glucat

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Chapter 4

File Index

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Chapter 5

Namespace Documentation

5.1 cga3 Namespace Reference

Definitions for 3D Conformal Geometric Algebra [DL].

Functions

- template<typename Multivector_T >
  Multivector_T cga3 (const Multivector_T &x)

  Convert Euclidean 3D vector to Conformal Geometric Algebra null vector [DL (10.50)].
- template<typename Multivector_T >
  Multivector_T cga3std (const Multivector_T &X)

  Convert CGA3 null vector to standard Conformal Geometric Algebra null vector [DL (10.52)].
- template<typename Multivector_T >
  Multivector_T agc3 (const Multivector_T &X)

  Convert CGA3 null vector to Euclidean 3D vector [DL (10.50)].

5.1.1 Detailed Description

Definitions for 3D Conformal Geometric Algebra [DL].

5.1.2 Function Documentation

5.1.2.1 template<typename Multivector_T > Multivector_T cga3::agc3 (const Multivector_T & *X*) [inline]

Convert CGA3 null vector to Euclidean 3D vector [DL (10.50)].

Definition at line 138 of file PyClical.h.

References cga3std(), PyClical::cl, and PyClical::ist.

5.1.2.2 template<typename Multivector_T > Multivector_T cga3::cga3 (const Multivector_T & *x*) [inline]

Convert Euclidean 3D vector to Conformal Geometric Algebra null vector [DL (10.50)].

Definition at line 115 of file PyClical.h.

References PyClical::cl, PyClical::ist, and PyClical::ninf3.

5.1.2.3 template<typename Multivector_T > Multivector_T cga3::cga3std (const Multivector_T & *X*) [inline]

Convert CGA3 null vector to standard Conformal Geometric Algebra null vector [DL (10.52)].

Definition at line 126 of file PyClical.h.

References PyClical::cl, PyClical::ist, and PyClical::ninf3.

Referenced by agc3().

5.2 glucat Namespace Reference

Namespaces

- gen
- matrix
- timing

Classes

- class basis_table
  Table of basis elements used as a cache by basis_element()
- class bool_to_type
  Bool to type.
- class clifford_algebra
  clifford_algebra<> declares the operations of a Clifford algebra
- class compare_types
  Type comparison.
- class compare_types< T, T >
- class control_t
  Parameters to control tests.
- struct CTAssertion
  Compile time assertion.
- struct CTAssertion< true >
- class error
  Specific exception class.
- singleton framed_multi
  A framed_multi<Scalar_T,LO,HI> is a framed approximation to a multivector.
- class glucat_error
  Abstract exception class.
- class index_set
  Index set class based on std::bitset<> in Gnu standard C++ library.
- class index_set_hash
- class matrix_multi
  A matrix_multi<Scalar_T,LO,HI> is a matrix approximation to a multivector.
- class numeric_traits
  Extra traits which extend numeric limits.
- class random_generator
  Random number generator with single instance per Scalar_T.
- class sorted_range
  Sorted range for use with output.
- class sorted_range< Sorted_Map_T, Sorted_Map_T >
- struct tuning
  Tuning policy.

Typedefs

- typedef int index_t

  Size of index_t should be enough to represent LO, HI.
- typedef unsigned long set_value_t

  Size of set_value_t should be enough to contain index_set<LO,HI>
- typedef int(* intfn)()

  For exception catching: pointer to function returning int.
- typedef int(* intintfn)(int)

  For exception catching: pointer to function of int returning int.

Enumerations

- enum precision_t { precision_demoted, precision_same, precision_promoted }

  Precision policy.

Functions

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  bool operator!= (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Test for inequality of multivectors.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  bool operator!= (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Test for inequality of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  bool operator!= (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Test for inequality of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator+ (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Geometric sum of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator+ (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Geometric sum of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator+ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric sum.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator- (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Geometric difference of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator- (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

Geometric difference of scalar and multivector.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator- (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric difference.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator* (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Product of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator* (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Product of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator* (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric product.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator^ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Outer product.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator& (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Inner product.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator% (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Left contraction.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T star (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator/ (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Quotient of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator/ (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Quotient of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator/ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric quotient.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > operator| (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > inv (const Multivector< Scalar_T, LO, HI > &val)

  Geometric multiplicative inverse.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > pow (const Multivector< Scalar_T, LO, HI > &lhs, int rhs)

  Integer power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > pow (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Multivector power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > outer_pow (const Multivector< Scalar_T, LO, HI > &lhs, int rhs)

  Outer product power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T scalar (const Multivector< Scalar_T, LO, HI > &val)

  Scalar part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T real (const Multivector< Scalar_T, LO, HI > &val)

  Real part: synonym for scalar part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T imag (const Multivector< Scalar_T, LO, HI > &val)

  Imaginary part: deprecated (always 0)
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > pure (const Multivector< Scalar_T, LO, HI > &val)

  Pure part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > even (const Multivector< Scalar_T, LO, HI > &val)

  Even part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > odd (const Multivector< Scalar_T, LO, HI > &val)

  Odd part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const std::vector< Scalar_T > vector_part (const Multivector< Scalar_T, LO, HI > &val)

Vector part of multivector, as a vector_t with respect to frame()

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > involute (const Multivector< Scalar_T, LO, HI > &val)

  Main involution, each {i} is replaced by -{i} in each term, eg. {1}∗{2} -> (-{2})∗(-{1})
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > reverse (const Multivector< Scalar_T, LO, HI > &val)

  Reversion, eg. {1}∗{2} -> {2}∗{1}.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > conj (const Multivector< Scalar_T, LO, HI > &val)

  Conjugation, rev o invo == invo o rev.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T quad (const Multivector< Scalar_T, LO, HI > &val)

  Scalar_T quadratic form == (rev(x)∗x)(0)
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T norm (const Multivector< Scalar_T, LO, HI > &val)

  Scalar_T norm == sum of norm of coordinates.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T abs (const Multivector< Scalar_T, LO, HI > &val)

  Absolute value == sqrt(norm)
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T max_abs (const Multivector< Scalar_T, LO, HI > &val)

  Maximum of absolute values of components of multivector: multivector infinity norm.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > complexifier (const Multivector< Scalar_T, LO, HI > &val)

  Square root of -1 which commutes with all members of the frame of the given multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > elliptic (const Multivector< Scalar_T, LO, HI > &val)
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > sqrt (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Square root of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > sqrt (const Multivector< Scalar_T, LO, HI > &val)

  Square root of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > clifford_exp (const Multivector< Scalar_T, LO, HI > &val)

Exponential of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > log (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Natural logarithm of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > log (const Multivector< Scalar_T, LO, HI > &val)

  Natural logarithm of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > cos (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Cosine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > cos (const Multivector< Scalar_T, LO, HI > &val)

  Cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > acos (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse cosine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > acos (const Multivector< Scalar_T, LO, HI > &val)

  Inverse cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > cosh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > acosh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic cosine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > acosh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > sin (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

Sine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > sin (const Multivector< Scalar_T, LO, HI > &val)

  Sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > asin (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse sine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > asin (const Multivector< Scalar_T, LO, HI > &val)

  Inverse sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > sinh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > asinh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic sine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > asinh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > tan (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Tangent of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > tan (const Multivector< Scalar_T, LO, HI > &val)

  Tangent of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > atan (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse tangent of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > atan (const Multivector< Scalar_T, LO, HI > &val)

  Inverse tangent of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > tanh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic tangent of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > atanh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic tangent of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > atanh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic tangent of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  static void check_complex (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Check that i is a valid complexifier for val.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > operator* (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Geometric product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > operator^ (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Outer product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > operator& (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Inner product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > operator% (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Left contraction.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T star (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > operator/ (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Geometric quotient.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > operator| (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::istream & operator>> (std::istream &s, framed_multi< Scalar_T, LO, HI > &val)

  Read multivector from input.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::ostream & operator<< (std::ostream &os, const framed_multi< Scalar_T, LO, HI > &val)

  Write multivector to output.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::ostream & operator<< (std::ostream &os, const std::pair< const index_set< LO, HI >, Scalar_T > &term)

  Write term to output.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > exp (const framed_multi< Scalar_T, LO, HI > &val)

  Exponential of multivector.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static Scalar_T crd_of_mult (const std::pair< const index_set< LO, HI >, Scalar_T > &lhs, const std::pair< const index_set< LO, HI >, Scalar_T > &rhs)

  Coordinate of product of terms.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const std::pair< const
  index_set< LO, HI >, Scalar_T > operator* (const std::pair< const index_set< LO, HI >, Scalar_T > &lhs, const std::pair< const index_set< LO, HI >, Scalar_T > &rhs)

  Product of terms.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > sqrt (const framed_multi< Scalar_T, LO, HI > &val, const framed_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Square root of multivector with specified complexifier.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > log (const framed_multi< Scalar_T, LO, HI > &val, const framed_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Natural logarithm of multivector with specified complexifier.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static Scalar_T crd_of_mult (const std::pair< const index_set< LO, HI >, Scalar_T > &lhs, const std::pair< const index_set< LO, HI >, Scalar_T > &rhs)

  Coordinate of product of terms.
- _GLUCAT_CTAssert (std::numeric_limits< unsigned char >::radix==2, CannotDetermineBitsPerChar) const index_t BITS_PER_CHAR

  If radix of unsigned char is not 2, we can't easily determine number of bits from sizeof.
- _GLUCAT_CTAssert (_GLUCAT_BITS_PER_ULONG==BITS_PER_SET_VALUE, BitsPerULongDoesNot↩ MatchSetValueT) const index_t DEFAULT_LO

  Default lowest index in an index set.
- template<typename LHS_T , typename RHS_T >
  LHS_T pos_mod (LHS_T lhs, RHS_T rhs)

  Modulo function which works reliably for lhs < 0.
- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > operator^ (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

  Symmetric set difference: exclusive or.
- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > operator& (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

  Set intersection: and.
- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > operator| (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

Set union: or.

- template<const index_t LO, const index_t HI>
  int compare (const index_set< LO, HI > &a, const index_set< LO, HI > &b)

  "lexicographic compare" eg. {3,4,5} is less than {3,7,8}
- _GLUCAT_CTAssert (sizeof(set_value_t) >=sizeof(std::bitset< DEFAULT_HI-DEFAULT_LO >), Default_↩
  index_set_too_big_for_value) template< const index_t LO

  Size of set_value_t should be enough to contain bitset<DEFAULT_HI-DEFAULT_LO>
- const index_t HI std::ostream & operator<< (std::ostream &os, const index_set< LO, HI > &ist)

  Write out index set.
- template<const index_t LO, const index_t HI>
  std::istream & operator>> (std::istream &s, index_set< LO, HI > &ist)

  Read in index set.
- int sign_of_square (index_t j)

  Square of generator {j}.
- template<const index_t LO, const index_t HI>
  index_t min_neg (const index_set< LO, HI > &ist)

  Minimum negative index, or 0 if none.
- template<const index_t LO, const index_t HI>
  index_t max_pos (const index_set< LO, HI > &ist)

  Maximum positive index, or 0 if none.
- static unsigned long inverse_reversed_gray (unsigned long x)

  Inverse reversed Gray code.
- static unsigned long inverse_gray (unsigned long x)

  Inverse Gray code.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > operator* (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Geometric product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > operator^ (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Outer product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > operator& (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Inner product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > operator% (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Left contraction.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T star (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > operator/ (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Geometric quotient.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > operator| (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::istream & operator>> (std::istream &s, matrix_multi< Scalar_T, LO, HI > &val)

  Read multivector from input.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::ostream & operator<< (std::ostream &os, const matrix_multi< Scalar_T, LO, HI > &val)

  Write multivector to output.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const index_set< LO, HI > reframe (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs, matrix_multi< Scalar_T, LO, HI > &lhs_reframed, matrix_multi< Scalar_T, LO, HI > &rhs_reframed)

  Find a common frame for operands of a binary operator.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > sqrt (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Square root of multivector with specified complexifier.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > matrix_sqrt (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i)

  Square root of multivector with specified complexifier.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > log (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Natural logarithm of multivector with specified complexifier.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > matrix_log (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i)

  Natural logarithm of multivector with specified complexifier.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > exp (const matrix_multi< Scalar_T, LO, HI > &val)

  Exponential of multivector.
- index_t offset_level (const index_t p, const index_t q)

  Determine the log2 dim corresponding to signature p, q.
- template<typename Matrix_Index_T , const index_t LO, const index_t HI>
  static Matrix_Index_T folded_dim (const index_set< LO, HI > &sub)

  Determine the matrix dimension of the fold of a subalegbra.
- template<typename Multivector_T , typename Matrix_T , typename Basis_Matrix_T >
  static Multivector_T fast (const Matrix_T &X, index_t level)

  Inverse generalized Fast Fourier Transform.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > pade_approx (const int array_size, const Scalar_T a[], const Scalar_T b[], const matrix_multi< Scalar_T, LO, HI > &X)

  Pade' approximation.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static void db_step (matrix_multi< Scalar_T, LO, HI > &M, matrix_multi< Scalar_T, LO, HI > &Y)

Single step of product form of Denman-Beavers square root iteration.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > db_sqrt (const matrix_multi< Scalar_T, LO, HI > &val)

  Product form of Denman-Beavers square root iteration.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > pade_log (const matrix_multi< Scalar_T, LO, HI > &val)

  Pade' approximation of log.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > cascade_log (const matrix_multi< Scalar_T, LO, HI > &val)

  Incomplete square root cascade and Pade' approximation of log.
- template<typename Scalar_T >
  Scalar_T log2 (const Scalar_T &x)

  Log base 2 of scalar.
- template<typename Scalar_T >
  numeric_traits< Scalar_T >
  ::promoted::type to_promote (const Scalar_T &val)

  Cast to promote.
- template<typename Scalar_T >
  numeric_traits< Scalar_T >
  ::demoted::type to_demote (const Scalar_T &val)

  Cast to demote.
- int try_catch (intfn f)

  Exception catching for functions returning int.
- int try_catch (intintfn f, int arg)

  Exception catching for functions of int returning int.

Variables

- const double MS_PER_S = 1000.0

  Timing constant: deprecated here - moved to test/timing.h.
- const index_t BITS_PER_SET_VALUE = std::numeric_limits<set_value_t>::digits

  Number of bits in set_value_t.
- const index_t DEFAULT_HI = index_t(BITS_PER_SET_VALUE / 2)

  Default highest index in an index set.
- const double DEFAULT_TRUNCATION = std::numeric_limits<float>::epsilon()

  Default for truncation.
- const unsigned int DEFAULT_Mult_Matrix_Threshold = 8
- const unsigned int DEFAULT_Div_Max_Steps = 4
- const unsigned int DEFAULT_Sqrt_Max_Steps = 256
- const unsigned int DEFAULT_Log_Max_Outer_Steps = 256
- const unsigned int DEFAULT_Log_Max_Inner_Steps = 32
- const unsigned int DEFAULT_Basis_Max_Count = 12
- const unsigned int DEFAULT_Fast_Size_Threshold = 1 << 6
- const unsigned int DEFAULT_Inv_Fast_Dim_Threshold = 1 << 3
- const unsigned int DEFAULT_Products_Size_Threshold = 1 << 22
- const precision_t DEFAULT_Function_Precision = precision_same
- static const long double l_pi = 3.14159265358979323846264338327950 29L
- static const long double l_ln2 = 0.69314718055994530941723212145817 66L

5.2.1 Typedef Documentation

5.2.1.1 typedef int glucat::index_t

Size of index_t should be enough to represent LO, HI.

Definition at line 77 of file global.h.

5.2.1.2 typedef int(∗ glucat::intfn)()

For exception catching: pointer to function returning int.

Definition at line 37 of file try_catch.h.

5.2.1.3 typedef int(∗ glucat::intintfn)(int)

For exception catching: pointer to function of int returning int.

Definition at line 40 of file try_catch.h.

5.2.1.4 typedef unsigned long glucat::set_value_t

Size of set_value_t should be enough to contain index_set<LO,HI>

Definition at line 79 of file global.h.

5.2.2 Enumeration Type Documentation

5.2.2.1 enum glucat::precision_t

Precision policy.

Enumerator

precision_demoted

precision_same

precision_promoted

Definition at line 117 of file global.h.

5.2.3 Function Documentation

5.2.3.1 glucat::_GLUCAT_CTAssert (std::numeric_limits< unsigned char >::radix = =2, CannotDetermineBitsPerChar) const

If radix of unsigned char is not 2, we can't easily determine number of bits from sizeof.

Number of bits per char is used to determine number of bits in set_value_t

5.2.3.2 glucat::_GLUCAT_CTAssert (_GLUCAT_BITS_PER_ULONG = =BITS_PER_SET_VALUE, BitsPerULongDoesNotMatchSetValueT) const

Default lowest index in an index set.

