template<class Field >
Field::Element_ptr **fgemv** (const Field &F, const FFLAS_TRANSPOSE TransA, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)
$$\text{finite prime Field GEneral Matrix Vector multiplication.}$$
- template<class Field >
void **fger** (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda)

fger: rank one update of a general matrix

- template<class Field >
void **ftrsv** (const [Field](#) &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, int incX)

ftrsv: *TR*angular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

- template<class Field >
size_t **bitsize** (const [Field](#) &F, size_t M, size_t N, const typename [Field::ConstElement_ptr](#) A, size_t lda)
bitsize: Computes the largest bitsize of the matrix' coefficients.
- template<> size_t **bitsize**< [Givaro::ZRing](#)< [Givaro::Integer](#) > > (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, size_t M, size_t N, const [Givaro::Integer](#) *A, size_t lda)
- template<class Field >
void **ftmrv** (const [Field](#) &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, int incX)

ftsm: *TR*angular Matrix Vector prodcut Computes $X \leftarrow \text{op}(A)X$

17.139.1 Macro Definition Documentation

17.139.1.1 __FFLASFFPACK_fflas_fflas_level2_INL

```
#define __FFLASFFPACK_fflas_fflas_level2_INL
```

17.140 fflas_level3.inl File Reference

```
#include "fflas_bounds.inl"
#include "fflas_helpers.inl"
#include "fflas-ffpack/paladin/parallel.h"
```

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Macros

- #define [__FFLASFFPACK_fflas_fflas_level3_INL](#)
- #define [__FFLAS__TRSM_READONLY](#)

Functions

- template<class Field >
void **MatF2MatD_Triangular** (const [Field](#) &F, [Givaro::DoubleDomain::Element_ptr](#) S, const size_t lds, typename [Field::ConstElement_ptr](#) const E, const size_t lde, const size_t m, const size_t n)
- template<class Field >
void **MatF2MatFI_Triangular** (const [Field](#) &F, [Givaro::FloatDomain::Element_ptr](#) S, const size_t lds, typename [Field::ConstElement_ptr](#) const E, const size_t lde, const size_t m, const size_t n)
- template<class Field >
void **ftsm** (const [Field](#) &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)

ftsm: **TR**angular System solve with **M**atrix.

- template<class Field >
void **ftmrm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)
*ftmrm: **TRI**angular **M**atrix **M**ultiply.*
- template<class Field >
void **ftmrm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)
*ftmrm: **TRI**angular **M**atrix **M**ultiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$ or $C \leftarrow \alpha B \text{op}(A) + \text{beta}C$.*
- template<class Field >
Field::Element_ptr **fsyrk** (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)
fsyrk: Symmetric Rank K update
- template<class Field >
Field::Element_ptr **fsyr2k** (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)
fsyr2k: Symmetric Rank 2K update
- template<class Field >
Field::Element_ptr **fsyrk** (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling
- template<class Field >
Field::Element_ptr **fsyrk** (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Sequential seq, const size_t threshold)
- template<class Field , class Cut , class Param >
Field::Element_ptr **fsyrk** (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold)
- template<class Field >
Field::Element_ptr **fsyrk** (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const std::vector< bool > &two←Block, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling
- template<typename Field >
Field::Element_ptr **fgemm** (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)
*fgemm: **F**ield **G**eneral **M**atrix **M**ultiply.*
- template<typename Field >
Field::Element_ptr **fgemm** (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const

typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, const ParSeqHelper::↵
Sequential seq)

- template<typename Field , class Cut , class Param >
[Field::Element_ptr](#) [fgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE
tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename
[Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const
typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, const ParSeqHelper::↵
Parallel< Cut, Param > par)
- template<typename Field >
[Field::Element_ptr](#) [pfgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE
tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename
[Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const
typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, size_t numthreads=0)
- template<class Field >
[Field::Element](#) * [pfgemm_1D_rec](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_↵
TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha,
const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t
ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, size_t seuil)
- template<class Field >
[Field::Element](#) * [pfgemm_2D_rec](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_↵
TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha,
const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t
ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, size_t seuil)
- template<class Field >
[Field::Element](#) * [pfgemm_3D_rec](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_↵
TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha,
const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t
ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, size_t seuil,
size_t *x)
- template<class Field >
[Field::Element_ptr](#) [pfgemm_3D_rec2](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_↵
TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const
typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const
typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, size_t seuil, size_t *x)
- template<class Field >
[Field::Element_ptr](#) [fsquare](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename
[Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::Element](#)
beta, typename [Field::Element_ptr](#) C, const size_t ldc)

fsquare: Squares a matrix.

17.140.1 Macro Definition Documentation

17.140.1.1 __FFLASFFPACK_fflas_fflas_level3_INL

```
#define __FFLASFFPACK_fflas_fflas_level3_INL
```

17.140.1.2 __FFLAS__TRSM_READONLY

```
#define __FFLAS__TRSM_READONLY
```

17.141 fflas_lvl1.C File Reference

C functions calls for level 1 [FFLAS](#) in fflas-c.h.


```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro//modular-balanced.h"
#include "givaro//modular.h"
```

Functions

- void [freducein_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- void [freduce_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fnegin_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- void [fneg_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fzero_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- bool [fiszero_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, bool positive)
- bool [fequal_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void [fassign_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fscal_1_modular_double](#) (const double p, const size_t n, const double alpha, double *X, const size_t incX, bool positive)
- void [fscal_1_modular_double](#) (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void [faxpy_1_modular_double](#) (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- double [fdot_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void [fswap_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void [fadd_1_modular_double](#) (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [fsub_1_modular_double](#) (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [faddin_1_modular_double](#) (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [fsubin_1_modular_double](#) (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)

17.141.1 Detailed Description

C functions calls for level 1 [FFLAS](#) in `fflas-c.h`.

Author

Brice Boyer

See also

[fflas/fflas_level1.inl](#)

17.141.2 Function Documentation

17.141.2.1 freducein_1_modular_double()

```
void freducein_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.141.2.2 freduce_1_modular_double()

```
void freduce_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive )
```

17.141.2.3 fnegin_1_modular_double()

```
void fnegin_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.141.2.4 fneg_1_modular_double()

```
void fneg_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive )
```

17.141.2.5 fzero_1_modular_double()

```
void fzero_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.141.2.6 fiszero_1_modular_double()

```
bool fiszero_1_modular_double (
    const double p,
    const size_t n,
```

```
    const double * X,  
    const size_t incX,  
    bool positive )
```

17.141.2.7 fequal_1_modular_double()

```
bool fequal_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    const double * Y,  
    const size_t incY,  
    bool positive )
```

17.141.2.8 fassign_1_modular_double()

```
void fassign_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * Y,  
    const size_t incY,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.141.2.9 fscaln_1_modular_double()

```
void fscaln_1_modular_double (  
    const double p,  
    const size_t n,  
    const double alpha,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.141.2.10 fscal_1_modular_double()

```
void fscal_1_modular_double (  
    const double p,  
    const size_t n,  
    const double alpha,  
    const double * X,  
    const size_t incX,  
    double * Y,  
    const size_t incY,  
    bool positive )
```

17.141.2.11 faxpy_1_modular_double()

```
void faxpy_1_modular_double (  
    const double p,  
    const size_t n,  
    const double alpha,
```

```
const double * X,  
const size_t incX,  
double * Y,  
const size_t incY,  
bool positive )
```

17.141.2.12 fdot_1_modular_double()

```
double fdot_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    const double * Y,  
    const size_t incY,  
    bool positive )
```

17.141.2.13 fswap_1_modular_double()

```
void fswap_1_modular_double (  
    const double p,  
    const size_t n,  
    double * X,  
    const size_t incX,  
    double * Y,  
    const size_t incY,  
    bool positive )
```

17.141.2.14 fadd_1_modular_double()

```
void fadd_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * A,  
    const size_t incA,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive )
```

17.141.2.15 fsub_1_modular_double()

```
void fsub_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * A,  
    const size_t incA,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive )
```

17.141.2.16 faddin_1_modular_double()

```
void faddin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive )
```

17.141.2.17 fsubin_1_modular_double()

```
void fsubin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive )
```

17.142 fflas_ivl2.C File Reference

C functions calls for level 2 [FFLAS](#) in `fflas-c.h`.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro/modular-balanced.h"
#include "givaro/modular.h"
```

Functions

- void [fassign_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fzero_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- bool [fequal_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, bool positive)
- bool [fiszero_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, bool positive)
- void [fidentity_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, const double d, bool positive)
- void [freducein_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- void [freduce_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fnegin_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- void [fneg_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fscalin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, double *A, const size_t lda, bool positive)
- void [fscale_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [faxpy_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)

- void [fmove_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fadd_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- void [fsub_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- void [fsubin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- void [faddin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- double * [fgemv_2_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) TransA, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, const double *X, const size_t incX, const double beta, double *Y, const size_t incY, bool positive)
- void [fger_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *X, const size_t incX, const double *Y, const size_t incY, double *A, const size_t lda, bool positive)
- void [ftrsv_2_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) TransA, const enum [FFLAS_C_DIAG](#) Diag, const size_t n, const double *A, const size_t lda, double *X, int incX, bool positive)

17.142.1 Detailed Description

C functions calls for level 2 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas_level2.inl](#)

17.142.2 Function Documentation

17.142.2.1 fassign_2_modular_double()

```
void fassign_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.142.2.2 fzero_2_modular_double()

```
void fzero_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive )
```

17.142.2.3 fequal_2_modular_double()

```
bool fequal_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    const double * B,
    const size_t ldb,
    bool positive )
```

17.142.2.4 fiszero_2_modular_double()

```
bool fiszero_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    bool positive )
```

17.142.2.5 fidentity_2_modular_double()

```
void fidentity_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    const double d,
    bool positive )
```

17.142.2.6 freducein_2_modular_double()

```
void freducein_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive )
```

17.142.2.7 freduce_2_modular_double()

```
void freduce_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.142.2.8 fnegin_2_modular_double()

```
void fnegin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive )
```

17.142.2.9 fneg_2_modular_double()

```
void fneg_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.142.2.10 fscaln_2_modular_double()

```
void fscaln_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    double * A,
    const size_t lda,
    bool positive )
```

17.142.2.11 fscale_2_modular_double()

```
void fscale_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.142.2.12 faxpy_2_modular_double()

```
void faxpy_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
```

```
double * B,  
const size_t ldb,  
bool positive )
```

17.142.2.13 fmove_2_modular_double()

```
void fmove_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    bool positive )
```

17.142.2.14 fadd_2_modular_double()

```
void fadd_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t lda,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive )
```

17.142.2.15 fsub_2_modular_double()

```
void fsub_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t lda,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive )
```

17.142.2.16 fsubin_2_modular_double()

```
void fsubin_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive )
```


17.142.2.17 faddin_2_modular_double()

```
void faddin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * B,
    const size_t ldb,
    double * C,
    const size_t ldc,
    bool positive )
```

17.142.2.18 fgemv_2_modular_double()

```
double* fgemv_2_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE TransA,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double * X,
    const size_t incX,
    const double beta,
    double * Y,
    const size_t incY,
    bool positive )
```

17.142.2.19 fger_2_modular_double()

```
void fger_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    double * A,
    const size_t lda,
    bool positive )
```

17.142.2.20 ftrsv_2_modular_double()

```
void ftrsv_2_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_TRANSPOSE TransA,
    const enum FFLAS_C_DIAG Diag,
    const size_t n,
    const double * A,
    const size_t lda,
```

```
double * X,
int incX,
bool positive )
```

17.143 fflas_lvl3.C File Reference

C functions calls for level 3 [FFLAS](#) in fflas-c.h.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro//modular-balanced.h"
#include "givaro//modular.h"
```

Functions

- void [ftrsm_3_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) tA, const enum [FFLAS_C_DIAG](#) Diag, const size_t m, const size_t n, const double alpha, const double *A, const size_t ldA, double *B, const size_t ldB, bool positive)
- void [ftrmm_3_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) tA, const enum [FFLAS_C_DIAG](#) Diag, const size_t m, const size_t n, const double alpha, double *A, const size_t ldA, double *B, const size_t ldB, bool positive)
- double * [fgemm_3_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) tA, const enum [FFLAS_C_TRANSPOSE](#) tB, const size_t m, const size_t n, const size_t k, const double alpha, const double *A, const size_t ldA, const double *B, const size_t ldB, const double betA, double *C, const size_t ldC, bool positive)
- double * [fsquare_3_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) tA, const size_t n, const double alpha, const double *A, const size_t ldA, const double betA, double *C, const size_t ldC, bool positive)

17.143.1 Detailed Description

C functions calls for level 3 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas_level3.inl](#)

17.143.2 Function Documentation

17.143.2.1 ftrsm_3_modular_double()

```
void ftrsm_3_modular_double (
    const double p,
    const enum FFLAS\_C\_SIDE Side,
    const enum FFLAS\_C\_UPLO Uplo,
    const enum FFLAS\_C\_TRANSPOSE tA,
    const enum FFLAS\_C\_DIAG Diag,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
```

```
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.143.2.2 ftrmm_3_modular_double()

```
void ftrmm_3_modular_double (   
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const enum FFLAS_C_UPLO Uplo,  
    const enum FFLAS_C_TRANSPOSE tA,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.143.2.3 fgemv_3_modular_double()

```
double* fgemv_3_modular_double (   
    const double p,  
    const enum FFLAS_C_TRANSPOSE tA,  
    const enum FFLAS_C_TRANSPOSE tB,  
    const size_t m,  
    const size_t n,  
    const size_t k,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    const double * B,  
    const size_t ldB,  
    const double betaA,  
    double * C,  
    const size_t ldC,  
    bool positive )
```

17.143.2.4 fsquare_3_modular_double()

```
double* fsquare_3_modular_double (   
    const double p,  
    const enum FFLAS_C_TRANSPOSE tA,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    const double betaA,  
    double * C,  
    const size_t ldC,  
    bool positive )
```

17.144 fflas_memory.h File Reference

```
#include "fflas-ffpack/utils/align-allocator.h"
#include <givaro/givinteger.h>
```

Namespaces

- [FFLAS](#)

Functions

- `template<class Element >`
`bool alignable ()`
- `template<> bool alignable< Givaro::Integer * > ()`
- `template<class Field >`
`Field::Element_ptr fflas_new (const Field &F, const size_t m, const Alignment align=Alignment::DEFAULT)`
- `template<class Field >`
`Field::Element_ptr fflas_new (const Field &F, const size_t m, const size_t n, const Alignment align=Alignment::DEFAULT)`
- `template<class Element >`
`Element * fflas_new (const size_t m, const Alignment align=Alignment::DEFAULT)`
- `template<> void fflas_delete (FFPACK::rns_double_elt_ptr A)`
- `template<class Ptr , class ... Args>`
`void fflas_delete (Ptr p, Args ... args)`
- `void prefetch (const int64_t *)`
- `void getTLBSize (int &tlb)`
- `void queryCacheSizes (int &l1, int &l2, int &l3)`
- `int queryL1CacheSize ()`
- `int queryTopLevelCacheSize ()`

17.145 fflas_pfgemm.inl File Reference

```
#include "fflas-ffpack/paladin/blockcuts.inl"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/paladin/pfgemm_variants.inl"
```

Namespaces

- [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_pfgemm_INL`
- `#define __FFLASFFPACK_SEQPARTHRESHOLD 220`
- `#define __FFLASFFPACK_DIMKPENALTY 1`

Functions

- `template<class Field , class ModeTrait , class Strat , class Param >`
`std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElement< Tag > >::value, typename Field::Element_ptr >::type fgemm (const Field &F, const FFLAS::FFLAS_TRANSPOSE ta, const FFLAS::FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr`

C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat, Param > > &H)

17.145.1 Macro Definition Documentation

17.145.1.1 __FFLASFFPACK_fflas_pfgemm_INL

```
#define __FFLASFFPACK_fflas_pfgemm_INL
```

17.145.1.2 __FFLASFFPACK_SEQPARTHRESHOLD

```
#define __FFLASFFPACK_SEQPARTHRESHOLD 220
```

17.145.1.3 __FFLASFFPACK_DIMKPENALTY

```
#define __FFLASFFPACK_DIMKPENALTY 1
```

17.146 fflas_pftrsm.inl File Reference

```
#include "fflas-ffpack/paladin/parallel.h"
```

Namespaces

- [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_pftrsm_INL](#)
- #define [PTRSM_HYBRID_THRESHOLD](#) 256

Functions

- template<class [Field](#) , class [Cut](#) , class [Param](#) >
[Field::Element_ptr](#) ftrsm (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_UPLO](#) UpLo, const [FFLAS::FFLAS_TRANSPOSE](#) TA, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, TRSMHelper< [StructureHelper::Iterative](#), [ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > > &H)
- template<class [Field](#) , class [Cut](#) , class [Param](#) >
[Field::Element_ptr](#) ftrsm (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_UPLO](#) UpLo, const [FFLAS::FFLAS_TRANSPOSE](#) TA, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, TRSMHelper< [StructureHelper::Hybrid](#), [ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > > &H)

17.146.1 Macro Definition Documentation

17.146.1.1 __FFLASFFPACK_fflas_pftrsm_INL

```
#define __FFLASFFPACK_fflas_pftrsm_INL
```

17.146.1.2 PTRSM_HYBRID_THRESHOLD

```
#define PTRSM_HYBRID_THRESHOLD 256
```

17.147 fflas_plevel1.h File Reference

```
#include "fflas-ffpack/paladin/parallel.h"
```

Namespaces

- [FFLAS](#)

Functions

- `template<class Field >`
`void pzero (const Field &F, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)`
- `template<class Field , class RandIter >`
`void prand (const Field &F, RandIter &G, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)`
- `template<class Field , class Cut , class Param >`
`Field::Element & fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element &d, const ParSeqHelper<
::Parallel< Cut, Param > par)`
- `template<typename Field , class Cut , class Param >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY, const ParSeqHelper::Parallel< Cut, Param > par)`

17.148 fflas_randommatrix.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include "fflas-ffpack/fflas/fflas.h"
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include <givaro/givranditer.h>
#include "fflas-ffpack/ffpack/ffpack.h"
```

Namespaces

- [FFPACK](#)

*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- `template<class Field , class RandIter >`
`Field::Element_ptr NonZeroRandomMatrix (const Field &F, size_t m, size_t n, typename Field::Element_ptr A, size_t lda, RandIter &G)`
Random non-zero Matrix.
- `template<class Field , class RandIter >`
`Field::Element_ptr NonZeroRandomMatrix (const Field &F, size_t m, size_t n, typename Field::Element_ptr A, size_t lda)`
Random non-zero Matrix.
- `template<class Field , class RandIter >`
`Field::Element_ptr RandomMatrix (const Field &F, size_t m, size_t n, typename Field::Element_ptr A, size_t lda, RandIter &G)`

Random Matrix.

- template<class Field >
Field::Element_ptr RandomMatrix (const Field &F, size_t m, size_t n, typename Field::Element_ptr A, size_t lda)

Random Matrix.

- template<class Field , class Randlter >
Field::Element_ptr RandomTriangularMatrix (const Field &F, size_t m, size_t n, const FFLAS::FFLAS_UPLO UpLo, const FFLAS::FFLAS_DIAG Diag, bool nonsingular, typename Field::Element_ptr A, size_t lda, Randlter &G)

Random Triangular Matrix.

- template<class Field >
Field::Element_ptr RandomTriangularMatrix (const Field &F, size_t m, size_t n, const FFLAS::FFLAS_UPLO UpLo, const FFLAS::FFLAS_DIAG Diag, bool nonsingular, typename Field::Element_ptr A, size_t lda)

Random Triangular Matrix.

- size_t RandInt (size_t a, size_t b)
- template<class Field , class Randlter >
Field::Element_ptr RandomSymmetricMatrix (const Field &F, size_t n, bool nonsingular, typename Field::Element_ptr A, size_t lda, Randlter &G)

Random Symmetric Matrix.

- template<class Field , class Randlter >
Field::Element_ptr RandomMatrixWithRank (const Field &F, size_t m, size_t n, size_t r, typename Field::Element_ptr A, size_t lda, Randlter &G)

Random Matrix with prescribed rank.

- template<class Field >
Field::Element_ptr RandomMatrixWithRank (const Field &F, size_t m, size_t n, size_t r, typename Field::Element_ptr A, size_t lda)

Random Matrix with prescribed rank.

- size_t * RandomIndexSubset (size_t N, size_t R, size_t *P)
Pick uniformly at random a sequence of R distinct elements from the set $\{0, \dots, N - 1\}$ using Knuth's shuffle.
- size_t * RandomPermutation (size_t N, size_t *P)
Pick uniformly at random a permutation of size N stored in LAPACK format using Knuth's shuffle.
- void RandomRankProfileMatrix (size_t M, size_t N, size_t R, size_t *rows, size_t *cols)
Pick uniformly at random an R -subpermutation of dimension $M \times N$: a matrix with only R non-zeros equal to one, in a random rook placement.
- void swapval (size_t k, size_t N, size_t *P, size_t val)
- void RandomSymmetricRankProfileMatrix (size_t N, size_t R, size_t *rows, size_t *cols)
Pick uniformly at random a symmetric R -subpermutation of dimension $N \times N$: a symmetric matrix with only R non-zeros, all equal to one, in a random rook placement.

- template<class Field , class Randlter >
Field::Element_ptr RandomMatrixWithRankandRPM (const Field &F, size_t M, size_t N, size_t R, typename Field::Element_ptr A, size_t lda, const size_t *RRP, const size_t *CRP, Randlter &G)

Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .

- template<class Field >
Field::Element_ptr RandomMatrixWithRankandRPM (const Field &F, size_t M, size_t N, size_t R, typename Field::Element_ptr A, size_t lda, const size_t *RRP, const size_t *CRP)

Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .

- template<class Field , class Randlter >
Field::Element_ptr RandomSymmetricMatrixWithRankandRPM (const Field &F, size_t N, size_t R, typename Field::Element_ptr A, size_t lda, const size_t *RRP, const size_t *CRP, Randlter &G)

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .

- template<class Field >
Field::Element_ptr RandomSymmetricMatrixWithRankandRPM (const Field &F, size_t M, size_t N, size_t R, typename Field::Element_ptr A, size_t lda, const size_t *RRP, const size_t *CRP)

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .

- `template<class Field , class RandIter >`

`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size_t M, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, RandIter &G)

Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

- `template<class Field >`

`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size_t M, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda)

Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

- `template<class Field , class RandIter >`

`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda, RandIter &G)

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

- `template<class Field >`

`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, size_t N, size_t R, typename `Field::Element_ptr` A, size_t lda)

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

- `template<class Field >`

`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, size_t n, const typename `Field::Element` d, typename `Field::Element_ptr` A, size_t lda)

Random Matrix with prescribed det.

- `template<class Field , class RandIter >`

`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, size_t n, const typename `Field::Element` d, typename `Field::Element_ptr` A, size_t lda, RandIter &G)

Random Matrix with prescribed det.

17.149 fflas_simd.h File Reference

```
#include "fflas-ffpack/utils/fflas_intrinsic.h"
#include <iostream>
#include <type_traits>
#include <limits>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include <fflas-ffpack/fflas/fflas_simd/simd_modular.inl>
```

Data Structures

- struct `support_simd< T >`
- struct `is_simd< T >`
- struct `NoSimd< T >`
- struct `SimdChooser< T, bool, bool >`
- struct `SimdChooser< T, false, b >`
- struct `SimdChooser< T, true, false >`
- struct `SimdChooser< T, true, true >`

Namespaces

- `FFLAS`

Macros

- `#define SIMD_INT 1`
- `#define INLINE inline`
- `#define CONST`
- `#define PURE`
- `#define NORML_MOD(C, P, NEGP, MIN, MAX, Q, T)`
- `#define FLOAT_MOD(C, P, INVP, Q)`

Typedefs

- `template<class T >`
`using Simd = typename SimdChooser< T >::value`

17.149.1 Macro Definition Documentation

17.149.1.1 SIMD_INT

```
#define SIMD_INT 1
```

17.149.1.2 INLINE

```
#define INLINE inline
```

17.149.1.3 CONST

```
#define CONST
```

17.149.1.4 PURE

```
#define PURE
```

17.149.1.5 NORML_MOD

```
#define NORML_MOD(  
    C,  
    P,  
    NEGP,  
    MIN,  
    MAX,  
    Q,  
    T )
```

Value:

```
{  
    Q = greater(C, MAX);  
    T = lesser(C, MIN);  
    Q = vand(Q, NEGP);  
    T = vand(T, P);  
    Q = vor(Q, T);  
    C = add(C, Q);  
}
```

17.149.1.6 FLOAT_MOD

```
#define FLOAT_MOD(
    C,
    P,
    INVP,
    Q )
```

Value:

```
{
    Q = mul(C, INVP);
    Q = floor(Q);
    C = fnmadd(C, Q, P);
}
```

17.149.2 Typedef Documentation

17.149.2.1 Simd

```
using Simd = typename SimdChooser<T>::value
```

17.150 fflas_sparse.C File Reference

C functions calls for level 1.5 and 2.5 [FFLAS](#) in fflas-c.h.

17.150.1 Detailed Description

C functions calls for level 1.5 and 2.5 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas_sparse.h](#)

17.151 fflas_sparse.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/paladin/parallel.h"
#include <recint/recint.h>
#include <givaro/udl.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/fflas/fflas_bounds.inl"
#include "fflas-ffpack/utils/fflas_memory.h"
#include <type_traits>
#include <vector>
#include <iostream>
#include "fflas-ffpack/fflas/fflas_sparse/sparse_matrix_traits.h"
#include "fflas-ffpack/fflas/fflas_sparse/utils.h"
#include "fflas-ffpack/fflas/fflas_sparse/csr.h"
#include "fflas-ffpack/fflas/fflas_sparse/coo.h"
#include "fflas-ffpack/fflas/fflas_sparse/ell.h"
```

```
#include "fflas-ffpack/fflas/fflas_sparse/sell.h"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb.h"
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd.h"
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo.h"
#include "fflas-ffpack/fflas/fflas_sparse.inl"
#include "fflas-ffpack/fflas/fflas_sparse/read_sparse.h"
```

Data Structures

- struct [HelperFlag](#)
- struct [CsrMat< Field >](#)
- struct [CooMat< Field >](#)
- struct [EllMat< Field >](#)
- struct [SpMat< Field, flag >](#)

Namespaces

- [MKL_CONFIG](#)
- [FFLAS](#)
- [FFLAS::sparse_details](#)

Macros

- [#define index_t uint32_t](#)
- [#define ROUND_DOWN\(x, s\) \(\(x\) & ~\(\(s\)-1\)\)](#)
- [#define __FFLASFFPACK_CACHE_LINE_SIZE 64](#)
- [#define assume_aligned\(pout, pin, v\) decltype\(pin\) pout = pin;](#)
- [#define DENSE_THRESHOLD 0.5](#)

Enumerations

- enum class [SparseMatrix_t](#) {
[CSR](#) , [CSR_ZO](#) , [CSC](#) , [CSC_ZO](#) ,
[COO](#) , [COO_ZO](#) , [ELL](#) , [ELL_ZO](#) ,
[SELL](#) , [SELL_ZO](#) , [ELL_simd](#) , [ELL_simd_ZO](#) ,
[CSR_HYB](#) , [HYB_ZO](#) }

Functions

- [template<class Field >](#)
[void init_y](#) (const [Field](#) &F, const [size_t](#) m, const [typename](#) [Field::Element](#) b, [typename](#) [Field::Element_ptr](#) y)
- [template<class Field >](#)
[void init_y](#) (const [Field](#) &F, const [size_t](#) m, const [size_t](#) n, const [typename](#) [Field::Element](#) b, [typename](#) [Field::Element_ptr](#) y, const [int](#) ldy)
- [template<class Field , class SM , class FC , class MZO >](#)
[std::enable_if< !\(std::is_same< \[typename\]\(#\) \[ElementTraits\]\(#\)< \[typename\]\(#\) \[Field::Element\]\(#\) >::value, \[ElementCategories::MachineFloatTag\]\(#\) >::value\)||std::is_same< \[typename\]\(#\) \[ElementTraits\]\(#\)< \[typename\]\(#\) \[Field::Element\]\(#\) >::value, \[ElementCategories::MachineIntTag\]\(#\) >::value\)>::type](#) [fspmv_dispatch](#) (const [Field](#) &F, const [SM](#) &A, [typename](#) [Field::ConstElement_ptr](#) x, [typename](#) [Field::Element_ptr](#) y, [FC](#) fc, [MZO](#) mzo)
- [template<class Field , class SM , class FC , class MZO >](#)
[std::enable_if< std::is_same< \[typename\]\(#\) \[ElementTraits\]\(#\)< \[typename\]\(#\) \[Field::Element\]\(#\) >::value, \[ElementCategories::MachineFloatTag\]\(#\) >::value\)||std::is_same< \[typename\]\(#\) \[ElementTraits\]\(#\)< \[typename\]\(#\) \[Field::Element\]\(#\) >::value, \[ElementCategories::MachineIntTag\]\(#\) >::value >::type](#) [fspmv_dispatch](#) (const [Field](#) &F, const [SM](#) &A, [typename](#) [Field::ConstElement_ptr](#) x, [typename](#) [Field::Element_ptr](#) y, [FC](#) fc, [MZO](#) mzo)
- [template<class Field , class SM >](#)
[void fspmv](#) (const [Field](#) &F, const [SM](#) &A, [typename](#) [Field::ConstElement_ptr](#) x, [typename](#) [Field::Element_ptr](#) y, [FieldCategories::GenericTag](#), [NotZOSparseMatrix](#))

- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< !(std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value) >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`

- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< !(std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value) >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`

- `template<class Field , class SM >`
`std::enable_if<!support_simd< typename Field::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::false_type)`
- `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::false_type)`
- `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::false_type)`
- `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::true_type)`
- `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::true_type)`
- `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field , class SM >`
`void fspm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, const typename Field::Element &beta, typename Field::Element_ptr y, int Idy)`

17.151.1 Macro Definition Documentation

17.151.1.1 index_t

```
#define index_t uint32_t
```

17.151.1.2 ROUND_DOWN

```
#define ROUND_DOWN(  
    x,  
    s ) ((x) & ~((s)-1))
```

17.151.1.3 __FFLASFFPACK_CACHE_LINE_SIZE

```
#define __FFLASFFPACK_CACHE_LINE_SIZE 64
```

17.151.1.4 assume_aligned

```
#define assume_aligned(  
    pout,
```

```

    pin,
    v ) decltype(pin) pout = pin;

```

17.151.1.5 DENSE_THRESHOLD

```
#define DENSE_THRESHOLD 0.5
```

17.152 fflas_sparse.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details](#)

Macros

- `#define __FFLASFFPACK_fflas_fflas_sparse_INL`

Functions

- `template<class Field >`
void [init_y](#) (const [Field](#) &F, const size_t m, const typename [Field::Element](#) b, typename [Field::Element_ptr](#) y)
- `template<class Field >`
void [init_y](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) b, typename [Field::Element_ptr](#) y, const int ldy)
- `template<class Field , class SM , class FC , class MZO >`
std::enable_if< ! (std::is_same< typename ElementTraits< typename [Field::Element](#) >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename [Field::Element](#) >::value, ElementCategories::MachineIntTag >::value) >::type [fspmv_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FC fc, MZO mzo)
- `template<class Field , class SM , class FC , class MZO >`
std::enable_if< std::is_same< typename ElementTraits< typename [Field::Element](#) >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename [Field::Element](#) >::value, ElementCategories::MachineIntTag >::value >::type [fspmv_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FC fc, MZO mzo)
- `template<class Field , class SM >`
void [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::GenericTag, NotZOSparseMatrix)
- `template<class Field , class SM >`
std::enable_if< !isSparseMatrixSimdFormat< [Field](#), SM >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::UnparametricTag, NotZOSparseMatrix)
- `template<class Field , class SM >`
std::enable_if< isSparseMatrixSimdFormat< [Field](#), SM >::value &&support_simd< typename [Field::Element](#) >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::UnparametricTag, NotZOSparseMatrix)
- `template<class Field , class SM >`
std::enable_if< !isSparseMatrixSimdFormat< [Field](#), SM >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::ModularTag, NotZOSparseMatrix)
- `template<class Field , class SM >`
std::enable_if< isSparseMatrixSimdFormat< [Field](#), SM >::value &&support_simd< typename [Field::Element](#) >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::ModularTag, NotZOSparseMatrix)
- `template<class Field , class SM >`
void [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::GenericTag, ZOSparseMatrix)

- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value && support_simd< typename Field::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< ! (std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value) >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineFloatTag >::value || std::is_same< typename ElementTraits< typename Field::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typename Field::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`

- `template<class Field, class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field, class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, const typename Field::Element &beta, typename Field::Element_ptr y, int ldy)`

17.152.1 Macro Definition Documentation

17.152.1.1 __FFLASFFPACK_fflas_fflas_sparse_INL

```
#define __FFLASFFPACK_fflas_fflas_sparse_INL
```

17.153 ffpack-fgesv.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <fflas-ffpack/ffpack/ffpack.h>
#include <iostream>
```

Functions

- `int main (int argc, char **argv)`

17.153.1 Function Documentation

17.153.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.154 ffpack-solve.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <fflas-ffpack/ffpack/ffpack.h>
#include <iostream>
```

Functions

- `int main (int argc, char **argv)`

17.154.1 Function Documentation

17.154.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

PS: the function Solve will modify the matrix A so here we used a duplicate matrix A2 otherwise $A \cdot x$ will not be equal to b for the later verification stage

17.155 ffpack.C File Reference

C functions calls for [FFPACK](#) in ffpack-c.h.