5.2.3.3 glucat::_GLUCAT_CTAssert (sizeof(set_value_t) >=sizeof(std::bitset< DEFAULT_HI-DEFAULT_LO >) , Default_index_set_too_big_for_value) const

Size of set_value_t should be enough to contain bitset<DEFAULT_HI-DEFAULT_LO>

Write out index set

5.2.3.4 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::abs (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Absolute value == sqrt(norm)

Definition at line 491 of file clifford_algebra_imp.h.

References glucat::numeric_traits< Scalar_T >::sqrt().

Referenced by PyClical.clifford::abs(), acos(), asin(), glucat::matrix::classify_eigenvalues(), clifford_to_str(), glucat::framed_multi< Scalar_T, LO, HI >::framed_multi(), matrix_log(), and matrix_sqrt().

5.2.3.5 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::acos (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = false) [inline]

Inverse cosine of multivector with specified complexifier.

Definition at line 798 of file clifford_algebra_imp.h.

References abs(), acosh(), and check_complex().

Referenced by glucat::numeric_traits< Scalar_T >::acos(), and acos().

5.2.3.6 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::acos (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Inverse cosine of multivector.

Definition at line 818 of file clifford_algebra_imp.h.

References acos(), and complexifier().

5.2.3.7 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::acosh (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = false) [inline]

Inverse hyperbolic cosine of multivector with specified complexifier.

Definition at line 738 of file clifford_algebra_imp.h.

References check_complex(), log(), norm(), and sqrt().

Referenced by acos(), and acosh().

5.2.3.8 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::acosh (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Inverse hyperbolic cosine of multivector.

Definition at line 758 of file clifford_algebra_imp.h.

References acosh(), and complexifier().

5.2.3.9 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::asin (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked =* false) [inline]

Inverse sine of multivector with specified complexifier.

Definition at line 905 of file clifford_algebra_imp.h.

References abs(), asinh(), and check_complex().

Referenced by glucat::numeric_traits< Scalar_T >::asin(), and asin().

5.2.3.10 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::asin (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Inverse sine of multivector.

Definition at line 925 of file clifford_algebra_imp.h.

References asin(), and complexifier().

5.2.3.11 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::asinh (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked =* false) [inline]

Inverse hyperbolic sine of multivector with specified complexifier.

Definition at line 845 of file clifford_algebra_imp.h.

References check_complex(), log(), norm(), and sqrt().

Referenced by asin(), and asinh().

5.2.3.12 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::asinh (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Inverse hyperbolic sine of multivector.

Definition at line 865 of file clifford_algebra_imp.h.

References asinh(), and complexifier().

5.2.3.13 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::atan (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked =* false) [inline]

Inverse tangent of multivector with specified complexifier.

Definition at line 1005 of file clifford_algebra_imp.h.

References atanh(), check_complex(), and scalar().

Referenced by glucat::numeric_traits< Scalar_T >::atan(), and atan().

5.2.3.14 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::atan (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Inverse tangent of multivector.

Definition at line 1025 of file clifford_algebra_imp.h.

References atan(), and complexifier().

5.2.3.15 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::atanh (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = false) [inline]

Inverse hyperbolic tangent of multivector with specified complexifier.

Definition at line 952 of file clifford_algebra_imp.h.

References check_complex(), log(), and norm().

Referenced by atan(), and atanh().

5.2.3.16 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::atanh (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Inverse hyperbolic tangent of multivector.

Definition at line 969 of file clifford_algebra_imp.h.

References atanh(), and complexifier().

5.2.3.17 template<typename Scalar_T , const index_t LO, const index_t HI> static const matrix_multi<Scalar_T,LO,HI> glucat::cascade_log (const matrix_multi< Scalar_T, LO, HI > & *val*) [static]

Incomplete square root cascade and Pade' approximation of log.

Definition at line 1976 of file matrix_multi_imp.h.

References db_step(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::log_max_inner_steps, glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::log_max_outer_steps, norm(), pade_log(), and pow().

Referenced by matrix_log().

5.2.3.18 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> static void glucat::check_complex (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = false) [inline], [static]

Check that i is a valid complexifier for val.

Definition at line 566 of file clifford_algebra_imp.h.

References complexifier().

Referenced by acos(), acosh(), asin(), asinh(), atan(), atanh(), cos(), log(), sin(), sqrt(), and tan().

5.2.3.19 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::clifford_exp (const Multivector< Scalar_T, LO, HI > & *val*)

Exponential of multivector.

Definition at line 604 of file clifford_algebra_imp.h.

References exp(), log2(), pow(), and scalar().

Referenced by exp().

5.2.3.20 template<const index_t LO, const index_t HI> int glucat::compare (const index_set< LO, HI > & *a,* const index_set< LO, HI > & *b*) [inline]

"lexicographic compare" eg. {3,4,5} is less than {3,7,8}

Lexicographic ordering of two sets: -1 if a<b, +1 if a>b, 0 if a==b.

Definition at line 573 of file index_set_imp.h.

References glucat::index_set< LO, HI >::lex_less_than().

5.2.3.21 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::complexifier (const Multivector< Scalar_T, LO, HI > & *val*)

Square root of -1 which commutes with all members of the frame of the given multivector.

Definition at line 506 of file clifford_algebra_imp.h.

References pos_mod().

Referenced by acos(), acosh(), asin(), asinh(), atan(), atanh(), check_complex(), cos(), elliptic(), log(), sin(), sqrt(), and tan().

5.2.3.22 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::conj (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Conjugation, rev o invo == invo o rev.

Definition at line 467 of file clifford_algebra_imp.h.

5.2.3.23 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::cos (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = false)

Cosine of multivector with specified complexifier.

Definition at line 765 of file clifford_algebra_imp.h.

References check_complex(), exp(), PyClical::pi, and scalar().

Referenced by glucat::numeric_traits< Scalar_T >::cos(), cos(), and tan().

5.2.3.24 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::cos (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Cosine of multivector.

Definition at line 789 of file clifford_algebra_imp.h.

References complexifier(), and cos().

5.2.3.25 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::cosh (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Hyperbolic cosine of multivector.

Definition at line 720 of file clifford_algebra_imp.h.

References exp(), and scalar().

Referenced by glucat::numeric_traits< Scalar_T >::cosh(), and tanh().

5.2.3.26 template<typename Scalar_T , const index_t LO, const index_t HI> static Scalar_T glucat::crd_of_mult (const std::pair< const index_set< LO, HI >, Scalar_T > & *lhs,* const std::pair< const index_set< LO, HI >, Scalar_T > & *rhs*) [inline], [static]

Coordinate of product of terms.

Referenced by operator%(), operator&(), operator*(), and operator^().

5.2.3.27 template<typename Scalar_T , const index_t LO, const index_t HI> static Scalar_T glucat::crd_of_mult (const std::pair< const index_set< LO, HI >, Scalar_T > & *lhs,* const std::pair< const index_set< LO, HI >, Scalar_T > & *rhs*) [inline], [static]

Coordinate of product of terms.

Definition at line 1906 of file framed_multi_imp.h.

5.2.3.28 template<typename Scalar_T , const index_t LO, const index_t HI> static const matrix_multi<Scalar_T,LO,HI> glucat::db_sqrt (const matrix_multi< Scalar_T, LO, HI > & *val*) [static]

Product form of Denman-Beavers square root iteration.

Definition at line 1375 of file matrix_multi_imp.h.

References db_step(), norm(), pow(), and glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_↩ Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_↩ Threshold, Products_Size_Threshold, Function_Precision >::sqrt_max_steps.

Referenced by matrix_sqrt().

5.2.3.29 template<typename Scalar_T , const index_t LO, const index_t HI> static void glucat::db_step (matrix_multi< Scalar_T, LO, HI > & *M,* matrix_multi< Scalar_T, LO, HI > & *Y*) [inline], [static]

Single step of product form of Denman-Beavers square root iteration.

Definition at line 1362 of file matrix_multi_imp.h.

References inv().

Referenced by cascade_log(), and db_sqrt().

5.2.3.30 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::elliptic (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Square root of -1 which commutes with all members of the frame of the given multivector The name "elliptic" is now deprecated: use "complexifier" instead.

Definition at line 557 of file clifford_algebra_imp.h.

References complexifier().

5.2.3.31 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::even (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Even part.

Definition at line 427 of file clifford_algebra_imp.h.

5.2.3.32 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::exp (const framed_multi< Scalar_T, LO, HI > & *val*)

Exponential of multivector.

Definition at line 1947 of file framed_multi_imp.h.

References clifford_exp(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::frame(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::function_precision, glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::isnan(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::mult_matrix_threshold, precision_demoted, precision_promoted, and scalar().

Referenced by clifford_exp(), cos(), cosh(), glucat::numeric_traits< Scalar_T >::exp(), exp(), matrix_log(), matrix_sqrt(), pow(), PyClical.clifford::pow(), sin(), and sinh().

5.2.3.33 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::exp (const matrix_multi< Scalar_T, LO, HI > & *val*)

Exponential of multivector.

Definition at line 2140 of file matrix_multi_imp.h.

References clifford_exp(), exp(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::function_precision, glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), precision_demoted, precision_promoted, and scalar().

5.2.3.34 template<typename Multivector_T , typename Matrix_T , typename Basis_Matrix_T > static Multivector_T glucat::fast (const Matrix_T & *X,* index_t *level*) [static]

Inverse generalized Fast Fourier Transform.

Definition at line 1083 of file matrix_multi_imp.h.

References glucat::matrix::signed_perm_nork().

5.2.3.35 template<typename Matrix_Index_T , const index_t LO, const index_t HI> static Matrix_Index_T glucat::folded_dim (const index_set< LO, HI > & *sub*) [inline], [static]

Determine the matrix dimension of the fold of a subalegbra.

Definition at line 91 of file matrix_multi_imp.h.

References glucat::index_set< LO, HI >::count_neg(), glucat::index_set< LO, HI >::count_pos(), and offset_level().

5.2.3.36 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::imag (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Imaginary part: deprecated (always 0)

Definition at line 411 of file clifford_algebra_imp.h.

Referenced by glucat::matrix::classify_eigenvalues().

5.2.3.37 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::inv (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Geometric multiplicative inverse.

Definition at line 321 of file clifford_algebra_imp.h.

Referenced by db_step(), matrix_log(), and matrix_sqrt().

5.2.3.38 static unsigned long glucat::inverse_gray (unsigned long *x*) [inline], [static]

Inverse Gray code.

Definition at line 861 of file index_set_imp.h.

Referenced by glucat::index_set< LO, HI >::sign_of_mult().

5.2.3.39 static unsigned long glucat::inverse_reversed_gray (unsigned long *x*) [inline], [static]

Inverse reversed Gray code.

Definition at line 844 of file index_set_imp.h.

Referenced by glucat::index_set< LO, HI >::sign_of_mult().

5.2.3.40 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::involute (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Main involution, each {i} is replaced by -{i} in each term, eg. {1}∗{2} -> (-{2})∗(-{1})

Main involution, each {i} is replaced by -{i} in each term, eg. {1} ->-{1}.

Definition at line 451 of file clifford_algebra_imp.h.

5.2.3.41 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::log (const matrix_multi< Scalar_T, LO, HI > & *val,* const matrix_multi< Scalar_T, LO, HI > & *i,* bool *prechecked*)

Natural logarithm of multivector with specified complexifier.

Definition at line 2023 of file matrix_multi_imp.h.

References check_complex(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log↩ _Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::function_precision, glucat::clifford_algebra< Scalar_T, index_↩ set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), matrix_log(), precision_demoted, and precision_↩ promoted.

5.2.3.42 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::log (const framed_multi< Scalar_T, LO, HI > & *val,* const framed_multi< Scalar_T, LO, HI > & *i,* bool *prechecked*)

Natural logarithm of multivector with specified complexifier.

Definition at line 1997 of file framed_multi_imp.h.

References check_complex(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::isnan(), log(), PyClical::pi, and glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::scalar().

5.2.3.43 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::log (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = `false`) `[inline]`

Natural logarithm of multivector with specified complexifier.

Definition at line 704 of file clifford_algebra_imp.h.

Referenced by acosh(), asinh(), atanh(), glucat::numeric_traits< Scalar_T >::log(), log(), matrix_log(), glucat::numeric_traits< Scalar_T >::NaN(), pow(), and PyClical.clifford::pow().

5.2.3.44 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::log (const Multivector< Scalar_T, LO, HI > & *val*) `[inline]`

Natural logarithm of multivector.

Definition at line 712 of file clifford_algebra_imp.h.

References complexifier(), and log().

5.2.3.45 template<typename Scalar_T > Scalar_T glucat::log2 (const Scalar_T & *x*) `[inline]`

Log base 2 of scalar.

Definition at line 302 of file scalar.h.

References glucat::numeric_traits< Scalar_T >::log2().

Referenced by clifford_exp().

5.2.3.46 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::matrix_log (const matrix_multi< Scalar_T, LO, HI > & *val,* const matrix_multi< Scalar_T, LO, HI > & *i*)

Natural logarithm of multivector with specified complexifier.

Definition at line 2064 of file matrix_multi_imp.h.

References abs(), glucat::matrix::both_eig_case, cascade_log(), glucat::matrix::classify_eigenvalues(), exp(), inv(), glucat::matrix::isnan(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), log(), glucat::matrix::eig_genus< Matrix_T >::m_eig_case, glucat::matrix::eig_genus< Matrix_T >::m_safe_arg, glucat::matrix::negative_eig_case, norm(), PyClical::pi, and glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::scalar().

Referenced by log().

5.2.3.47 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::matrix_sqrt (const matrix_multi< Scalar_T, LO, HI > & *val,* const matrix_multi< Scalar_T, LO, HI > & *i*)

Square root of multivector with specified complexifier.

Definition at line 1645 of file matrix_multi_imp.h.

References abs(), glucat::matrix::both_eig_case, glucat::matrix::classify_eigenvalues(), db_sqrt(), exp(), inv(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), glucat::matrix::eig_genus< Matrix_T >::m_eig_case, glucat::matrix::eig_genus< Matrix_T >::m_safe_arg, glucat::matrix::negative_eig_case, norm(), pade_approx(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::scalar(), and sqrt().

Referenced by sqrt().

5.2.3.48 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::max_abs (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Maximum of absolute values of components of multivector: multivector infinity norm.

Definition at line 499 of file clifford_algebra_imp.h.

5.2.3.49 template<const index_t LO, const index_t HI> index_t glucat::max_pos (const index_set< LO, HI > & *ist*) [inline]

Maximum positive index, or 0 if none.

Definition at line 974 of file index_set_imp.h.

References glucat::index_set< LO, HI >::max().

5.2.3.50 template<const index_t LO, const index_t HI> index_t glucat::min_neg (const index_set< LO, HI > & *ist*) [inline]

Minimum negative index, or 0 if none.

Definition at line 967 of file index_set_imp.h.

References glucat::index_set< LO, HI >::min().

5.2.3.51 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::norm (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Scalar_T norm == sum of norm of coordinates.

Definition at line 483 of file clifford_algebra_imp.h.

Referenced by acosh(), asinh(), atanh(), cascade_log(), glucat::matrix::classify_eigenvalues(), db_sqrt(), matrix_log(), and matrix_sqrt().

5.2.3.52 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::odd (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Odd part.

Definition at line 435 of file clifford_algebra_imp.h.

5.2.3.53 index_t glucat::offset_level (const index_t *p*, const index_t *q*) [inline]

Determine the log2 dim corresponding to signature p, q.

Definition at line 76 of file matrix_multi_imp.h.

References pos_mod().

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::basis_element(), and folded_dim().

5.2.3.54 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> bool glucat::operator!= (const Multivector< Scalar_T, LO, HI > & *lhs*, const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Test for inequality of multivectors.

Definition at line 78 of file clifford_algebra_imp.h.

5.2.3.55 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> bool glucat::operator!= (const Multivector< Scalar_T, LO, HI > & *lhs*, const Scalar_T & *scr*) [inline]

Test for inequality of multivector and scalar.

Definition at line 86 of file clifford_algebra_imp.h.

5.2.3.56 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> bool glucat::operator!= (const Scalar_T & *scr*, const Multivector< Scalar_T, LO, HI > & *rhs*) [inline]

Test for inequality of scalar and multivector.

Definition at line 94 of file clifford_algebra_imp.h.

5.2.3.57 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::operator% (const matrix_multi< Scalar_T, LO, HI > & *lhs*, const matrix_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Left contraction.

Definition at line 635 of file matrix_multi_imp.h.

5.2.3.58 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::operator% (const framed_multi< Scalar_T, LO, HI > & *lhs*, const framed_multi< Scalar_T, LO, HI > & *rhs*)

Left contraction.

Definition at line 719 of file framed_multi_imp.h.