```
#include "fflas-ffpack/interfaces/libs/ffpack_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "givaro/modular-balanced.h"
#include "givaro/modular.h"
```

Functions

- void [LAPACKPerm2MathPerm](#) (size_t *MathP, const size_t *LapackP, const size_t N)
- void [MathPerm2LAPACKPerm](#) (size_t *LapackP, const size_t *MathP, const size_t N)
- void [MatrixApplyS_modular_double](#) (const double p, double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)
- void [PermApplyS_double](#) (double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)
- void [MatrixApplyT_modular_double](#) (const double p, double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)
- void [PermApplyT_double](#) (double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)
- void [composePermutationsLLM](#) (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void [composePermutationsLLL](#) (size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void [composePermutationsMLM](#) (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)
- void [cyclic_shift_mathPerm](#) (size_t *P, const size_t s)
- void [cyclic_shift_row_modular_double](#) (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void [cyclic_shift_col_modular_double](#) (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void [applyP_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const enum [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, double *A, const size_t lda, const size_t *P, bool positive)
- void [fgetrsin_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *B, const size_t ldb, int *info, bool positive)
- double * [fgetrsv_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *X, const size_t idx, const double *B, const size_t ldb, int *info, bool positive)
- size_t [fgesvin_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, double *A, const size_t lda, double *B, const size_t ldb, int *info, bool positive)
- size_t [fgesv_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, double *A, const size_t lda, double *X, const size_t idx, const double *B, const size_t ldb, int *info, bool positive)
- void [ftrtri_modular_double](#) (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const enum [FFLAS::FFLAS_DIAG](#) Diag, const size_t N, double *A, const size_t lda, bool positive)
- void [trinv_left_modular_double](#) (const double p, const size_t N, const double *L, const size_t ldl, double *X, const size_t idx, bool positive)
- void [ftrtrm_modular_double](#) (const double p, const [FFLAS::FFLAS_SIDE](#) side, const enum [FFLAS::FFLAS_DIAG](#) Diag, const size_t N, double *A, const size_t lda, bool positive)

- [illegible]

- `size_t pReducedColumnEchelonForm_modular_int32_t` (const `int32_t` p, const `size_t` M, const `size_t` N, `int32_t` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t pReducedRowEchelonForm_modular_int32_t` (const `int32_t` p, const `size_t` M, const `size_t` N, `int32_t` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `double * Invertin_modular_double` (const double p, const `size_t` M, double *A, const `size_t` lda, int *nullity, bool positive)
- `double * Invert_modular_double` (const double p, const `size_t` M, const double *A, const `size_t` lda, double *X, const `size_t` idx, int *nullity, bool positive)
- `double * Invert2_modular_double` (const double p, const `size_t` M, double *A, const `size_t` lda, double *X, const `size_t` idx, int *nullity, bool positive)
- `size_t KrylovElim_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Q, const `size_t` deg, `size_t` *iterates, `size_t` *inviterates, const `size_t` maxit, `size_t` virt, bool positive)
- `size_t SpecRankProfile_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, const `size_t` deg, `size_t` *rankProfile, bool positive)
- `size_t Rank_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `bool IsSingular_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `double Det_modular_double` (const double p, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `double * Solve_modular_double` (const double p, const `size_t` M, double *A, const `size_t` lda, double *x, const int incx, const double *b, const int incb, bool positive)
- `void solveLB_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, double *L, const `size_t` ldl, const `size_t` *Q, double *B, const `size_t` ldb, bool positive)
- `void solveLB2_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, double *L, const `size_t` ldl, const `size_t` *Q, double *B, const `size_t` ldb, bool positive)
- `void RandomNullSpaceVector_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double *X, const `size_t` incX, bool positive)
- `size_t NullSpaceBasis_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double **NS, `size_t` *ldn, `size_t` *NSdim, bool positive)
- `size_t RowRankProfile_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ColumnRankProfile_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `void RankProfileFromLU` (const `size_t` *P, const `size_t` N, const `size_t` R, `size_t` *rkprofile, const enum `FFPACK_C_LU_TAG` LuTag)
- `size_t LeadingSubmatrixRankProfiles` (const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` LSm, const `size_t` LSn, const `size_t` *P, const `size_t` *Q, `size_t` *RRP, `size_t` *CRP)
- `size_t RowRankProfileSubmatrixIndices_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rowindices, `size_t` **colindices, `size_t` *R, bool positive)
- `size_t ColRankProfileSubmatrixIndices_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rowindices, `size_t` **colindices, `size_t` *R, bool positive)
- `size_t RowRankProfileSubmatrix_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double **X, `size_t` *R, bool positive)
- `size_t ColRankProfileSubmatrix_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double **X, `size_t` *R, bool positive)
- `void getTriangular_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const enum `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, const `size_t` R, const double *A, const `size_t` lda, double *T, const `size_t` ldt, const bool OnlyNonZeroVectors, bool positive)
- `void getTriangularin_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const enum `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, const `size_t` R, double *A, const `size_t` lda, bool positive)

- void [getEchelonForm_modular_double](#) (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const enum [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getEchelonFormin_modular_double](#) (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const enum [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getEchelonTransform_modular_double](#) (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const enum [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getReducedEchelonForm_modular_double](#) (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getReducedEchelonFormin_modular_double](#) (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getReducedEchelonTransform_modular_double](#) (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [PLUQtoEchelonPermutation](#) (const size_t N, const size_t R, const size_t *P, size_t *outPerm)

17.155.1 Detailed Description

C functions calls for [FFPACK](#) in ffpack-c.h.

Author

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See also

[ffpack/ffpack.h](#)

17.155.2 Function Documentation

17.155.2.1 LAPACKPerm2MathPerm()

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N )
```

17.155.2.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N )
```

17.155.2.3 MatrixApplyS_modular_double()

```
void MatrixApplyS_modular_double (
    const double p,
    double * A,
```

```

    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    bool positive )

```

17.155.2.4 PermApplyS_double()

```

void PermApplyS_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 )

```

17.155.2.5 MatrixApplyT_modular_double()

```

void MatrixApplyT_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    bool positive )

```

17.155.2.6 PermApplyT_double()

```

void PermApplyT_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 )

```

17.155.2.7 composePermutationsLLM()

```

void composePermutationsLLM (
    size_t * MathP,
    const size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N )

```

17.155.2.8 composePermutationsLLL()

```
void composePermutationsLLL (
    size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N )
```

17.155.2.9 composePermutationsMLM()

```
void composePermutationsMLM (
    size_t * MathP1,
    const size_t * P2,
    const size_t R,
    const size_t N )
```

17.155.2.10 cyclic_shift_mathPerm()

```
void cyclic_shift_mathPerm (
    size_t * P,
    const size_t s )
```

17.155.2.11 cyclic_shift_row_modular_double()

```
void cyclic_shift_row_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive )
```

17.155.2.12 cyclic_shift_col_modular_double()

```
void cyclic_shift_col_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive )
```

17.155.2.13 applyP_modular_double()

```
void applyP_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const enum FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    double * A,
```

```
    const size_t lda,  
    const size_t * P,  
    bool positive )
```

17.155.2.14 fgetrsin_modular_double()

```
void fgetrsin_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * A,  
    const size_t lda,  
    const size_t * P,  
    const size_t * Q,  
    double * B,  
    const size_t ldb,  
    int * info,  
    bool positive )
```

17.155.2.15 fgetrsv_modular_double()

```
double* fgetrsv_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t NRHS,  
    const size_t R,  
    double * A,  
    const size_t lda,  
    const size_t * P,  
    const size_t * Q,  
    double * X,  
    const size_t ldx,  
    const double * B,  
    const size_t ldb,  
    int * info,  
    bool positive )
```

17.155.2.16 fgesvin_modular_double()

```
size_t fgesvin_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_SIDE Side,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    int * info,  
    bool positive )
```


17.155.2.17 fgesv_modular_double()

```
size_t fgesv_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    double * A,
    const size_t lda,
    double * X,
    const size_t ldX,
    const double * B,
    const size_t ldb,
    int * info,
    bool positive )
```

17.155.2.18 ftrtri_modular_double()

```
void ftrtri_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )
```

17.155.2.19 trinv_left_modular_double()

```
void trinv_left_modular_double (
    const double p,
    const size_t N,
    const double * L,
    const size_t ldl,
    double * X,
    const size_t ldX,
    bool positive )
```

17.155.2.20 ftrtrm_modular_double()

```
void ftrtrm_modular_double (
    const double p,
    const FFLAS::FFLAS_SIDE side,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )
```

17.155.2.21 PLUQ_modular_double()

```
size_t PLUQ_modular_double (
    const double p,
    const enum FFLAS::FFLAS_DIAG Diag,
```

```

    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    bool positive )

```

17.155.2.22 LUdivine_modular_double()

```

size_t LUdivine_modular_double (
    const double p,
    const enum FFLAS::FFLAS_DIAG Diag,
    const enum FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const enum FFPACK_C_LU_TAG LuTag,
    const size_t cutoff,
    bool positive )

```

17.155.2.23 ColumnEchelonForm_modular_double()

```

size_t ColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.24 RowEchelonForm_modular_double()

```

size_t RowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.25 ReducedColumnEchelonForm_modular_double()

```

size_t ReducedColumnEchelonForm_modular_double (

```

```
const double p,
const size_t M,
const size_t N,
double * A,
const size_t lda,
size_t * P,
size_t * Qt,
const bool transform,
const enum FFPACK_C_LU_TAG LuTag,
bool positive )
```

17.155.2.26 ReducedRowEchelonForm_modular_double()

```
size_t ReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.27 ColumnEchelonForm_modular_float()

```
size_t ColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.28 RowEchelonForm_modular_float()

```
size_t RowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.29 ReducedColumnEchelonForm_modular_float()

```
size_t ReducedColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.30 ReducedRowEchelonForm_modular_float()

```
size_t ReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.31 ColumnEchelonForm_modular_int32_t()

```
size_t ColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.32 RowEchelonForm_modular_int32_t()

```
size_t RowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.33 ReducedColumnEchelonForm_modular_int32_t()

```
size_t ReducedColumnEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.155.2.34 ReducedRowEchelonForm_modular_int32_t()

```
size_t ReducedRowEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.155.2.35 pColumnEchelonForm_modular_double()

```
size_t pColumnEchelonForm_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.155.2.36 pRowEchelonForm_modular_double()

```
size_t pRowEchelonForm_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.155.2.37 pReducedColumnEchelonForm_modular_double()

```

size_t pReducedColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.38 pReducedRowEchelonForm_modular_double()

```

size_t pReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.39 pColumnEchelonForm_modular_float()

```

size_t pColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.40 pRowEchelonForm_modular_float()

```

size_t pRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.41 pReducedColumnEchelonForm_modular_float()

```
size_t pReducedColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.42 pReducedRowEchelonForm_modular_float()

```
size_t pReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.43 pColumnEchelonForm_modular_int32_t()

```
size_t pColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.44 pRowEchelonForm_modular_int32_t()

```
size_t pRowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.45 pReducedColumnEchelonForm_modular_int32_t()

```

size_t pReducedColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.46 pReducedRowEchelonForm_modular_int32_t()

```

size_t pReducedRowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.47 Invertin_modular_double()

```

double* Invertin_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    int * nullity,
    bool positive )

```

17.155.2.48 Invert_modular_double()

```

double* Invert_modular_double (
    const double p,
    const size_t M,
    const double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    int * nullity,
    bool positive )

```

17.155.2.49 Invert2_modular_double()

```

double* Invert2_modular_double (
    const double p,
    const size_t M,

```



```
double * A,  
const size_t lda,  
double * X,  
const size_t ldX,  
int * nullity,  
bool positive )
```

17.155.2.50 KrylovElim_modular_double()

```
size_t KrylovElim_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Q,  
    const size_t deg,  
    size_t * iterates,  
    size_t * inviterates,  
    const size_t maxit,  
    size_t virt,  
    bool positive )
```

17.155.2.51 SpecRankProfile_modular_double()

```
size_t SpecRankProfile_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    const size_t deg,  
    size_t * rankProfile,  
    bool positive )
```

17.155.2.52 Rank_modular_double()

```
size_t Rank_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.155.2.53 IsSingular_modular_double()

```
bool IsSingular_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.155.2.54 Det_modular_double()

```
double Det_modular_double (
    const double p,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )
```

17.155.2.55 Solve_modular_double()

```
double* Solve_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    double * x,
    const int incx,
    const double * b,
    const int incb,
    bool positive )
```

17.155.2.56 solveLB_modular_double()

```
void solveLB_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * L,
    const size_t ldl,
    const size_t * Q,
    double * B,
    const size_t ldb,
    bool positive )
```

17.155.2.57 solveLB2_modular_double()

```
void solveLB2_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * L,
    const size_t ldl,
    const size_t * Q,
    double * B,
    const size_t ldb,
    bool positive )
```

17.155.2.58 RandomNullSpaceVector_modular_double()

```
void RandomNullSpaceVector_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * X,
    const size_t incX,
    bool positive )
```

17.155.2.59 NullSpaceBasis_modular_double()

```
size_t NullSpaceBasis_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** NS,
    size_t * ldn,
    size_t * NSdim,
    bool positive )
```

17.155.2.60 RowRankProfile_modular_double()

```
size_t RowRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.61 ColumnRankProfile_modular_double()

```
size_t ColumnRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.62 RankProfileFromLU()

```
void RankProfileFromLU (
    const size_t * P,
```

```

    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const enum FFPACK_C_LU_TAG LuTag )

```

17.155.2.63 LeadingSubmatrixRankProfiles()

```

size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP )

```

17.155.2.64 RowRankProfileSubmatrixIndices_modular_double()

```

size_t RowRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )

```

17.155.2.65 ColRankProfileSubmatrixIndices_modular_double()

```

size_t ColRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )

```

17.155.2.66 RowRankProfileSubmatrix_modular_double()

```

size_t RowRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive )

```

17.155.2.67 ColRankProfileSubmatrix_modular_double()

```
size_t ColRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive )
```

17.155.2.68 getTriangular_modular_double()

```
void getTriangular_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    bool positive )
```

17.155.2.69 getTriangularin_modular_double()

```
void getTriangularin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    bool positive )
```

17.155.2.70 getEchelonForm_modular_double()

```
void getEchelonForm_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
```

```

    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.71 getEchelonFormin_modular_double()

```

void getEchelonFormin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.72 getEchelonTransform_modular_double()

```

void getEchelonTransform_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.73 getReducedEchelonForm_modular_double()

```

void getReducedEchelonForm_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.155.2.74 getReducedEchelonFormin_modular_double()

```
void getReducedEchelonFormin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.75 getReducedEchelonTransform_modular_double()

```
void getReducedEchelonTransform_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.155.2.76 PLUQtoEchelonPermutation()

```
void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
    const size_t * P,
    size_t * outPerm )
```

17.156 ffpack.dox File Reference**17.157 ffpack.h File Reference**

Set of elimination based routines for dense linear algebra.

```
#include "givaro/givpoly1.h"
#include <fflas-ffpack/fflas-ffpack-config.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include <list>
#include <vector>
#include <iostream>
#include <algorithm>
#include "fflas-ffpack/checkers/checkers_ffpack.h"
#include "ffpack_fgesv.inl"
#include "ffpack_fgetrs.inl"
#include "fflas-ffpack/checkers/checkers_ffpack.inl"
```

```
#include "ffpack_pluq.inl"
#include "ffpack_pluq_mp.inl"
#include "ffpack_ppluq.inl"
#include "ffpack_ludivine.inl"
#include "ffpack_ludivine_mp.inl"
#include "ffpack_echelonforms.inl"
#include "ffpack_fsytrf.inl"
#include "ffpack_invert.inl"
#include "ffpack_ftrtr.inl"
#include "ffpack_ftrstr.inl"
#include "ffpack_ftrssyr2k.inl"
#include "ffpack_charpoly_kglu.inl"
#include "ffpack_charpoly_kgfast.inl"
#include "ffpack_charpoly_kgfastgeneralized.inl"
#include "ffpack_charpoly_danilevski.inl"
#include "ffpack_charpoly.inl"
#include "ffpack_frobenius.inl"
#include "ffpack_minpoly.inl"
#include "ffpack_krylovelim.inl"
#include "ffpack_permutation.inl"
#include "ffpack_rankprofiles.inl"
#include "ffpack_det_mp.inl"
#include "ffpack.inl"
```

Data Structures

- class [CharpolyFailed](#)

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

- [FFPACK::Protected](#)

Macros

- `#define __FFLASFFPACK_FTRSTR_THRESHOLD 64`
- `#define __FFLASFFPACK_FTRSSYR2K_THRESHOLD 64`

Functions

- void [LAPACKPerm2MathPerm](#) (size_t *MathP, const size_t *LapackP, const size_t N)
Conversion of a permutation from LAPACK format to Math format.
- void [MathPerm2LAPACKPerm](#) (size_t *LapackP, const size_t *MathP, const size_t N)
Conversion of a permutation from Maths format to LAPACK format.
- template<class Field >
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P)
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.
- template<class Field >
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t m, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const [FFLAS::ParSeqHelper::Sequential](#) seq)

- `template<class Field , class Cut , class Param >`
`void applyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans,`
`const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const`
`size_t *P, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class Field >`
`void MonotonicApplyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE`
`Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda,`
`const size_t *P, const size_t R)`
Apply a R-monotonically increasing permutation P, to the matrix A.
- `template<class Field >`
`void fgetrs (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const`
`size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename`
`Field::Element_ptr B, const size_t ldb, int *info)`
Solve the system $AX = B$ or $XA = B$.
- `template<class Field >`
`Field::Element_ptr fgetrs (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N,`
`const size_t NRHS, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P,`
`const size_t *Q, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const`
`size_t ldb, int *info)`
Solve the system $AX = B$ or $XA = B$.
- `template<class Field >`
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, int *info)`
Square system solver.
- `template<class Field >`
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t`
`NRHS, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx,`
`typename Field::ConstElement_ptr B, const size_t ldb, int *info)`
Rectangular system solver.
- `template<class Field >`
`void ftrtri (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t`
`N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FTRTRI_THRESHOLD)`
Compute the inverse of a triangular matrix.
- `template<class Field >`
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldl, typename`
`Field::Element_ptr X, const size_t ldx)`
- `template<class Field >`
`void ftrtm (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t`
`N, typename Field::Element_ptr A, const size_t lda)`
Compute the product of two triangular matrices of opposite shape.
- `template<class Field >`
`void ftrstr (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_UPLO Uplo,`
`const FFLAS::FFLAS_DIAG diagA, const FFLAS::FFLAS_DIAG diagB, const size_t N, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t`
`threshold=__FFLASFFPACK_FTRSTR_THRESHOLD)`
Solve a triangular system with a triangular right hand side of the same shape.
- `template<class Field >`
`void ftrssyr2k (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const`
`size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t`
`ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)`
Solve a triangular system in a symmetric sum: find B upper/lower triangular such that $A^T B + B^T A = C$ where C is symmetric.
- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr`
`A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`

Triangular factorization of symmetric matrices.

- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field , class Cut , class Param >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field >`
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, typename Field::Element_ptr D, const size_t incD, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`

Triangular factorization of symmetric matrices.

- `template<class Field >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Q)`

Compute a PLUQ factorization of the given matrix.

- `template<class Field >`
`size_t pPLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Q)`
- `template<class Field >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, type-`
`name Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Sequential`
`&PShelper, size_t BCThreshold=__FFLASFFPACK_PLUQ_THRESHOLD)`
- `template<class Field , class Cut , class Param >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< Cut,`
`Param > &PShelper)`
- `template<class Field >`
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans,`
`const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt,`
`const FFPACK_LU_TAG LuTag=FpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE_THRESHOLD)`

Compute the CUP or PLE factorization of the given matrix.

- `template<class Field >`
`size_t LUdivine_construct (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N,`
`typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx,`
`typename Field::Element_ptr u, const size_t incu, size_t *P, bool computeX, const FFPACK_MINPOLY_TAG`
`MinTag=FpackDense, const size_t kg_mc=0, const size_t kg_mb=0, const size_t kg_j=0)`
- `template<class Field >`
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, bool transform=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

Compute the Column Echelon form of the input matrix in-place.

- `template<class Field >`
`size_t pColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG`
`LuTag=FpackTileRecursive)`
- `template<class Field , class PShelper >`
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PShelper`
`&psh)`
- `template<class Field >`
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

Compute the Row Echelon form of the input matrix in-place.

- `template<class Field >`
`size_t pRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform=false, `size_t` numthreads=0, const `FFPACK_LU_TAG` LuTag=`FfpackTileRecursive`)
- `template<class Field , class PSHelper >`
`size_t RowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag, const `PSHelper` &psH)
- `template<class Field >`
`size_t ReducedColumnEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform=false, const `FFPACK_LU_TAG` LuTag=`FfpackSlabRecursive`)
Compute the Reduced Column Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pReducedColumnEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform=false, `size_t` numthreads=0, const `FFPACK_LU_TAG` LuTag=`FfpackTileRecursive`)
- `template<class Field , class PSHelper >`
`size_t ReducedColumnEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag, const `PSHelper` &psH)
- `template<class Field >`
`size_t ReducedRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform=false, const `FFPACK_LU_TAG` LuTag=`FfpackSlabRecursive`)
Compute the Reduced Row Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pReducedRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform=false, `size_t` numthreads=0, const `FFPACK_LU_TAG` LuTag=`FfpackTileRecursive`)
- `template<class Field , class PSHelper >`
`size_t ReducedRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag, const `PSHelper` &psH)
- `template<class Field >`
`size_t GaussJordan` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, const `size_t` colbeg, const `size_t` rowbeg, const `size_t` colsize, `size_t` *P, `size_t` *Q, const `FFPACK::FFPACK_LU_TAG` LuTag)
Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.
- `template<class Field >`
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, int &nullity)
Invert the given matrix in place or computes its nullity if it is singular.
- `template<class Field >`
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &nullity)
Invert the given matrix or computes its nullity if it is singular.
- `template<class Field >`
`Field::Element_ptr Invert2` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &nullity)
Invert the given matrix or computes its nullity if it is singular.
- `template<class PolRing >`
`std::list< typename PolRing::Element > & CharPoly` (const `PolRing` &R, `std::list< typename PolRing::Element >` &charp, const `size_t` N, typename `PolRing::Domain_t::Element_ptr` A, const `size_t` lda, typename `PolRing::Domain_t::RandIter` &G, const `FFPACK_CHARPOLY_TAG` CharpTag=`FfpackAuto`, const `size_t` degree=`_FflasFfpackArithProgThreshold`)

Compute the characteristic polynomial of the matrix A.

- `template<class PolRing >`
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, type-`
`name PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::Randlter &G, const`
`FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`

Compute the characteristic polynomial of the matrix A.

- `template<class PolRing >`
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N,`
`typename PolRing::Domain_t::Element_ptr A, const size_t lda, const FFPACK_CHARPOLY_TAG Charp←`
`Tag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`

Compute the characteristic polynomial of the matrix A.

- `template<class Field , class Polynomial >`
`std::list< Polynomial > & KellerGehrig (const Field &F, std::list< Polynomial > &charp, const size_t N, type-`
`name Field::ConstElement_ptr A, const size_t lda)`
- `template<class Field , class Polynomial >`
`int KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, size_t *kg_mc, size_t *kg_mb, size_t *kg_j)`
- `template<class Field , class Polynomial >`
`std::list< Polynomial > & KGFast_generalized (const Field &F, std::list< Polynomial > &charp, const size_t`
`N, typename Field::Element_ptr A, const size_t lda)`
- `template<class Field >`
`void fgmv_kgf (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, type-`
`name Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, const`
`size_t kg_mc, const size_t kg_mb, const size_t kg_j)`
- `template<class Field , class Polynomial , class Randlter >`
`std::list< Polynomial > & LUKrylov (const Field &F, std::list< Polynomial > &charp, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, typename Field::Element_ptr U, const size_t ldu, Randlter &G)`
- `template<class Field , class Polynomial >`
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, type-`
`name Field::Element_ptr A, const size_t lda)`
- `template<class PolRing >`
`void RandomKrylovPrecond (const PolRing &PR, std::list< typename PolRing::Element > &completed←`
`Factors, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, size_t &Nb, typename`
`PolRing::Domain_t::Element_ptr &B, size_t &ldb, typename PolRing::Domain_t::Randlter &g, const size_t←`
`t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`
- `template<class PolRing >`
`std::list< typename PolRing::Element > & ArithProg (const PolRing &PR, std::list< typename PolRing::←`
`Element > &frobeniusForm, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda,`
`const size_t degree)`
- `template<class Field , class Polynomial >`
`std::list< Polynomial > & LUKrylov_KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N,`
`typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field , class Polynomial >`
`Polynomial & MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr`
`A, const size_t lda)`

Compute the minimal polynomial of the matrix A.

- `template<class Field , class Polynomial , class Randlter >`
`Polynomial & MinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr`
`A, const size_t lda, Randlter &G)`

Compute the minimal polynomial of the matrix A.

- `template<class Field , class Polynomial >`
`Polynomial & MatVecMinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr`
`A, const size_t lda, typename Field::ConstElement_ptr v, const size_t incv)`

Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis $(v, Av, \dots, A^N v)$.