References _GLUCAT_HASH_SIZE_T, crd_of_mult(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::frame(), and glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt↩_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast↩_Dim_Threshold, Products_Size_Threshold, Function_Precision >::products_size_threshold.

5.2.3.59 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator% (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Left contraction.

Definition at line 243 of file clifford_algebra_imp.h.

5.2.3.60 template<const index_t LO, const index_t HI> const index_set< LO, HI > glucat::operator& (const index_set< LO, HI > & *lhs,* const index_set< LO, HI > & *rhs*) [inline]

Set intersection: and.

Definition at line 186 of file index_set_imp.h.

5.2.3.61 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::operator& (const matrix_multi< Scalar_T, LO, HI > & *lhs,* const matrix_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Inner product.

Definition at line 616 of file matrix_multi_imp.h.

5.2.3.62 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::operator& (const framed_multi< Scalar_T, LO, HI > & *lhs,* const framed_multi< Scalar_T, LO, HI > & *rhs*)

Inner product.

Definition at line 601 of file framed_multi_imp.h.

References _GLUCAT_HASH_SIZE_T, crd_of_mult(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::frame(), and glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt↩ _Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast↩ _Dim_Threshold, Products_Size_Threshold, Function_Precision >::products_size_threshold.

5.2.3.63 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator& (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Inner product.

Definition at line 228 of file clifford_algebra_imp.h.

5.2.3.64 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::operator* (const matrix_multi< Scalar_T, LO, HI > & *lhs,* const matrix_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric product.

Definition at line 547 of file matrix_multi_imp.h.

References glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), glucat::matrix_multi< Scalar_T, LO, HI >::m_frame, glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix, and reframe().

5.2.3.65 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::operator* (const framed_multi< Scalar_T, LO, HI > & *lhs,* const framed_multi< Scalar_T, LO, HI > & *rhs*)

Geometric product.

Definition at line 400 of file framed_multi_imp.h.

References _GLUCAT_HASH_SIZE_T, glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::frame(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::isnan(), and glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::mult_matrix_threshold.

5.2.3.66 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator* (const Multivector< Scalar_T, LO, HI > & *lhs,* const Scalar_T & *scr*) [inline]

Product of multivector and scalar.

Definition at line 172 of file clifford_algebra_imp.h.

5.2.3.67 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator* (const Scalar_T & *scr,* const Multivector< Scalar_T, LO, HI > & *rhs*) [inline]

Product of scalar and multivector.

Definition at line 183 of file clifford_algebra_imp.h.

5.2.3.68 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator* (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric product.

Definition at line 198 of file clifford_algebra_imp.h.

5.2.3.69 template<typename Scalar_T , const index_t LO, const index_t HI> const std::pair< const index_set< LO, HI >, Scalar_T > glucat::operator* (const std::pair< const index_set< LO, HI >, Scalar_T > & *lhs,* const std::pair< const index_set< LO, HI >, Scalar_T > & *rhs*) [inline]

Product of terms.

Definition at line 1914 of file framed_multi_imp.h.

References crd_of_mult().

5.2.3.70 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator+ (const Multivector< Scalar_T, LO, HI > & *lhs,* const Scalar_T & *scr*) [inline]

Geometric sum of multivector and scalar.

Definition at line 102 of file clifford_algebra_imp.h.

5.2.3.71 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator+ (const Scalar_T & *scr,* const Multivector< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric sum of scalar and multivector.

Definition at line 113 of file clifford_algebra_imp.h.

5.2.3.72 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator+ (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric sum.

Definition at line 127 of file clifford_algebra_imp.h.

5.2.3.73 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator- (const Multivector< Scalar_T, LO, HI > & *lhs,* const Scalar_T & *scr*) [inline]

Geometric difference of multivector and scalar.

Definition at line 138 of file clifford_algebra_imp.h.

5.2.3.74 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator- (const Scalar_T & *scr,* const Multivector< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric difference of scalar and multivector.

Definition at line 149 of file clifford_algebra_imp.h.

5.2.3.75 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator- (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric difference.

Definition at line 161 of file clifford_algebra_imp.h.

5.2.3.76 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::operator/ (const matrix_multi< Scalar_T, LO, HI > & *lhs,* const matrix_multi< Scalar_T, LO, HI > & *rhs*)

Geometric quotient.

Definition at line 668 of file matrix_multi_imp.h.

References glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size↩_Threshold, Function_Precision >::div_max_steps, glucat::matrix::isnan(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), glucat::matrix_multi< Scalar_T, LO, HI >::m_frame, and reframe().

5.2.3.77 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::operator/ (const framed_multi< Scalar_T, LO, HI > & *lhs,* const framed_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric quotient.

Definition at line 914 of file framed_multi_imp.h.

References glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::frame().

5.2.3.78 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator/ (const Multivector< Scalar_T, LO, HI > & *lhs,* const Scalar_T & *scr*) [inline]

Quotient of multivector and scalar.

Definition at line 269 of file clifford_algebra_imp.h.

5.2.3.79 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator/ (const Scalar_T & *scr,* const Multivector< Scalar_T, LO, HI > & *rhs*) [inline]

Quotient of scalar and multivector.

Definition at line 280 of file clifford_algebra_imp.h.

5.2.3.80 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator/ (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Geometric quotient.

Definition at line 295 of file clifford_algebra_imp.h.

5.2.3.81 template<typename Scalar_T , const index_t LO, const index_t HI> std::ostream & glucat::operator<< (std::ostream & *os,* const matrix_multi< Scalar_T, LO, HI > & *val*) [inline]

Write multivector to output.

Definition at line 1025 of file matrix_multi_imp.h.

5.2.3.82 template<typename Scalar_T , const index_t LO, const index_t HI> std::ostream & glucat::operator<< (std::ostream & *os,* const framed_multi< Scalar_T, LO, HI > & *val*)

Write multivector to output.

Definition at line 1366 of file framed_multi_imp.h.

References glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_begin, and glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_end.

5.2.3.83 template<typename Scalar_T , const index_t LO, const index_t HI> std::ostream & glucat::operator<< (std::ostream & *os,* const std::pair< const index_set< LO, HI >, Scalar_T > & *term*)

Write term to output.

Definition at line 1398 of file framed_multi_imp.h.

References pow(), and glucat::numeric_traits< Scalar_T >::to_double().

5.2.3.84 std::ostream & glucat::operator<< (std::ostream & *os,* const index_set< LO, HI > & *ist*)

Write out index set.

Definition at line 611 of file index_set_imp.h.

References PyClical::ist.

5.2.3.85 template<typename Scalar_T , const index_t LO, const index_t HI> std::istream & glucat::operator>> (std::istream & *s,* matrix_multi< Scalar_T, LO, HI > & *val*) [inline]

Read multivector from input.

Definition at line 1035 of file matrix_multi_imp.h.

5.2.3.86 template<typename Scalar_T , const index_t LO, const index_t HI> std::istream & glucat::operator>> (std::istream & *s,* framed_multi< Scalar_T, LO, HI > & *val*)

Read multivector from input.

Definition at line 1436 of file framed_multi_imp.h.

References PyClical::ist.

5.2.3.87 template<const index_t LO, const index_t HI> std::istream & glucat::operator>> (std::istream & *s,* index_set< LO, HI > & *ist*)

Read in index set.

Definition at line 633 of file index_set_imp.h.

References glucat::index_set< LO, HI >::set().

5.2.3.88 template<const index_t LO, const index_t HI> const index_set< LO, HI > glucat::operator^ (const index_set< LO, HI > & *lhs,* const index_set< LO, HI > & *rhs*) [inline]

Symmetric set difference: exclusive or.

Definition at line 161 of file index_set_imp.h.

5.2.3.89 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::operator^ (const matrix_multi< Scalar_T, LO, HI > & *lhs,* const matrix_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Outer product.

Definition at line 597 of file matrix_multi_imp.h.

5.2.3.90 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::operator^ (const framed_multi< Scalar_T, LO, HI > & *lhs,* const framed_multi< Scalar_T, LO, HI > & *rhs*)

Outer product.

Definition at line 501 of file framed_multi_imp.h.

References _GLUCAT_HASH_SIZE_T, crd_of_mult(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::frame(), and glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt↩ _Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast↩ _Dim_Threshold, Products_Size_Threshold, Function_Precision >::products_size_threshold.

5.2.3.91 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator^ (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Outer product.

Definition at line 213 of file clifford_algebra_imp.h.

5.2.3.92 template<const index_t LO, const index_t HI> const index_set< LO, HI > glucat::operator| (const index_set< LO, HI > & *lhs,* const index_set< LO, HI > & *rhs*) [inline]

Set union: or.

Definition at line 211 of file index_set_imp.h.

5.2.3.93 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::operator| (const matrix_multi< Scalar_T, LO, HI > & *lhs,* const matrix_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Transformation via twisted adjoint action.

Definition at line 777 of file matrix_multi_imp.h.

References glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >↩ ::involute().

5.2.3.94 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::operator| (const framed_multi< Scalar_T, LO, HI > & *lhs,* const framed_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Transformation via twisted adjoint action.

Definition at line 940 of file framed_multi_imp.h.

References glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >↩ ::involute().

5.2.3.95 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::operator| (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Transformation via twisted adjoint action.

Definition at line 310 of file clifford_algebra_imp.h.

5.2.3.96 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::outer_pow (const Multivector< Scalar_T, LO, HI > & *lhs,* int *rhs*)

Outer product power of multivector.

Definition at line 384 of file clifford_algebra_imp.h.

5.2.3.97 template<typename Scalar_T , const index_t LO, const index_t HI> static const matrix_multi<Scalar_T,LO,HI> glucat::pade_approx (const int *array_size,* const Scalar_T *a[],* const Scalar_T *b[],* const matrix_multi< Scalar_T, LO, HI > & *X*) [inline],[static]

Pade' approximation.

Definition at line 1302 of file matrix_multi_imp.h.

References glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan().

Referenced by matrix_sqrt(), and pade_log().

5.2.3.98 template<typename Scalar_T , const index_t LO, const index_t HI> static const matrix_multi<Scalar_T,LO,HI> glucat::pade_log (const matrix_multi< Scalar_T, LO, HI > & *val*) [static]

Pade' approximation of log.

Definition at line 1955 of file matrix_multi_imp.h.

References glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), and pade_approx().

Referenced by cascade_log().

5.2.3.99 template<typename LHS_T , typename RHS_T > LHS_T glucat::pos_mod (LHS_T *lhs,* RHS_T *rhs*) [inline]

Modulo function which works reliably for lhs < 0.

Definition at line 187 of file global.h.

Referenced by complexifier(), glucat::matrix_multi< Scalar_T, LO, HI >::fast_framed_multi(), glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi(), glucat::gen::generator_table< Matrix_T >::gen_vector(), offset_level(), and glucat::gen::generator_table< Matrix_T >::operator()().

5.2.3.100 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::pow (const Multivector< Scalar_T, LO, HI > & *lhs,* int *rhs*)

Integer power of multivector.

Definition at line 328 of file clifford_algebra_imp.h.

Referenced by cascade_log(), clifford_exp(), db_sqrt(), operator<<(), and glucat::numeric_traits< Scalar_T >::pow().

5.2.3.101 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::pow (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Multivector power of multivector.

Definition at line 361 of file clifford_algebra_imp.h.

References exp(), and log().

5.2.3.102 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::pure (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Pure part.

Definition at line 419 of file clifford_algebra_imp.h.

5.2.3.103 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::quad (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Scalar_T quadratic form == (rev(x)*x)(0)

Definition at line 475 of file clifford_algebra_imp.h.

5.2.3.104 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::real (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Real part: synonym for scalar part.

Definition at line 400 of file clifford_algebra_imp.h.

Referenced by glucat::matrix::classify_eigenvalues().

5.2.3.105 template<typename Scalar_T , const index_t LO, const index_t HI> const index_set< LO, HI > glucat::reframe (const matrix_multi< Scalar_T, LO, HI > & *lhs,* const matrix_multi< Scalar_T, LO, HI > & *rhs,* matrix_multi< Scalar_T, LO, HI > & *lhs_reframed,* matrix_multi< Scalar_T, LO, HI > & *rhs_reframed*) [inline]

Find a common frame for operands of a binary operator.

Definition at line 350 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_frame.

Referenced by operator*(), and operator/().

5.2.3.106 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::reverse (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Reversion, eg. {1}*{2} -> {2}*{1}.

Definition at line 459 of file clifford_algebra_imp.h.

5.2.3.107 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::scalar (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Scalar part.

Definition at line 392 of file clifford_algebra_imp.h.

Referenced by atan(), clifford_exp(), cos(), cosh(), exp(), glucat::framed_multi< Scalar_T, LO, HI >::fast(), sin(), sinh(), tan(), and tanh().

5.2.3.108 int glucat::sign_of_square (index_t *j*) [inline]

Square of generator {j}.

Square of generator index j.

Definition at line 960 of file index_set_imp.h.

5.2.3.109 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::sin (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = `false`)

Sine of multivector with specified complexifier.

Definition at line 872 of file clifford_algebra_imp.h.

References check_complex(), exp(), PyClical::pi, and scalar().

Referenced by glucat::numeric_traits< Scalar_T >::sin(), sin(), and tan().

5.2.3.110 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::sin (const Multivector< Scalar_T, LO, HI > & *val*) `[inline]`

Sine of multivector.

Definition at line 896 of file clifford_algebra_imp.h.

References complexifier(), and sin().

5.2.3.111 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::sinh (const Multivector< Scalar_T, LO, HI > & *val*) `[inline]`

Hyperbolic sine of multivector.

Definition at line 826 of file clifford_algebra_imp.h.

References exp(), and scalar().

Referenced by glucat::numeric_traits< Scalar_T >::sinh(), and tanh().

5.2.3.112 template<typename Scalar_T , const index_t LO, const index_t HI> const **matrix_multi**< Scalar_T, LO, HI > glucat::sqrt (const matrix_multi< Scalar_T, LO, HI > & *val,* const matrix_multi< Scalar_T, LO, HI > & *i,* bool *prechecked*)

Square root of multivector with specified complexifier.

Definition at line 1600 of file matrix_multi_imp.h.

References check_complex(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::function_precision, glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::isnan(), matrix_sqrt(), precision_demoted, and precision_promoted.

5.2.3.113 template<typename Scalar_T , const index_t LO, const index_t HI> const **framed_multi**< Scalar_T, LO, HI > glucat::sqrt (const framed_multi< Scalar_T, LO, HI > & *val,* const framed_multi< Scalar_T, LO, HI > & *i,* bool *prechecked*)

Square root of multivector with specified complexifier.

Definition at line 1924 of file framed_multi_imp.h.

References check_complex(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::isnan(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::scalar(), and sqrt().

5.2.3.114 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::sqrt (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = false) [inline]

Square root of multivector with specified complexifier.

Definition at line 589 of file clifford_algebra_imp.h.

Referenced by acosh(), asinh(), matrix_sqrt(), glucat::framed_multi< Scalar_T, LO, HI >::random(), and sqrt().

5.2.3.115 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::sqrt (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Square root of multivector.

Definition at line 597 of file clifford_algebra_imp.h.

References complexifier(), and sqrt().

5.2.3.116 template<typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::star (const matrix_multi< Scalar_T, LO, HI > & *lhs,* const matrix_multi< Scalar_T, LO, HI > & *rhs*) [inline]

Hestenes scalar product.

Definition at line 654 of file matrix_multi_imp.h.

5.2.3.117 template<typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::star (const framed_multi< Scalar_T, LO, HI > & *lhs,* const framed_multi< Scalar_T, LO, HI > & *rhs*)

Hestenes scalar product.

Definition at line 855 of file framed_multi_imp.h.

5.2.3.118 template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI> Scalar_T glucat::star (const Multivector< Scalar_T, LO, HI > & *lhs,* const RHS< Scalar_T, LO, HI > & *rhs*) [inline]

Hestenes scalar product.

Definition at line 258 of file clifford_algebra_imp.h.

5.2.3.119 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::tan (const Multivector< Scalar_T, LO, HI > & *val,* const Multivector< Scalar_T, LO, HI > & *i,* const bool *prechecked* = false) [inline]

Tangent of multivector with specified complexifier.

Definition at line 977 of file clifford_algebra_imp.h.

References check_complex(), cos(), scalar(), and sin().

Referenced by glucat::numeric_traits< Scalar_T >::tan(), and tan().

5.2.3.120 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::tan (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Tangent of multivector.

Definition at line 996 of file clifford_algebra_imp.h.

References complexifier(), and tan().

5.2.3.121 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const Multivector< Scalar_T, LO, HI > glucat::tanh (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Hyperbolic tangent of multivector.

Definition at line 933 of file clifford_algebra_imp.h.

References cosh(), scalar(), and sinh().