- template<class Field , class Polynomial >
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) v, const size_t incv, typename [Field::Element_ptr](#) K, const size_t ldk, size_t *P)
- template<class Field , class Polynomial >
Polynomial & [Hybrid_KGF_LUK_MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, size_t *P, const FFPACK_MINPOLY_TAG MinTag=[FFPACK::FfpackDense](#), const size_t kg_mc=0, const size_t kg_↵ mb=0, const size_t kg_j=0)
- template<class Field >
size_t [Rank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)
Computes the rank of the given matrix using a PLUQ factorization.
- template<class Field >
size_t [pRank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t numthreads=0)
- template<class Field , class PSHelper >
size_t [Rank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, const PSHelper &psH)
- template<class Field >
bool [IsSingular](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)
Returns true if the given matrix is singular.
- template<class Field >
[Field::Element](#) & [Det](#) (const [Field](#) &F, typename [Field::Element](#) &det, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P=NULL, size_t *Q=NULL)
Returns the determinant of the given square matrix.
- template<class Field >
[Field::Element](#) & [pDet](#) (const [Field](#) &F, typename [Field::Element](#) &det, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t numthreads=0, size_t *P=NULL, size_t *Q=NULL)
- template<class Field , class PSHelper >
[Field::Element](#) & [Det](#) (const [Field](#) &F, typename [Field::Element](#) &det, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, const PSHelper &psH, size_t *P=NULL, size_t *Q=NULL)
- template<class Field >
[Field::Element_ptr](#) [Solve](#) (const [Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) x, const int incx, typename [Field::ConstElement_ptr](#) b, const int incb)
Solves a linear system $AX = b$ using PLUQ factorization.
- template<class Field , class PSHelper >
[Field::Element_ptr](#) [Solve](#) (const [Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) x, const int incx, typename [Field::ConstElement_ptr](#) b, const int incb, PSHelper &psH)
- template<class Field >
[Field::Element_ptr](#) [pSolve](#) (const [Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) x, const int incx, typename [Field::ConstElement_ptr](#) b, const int incb, size_t numthreads=0)
- template<class Field >
*void [RandomNullSpaceVector](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t incX)
Solve $LX = B$ or $XL = B$ in place.
- template<class Field >
size_t [NullSpaceBasis](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) &NS, size_t &ldn, size_t ↵ t &NSdim)
Computes a basis of the Left/Right nullspace of the matrix A.
- template<class Field >
size_t [RowRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag=[FfpackSlabRecursive](#))

Computes the row rank profile of A.

- template<class Field >
size_t [pRowRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=[FfpackTileRecursive](#))
- template<class Field , class PSHelper >
size_t [RowRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)
- template<class Field >
size_t [ColumnRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag=[FfpackSlabRecursive](#))

Computes the column rank profile of A.

- template<class Field >
size_t [pColumnRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=[FfpackTileRecursive](#))
- template<class Field , class PSHelper >
size_t [ColumnRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)
- void [RankProfileFromLU](#) (const size_t *P, const size_t N, const size_t R, size_t *rkprofile, const FFPACK_LU_TAG LuTag)

Recovers the column/row rank profile from the permutation of an LU decomposition.

- size_t [LeadingSubmatrixRankProfiles](#) (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSn, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP)

Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.

- template<class Field >
size_t [RowRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rowindices, size_t *colindices, size_t &R)

RowRankProfileSubmatrixIndices.

- template<class Field >
size_t [ColRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rowindices, size_t *colindices, size_t &R)

Computes the indices of the submatrix $r \times r$ X of A whose columns correspond to the column rank profile of A.

- template<class Field >
size_t [RowRankProfileSubmatrix](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) &X, size_t &R)

Computes the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.

- template<class Field >
size_t [ColRankProfileSubmatrix](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) &X, size_t &R)

Compute the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.

- template<class Field >
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false)

Extracts a triangular matrix from a compact storage $A=L\backslash U$ of rank R.

- template<class Field >
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda)

Cleans up a compact storage $A=L\backslash U$ to reveal a triangular matrix of rank R.

- template<class Field >
void [getEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=[FfpackSlabRecursive](#))

Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.

- `template<class Field >`
`void getEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t lda, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Cleans up a compact storage $A=L\backslash U$ obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R .
- `template<class Field >`
`void getEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.
- `template<class Field >`
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.
- `template<class Field >`
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t lda, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Cleans up a compact storage $A=L\backslash U$ of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.
- `template<class Field >`
`void getReducedEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.
- `void PLUQtoEchelonPermutation (const size_t N, const size_t R, const size_t *P, size_t *outPerm)`
Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.
- `template<class Field >`
`Field::Element_ptr LQUPtoInverseOfFullRankMinor (const Field &F, const size_t rank, typename Field::Element_ptr A_factors, const size_t lda, const size_t *QtPointer, typename Field::Element_ptr X, const size_t ldx)`
LQUPtoInverseOfFullRankMinor.

17.157.1 Detailed Description

Set of elimination based routines for dense linear algebra.

Matrices are supposed over finite prime field of characteristic less than 2^{26} .

17.157.2 Macro Definition Documentation

17.157.2.1 __FFLASFFPACK_FTRSTR_THRESHOLD

```
#define __FFLASFFPACK_FTRSTR_THRESHOLD 64
```

17.157.2.2 __FFLASFFPACK_FTRSSYR2K_THRESHOLD

```
#define __FFLASFFPACK_FTRSSYR2K_THRESHOLD 64
```

17.158 ffpack.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_INL`

Functions

- `template<class Field >`
`size_t Rank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda)`
Computes the rank of the given matrix using a PLUQ factorization.
- `template<class Field >`
`size_t pRank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t numthreads=0)`
- `template<class Field , class PSHelper >`
`size_t Rank (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, const PSHelper &psH)`
- `template<class Field >`
`bool IsSingular (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda)`
Returns true if the given matrix is singular.
- `template<class Field >`
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P=NULL, size_t *Q=NULL)`
Returns the determinant of the given square matrix.
- `template<class Field >`
`Field::Element & pDet (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t numthreads=0, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field , class PSHelper >`
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, const PSHelper &psH, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field >`
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb)`
Solves a linear system $AX = b$ using PLUQ factorization.
- `template<class Field , class PSHelper >`
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, PSHelper &psH)`
- `template<class Field >`
`Field::Element_ptr pSolve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, size_t numthreads=0)`
- `template<class Field >`
`void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t incX)`
Solve $LX = B$ or $XL = B$ in place.
- `template<class Field >`
`size_t NullSpaceBasis (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &NS, size_t &ldn, size_t &NSdim)`

Computes a basis of the Left/Right nullspace of the matrix A.

- `template<class Field >`
`void solveLB (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field >`
`void solveLB2 (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`

17.158.1 Macro Definition Documentation

17.158.1.1 __FFLASFFPACK_ffpack_INL

```
#define __FFLASFFPACK_ffpack_INL
```

17.159 ffpack_c.h File Reference

```
#include <stdbool.h>
#include <stdlib.h>
#include <inttypes.h>
```

Macros

- `#define FFPACK_COMPILED`

Enumerations

- `enum FFLAS_C_ORDER { FflasRowMajor = 101, FflasColMajor = 102, FflasRowMajor = 101, FflasColMajor = 102 }`
- `enum FFLAS_C_TRANSPOSE { FflasNoTrans = 111, FflasTrans = 112, FflasNoTrans = 111, FflasTrans = 112 }`
- `enum FFLAS_C_UPLO { FflasUpper = 121, FflasLower = 122, FflasUpper = 121, FflasLower = 122 }`
- `enum FFLAS_C_DIAG { FflasNonUnit = 131, FflasUnit = 132, FflasNonUnit = 131, FflasUnit = 132 }`
- `enum FFLAS_C_SIDE { FflasLeft = 141, FflasRight = 142, FflasLeft = 141, FflasRight = 142 }`
- `enum FFPACK_C_LU_TAG { FfpackSlabRecursive = 1, FfpackTileRecursive = 2, FfpackSingular = 3 }`
- `enum FFPACK_C_CHARPOLY_TAG { FfpackLUK = 1, FfpackKG = 2, FfpackHybrid = 3, FfpackKGFast = 4, FfpackDanilevski = 5, FfpackArithProg = 6, FfpackKGFastG = 7 }`
- `enum FFPACK_C_MINPOLY_TAG { FfpackDense = 1, FfpackKGF = 2 }`

Functions

- `void LAPACKPerm2MathPerm (size_t *MathP, const size_t *LapackP, const size_t N)`
- `void MathPerm2LAPACKPerm (size_t *LapackP, const size_t *MathP, const size_t N)`
- `void MatrixApplyS_modular_double (const double p, double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)`
- `void PermApplyS_double (double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `void MatrixApplyT_modular_double (const double p, double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)`
- `void PermApplyT_double (double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`

- void [composePermutationsLLM](#) (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void [composePermutationsLLL](#) (size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void [composePermutationsMLM](#) (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)
- void [cyclic_shift_mathPerm](#) (size_t *P, const size_t s)
- void [cyclic_shift_row_modular_double](#) (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void [cyclic_shift_col_modular_double](#) (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void [applyP_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const enum [FFLAS_C_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, double *A, const size_t lda, const size_t *P, bool positive)
- void [fgetrsin_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const size_t M, const size_t N, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *B, const size_t ldb, int *info, bool positive)
- double * [fgetrs_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *X, const size_t ldx, const double *B, const size_t ldb, int *info, bool positive)
- size_t [fgesvin_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const size_t M, const size_t N, double *A, const size_t lda, double *B, const size_t ldb, int *info, bool positive)
- size_t [fgesv_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, double *A, const size_t lda, double *X, const size_t ldx, const double *B, const size_t ldb, int *info)
- void [ftrtri_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_DIAG](#) Diag, const size_t N, double *A, const size_t lda, bool positive)
- void [trinv_left_modular_double](#) (const double p, const size_t N, const double *L, const size_t ldl, double *X, const size_t ldx, bool positive)
- void [ftrtrm_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) diag, const size_t N, double *A, const size_t lda, bool positive)
- size_t [PLUQ_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, bool positive)
- size_t [LUdivine_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const enum [FFLAS_C_TRANSPOSE](#) trans, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const enum [FFPACK_C_LU_TAG](#) LuTag, const size_t cutoff, bool positive)
- size_t [LUdivine_small_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const enum [FFLAS_C_TRANSPOSE](#) trans, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [LUdivine_gauss_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ColumnEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [RowEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ColumnEchelonForm_modular_float](#) (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [RowEchelonForm_modular_float](#) (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ColumnEchelonForm_modular_int32_t](#) (const [int32_t](#) p, const size_t M, const size_t N, [int32_t](#) *A, const size_t lda, size_t *P, size_t *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [RowEchelonForm_modular_int32_t](#) (const [int32_t](#) p, const size_t M, const size_t N, [int32_t](#) *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedColumnEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedRowEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)

- `size_t ReducedColumnEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedRowEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedColumnEchelonForm_modular_int32_t` (const `int32_t` p, const `size_t` M, const `size_t` N, `int32_t` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedRowEchelonForm_modular_int32_t` (const `int32_t` p, const `size_t` M, const `size_t` N, `int32_t` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ReducedRowEchelonForm2_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, bool positive)
- `size_t REF_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, const `size_t` colbeg, const `size_t` rowbeg, const `size_t` colsize, `size_t` *Qt, `size_t` *P, bool positive)
- `double * Invertin_modular_double` (const double p, const `size_t` M, double *A, const `size_t` lda, int *nullity, bool positive)
- `double * Invert_modular_double` (const double p, const `size_t` M, const double *A, const `size_t` lda, double *X, const `size_t` ldx, int *nullity, bool positive)
- `double * Invert2_modular_double` (const double p, const `size_t` M, double *A, const `size_t` lda, double *X, const `size_t` ldx, int *nullity, bool positive)
- `size_t KrylovElim_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Q, const `size_t` deg, `size_t` *iterates, `size_t` *inviterates, const `size_t` maxit, `size_t` virt, bool positive)
- `size_t SpecRankProfile_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, const `size_t` deg, `size_t` *rankProfile, bool positive)
- `size_t Rank_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `bool IsSingular_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `double Det_modular_double` (const double p, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `double * Solve_modular_double` (const double p, const `size_t` M, double *A, const `size_t` lda, double *x, const int incx, const double *b, const int incb, bool positive)
- `void solveLB_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, double *L, const `size_t` ldl, const `size_t` *Q, double *B, const `size_t` ldb)
- `void solveLB2_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, double *L, const `size_t` ldl, const `size_t` *Q, double *B, const `size_t` ldb, bool positive)
- `void RandomNullSpaceVector_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double *X, const `size_t` incX, bool positive)
- `size_t NullSpaceBasis_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double **NS, `size_t` *ldn, `size_t` *NSdim, bool positive)
- `size_t RowRankProfile_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ColumnRankProfile_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `void RankProfileFromLU` (const `size_t` *P, const `size_t` N, const `size_t` R, `size_t` *rkprofile, const enum `FFPACK_C_LU_TAG` LuTag)
- `size_t LeadingSubmatrixRankProfiles` (const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` LSm, const `size_t` LSn, const `size_t` *P, const `size_t` *Q, `size_t` *RRP, `size_t` *CRP)
- `size_t RowRankProfileSubmatrixIndices_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rowindices, `size_t` **colindices, `size_t` *R, bool positive)
- `size_t ColRankProfileSubmatrixIndices_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` **rowindices, `size_t` **colindices, `size_t` *R, bool positive)
- `size_t RowRankProfileSubmatrix_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double **X, `size_t` *R, bool positive)
- `size_t ColRankProfileSubmatrix_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, double **X, `size_t` *R, bool positive)

- void [getTriangular_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, bool positive)
- void [getTriangularin_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_DIAG](#) diag, const size_t M, const size_t N, const size_t R, double *A, const size_t lda, bool positive)
- void [getEchelonForm_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getEchelonFormin_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getEchelonTransform_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getReducedEchelonForm_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getReducedEchelonFormin_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [getReducedEchelonTransform_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- void [PLUQtoEchelonPermutation](#) (const size_t N, const size_t R, const size_t *P, size_t *outPerm)

17.159.1 Macro Definition Documentation

17.159.1.1 FFPACK_COMPILED

```
#define FFPACK_COMPILED
```

17.159.2 Enumeration Type Documentation

17.159.2.1 FFLAS_C_ORDER

```
enum FFLAS\_C\_ORDER
```

Enumerator

| | |
|---------------|-----------|
| FflasRowMajor | row major |
| FflasColMajor | col major |
| FflasRowMajor | |
| FflasColMajor | |

17.159.2.2 FFLAS_C_TRANSPOSE

```
enum FFLAS\_C\_TRANSPOSE
```

Enumerator

| | |
|--------------|---------------------------|
| FflasNoTrans | Matrix is not transposed. |
| FflasTrans | Matrix is transposed. |
| FflasNoTrans | |
| FflasTrans | |

17.159.2.3 FFLAS_C_UPLOenum [FFLAS_C_UPLO](#)

Enumerator

| | |
|------------|--|
| FflasUpper | Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$) |
| FflasLower | Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$) |
| FflasUpper | |
| FflasLower | |

17.159.2.4 FFLAS_C_DIAGenum [FFLAS_C_DIAG](#)

Enumerator

| | |
|--------------|---|
| FflasNonUnit | Triangular matrix has an explicit arbitrary diagonal. |
| FflasUnit | Triangular matrix has an implicit unit diagonal ($T_{i,i} = 1$) |
| FflasNonUnit | |
| FflasUnit | |

17.159.2.5 FFLAS_C_SIDEenum [FFLAS_C_SIDE](#)

Enumerator

| | |
|------------|---------------------------------|
| FflasLeft | Operator applied on the left. |
| FflasRight | Operator applied on the righth. |
| FflasLeft | |
| FflasRight | |

17.159.2.6 FFPACK_C_LU_TAGenum [FFPACK_C_LU_TAG](#)

Enumerator

| | |
|---------------------|--|
| FfpackSlabRecursive | |
| FfpackTileRecursive | |

Enumerator

| | |
|----------------|--|
| FfpackSingular | |
|----------------|--|

17.159.2.7 FFPACK_C_CHARPOLY_TAG

enum [FFPACK_C_CHARPOLY_TAG](#)

Enumerator

| | |
|------------------|--|
| FfpackLUK | |
| FfpackKG | |
| FfpackHybrid | |
| FfpackKGFast | |
| FfpackDanilevski | |
| FfpackArithProg | |
| FfpackKGFastG | |

17.159.2.8 FFPACK_C_MINPOLY_TAG

enum [FFPACK_C_MINPOLY_TAG](#)

Enumerator

| | |
|-------------|--|
| FfpackDense | |
| FfpackKGF | |

17.159.3 Function Documentation**17.159.3.1 LAPACKPerm2MathPerm()**

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N )
```

17.159.3.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N )
```

17.159.3.3 MatrixApplyS_modular_double()

```
void MatrixApplyS_modular_double (
    const double p,
    double * A,
```

```
const size_t lda,  
const size_t width,  
const size_t M2,  
const size_t R1,  
const size_t R2,  
const size_t R3,  
const size_t R4,  
bool positive )
```

17.159.3.4 PermApplyS_double()

```
void PermApplyS_double (  
    double * A,  
    const size_t lda,  
    const size_t width,  
    const size_t M2,  
    const size_t R1,  
    const size_t R2,  
    const size_t R3,  
    const size_t R4 )
```

17.159.3.5 MatrixApplyT_modular_double()

```
void MatrixApplyT_modular_double (  
    const double p,  
    double * A,  
    const size_t lda,  
    const size_t width,  
    const size_t N2,  
    const size_t R1,  
    const size_t R2,  
    const size_t R3,  
    const size_t R4,  
    bool positive )
```

17.159.3.6 PermApplyT_double()

```
void PermApplyT_double (  
    double * A,  
    const size_t lda,  
    const size_t width,  
    const size_t N2,  
    const size_t R1,  
    const size_t R2,  
    const size_t R3,  
    const size_t R4 )
```

17.159.3.7 composePermutationsLLM()

```
void composePermutationsLLM (  
    size_t * MathP,  
    const size_t * P1,  
    const size_t * P2,  
    const size_t R,  
    const size_t N )
```

17.159.3.8 composePermutationsLLL()

```
void composePermutationsLLL (
    size_t * P1,
    const size_t * P2,
    const size_t R,
    const size_t N )
```

17.159.3.9 composePermutationsMLM()

```
void composePermutationsMLM (
    size_t * MathP1,
    const size_t * P2,
    const size_t R,
    const size_t N )
```

17.159.3.10 cyclic_shift_mathPerm()

```
void cyclic_shift_mathPerm (
    size_t * P,
    const size_t s )
```

17.159.3.11 cyclic_shift_row_modular_double()

```
void cyclic_shift_row_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive )
```

17.159.3.12 cyclic_shift_col_modular_double()

```
void cyclic_shift_col_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive )
```

17.159.3.13 applyP_modular_double()

```
void applyP_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const enum FFLAS_C_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    double * A,
```



```
    const size_t lda,  
    const size_t * P,  
    bool positive )
```

17.159.3.14 fgetrsin_modular_double()

```
void fgetrsin_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * A,  
    const size_t lda,  
    const size_t * P,  
    const size_t * Q,  
    double * B,  
    const size_t ldb,  
    int * info,  
    bool positive )
```

17.159.3.15 fgetrs_modular_double()

```
double* fgetrs_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t NRHS,  
    const size_t R,  
    double * A,  
    const size_t lda,  
    const size_t * P,  
    const size_t * Q,  
    double * X,  
    const size_t ldx,  
    const double * B,  
    const size_t ldb,  
    int * info,  
    bool positive )
```

17.159.3.16 fgesvin_modular_double()

```
size_t fgesvin_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    int * info,  
    bool positive )
```

17.159.3.17 fgesv_modular_double()

```

size_t fgesv_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    const double * B,
    const size_t ldb,
    int * info )

```

17.159.3.18 ftrtri_modular_double()

```

void ftrtri_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG Diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )

```

17.159.3.19 trinv_left_modular_double()

```

void trinv_left_modular_double (
    const double p,
    const size_t N,
    const double * L,
    const size_t ldl,
    double * X,
    const size_t ldx,
    bool positive )

```

17.159.3.20 ftrtrm_modular_double()

```

void ftrtrm_modular_double (
    const double p,
    const enum FFLAS_C_DIAG diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )

```

17.159.3.21 PLUQ_modular_double()

```

size_t PLUQ_modular_double (
    const double p,
    const enum FFLAS_C_DIAG Diag,
    const size_t M,
    const size_t N,

```

```
double * A,
const size_t lda,
size_t * P,
size_t * Q,
bool positive )
```

17.159.3.22 LUdivine_modular_double()

```
size_t LUdivine_modular_double (
    const double p,
    const enum FFLAS_C_DIAG Diag,
    const enum FFLAS_C_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const enum FFPACK_C_LU_TAG LuTag,
    const size_t cutoff,
    bool positive )
```

17.159.3.23 LUdivine_small_modular_double()

```
size_t LUdivine_small_modular_double (
    const double p,
    const enum FFLAS_C_DIAG Diag,
    const enum FFLAS_C_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.24 LUdivine_gauss_modular_double()

```
size_t LUdivine_gauss_modular_double (
    const double p,
    const enum FFLAS_C_DIAG Diag,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.25 ColumnEchelonForm_modular_double()

```
size_t ColumnEchelonForm_modular_double (
    const double p,
```

```

    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.26 RowEchelonForm_modular_double()

```

size_t RowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.27 ColumnEchelonForm_modular_float()

```

size_t ColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.28 RowEchelonForm_modular_float()

```

size_t RowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.29 ColumnEchelonForm_modular_int32_t()

```

size_t ColumnEchelonForm_modular_int32_t (

```

```
const int32_t p,  
const size_t M,  
const size_t N,  
int32_t * A,  
const size_t lda,  
size_t * P,  
size_t * Qt,  
bool transform,  
const enum FFPACK_C_LU_TAG LuTag,  
bool positive )
```

17.159.3.30 RowEchelonForm_modular_int32_t()

```
size_t RowEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.159.3.31 ReducedColumnEchelonForm_modular_double()

```
size_t ReducedColumnEchelonForm_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.159.3.32 ReducedRowEchelonForm_modular_double()

```
size_t ReducedRowEchelonForm_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.159.3.33 ReducedColumnEchelonForm_modular_float()

```
size_t ReducedColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.34 ReducedRowEchelonForm_modular_float()

```
size_t ReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.35 ReducedColumnEchelonForm_modular_int32_t()

```
size_t ReducedColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.36 ReducedRowEchelonForm_modular_int32_t()

```
size_t ReducedRowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.37 ReducedRowEchelonForm2_modular_double()

```
size_t ReducedRowEchelonForm2_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    bool positive )
```

17.159.3.38 REF_modular_double()

```
size_t REF_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    const size_t colbeg,
    const size_t rowbeg,
    const size_t colsize,
    size_t * Qt,
    size_t * P,
    bool positive )
```

17.159.3.39 Invertin_modular_double()

```
double* Invertin_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    int * nullity,
    bool positive )
```

17.159.3.40 Invert_modular_double()

```
double* Invert_modular_double (
    const double p,
    const size_t M,
    const double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    int * nullity,
    bool positive )
```

17.159.3.41 Invert2_modular_double()

```
double* Invert2_modular_double (
    const double p,
    const size_t M,
```

```
double * A,  
const size_t lda,  
double * X,  
const size_t ldX,  
int * nullity,  
bool positive )
```

17.159.3.42 KrylovElim_modular_double()

```
size_t KrylovElim_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Q,  
    const size_t deg,  
    size_t * iterates,  
    size_t * inviterates,  
    const size_t maxit,  
    size_t virt,  
    bool positive )
```

17.159.3.43 SpecRankProfile_modular_double()

```
size_t SpecRankProfile_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    const size_t deg,  
    size_t * rankProfile,  
    bool positive )
```

17.159.3.44 Rank_modular_double()

```
size_t Rank_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.159.3.45 IsSingular_modular_double()

```
bool IsSingular_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```


17.159.3.46 Det_modular_double()

```
double Det_modular_double (
    const double p,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )
```

17.159.3.47 Solve_modular_double()

```
double* Solve_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    double * x,
    const int incx,
    const double * b,
    const int incb,
    bool positive )
```

17.159.3.48 solveLB_modular_double()

```
void solveLB_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * L,
    const size_t ldl,
    const size_t * Q,
    double * B,
    const size_t ldb )
```

17.159.3.49 solveLB2_modular_double()

```
void solveLB2_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * L,
    const size_t ldl,
    const size_t * Q,
    double * B,
    const size_t ldb,
    bool positive )
```

17.159.3.50 RandomNullSpaceVector_modular_double()

```
void RandomNullSpaceVector_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * X,
    const size_t incX,
    bool positive )
```

17.159.3.51 NullSpaceBasis_modular_double()

```
size_t NullSpaceBasis_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** NS,
    size_t * ldn,
    size_t * NSdim,
    bool positive )
```

17.159.3.52 RowRankProfile_modular_double()

```
size_t RowRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.53 ColumnRankProfile_modular_double()

```
size_t ColumnRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.54 RankProfileFromLU()

```
void RankProfileFromLU (
    const size_t * P,
```

```

    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const enum FFPACK_C_LU_TAG LuTag )

```

17.159.3.55 LeadingSubmatrixRankProfiles()

```

size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP )

```

17.159.3.56 RowRankProfileSubmatrixIndices_modular_double()

```

size_t RowRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )

```

17.159.3.57 ColRankProfileSubmatrixIndices_modular_double()

```

size_t ColRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )

```

17.159.3.58 RowRankProfileSubmatrix_modular_double()

```

size_t RowRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive )

```

17.159.3.59 ColRankProfileSubmatrix_modular_double()

```
size_t ColRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive )
```

17.159.3.60 getTriangular_modular_double()

```
void getTriangular_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    bool positive )
```

17.159.3.61 getTriangularin_modular_double()

```
void getTriangularin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    bool positive )
```

17.159.3.62 getEchelonForm_modular_double()

```
void getEchelonForm_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
```

```

    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.63 getEchelonFormin_modular_double()

```

void getEchelonFormin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.64 getEchelonTransform_modular_double()

```

void getEchelonTransform_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.65 getReducedEchelonForm_modular_double()

```

void getReducedEchelonForm_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.159.3.66 getReducedEchelonFormin_modular_double()

```
void getReducedEchelonFormin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.67 getReducedEchelonTransform_modular_double()

```
void getReducedEchelonTransform_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.159.3.68 PLUQtoEchelonPermutation()

```
void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
    const size_t * P,
    size_t * outPerm )
```

17.160 ffpack_charpoly.inl File Reference

```
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "ffpack_charpoly_mp.inl"
```

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- [FFPACK::Protected](#)

Macros

- `#define` [__FFLASFFPACK_charpoly_INL](#)

Functions

- `template<class PolRing >`
`std::list< typename PolRing::Element > & CharPoly (const PolRing &R, std::list< typename PolRing::Element > &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`
Compute the characteristic polynomial of the matrix A.
- `template<class PolRing >`
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`
Compute the characteristic polynomial of the matrix A.
- `template<class Field , class Polynomial , class RandIter >`
`std::list< Polynomial > & LUKrylov (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr U, const size_t ldu, RandIter &G)`
- `template<class Field , class Polynomial >`
`std::list< Polynomial > & LUKrylov_KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx)`

17.160.1 Macro Definition Documentation

17.160.1.1 __FFLASFFPACK_charpoly_INL

```
#define __FFLASFFPACK_charpoly_INL
```

17.161 ffpack_charpoly_danilevski.inl File Reference

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_charpoly_danilveski_INL`

Functions

- `template<class Field , class Polynomial >`
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda)`

17.161.1 Macro Definition Documentation

17.161.1.1 __FFLASFFPACK_ffpack_charpoly_danilveski_INL

```
#define __FFLASFFPACK_ffpack_charpoly_danilveski_INL
```

17.162 ffpack_charpoly_kgfast.inl File Reference

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- [FFPACK::Protected](#)

Macros

- `#define __FFLASFFPACK_ffpack_charpoly_kgfast_INL`

Functions

- `template<class Field , class Polynomial >`
`int KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *kg_mc, size_t *kg_mb, size_t *kg_j)`
- `template<class Field >`
`void fgemv_kgf (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, type-
name Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, const
size_t kg_mc, const size_t kg_mb, const size_t kg_j)`

17.162.1 Macro Definition Documentation

17.162.1.1 __FFLASFFPACK_ffpack_charpoly_kgfast_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kgfast_INL
```

17.163 ffpack_charpoly_kgfastgeneralized.inl File Reference

```
#include <iostream>
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- [FFPACK::Protected](#)

Macros

- `#define __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL`

Functions

- `template<class Field >`
`Field::Element_ptr buildMatrix (const Field &F, typename Field::ConstElement_ptr E, typename Field::ConstElement_ptr
C, const size_t lda, const size_t *B, const size_t *T, const size_t me, const size_t mc, const size_t lambda,
const size_t mu)`
- `template<class Field , class Polynomial >`
`std::list< Polynomial > & KGFast_generalized (const Field &F, std::list< Polynomial > &charp, const size_t
N, typename Field::Element_ptr A, const size_t lda)`

17.163.1 Macro Definition Documentation

17.163.1.1 __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL
```

17.164 ffpack_charpoly_kglu.inl File Reference

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- [FFPACK::Protected](#)

Macros

- #define [__FFLASFFPACK_ffpack_charpoly_kglu_INL](#)

Functions

- template<class Field >
size_t [updateD](#) (const [Field](#) &F, size_t *d, size_t k, std::vector< std::vector< typename [Field::Element](#) > > &minpt)
- template<class Field >
size_t [newD](#) (const [Field](#) &F, size_t *d, bool &KeepOn, const size_t l, const size_t N, typename [Field::Element_ptr](#) X, const size_t *Q, std::vector< std::vector< typename [Field::Element](#) > > &minpt)
- template<class Field, class Polynomial >
std::list< Polynomial > & [KellerGehrig](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size_t N, type-
name [Field::ConstElement_ptr](#) A, const size_t lda)

17.164.1 Macro Definition Documentation

17.164.1.1 __FFLASFFPACK_ffpack_charpoly_kglu_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kglu_INL
```

17.165 ffpack_charpoly_mp.inl File Reference

```
#include <givaro/zring.h>
#include "givaro/givinteger.h"
#include "givaro/givpoly1.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
```

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFPACK_charpoly_mp_INL](#)

Functions

- [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >::Element_ptr CharPoly (const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, typename [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >::Element_ptr charp, const size_t N, typename [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >::Element_ptr A, const size_t Ida, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag, size_t degree)
- template<> Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & [CharPoly](#) (const Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > &R, Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element &charp, const size_t N, Givaro::Integer *A, const size_t Ida, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag, size_t degree)

17.165.1 Macro Definition Documentation

17.165.1.1 __FFPACK_charpoly_mp_INL

```
#define __FFPACK_charpoly_mp_INL
```

17.166 ffpack_det_mp.inl File Reference

```
#include <givaro/zring.h>
#include "givaro/givinteger.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFPACK_det_mp_INL](#)

Functions

- template<class PSHelper > [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >::Element_ptr & [Det](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, typename [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >::Element_ptr &det, const size_t N, typename [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >::Element_ptr A, const size_t Ida, const PSHelper &psH)
- template<class PSHelper > Givaro::Integer & [Det](#) (const Givaro::ZRing< Givaro::Integer > &F, Givaro::Integer &det, const size_t N, Givaro::Integer *A, const size_t Ida, const PSHelper &psH, size_t *P, size_t *Q)

17.166.1 Macro Definition Documentation

17.166.1.1 __FFPACK_det_mp_INL

```
#define __FFPACK_det_mp_INL
```

17.167 ffpack_echelonforms.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_echelon_forms_INL`
- `#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 256`

Functions

- `template<class Field >`
`void getTriangular (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false)`
Extracts a triangular matrix from a compact storage $A=L\backslash U$ of rank R .
- `template<class Field >`
`void getTriangular (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr A, const size_t lda)`
Cleans up a compact storage $A=L\backslash U$ to reveal a triangular matrix of rank R .
- `void PLUQtoEchelonPermutation (const size_t N, const size_t R, const size_t *P, size_t *outPerm)`
Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.
- `template<class Field >`
`void getEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or Column↔EchelonForm.
- `template<class Field >`
`void getEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t lda, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Cleans up a compact storage $A=L\backslash U$ obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R .
- `template<class Field >`
`void getEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelon↔Form or ColumnEchelonForm.
- `template<class Field >`
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.
- `template<class Field >`
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t lda, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`

Cleans up a compact storage $A=L\backslash U$ of rank R obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

- `template<class Field >`
`void getReducedEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr T, const size_t ldt, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`

Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by `RowEchelonForm` or `ColumnEchelonForm`.

17.167.1 Macro Definition Documentation

17.167.1.1 `__FFLASFFPACK_ffpack_echelon_forms_INL`

```
#define __FFLASFFPACK_ffpack_echelon_forms_INL
```

17.167.1.2 `__FFLASFFPACK_GAUSSJORDAN_BASECASE`

```
#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 256
```

17.168 `ffpack_fgesv.inl` File Reference

Namespaces

- [FFPACK](#)

*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_fgesv_INL`

Functions

- `template<class Field >`
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, int *info)`
Square system solver.
- `template<class Field >`
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`
Rectangular system solver.

17.168.1 Macro Definition Documentation

17.168.1.1 `__FFLASFFPACK_ffpack_fgesv_INL`

```
#define __FFLASFFPACK_ffpack_fgesv_INL
```

17.169 ffpack_fgetrs.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_fgetrs_INL`

Functions

- `template<class Field >`
`void fgetrs (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename Field::Element_ptr B, const size_t ldb, int *info)`
Solve the system $AX = B$ or $XA = B$.
- `template<class Field >`
`Field::Element_ptr fgetrs (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename Field::Element_ptr X, const size_t idx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`
Solve the system $A X = B$ or $X A = B$.

17.169.1 Macro Definition Documentation

17.169.1.1 __FFLASFFPACK_ffpack_fgetrs_INL

```
#define __FFLASFFPACK_ffpack_fgetrs_INL
```

17.170 ffpack_frobenius.inl File Reference

```
#include <givaro/givranditer.h>
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

- [FFPACK::Protected](#)

Functions

- `template<class Field >`
`void CompressRows (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`
`void CompressRowsQK (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)`
- `template<class Field >`
`void DeCompressRows (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`

- `template<class Field >`
`void DeCompressRowsQK (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)`
- `template<class Field >`
`void CompressRowsQA (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`
`void DeCompressRowsQA (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class PolRing >`
`void RandomKrylovPrecond (const PolRing &PR, std::list< typename PolRing::Element > &completedFactors, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, size_t &Nb, typename PolRing::Domain_t::Element_ptr &B, size_t &ldb, typename PolRing::Domain_t::RandIter &g, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`
- `template<class PolRing >`
`std::list< typename PolRing::Element > &ArithProg (const PolRing &PR, std::list< typename PolRing::Element > &frobeniusForm, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, const size_t degree)`

17.171 ffpack_fsytrf.inl File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_fsytrf_INL`

Functions

- `template<class Field >`
`bool fsytrf_BC_Crout (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
- `template<class Field >`
`size_t fsytrf_BC_RL (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
- `template<class Field >`
`size_t fsytrf_UP_RPM_BC_RL (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field >`
`size_t fsytrf_LOW_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field >`
`size_t fsytrf_UP_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field >`
`size_t fsytrf_UP_RPM (const Field &Fi, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P, size_t BCThreshold)`
- `template<class Field >`
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename`

```
Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv,
FFLAS::ParSeqHelper::Sequential seq, size_t threshold)
```

- `template<class Field , class Cut , class Param >`
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv,`
`FFLAS::ParSeqHelper::Parallel< Cut, Param > par, size_t threshold)`
- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr`
`A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
Triangular factorization of symmetric matrices.
- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field , class Cut , class Param >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A,`
`const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field >`
`size_t fsytrf_RPM (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename`
`Field::Element_ptr A, const size_t lda, size_t *P, size_t threshold)`
- `template<class Field >`
`void getTridiagonal (const Field &F, const size_t N, const size_t R, typename Field::ConstElement_ptr A,`
`const size_t lda, size_t *P, typename Field::Element_ptr T, const size_t ldt)`

17.171.1 Macro Definition Documentation

17.171.1.1 __FFLASFFPACK_ffpack_fsytrf_INL

```
#define __FFLASFFPACK_ffpack_fsytrf_INL
```

17.172 ffpack_ftrssyr2k.inl File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_ftrssyr2k_INL`

Functions

- `template<class Field >`
`void ftrssyr2k (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const`
`size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t`
`ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)`
Solve a triangular system in a symmetric sum: find B upper/lower triangular such that $A^T B + B^T A = C$ where C is symmetric.

17.172.1 Macro Definition Documentation

17.172.1.1 __FFLASFFPACK_ffpack_ftrssyr2k_INL

```
#define __FFLASFFPACK_ffpack_ftrssyr2k_INL
```

17.173 ffpack_ftrstr.inl File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_ftrstr_INL](#)

Functions

- template<class Field >
void [ftrstr](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diagA, const [FFLAS::FFLAS_DIAG](#) diagB, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, const size_t threshold=[__FFLASFFPACK_FTRSTR_THRESHOLD](#))

Solve a triangular system with a triangular right hand side of the same shape.

17.173.1 Macro Definition Documentation

17.173.1.1 __FFLASFFPACK_ffpack_ftrstr_INL

```
#define __FFLASFFPACK_ffpack_ftrstr_INL
```

17.174 ffpack_ftrtr.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1
- #define [__FFLASFFPACK_ffpack_ftrtr_INL](#)

Functions

- template<class Field >
void [ftrtri](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, const size_t threshold=[__FFLASFFPACK_FTRTRI_THRESHOLD](#))
Compute the inverse of a triangular matrix.
- template<class Field >
void [ftrtrm](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_DIAG](#) diag, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)

Compute the product of two triangular matrices of opposite shape.

- `template<class Field >`
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldl, typename Field::Element_ptr X, const size_t ldx)`

17.174.1 Macro Definition Documentation

17.174.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.174.1.2 __FFLASFFPACK_ffpack_ftrtr_INL

```
#define __FFLASFFPACK_ffpack_ftrtr_INL
```

17.175 ffpack_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "ffpack_inst_implem.inl"
```

Macros

- `#define __FFPACK_INST_C`
- `#define FFLAS_COMPILED`
- `#define INST_OR_DECL`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.175.1 Macro Definition Documentation

17.175.1.1 __FFPACK_INST_C

```
#define __FFPACK_INST_C
```

17.175.1.2 FFLAS_COMPILED

```
#define FFLAS_COMPILED
```

17.175.1.3 INST_OR_DECL

```
#define INST_OR_DECL
```

17.175.1.4 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.175.1.5 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.175.1.6 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.175.1.7 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.175.1.8 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.175.1.9 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.175.1.10 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.175.1.11 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.176 ffpack_inst.h File Reference

```
#include "givaro/modular.h"  
#include "givaro/modular-balanced.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "ffpack_inst_implem.inl"
```

Macros

- #define FFLAS_COMPILED
- #define INST_OR_DECL <>
- #define FFLAS_FIELD Givaro::ModularBalanced
- #define FFLAS_ELT double
- #define FFLAS_ELT float

- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.176.1 Macro Definition Documentation

17.176.1.1 FFLAS_COMPILED

```
#define FFLAS_COMPILED
```

17.176.1.2 INST_OR_DECL

```
#define INST_OR_DECL <>
```

17.176.1.3 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.176.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.176.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.176.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.176.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.176.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.176.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.176.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.177 ffpack_inst_implem.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- void [composePermutationsLLM](#) (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in MathP as a MathPermutation format.
- void [composePermutationsLLL](#) (size_t *P1, const size_t *P2, const size_t R, const size_t N)
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.
- void [composePermutationsMLM](#) (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)
Computes $\text{MathP1} \times \text{Diag}(I_R, P2)$ where MathP1 is a MathPermutation and $P2$ a LAPACK permutation and store the result in MathP1 as a MathPermutation format.
- void [cyclic_shift_mathPerm](#) (size_t *P, const size_t s)
- template<typename Base_t >
void [cyclic_shift_row_col](#) (Base_t *A, size_t m, size_t n, size_t lda)
- template [INST_OR_DECL](#) void [cyclic_shift_row](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, [FFLAS_ELT](#) *A, size_t m, size_t n, size_t lda)
- template [INST_OR_DECL](#) void [cyclic_shift_col](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, [FFLAS_ELT](#) *A, size_t m, size_t n, size_t lda)
- template [INST_OR_DECL](#) void [applyP](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, [FFLAS_ELT](#) *A, const size_t lda, const size_t *P)
- template [INST_OR_DECL](#) void [fgetrs](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t R, [FFLAS_ELT](#) *A, const size_t lda, const size_t *P, const size_t *Q, [FFLAS_ELT](#) *B, const size_t ldb, int *info)
- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [fgetrs](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, [FFLAS_ELT](#) *A, const size_t lda, const size_t *P, const size_t *Q, [FFLAS_ELT](#) *X, const size_t ldx, const [FFLAS_ELT](#) *B, const size_t ldb, int *info)
- template [INST_OR_DECL](#) size_t [fgesv](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *B, const size_t ldb, int *info)
- template [INST_OR_DECL](#) size_t [fgesv](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *X, const size_t ldx, const [FFLAS_ELT](#) *B, const size_t ldb, int *info)
- template [INST_OR_DECL](#) void [ftrtri](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t N, [FFLAS_ELT](#) *A, const size_t lda, const size_t threshold)
- template [INST_OR_DECL](#) void [trinv_left](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t N, const [FFLAS_ELT](#) *L, const size_t ldl, [FFLAS_ELT](#) *X, const size_t ldx)
- template [INST_OR_DECL](#) void [ftrtrm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_DIAG](#) diag, const size_t N, [FFLAS_ELT](#) *A, const size_t lda)
- template [INST_OR_DECL](#) size_t [PLUQ](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, [FFLAS_ELT](#) *A, const size_t lda, size_t *P, size_t *Q)
- template [INST_OR_DECL](#) size_t [LUdivine](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const size_t M, const size_t N, [FFLAS_ELT](#) *A, const size_t lda, size_t *P, size_t *Qt, const [FFPACK_LU_TAG](#) LuTag, const size_t cutoff)
- template [INST_OR_DECL](#) size_t [LUdivine_small](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const size_t M, const size_t N, [FFLAS_ELT](#) *A, const size_t lda, size_t *P, size_t *Q, const [FFPACK_LU_TAG](#) LuTag)

- template `INST_OR_DECL` `size_t` `LUdivine_gauss` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Q, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t` `RowEchelonForm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t` `ReducedRowEchelonForm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t` `ColumnEchelonForm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t` `ReducedColumnEchelonForm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `FFLAS_ELT` * `Invert` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, `FFLAS_ELT` *A, const `size_t` lda, int &nullity)
- template `INST_OR_DECL` `FFLAS_ELT` * `Invert` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, const `size_t` idx, int &nullity)
- template `INST_OR_DECL` `FFLAS_ELT` * `Invert2` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, const `size_t` idx, int &nullity)
- template `INST_OR_DECL` `std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > & CharPoly` (const `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > &R`, `std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > &charp`, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_FIELD< FFLAS_ELT >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, const `size_t` degree)
- template `INST_OR_DECL` `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly` (const `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > &R`, `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element &charp`, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_FIELD< FFLAS_ELT >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, const `size_t` degree)
- template `INST_OR_DECL` `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly` (const `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > &R`, `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element &charp`, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, const `FFPACK_CHARPOLY_TAG` CharpTag, const `size_t` degree)
- template `INST_OR_DECL` `std::vector< FFLAS_ELT > & MinPoly` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `std::vector< FFLAS_ELT > &minP`, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_FIELD< FFLAS_ELT >::RandIter &G`)
- template `INST_OR_DECL` `std::vector< FFLAS_ELT > & MinPoly` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `std::vector< FFLAS_ELT > &minP`, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL` `std::vector< FFLAS_ELT > & MatVecMinPoly` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `std::vector< FFLAS_ELT > &minP`, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` *V, const `size_t` incv)
- template `INST_OR_DECL` `size_t` `KrylovElim` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Q, const `size_t` deg, `size_t` *iterates, `size_t` *inviterates, const `size_t` maxit, `size_t` virt)
- template `INST_OR_DECL` `size_t` `SpecRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, const `size_t` deg, `size_t` *rankProfile)
- template `INST_OR_DECL` `size_t` `Rank` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL` bool `IsSingular` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL` `FFLAS_ELT` & `Det` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `FFLAS_ELT` &det, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Q)
- template `INST_OR_DECL` `FFLAS_ELT` & `Det` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `FFLAS_ELT` &det, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter::Threads >` &parH, `size_t` *P, `size_t` *Q)

- template `INST_OR_DECL FFLAS_ELT * Solve` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *x, const int incx, const `FFLAS_ELT` *b, const int incb)
- template `INST_OR_DECL void solveLB` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` *L, const `size_t` ldl, const `size_t` *Q, `FFLAS_ELT` *B, const `size_t` ldb)
- template `INST_OR_DECL void solveLB2` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` *L, const `size_t` ldl, const `size_t` *Q, `FFLAS_ELT` *B, const `size_t` ldb)
- template `INST_OR_DECL void RandomNullSpaceVector` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, const `size_t` incX)
- template `INST_OR_DECL size_t NullSpaceBasis` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *&NS, `size_t` &ldn, `size_t` &NSdim)
- template `INST_OR_DECL size_t RowRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rkprofile, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL size_t ColumnRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rkprofile, const `FFPACK_LU_TAG` LuTag)
- void `RankProfileFromLU` (const `size_t` *P, const `size_t` N, const `size_t` R, `size_t` *&rkprofile, const `FFPACK_LU_TAG` LuTag)

Recovers the column/row rank profile from the permutation of an LU decomposition.

- `size_t LeadingSubmatrixRankProfiles` (const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` LSm, const `size_t` LSn, const `size_t` *P, const `size_t` *Q, `size_t` *RRP, `size_t` *CRP)

Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.

- template `INST_OR_DECL size_t RowRankProfileSubmatrixIndices` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rowindices, `size_t` *&colindices, `size_t` &R)
- template `INST_OR_DECL size_t ColRankProfileSubmatrixIndices` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rowindices, `size_t` *&colindices, `size_t` &R)
- template `INST_OR_DECL size_t RowRankProfileSubmatrix` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *&X, `size_t` &R)
- template `INST_OR_DECL size_t ColRankProfileSubmatrix` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *&X, `size_t` &R)
- template `INST_OR_DECL void getTriangular< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const bool OnlyNonZeroVectors)
- template `INST_OR_DECL void getTriangular< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL void getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const bool OnlyNonZeroVectors, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL void getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, `FFLAS_ELT` *A, const `size_t` lda, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL void getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `size_t` *Q, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL void getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const bool OnlyNonZeroVectors, const `FFPACK_LU_TAG` LuTag)

- template `INST_OR_DECL` void `getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, `FFLAS_ELT` *A, const `size_t` lda, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `size_t` *Q, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const `FFPACK_LU_TAG` LuTag)
- void `PLUQtoEchelonPermutation` (const `size_t` N, const `size_t` R, const `size_t` *P, `size_t` *outPerm)
Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.
- template `INST_OR_DECL` `FFLAS_ELT` * `LQUPtoInverseOfFullRankMinor` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` rank, `FFLAS_ELT` *A_factors, const `size_t` lda, const `size_t` *QtPointer, `FFLAS_ELT` *X, const `size_t` ldx)

17.178 ffpack_invert.inl File Reference

Namespaces

- `FFPACK`

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_invert_INL`

Functions

- template<class Field >
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, int &nullity)
Invert the given matrix in place or computes its nullity if it is singular.
- template<class Field >
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &nullity)
Invert the given matrix or computes its nullity if it is singular.
- template<class Field >
`Field::Element_ptr Invert2` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &nullity)
Invert the given matrix or computes its nullity if it is singular.

17.178.1 Macro Definition Documentation

17.178.1.1 __FFLASFFPACK_ffpack_invert_INL

```
#define __FFLASFFPACK_ffpack_invert_INL
```

17.179 ffpack_krylovelim.inl File Reference

Macros

- `#define __FFLASFFPACK_ffpack_krylovelim_INL`

17.179.1 Macro Definition Documentation

17.179.1.1 __FFLASFFPACK_ffpack_krylovelim_INL

```
#define __FFLASFFPACK_ffpack_krylovelim_INL
```

17.180 ffpack_ludivine.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_bounds.inl"
```

Data Structures

- class [callLUdivine_small< Element >](#)
- class [callLUdivine_small< double >](#)
- class [callLUdivine_small< float >](#)

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- [FFPACK::Protected](#)

Macros

- [#define __FFLASFFPACK_ffpack_ludivine_INL](#)

Functions

- [template<class Field >](#)
[size_t LUdivine_gauss](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [size_t](#) M, const [size_t](#) N, typename [Field::Element_ptr](#) A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag)
- [template<class Field >](#)
[size_t LUdivine_small](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const [size_t](#) M, const [size_t](#) N, typename [Field::Element_ptr](#) A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag)
- [template<class Field >](#)
[size_t LUdivine](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const [size_t](#) M, const [size_t](#) N, typename [Field::Element_ptr](#) A, const [size_t](#) lda, [size_t](#) *P, [size_t](#) *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag, const [size_t](#) cutoff)
- [template<class Field >](#)
[size_t LUdivine_construct](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [size_t](#) M, const [size_t](#) N, typename [Field::ConstElement_ptr](#) A, const [size_t](#) lda, typename [Field::Element_ptr](#) X, const [size_t](#) ldx, typename [Field::Element_ptr](#) u, const [size_t](#) incu, [size_t](#) *P, bool computeX, const [FFPACK::FFPACK_MINPOLY_TAG](#) MinTag, const [size_t](#) kg_mc, const [size_t](#) kg_mb, const [size_t](#) kg_j)

17.180.1 Macro Definition Documentation

17.180.1.1 __FFLASFFPACK_ffpack_ludivine_INL

```
#define __FFLASFFPACK_ffpack_ludivine_INL
```


17.181 ffpack_ludivine_mp.inl File Reference

```
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack_ludivine.inl"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFPACK_ludivine_mp_INL](#)

Functions

- template<> size_t [LUdivine](#) (const Givaro::Modular< Givaro::Integer > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag, const size_t cutoff)

17.181.1 Macro Definition Documentation

17.181.1.1 __FFPACK_ludivine_mp_INL

```
#define __FFPACK_ludivine_mp_INL
```

17.182 ffpack_minpoly.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

- [FFPACK::Protected](#)

Macros

- #define [__FFLASFFPACK_ffpack_minpoly_INL](#)

Functions

- template<class Field , class Polynomial >
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda)
Compute the minimal polynomial of the matrix A.
- template<class Field , class Polynomial , class RandIter >
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, RandIter &G)
Compute the minimal polynomial of the matrix A.

- `template<class Field , class Polynomial >`
`Polynomial & MatVecMinPoly` (const `Field` &F, `Polynomial` &minP, const `size_t` N, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` v, const `size_t` incv)
Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis $(v, Av, \dots, A^N v)$.
- `template<class Field , class Polynomial >`
`Polynomial & MatVecMinPoly` (const `Field` &F, `Polynomial` &minP, const `size_t` N, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::Element_ptr` v, const `size_t` incv, typename `Field::Element_ptr` K, const `size_t` ldk, `size_t` *P)
- `template<class Field , class Polynomial >`
`Polynomial & Hybrid_KGF_LUK_MinPoly` (const `Field` &F, `Polynomial` &minP, const `size_t` N, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, `size_t` *P, const `FFPACK_MINPOLY_TAG` MinTag=`FFPACK::FfpackDense`, const `size_t` kg_mc=0, const `size_t` kg_↵ mb=0, const `size_t` kg_j=0)

17.182.1 Macro Definition Documentation

17.182.1.1 __FFLASFFPACK_ffpack_minpoly_INL

```
#define __FFLASFFPACK_ffpack_minpoly_INL
```

17.183 ffpack_permutation.inl File Reference

```
#include <givaro/zring.h>
#include "fflas-ffpack/fflas/fflas_fassign.h"
```

Namespaces

- [FFPACK](#)

*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_permutation_INL`
- `#define FFLASFFPACK_PERM_BKSIZE 32`

Functions

- `template<class Field >`
`void MonotonicApplyP` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `FFLAS::FFLAS_TRANSPOSE` Trans, const `size_t` M, const `size_t` ibeg, const `size_t` iend, typename `Field::Element_ptr` A, const `size_t` lda, const `size_t` *P, const `size_t` R)
Apply a R-monotonically increasing permutation P, to the matrix A.
- `template<class Field >`
`void MonotonicCompress` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, const `size_t` incA, const `size_t` *MathP, const `size_t` R, const `size_t` maxpiv, const `size_t` rowstomove, const `std::vector< bool >` &ispiv)
- `template<class Field >`
`void MonotonicCompressMorePivots` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, type-name `Field::Element_ptr` A, const `size_t` lda, const `size_t` incA, const `size_t` *MathP, const `size_t` R, const `size_t` rowstomove, const `size_t` lenP)
- `template<class Field >`
`void MonotonicCompressCycles` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, const `size_t` incA, const `size_t` *MathP, const `size_t` lenP)

- `template<class Field >`
`void MonotonicExpand (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`
- `template<class Field >`
`void applyP_block (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P)`
- `template<class Field >`
`void applyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field >`
`void doApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field, class Cut, class Param >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T >`
`void PermApplyS (T *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void doApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field, class Cut, class Param >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T >`
`void PermApplyT (T *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `void LAPACKPerm2MathPerm (size_t *MathP, const size_t *LapackP, const size_t N)`
Conversion of a permutation from LAPACK format to Math format.
- `void MathPerm2LAPACKPerm (size_t *LapackP, const size_t *MathP, const size_t N)`
Conversion of a permutation from Maths format to LAPACK format.
- `void composePermutationsLLL (size_t *P1, const size_t *P2, const size_t R, const size_t N)`
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.
- `void composePermutationsLLM (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)`
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $MathP$ as a MathPermutation format.

- void [composePermutationsMLM](#) (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)
Computes MathP1 x Diag (I_R, P2) where MathP1 is a MathPermutation and P2 a LAPACK permutation and store the result in MathP1 as a MathPermutation format.
- void [cyclic_shift_mathPerm](#) (size_t *P, const size_t s)
- template<class Field >
void [cyclic_shift_row_col](#) (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)
- template<class Field >
void [cyclic_shift_row](#) (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)
- template<typename T >
void [cyclic_shift_row](#) (const RNSIntegerMod< T > &F, typename T::Element_ptr A, size_t m, size_t n, size_t lda)
- template<class Field >
void [cyclic_shift_col](#) (const Field &F, typename Field::Element_ptr A, size_t m, size_t n, size_t lda)
- template<typename T >
void [cyclic_shift_col](#) (const RNSIntegerMod< T > &F, typename T::Element_ptr A, size_t m, size_t n, size_t lda)
- template<class Field >
void [applyP](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P)
Computes P1 x Diag (I_R, P2) where P1 is a LAPACK and P2 a LAPACK permutation and store the result in P1 as a LAPACK permutation.
- template<class Field, class Cut, class Param >
void [applyP](#) (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)

17.183.1 Macro Definition Documentation

17.183.1.1 __FFLASFFPACK_ffpack_permutation_INL

```
#define __FFLASFFPACK_ffpack_permutation_INL
```

17.183.1.2 FFLASFFPACK_PERM_BKSIZE

```
#define FFLASFFPACK_PERM_BKSIZE 32
```

17.184 fpack_pluq.inl File Reference

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_pluq_INL](#)
- #define [CROUT](#)

Functions

- template<class Field >
size_t [PLUQ_basecaseV3](#) (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element *A, const size_t lda, size_t *P, size_t *Q)

- `template<class Field >`
`size_t PLUQ_basecaseV2` (const `Field` &Fi, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, typename `Field::Element` *A, const `size_t` lda, `size_t` *P, `size_t` *Q)
- `template<class Field >`
`size_t PLUQ_basecaseCrout` (const `Field` &Fi, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Q)
- `template<class Field >`
`size_t _PLUQ` (const `Field` &Fi, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Q, `size_t` BCThreshold)
- `template<class Field >`
`size_t PLUQ` (const `Field` &F, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Q, const `FFLAS::ParSeqHelper::Sequential` &PSHelper, `size_t` BCThreshold=`__FFLASFFPACK_PLUQ_THRESHOLD`)
- `template<class Field >`
`size_t PLUQ` (const `Field` &F, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` *P, `size_t` *Q)

Compute a PLUQ factorization of the given matrix.