Referenced by glucat::numeric_traits< Scalar_T >::tanh().

5.2.3.122 template<typename Scalar_T > numeric_traits<Scalar_T>::demoted::type glucat::to_demote (const Scalar_T & *val*) [inline]

Cast to demote.

Definition at line 134 of file scalar_imp.h.

References glucat::numeric_traits< Scalar_T >::to_scalar_t().

5.2.3.123 template<typename Scalar_T > numeric_traits<Scalar_T>::promoted::type glucat::to_promote (const Scalar_T & *val*) [inline]

Cast to promote.

Definition at line 124 of file scalar_imp.h.

References glucat::numeric_traits< Scalar_T >::to_scalar_t().

5.2.3.124 int glucat::try_catch (intfn *f*)

Exception catching for functions returning int.

Definition at line 49 of file try_catch.h.

References PyClical::e(), and glucat::glucat_error::print_error_msg().

Referenced by glucat::control_t::call().

5.2.3.125 int glucat::try_catch (intintfn *f,* int *arg*)

Exception catching for functions of int returning int.

Definition at line 64 of file try_catch.h.

References PyClical::e(), and glucat::glucat_error::print_error_msg().

5.2.3.126 template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI> const std::vector< Scalar_T > glucat::vector_part (const Multivector< Scalar_T, LO, HI > & *val*) [inline]

Vector part of multivector, as a vector_t with respect to frame()

Definition at line 443 of file clifford_algebra_imp.h.

5.2.4 Variable Documentation

5.2.4.1 const index_t glucat::BITS_PER_SET_VALUE = std::numeric_limits<set_value_t>::digits

Number of bits in set_value_t.

Definition at line 103 of file global.h.

5.2.4.2 const unsigned int glucat::DEFAULT_Basis_Max_Count = 12

Definition at line 130 of file global.h.

5.2.4.3 const unsigned int glucat::DEFAULT_Div_Max_Steps = 4

Definition at line 126 of file global.h.

5.2.4.4 const unsigned int glucat::DEFAULT_Fast_Size_Threshold = 1 << 6

Definition at line 131 of file global.h.

5.2.4.5 const precision_t glucat::DEFAULT_Function_Precision = precision_same

Definition at line 134 of file global.h.

5.2.4.6 const index_t glucat::DEFAULT_HI = index_t(BITS_PER_SET_VALUE / 2)

Default highest index in an index set.

Definition at line 111 of file global.h.

5.2.4.7 const unsigned int glucat::DEFAULT_Inv_Fast_Dim_Threshold = 1 << 3

Definition at line 132 of file global.h.

5.2.4.8 const unsigned int glucat::DEFAULT_Log_Max_Inner_Steps = 32

Definition at line 129 of file global.h.

5.2.4.9 const unsigned int glucat::DEFAULT_Log_Max_Outer_Steps = 256

Definition at line 128 of file global.h.

5.2.4.10 const unsigned int glucat::DEFAULT_Mult_Matrix_Threshold = 8

Definition at line 125 of file global.h.

5.2.4.11 const unsigned int glucat::DEFAULT_Products_Size_Threshold = 1 << 22

Definition at line 133 of file global.h.

5.2.4.12 const unsigned int glucat::DEFAULT_Sqrt_Max_Steps = 256

Definition at line 127 of file global.h.

5.2.4.13 const double glucat::DEFAULT_TRUNCATION = std::numeric_limits<float>::epsilon()

Default for truncation.

Definition at line 114 of file global.h.

5.2.4.14 const long double glucat::l_ln2 = 0.693147180559945309417232121458176 6L [static]

Definition at line 41 of file long_double.h.

Referenced by glucat::numeric_traits< Scalar_T >::ln_2().

5.2.4.15 const long double glucat::l_pi = 3.14159265358979323846264338327950 29L [static]

Definition at line 40 of file long_double.h.

Referenced by glucat::numeric_traits< Scalar_T >::pi().

5.2.4.16 const double glucat::MS_PER_S = 1000.0

Timing constant: deprecated here - moved to test/timing.h.

Definition at line 83 of file global.h.

5.3 glucat::gen Namespace Reference

Classes

- class generator_table

  Table of generators for specific signatures.

Typedefs

- typedef std::pair< index_t, index_t > signature_t

  A signature is a pair of indices, p, q, with p == frame.max(), q == -frame.min()

Variables

- static const index_t offset_to_super [] = {0,-1, 0,-1,-2, 3, 2, 1}

  Offsets between the current signature and that of the real superalgebra.

5.3.1 Typedef Documentation

5.3.1.1 typedef std::pair<index_t, index_t> glucat::gen::signature_t

A signature is a pair of indices, p, q, with p == frame.max(), q == -frame.min()

Definition at line 43 of file generation.h.

5.3.2 Variable Documentation

5.3.2.1 const index_t glucat::gen::offset_to_super[ ] = {0,-1, 0,-1,-2, 3, 2, 1} [static]

Offsets between the current signature and that of the real superalgebra.

Definition at line 81 of file generation.h.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::fast_framed_multi(), glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi(), and glucat::gen::generator_table< Matrix_T >::operator()().

5.4 glucat::matrix Namespace Reference

Classes

- struct eig_genus

  Structure containing classification of eigenvalues.

Enumerations

- enum eig_case_t { safe_eig_case, negative_eig_case, both_eig_case }

  Classification of eigenvalues of a matrix.

Functions

- template<typename LHS_T , typename RHS_T >
  const RHS_T kron (const LHS_T &lhs, const RHS_T &rhs)

  Kronecker tensor product of matrices - as per Matlab kron.
- template<typename LHS_T , typename RHS_T >
  const RHS_T mono_kron (const LHS_T &lhs, const RHS_T &rhs)

  Sparse Kronecker tensor product of monomial matrices.
- template<typename LHS_T , typename RHS_T >
  const RHS_T nork (const LHS_T &lhs, const RHS_T &rhs, const bool mono=true)

  Left inverse of Kronecker product.
- template<typename LHS_T , typename RHS_T >
  const RHS_T signed_perm_nork (const LHS_T &lhs, const RHS_T &rhs)

  Left inverse of Kronecker product where lhs is a signed permutation matrix.
- template<typename Matrix_T >
  Matrix_T::size_type nnz (const Matrix_T &m)

  Number of non-zeros.
- template<typename Matrix_T >
  bool isnan (const Matrix_T &m)

  Not a Number.
- template<typename Matrix_T >
  const Matrix_T unit (const typename Matrix_T::size_type n)

  Unit matrix - as per Matlab eye.
- template<typename LHS_T , typename RHS_T >
  const RHS_T::expression_type mono_prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas↩
  ::matrix_expression< RHS_T > &rhs)

  Product of monomial matrices.
- template<typename LHS_T , typename RHS_T >
  const RHS_T::expression_type sparse_prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas↩
  ::matrix_expression< RHS_T > &rhs)

Product of sparse matrices.

- template<typename LHS_T , typename RHS_T >
  const RHS_T::expression_type prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas::matrix↩
  _expression< RHS_T > &rhs)

  Product of matrices.

- template<typename Scalar_T , typename LHS_T , typename RHS_T >
  Scalar_T inner (const LHS_T &lhs, const RHS_T &rhs)

  Inner product: sum(x(i,j)∗y(i,j))/x.nrows()

- template<typename Matrix_T >
  Matrix_T::value_type norm_frob2 (const Matrix_T &val)

  Square of Frobenius norm.

- template<typename Matrix_T >
  Matrix_T::value_type trace (const Matrix_T &val)

  Matrix trace.

- template<typename Matrix_T >
  ublas::vector< std::complex
  < double > > eigenvalues (const Matrix_T &val)

  Eigenvalues of a matrix.

- template<typename Matrix_T >
  eig_genus< Matrix_T > classify_eigenvalues (const Matrix_T &val)

  Classify the eigenvalues of a matrix.

- template<typename LHS_T , typename RHS_T >
  void nork_range (RHS_T &result, const typename LHS_T::const_iterator2 lhs_it2, const RHS_T &rhs, const typename RHS_T::size_type res_s1, const typename RHS_T::size_type res_s2)

  Utility routine for nork: calculate result for a range of indices.

- template<typename Matrix_T >
  static ublas::matrix< double,
  ublas::column_major > to_lapack (const Matrix_T &val)

  Convert matrix to LAPACK format.

5.4.1 Enumeration Type Documentation

5.4.1.1 enum glucat::matrix::eig_case_t

Classification of eigenvalues of a matrix.

Enumerator

safe_eig_case

negative_eig_case

both_eig_case

Definition at line 127 of file matrix.h.

5.4.2 Function Documentation

5.4.2.1 template<typename Matrix_T > eig_genus< Matrix_T > glucat::matrix::classify_eigenvalues (const Matrix_T & *val*)

Classify the eigenvalues of a matrix.

Definition at line 526 of file matrix_imp.h.

References glucat::abs(), both_eig_case, eigenvalues(), glucat::imag(), glucat::matrix::eig_genus< Matrix_T >::m_eig_case, glucat::matrix::eig_genus< Matrix_T >::m_safe_arg, negative_eig_case, glucat::norm(), glucat::numeric_traits< Scalar_T >::pi(), PyClical::pi, glucat::real(), and safe_eig_case.

Referenced by glucat::matrix_log(), and glucat::matrix_sqrt().

5.4.2.2 template<typename Matrix_T > ublas::vector< std::complex< double > > glucat::matrix::eigenvalues (const Matrix_T & *val*)

Eigenvalues of a matrix.

Definition at line 493 of file matrix_imp.h.

References to_lapack().

Referenced by classify_eigenvalues().

5.4.2.3 template<typename Scalar_T , typename LHS_T , typename RHS_T > Scalar_T glucat::matrix::inner (const LHS_T & *lhs,* const RHS_T & *rhs*)

Inner product: sum(x(i,j)∗y(i,j))/x.nrows()

Inner product: sum(lhs(i,j)∗rhs(i,j))/lhs.nrows()

Definition at line 391 of file matrix_imp.h.

5.4.2.4 template<typename Matrix_T > bool glucat::matrix::isnan (const Matrix_T & *m*)

Not a Number.

Definition at line 292 of file matrix_imp.h.

Referenced by glucat::matrix_log(), and glucat::operator/().

5.4.2.5 template<typename LHS_T , typename RHS_T > const RHS_T glucat::matrix::kron (const LHS_T & *lhs,* const RHS_T & *rhs*)

Kronecker tensor product of matrices - as per Matlab kron.

Definition at line 73 of file matrix_imp.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fast().

5.4.2.6 template<typename LHS_T , typename RHS_T > const RHS_T glucat::matrix::mono_kron (const LHS_T & *lhs,* const RHS_T & *rhs*)

Sparse Kronecker tensor product of monomial matrices.

Definition at line 116 of file matrix_imp.h.

Referenced by glucat::gen::generator_table< Matrix_T >::gen_from_pm1_qm1().

5.4.2.7 template<typename LHS_T , typename RHS_T > const RHS_T::expression_type glucat::matrix::mono_prod (const ublas::matrix_expression< LHS_T > & *lhs,* const ublas::matrix_expression< RHS_T > & *rhs*)

Product of monomial matrices.

Definition at line 326 of file matrix_imp.h.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::basis_element(), glucat::gen::generator_table< Matrix_T >::gen_from_pm4_qp4(), glucat::gen::generator_table< Matrix_T >::gen_from_pp4_qm4(), and glucat::gen::generator_table< Matrix_T >::gen_from_qp1_pm1().

5.4.2.8 template<typename Matrix_T > Matrix_T::size_type glucat::matrix::nnz (const Matrix_T & *m*)

Number of non-zeros.

Definition at line 269 of file matrix_imp.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::framed_multi().

5.4.2.9 template<typename LHS_T , typename RHS_T > const RHS_T glucat::matrix::nork (const LHS_T & *lhs,* const RHS_T & *rhs,* const bool *mono* = `true`)

Left inverse of Kronecker product.

Definition at line 188 of file matrix_imp.h.

References norm_frob2().

5.4.2.10 template<typename LHS_T , typename RHS_T > void glucat::matrix::nork_range (RHS_T & *result,* const typename LHS_T::const_iterator2 *lhs_it2,* const RHS_T & *rhs,* const typename RHS_T::size_type *res_s1,* const typename RHS_T::size_type *res_s2*)

Utility routine for nork: calculate result for a range of indices.

Definition at line 155 of file matrix_imp.h.

References glucat::numeric_traits< Scalar_T >::to_scalar_t().

5.4.2.11 template<typename Matrix_T > Matrix_T::value_type glucat::matrix::norm_frob2 (const Matrix_T & *val*)

Square of Frobenius norm.

Definition at line 413 of file matrix_imp.h.

Referenced by nork().

5.4.2.12 template<typename LHS_T , typename RHS_T > const RHS_T::expression_type glucat::matrix::prod (const ublas::matrix_expression< LHS_T > & *lhs,* const ublas::matrix_expression< RHS_T > & *rhs*) `[inline]`

Product of matrices.

Definition at line 373 of file matrix_imp.h.

5.4.2.13 template<typename LHS_T , typename RHS_T > const RHS_T glucat::matrix::signed_perm_nork (const LHS_T & *lhs,* const RHS_T & *rhs*)

Left inverse of Kronecker product where lhs is a signed permutation matrix.

Definition at line 237 of file matrix_imp.h.

Referenced by glucat::fast().

5.4.2.14 template<typename LHS_T , typename RHS_T > const RHS_T::expression_type glucat::matrix::sparse_prod (const ublas::matrix_expression< LHS_T > & *lhs,* const ublas::matrix_expression< RHS_T > & *rhs*) `[inline]`

Product of sparse matrices.

Definition at line 362 of file matrix_imp.h.

5.4.2.15 template<typename Matrix_T > static ublas::matrix<double, ublas::column_major> glucat::matrix::to_lapack (const Matrix_T & *val*) [static]

Convert matrix to LAPACK format.

Definition at line 461 of file matrix_imp.h.

Referenced by eigenvalues().

5.4.2.16 template<typename Matrix_T > Matrix_T::value_type glucat::matrix::trace (const Matrix_T & *val*)

Matrix trace.

Definition at line 437 of file matrix_imp.h.

References glucat::numeric_traits< Scalar_T >::NaN().

5.4.2.17 template<typename Matrix_T > const Matrix_T glucat::matrix::unit (const typename Matrix_T::size_type *n*) [inline]

Unit matrix - as per Matlab eye.

Definition at line 317 of file matrix_imp.h.

5.5 glucat::timing Namespace Reference

Functions

- static double elapsed (clock_t cpu_time)

  Elapsed time in milliseconds.

Variables

- const double MS_PER_SEC = 1000.0

  Timing constant: milliseconds per second.
- const double MS_PER_CLOCK = MS_PER_SEC / double(CLOCKS_PER_SEC)

  Timing constant: milliseconds per clock.
- const int EXTRA_TRIALS = 2

  Timing constant: trial expansion factor.

5.5.1 Function Documentation

5.5.1.1 static double glucat::timing::elapsed (clock_t *cpu_time*) [inline], [static]

Elapsed time in milliseconds.

Definition at line 51 of file timing.h.

References MS_PER_CLOCK.

5.5.2 Variable Documentation

5.5.2.1 const int glucat::timing::EXTRA_TRIALS = 2

Timing constant: trial expansion factor.

Definition at line 45 of file timing.h.

5.5.2.2 const double glucat::timing::MS_PER_CLOCK = MS_PER_SEC / double(CLOCKS_PER_SEC)

Timing constant: milliseconds per clock.

Definition at line 42 of file timing.h.

Referenced by elapsed().

5.5.2.3 const double glucat::timing::MS_PER_SEC = 1000.0

Timing constant: milliseconds per second.

Definition at line 39 of file timing.h.

5.6 PyClical Namespace Reference

Classes

- class clifford
- class index_set

Functions

- def index_set_hidden_doctests
- def clifford_hidden_doctests
- def e
- def istpq
- def _test

Variables

- string __version__ = "0.8.2"
- tuple tau = atan(clifford(1.0))
- float pi = tau/2.0
- cl = clifford
- ist = index_set
- tuple ninf3 = e(4)
- tuple nbar3 = e(4)

5.6.1 Function Documentation

5.6.1.1 def PyClical._test ( ) [private]

Definition at line 1913 of file PyClical.pyx.