17.184.1 Macro Definition Documentation

17.184.1.1 __FFLASFFPACK_ffpack_pluq_INL

```
#define __FFLASFFPACK_ffpack_pluq_INL
```

17.184.1.2 CROUT

```
#define CROUT
```

17.185 ffpack_pluq_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "givaro/givinteger.h"
#include "givaro/modular-integer.h"
```

Namespaces

- `FFPACK`

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFPACK_pluq_mp_INL`

Functions

- `template<class Cut , class Param >`
`size_t PLUQ` (const `Givaro::Modular` < `Givaro::Integer` > &F, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` M, const `size_t` N, typename `Givaro::Integer` *A, const `size_t` lda, `size_t` *P, `size_t` *Q, `size_t` BCThreshold, `FFLAS::ParSeqHelper::Parallel` < Cut, Param > &PSHelper)

17.185.1 Macro Definition Documentation

17.185.1.1 __FFPACK_pluq_mp_INL

```
#define __FFPACK_pluq_mp_INL
```

17.186 ffpack_ppluq.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_ppluq_INL](#)
- #define [__FFLAS__TRSM_READONLY](#)
- #define [PBASECASE_K](#) 256

Functions

- template<class Field >
void [threads_fgemm](#) (const size_t m, const size_t n, const size_t r, int nbthreads, size_t *W1, size_t *W2, size_t *W3, size_t gamma)
- template<class Field >
void [threads_ftrsm](#) (const size_t m, const size_t n, int nbthreads, size_t *t1, size_t *t2)
- template<class Field >
size_t [PLUQ](#) (const [Field](#) &Fi, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, const [FFLAS::ParSeqHelper::Parallel](#)<[FFLAS::CuttingStrategy::Recursive](#), [FFLAS::StrategyParameter::Threads](#) > &PHelper)
- template<class Field >
size_t [pPLUQ](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q)

17.186.1 Macro Definition Documentation

17.186.1.1 __FFLASFFPACK_ffpack_ppluq_INL

```
#define __FFLASFFPACK_ffpack_ppluq_INL
```

17.186.1.2 __FFLAS__TRSM_READONLY

```
#define __FFLAS__TRSM_READONLY
```

17.186.1.3 PBASECASE_K

```
#define PBASECASE_K 256
```

17.187 ffpack_rankprofiles.inl File Reference

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_rank_profiles_INL`

Functions

- `template<class Field >`
`size_t RowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Computes the row rank profile of A.
- `template<class Field >`
`size_t pRowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper >`
`size_t RowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)`
- `template<class Field >`
`size_t ColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`
Computes the column rank profile of A.
- `template<class Field >`
`size_t pColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field, class PSHelper >`
`size_t ColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)`
- `void RankProfileFromLU (const size_t *P, const size_t N, const size_t R, size_t *rkprofile, const FFPACK_LU_TAG LuTag)`
Recovers the column/row rank profile from the permutation of an LU decomposition.
- `size_t LeadingSubmatrixRankProfiles (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSn, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP)`
Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.
- `template<class Field >`
`size_t RowRankProfileSubmatrixIndices (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rowindices, size_t *colindices, size_t &R)`
RowRankProfileSubmatrixIndices.
- `template<class Field >`
`size_t ColRankProfileSubmatrixIndices (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *rowindices, size_t *colindices, size_t &R)`
Computes the indices of the submatrix $r \times r$ X of A whose columns correspond to the column rank profile of A.
- `template<class Field >`
`size_t RowRankProfileSubmatrix (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &X, size_t &R)`
Computes the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.
- `template<class Field >`
`size_t ColRankProfileSubmatrix (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &X, size_t &R)`
Compute the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.

- `template<class Field >`
`Field::Element_ptr LQUPtoInverseOfFullRankMinor (const Field &F, const size_t rank, typename`
`Field::Element_ptr A_factors, const size_t lda, const size_t *QtPointer, typename Field::Element_ptr X,`
`const size_t ldx)`
`LQUPtoInverseOfFullRankMinor.`

17.187.1 Macro Definition Documentation

17.187.1.1 __FFLASFFPACK_ffpack_rank_profiles_INL

```
#define __FFLASFFPACK_ffpack_rank_profiles_INL
```

17.188 fgemm_classical.inl File Reference

```
#include <cmath>
#include "fflas-ffpack/field/field-traits.h"
```

Macros

- `#define __FFLASFFPACK_fflas_fflas_fgemm_classical_INL`

17.188.1 Macro Definition Documentation

17.188.1.1 __FFLASFFPACK_fflas_fflas_fgemm_classical_INL

```
#define __FFLASFFPACK_fflas_fflas_fgemm_classical_INL
```

17.189 fgemm_classical_mp.inl File Reference

matrix multiplication with multiprecision input (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)

```
#include <givaro/modular-integer.h>
#include <givaro/zring.h>
#include "fflas-ffpack/field/rns-double.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas-ffpack/fflas/fflas_bounds.inl"
```

Data Structures

- `struct MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >`
- `struct MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >`
- `struct MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >`

Namespaces

- `FFLAS`

Macros

- `#define __FFPACK_fgemmm_classical_INL`

Functions

- `template<typename RNS , typename ParSeqTrait >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemmm (const FFPACK::RNSInteger< RNS > &F, const`
`FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k,`
`const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS`
`>::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr`
`Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename`
`FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger<`
`RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper↵`
`::Sequential, ParSeqTrait > > &H)`
- `template<typename RNS >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemmm (const FFPACK::RNSInteger< RNS > &F, const`
`FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k,`
`const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS`
`>::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr`
`Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename`
`FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger<`
`RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Sequential > &H)`
- `template<typename RNS , typename ParSeqTrait >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemmm (const FFPACK::RNSInteger< RNS > &F, const`
`FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k,`
`const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS`
`>::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr`
`Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename`
`FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger<`
`RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper↵`
`::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads >, ParSeqTrait > > &H)`
- `template<typename RNS , typename Cut , typename Param >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemmm (const FFPACK::RNSInteger< RNS > &F, const`
`FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k,`
`const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS`
`>::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr`
`Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename`
`FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger<`
`RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Parallel< Cut, Param > >`
`&H)`
- `template<class ParSeq >`
`Givaro::Integer * fgemmm (const Givaro::ZRing< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const`
`FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const`
`Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, Givaro::Integer beta, Givaro::↵`
`Integer *C, const size_t ldc, MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, Mode↵`
`Categories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`
- `template<typename RNS , class ModeT >`
`RNS::Element_ptr fgemmm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const`
`FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element alpha,`
`typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd, const size_t ↵`
`ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc, MMHelper<`
`FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential > &H)`
- `template<typename RNS >`
`RNS::Element_ptr fgemmm (const FFPACK::RNSIntegerMod< RNS > &F, const FFLAS_TRANSPOSE ta,`
`const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element`
`alpha, typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd,`
`const size_t ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc,`
`MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > &H)`

- `Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelper< Algo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)`
- `template<class ParSeq >
Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelper< Algo::Auto, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`
- `template<size_t K1, size_t K2, class ParSeq >
Reclnt::ruint< K1 > * fgemm (const Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Reclnt::ruint< K1 > alpha, const Reclnt::ruint< K1 > *A, const size_t lda, const Reclnt::ruint< K1 > *B, const size_t ldb, Reclnt::ruint< K1 > beta, Reclnt::ruint< K1 > *C, const size_t ldc, MMHelper< Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`

17.189.1 Detailed Description

matrix multiplication with multiprecision input (either over Z or over Z/pZ)

17.189.2 Macro Definition Documentation

17.189.2.1 __FFPACK_fgemm_classical_INL

```
#define __FFPACK_fgemm_classical_INL
```

17.190 fgemm_winograd.inl File Reference

```
#include <stdint.h>
#include <givaro/modular.h>
#include <givaro/zring.h>
#include "fgemm_classical.inl"
#include "schedule_winograd.inl"
#include "schedule_winograd_acc.inl"
#include "schedule_winograd_acc_ip.inl"
#include "schedule_winograd_ip.inl"
#include "fflas-ffpack/fflas-ffpack-config.h"
```

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Macros

- `#define __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL`
- `#define NEWWINO`

Functions

- template<class Field >
int [WinogradThreshold](#) (const [Field](#) &F)
Computes the number of recursive levels to perform.
- template<> int [WinogradThreshold](#) (const Givaro::Modular< float > &F)
- template<> int [WinogradThreshold](#) (const [Givaro::ModularBalanced](#)< double > &F)
- template<> int [WinogradThreshold](#) (const [Givaro::ModularBalanced](#)< float > &F)
- template<class Field >
int [WinogradSteps](#) (const [Field](#) &F, const size_t &m)
Computes the number of recursive levels to perform.
- template<class Field , class FieldMode >
void [DynamicPeeling](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode > &H, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmin, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmax)
- template<class Field , class FieldMode >
void [DynamicPeeling2](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode > &H, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmin, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmax)
- template<class Field , class FieldMode >
void [WinogradCalc](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode > &H)
- template<class Field , class ModeT >
[Field::Element_ptr](#) [fgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, ModeT > &H)
- template<class Field , class ModeT , class Cut , class Param >
[Field::Element_ptr](#) [fgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::WinogradPar, ModeT, ParSeqHelper::Parallel< Cut, Param > > &H)

17.190.1 Macro Definition Documentation

17.190.1.1 __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL

```
#define __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL
```

17.190.1.2 NEWWINO

```
#define NEWWINO
```

17.191 field-traits.h File Reference

Field Traits.

```
#include <type_traits>
#include "fflas-ffpack/field/rns-double-elt.h"
#include "recint/rmint.h"
#include "givaro/modular-general.h"
#include "givaro/zring.h"
```

Data Structures

- struct [GenericTag](#)
generic ring.
- struct [ModularTag](#)
This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`
- struct [UnparametricTag](#)
If the field uses a representation with infix operators.
- struct [DefaultTag](#)
No specific mode of action: use standard field operations.
- struct [DefaultBoundedTag](#)
Use standard field operations, but keeps track of bounds on input and output.
- struct [ConvertTo< T >](#)
Force conversion to appropriate element type of `ElementCategory T`.
- struct [DelayedTag](#)
Performs field operations with delayed mod reductions. Ensures result is reduced.
- struct [LazyTag](#)
Performs field operations with delayed mod only when necessary. Result may not be reduced.
- struct [GenericTag](#)
default is generic
- struct [MachineFloatTag](#)
float or double
- struct [MachineIntTag](#)
short, int, long, long long, and unsigned variants
- struct [FixedPrecIntTag](#)
Fixed precision integers above machine precision: `Givaro::recInt`.
- struct [ArbitraryPrecIntTag](#)
Arbitrary precision integers: `GMP`.
- struct [RNSElementTag](#)
Representation in a Residue Number System.
- struct [ElementTraits< Element >](#)
Element Traits.
- struct [ElementTraits< float >](#)
- struct [ElementTraits< double >](#)
- struct [ElementTraits< int8_t >](#)
- struct [ElementTraits< int16_t >](#)
- struct [ElementTraits< int32_t >](#)
- struct [ElementTraits< int64_t >](#)
- struct [ElementTraits< uint8_t >](#)
- struct [ElementTraits< uint16_t >](#)
- struct [ElementTraits< uint32_t >](#)
- struct [ElementTraits< uint64_t >](#)
- struct [ElementTraits< Givaro::Integer >](#)

- struct [ElementTraits](#)< [RecInt::rint](#)< K > >
 - struct [ElementTraits](#)< [RecInt::ruint](#)< K > >
 - struct [ElementTraits](#)< [RecInt::rmint](#)< K, MG > >
 - struct [ElementTraits](#)< [FFPACK::rns_double_elt](#) >
 - struct [ModeTraits](#)< [Field](#) >
- ModeTraits.*
- struct [ModeTraits](#)< [Givaro::Modular](#)< [Element](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [int8_t](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [int16_t](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [int32_t](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [uint8_t](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [uint16_t](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [uint32_t](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [Givaro::Integer](#), [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::Modular](#)< [RecInt::ruint](#)< K >, [Compute](#) > >
 - struct [ModeTraits](#)< [Givaro::ModularBalanced](#)< [Element](#) > >
 - struct [ModeTraits](#)< [Givaro::ModularBalanced](#)< [int8_t](#) > >
 - struct [ModeTraits](#)< [Givaro::ModularBalanced](#)< [int16_t](#) > >
 - struct [ModeTraits](#)< [Givaro::ModularBalanced](#)< [int32_t](#) > >
 - struct [ModeTraits](#)< [Givaro::ModularBalanced](#)< [Givaro::Integer](#) > >
 - struct [ModeTraits](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) > >
 - struct [ModeTraits](#)< [Givaro::ZRing](#)< [float](#) > >
 - struct [ModeTraits](#)< [Givaro::ZRing](#)< [double](#) > >
 - struct [ModeTraits](#)< [Givaro::Montgomery](#)< T > >
 - struct [FieldTraits](#)< [Field](#) >
- FieldTrait.*
- struct [FieldTraits](#)< [Givaro::ZRing](#)< [RecInt::ruint](#)< K > > >
 - struct [FieldTraits](#)< [Givaro::Modular](#)< [Element](#) > >
 - struct [FieldTraits](#)< [Givaro::ModularBalanced](#)< [Element](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [double](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [float](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [int16_t](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [uint16_t](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [int32_t](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [uint32_t](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [int64_t](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [uint64_t](#) > >
 - struct [FieldTraits](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) > >
 - struct [FieldTraits](#)< [FFPACK::RNSInteger](#)< T > >
 - struct [FieldTraits](#)< [FFPACK::RNSIntegerMod](#)< T > >
 - struct [associatedDelayedField](#)< [Field](#) >
 - struct [associatedDelayedField](#)< const [Givaro::Modular](#)< T, X > >
 - struct [associatedDelayedField](#)< const [Givaro::ModularBalanced](#)< T > >
 - struct [associatedDelayedField](#)< const [Givaro::ZRing](#)< T > >
 - struct [associatedDelayedField](#)< const [FFPACK::RNSIntegerMod](#)< RNS > >

Namespaces

- [Reclnt](#)
- [Givaro](#)
- [FFPACK](#)

*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

- [FFLAS](#)
- [FFLAS::FieldCategories](#)

Traits and categories will need to be placed in a proper file later.

- [FFLAS::ModeCategories](#)

Specifies the mode of action for an algorithm w.r.t.

- [FFLAS::ElementCategories](#)

17.191.1 Detailed Description

Field Traits.

17.192 field.doxy File Reference

17.193 flimits.h File Reference

```
#include <climits>
#include <limits>
#include <type_traits>
#include <givaro/givinteger.h>
```

Data Structures

- struct [limits< unsigned char >](#)
- struct [limits< signed char >](#)
- struct [limits< char >](#)
- struct [limits< unsigned short int >](#)
- struct [limits< short int >](#)
- struct [limits< unsigned int >](#)
- struct [limits< int >](#)
- struct [limits< unsigned long >](#)
- struct [limits< long >](#)
- struct [limits< unsigned long long >](#)
- struct [limits< long long >](#)
- struct [limits< float >](#)
- struct [limits< double >](#)
- struct [limits< Givaro::Integer >](#)
- struct [limits< Reclnt::ruint< K > >](#)
- struct [limits< Reclnt::rint< K > >](#)

Functions

- template<class T, class E >
std::enable_if< std::is_signed< T >::value==std::is_signed< E >::value, bool >::type [in_range](#) (E e)
- template<class T, class E >
std::enable_if<(std::is_signed< T >::value) &&!std::is_signed< E >::value, bool >::type [in_range](#) (E e)
- template<class T, class E >
std::enable_if<!std::is_signed< T >::value) &&std::is_signed< E >::value, bool >::type [in_range](#) (E e)

17.193.1 Function Documentation

17.193.1.1 in_range() [1/3]

```
std::enable_if<std::is_signed<T>::value == std::is_signed<E>::value, bool>::type in_range (
    E e )
```

17.193.1.2 in_range() [2/3]

```
std::enable_if<(std::is_signed<T>::value) && !(std::is_signed<E>::value), bool>::type in_↵
range (
    E e )
```

17.193.1.3 in_range() [3/3]

```
std::enable_if<!(std::is_signed<T>::value) && (std::is_signed<E>::value), bool>::type in_↵
range (
    E e )
```

17.194 fsyrk.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <ctime>
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))
- #define [GFOPS](#)(n, t) ([CUBE](#)(double(n)/1000.0)/(3.0*t))

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- int [main](#) ()

17.194.1 Macro Definition Documentation

17.194.1.1 CUBE

```
#define CUBE(
    x ) ((x)*(x)*(x))
```

17.194.1.2 GFOPS

```
#define GFOPS(  
    n,  
    t ) (CUBE(double(n)/1000.0)/(3.0*t))
```

17.194.2 Typedef Documentation

17.194.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.194.3 Function Documentation

17.194.3.1 main()

```
int main (  
    void )
```

17.195 fsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "fflas-ffpack/utils/fflas_randommatrix.h"  
#include <ctime>
```

Macros

- #define CUBE(x) ((x)*(x)*(x))
- #define GFOPS(n, t) (CUBE(double(n)/1000.0)/(3.0*t))

Typedefs

- typedef Givaro::Timer TTimer

Functions

- int main ()

17.195.1 Macro Definition Documentation

17.195.1.1 CUBE

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```


17.195.1.2 GFOPS

```
#define GFOPS(
    n,
    t ) (CUBE(double(n)/1000.0)/(3.0*t))
```

17.195.2 Typedef Documentation

17.195.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.195.3 Function Documentation

17.195.3.1 main()

```
int main (
    void )
```

17.196 ftrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

Macros

- #define CUBE(x) ((x)*(x)*(x))
- #define GFOPS(n, t) (CUBE(double(n)/1000.0)/(3.0*t))

Typedefs

- typedef Givaro::Timer TTimer

Functions

- int main ()

17.196.1 Macro Definition Documentation

17.196.1.1 CUBE

```
#define CUBE(
    x ) ((x)*(x)*(x))
```

17.196.1.2 GFOPS

```
#define GFOPS(  
    n,  
    t ) (CUBE(double(n)/1000.0)/(3.0*t))
```

17.196.2 Typedef Documentation

17.196.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.196.3 Function Documentation

17.196.3.1 main()

```
int main (  
    void )
```

17.197 gmp.C File Reference

```
#include <gmpxx.h>
```

Functions

- int [main](#) ()

17.197.1 Function Documentation

17.197.1.1 main()

```
int main (  
    void )
```

17.198 hyb_zo.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_utils.inl"  
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_spmv.inl"  
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_spmv.inl"
```

Data Structures

- struct [Sparse](#)< [_Field](#), [SparseMatrix_t::HYB_ZO](#) >

Namespaces

- [FFLAS](#)

17.199 hyb_zo_pspmm.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL`

Functions

- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::↵`
`UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, uint64_t kmax)`

17.199.1 Macro Definition Documentation

17.199.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL
```

17.200 hyb_zo_pspmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename`
`Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename`
`Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename`
`Field::ConstElement_ptr x, typename Field::Element_ptr y, uint64_t kmax)`

17.200.1 Macro Definition Documentation

17.200.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL
```

17.201 hyb_zo_spm.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_HYB_ZO_spm_INL](#)

Functions

- `template<class Field >`
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-
name [Field::ConstElement_ptr](#) x, int ldx, typename [Field::Element_ptr](#) y, int ldy, FieldCategories::GenericTag)
- `template<class Field >`
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, size_t blockSize,
typename [Field::ConstElement_ptr](#) x, int ldx, typename [Field::Element_ptr](#) y, int ldy, FieldCategories::↔
UnparametricTag)
- `template<class Field >`
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-
name [Field::ConstElement_ptr](#) x, int ldx, typename [Field::Element_ptr](#) y, int ldy, [uint64_t](#) kmax)

17.201.1 Macro Definition Documentation

17.201.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_spm_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spm_INL
```

17.202 hyb_zo_spmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL](#)

Functions

- `template<class Field >`
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, typename [Field::ConstElement_ptr](#)
x, typename [Field::Element_ptr](#) y, FieldCategories::GenericTag)
- `template<class Field >`
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, typename [Field::ConstElement_ptr](#)
x, typename [Field::Element_ptr](#) y, FieldCategories::UnparametricTag)
- `template<class Field >`
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, typename [Field::ConstElement_ptr](#)
x, typename [Field::Element_ptr](#) y, [uint64_t](#) kmax)

17.202.1 Macro Definition Documentation

17.202.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL
```

17.203 hyb_zo_utils.inl File Reference

Namespaces

- [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL](#)

Functions

- template<class Field >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A)
- template<class Field , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<typename _Field >
std::ostream & [operator<<](#) (std::ostream &os, const Sparse< _Field, SparseMatrix_t::HYB_ZO > &A)

17.203.1 Macro Definition Documentation

17.203.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL
```

17.204 igemm.doxy File Reference

17.205 igemm.h File Reference

```
#include "igemm_kernels.h"
#include "igemm_tools.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "igemm.inl"
```

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Enumerations

- enum [number_kind](#) { [zero](#) =0 , [one](#) =1 , [mone](#) =-1 , [other](#) =2 }

Functions

- `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB>`
void `igemm_colmajor` (size_t rows, size_t cols, size_t depth, const `int64_t` alpha, const `int64_t` *A, size_t lda, const `int64_t` *B, size_t ldb, `int64_t` *C, size_t ldc)
- `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB, enum number_kind alpha_kind>`
void `igemm_colmajor` (size_t rows, size_t cols, size_t depth, const `int64_t` alpha, const `int64_t` *A, size_t lda, const `int64_t` *B, size_t ldb, `int64_t` *C, size_t ldc)
- void `igemm` (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t rows, size_t cols, size_t depth, const `int64_t` alpha, const `int64_t` *A, size_t lda, const `int64_t` *B, size_t ldb, const `int64_t` beta, `int64_t` *C, size_t ldc)
- void `igemm_` (const enum FFLAS_ORDER Order, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, const size_t M, const size_t N, const size_t K, const `int64_t` alpha, const `int64_t` *A, const size_t lda, const `int64_t` *B, const size_t ldb, const `int64_t` beta, `int64_t` *C, const size_t ldc)

17.206 igemm.inl File Reference

```
#include "fflas-ffpack/utils/fflas_memory.h"
```

Namespaces

- [FFLAS](#)
- [FFLAS::Protected](#)

Macros

- `#define` [__FFLASFFPACK_fflas_igemm_igemm_INL](#)

Functions

- `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB>`
void `igemm_colmajor` (size_t rows, size_t cols, size_t depth, const `int64_t` alpha, const `int64_t` *A, size_t lda, const `int64_t` *B, size_t ldb, `int64_t` *C, size_t ldc)
- `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB, enum number_kind alpha_kind>`
void `igemm_colmajor` (size_t rows, size_t cols, size_t depth, const `int64_t` alpha, const `int64_t` *A, size_t lda, const `int64_t` *B, size_t ldb, `int64_t` *C, size_t ldc)
- void `igemm` (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t rows, size_t cols, size_t depth, const `int64_t` alpha, const `int64_t` *A, size_t lda, const `int64_t` *B, size_t ldb, const `int64_t` beta, `int64_t` *C, size_t ldc)
- void `igemm_` (const enum FFLAS_ORDER Order, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, const size_t M, const size_t N, const size_t K, const `int64_t` alpha, const `int64_t` *A, const size_t lda, const `int64_t` *B, const size_t ldb, const `int64_t` beta, `int64_t` *C, const size_t ldc)

17.206.1 Macro Definition Documentation

17.206.1.1 [__FFLASFFPACK_fflas_igemm_igemm_INL](#)

```
#define __FFLASFFPACK_fflas_igemm_igemm_INL
```

17.207 igemm_kernels.h File Reference

```
#include "igemm_kernels.inl"
```

Namespaces

- [FFLAS](#)
- [FFLAS::details](#)

Functions

- `template<enum number_kind K>`
void [igebb44](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb24](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb14](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb41](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb21](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb11](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebp](#) (size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *blockA, size_t lda, const [int64_t](#) *blockB, size_t ldb, [int64_t](#) *C, size_t ldc)

17.208 igemm_kernels.inl File Reference

```
#include "fflas-ffpack/utils/fflas_memory.h"
#include "igemm_tools.h"
```

Namespaces

- [FFLAS](#)
- [FFLAS::details](#)

Macros

- `#define __FFLASFFPACK_fflas_igemm_igemm_kernels_INL`

Functions

- `template<enum number_kind K>`
void [igebb44](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb24](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb14](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb41](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)

- `template<enum number_kind K>`
`void igebb21 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb11 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t *blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebp (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *blockA, size_t lda, const int64_t *blockB, size_t ldb, int64_t *C, size_t ldc)`

17.208.1 Macro Definition Documentation

17.208.1.1 __FFLASFFPACK_fflas_igemm_igemm_kernels_INL

```
#define __FFLASFFPACK_fflas_igemm_igemm_kernels_INL
```

17.209 igemm_tools.h File Reference

```
#include "igemm_tools.inl"
```

Namespaces

- [FFLAS](#)
- [FFLAS::details](#)

Functions

- `template<size_t k, bool transpose>`
`void pack_lhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `template<size_t k, bool transpose>`
`void pack_rhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `void gebp (size_t rows, size_t cols, size_t depth, int64_t *C, size_t ldc, const int64_t *blockA, size_t lda, const int64_t *BlockB, size_t ldb, int64_t *BlockW)`
- `void BlockingFactor (size_t &m, size_t &n, size_t &k)`

17.210 igemm_tools.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
```

Namespaces

- [FFLAS](#)
- [FFLAS::details](#)

Macros

- `#define __FFLASFFPACK_fflas_igemm_igemm_tools_INL`

Functions

- template<size_t k, bool transpose>
void [pack_rhs](#) (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)
- template<size_t k, bool transpose>
void [pack_lhs](#) (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)
- void [BlockingFactor](#) (size_t &m, size_t &n, size_t &k)

17.210.1 Macro Definition Documentation

17.210.1.1 __FFLASFFPACK_fflas_igemm_igemm_tools_INL

```
#define __FFLASFFPACK_fflas_igemm_igemm_tools_INL
```

17.211 instrset.h File Reference

```
#include <stdlib.h>
```

Data Structures

- class [Const_int_t](#)< n >
- class [Const_uint_t](#)< n >
- class [Static_error_check](#)< bool >
- class [Static_error_check](#)< false >

Macros

- #define [INSTRSET_H](#) 125
- #define [INSTRSET](#) 0
- #define [const_int](#)(n) ([Const_int_t](#) <n>())
- #define [const_uint](#)(n) ([Const_uint_t](#) <n>())

Typedefs

- typedef signed char [int8_t](#)
- typedef unsigned char [uint8_t](#)
- typedef signed short int [int16_t](#)
- typedef unsigned short int [uint16_t](#)
- typedef signed int [int32_t](#)
- typedef unsigned int [uint32_t](#)
- typedef long long [int64_t](#)
- typedef unsigned long long [uint64_t](#)
- typedef [int32_t](#) [intptr_t](#)

Functions

- int [instrset_detect](#) (void)
- bool [hasFMA3](#) (void)
- bool [hasFMA4](#) (void)
- bool [hasXOP](#) (void)
- bool [hasAVX512ER](#) (void)

17.211.1 Macro Definition Documentation

17.211.1.1 INSTRSET_H

```
#define INSTRSET_H 125
```

17.211.1.2 INSTRSET

```
#define INSTRSET 0
```

17.211.1.3 const_int

```
#define const_int(  
    n ) (Const_int_t <n>())
```

17.211.1.4 const_uint

```
#define const_uint(  
    n ) (Const_uint_t<n>())
```

17.211.2 Typedef Documentation

17.211.2.1 int8_t

```
typedef signed char int8_t
```

17.211.2.2 uint8_t

```
typedef unsigned char uint8_t
```

17.211.2.3 int16_t

```
typedef signed short int int16_t
```

17.211.2.4 uint16_t

```
typedef unsigned short int uint16_t
```

17.211.2.5 int32_t

```
typedef signed int int32_t
```

17.211.2.6 uint32_t

```
typedef unsigned int uint32_t
```

17.211.2.7 int64_t

```
typedef long long int64_t
```

17.211.2.8 uint64_t

```
typedef unsigned long long uint64_t
```

17.211.2.9 intptr_t

```
typedef int32_t intptr_t
```

17.211.3 Function Documentation

17.211.3.1 instrset_detect()

```
int instrset_detect (  
    void )
```

17.211.3.2 hasFMA3()

```
bool hasFMA3 (  
    void )
```

17.211.3.3 hasFMA4()

```
bool hasFMA4 (  
    void )
```

17.211.3.4 hasXOP()

```
bool hasXOP (  
    void )
```

17.211.3.5 hasAVX512ER()

```
bool hasAVX512ER (  
    void )
```

17.212 instrset_detect.cpp File Reference

```
#include "instrset.h"
```

Functions

- int [instrset_detect](#) (void)
- bool [hasFMA3](#) (void)
- bool [hasFMA4](#) (void)
- bool [hasXOP](#) (void)
- bool [hasF16C](#) (void)
- bool [hasAVX512ER](#) (void)

17.212.1 Function Documentation

17.212.1.1 instrset_detect()

```
int instrset_detect (  
    void )
```

17.212.1.2 hasFMA3()

```
bool hasFMA3 (  
    void )
```

17.212.1.3 hasFMA4()

```
bool hasFMA4 (  
    void )
```

17.212.1.4 hasXOP()

```
bool hasXOP (  
    void )
```

17.212.1.5 hasF16C()

```
bool hasF16C (  
    void )
```

17.212.1.6 hasAVX512ER()

```
bool hasAVX512ER (  
    void )
```

17.213 interfaces.doxy File Reference

17.214 kaapi_routines.inl File Reference

Macros

- [#define __FFLASFFPACK_KAAPI_ROUTINES_INL](#)

17.214.1 Macro Definition Documentation

17.214.1.1 __FFLASFFPACK_KAAPI_ROUTINES_INL

```
#define __FFLASFFPACK_KAAPI_ROUTINES_INL
```

17.215 lapack.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- `#define __FFLASFFPACK_CONFIGURATION`
- `#define __FFLASFFPACK_HAVE_LAPACK 1`

Functions

- `int main ()`

17.215.1 Macro Definition Documentation

17.215.1.1 __FFLASFFPACK_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

17.215.1.2 __FFLASFFPACK_HAVE_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

17.215.2 Function Documentation

17.215.2.1 main()

```
int main (
    void )
```

17.216 mainpage.doxy File Reference

17.217 Matio.h File Reference

```
#include <cstring>
#include <stdio.h>
#include <stdlib.h>
#include "fflas_memory.h"
```

Functions

- `template<class Field >`
`Field::Element_ptr read_field (const Field &F, const char *mat_file, size_t *tni, size_t *tnj)`
- `template<class Field >`
`std::ostream & write_field (const Field &F, std::ostream &c, typename Field::ConstElement_ptr E, int n, int m, int id, bool mapleFormat=false, bool column_major=false)`

17.217.1 Function Documentation

17.217.1.1 read_field()

```
Field::Element_ptr read_field (
    const Field & F,
    const char * mat_file,
    size_t * tni,
    size_t * tnj )
```

17.217.1.2 write_field()

```
std::ostream& write_field (
    const Field & F,
    std::ostream & c,
    typename Field::ConstElement_ptr E,
    int n,
    int m,
    int id,
    bool mapleFormat = false,
    bool column_major = false )
```

17.218 matmul.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example computes the matrix multiplication over a defined finite field.

17.218.1 Function Documentation

17.218.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example computes the matrix multiplication over a defined finite field.

Outputs the product of the matrix given as input.

17.219 matmul.doxy File Reference

17.220 parallel.h File Reference