5.6.1.2 def PyClical.clifford_hidden_doctests ( )

```
Tests for functions that Doctest cannot see.

For clifford.__cinit__: Construct an object of type clifford.

>>> print clifford(2)
2
>>> print clifford(2L)
2
>>> print clifford(2.0)
2
>>> print clifford(1.0e-1)
0.1
>>> print clifford("2")
2
>>> print clifford("2{1,2,3}")
2{1,2,3}
>>> print clifford(clifford("2{1,2,3}"))
2{1,2,3}
>>> print clifford("-{1}")
-{1}
>>> print clifford(2,index_set({1,2}))
2{1,2}
>>> print clifford([2,3],index_set({1,2}))
2{1}+3{2}
>>> print clifford([1,2])
Traceback (most recent call last):
  ...
TypeError: Cannot initialize clifford object from <type 'list'>.
>>> print clifford(None)
Traceback (most recent call last):
  ...
TypeError: Cannot initialize clifford object from <type 'NoneType'>.
>>> print clifford(None,[1,2])
Traceback (most recent call last):
  ...
TypeError: Cannot initialize clifford object from (<type 'NoneType'>, <type 'list'>).
>>> print clifford([1,2],[1,2])
Traceback (most recent call last):
  ...
TypeError: Cannot initialize clifford object from (<type 'list'>, <type 'list'>).
>>> print clifford("")
Traceback (most recent call last):
  ...
ValueError: Cannot initialize clifford object from invalid string ''.
>>> print clifford("{")
Traceback (most recent call last):
  ...
ValueError: Cannot initialize clifford object from invalid string '{'.
>>> print clifford("{1")
Traceback (most recent call last):
  ...
ValueError: Cannot initialize clifford object from invalid string '{1'.
>>> print clifford("+")
Traceback (most recent call last):
  ...
ValueError: Cannot initialize clifford object from invalid string '+'.
>>> print clifford("-")
Traceback (most recent call last):
  ...
ValueError: Cannot initialize clifford object from invalid string '-'.
>>> print clifford("{1}+")
Traceback (most recent call last):
  ...
ValueError: Cannot initialize clifford object from invalid string '{1}+'.

For clifford.__richcmp__: Compare objects of type clifford.

>>> clifford("{1}") == clifford("1{1}")
True
>>> clifford("{1}") != clifford("1.0{1}")
False
```

```
>>> clifford("{1}") != clifford("1.0")
True
>>> clifford("{1,2}") == None
False
>>> clifford("{1,2}") != None
True
>>> None == clifford("{1,2}")
False
>>> None != clifford("{1,2}")
True
```

Definition at line 1243 of file PyClical.pyx.

5.6.1.3 def PyClical.e (*obj*)

```
Abbreviation for clifford(index_set(obj)).

>>> print e(1)
{1}
>>> print e(-1)
{-1}
>>> print e(0)
1
```

Definition at line 1887 of file PyClical.pyx.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >.basis_element(), clifford_to_str(), glucat::framed_multi< Scalar_T, LO, HI >.framed_multi(), glucat::matrix_multi< Scalar_T, LO, HI >.matrix_multi(), and glucat.try_catch().

5.6.1.4 def PyClical.index_set_hidden_doctests ( )

```
Tests for functions that Doctest cannot see.

For index_set.__cinit__: Construct index_set.

>>> print index_set(1)
{1}
>>> print index_set({1,2})
{1,2}
>>> print index_set(index_set({1,2}))
{1,2}
>>> print index_set({1,2})
{1,2}
>>> print index_set({1,2,1})
{1,2}
>>> print index_set({1,2,1})
{1,2}
>>> print index_set("")
{}
>>> print index_set("{")
Traceback (most recent call last):
...
ValueError: Cannot initialize index_set object from invalid string '{'.
>>> print index_set("{1")
Traceback (most recent call last):
...
ValueError: Cannot initialize index_set object from invalid string '{1'.
>>> print index_set("{1,2,100}")
Traceback (most recent call last):
...
ValueError: Cannot initialize index_set object from invalid string '{1,2,100}'.
>>> print index_set({1,2,100})
Traceback (most recent call last):
...
IndexError: Cannot initialize index_set object from invalid set([1, 2, 100]).
>>> print index_set([1,2])
Traceback (most recent call last):
...
```

```
TypeError: Cannot initialize index_set object from <type 'list'>.

For index_set.__richcmp__: Compare two objects of class index_set.

>>> index_set(1) == index_set({1})
True
>>> index_set({1}) != index_set({1})
False
>>> index_set({1}) != index_set({2})
True
>>> index_set({1}) == index_set({2})
False
>>> index_set({1}) < index_set({2})
True
>>> index_set({1}) <= index_set({2})
True
>>> index_set({1}) > index_set({2})
False
>>> index_set({1}) >= index_set({2})
False
>>> None == index_set({1,2})
False
>>> None != index_set({1,2})
True
>>> None < index_set({1,2})
False
>>> None <= index_set({1,2})
False
>>> None > index_set({1,2})
False
>>> None >= index_set({1,2})
False
>>> index_set({1,2}) == None
False
>>> index_set({1,2}) != None
True
>>> index_set({1,2}) < None
False
>>> index_set({1,2}) <= None
False
>>> index_set({1,2}) > None
False
>>> index_set({1,2}) >= None
False
```

Definition at line 404 of file PyClical.pyx.

5.6.1.5 def PyClical.istpq (*p*, *q*)

```
Abbreviation for index_set({-q,...p}).

>>> print istpq(2,3)
{-3,-2,-1,1,2}
```

Definition at line 1900 of file PyClical.pyx.

5.6.2 Variable Documentation

5.6.2.1 string PyClical.__version__ = "0.8.2"

Definition at line 32 of file PyClical.pyx.

5.6.2.2 PyClical.cl = clifford

Definition at line 1859 of file PyClical.pyx.

Referenced by cga3.agc3(), cga3.cga3(), and cga3.cga3std().

5.6.2.3 PyClical.ist = index_set

Definition at line 1879 of file PyClical.pyx.

Referenced by cga3.agc3(), cga3.cga3(), cga3.cga3std(), glucat::framed_multi< Scalar_T, LO, HI >.framed_multi(), index_set_to_str(), glucat.operator<<(), and glucat.operator>>().

5.6.2.4 tuple PyClical.nbar3 = e(4)

Definition at line 1910 of file PyClical.pyx.

5.6.2.5 tuple PyClical.ninf3 = e(4)

Definition at line 1909 of file PyClical.pyx.

Referenced by cga3.cga3(), and cga3.cga3std().

5.6.2.6 float PyClical.pi = tau/2.0

Definition at line 1857 of file PyClical.pyx.

Referenced by glucat::matrix.classify_eigenvalues(), glucat.cos(), glucat.log(), glucat.matrix_log(), and glucat.sin().

5.6.2.7 tuple PyClical.tau = atan(clifford(1.0))

Definition at line 1856 of file PyClical.pyx.

5.7 std Namespace Reference

Classes

- struct numeric_limits< glucat::framed_multi< Scalar_T, LO, HI > >

  Numeric limits for framed_multi inherit limits for the corresponding scalar type.
- struct numeric_limits< glucat::matrix_multi< Scalar_T, LO, HI > >

  Numeric limits for matrix_multi inherit limits for the corresponding scalar type.

Chapter 6

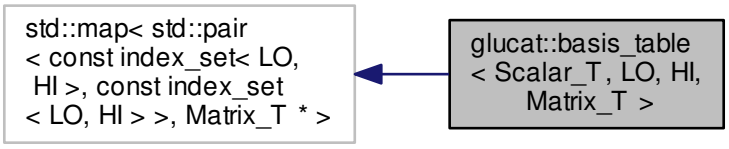
Class Documentation

6.1 glucat::basis_table< Scalar_T, LO, HI, Matrix_T > Class Template Reference

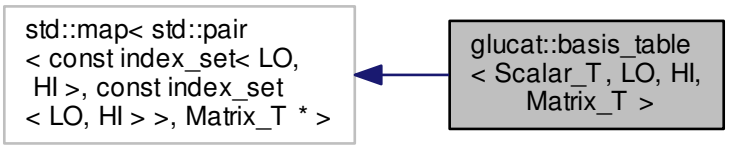
Table of basis elements used as a cache by basis_element()

`#include <matrix_multi_imp.h>`

Inheritance diagram for glucat::basis_table< Scalar_T, LO, HI, Matrix_T >:



Collaboration diagram for glucat::basis_table< Scalar_T, LO, HI, Matrix_T >:



Static Public Member Functions

- static basis_table & basis ()

  Single instance of basis table.

Private Member Functions

- basis_table ()
- ~basis_table ()
- basis_table (const basis_table &)
- basis_table & operator= (const basis_table &)

Friends

- class friend_for_private_destructor

6.1.1 Detailed Description

template<typename Scalar_T, const index_t LO, const index_t HI, typename Matrix_T>class glucat::basis_table< Scalar_T, LO, HI, Matrix_T >

Table of basis elements used as a cache by basis_element()

Definition at line 1218 of file matrix_multi_imp.h.

6.1.2 Constructor & Destructor Documentation

6.1.2.1 template<typename Scalar_T , const index_t LO, const index_t HI, typename Matrix_T > glucat::basis_table< Scalar_T, LO, HI, Matrix_T >::basis_table ( ) [inline], [private]

Definition at line 1228 of file matrix_multi_imp.h.

6.1.2.2 template<typename Scalar_T , const index_t LO, const index_t HI, typename Matrix_T > glucat::basis_table< Scalar_T, LO, HI, Matrix_T >::~basis_table ( ) [inline], [private]

Definition at line 1229 of file matrix_multi_imp.h.

6.1.2.3 template<typename Scalar_T , const index_t LO, const index_t HI, typename Matrix_T > glucat::basis_table< Scalar_T, LO, HI, Matrix_T >::basis_table (const basis_table< Scalar_T, LO, HI, Matrix_T > &) [private]

6.1.3 Member Function Documentation

6.1.3.1 template<typename Scalar_T , const index_t LO, const index_t HI, typename Matrix_T > static basis_table& glucat::basis_table< Scalar_T, LO, HI, Matrix_T >::basis ( ) [inline], [static]

Single instance of basis table.

Definition at line 1224 of file matrix_multi_imp.h.

6.1.3.2 template<typename Scalar_T , const index_t LO, const index_t HI, typename Matrix_T > basis_table& glucat::basis_table< Scalar_T, LO, HI, Matrix_T >::operator= (const basis_table< Scalar_T, LO, HI, Matrix_T > &) [private]

6.1.4 Friends And Related Function Documentation

6.1.4.1 template<typename Scalar_T , const index_t LO, const index_t HI, typename Matrix_T > friend class friend_for_private_destructor [friend]

Friend declaration to avoid compiler warning: "... only defines a private destructor and has no friends" Ref: Carlos O'Ryan, ACE http://doc.ece.uci.edu

Definition at line 1236 of file matrix_multi_imp.h.

The documentation for this class was generated from the following file:

- glucat/matrix_multi_imp.h

6.2 glucat::bool_to_type< truth_value > Class Template Reference

Bool to type.

`#include <global.h>`

Private Types

- enum { value = truth_value }

6.2.1 Detailed Description

template<bool truth_value>class glucat::bool_to_type< truth_value >

Bool to type.

Definition at line 69 of file global.h.

6.2.2 Member Enumeration Documentation

6.2.2.1 template<bool truth_value> anonymous enum [private]

Enumerator

value

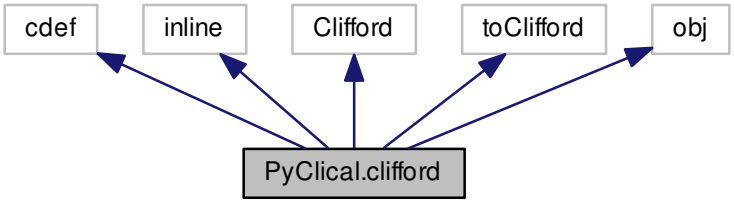
Definition at line 72 of file global.h.

The documentation for this class was generated from the following file:

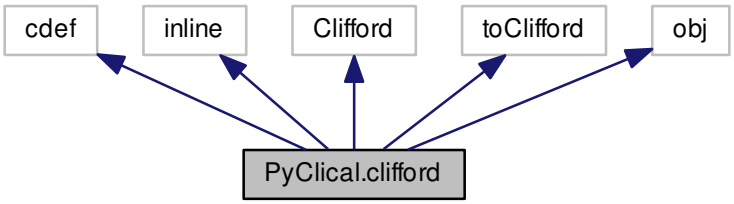
- glucat/global.h

6.3 PyClical.clifford Class Reference

Inheritance diagram for PyClical.clifford:



Collaboration diagram for PyClical.clifford:



Public Member Functions

- def __cinit__
- def __dealloc__
- def __contains__
- def __iter__
- def reframe
- def __richcmp__
- def __getitem__
- def __neg__
- def __pos__
- def __add__
- def __iadd__
- def __sub__
- def __isub__
- def __mul__
- def __imul__
- def __mod__
- def __imod__
- def __and__

- def __iand__
- def __xor__
- def __ixor__
- def __div__
- def __idiv__
- def inv
- def __or__
- def __ior__
- def __pow__
- def pow
- def outer_pow
- def __call__
- def scalar
- def pure
- def even
- def odd
- def vector_part
- def involute
- def reverse
- def conj
- def quad
- def norm
- def abs
- def max_abs
- def truncated
- def isnan
- def frame
- def __repr__
- def __str__

Public Attributes

- instance

6.3.1 Detailed Description

```
Python class clifford wraps C++ class Clifford.
```

Definition at line 532 of file PyClical.pyx.

6.3.2 Member Function Documentation

6.3.2.1 def PyClical.clifford.__add__ (*lhs, rhs*)

```
Geometric sum.

>>> print clifford(1) + clifford("{2}")
1+{2}
>>> print clifford("{1}") + clifford("{2}")
{1}+{2}
```

Definition at line 739 of file PyClical.pyx.

6.3.2.2 def PyClical.clifford.__and__ (*lhs, rhs*)

```
Inner product.

>>> print clifford("{1}") & clifford("{2}")
0
>>> print clifford(2) & clifford("{2}")
0
>>> print clifford("{1}") & clifford("{1}")
1
>>> print clifford("{1}") & clifford("{1,2}")
{2}
```

Definition at line 835 of file PyClical.pyx.

6.3.2.3 def PyClical.clifford.__call__ (*self, grade*)

```
Pure grade-vector part.

>>> print clifford("{1}")(1)
{1}
>>> print clifford("{1}")(0)
0
>>> print clifford("1+{1}+{1,2}")(0)
1
>>> print clifford("1+{1}+{1,2}")(1)
{1}
>>> print clifford("1+{1}+{1,2}")(2)
{1,2}
>>> print clifford("1+{1}+{1,2}")(3)
0
```

Definition at line 1019 of file PyClical.pyx.

6.3.2.4 def PyClical.clifford.__cinit__ (*self, other* = 0, *ixt* = None)

```
Construct an object of type clifford.

>>> print clifford(2)
2
>>> print clifford(2L)
2
>>> print clifford(2.0)
2
>>> print clifford(1.0e-1)
0.1
>>> print clifford("2")
2
>>> print clifford("2{1,2,3}")
2{1,2,3}
>>> print clifford(clifford("2{1,2,3}"))
2{1,2,3}
>>> print clifford("-{1}")
-{1}
>>> print clifford(2,index_set({1,2}))
2{1,2}
>>> print clifford([2,3],index_set({1,2}))
2{1}+3{2}
```

Definition at line 563 of file PyClical.pyx.

6.3.2.5 def PyClical.clifford.__contains__ (*self, x*)

```
Not applicable.
```

```
>>> x=clifford(index_set({-3,4,7})); -3 in x
Traceback (most recent call last):
  ...
TypeError: Not applicable.
```

Definition at line 626 of file PyClical.pyx.

6.3.2.6 def PyClical.clifford.__dealloc__ (*self*)

```
Clean up by deallocating the instance of C++ class Clifford.
```

Definition at line 620 of file PyClical.pyx.

References PyClical.index_set.instance, and PyClical.clifford.instance.

6.3.2.7 def PyClical.clifford.__div__ (*lhs, rhs*)

```
Geometric quotient.

>>> print clifford("{1}") / clifford("{2}")
{1,2}
>>> print clifford(2) / clifford("{2}")
2{2}
>>> print clifford("{1}") / clifford("{1}")
1
>>> print clifford("{1}") / clifford("{1,2}")
-{2}
```

Definition at line 895 of file PyClical.pyx.

6.3.2.8 def PyClical.clifford.__getitem__ (*self, ixt*)

```
Subscripting: map from index set to scalar coordinate.

>>> clifford("{1}")[index_set(1)]
1.0
>>> clifford("{1}")[index_set({1})]
1.0
>>> clifford("{1}")[index_set({1,2})]
0.0
>>> clifford("2{1,2}")[index_set({1,2})]
2.0
```

Definition at line 706 of file PyClical.pyx.

6.3.2.9 def PyClical.clifford.__iadd__ (*self, rhs*)

```
Geometric sum.

>>> x = clifford(1); x += clifford("{2}"); print x
1+{2}
```

Definition at line 750 of file PyClical.pyx.