```
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/paladin/blockcuts.inl"
```

Macros

- #define [__FFLASFFPACK_SEQUENTIAL](#)
- #define [index_t](#) size_t
- #define [TASK](#)(M, l) {l;}

- `#define WAIT`
- `#define CHECK_DEPENDENCIES`
- `#define BARRIER`
- `#define PAR_BLOCK`
- `#define SYNCH_GROUP(Args...) {{Args};}`
- `#define NUM_THREADS 1`
- `#define MAX_THREADS 1`
- `#define READ(Args...)`
- `#define WRITE(Args...)`
- `#define READWRITE(Args...)`
- `#define CONSTREFERENCE(...)`
- `#define VALUE(...)`
- `#define BEGIN_PARALLEL_MAIN(Args...) int main(Args) {`
- `#define END_PARALLEL_MAIN(void) return 0; }`
- `#define FORBLOCK1D(iter, m, Helper, Args...)`
- `#define FOR1D(i, m, Helper, Args...)`
- `#define PARFORBLOCK1D(iter, m, Helper, Args...)`
- `#define PARFOR1D(iter, m, Helper, Args...)`
- `#define FORBLOCK2D(iter, m, n, Helper, Args...)`
- `#define FOR2D(i, j, m, n, Helper, Args...)`
- `#define PARFORBLOCK2D(iter, m, n, Helper, Args...) FORBLOCK2D(iter, m, n, Helper, Args)`
- `#define PARFOR2D(i, j, m, n, Helper, Args...) FOR2D(i, j, m, n, Helper, Args)`
- `#define COMMA ,`
- `#define MODE(...) __VA_ARGS__`
- `#define RETURNPARAM(f, P1, Args...) P1=f(Args)`
- `#define NUMARGS(...) PP_NARG_(__VA_ARGS__, PP_RSEQ_N())`
- `#define PP_NARG_(...) PP_ARG_N(__VA_ARGS__)`
- `#define PP_ARG_N(_1, _2, _3, _4, _5, _6, _7, _8, _9, _10, _11, _12, _13, _14, _15, _16, _17, _18, _19, _20, _21, _22, _23, _24, _25, _26, _27, _28, _29, _30, _31, _32, _33, _34, _35, _36, _37, _38, _39, _40, _41, _42, _43, _44, _45, _46, _47, _48, _49, _50, _51, _52, _53, _54, _55, _56, _57, _58, _59, _60, _61, _62, _63, N, ...) N`
- `#define PP_RSEQ_N()`
- `#define NOSPLIT() FFLAS::ParSeqHelper::Sequential()`
- `#define splitting_0() FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block,FFLAS::StrategyParameter::Threads>()`
- `#define splitting_1(a) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block,FFLAS::StrategyParameter::Threads>(a)`
- `#define splitting_2(a, c) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block,c>(a)`
- `#define splitting_3(a, b, c) FFLAS::ParSeqHelper::Parallel<b,c>(a)`
- `#define splitt(_1, _2, _3, NAME, ...) NAME`
- `#define SPLITTER(...) splitt(__VA_ARGS__, splitting_3, splitting_2, splitting_1, splitting_0)(__VA_ARGS__)`

17.220.1 Macro Definition Documentation

17.220.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.220.1.2 index_t

```
#define index_t size_t
```

17.220.1.3 TASK

```
#define TASK(  
    M,  
    I ) {I;}
```

17.220.1.4 WAIT

```
#define WAIT
```

17.220.1.5 CHECK_DEPENDENCIES

```
#define CHECK_DEPENDENCIES
```

17.220.1.6 BARRIER

```
#define BARRIER
```

17.220.1.7 PAR_BLOCK

```
#define PAR_BLOCK
```

17.220.1.8 SYNCH_GROUP

```
#define SYNCH_GROUP(  
    Args... ) {{Args};}
```

17.220.1.9 NUM_THREADS

```
#define NUM_THREADS 1
```

17.220.1.10 MAX_THREADS

```
#define MAX_THREADS 1
```

17.220.1.11 READ

```
#define READ(  
    Args... )
```

17.220.1.12 WRITE

```
#define WRITE(  
    Args... )
```

17.220.1.13 READWRITE

```
#define READWRITE(  
    Args... )
```


17.220.1.14 CONSTREFERENCE

```
#define CONSTREFERENCE(
    ... )
```

17.220.1.15 VALUE

```
#define VALUE(
    ... )
```

17.220.1.16 BEGIN_PARALLEL_MAIN

```
#define BEGIN_PARALLEL_MAIN(
    Args... ) int main(Args) {
```

17.220.1.17 END_PARALLEL_MAIN

```
#define END_PARALLEL_MAIN(
    void ) return 0; }
```

17.220.1.18 FORBLOCK1D

```
#define FORBLOCK1D(
    iter,
    m,
    Helper,
    Args... )
```

Value:

```
{ FFLAS::ForStrategy1D<std::remove_const<decltype(m)>::type, typename decltype(Helper)::Cut, typename
  decltype(Helper)::Param> iter(m, Helper); \
  for(iter.initialize(); !iter.isTerminated(); ++iter) \
  { Args; } }
```

17.220.1.19 FOR1D

```
#define FOR1D(
    i,
    m,
    Helper,
    Args... )
```

Value:

```
FORBLOCK1D(_internal_iterator, m, Helper, \
  for(auto i=_internal_iterator.begin(); i!=_internal_iterator.end(); ++i) \
  { Args; })
```

17.220.1.20 PARFORBLOCK1D

```
#define PARFORBLOCK1D(
    iter,
    m,
    Helper,
    Args... )
```

Value:

```
for(std::remove_const<decltype(m)>::type iter=0; iter<m; ++iter) \
{ Args; }
```

17.220.1.21 PARFOR1D

```
#define PARFOR1D(
    iter,
    m,
    Helper,
    Args... )
```

Value:

```
for(std::remove_const<decltype(m)>::type iter=0; iter<m; ++iter) \
{ Args; }
```

17.220.1.22 FORBLOCK2D

```
#define FORBLOCK2D(
    iter,
    m,
    n,
    Helper,
    Args... )
```

Value:

```
{ FFLAS::ForStrategy2D<std::remove_const<decltype(m)>::type, typename decltype(Helper)::Cut, typename
    decltype(Helper)::Param> iter(m,n,Helper); \
    for(iter.initialize(); !iter.isTerminated(); ++iter) \
    { Args; } }
```

17.220.1.23 FOR2D

```
#define FOR2D(
    i,
    j,
    m,
    n,
    Helper,
    Args... )
```

Value:

```
FORBLOCK2D(_internal_iterator, m, n, Helper, \
    for(auto i=_internal_iterator.ibegin(); i!=_internal_iterator.iend(); ++i) \
    for(auto j=_internal_iterator.jbegin(); j!=_internal_iterator.jend(); ++j) \
    { Args; })
```

17.220.1.24 PARFORBLOCK2D

```
#define PARFORBLOCK2D(
    iter,
    m,
    n,
    Helper,
    Args... ) FORBLOCK2D(iter, m, n, Helper, Args)
```

17.220.1.25 PARFOR2D

```
#define PARFOR2D(
    i,
    j,
    m,
    n,
    Helper,
    Args... ) FOR2D(i, j, m, n, Helper, Args)
```

17.220.1.26 COMMA

```
#define COMMA ,
```

17.220.1.27 MODE

```
#define MODE(  
    ... ) __VA_ARGS__
```

17.220.1.28 RETURNPARAM

```
#define RETURNPARAM(  
    f,  
    Pl,  
    Args... ) Pl=f(Args)
```

17.220.1.29 NUMARGS

```
#define NUMARGS(  
    ... ) PP_NARG_(__VA_ARGS__, PP_RSEQ_N())
```

17.220.1.30 PP_NARG_

```
#define PP_NARG_(  
    ... ) PP_ARG_N(__VA_ARGS__)
```

17.220.1.31 PP_ARG_N

```
#define PP_ARG_N(  
    _1,  
    _2,  
    _3,  
    _4,  
    _5,  
    _6,  
    _7,  
    _8,  
    _9,  
    _10,  
    _11,  
    _12,  
    _13,  
    _14,  
    _15,  
    _16,  
    _17,  
    _18,  
    _19,  
    _20,  
    _21,  
    _22,  
    _23,  
    _24,  
    _25,
```

```
_26,  
_27,  
_28,  
_29,  
_30,  
_31,  
_32,  
_33,  
_34,  
_35,  
_36,  
_37,  
_38,  
_39,  
_40,  
_41,  
_42,  
_43,  
_44,  
_45,  
_46,  
_47,  
_48,  
_49,  
_50,  
_51,  
_52,  
_53,  
_54,  
_55,  
_56,  
_57,  
_58,  
_59,  
_60,  
_61,  
_62,  
_63,  
N,  
... ) N
```

17.220.1.32 PP_RSEQ_N

```
#define PP_RSEQ_N( )
```

Value:

```
63,62,61,60, \  
59,58,57,56,55,54,53,52,51,50, \  
49,48,47,46,45,44,43,42,41,40, \  
39,38,37,36,35,34,33,32,31,30, \  
29,28,27,26,25,24,23,22,21,20, \  
19,18,17,16,15,14,13,12,11,10, \  
9,8,7,6,5,4,3,2,1,0
```

17.220.1.33 NOSPLIT

```
#define NOSPLIT( ) FFLAS::ParSeqHelper::Sequential()
```

17.220.1.34 splitting_0

```
#define splitting_0( ) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, FFLAS::StrategyParameter::Threads>(a)
```

17.220.1.35 splitting_1

```
#define splitting_1(
    a ) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, FFLAS::StrategyParameter::Threads>(a)
```

17.220.1.36 splitting_2

```
#define splitting_2(
    a,
    c ) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, c>(a)
```

17.220.1.37 splitting_3

```
#define splitting_3(
    a,
    b,
    c ) FFLAS::ParSeqHelper::Parallel<b, c>(a)
```

17.220.1.38 splitt

```
#define splitt(
    _1,
    _2,
    _3,
    NAME,
    ... ) NAME
```

17.220.1.39 SPLITTER

```
#define SPLITTER(
    ... ) splitt(__VA_ARGS__, splitting_3, splitting_2, splitting_1, splitting_0) (↔
__VA_ARGS__)
```

17.221 pfgemm_variants.inl File Reference**Namespaces**

- [FFLAS](#)

Functions

- `template<class Field, class AlgoT, class FieldTrait>`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename`
`Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, Al-`
`goT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads > &H)`
- `template<class Field, class AlgoT, class FieldTrait>`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename`

```
Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDAdaptive > > &H)
```

- template<class Field , class AlgoT , class FieldTrait >
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive > > &H)
- template<class Field , class AlgoT , class FieldTrait >
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoD > > &H)
- template<class Field , class AlgoT , class FieldTrait >
Field::Element_ptr pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeD > > &H)
- template<class Field , class AlgoT , class FieldTrait >
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDInPlace > > &H)

17.222 pfgemv.inl File Reference

Namespaces

- FFLAS

Functions

- template<class Field , class AlgoT , class FieldTrait >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::Threads > > &H)
- template<class Field , class AlgoT , class FieldTrait , class Cut >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Row, Cut > > &H)

17.223 pluq.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
```

```
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

Macros

- `#define CUBE(x) ((x)*(x)*(x))`
- `#define GFOPS(m, n, r, t) (2.0/3.0*CUBE(double(n)/1000.0) +2*m/1000.0*n/1000.0*double(r)/1000.0 - double(r)/1000.0*double(r)/1000.0*(m+n)/1000)/t`

Typedefs

- `typedef Givaro::Timer TTimer`

Functions

- `int main ()`

17.223.1 Macro Definition Documentation

17.223.1.1 CUBE

```
#define CUBE(
    x )  ((x)*(x)*(x))
```

17.223.1.2 GFOPS

```
#define GFOPS(
    m,
    n,
    r,
    t ) (2.0/3.0*CUBE(double(n)/1000.0) +2*m/1000.0*n/1000.0*double(r)/1000.0 - double(r)/1000.0*double(r)/1000.0*(m+n)/1000)/t
```

17.223.2 Typedef Documentation

17.223.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.223.3 Function Documentation

17.223.3.1 main()

```
int main (
    void )
```

17.224 pluq.C File Reference

```
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int [main](#) (int argc, char **argv)

17.224.1 Function Documentation

17.224.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.225 rank.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example computes the rank of a matrix over a defined finite field.

17.225.1 Function Documentation

17.225.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example computes the rank of a matrix over a defined finite field.
Outputs the rank.

17.226 read_sparse.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <fstream>
#include <string>
#include <cstdlib>
#include <iterator>
```


Data Structures

- struct [Coo< Field >](#)
- struct [readMyMachineType< Field, T >](#)
- struct [readMyMachineType< Field, mpz_t >](#)

Namespaces

- [FFLAS](#)
- [FFLAS::details_spmv](#)

Macros

- `#define` [DNS_BIN_VER](#) 0
- `#define` [mask_t](#) [uint64_t](#)

Functions

- `template<class Field , bool sorted = true, bool read_integer = false>`
void [readSmsFormat](#) (const std::string &path, const [Field](#) &f, [index_t](#) *&row, [index_t](#) *&col, typename [Field::Element_ptr](#) &val, [index_t](#) &rowdim, [index_t](#) &coldim, [uint64_t](#) &n nz)
- `template<class Field >`
void [readSprFormat](#) (const std::string &path, const [Field](#) &f, [index_t](#) *&row, [index_t](#) *&col, typename [Field::Element_ptr](#) &val, [index_t](#) &rowdim, [index_t](#) &coldim, [uint64_t](#) &n nz)
- `template<class T >`
`std::enable_if< std::is_integral< T >::value, int >` [getDataType](#) ()
- `template<class T >`
`std::enable_if< std::is_floating_point< T >::value, int >` [getDataType](#) ()
- `template<class T >`
`std::enable_if< std::is_same< T, mpz_t >::value, int >` [getDataType](#) ()
- `template<class T >`
int [getDataType](#) ()
- `template<class Field >`
void [readMachineType](#) (const [Field](#) &F, typename [Field::Element](#) &modulo, typename [Field::Element_ptr](#) val, std::ifstream &file, const [uint64_t](#) dims, const [mask_t](#) data_type, const [mask_t](#) field_desc)
- `template<class Field >`
void [readDnsFormat](#) (const std::string &path, const [Field](#) &F, [index_t](#) &rowdim, [index_t](#) &coldim, typename [Field::Element_ptr](#) &val)
- `template<class Field >`
void [writeDnsFormat](#) (const std::string &path, const [Field](#) &F, const [index_t](#) &rowdim, const [index_t](#) &coldim, typename [Field::Element_ptr](#) A, [index_t](#) ldA)

17.226.1 Macro Definition Documentation

17.226.1.1 DNS_BIN_VER

```
#define DNS_BIN_VER 0
```

17.226.1.2 mask_t

```
#define mask_t uint64_t
```

17.227 regression-check.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- bool [check1](#) ()
- bool [check2](#) ()
- bool [check3](#) ()
- bool [check4](#) ()
- bool [checkZeroDimCharpoly](#) ()
- bool [checkZeroDimMinPoly](#) ()
- bool [gf2ModularBalanced](#) ()
- int [main](#) ()

17.227.1 Function Documentation

17.227.1.1 [check1\(\)](#)

```
bool check1 ( )
```

17.227.1.2 [check2\(\)](#)

```
bool check2 ( )
```

17.227.1.3 [check3\(\)](#)

```
bool check3 ( )
```

17.227.1.4 [check4\(\)](#)

```
bool check4 ( )
```

17.227.1.5 [checkZeroDimCharpoly\(\)](#)

```
bool checkZeroDimCharpoly ( )
```

17.227.1.6 [checkZeroDimMinPoly\(\)](#)

```
bool checkZeroDimMinPoly ( )
```

17.227.1.7 [gf2ModularBalanced\(\)](#)

```
bool gf2ModularBalanced ( )
```

17.227.1.8 main()

```
int main (
    void )
```

17.228 rns-double-elt.h File Reference

rns elt structure with double support

```
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/utils/cast.h"
```

Data Structures

- struct [rns_double_elt](#)
- struct [rns_double_elt_ptr](#)
- struct [rns_double_elt_cstptr](#)

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- template<> [rns_double_elt_ptr fflas_const_cast](#) (rns_double_elt_cstptr x)
- template<> [rns_double_elt_cstptr fflas_const_cast](#) (rns_double_elt_ptr x)

17.228.1 Detailed Description

rns elt structure with double support

17.229 rns-double-recint.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_freduce.h"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_field_rns_double_recint_INL](#)

17.229.1 Macro Definition Documentation

17.229.1.1 __FFLASFFPACK_field_rns_double_recint_INL

```
#define __FFLASFFPACK_field_rns_double_recint_INL
```

17.230 rns-double.h File Reference

rns structure with double support

```
#include <iterator>
#include <vector>
#include <givaro/modular-floating.h>
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include "givaro/modular-extended.h"
#include <recint/ruint.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include "fflas-ffpack/field/rns-double-elt.h"
#include "rns-double.inl"
#include "rns-double-recint.inl"
```

Data Structures

- struct [rns_double](#)
- struct [rns_double_extended](#)
- class [rnsRandIter](#)< [RNS](#) >

Namespaces

- [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- [FFLAS](#)

Macros

- #define [ROUND_DOWN](#)(x, s) ((x) & ~((s)-1))

Functions

- template<> void [fflas_delete](#) ([FFPACK::rns_double_elt_ptr](#) A)
- template<> void [fflas_delete](#) ([FFPACK::rns_double_elt_cstptr](#) A)

17.230.1 Detailed Description

rns structure with double support

17.230.2 Macro Definition Documentation

17.230.2.1 ROUND_DOWN

```
#define ROUND_DOWN(
    x,
    s ) ((x) & ~((s)-1))
```

17.231 rns-double.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_freduce.h"
```

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_field_rns_double_INL`

17.231.1 Macro Definition Documentation

17.231.1.1 __FFLASFFPACK_field_rns_double_INL

```
#define __FFLASFFPACK_field_rns_double_INL
```

17.232 rns-integer-mod.h File Reference

representation of $\mathbb{Z}/p\mathbb{Z}$ using RNS representation (note: fixed precision)

```
#include <vector>
#include <cmath>
#include <recint/recint.h>
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include <givaro/udl.h>
#include "givaro/modular-extended.h"
#include "fflas-ffpack/field/rns-double.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas/fflas_level1.inl"
#include "fflas-ffpack/fflas/fflas_level2.inl"
#include "fflas-ffpack/fflas/fflas_level3.inl"
#include "fflas-ffpack/fflas/fflas_enum.h"
#include "fflas-ffpack/fflas/fflas_fscal_mp.inl"
```

Data Structures

- class [RNSIntegerMod< RNS >](#)
- class [RNSIntegerMod< RNS >::RandIter](#)

Namespaces

- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

- [FFLAS](#)

Functions

- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const Alignment align)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS >`
`void finit_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename RNS::Element_ptr A)`

- `template<typename RNS >`
`void finit_trans_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename RNS::Element_ptr A)`
- `template<typename RNS >`
`void fconvert_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement_ptr A)`
- `template<typename RNS >`
`void fconvert_trans_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement_ptr A)`

17.232.1 Detailed Description

representation of $\mathbb{Z}/p\mathbb{Z}$ using RNS representation (note: fixed precision)

17.233 rns-integer.h File Reference

representation of \mathbb{Z} using RNS representation (note: fixed precision)

```
#include <givaro/givinteger.h>
#include "fflas-ffpack/field/rns-double.h"
```

Data Structures

- class `RNSInteger< RNS >`
- class `RNSInteger< RNS >::RandIter`

Namespaces

- `FFPACK`
Finite Field PACK Set of elimination based routines for dense linear algebra.
- `FFLAS`

Functions

- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const Alignment align)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS >`
`void finit_rns (const FFPACK::RNSInteger< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename FFPACK::RNSInteger< RNS >::Element_ptr A)`
- `template<typename RNS >`
`void fconvert_rns (const FFPACK::RNSInteger< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr A)`

17.233.1 Detailed Description

representation of \mathbb{Z} using RNS representation (note: fixed precision)

17.234 rns.h File Reference

Namespaces

- `FFPACK`
Finite Field PACK Set of elimination based routines for dense linear algebra.

17.235 rns.inl File Reference

```
#include "rns-double.h"
#include "rns-integer.h"
#include "rns-integer-mod.h"
```

Macros

- `#define __FFLASFFPACK_field_rns_INL`

17.235.1 Macro Definition Documentation

17.235.1.1 __FFLASFFPACK_field_rns_INL

```
#define __FFLASFFPACK_field_rns_INL
```

17.236 schedule_bini.inl File Reference

Bini implementation.

Namespaces

- [FFLAS](#)
- [FFLAS::BLAS3](#)

Macros

- `#define __FFLASFFPACK_fgemm_bini_INL`

Functions

- `template<class Field >`
`void Bini (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, const size_t kmax, const size_t w, const FFLAS_BASE base, const size_t rec_level)`

17.236.1 Detailed Description

Bini implementation.

17.236.2 Macro Definition Documentation

17.236.2.1 __FFLASFFPACK_fgemm_bini_INL

```
#define __FFLASFFPACK_fgemm_bini_INL
```

17.237 schedule_winograd.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::BLAS3](#)

Macros

- `#define __FFLASFFPACK_fgemm_winograd_INL`

Functions

- `template<class Field , class FieldTrait , class Strat , class Param >`
`Field::Element_ptr WinoPar (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel< Strat, Param > > &WH)`
- `template<class Field , class FieldTrait >`
`void Winograd (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`

17.237.1 Macro Definition Documentation

17.237.1.1 __FFLASFFPACK_fgemm_winograd_INL

```
#define __FFLASFFPACK_fgemm_winograd_INL
```

17.238 schedule_winograd_acc.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::BLAS3](#)

Macros

- `#define __FFLASFFPACK_fgemm_winograd_acc_INL`

Functions

- `template<class Field , class FieldTrait >`
`void WinogradAcc_3_23 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_3_21 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`


```
const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,
MMHelperAlgo::Winograd, FieldTrait > &WH)
```

- `template<class Field , class FieldTrait >`
`void WinogradAcc_2_24 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename`
`Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename`
`Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd,`
`FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_2_27 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename`
`Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename`
`Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd,`
`FieldTrait > &WH)`

17.238.1 Macro Definition Documentation

17.238.1.1 __FFLASFFPACK_fgemm_winograd_acc_INL

```
#define __FFLASFFPACK_fgemm_winograd_acc_INL
```

17.239 schedule_winograd_acc_ip.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::BLAS3](#)

Macros

- `#define __FFLASFFPACK_fgemm_winograd_acc_ip_INL`

Functions

- `template<class Field , class FieldTrait >`
`void WinogradAcc_LR (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const`
`size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr`
`A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta,`
`typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, Field`
`Trait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename`
`Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename`
`Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelper`
`Algo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const`
`size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr`
`A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element`
`beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd,`
`FieldTrait > &WH)`

17.239.1 Macro Definition Documentation

17.239.1.1 __FFLASFFPACK_fgemm_winograd_acc_ip_INL

```
#define __FFLASFFPACK_fgemm_winograd_acc_ip_INL
```

17.240 schedule_winograd_ip.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::BLAS3](#)

Macros

- #define [__FFLASFFPACK_fgemm_winograd_ip_INL](#)

Functions

- template<class Field , class FieldTrait >
void [Winograd_LR_S](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, const MMHelper< [Field](#), MMHelperAlgo::Winograd, Field↔Trait > &WH)
- template<class Field , class FieldTrait >
void [Winograd_L_S](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, const MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldTrait > &WH)
- template<class Field , class FieldTrait >
void [Winograd_R_S](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, const typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, const MMHelper< [Field](#), MMHelper↔Algo::Winograd, FieldTrait > &WH)

17.240.1 Macro Definition Documentation

17.240.1.1 __FFLASFFPACK_fgemm_winograd_ip_INL

```
#define __FFLASFFPACK_fgemm_winograd_ip_INL
```

17.241 sell.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/sell/sell_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/sell/sell_spmv.inl"
```

Data Structures

- struct [Sparse<_Field, SparseMatrix_t::SELL >](#)
- struct [Sparse<_Field, SparseMatrix_t::SELL_ZO >](#)

Namespaces

- [FFLAS](#)

17.242 sell_pspmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- [#define __FFLASFFPACK_fflas_sparse_sell_pspmv_INL](#)

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.242.1 Macro Definition Documentation

17.242.1.1 __FFLASFFPACK_fflas_sparse_sell_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_sell_pspmv_INL
```

17.243 sell_spmv.inl File Reference

Namespaces

- [FFLAS](#)
- [FFLAS::sparse_details_impl](#)

Macros

- [#define __FFLASFFPACK_fflas_sparse_sell_spmv_INL](#)

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.243.1 Macro Definition Documentation

17.243.1.1 __FflasFPACK_fflas_sparse_sell_spmv_INL

```
#define __FflasFPACK_fflas_sparse_sell_spmv_INL
```

17.244 sell_utils.inl File Reference

Data Structures

- struct [Info](#)
- struct [Coo< ValT, IdxT >](#)

Namespaces

- [FFLAS](#)
- [FFLAS::sell_details](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_sell_utils_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL_ZO > &A)`
- `template<class Field >`
`void sparse_print (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz, uint64_t sigma=0)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.244.1 Macro Definition Documentation

17.244.1.1 __FFLASFFPACK_fflas_sparse_sell_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_sell_utils_INL
```

17.245 simd.dox File Reference

17.246 simd128.inl File Reference

```
#include "simd128_float.inl"
#include "simd128_double.inl"
```

Data Structures

- struct [Simd128fp_base](#)
- struct [Simd128i_base](#)

Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd128_INL`

Typedefs

- `template<class T >`
`using Simd128 = Simd128_impl< std::is_arithmetic< T >::value, std::is_integral< T >::value, std::is_↵`
`signed< T >::value, sizeof(T)>`

17.246.1 Macro Definition Documentation

17.246.1.1 `__FFLASFFPACK_fflas_ffpack_utils_simd128_INL`

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_INL
```

17.246.2 Typedef Documentation

17.246.2.1 `Simd128`

```
using Simd128 = Simd128_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std::is_signed<T>::value, sizeof(T)>
```

17.247 `simd128_double.inl` File Reference

Data Structures

- struct `Simd128_impl< true, false, true, 8 >`

Macros

- #define `__FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL`

17.247.1 Macro Definition Documentation

17.247.1.1 `__FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL`

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL
```

17.248 `simd128_float.inl` File Reference

Data Structures

- struct `Simd128_impl< true, false, true, 4 >`

Macros

- #define `__FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL`

17.248.1 Macro Definition Documentation

17.248.1.1 `__FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL`

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL
```

17.249 `simd128_int16.inl` File Reference

Data Structures

- struct `Simd128_impl< true, true, true, 2 >`
- union `Simd128_impl< true, true, true, 2 >::Converter`
- struct `Simd128_impl< true, true, false, 2 >`
- union `Simd128_impl< true, true, false, 2 >::Converter`

Macros

- [#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL](#)

17.249.1 Macro Definition Documentation

17.249.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL
```

17.250 simd128_int32.inl File Reference

Data Structures

- struct [Simd128_impl< true, true, true, 4 >](#)
- union [Simd128_impl< true, true, true, 4 >::Converter](#)
- struct [Simd128_impl< true, true, false, 4 >](#)
- union [Simd128_impl< true, true, false, 4 >::Converter](#)

Macros

- [#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL](#)

17.250.1 Macro Definition Documentation

17.250.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL
```

17.251 simd128_int64.inl File Reference

Data Structures

- struct [Simd128_impl< true, true, true, 8 >](#)
- union [Simd128_impl< true, true, true, 8 >::Converter](#)
- struct [Simd128_impl< true, true, false, 8 >](#)
- union [Simd128_impl< true, true, false, 8 >::Converter](#)

Macros

- [#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL](#)
- [#define vect_t Simd128_impl<true,true,true,8>::vect_t](#)

17.251.1 Macro Definition Documentation

17.251.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL
```

17.251.1.2 vect_t

```
#define vect_t Simd128_impl<true,true,true,8>::vect_t
```

17.252 simd256.inl File Reference

```
#include "simd256_float.inl"
#include "simd256_double.inl"
```

Data Structures

- struct [Simd256fp_base](#)
- struct [Simd256i_base](#)

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_INL](#)

Typedefs

- template<class T >
using [Simd256](#) = [Simd256_impl](#)< std::is_arithmetic< T >::value, std::is_integral< T >::value, std::is_↵
signed< T >::value, sizeof(T)>

17.252.1 Macro Definition Documentation

17.252.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_INL
```

17.252.2 Typedef Documentation

17.252.2.1 Simd256

```
using Simd256 = Simd256\_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std↵  
::is_signed<T>::value, sizeof(T)>
```

17.253 simd256_double.inl File Reference

Data Structures

- struct [Simd256_impl](#)< true, false, true, 8 >

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL](#)

17.253.1 Macro Definition Documentation

17.253.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL
```

17.254 simd256_float.inl File Reference**Data Structures**

- struct [Simd256_impl](#)< true, false, true, 4 >

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL](#)

17.254.1 Macro Definition Documentation**17.254.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL**

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL
```

17.255 simd256_int16.inl File Reference**Data Structures**

- struct [Simd256_impl](#)< true, true, true, 2 >
- union [Simd256_impl](#)< true, true, true, 2 >::Converter
- struct [Simd256_impl](#)< true, true, false, 2 >
- union [Simd256_impl](#)< true, true, false, 2 >::Converter

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL](#)

17.255.1 Macro Definition Documentation**17.255.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL**

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL
```

17.256 simd256_int32.inl File Reference**Data Structures**

- struct [Simd256_impl](#)< true, true, true, 4 >
- union [Simd256_impl](#)< true, true, true, 4 >::Converter
- struct [Simd256_impl](#)< true, true, false, 4 >
- union [Simd256_impl](#)< true, true, false, 4 >::Converter

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL](#)

17.256.1 Macro Definition Documentation

17.256.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL
```

17.257 simd256_int64.inl File Reference

Data Structures

- struct [Simd256_impl< true, true, true, 8 >](#)
- union [Simd256_impl< true, true, true, 8 >::Converter](#)
- struct [Simd256_impl< true, true, false, 8 >](#)
- union [Simd256_impl< true, true, false, 8 >::Converter](#)

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL](#)
- #define [vect_t Simd256_impl<true, true, true, 8>::vect_t](#)

17.257.1 Macro Definition Documentation

17.257.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL
```

17.257.1.2 vect_t

```
#define vect_t Simd256\_impl<true, true, true, 8>::vect\_t
```

17.258 simd512.inl File Reference

```
#include "simd512_float.inl"
#include "simd512_double.inl"
#include "simd512_int64.inl"
```

Data Structures

- struct [Simd512fp_base](#)
- struct [Simd512i_base](#)

Macros

- #define [__FFLASFFPACK_simd512_INL](#)

Typedefs

- template<class T >
using [Simd512](#) = [Simd512_impl< std::is_arithmetic< T >::value, std::is_integral< T >::value, std::is_↵
signed< T >::value, sizeof\(T\)>](#)

17.258.1 Macro Definition Documentation

17.258.1.1 __FFLASFFPACK_simd512_INL

```
#define __FFLASFFPACK_simd512_INL
```

17.258.2 Typedef Documentation

17.258.2.1 Simd512

```
using Simd512 = Simd512_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std::is_signed<T>::value, sizeof(T)>
```

17.259 simd512_double.inl File Reference

Data Structures

- struct [Simd512_impl](#)< true, false, true, 8 >

Macros

- #define [__FFLASFFPACK_simd512_double_INL](#)

17.259.1 Macro Definition Documentation

17.259.1.1 __FFLASFFPACK_simd512_double_INL

```
#define __FFLASFFPACK_simd512_double_INL
```

17.260 simd512_float.inl File Reference

Data Structures

- struct [Simd512_impl](#)< true, false, true, 4 >

Macros

- #define [__FFLASFFPACK_simd512_float_INL](#)

17.260.1 Macro Definition Documentation

17.260.1.1 __FFLASFFPACK_simd512_float_INL

```
#define __FFLASFFPACK_simd512_float_INL
```

17.261 simd512_int32.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd/simd512_int64.inl"
```

Data Structures

- struct [Simd256_impl](#)< true, true, true, 4 >
- union [Simd256_impl](#)< true, true, true, 4 >::Converter
- struct [Simd256_impl](#)< true, true, false, 4 >
- union [Simd256_impl](#)< true, true, false, 4 >::Converter

Macros

- #define [__FFLASFFPACK_simd512_int32_INL](#)

17.261.1 Macro Definition Documentation

17.261.1.1 __FFLASFFPACK_simd512_int32_INL

```
#define __FFLASFFPACK_simd512_int32_INL
```

17.262 simd512_int64.inl File Reference

Data Structures

- struct [Simd512_impl](#)< true, true, true, 8 >
- union [Simd512_impl](#)< true, true, true, 8 >::Converter
- struct [Simd512_impl](#)< true, true, false, 8 >
- union [Simd512_impl](#)< true, true, false, 8 >::Converter

Macros

- #define [_simd512_int64_INL](#)
- #define [vect_t Simd512_impl](#)<true, true, true, 8>::vect_t

17.262.1 Macro Definition Documentation

17.262.1.1 _simd512_int64_INL

```
#define _simd512_int64_INL
```

17.262.1.2 vect_t

```
#define vect_t Simd512\_impl<true, true, true, 8>::vect_t
```

17.263 simd_modular.inl File Reference

Data Structures

- class [FieldSimd](#)< [_Field](#) >

17.264 solve.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example solve the quare system defined by the input over a defined finite field.

17.264.1 Function Documentation

17.264.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example solve the quare system defined by the input over a defined finite field.

17.265 sparse_matrix_traits.h File Reference

```
#include <type_traits>
```

Data Structures

- struct [isSparseMatrix](#)< Field, M >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::CSR > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::COO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::SELL > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >
- struct [isZOSparseMatrix](#)< F, M >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >
- struct [isSparseMatrixSimdFormat](#)< F, M >
- struct [isSparseMatrixMKLFormat](#)< F, M >
- struct [tfn_plus](#)
- struct [tfn_mul](#)
- struct [tfn_mul_eq](#)
- struct [tfn_minus](#)
- struct [tfn_plus_eq](#)
- struct [tfn_minus_eq](#)
- struct [has_plus_impl](#)< C >
- struct [has_mul_impl](#)< C >
- struct [has_mul_eq_impl](#)< C >
- struct [has_plus_eq_impl](#)< C >
- struct [has_minus_eq_impl](#)< C >
- struct [has_minus_impl](#)< C >
- struct [has_operation](#)< T >

Namespaces

- [FFLAS](#)

Typedefs

- using [ZOSparseMatrix](#) = std::true_type
- using [NotZOSparseMatrix](#) = std::false_type
- using [SimdSparseMatrix](#) = std::true_type
- using [NoSimdSparseMatrix](#) = std::false_type
- using [MKLSparseMatrixFormat](#) = std::true_type
- using [NotMKLSparseMatrixFormat](#) = std::false_type
- template<class T >
using [has_plus](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_plus_impl< T > >::type
- template<class T >
using [has_minus](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_minus_↵_impl< T > >::type
- template<class T >
using [has_equal](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, std::is_copy_↵_assignable< T > >::type
- template<class T >
using [has_plus_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_plus_↵_eq_impl< T > >::type
- template<class T >
using [has_minus_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_↵_minus_eq_impl< T > >::type
- template<class T >
using [has_mul](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_impl< T > >::type
- template<class T >
using [has_mul_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_↵_eq_impl< T > >::type

17.266 test-charpoly-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Macros

- #define [ENABLE_CHECKER_charpoly](#) 1
- #define [TIME_CHECKER_CHARPOLY](#) 1

Functions

- template<class Field , class Polynomial >
void [printPolynomial](#) (const [Field](#) &F, Polynomial &v)
- int [main](#) (int argc, char **argv)

17.266.1 Macro Definition Documentation

17.266.1.1 ENABLE_CHECKER_charpoly

```
#define ENABLE_CHECKER_charpoly 1
```

17.266.1.2 TIME_CHECKER_CHARPOLY

```
#define TIME_CHECKER_CHARPOLY 1
```

17.266.2 Function Documentation

17.266.2.1 printPolynomial()

```
void printPolynomial (
    const Field & F,
    Polynomial & v )
```

17.266.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.267 test-charpoly.C File Reference

```
#include <iostream>
#include <iomanip>
#include "givaro/modular.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <random>
#include <chrono>
```

Functions

- template<class Field , class RandIter >
bool [launch_test](#) (const Field &F, size_t n, typename Field::Element *A, size_t lda, size_t nbit, RandIter &G, FFPACK::FFPACK_CHARPOLY_TAG CT)
- template<class Field >
bool [run_with_field](#) (const Givaro::Integer p, uint64_t bits, size_t n, std::string file, int variant, size_t iter, uint64_t seed)
- int [main](#) (int argc, char **argv)

17.267.1 Function Documentation

17.267.1.1 launch_test()

```
bool launch_test (
    const Field & F,
    size_t n,
    typename Field::Element * A,
    size_t lda,
    size_t nbit,
    RandIter & G,
    FFPACK::FFPACK_CHARPOLY_TAG CT )
```

17.267.1.2 run_with_field()

```
bool run_with_field (
    const Givaro::Integer p,
    uint64_t bits,
    size_t n,
    std::string file,
    int variant,
    size_t iter,
    uint64_t seed )
```

17.267.1.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.268 test-compressQ.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <list>
#include <vector>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Typedefs

- typedef Givaro::Modular< double > [Field](#)

Functions

- template<class T >
std::ostream & [printvect](#) (std::ostream &o, vector< T > &vect)
- int [main](#) (int argc, char **argv)

17.268.1 Typedef Documentation**17.268.1.1 Field**

```
typedef Givaro::Modular<double> Field
```


17.268.2 Function Documentation

17.268.2.1 printvect()

```
std::ostream& printvect (
    std::ostream & o,
    vector< T > & vect )
```

Bug does not belong here

17.268.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.269 test-det-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/checkers/checkers_ffpack.h"
#include "fflas-ffpack/checkers/checkers_ffpack.inl"
```

Macros

- `#define` [ENABLE_CHECKER_Det](#) 1
- `#define` [TIME_CHECKER_Det](#) 1

Functions

- `int` [main](#) (int argc, char **argv)

17.269.1 Macro Definition Documentation

17.269.1.1 ENABLE_CHECKER_Det

```
#define ENABLE_CHECKER_Det 1
```

17.269.1.2 TIME_CHECKER_Det

```
#define TIME_CHECKER_Det 1
```

17.269.2 Function Documentation

17.269.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.270 test-det.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

Functions

- `template<class Field , class RandIter >`
`bool test_det (Field &F, size_t n, int iter, RandIter &G)`
- `int main (int argc, char **argv)`

17.270.1 Function Documentation

17.270.1.1 test_det()

```
bool test_det (
    Field & F,
    size_t n,
    int iter,
    RandIter & G )
```

Todo test with stride

17.270.1.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.271 test-echelon.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <iomanip>
#include <givaro/modular-balanced.h>
#include <givaro/udl.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

```
#include <random>
#include <chrono>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 25`
- `#define __FFLASFFPACK_PLUQ_THRESHOLD 25`

Functions

- `template<class Field , class Randlter >`
`bool test_colechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag,`
`Randlter &G, bool par)`
- `template<class Field , class Randlter >`
`bool test_rowechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag,`
`Randlter &G, bool par)`
- `template<class Field , class Randlter >`
`bool test_redcolechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag,`
`Randlter &G, bool par)`
- `template<class Field , class Randlter >`
`bool test_redrowechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag,`
`Randlter &G, bool par)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, size_t m, size_t n, size_t r, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.271.1 Macro Definition Documentation

17.271.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.271.1.2 __FFLASFFPACK_GAUSSJORDAN_BASECASE

```
#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 25
```

17.271.1.3 __FFLASFFPACK_PLUQ_THRESHOLD

```
#define __FFLASFFPACK_PLUQ_THRESHOLD 25
```

17.271.2 Function Documentation

17.271.2.1 test_colechelon()

```
bool test_colechelon (
    Field & F,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
```

```
FFPACK::FFPACK_LU_TAG LuTag,  
RandIter & G,  
bool par )
```

Todo check Ida

17.271.2.2 test_rowechelon()

```
bool test_rowechelon (  
    Field & F,  
    size_t m,  
    size_t n,  
    size_t r,  
    size_t iters,  
    FFPACK::FFPACK_LU_TAG LuTag,  
    RandIter & G,  
    bool par )
```

Todo check Ida

17.271.2.3 test_redcolechelon()

```
bool test_redcolechelon (  
    Field & F,  
    size_t m,  
    size_t n,  
    size_t r,  
    size_t iters,  
    FFPACK::FFPACK_LU_TAG LuTag,  
    RandIter & G,  
    bool par )
```

Todo check Ida

17.271.2.4 test_redrowechelon()

```
bool test_redrowechelon (  
    Field & F,  
    size_t m,  
    size_t n,  
    size_t r,  
    size_t iters,  
    FFPACK::FFPACK_LU_TAG LuTag,  
    RandIter & G,  
    bool par )
```

Todo check Ida

17.271.2.5 run_with_field()

```
bool run_with_field (  
    Givaro::Integer q,  
    uint64_t b,
```

```

    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed )

```

17.271.2.6 main()

```

int main (
    int argc,
    char ** argv )

```

17.272 test-fadd.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"

```

Functions

- template<class Field >
bool [test_fadd](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- template<class Field >
bool [test_faddin](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- template<class Field >
bool [test_fsub](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- template<class Field >
bool [test_fsubin](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- int [main](#) (int ac, char **av)

17.272.1 Function Documentation

17.272.1.1 test_fadd()

```

bool test_fadd (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64\_t seed )

```

17.272.1.2 test_faddin()

```

bool test_faddin (
    const Field & F,
    size_t m,
    size_t k,

```

```

    size_t n,
    bool timing,
    uint64_t seed )

```

17.272.1.3 test_fsub()

```

bool test_fsub (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed )

```

17.272.1.4 test_fsubin()

```

bool test_fsubin (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed )

```

17.272.1.5 main()

```

int main (
    int ac,
    char ** av )

```

17.273 test-fdot.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include <givaro/zring.h>
#include <givaro/modular.h>
#include <random>
#include <chrono>

```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename Field >
 bool [check_fdot](#) (const Field &F, size_t n, typename Field::ConstElement_ptr a, size_t inca, typename Field::ConstElement_ptr b, size_t incb)

- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, size_t BS, size_t n, size_t iters, [uint64_t](#) seed)
- bool [run_with_Integer](#) (size_t BS, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.273.1 Macro Definition Documentation

17.273.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.273.2 Function Documentation

17.273.2.1 check_fdot()

```
bool check_fdot (
    const Field & F,
    size_t n,
    typename Field::ConstElement\_ptr a,
    size_t inca,
    typename Field::ConstElement\_ptr b,
    size_t incb )
```

17.273.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t BS,
    size_t n,
    size_t iters,
    uint64\_t seed )
```

17.273.2.3 run_with_Integer()

```
bool run_with_Integer (
    size_t BS,
    size_t n,
    size_t iters,
    uint64\_t seed )
```

17.273.2.4 main()

```
int main (
    int argc,
    char ** argv )
```

17.274 test-fgemm-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
```

```
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

Macros

- `#define` [ENABLE_ALL_CHECKINGS](#) 1

Functions

- `template<class Field , class RandIter >`
`bool` [launch_MM_dispatch](#) (const [Field](#) &F, const int mm, const int nn, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t iters, RandIter &G)
- `template<class Field >`
`bool` [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, int m, int n, int k, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.274.1 Macro Definition Documentation

17.274.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.274.2 Function Documentation

17.274.2.1 launch_MM_dispatch()

```
bool launch_MM_dispatch (
    const Field & F,
    const int mm,
    const int nn,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    RandIter & G )
```

Bug test for ldX equal

Bug test for transpo

Todo does nbw actually do nbw recursive calls and then call blas (check ?) ?

17.274.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64\_t b,
    int m,
    int n,
    int k,
    size_t iters,
    uint64\_t seed )
```


17.274.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.275 test-fgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <random>
```

Macros

- #define [ENABLE_CHECKER_fgemm](#) 1

Functions

- template<class Field >
bool [check_MM](#) (const [Field](#) &F, const typename [Field::Element_ptr](#) Cd, enum [FFLAS_TRANSPOSE](#) &ta, enum [FFLAS_TRANSPOSE](#) &tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element_ptr](#) A, size_t lda, const typename [Field::Element_ptr](#) B, size_t ldb, const typename [Field::Element](#) &beta, const typename [Field::Element_ptr](#) C, size_t ldc)
- template<class Field , class RandIter >
bool [launch_MM](#) (const [Field](#) &F, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t ldc, const size_t lda, enum [FFLAS_TRANSPOSE](#) ta, const size_t ldb, enum [FFLAS_TRANSPOSE](#) tb, size_t iters, int nbw, bool par, RandIter &G)
- template<class Field , class RandIter >
bool [launch_MM_dispatch](#) (const [Field](#) &F, const int mm, const int nn, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t iters, const int nbw, const bool par, RandIter &G)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, int m, int n, int k, int nbw, size_t iters, bool par, size_t seed)
- int [main](#) (int argc, char **argv)

17.275.1 Macro Definition Documentation

17.275.1.1 ENABLE_CHECKER_fgemm

```
#define ENABLE_CHECKER_fgemm 1
```

17.275.2 Function Documentation

17.275.2.1 check_MM()

```

bool check_MM (
    const Field & F,
    const typename Field::Element_ptr Cd,
    enum FFLAS_TRANSPOSE & ta,
    enum FFLAS_TRANSPOSE & tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element_ptr A,
    size_t lda,
    const typename Field::Element_ptr B,
    size_t ldb,
    const typename Field::Element & beta,
    const typename Field::Element_ptr C,
    size_t ldc )

```

17.275.2.2 launch_MM()

```

bool launch_MM (
    const Field & F,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t ldc,
    const size_t lda,
    enum FFLAS_TRANSPOSE ta,
    const size_t ldb,
    enum FFLAS_TRANSPOSE tb,
    size_t iters,
    int nbw,
    bool par,
    RandIter & G )

```

17.275.2.3 launch_MM_dispatch()

```

bool launch_MM_dispatch (
    const Field & F,
    const int mm,
    const int nn,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    const int nbw,
    const bool par,
    RandIter & G )

```

Bug test for ldX equal

Bug test for transpo

Todo does nbw actually do nbw recursive calls and then call blas (check ?) ?

17.275.2.4 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int n,
    int k,
    int nbw,
    size_t iters,
    bool par,
    size_t seed )
```

17.275.2.5 main()

```
int main (
    int argc,
    char ** argv )
```

17.276 test-fgemv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

Functions

- `template<class Field >`
`bool check_MV (const Field &F, const typename Field::Element_ptr Cd, enum FFLAS_TRANSPOSE &ta, const size_t m, const size_t k, const typename Field::Element &alpha, const typename Field::Element_ptr A, size_t lda, const typename Field::Element_ptr X, size_t incX, const typename Field::Element &beta, const typename Field::Element_ptr Y, size_t incY)`
- `template<class Field , class RandIter >`
`bool launch_MV (const Field &F, const size_t m, const size_t k, const typename Field::Element alpha, const typename Field::Element beta, const size_t lda, enum FFLAS_TRANSPOSE ta, const size_t incX, const size_t incY, size_t iters, bool par, RandIter &G)`
- `template<class Field , class RandIter >`
`bool launch_MV_dispatch (const Field &F, const int mm, const int kk, const typename Field::Element alpha, const typename Field::Element beta, const size_t iters, const bool par, RandIter &G)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, int m, int k, size_t iters, bool par, uint64_t seed)`
- `int main (int argc, char **argv)`

17.276.1 Function Documentation

17.276.1.1 check_MV()

```

bool check_MV (
    const Field & F,
    const typename Field::Element_ptr Cd,
    enum FFLAS_TRANSPOSE & ta,
    const size_t m,
    const size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element_ptr A,
    size_t lda,
    const typename Field::Element_ptr X,
    size_t incX,
    const typename Field::Element & beta,
    const typename Field::Element_ptr Y,
    size_t incY )

```

17.276.1.2 launch_MV()

```

bool launch_MV (
    const Field & F,
    const size_t m,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t lda,
    enum FFLAS_TRANSPOSE ta,
    const size_t incX,
    const size_t incY,
    size_t iters,
    bool par,
    RandIter & G )

```

17.276.1.3 launch_MV_dispatch()

```

bool launch_MV_dispatch (
    const Field & F,
    const int mm,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    const bool par,
    RandIter & G )

```

17.276.1.4 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int k,
    size_t iters,
    bool par,
    uint64_t seed )

```

17.276.1.5 main()

```
int main (
    int argc,
    char ** argv )
```

17.277 test-fger.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular-integral.h>
#include <givaro/modular-balanced.h>
#include <givaro/givintprime.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Macros

- `#define TIME 1`

Functions

- `template<class Field >`
`bool check_fger (const Field &F, const typename Field::Element_ptr Cd, const size_t m, const size_t n, const`
`typename Field::Element &alpha, const typename Field::Element_ptr x, const size_t incx, const typename`
`Field::Element_ptr y, const size_t incy, const typename Field::Element_ptr C, const size_t ldc)`
- `template<class Field , class RandIter >`
`bool launch_fger (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, const`
`size_t ldc, const size_t inca, const size_t incb, size_t iters, RandIter &G)`
- `template<class Field , class RandIter >`
`bool launch_fger_dispatch (const Field &F, const size_t nn, const typename Field::Element alpha, const`
`size_t iters, RandIter &G)`
- `template<class Field >`
`bool run_with_field (int64_t q, uint64_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.277.1 Macro Definition Documentation

17.277.1.1 TIME

```
#define TIME 1
```

17.277.2 Function Documentation

17.277.2.1 check_fger()

```
bool check_fger (
    const Field & F,
    const typename Field::Element_ptr Cd,
```

```
const size_t m,  
const size_t n,  
const typename Field::Element & alpha,  
const typename Field::Element_ptr x,  
const size_t incx,  
const typename Field::Element_ptr y,  
const size_t incy,  
const typename Field::Element_ptr C,  
const size_t ldc )
```

17.277.2.2 launch_fger()

```
bool launch_fger (  
    const Field & F,  
    const size_t m,  
    const size_t n,  
    const typename Field::Element alpha,  
    const size_t ldc,  
    const size_t inca,  
    const size_t incb,  
    size_t iters,  
    RandIter & G )
```

17.277.2.3 launch_fger_dispatch()

```
bool launch_fger_dispatch (  
    const Field & F,  
    const size_t nn,  
    const typename Field::Element alpha,  
    const size_t iters,  
    RandIter & G )
```

Bug test for incx equal

Bug test for transpo

Todo does nbw actually do nbw recursive calls and then call blas (check ?) ?

17.277.2.4 run_with_field()

```
bool run_with_field (  
    int64_t q,  
    uint64_t b,  
    size_t n,  
    size_t iters,  
    uint64_t seed )
```

17.277.2.5 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.278 test-fgesv.C File Reference

```
#include <iostream>
#include <iomanip>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

Functions

- template<class Field, class RandIter >
bool [test_square_fgesv](#) (Field &F, [FFLAS_SIDE](#) side, string fileA, string fileB, size_t m, size_t k, size_t r, RandIter &G)
- template<class Field, class RandIter >
bool [test_rect_fgesv](#) (Field &F, [FFLAS_SIDE](#) side, string fileA, string fileB, size_t m, size_t n, size_t k, size_t r, RandIter &G)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, size_t m, size_t n, size_t k, size_t r, size_t iters, string fileA, string fileB, [uint64_t](#) &seed)
- int [main](#) (int argc, char **argv)

17.278.1 Function Documentation

17.278.1.1 test_square_fgesv()

```
bool test_square_fgesv (
    Field & F,
    FFLAS_SIDE side,
    string fileA,
    string fileB,
    size_t m,
    size_t k,
    size_t r,
    RandIter & G )
```

17.278.1.2 test_rect_fgesv()

```
bool test_rect_fgesv (
    Field & F,
    FFLAS_SIDE side,
    string fileA,
    string fileB,
    size_t m,
    size_t n,
    size_t k,
    size_t r,
    RandIter & G )
```

17.278.1.3 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
```

```

uint64_t b,
size_t m,
size_t n,
size_t k,
size_t r,
size_t iters,
string fileA,
string fileB,
uint64_t & seed )

```

17.278.1.4 main()

```

int main (
    int argc,
    char ** argv )

```

17.279 test-finit.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"
#include <random>
#include <chrono>

```

Functions

- template<class Field >
bool [test_freduce](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t m, size_t k, size_t n, size_t iters, bool timing, [uint64_t](#) seed)
- int [main](#) (int ac, char **av)

17.279.1 Function Documentation

17.279.1.1 test_freduce()

```

bool test_freduce (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64\_t seed )

```


17.279.1.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t k,
    size_t n,
    size_t iters,
    bool timing,
    uint64_t seed )
```

17.279.1.3 main()

```
int main (
    int ac,
    char ** av )
```

17.280 test-fscal.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"
```

Functions

- template<class Field , class Randlter >
bool [test_fscal](#) (const [Field](#) &F, const typename [Field::Element](#) &alpha, size_t m, size_t k, size_t n, bool timing, Randlter &G)
- template<class Field >
bool [test_fscal](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- template<class Field , class Randlter >
bool [test_fscaln](#) (const [Field](#) &F, const typename [Field::Element](#) &alpha, size_t m, size_t k, size_t n, bool timing, Randlter &G)
- template<class Field >
bool [test_fscaln](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- int [main](#) (int ac, char **av)

17.280.1 Function Documentation

17.280.1.1 test_fscal() [1/2]

```
bool test_fscal (
    const Field & F,
    const typename Field::Element & alpha,
    size_t m,
    size_t k,
    size_t n,
```

```

    bool timing,
    RandIter & G )

```

17.280.1.2 test_fscal() [2/2]

```

bool test_fscal (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed )

```

17.280.1.3 test_fscalin() [1/2]

```

bool test_fscalin (
    const Field & F,
    const typename Field::Element & alpha,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    RandIter & G )

```

17.280.1.4 test_fscalin() [2/2]

```

bool test_fscalin (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed )

```

17.280.1.5 main()

```

int main (
    int ac,
    char ** av )

```

17.281 test-fsyr2k.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>

```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename Field , class RandIter >
bool [check_fsyr2k](#) (const [Field](#) &F, size_t n, size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element](#) &beta, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_TRANSPOSE](#) trans, RandIter &Rand)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t k, int a, int c, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.281.1 Macro Definition Documentation

17.281.1.1 [ENABLE_ALL_CHECKINGS](#)

```
#define ENABLE_ALL_CHECKINGS 1
```

17.281.2 Function Documentation

17.281.2.1 [check_fsyr2k\(\)](#)

```
bool check_fsyr2k (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS\_UPLO uplo,
    FFLAS::FFLAS\_TRANSPOSE trans,
    RandIter & Rand )
```

17.281.2.2 [run_with_field\(\)](#)

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t k,
    int a,
    int c,
    size_t iters,
    uint64\_t seed )
```

17.281.2.3 [main\(\)](#)

```
int main (
    int argc,
    char ** argv )
```

17.282 test-fsyrrk.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename Field , class RandIter >
bool [check_fsyrrk](#) (const [Field](#) &F, size_t n, size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element](#) &beta, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_TRANSPOSE](#) trans, RandIter &Rand)
- template<typename Field , class RandIter >
bool [check_fsyrrk_diag](#) (const [Field](#) &F, size_t n, size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element](#) &beta, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_TRANSPOSE](#) trans, RandIter &Rand)
- template<typename Field , class RandIter >
bool [check_fsyrrk_bkdiag](#) (const [Field](#) &F, size_t n, size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element](#) &beta, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_TRANSPOSE](#) trans, RandIter &Rand)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t k, int a, int c, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.282.1 Macro Definition Documentation

17.282.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.282.2 Function Documentation

17.282.2.1 check_fsyrrk()

```
bool check_fsyrrk (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS\_UPLO uplo,
    FFLAS::FFLAS\_TRANSPOSE trans,
    RandIter & Rand )
```

17.282.2.2 check_fsyrrk_diag()

```
bool check_fsyrrk_diag (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand )
```

17.282.2.3 check_fsyrrk_bkdiag()

```
bool check_fsyrrk_bkdiag (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand )
```

17.282.2.4 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t k,
    int a,
    int c,
    size_t iters,
    uint64_t seed )
```

17.282.2.5 main()

```
int main (
    int argc,
    char ** argv )
```

17.283 test-fsytrf.C File Reference

```
#include <iostream>
#include <iterator>
#include <vector>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include <iomanip>
#include <random>
#include <chrono>
#include <givaro/modular.h>
#include "fflas-ffpack/utils/test-utils.h"
```

Functions

- `template<typename T >`
`std::ostream & operator<< (std::ostream &os, const std::vector< T > &x)`
- `template<class Field , class RandIter >`
`bool test_RPM_fsytrf (Field &F, FFLAS_UPLO uplo, string file, size_t n, size_t r, RandIter &G, size_t threshold)`
- `template<class Field , class RandIter >`
`bool test_generic_fsytrf (Field &F, FFLAS_UPLO uplo, string file, size_t n, RandIter &G, size_t threshold)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, size_t n, size_t r, size_t iters, string file, size_t threshold, uint64_t &seed)`
- `int main (int argc, char **argv)`

17.283.1 Function Documentation

17.283.1.1 operator<<()

```
std::ostream& operator<< (
    std::ostream & os,
    const std::vector< T > & x )
```

17.283.1.2 test_RPM_fsytrf()

```
bool test_RPM_fsytrf (
    Field & F,
    FFLAS_UPLO uplo,
    string file,
    size_t n,
    size_t r,
    RandIter & G,
    size_t threshold )
```

17.283.1.3 test_generic_fsytrf()

```
bool test_generic_fsytrf (
    Field & F,
    FFLAS_UPLO uplo,
    string file,
    size_t n,
    RandIter & G,
    size_t threshold )
```

17.283.1.4 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t n,
    size_t r,
    size_t iters,
    string file,
    size_t threshold,
    uint64_t & seed )
```

17.283.1.5 main()

```
int main (
    int argc,
    char ** argv )
```

17.284 test-fftrmm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`

Functions

- `template<typename Field , class RandIter >`
`bool check_fftrmm (const Field &F, size_t m, size_t n, const typename Field::Element &alpha,`
`FFLAS::FFLAS_SIDE side, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, FFLAS::FFLAS_DIAG`
`diag, RandIter &Rand)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t m, size_t n, uint64_t a, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.284.1 Macro Definition Documentation