6.3.2.10 def PyClical.clifford.__iand__ (*self, rhs*)

```
Inner product.

>>> x = clifford("{1}"); x &= clifford("{2}"); print x
0
```

```
>>> x = clifford(2); x &= clifford("{2}"); print x
0
>>> x = clifford("{1}"); x &= clifford("{1}"); print x
1
>>> x = clifford("{1}"); x &= clifford("{1,2}"); print x
{2}
```

Definition at line 850 of file PyClical.pyx.

6.3.2.11 def PyClical.clifford.__idiv__ (*self, rhs*)

```
Geometric quotient.

>>> x = clifford("{1}"); x /= clifford("{2}"); print x
{1,2}
>>> x = clifford(2); x /= clifford("{2}"); print x
2{2}
>>> x = clifford("{1}"); x /= clifford("{1}"); print x
1
>>> x = clifford("{1}"); x /= clifford("{1,2}"); print x
-{2}
```

Definition at line 910 of file PyClical.pyx.

6.3.2.12 def PyClical.clifford.__imod__ (*self, rhs*)

```
Contraction.

>>> x = clifford("{1}"); x %= clifford("{2}"); print x
0
>>> x = clifford(2); x %= clifford("{2}"); print x
2{2}
>>> x = clifford("{1}"); x %= clifford("{1}"); print x
1
>>> x = clifford("{1}"); x %= clifford("{1,2}"); print x
{2}
```

Definition at line 820 of file PyClical.pyx.

6.3.2.13 def PyClical.clifford.__imul__ (*self, rhs*)

```
Geometric product.

>>> x = clifford(2); x *= clifford("{2}"); print x
2{2}
>>> x = clifford("{1}"); x *= clifford("{2}"); print x
{1,2}
>>> x = clifford("{1}"); x *= clifford("{1,2}"); print x
{2}
```

Definition at line 792 of file PyClical.pyx.

6.3.2.14 def PyClical.clifford.__ior__ (*self, rhs*)

```
Transform left hand side, using right hand side as a transformation.

>>> x=clifford("{1,2}") * pi/2; y=clifford("{1}"); y|=x; print y
-{1}
>>> x=clifford("{1,2}") * pi/2; y=clifford("{1}"); y|=exp(x); print y
-{1}
```

Definition at line 949 of file PyClical.pyx.

6.3.2.15 def PyClical.clifford.__isub__ (*self, rhs*)

```
Geometric difference.

>>> x = clifford(1); x -= clifford("{2}"); print x
1-{2}
```

Definition at line 770 of file PyClical.pyx.

6.3.2.16 def PyClical.clifford.__iter__ (*self*)

```
Not applicable.

>>> for a in clifford(index_set({-3,4,7})): print a,
Traceback (most recent call last):
  ...
TypeError: Not applicable.
```

Definition at line 637 of file PyClical.pyx.

6.3.2.17 def PyClical.clifford.__ixor__ (*self, rhs*)

```
Outer product.

>>> x = clifford("{1}"); x ^= clifford("{2}"); print x
{1,2}
>>> x = clifford(2); x ^= clifford("{2}"); print x
2{2}
>>> x = clifford("{1}"); x ^= clifford("{1}"); print x
0
>>> x = clifford("{1}"); x ^= clifford("{1,2}"); print x
0
```

Definition at line 880 of file PyClical.pyx.

6.3.2.18 def PyClical.clifford.__mod__ (*lhs, rhs*)

```
Contraction.

>>> print clifford("{1}") % clifford("{2}")
0
>>> print clifford(2) % clifford("{2}")
2{2}
>>> print clifford("{1}") % clifford("{1}")
1
>>> print clifford("{1}") % clifford("{1,2}")
{2}
```

Definition at line 805 of file PyClical.pyx.

6.3.2.19 def PyClical.clifford.__mul__ (*lhs, rhs*)

```
Geometric product.

>>> print clifford("{1}") * clifford("{2}")
{1,2}
>>> print clifford(2) * clifford("{2}")
2{2}
>>> print clifford("{1}") * clifford("{1,2}")
{2}
```

Definition at line 779 of file PyClical.pyx.

6.3.2.20 def PyClical.clifford.__neg__ (*self*)

```
Unary -.

>>> print -clifford("{1}")
-{1}
```

Definition at line 721 of file PyClical.pyx.

6.3.2.21 def PyClical.clifford.__or__ (*lhs*, *rhs*)

```
Transform left hand side, using right hand side as a transformation.

>>> x=clifford("{1,2}") * pi/2; y=clifford("{1}"); print y|x
-{1}
>>> x=clifford("{1,2}") * pi/2; y=clifford("{1}"); print y|exp(x)
-{1}
```

Definition at line 938 of file PyClical.pyx.

6.3.2.22 def PyClical.clifford.__pos__ (*self*)

```
Unary +.

>>> print +clifford("{1}")
{1}
```

Definition at line 730 of file PyClical.pyx.

6.3.2.23 def PyClical.clifford.__pow__ (*self*, *m*, *dummy*)

```
Power: self to the m.

>>> x=clifford("{1}"); print x ** 2
1
>>> x=clifford("2"); print x ** 2
4
>>> x=clifford("2+{1}"); print x ** 0
1
>>> x=clifford("2+{1}"); print x ** 1
2+{1}
>>> x=clifford("2+{1}"); print x ** 2
5+4{1}
>>> i=clifford("{1,2}");print exp(pi/2) * (i ** i)
1
```

Definition at line 960 of file PyClical.pyx.

References PyClical.clifford.pow().

6.3.2.24 def PyClical.clifford.__repr__ (*self*)

```
The "official" string representation of self.

>>> clifford("1+3{-1}+2{1,2}+4{-2,7}").__repr__()
'clifford("1+3{-1}+2{1,2}+4{-2,7}")'
```

Definition at line 1225 of file PyClical.pyx.

References clifford_to_repr().

6.3.2.25 def PyClical.clifford.__richcmp__ (*lhs, rhs, int, op*)

```
Compare objects of type clifford.

>>> clifford("{1}") == clifford("1{1}")
True
>>> clifford("{1}") != clifford("1.0{1}")
False
>>> clifford("{1}") != clifford("1.0")
True
>>> clifford("{1,2}") == None
False
>>> clifford("{1,2}") != None
True
>>> None == clifford("{1,2}")
False
>>> None != clifford("{1,2}")
True
```

Definition at line 671 of file PyClical.pyx.

6.3.2.26 def PyClical.clifford.__str__ (*self*)

```
The "informal" string representation of self.

>>> clifford("1+3{-1}+2{1,2}+4{-2,7}").__str__()
'1+3{-1}+2{1,2}+4{-2,7}'
```

Definition at line 1234 of file PyClical.pyx.

References clifford_to_str().

6.3.2.27 def PyClical.clifford.__sub__ (*lhs, rhs*)

```
Geometric difference.

>>> print clifford(1) - clifford("{2}")
1-{2}
>>> print clifford("{1}") - clifford("{2}")
{1}-{2}
```

Definition at line 759 of file PyClical.pyx.

6.3.2.28 def PyClical.clifford.__xor__ (*lhs, rhs*)

```
Outer product.

>>> print clifford("{1}") ^ clifford("{2}")
{1,2}
>>> print clifford(2) ^ clifford("{2}")
2{2}
>>> print clifford("{1}") ^ clifford("{1}")
0
>>> print clifford("{1}") ^ clifford("{1,2}")
0
```

Definition at line 865 of file PyClical.pyx.

6.3.2.29 def PyClical.clifford.abs (*self*)

```
Absolute value: square root of norm.

>>> clifford("1+{-1}+{1,2}+{1,2,3}").abs()
2.0
```

Definition at line 1174 of file PyClical.pyx.

References glucat.abs().

6.3.2.30 def PyClical.clifford.conj (*self*)

```
Conjugation, reverse o involute == involute o reverse.

>>> print (clifford("{1}")).conj()
-{1}
>>> print (clifford("{2}") * clifford("{1}")).conj()
{1,2}
>>> print (clifford("{1}") * clifford("{2}")).conj()
-{1,2}
>>> print clifford("1+{1}+{1,2}").conj()
1-{1}-{1,2}
```

Definition at line 1137 of file PyClical.pyx.

6.3.2.31 def PyClical.clifford.even (*self*)

```
Even part of multivector, sum of even grade terms.

>>> print clifford("1+{1}+{1,2}").even()
1+{1,2}
```

Definition at line 1060 of file PyClical.pyx.

6.3.2.32 def PyClical.clifford.frame (*self*)

```
Subalgebra generated by all generators of terms of given multivector.

>>> print clifford("1+3{-1}+2{1,2}+4{-2,7}").frame()
{-2,-1,1,2,7}
>>> s=clifford("1+3{-1}+2{1,2}+4{-2,7}").frame(); type(s)
<type 'PyClical.index_set'>
```

Definition at line 1214 of file PyClical.pyx.

6.3.2.33 def PyClical.clifford.inv (*self*)

```
Geometric multiplicative inverse.

>>> x = clifford("{1}"); print x.inv()
{1}
>>> x = clifford(2); print x.inv()
0.5
>>> x = clifford("{1,2}"); print x.inv()
-{1,2}
```

Definition at line 925 of file PyClical.pyx.

6.3.2.34 def PyClical.clifford.involute (*self*)

```
Main involution, each {i} is replaced by -{i} in each term,
eg. clifford("{1}") -> -clifford("{1}").

>>> print clifford("{1}").involute()
-{1}
>>> print (clifford("{2}") * clifford("{1}")).involute()
-{1,2}
```

```
>>> print (clifford("{1}") * clifford("{2}")).involute()
{1,2}
>>> print clifford("1+{1}+{1,2}").involute()
1-{1}+{1,2}
```

Definition at line 1106 of file PyClical.pyx.

6.3.2.35 def PyClical.clifford.isnan (*self*)

```
Check if a multivector contains any IEEE NaN values.

>>> clifford().isnan()
False
```

Definition at line 1205 of file PyClical.pyx.

6.3.2.36 def PyClical.clifford.max_abs (*self*)

```
Maximum of absolute values of components of multivector: multivector infinity norm.

>>> clifford("1+{-1}+{1,2}+{1,2,3}").max_abs()
1.0
>>> clifford("3+2{1}+{1,2}").max_abs()
3.0
```

Definition at line 1183 of file PyClical.pyx.

6.3.2.37 def PyClical.clifford.norm (*self*)

```
Norm == sum of squares of coordinates.

>>> clifford("1+{1}+{1,2}").norm()
3.0
>>> clifford("1+{-1}+{1,2}+{1,2,3}").norm()
4.0
```

Definition at line 1163 of file PyClical.pyx.

6.3.2.38 def PyClical.clifford.odd (*self*)

```
Odd part of multivector, sum of odd grade terms.

>>> print clifford("1+{1}+{1,2}").odd()
{1}
```

Definition at line 1069 of file PyClical.pyx.

6.3.2.39 def PyClical.clifford.outer_pow (*self, m*)

```
Outer product power.

>>> x=clifford("2+{1}"); print x.outer_pow(0)
1
>>> x=clifford("2+{1}"); print x.outer_pow(1)
2+{1}
>>> x=clifford("2+{1}"); print x.outer_pow(2)
4+4{1}
>>> print clifford("1+{1}+{1,2}").outer_pow(3)
1+3{1}+3{1,2}
```

Definition at line 1003 of file PyClical.pyx.

6.3.2.40 def PyClical.clifford.pow (*self, m*)

```
Power: self to the m.

>>> x=clifford("{1}"); print x.pow(2)
1
>>> x=clifford("2"); print x.pow(2)
4
>>> x=clifford("2+{1}"); print x.pow(0)
1
>>> x=clifford("2+{1}"); print x.pow(1)
2+{1}
>>> x=clifford("2+{1}"); print x.pow(2)
5+4{1}
>>> print clifford("1+{1}+{1,2}").pow(3)
1+3{1}+3{1,2}
>>> i=clifford("{1,2}");print exp(pi/2) * i.pow(i)
1
```

Definition at line 979 of file PyClical.pyx.

References glucat.exp(), and glucat.log().

Referenced by PyClical.clifford.__pow__().

6.3.2.41 def PyClical.clifford.pure (*self*)

```
Pure part.

>>> print clifford("1+{1}+{1,2}").pure()
{1}+{1,2}
>>> print clifford("{1,2}").pure()
{1,2}
```

Definition at line 1049 of file PyClical.pyx.

6.3.2.42 def PyClical.clifford.quad (*self*)

```
Quadratic form == (rev(x)*x)(0).

>>> print clifford("1+{1}+{1,2}").quad()
3.0
>>> print clifford("1+{-1}+{1,2}+{1,2,3}").quad()
2.0
```

Definition at line 1152 of file PyClical.pyx.

6.3.2.43 def PyClical.clifford.reframe (*self, ixt*)

```
Put self into a larger frame, containing the union of self.frame() and index set ixt.
This can be used to make multiplication faster, by multiplying within a common frame.

>>> clifford("2+3{1}").reframe(index_set({1,2,3}))
clifford("2+3{1}")
>>> s=index_set({1,2,3});t=index_set({-3,-2,-1});x=random_clifford(s); x.reframe(t).frame() == (s|t);
True
```

Definition at line 648 of file PyClical.pyx.

6.3.2.44 def PyClical.clifford.reverse (*self*)

```
Reversion, eg. clifford("{1}")*clifford("{2}") -> clifford("{2}")*clifford("{1}").
```

```
>>> print clifford("{1}").reverse()
{1}
>>> print (clifford("{2}") * clifford("{1}")).reverse()
{1,2}
>>> print (clifford("{1}") * clifford("{2}")).reverse()
-{1,2}
>>> print clifford("1+{1}+{1,2}").reverse()
1+{1}-{1,2}
```

Definition at line 1122 of file PyClical.pyx.

6.3.2.45 def PyClical.clifford.scalar (*self*)

```
Scalar part.

>>> clifford("1+{1}+{1,2}").scalar()
1.0
>>> clifford("{1,2}").scalar()
0.0
```

Definition at line 1038 of file PyClical.pyx.

6.3.2.46 def PyClical.clifford.truncated (*self, limit*)

```
Remove all terms of self with relative size smaller than limit.

>>> clifford("1e8+{1}+1e-8{1,2}").truncated(1.0e-6)
clifford("100000000")
>>> clifford("1e4+{1}+1e-4{1,2}").truncated(1.0e-6)
clifford("10000+{1}")
```

Definition at line 1194 of file PyClical.pyx.

6.3.2.47 def PyClical.clifford.vector_part (*self, frm =* None)

```
Vector part of multivector, as a Python list, with respect to frm.

>>> print clifford("1+2{1}+3{2}+4{1,2}").vector_part()
[2.0, 3.0]
>>> print clifford("1+2{1}+3{2}+4{1,2}").vector_part(index_set({-1,1,2}))
[0.0, 2.0, 3.0]
```

Definition at line 1078 of file PyClical.pyx.

6.3.3 Member Data Documentation

6.3.3.1 PyClical.clifford.instance

Definition at line 592 of file PyClical.pyx.

Referenced by PyClical.clifford.__dealloc__().

The documentation for this class was generated from the following file:

- pyclical/PyClical.pyx

6.4 glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T > Class Template Reference

clifford_algebra<> declares the operations of a Clifford algebra

`#include <clifford_algebra.h>`

Public Types

- typedef Scalar_T scalar_t
- typedef Index_Set_T index_set_t
- typedef Multivector_T multivector_t
- typedef std::pair< const index_set_t, Scalar_T > pair_t
- typedef std::vector< Scalar_T > vector_t

Public Member Functions

- virtual ~clifford_algebra ()
- virtual bool operator== (const multivector_t &val) const =0

  Test for equality of multivectors.
- virtual bool operator== (const Scalar_T &scr) const =0

  Test for equality of multivector and scalar.
- virtual multivector_t & operator+= (const multivector_t &rhs)=0

  Geometric sum.
- virtual multivector_t & operator+= (const Scalar_T &scr)=0

  Geometric sum of multivector and scalar.
- virtual multivector_t & operator-= (const multivector_t &rhs)=0

  Geometric difference.
- virtual const multivector_t operator- () const =0

  Unary -.
- virtual multivector_t & operator*= (const Scalar_T &scr)=0

  Product of multivector and scalar.
- virtual multivector_t & operator*= (const multivector_t &rhs)=0

  Geometric product.
- virtual multivector_t & operator%= (const multivector_t &rhs)=0

  Contraction.
- virtual multivector_t & operator&= (const multivector_t &rhs)=0

  Inner product.
- virtual multivector_t & operator^= (const multivector_t &rhs)=0

  Outer product.
- virtual multivector_t & operator/= (const Scalar_T &scr)=0

  Quotient of multivector and scalar.
- virtual multivector_t & operator/= (const multivector_t &rhs)=0

  Geometric quotient.
- virtual multivector_t & operator|= (const multivector_t &rhs)=0

  Transformation via twisted adjoint action.
- virtual const multivector_t inv () const =0

  Geometric multiplicative inverse.
- virtual const multivector_t pow (int m) const =0

  this to the m
- virtual const multivector_t outer_pow (int m) const =0

  Outer product power.
- virtual const index_set_t frame () const =0

  Subalgebra generated by all generators of terms of given multivector.
- virtual index_t grade () const =0

Maximum of the grades of each term.

- virtual Scalar_T operator[] (const index_set_t ist) const =0

  Subscripting: map from index set to scalar coordinate.
- virtual const multivector_t operator() (index_t grade) const =0

  Pure grade-vector part.
- virtual Scalar_T scalar () const =0

  Scalar part.
- virtual const multivector_t pure () const =0

  Pure part.
- virtual const multivector_t even () const =0

  Even part of multivector, sum of even grade terms.
- virtual const multivector_t odd () const =0

  Odd part of multivector, sum of odd grade terms.
- virtual const vector_t vector_part () const =0

  Vector part of multivector, as a vector_t with respect to frame()
- virtual const vector_t vector_part (const index_set_t frm, const bool prechecked) const =0

  Vector part of multivector, as a vector_t with respect to frm.
- virtual const multivector_t involute () const =0

  Main involution, each {i} is replaced by -{i} in each term, eg. {1} -> -{1}.
- virtual const multivector_t reverse () const =0

  Reversion, eg. {1}{2} -> {2}*{1}.*
- virtual const multivector_t conj () const =0

  Conjugation, reverse o involute == involute o reverse.
- virtual Scalar_T quad () const =0

  *Scalar_T quadratic form == (rev(x)*x)(0)*
- virtual Scalar_T norm () const =0

  Scalar_T norm == sum of norm of coordinates.
- virtual Scalar_T max_abs () const =0

  Maximum of absolute values of components of multivector: multivector infinity norm.
- virtual const multivector_t truncated (const Scalar_T &limit=Scalar_T(DEFAULT_TRUNCATION)) const =0

  Remove all terms with relative size smaller than limit.
- virtual bool isnan () const =0

  Check if a multivector contains any IEEE NaN values.
- virtual void write (const std::string &msg="") const =0

  Write formatted multivector to output.
- virtual void write (std::ofstream &ofile, const std::string &msg="") const =0

  Write formatted multivector to file.

Static Public Member Functions

- static const std::string classname ()

6.4.1 Detailed Description

template<typename Scalar_T, typename Index_Set_T, typename Multivector_T>class glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >

clifford_algebra<> declares the operations of a Clifford algebra

Definition at line 42 of file clifford_algebra.h.

6.4.2 Member Typedef Documentation

6.4.2.1 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> typedef Index_Set_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::index_set_t

Definition at line 46 of file clifford_algebra.h.

6.4.2.2 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> typedef Multivector_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::multivector_t

Definition at line 47 of file clifford_algebra.h.

6.4.2.3 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> typedef std::pair< const index_set_t, Scalar_T > glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::pair_t

Definition at line 48 of file clifford_algebra.h.

6.4.2.4 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> typedef Scalar_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::scalar_t

Definition at line 45 of file clifford_algebra.h.

6.4.2.5 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> typedef std::vector<Scalar_T> glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::vector_t

Definition at line 49 of file clifford_algebra.h.

6.4.3 Constructor & Destructor Documentation

6.4.3.1 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::~clifford_algebra ( ) [inline], [virtual]

Definition at line 53 of file clifford_algebra.h.

6.4.4 Member Function Documentation

6.4.4.1 template<typename Scalar_T , typename Index_Set_T , typename Multivector_T > const std::string glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::classname ( ) [static]

Definition at line 66 of file clifford_algebra_imp.h.

6.4.4.2 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::conj ( ) const [pure virtual]

Conjugation, reverse o involute == involute o reverse.

6.4.4.3 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::even ( ) const [pure virtual]

Even part of multivector, sum of even grade terms.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi().

6.4.4.4 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const index_set_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::frame ( ) const [pure virtual]

Subalgebra generated by all generators of terms of given multivector.

6.4.4.5 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual index_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::grade ( ) const [pure virtual]

Maximum of the grades of each term.

6.4.4.6 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::inv ( ) const [pure virtual]

Geometric multiplicative inverse.

6.4.4.7 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::involute ( ) const [pure virtual]

Main involution, each {i} is replaced by -{i} in each term, eg. {1} -> -{1}.

6.4.4.8 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual bool glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::isnan ( ) const [pure virtual]

Check if a multivector contains any IEEE NaN values.

6.4.4.9 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual Scalar_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::max_abs ( ) const [pure virtual]

Maximum of absolute values of components of multivector: multivector infinity norm.

6.4.4.10 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual Scalar_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::norm ( ) const [pure virtual]

Scalar_T norm == sum of norm of coordinates.

6.4.4.11 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::odd ( ) const [pure virtual]

Odd part of multivector, sum of odd grade terms.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi().

6.4.4.12 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator%= (const multivector_t & *rhs*) [pure virtual]

Contraction.

6.4.4.13 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator&= (const multivector_t & *rhs*) [pure virtual]

Inner product.

6.4.4.14 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator() (index_t *grade*) const [pure virtual]

Pure grade-vector part.

6.4.4.15 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator*= (const Scalar_T & *scr*) [pure virtual]

Product of multivector and scalar.

6.4.4.16 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator*= (const multivector_t & *rhs*) [pure virtual]

Geometric product.

6.4.4.17 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator+= (const multivector_t & *rhs*) [pure virtual]

Geometric sum.

6.4.4.18 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator+= (const Scalar_T & *scr*) [pure virtual]

Geometric sum of multivector and scalar.

6.4.4.19 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator- ( ) const [pure virtual]

Unary -.

6.4.4.20 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator-= (const multivector_t & *rhs*) [pure virtual]

Geometric difference.

6.4.4.21 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator/= (const Scalar_T & *scr*) [pure virtual]

Quotient of multivector and scalar.

6.4.4.22 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator/= (const multivector_t & *rhs*) [pure virtual]

Geometric quotient.

6.4.4.23 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual bool glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator== (const multivector_t & *val*) const [pure virtual]

Test for equality of multivectors.

6.4.4.24 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual bool glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator== (const Scalar_T & *scr*) const [pure virtual]

Test for equality of multivector and scalar.

6.4.4.25 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual Scalar_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator[] (const index_set_t *ist*) const [pure virtual]

Subscripting: map from index set to scalar coordinate.

6.4.4.26 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator^= (const multivector_t & *rhs*) [pure virtual]

Outer product.

6.4.4.27 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual multivector_t& glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::operator|= (const multivector_t & *rhs*) [pure virtual]

Transformation via twisted adjoint action.

6.4.4.28 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::outer_pow (int *m*) const [pure virtual]

Outer product power.

6.4.4.29 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::pow (int *m*) const [pure virtual]

$*$this to the m

6.4.4.30 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::pure ( ) const [pure virtual]

Pure part.

6.4.4.31 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual Scalar_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::quad ( ) const [pure virtual]

Scalar_T quadratic form == (rev(x)∗x)(0)

6.4.4.32 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::reverse ( ) const [pure virtual]

Reversion, eg. {1}∗{2} -> {2}∗{1}.

6.4.4.33 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual Scalar_T glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::scalar ( ) const [pure virtual]

Scalar part.

6.4.4.34 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const multivector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::truncated (const Scalar_T & *limit* = Scalar_T(**DEFAULT_TRUNCATION**)) const [pure virtual]

Remove all terms with relative size smaller than limit.

6.4.4.35 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const vector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::vector_part ( ) const [pure virtual]

Vector part of multivector, as a vector_t with respect to frame()

6.4.4.36 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual const vector_t glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::vector_part (const index_set_t *frm*, const bool *prechecked*) const [pure virtual]

Vector part of multivector, as a vector_t with respect to frm.

6.4.4.37 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual void glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::write (const std::string & *msg* = " ") const [pure virtual]

Write formatted multivector to output.

6.4.4.38 template<typename Scalar_T, typename Index_Set_T, typename Multivector_T> virtual void glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::write (std::ofstream & *ofile*, const std::string & *msg* = " ") const [pure virtual]

Write formatted multivector to file.

The documentation for this class was generated from the following files:

- glucat/clifford_algebra.h
- glucat/clifford_algebra_imp.h

6.5 glucat::compare_types< LHS_T, RHS_T > Class Template Reference

Type comparison.

`#include <global.h>`

Public Types

- enum { are_same = false }

6.5.1 Detailed Description

template<typename LHS_T, typename RHS_T>class glucat::compare_types< LHS_T, RHS_T >

Type comparison.

Definition at line 54 of file global.h.

6.5.2 Member Enumeration Documentation

6.5.2.1 template<typename LHS_T , typename RHS_T > anonymous enum

Enumerator

are_same

Definition at line 57 of file global.h.

The documentation for this class was generated from the following file:

- glucat/global.h

6.6 glucat::compare_types< T, T > Class Template Reference

`#include <global.h>`

Public Types

- enum { are_same = true }

6.6.1 Detailed Description

template<typename T>class glucat::compare_types< T, T >

Definition at line 60 of file global.h.

6.6.2 Member Enumeration Documentation

6.6.2.1 template<typename T > anonymous enum

Enumerator

are_same

Definition at line 63 of file global.h.

The documentation for this class was generated from the following file:

- glucat/global.h

6.7 glucat::control_t Class Reference

Parameters to control tests.

`#include <control.h>`

Public Member Functions

- int call (intfn f) const

  Call a function that returns int.
- int call (intintfn f, int arg) const

  Call a function of int that returns int.

Static Public Member Functions

- static const control_t & control (int argc, char **argv)
- static bool verbose ()

  Produce more detailed output from tests.

Private Member Functions

- bool valid () const
- bool catch_exceptions () const
- control_t (int argc, char **argv)

  Constructor from program arguments.
- control_t ()
- ~control_t ()
- control_t (const control_t &)
- control_t & operator= (const control_t &)

Private Attributes

- bool m_valid

  Test parameters are valid.
- bool m_catch_exceptions

  Catch exceptions.

Static Private Attributes

- static bool m_verbose_output = false

  Produce more detailed output from tests.

Friends

- class friend_for_private_destructor

6.7.1 Detailed Description

Parameters to control tests.

Definition at line 39 of file control.h.

6.7.2 Constructor & Destructor Documentation

6.7.2.1 glucat::control_t::control_t (int *argc,* char ** *argv*) [private]

Constructor from program arguments.

Test control constructor from program arguments.

Definition at line 89 of file control.h.

References GLUCAT_PACKAGE_NAME, GLUCAT_VERSION, m_catch_exceptions, m_valid, m_verbose_output, and valid().

6.7.2.2 glucat::control_t::control_t ( ) [inline], [private]

Definition at line 59 of file control.h.

6.7.2.3 glucat::control_t::~control_t ( ) [inline], [private]

Definition at line 60 of file control.h.

6.7.2.4 glucat::control_t::control_t (const control_t &) [private]

6.7.3 Member Function Documentation

6.7.3.1 int glucat::control_t::call (intfn *f*) const [inline]

Call a function that returns int.

Definition at line 137 of file control.h.

References catch_exceptions(), glucat::try_catch(), and valid().

6.7.3.2 int glucat::control_t::call (intintfn *f,* int *arg*) const [inline]

Call a function of int that returns int.

Definition at line 151 of file control.h.

References catch_exceptions(), glucat::try_catch(), and valid().

6.7.3.3 bool glucat::control_t::catch_exceptions ( ) const [inline], [private]

Definition at line 49 of file control.h.

References m_catch_exceptions.

Referenced by call().

6.7.3.4 static const control_t& glucat::control_t::control (int *argc,* char ** *argv*) [inline], [static]

Single instance Ref: Scott Meyers, "Effective C++" Second Edition, Addison-Wesley, 1998.

Definition at line 71 of file control.h.

6.7.3.5 control_t& glucat::control_t::operator= (const control_t &) [private]

6.7.3.6 bool glucat::control_t::valid ( ) const [inline], [private]

Definition at line 44 of file control.h.

References m_valid.

Referenced by call(), and control_t().

6.7.3.7 static bool glucat::control_t::verbose ( ) [inline], [static]

Produce more detailed output from tests.

Definition at line 80 of file control.h.

References m_verbose_output.

6.7.4 Friends And Related Function Documentation

6.7.4.1 friend class friend_for_private_destructor [friend]

Friend declaration to avoid compiler warning: "... only defines a private destructor and has no friends" Ref: Carlos O'Ryan, ACE http://doc.ece.uci.edu

Definition at line 67 of file control.h.

6.7.5 Member Data Documentation

6.7.5.1 bool glucat::control_t::m_catch_exceptions [private]

Catch exceptions.

Definition at line 48 of file control.h.

Referenced by catch_exceptions(), and control_t().

6.7.5.2 bool glucat::control_t::m_valid [private]

Test parameters are valid.

Definition at line 43 of file control.h.

Referenced by control_t(), and valid().

6.7.5.3 bool glucat::control_t::m_verbose_output = false [static], [private]

Produce more detailed output from tests.

Definition at line 53 of file control.h.

Referenced by control_t(), and verbose().

The documentation for this class was generated from the following file:

- test/control.h

6.8 glucat::CTAssertion< bool > Struct Template Reference

Compile time assertion.

`#include <global.h>`

6.8.1 Detailed Description

template<bool>struct glucat::CTAssertion< bool >

Compile time assertion.

Definition at line 46 of file global.h.

The documentation for this struct was generated from the following file:

- glucat/global.h

6.9 glucat::CTAssertion< true > Struct Template Reference

`#include <global.h>`

6.9.1 Detailed Description

template<>struct glucat::CTAssertion< true >

Definition at line 47 of file global.h.

The documentation for this struct was generated from the following file:

- glucat/global.h

6.10 glucat::numeric_traits< Scalar_T >::demoted<> Struct Template Reference

Demoted type for long double.

`#include <long_double.h>`

Public Types

- typedef long double type
- typedef float type

6.10.1 Detailed Description

template<typename Scalar_T>template<>struct glucat::numeric_traits< Scalar_T >::demoted<>

Demoted type for long double.

Demoted type.

Definition at line 47 of file long_double.h.

6.10.2 Member Typedef Documentation

6.10.2.1 template<typename Scalar_T > typedef long double glucat::numeric_traits< Scalar_T >::demoted<>::type

Definition at line 49 of file long_double.h.

6.10.2.2 template<typename Scalar_T > typedef float glucat::numeric_traits< Scalar_T >::demoted<>::type

Definition at line 147 of file scalar.h.

The documentation for this struct was generated from the following files:

- glucat/long_double.h
- glucat/scalar.h

6.11 glucat::matrix::eig_genus< Matrix_T > Struct Template Reference

Structure containing classification of eigenvalues.

`#include <matrix.h>`

Public Types

- typedef Matrix_T::value_type Scalar_T

Public Attributes

- eig_case_t m_eig_case

  What kind of eigenvalues does the matrix contain?
- Scalar_T m_safe_arg

  Argument such that exp(pi-m_safe_arg) lies between arguments of eigenvalues.

6.11.1 Detailed Description

template<typename Matrix_T>struct glucat::matrix::eig_genus< Matrix_T >

Structure containing classification of eigenvalues.

Definition at line 131 of file matrix.h.

6.11.2 Member Typedef Documentation

6.11.2.1 template<typename Matrix_T> typedef Matrix_T::value_type glucat::matrix::eig_genus< Matrix_T >::Scalar_T

Definition at line 133 of file matrix.h.

6.11.3 Member Data Documentation

6.11.3.1 template<typename Matrix_T> eig_case_t glucat::matrix::eig_genus< Matrix_T >::m_eig_case

What kind of eigenvalues does the matrix contain?

Definition at line 135 of file matrix.h.

Referenced by glucat::matrix::classify_eigenvalues(), glucat::matrix_log(), and glucat::matrix_sqrt().

6.11.3.2 template<typename Matrix_T> Scalar_T glucat::matrix::eig_genus< Matrix_T >::m_safe_arg

Argument such that exp(pi-m_safe_arg) lies between arguments of eigenvalues.

Definition at line 137 of file matrix.h.

Referenced by glucat::matrix::classify_eigenvalues(), glucat::matrix_log(), and glucat::matrix_sqrt().