17.284.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.284.2 Function Documentation

17.284.2.1 check_fftrmm()

```
bool check_fftrmm (
    const Field & F,
    size_t m,
    size_t n,
    const typename Field::Element & alpha,
    FFLAS::FFLAS_SIDE side,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
```

```

    FFLAS::FFLAS_DIAG diag,
    RandIter & Rand )

```

17.284.2.2 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t n,
    uint64_t a,
    size_t iters,
    uint64_t seed )

```

17.284.2.3 main()

```

int main (
    int argc,
    char ** argv )

```

17.285 test-ffrmv.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <chrono>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>

```

Macros

- #define `__FFLASFFPACK_SEQUENTIAL`
- #define `ENABLE_ALL_CHECKINGS` 1

Functions

- template<typename Field , class RandIter >
bool `check_ffrmv` (const Field &F, size_t n, FFLAS_UPLO uplo, FFLAS_TRANSPOSE trans, FFLAS_DIAG diag, RandIter &Rand)
- template<class Field >
bool `run_with_field` (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)
- int `main` (int argc, char **argv)

17.285.1 Macro Definition Documentation

17.285.1.1 __FFLASFFPACK_SEQUENTIAL

```

#define __FFLASFFPACK_SEQUENTIAL

```


17.285.1.2 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.285.2 Function Documentation

17.285.2.1 check_ftrmv()

```
bool check_ftrmv (
    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_TRANSPOSE trans,
    FFLAS_DIAG diag,
    RandIter & Rand )
```

17.285.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.285.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.286 test-ftrsm-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- int [main](#) (int argc, char **argv)

17.286.1 Macro Definition Documentation

17.286.1.1 `ENABLE_ALL_CHECKINGS`

```
#define ENABLE_ALL_CHECKINGS 1
```

17.286.2 Function Documentation

17.286.2.1 `main()`

```
int main (
    int argc,
    char ** argv )
```

17.287 `test-ftsrm.C` File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

Macros

- `#define` [__FFLASFFPACK_SEQUENTIAL](#)
- `#define` [ENABLE_ALL_CHECKINGS](#) 1

Functions

- `template<typename Field , class RandIter >`
`bool` [check_ftsrm](#) (const [Field](#) &F, `size_t` m, `size_t` n, const `typename` [Field::Element](#) &alpha, [FFLAS::FFLAS_SIDE](#) side, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_TRANSPOSE](#) trans, [FFLAS::FFLAS_DIAG](#) diag, [RandIter](#) &Rand)
- `template<class Field >`
`bool` [run_with_field](#) ([Givaro::Integer](#) q, `size_t` b, `size_t` m, `size_t` n, [uint64_t](#) a, `size_t` iters, [uint64_t](#) seed)
- `int` [main](#) (`int` argc, `char **`argv)

17.287.1 Macro Definition Documentation

17.287.1.1 `__FFLASFFPACK_SEQUENTIAL`

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.287.1.2 `ENABLE_ALL_CHECKINGS`

```
#define ENABLE_ALL_CHECKINGS 1
```

17.287.2 Function Documentation

17.287.2.1 check_ffrsm()

```
bool check_ffrsm (
    const Field & F,
    size_t m,
    size_t n,
    const typename Field::Element & alpha,
    FFLAS::FFLAS_SIDE side,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    FFLAS::FFLAS_DIAG diag,
    RandIter & Rand )
```

17.287.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t n,
    uint64_t a,
    size_t iters,
    uint64_t seed )
```

17.287.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.288 test-ffrssyr2k.C File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

Macros

- #define `ENABLE_ALL_CHECKINGS` 1

Functions

- `template<typename Field , class RandIter >`
`bool check_ftrssyr2k` (const `Field` &`F`, `size_t` `n`, `FFLAS::FFLAS_UPLO` `uplo`, `FFLAS::FFLAS_DIAG` `diagA`, `RandIter` &`Rand`)
- `template<class Field >`
`bool run_with_field` (`Givaro::Integer` `q`, `size_t` `b`, `size_t` `n`, `size_t` `iters`, `uint64_t` `seed`)
- `int main` (`int` `argc`, `char **argv`)

17.288.1 Macro Definition Documentation

17.288.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.288.2 Function Documentation

17.288.2.1 check_ftrssyr2k()

```
bool check_ftrssyr2k (
    const Field & F,
    size_t n,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_DIAG diagA,
    RandIter & Rand )
```

17.288.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.288.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.289 test-ftrstr.C File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

```
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename Field , class RandIter >
bool [check_ftrstr](#) (const [Field](#) &F, size_t n, [FFLAS::FFLAS_SIDE](#) side, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_DIAG](#) diagA, [FFLAS::FFLAS_DIAG](#) diagB, RandIter &Rand)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.289.1 Macro Definition Documentation

17.289.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.289.2 Function Documentation

17.289.2.1 check_ftrstr()

```
bool check_ftrstr (
    const Field & F,
    size_t n,
    FFLAS::FFLAS\_SIDE side,
    FFLAS::FFLAS\_UPLO uplo,
    FFLAS::FFLAS\_DIAG diagA,
    FFLAS::FFLAS\_DIAG diagB,
    RandIter & Rand )
```

17.289.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64\_t seed )
```

17.289.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.290 test-fftrsv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define ENABLE_ALL_CHECKINGS 1`

Functions

- `template<typename Field , class RandIter >`
`bool check_fftrsv (const Field &F, size_t n, FFLAS_UPLO uplo, FFLAS_TRANSPOSE trans, FFLAS_DIAG diag, RandIter &Rand)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.290.1 Macro Definition Documentation

17.290.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.290.1.2 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.290.2 Function Documentation

17.290.2.1 check_fftrsv()

```
bool check_fftrsv (
    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_TRANSPOSE trans,
    FFLAS_DIAG diag,
    RandIter & Rand )
```

17.290.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.290.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.291 test-fftrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Macros

- #define [__FFLASFFPACK_SEQUENTIAL](#)
- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename Field , class RandIter >
bool [check_fftrtri](#) (const [Field](#) &F, size_t n, [FFLAS_UPLO](#) uplo, [FFLAS_DIAG](#) diag, RandIter &Rand)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.291.1 Macro Definition Documentation

17.291.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.291.1.2 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.291.2 Function Documentation

17.291.2.1 check_ftrtri()

```
bool check_ftrtri (
    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_DIAG diag,
    RandIter & Rand )
```

17.291.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.291.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.292 test-interfaces-c.c File Reference

```
#include <fflas-ffpack/interfaces/libs/fflas_c.h>
#include <fflas-ffpack/interfaces/libs/ffpack_c.h>
#include <stdlib.h>
#include <stdio.h>
```

Functions

- int [main](#) ()

17.292.1 Function Documentation

17.292.1.1 main()

```
int main (
    void )
```

17.293 test-invert-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```



```
#include "fflas-ffpack/utils/fflas_randommatrix.h"
```

Macros

- `#define` [ENABLE_ALL_CHECKINGS](#) 1

Functions

- `int` [main](#) (int argc, char **argv)

17.293.1 Macro Definition Documentation

17.293.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.293.2 Function Documentation

17.293.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.294 test-io.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <random>
#include <givaro/modular.h>
#include <givaro/zring.h>
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Data Structures

- struct [CompactElement](#)< [Element](#) >
- struct [CompactElement](#)< [double](#) >
- struct [CompactElement](#)< [float](#) >
- struct [CompactElement](#)< [int64_t](#) >
- struct [CompactElement](#)< [int32_t](#) >
- struct [CompactElement](#)< [int16_t](#) >

Functions

- `template<class Field >`
`bool` [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, `size_t` m, `size_t` n, `size_t` iters, [uint64_t](#) seed)
- `int` [main](#) (int argc, char **argv)

17.294.1 Function Documentation

17.294.1.1 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.294.1.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.295 test-lu.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-balanced.h>
#include <iostream>
#include <iomanip>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/args-parser.h"
#include <random>
```

Macros

- #define `BASECASE_K` 37
- #define `__FFLASFFPACK_SEQUENTIAL`
- #define `__LUDIVINE_CUTOFF` 1

Functions

- template<class Field , FFLAS::FFLAS_DIAG diag, FFLAS_TRANSPOSE trans>
bool `test_LUdivine` (const Field &F, typename Field::ConstElement_ptr A, size_t lda, size_t r, size_t m, size_t n)
Tests the LUdivine routine.
- template<class Field , FFLAS_DIAG diag>
bool `verifPLUQ` (const Field &F, typename Field::ConstElement_ptr A, size_t lda, typename Field::Element_ptr PLUQ, size_t ldpluq, size_t *P, size_t *Q, size_t m, size_t n, size_t R)
Verifies that $B = PLUQ$ where A stores $[L|U]$.
- template<class Field , FFLAS_DIAG diag, class RandIter >
bool `test_pluq` (const Field &F, typename Field::ConstElement_ptr A, size_t r, size_t m, size_t n, size_t lda, RandIter &G)
Tests the LUdivine routine.
- template<class Field , FFLAS_DIAG diag, FFLAS_TRANSPOSE trans, class RandIter >
bool `launch_test` (const Field &F, size_t r, size_t m, size_t n, RandIter &G)

- template<class Field >
bool `run_with_field` (Givaro::Integer q, `uint64_t` b, `size_t` m, `size_t` n, `size_t` r, `size_t` iters, `uint64_t` seed)
- int `main` (int argc, char **argv)

Variables

- Givaro::Timer `tperm`
- Givaro::Timer `tgemm`
- Givaro::Timer `tBC`
- Givaro::Timer `ttrsm`
- Givaro::Timer `trest`
- Givaro::Timer `timtot`
- `size_t` `mvcnt` = 0

17.295.1 Macro Definition Documentation

17.295.1.1 BASECASE_K

```
#define BASECASE_K 37
```

17.295.1.2 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.295.1.3 __LUDIVINE_CUTOFF

```
#define __LUDIVINE_CUTOFF 1
```

17.295.2 Function Documentation

17.295.2.1 test_LUdivine()

```
bool test_LUdivine (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t lda,
    size_t r,
    size_t m,
    size_t n )
```

Tests the LUdivine routine.

Template Parameters

| | |
|--------------|--------------------|
| <i>Field</i> | Field |
| <i>Diag</i> | Unit diagonal in U |
| <i>Trans</i> | |

Parameters

| | |
|----------|-----------------------|
| <i>F</i> | field |
| <i>A</i> | Matrix (preallocated) |

Parameters

| | |
|------------|------------------|
| <i>r</i> | rank of A |
| <i>m</i> | rows |
| <i>n</i> | cols |
| <i>lda</i> | leading dim of A |

Returns

0 iff correct, 1 otherwise

17.295.2.2 verifPLUQ()

```
bool verifPLUQ (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t lda,
    typename Field::Element_ptr PLUQ,
    size_t ldpluq,
    size_t * P,
    size_t * Q,
    size_t m,
    size_t n,
    size_t R )
```

Verifies that $B = PLUQ$ where A stores $[L\backslash U]$.

Template Parameters

| | |
|--------------|--------------------|
| <i>Field</i> | Field |
| <i>Diag</i> | Unit diagonal in U |

Parameters

| | |
|------------|-----------------------|
| <i>F</i> | field |
| <i>A</i> | Matrix (preallocated) |
| <i>r</i> | rank of A |
| <i>m</i> | rows |
| <i>n</i> | cols |
| <i>lda</i> | leading dim of A |

Returns

0 iff correct, 1 otherwise

17.295.2.3 test_pluq()

```
bool test_pluq (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t r,
    size_t m,
    size_t n,
```

```

    size_t lda,
    RandIter & G )

```

Tests the LUdivine routine.

Template Parameters

| | |
|--------------|--------------------|
| <i>Field</i> | Field |
| <i>Diag</i> | Unit diagonal in U |
| <i>Trans</i> | |

Parameters

| | |
|------------|-----------------------|
| <i>F</i> | field |
| <i>A</i> | Matrix (preallocated) |
| <i>r</i> | rank of A |
| <i>m</i> | rows |
| <i>n</i> | cols |
| <i>lda</i> | leading dim of A |

Returns

0 iff correct, 1 otherwise

17.295.2.4 launch_test()

```

bool launch_test (
    const Field & F,
    size_t r,
    size_t m,
    size_t n,
    RandIter & G )

```

17.295.2.5 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed )

```

17.295.2.6 main()

```

int main (
    int argc,
    char ** argv )

```

17.295.3 Variable Documentation

17.295.3.1 tperm

```
Givaro::Timer tperm
```

17.295.3.2 tgemm

```
Givaro::Timer tgemm
```

17.295.3.3 tBC

```
Givaro::Timer tBC
```

17.295.3.4 ttrsm

```
Givaro::Timer ttrsm
```

17.295.3.5 trest

```
Givaro::Timer trest
```

17.295.3.6 timtot

```
Givaro::Timer timtot
```

17.295.3.7 mvcnt

```
size_t mvcnt = 0
```

17.296 test-maxdelayeddim.C File Reference

```
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include <stdlib.h>
#include <stdio.h>
```

Macros

- #define [MAX_WITH_SIZE_T](#)(x) ((static_cast<[uint64_t](#)>(std::numeric_limits<size_t>::max()) < x)? std::numeric_limits<size_t>::max() : x)

Functions

- template<class Field >
bool [test](#) (Givaro::Integer p, size_t kmax)
- int [main](#) ()

17.296.1 Macro Definition Documentation

17.296.1.1 MAX_WITH_SIZE_T

```
#define MAX_WITH_SIZE_T(
    x ) ( (static_cast<uint64_t>(std::numeric_limits<size_t>::max()) < x)? std::
::numeric_limits<size_t>::max() : x )
```

17.296.2 Function Documentation

17.296.2.1 test()

```
bool test (
    Givaro::Integer p,
    size_t kmax )
```

17.296.2.2 main()

```
int main (
    void )
```

17.297 test-minpoly.C File Reference

```
#include <iomanip>
#include <iostream>
#include <random>
#include <chrono>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <givaro/modular-integer.h>
#include <givaro/givpoly1factor.h>
#include <givaro/givpoly1.h>
```

Functions

- template<typename Field , class RandIter >
bool [check_minpoly](#) (const [Field](#) &F, size_t n, RandIter &G)
- template<class Field >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.297.1 Function Documentation

17.297.1.1 check_minpoly()

```
bool check_minpoly (
    const Field & F,
```

```

    size_t n,
    RandIter & G )

```

17.297.1.2 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )

```

17.297.1.3 main()

```

int main (
    int argc,
    char ** argv )

```

17.298 test-multifile1.C File Reference

```
#include "fflas-ffpack/fflas-ffpack.h"
```

17.299 test-multifile2.C File Reference

```
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (void)

17.299.1 Function Documentation

17.299.1.1 main()

```

int main (
    void )

```

17.300 test-nullspace.C File Reference

```

#include <iomanip>
#include <iostream>
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/timer.h"

```


Functions

- `template<class Field >`
`std::string checkingMessage (const Field &F)`
- `template<class Field >`
`Field::Element_ptr readOrRandomMatrixWithRankAndRandomRPM (const Field &F, std::string file, size_t m, size_t n, size_t lda, size_t r, uint64_t seed)`
If file is not empty, read it and set m, n, lda and r.
- `template<class Field >`
`bool test_nullspace (Field &F, FFLAS::FFLAS_SIDE side, size_t m, size_t n, size_t r, typename Field::Element_ptr A, size_t lda)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, size_t m, size_t n, size_t r, size_t iters, std::string file, uint64_t &seed)`
- `int main (int argc, char **argv)`

17.300.1 Function Documentation

17.300.1.1 checkingMessage()

```
std::string checkingMessage (
    const Field & F )
```

17.300.1.2 readOrRandomMatrixWithRankAndRandomRPM()

```
Field::Element_ptr readOrRandomMatrixWithRankAndRandomRPM (
    const Field & F,
    std::string file,
    size_t m,
    size_t n,
    size_t lda,
    size_t r,
    uint64_t seed )
```

If file is not empty, read it and set m, n, lda and r.

Otherwise, generate a random matrix of size m x n with random lda.

17.300.1.3 test_nullspace()

```
bool test_nullspace (
    Field & F,
    FFLAS::FFLAS_SIDE side,
    size_t m,
    size_t n,
    size_t r,
    typename Field::Element_ptr A,
    size_t lda )
```

17.300.1.4 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
```

```

    size_t iters,
    std::string file,
    uint64_t & seed )

```

17.300.1.5 main()

```

int main (
    int argc,
    char ** argv )

```

17.301 test-permutations.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/ffpack/ffpack.h"

```

Functions

- bool [checkMonotonicApplyP](#) ([FFLAS_SIDE](#) Side, [FFLAS_TRANSPOSE](#) trans, size_t *P, size_t N, size_t R)
- int [main](#) ()

Variables

- Givaro::Timer [tperm](#)
- Givaro::Timer [tgemm](#)
- Givaro::Timer [tBC](#)
- Givaro::Timer [ttrsm](#)
- Givaro::Timer [trest](#)
- Givaro::Timer [timtot](#)

17.301.1 Function Documentation

17.301.1.1 checkMonotonicApplyP()

```

bool checkMonotonicApplyP (
    FFLAS\_SIDE Side,
    FFLAS\_TRANSPOSE trans,
    size_t * P,
    size_t N,
    size_t R )

```

17.301.1.2 main()

```

int main (
    void )

```

17.301.2 Variable Documentation

17.301.2.1 tperm

Givaro::Timer tperm

17.301.2.2 tgemm

Givaro::Timer tgemm

17.301.2.3 tBC

Givaro::Timer tBC

17.301.2.4 ttrsm

Givaro::Timer ttrsm

17.301.2.5 trest

Givaro::Timer trest

17.301.2.6 timtot

Givaro::Timer timtot

17.302 test-pluq-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- int [main](#) (int argc, char **argv)

17.302.1 Macro Definition Documentation

17.302.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.302.2 Function Documentation

17.302.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.303 test-rankprofiles.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <iostream>
#include <iomanip>
#include <random>
#include <chrono>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`

Functions

- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, size_t m, size_t n, size_t r, size_t iters, uint64_t seed, bool par)`
- `int main (int argc, char **argv)`

17.303.1 Macro Definition Documentation**17.303.1.1 __FFLASFFPACK_SEQUENTIAL**

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.303.2 Function Documentation**17.303.2.1 run_with_field()**

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed,
    bool par )
```

17.303.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.304 test-rpm.C File Reference

```
#include <iostream>
#include "givaro/modular.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Functions

- bool [checkRPM](#) (size_t M, size_t N, size_t R)
- bool [checkSymmetricRPM](#) (size_t N, size_t R)
- int [main](#) (int argc, char **argv)

17.304.1 Function Documentation

17.304.1.1 checkRPM()

```
bool checkRPM (
    size_t M,
    size_t N,
    size_t R )
```

17.304.1.2 checkSymmetricRPM()

```
bool checkSymmetricRPM (
    size_t N,
    size_t R )
```

17.304.1.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.305 test-simd.C File Reference

```
#include "givaro/givinteger.h"
#include "givaro/givprint.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <array>
```

```
#include <vector>
#include <random>
#include <string>
#include <functional>
#include <limits>
#include <type_traits>
#include <algorithm>
```

Data Structures

- struct [ScalFunctions](#)< Element, typename enable_if< is_floating_point< Element >::value >::type >
- struct [ScalFunctions](#)< Element, typename enable_if< is_integral< Element >::value >::type >

Macros

- #define [REGISTER_TYPE_NAME](#)(type) template<> const char *[TypeName](#)<type>(){return #type;}
- #define [TEST_ONE_OP](#)(name) btest &= [test_op](#)<simd> (simd::name, Scal::name, #name);

Typedefs

- typedef Givaro::Integer [integer](#)

Functions

- template<typename... >
const char * [TypeName](#) ()
- [REGISTER_TYPE_NAME](#) (float)
- [REGISTER_TYPE_NAME](#) (double)
- [REGISTER_TYPE_NAME](#) (int16_t)
- [REGISTER_TYPE_NAME](#) (int32_t)
- [REGISTER_TYPE_NAME](#) (int64_t)
- [REGISTER_TYPE_NAME](#) (uint16_t)
- [REGISTER_TYPE_NAME](#) (uint32_t)
- [REGISTER_TYPE_NAME](#) (uint64_t)
- template<class Element , class Alloc >
enable_if< is_integral< Element >::value >::type [generate_random_vector](#) (vector< Element, Alloc > &a)
- template<class Element , class Alloc >
enable_if< is_floating_point< Element >::value >::type [generate_random_vector](#) (vector< Element, Alloc > &a)
- template<class Element >
enable_if< is_integral< Element >::value, bool >::type [check_eq](#) (Element x, Element y)
- template<class Element >
enable_if< is_floating_point< Element >::value, bool >::type [check_eq](#) (Element x, Element y)
- template<class Ret , class T >
Ret [eval_func_on_array](#) (function< Ret()> f, array< T, 0 > arr)
- template<class Ret , class T , class... TArgs>
Ret [eval_func_on_array](#) (function< Ret(T, TArgs...)> f, array< typename remove_reference< T >::type, sizeof...(TArgs)+1 > &arr)
- template<class Simd , class RScal , class... AScal, class RSimd , class... ASimd>
enable_if< sizeof...(AScal)==sizeof...(ASimd), bool >::type [test_op](#) (RSimd(&FSimd)(ASimd...), RScal(&FScal)(AScal...), string frame)
- template<class simd , class Element >
enable_if< is_floating_point< Element >::value, bool >::type [test_impl](#) ()
- template<class simd , class Element >
enable_if< is_integral< Element >::value, bool >::type [test_impl](#) ()

- `template<class Element >`
`enable_if< is_integral< Element >::value, bool >::type test ()`
- `template<class Element >`
`enable_if< is_floating_point< Element >::value, bool >::type test ()`
- `int main (int argc, char *argv[])`

17.305.1 Macro Definition Documentation

17.305.1.1 REGISTER_TYPE_NAME

```
#define REGISTER_TYPE_NAME(  
    type )    template<> const char *TypeName<type>(){return #type;}
```

17.305.1.2 TEST_ONE_OP

```
#define TEST_ONE_OP(  
    name )    btest &= test_op<simd> (simd::name, Scal::name, #name);
```

17.305.2 Typedef Documentation

17.305.2.1 integer

```
typedef Givaro::Integer integer
```

17.305.3 Function Documentation

17.305.3.1 TypeName()

```
const char* TypeName ( )
```

17.305.3.2 REGISTER_TYPE_NAME() [1/8]

```
REGISTER_TYPE_NAME (  
    float )
```

17.305.3.3 REGISTER_TYPE_NAME() [2/8]

```
REGISTER_TYPE_NAME (  
    double )
```

17.305.3.4 REGISTER_TYPE_NAME() [3/8]

```
REGISTER_TYPE_NAME (  
    int16_t )
```

17.305.3.5 REGISTER_TYPE_NAME() [4/8]

```
REGISTER_TYPE_NAME (
    int32_t )
```

17.305.3.6 REGISTER_TYPE_NAME() [5/8]

```
REGISTER_TYPE_NAME (
    int64_t )
```

17.305.3.7 REGISTER_TYPE_NAME() [6/8]

```
REGISTER_TYPE_NAME (
    uint16_t )
```

17.305.3.8 REGISTER_TYPE_NAME() [7/8]

```
REGISTER_TYPE_NAME (
    uint32_t )
```

17.305.3.9 REGISTER_TYPE_NAME() [8/8]

```
REGISTER_TYPE_NAME (
    uint64_t )
```

17.305.3.10 generate_random_vector() [1/2]

```
enable_if<is_integral<Element>::value>::type generate_random_vector (
    vector< Element, Alloc > & a )
```

17.305.3.11 generate_random_vector() [2/2]

```
enable_if<is_floating_point<Element>::value>::type generate_random_vector (
    vector< Element, Alloc > & a )
```

17.305.3.12 check_eq() [1/2]

```
enable_if<is_integral<Element>::value, bool>::type check_eq (
    Element x,
    Element y )
```

17.305.3.13 check_eq() [2/2]

```
enable_if<is_floating_point<Element>::value, bool>::type check_eq (
    Element x,
    Element y )
```


17.305.3.14 eval_func_on_array() [1/2]

```
Ret eval_func_on_array (
    function< Ret ()> f,
    array< T, 0 > arr )
```

17.305.3.15 eval_func_on_array() [2/2]

```
Ret eval_func_on_array (
    function< Ret (T, TArgs...)> f,
    array< typename remove_reference< T >::type, sizeof...(TArgs)+1 > & arr )
```

17.305.3.16 test_op()

```
enable_if<sizeof...(AScal) == sizeof...(ASimd), bool>::type test_op (
    RSimd(&) (ASimd...)  FSimd,
    RScal(&) (AScal...)  FScal,
    string fname )
```

17.305.3.17 test_impl() [1/2]

```
enable_if<is_floating_point<Element>::value, bool>::type test_impl ( )
```

17.305.3.18 test_impl() [2/2]

```
enable_if<is_integral<Element>::value, bool>::type test_impl ( )
```

17.305.3.19 test() [1/2]

```
enable_if<is_integral<Element>::value, bool>::type test ( )
```

17.305.3.20 test() [2/2]

```
enable_if<is_floating_point<Element>::value, bool>::type test ( )
```

17.305.3.21 main()

```
int main (
    int argc,
    char * argv[] )
```

17.306 test-solve.C File Reference

```
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

```
#include <givaro/modular-balanced.h>
```

Functions

- `template<typename Field , class RandIter >`
`bool check_solve (const Field &F, size_t m, RandIter &Rand, bool isParallel)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t m, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.306.1 Function Documentation

17.306.1.1 check_solve()

```
bool check_solve (
    const Field & F,
    size_t m,
    RandIter & Rand,
    bool isParallel )
```

17.306.1.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t iters,
    uint64_t seed )
```

17.306.1.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.307 test-utils.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include <givaro/givranditer.h>
#include <random>
#include <functional>
```

Namespaces

- [FFLAS](#)
- [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- [uint64_t](#) [getSeed](#) ()
- `template<typename Field >`
[Givaro::Integer](#) [maxFieldElt](#) ()
- `template<>` [Givaro::Integer](#) [maxFieldElt](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) > > ()
- `template<typename Field >`
[Field](#) * [chooseField](#) ([Givaro::Integer](#) q, [uint64_t](#) b, [uint64_t](#) seed)
- `template<>` [Givaro::ZRing](#)< [int32_t](#) > * [chooseField](#)< [Givaro::ZRing](#)< [int32_t](#) > > ([Givaro::Integer](#) q, [uint64_t](#) b, [uint64_t](#) seed)
- `template<>` [Givaro::ZRing](#)< [int64_t](#) > * [chooseField](#)< [Givaro::ZRing](#)< [int64_t](#) > > ([Givaro::Integer](#) q, [uint64_t](#) b, [uint64_t](#) seed)
- `template<>` [Givaro::ZRing](#)< [float](#) > * [chooseField](#)< [Givaro::ZRing](#)< [float](#) > > ([Givaro::Integer](#) q, [uint64_t](#) b, [uint64_t](#) seed)
- `template<>` [Givaro::ZRing](#)< [double](#) > * [chooseField](#)< [Givaro::ZRing](#)< [double](#) > > ([Givaro::Integer](#) q, [uint64_t](#) b, [uint64_t](#) seed)

17.308 timer.h File Reference

```
#include <time.h>
#include <givaro/givtimer.h>
```

Namespaces

- [FFLAS](#)

Typedefs

- `typedef Givaro::Timer` [Timer](#)
- `typedef Givaro::BaseTimer` [BaseTimer](#)
- `typedef Givaro::UserTimer` [UserTimer](#)
- `typedef Givaro::SysTimer` [SysTimer](#)

17.309 utils.h File Reference

```
#include <algorithm>
#include <numeric>
#include <vector>
```

Data Structures

- struct [StatsMatrix](#)

Namespaces

- [FFLAS](#)

Functions

- `template<class It >`
[double](#) [computeDeviation](#) (It begin, It end)
- `template<class Field >`
[StatsMatrix](#) [getStat](#) (const [Field](#) &F, const [index_t](#) *row, const [index_t](#) *col, typename [Field::ConstElement_ptr](#) val, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.310 winograd.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <fstream>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include <ctime>
```

Macros

- #define [DOUBLE_TO_FLOAT_CROSSOVER](#) 0
- #define [GFOPS](#)(n, t) (2.0/t*(double)n/1000.0*(double)n/1000.0*(double)n/1000.0)

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- template<class Field >
bool [balanced](#) (const [Field](#) &)
- template<class T >
bool [balanced](#) (const [Givaro::ModularBalanced](#)< T > &)
- int [main](#) ()

17.310.1 Macro Definition Documentation

17.310.1.1 [DOUBLE_TO_FLOAT_CROSSOVER](#)

```
#define DOUBLE_TO_FLOAT_CROSSOVER 0
```

17.310.1.2 [GFOPS](#)

```
#define GFOPS(  
    n,  
    t ) (2.0/t*(double)n/1000.0*(double)n/1000.0*(double)n/1000.0)
```

17.310.2 Typedef Documentation

17.310.2.1 [TTimer](#)

```
typedef Givaro::Timer TTimer
```

17.310.3 Function Documentation

17.310.3.1 balanced() [1/2]

```
bool balanced (  
    const Field & )
```

17.310.3.2 balanced() [2/2]

```
bool balanced (  
    const Givaro::ModularBalanced< T > & )
```

17.310.3.3 main()

```
int main (  
    void )
```


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