The documentation for this struct was generated from the following file:

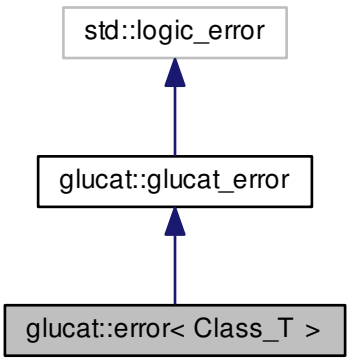
- glucat/matrix.h

6.12 glucat::error< Class_T > Class Template Reference

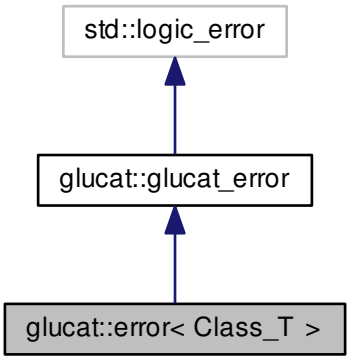
Specific exception class.

`#include <errors.h>`

Inheritance diagram for glucat::error< Class_T >:



Collaboration diagram for glucat::error< Class_T >:



Public Member Functions

- error (const std::string &msg)

  Specific exception class.
- error (const std::string &context, const std::string &msg)
- virtual const std::string heading () const throw ()
- virtual const std::string classname () const throw ()
- virtual void print_error_msg () const

Additional Inherited Members

6.12.1 Detailed Description

template<class Class_T>class glucat::error< Class_T >

Specific exception class.

Definition at line 57 of file errors.h.

6.12.2 Constructor & Destructor Documentation

6.12.2.1 template<class Class_T > glucat::error< Class_T >::error (const std::string & *msg*)

Specific exception class.

Definition at line 39 of file errors_imp.h.

6.12.2.2 template<class Class_T > glucat::error< Class_T >::error (const std::string & *context,* const std::string & *msg*)

Definition at line 45 of file errors_imp.h.

6.12.3 Member Function Documentation

6.12.3.1 template<class Class_T > const std::string glucat::error< Class_T >::classname ( ) const throw) [virtual]

Implements glucat::glucat_error.

Definition at line 58 of file errors_imp.h.

6.12.3.2 template<class Class_T > const std::string glucat::error< Class_T >::heading ( ) const throw) [virtual]

Implements glucat::glucat_error.

Definition at line 52 of file errors_imp.h.

6.12.3.3 template<class Class_T > void glucat::error< Class_T >::print_error_msg ( ) const [virtual]

Implements glucat::glucat_error.

Definition at line 64 of file errors_imp.h.

The documentation for this class was generated from the following files:

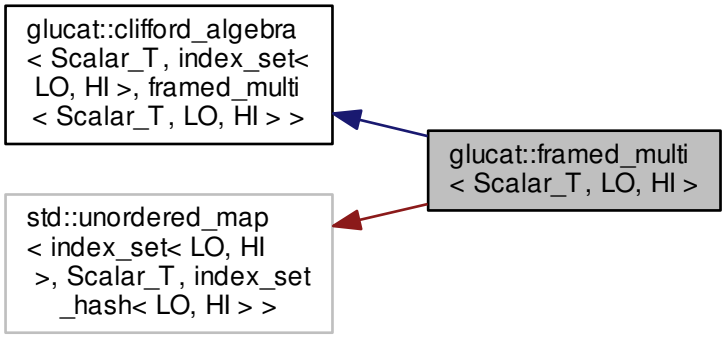
- glucat/errors.h
- glucat/errors_imp.h

6.13 glucat::framed_multi< Scalar_T, LO, HI > Singleton Reference

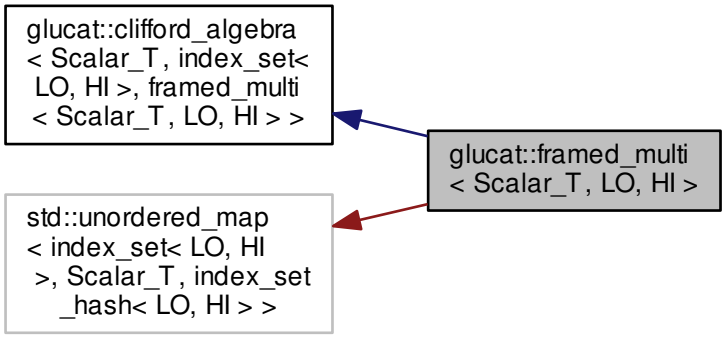
A framed_multi<Scalar_T,LO,HI> is a framed approximation to a multivector.

`#include <framed_multi.h>`

Inheritance diagram for glucat::framed_multi< Scalar_T, LO, HI >:



Collaboration diagram for glucat::framed_multi< Scalar_T, LO, HI >:



Classes

- class hash_size_t
- class var_term

  Variable term.

Public Types

- typedef framed_multi multivector_t
- typedef multivector_t framed_multi_t
- typedef Scalar_T scalar_t
- typedef index_set< LO, HI > index_set_t
- typedef std::pair< const index_set_t, Scalar_T > term_t
- typedef std::vector< Scalar_T > vector_t
- typedef error< multivector_t > error_t
- typedef matrix_multi< Scalar_T, LO, HI > matrix_multi_t

Public Member Functions

- ~framed_multi ()

  Destructor.
- framed_multi ()

  Default constructor.
- template<typename Other_Scalar_T > framed_multi (const framed_multi< Other_Scalar_T, LO, HI > &val)

  Construct a multivector from a multivector with a different scalar type.
- template<typename Other_Scalar_T > framed_multi (const framed_multi< Other_Scalar_T, LO, HI > &val, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a given multivector.
- framed_multi (const framed_multi_t &val, const index_set_t frm, const bool prechecked=false)

Construct a multivector, within a given frame, from a given multivector.

- framed_multi (const index_set_t ist, const Scalar_T &crd=Scalar_T(1))

  Construct a multivector from an index set and a scalar coordinate.
- framed_multi (const index_set_t ist, const Scalar_T &crd, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from an index set and a scalar coordinate.
- framed_multi (const Scalar_T &scr, const index_set_t frm=index_set_t())

  Construct a multivector from a scalar (within a frame, if given)
- framed_multi (const int scr, const index_set_t frm=index_set_t())

  Construct a multivector from an int (within a frame, if given)
- framed_multi (const vector_t &vec, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a given vector.
- framed_multi (const std::string &str)

  Construct a multivector from a string: eg: "3+2{1,2}-6.1e-2{2,3}".
- framed_multi (const std::string &str, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a string: eg: "3+2{1,2}-6.1e-2{2,3}".
- framed_multi (const char *str)

  Construct a multivector from a char: eg: "3+2{1,2}-6.1e-2{2,3}".*
- framed_multi (const char *str, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a char: eg: "3+2{1,2}-6.1e-2{2,3}".*
- template<typename Other_Scalar_T >
  framed_multi (const matrix_multi< Other_Scalar_T, LO, HI > &val)

  Construct a multivector from a matrix_multi_t.
- template<typename Other_Scalar_T >
  const matrix_multi
  < Other_Scalar_T, LO, HI > fast_matrix_multi (const index_set_t frm) const

  Use generalized FFT to construct a matrix_multi_t.
- const framed_multi_t fast_framed_multi () const

  Use inverse generalized FFT to construct a framed_multi_t.
- _GLUCAT_CLIFFORD_ALGEBRA_OPERATIONS
  unsigned long nbr_terms () const

  Number of terms.
- multivector_t & operator+= (const term_t &term)

  Add a term, if non-zero.

Static Public Member Functions

- static const std::string classname ()

  Class name used in messages.
- static const framed_multi_t random (const index_set_t frm, Scalar_T fill=Scalar_T(1))

  Random multivector within a frame.

Private Types

- typedef class var_term var_term_t
- typedef matrix_multi_t::matrix_t matrix_t
- typedef std::map< index_set_t,
  Scalar_T, std::less< const
  index_set_t > > sorted_map_t
- typedef std::unordered_map
  < index_set_t, Scalar_T,
  index_set_hash< LO, HI > > map_t

- typedef std::pair< const multivector_t, const multivector_t > framed_pair_t
- typedef map_t::size_type size_type
- typedef map_t::iterator iterator
- typedef map_t::const_iterator const_iterator

Private Member Functions

- framed_multi (const hash_size_t &hash_size)

  Private constructor using hash_size.
- multivector_t fold (const index_set_t frm) const

  Subalgebra isomorphism: fold each term within the given frame.
- multivector_t unfold (const index_set_t frm) const

  Subalgebra isomorphism: unfold each term within the given frame.
- multivector_t & centre_pm4_qp4 (index_t &p, index_t &q)

  Subalgebra isomorphism: R_{p,q} to R_{p-4,q+4}.
- multivector_t & centre_pp4_qm4 (index_t &p, index_t &q)

  Subalgebra isomorphism: R_{p,q} to R_{p+4,q-4}.
- multivector_t & centre_qp1_pm1 (index_t &p, index_t &q)

  Subalgebra isomorphism: R_{p,q} to R_{q+1,p-1}.
- const framed_pair_t divide (const index_set_t ist) const

  Divide multivector into part divisible by index_set and remainder.
- const matrix_t fast (const index_t level, const bool odd) const

  Generalized FFT from framed_multi_t to matrix_t.

Friends

- template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> class matrix_multi
- template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> class framed_multi
- const framed_multi_t operator* (const framed_multi_t &lhs, const framed_multi_t &rhs)
- const framed_multi_t operator^ (const framed_multi_t &lhs, const framed_multi_t &rhs)
- const framed_multi_t operator& (const framed_multi_t &lhs, const framed_multi_t &rhs)
- const framed_multi_t operator% (const framed_multi_t &lhs, const framed_multi_t &rhs)
- Scalar_T star (const framed_multi_t &lhs, const framed_multi_t &rhs)
- const framed_multi_t operator/ (const framed_multi_t &lhs, const framed_multi_t &rhs)
- const framed_multi_t operator| (const framed_multi_t &lhs, const framed_multi_t &rhs)
- std::istream & operator>> (std::istream &s, multivector_t &val)
- std::ostream & operator<< (std::ostream &os, const multivector_t &val)
- std::ostream & operator<< (std::ostream &os, const term_t &term)
- const framed_multi_t exp (const framed_multi_t &val)

6.13.1 Detailed Description

template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI>singleton glucat::framed_multi< Scalar_T, LO, HI >

A framed_multi<Scalar_T,LO,HI> is a framed approximation to a multivector.

Definition at line 65 of file framed_multi.h.

6.13.2 Member Typedef Documentation

6.13.2.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef map_t::const_iterator glucat::framed_multi< Scalar_T, LO, HI >::const_iterator [private]

Definition at line 196 of file framed_multi.h.

6.13.2.2 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef error<multivector_t> glucat::framed_multi< Scalar_T, LO, HI >::error_t

Definition at line 155 of file framed_multi.h.

6.13.2.3 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef multivector_t glucat::framed_multi< Scalar_T, LO, HI >::framed_multi_t

Definition at line 150 of file framed_multi.h.

6.13.2.4 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::pair< const multivector_t, const multivector_t > glucat::framed_multi< Scalar_T, LO, HI >::framed_pair_t [private]

Definition at line 193 of file framed_multi.h.

6.13.2.5 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef index_set<LO,HI> glucat::framed_multi< Scalar_T, LO, HI >::index_set_t

Definition at line 152 of file framed_multi.h.

6.13.2.6 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef map_t::iterator glucat::framed_multi< Scalar_T, LO, HI >::iterator [private]

Definition at line 195 of file framed_multi.h.

6.13.2.7 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::unordered_map< index_set_t, Scalar_T, index_set_hash<LO,HI> > glucat::framed_multi< Scalar_T, LO, HI >::map_t [private]

Definition at line 175 of file framed_multi.h.

6.13.2.8 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef matrix_multi<Scalar_T,LO,HI> glucat::framed_multi< Scalar_T, LO, HI >::matrix_multi_t

Definition at line 156 of file framed_multi.h.

6.13.2.9 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef matrix_multi_t::matrix_t glucat::framed_multi< Scalar_T, LO, HI >::matrix_t [private]

Definition at line 165 of file framed_multi.h.

6.13.2.10 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef framed_multi glucat::framed_multi< Scalar_T, LO, HI >::multivector_t

Definition at line 149 of file framed_multi.h.

6.13.2.11 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef Scalar_T glucat::framed_multi< Scalar_T, LO, HI >::scalar_t

Definition at line 151 of file framed_multi.h.

6.13.2.12 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef map_t::size_type glucat::framed_multi< Scalar_T, LO, HI >::size_type [private]

Definition at line 194 of file framed_multi.h.

6.13.2.13 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::map< index_set_t, Scalar_T, std::less<const index_set_t> > glucat::framed_multi< Scalar_T, LO, HI >::sorted_map_t [private]

Definition at line 172 of file framed_multi.h.

6.13.2.14 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::pair<const index_set_t, Scalar_T> glucat::framed_multi< Scalar_T, LO, HI >::term_t

Definition at line 153 of file framed_multi.h.

6.13.2.15 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef class var_term glucat::framed_multi< Scalar_T, LO, HI >::var_term_t [private]

Definition at line 164 of file framed_multi.h.

6.13.2.16 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::vector<Scalar_T> glucat::framed_multi< Scalar_T, LO, HI >::vector_t

Definition at line 154 of file framed_multi.h.

6.13.3 Constructor & Destructor Documentation

6.13.3.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::framed_multi< Scalar_T, LO, HI >::~framed_multi ( ) [inline]

Destructor.

Definition at line 202 of file framed_multi.h.

6.13.3.2 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi ( )

Default constructor.

Definition at line 67 of file framed_multi_imp.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::framed_multi().

6.13.3.3 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const hash_size_t & *hash_size*) [private]

Private constructor using hash_size.

Definition at line 74 of file framed_multi_imp.h.

6.13.3.4 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const framed_multi< Other_Scalar_T, LO, HI > & *val*)

Construct a multivector from a multivector with a different scalar type.

Definition at line 82 of file framed_multi_imp.h.

6.13.3.5 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const framed_multi< Other_Scalar_T, LO, HI > & *val,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from a given multivector.

Definition at line 97 of file framed_multi_imp.h.

6.13.3.6 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const framed_multi_t & *val,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from a given multivector.

Definition at line 112 of file framed_multi_imp.h.

6.13.3.7 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const index_set_t *ist,* const Scalar_T & *crd* = Scalar_T(1))

Construct a multivector from an index set and a scalar coordinate.

Definition at line 120 of file framed_multi_imp.h.

6.13.3.8 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const index_set_t *ist,* const Scalar_T & *crd,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from an index set and a scalar coordinate.

Definition at line 130 of file framed_multi_imp.h.

6.13.3.9 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const Scalar_T & *scr,* const index_set_t *frm* = index_set_t())

Construct a multivector from a scalar (within a frame, if given)

Definition at line 143 of file framed_multi_imp.h.

6.13.3.10 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const int *scr,* const index_set_t *frm* = index_set_t())

Construct a multivector from an int (within a frame, if given)

Definition at line 153 of file framed_multi_imp.h.

6.13.3.11 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const vector_t & *vec,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from a given vector.

Definition at line 163 of file framed_multi_imp.h.

References glucat::index_set< LO, HI >::count(), glucat::index_set< LO, HI >::max(), and glucat::index_set< LO, HI >::min().

6.13.3.12 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const std::string & *str*)

Construct a multivector from a string: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 186 of file framed_multi_imp.h.

6.13.3.13 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const std::string & *str,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from a string: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 202 of file framed_multi_imp.h.

6.13.3.14 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const char * *str*) [inline]

Construct a multivector from a char*: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 238 of file framed_multi.h.

References glucat::framed_multi< Scalar_T, LO, HI >::framed_multi().

6.13.3.15 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const char * *str,* const index_set_t *frm,* const bool *prechecked* = false) [inline]

Construct a multivector, within a given frame, from a char*: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 241 of file framed_multi.h.

References glucat::framed_multi< Scalar_T, LO, HI >::framed_multi().

6.13.3.16 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > glucat::framed_multi< Scalar_T, LO, HI >::framed_multi (const matrix_multi< Other_Scalar_T, LO, HI > & *val*)

Construct a multivector from a matrix_multi_t.

Definition at line 215 of file framed_multi_imp.h.

References _GLUCAT_HASH_SIZE_T, glucat::abs(), glucat::matrix_multi< Scalar_T, LO, HI >::basis_element(), glucat::index_set< LO, HI >::count(), PyClical::e(), glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::frame(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_↩ Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast↩ _Dim_Threshold, Products_Size_Threshold, Function_Precision >::inv_fast_dim_threshold, PyClical::ist, glucat↩

::matrix_multi< Scalar_T, LO, HI >::m_matrix, glucat::matrix::nnz(), and glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, matrix_multi< Scalar_T, LO, HI > >::norm().

6.13.4 Member Function Documentation

6.13.4.1 template<typename Scalar_T , const index_t LO, const index_t HI> framed_multi< Scalar_T, LO, HI > & glucat::framed_multi< Scalar_T, LO, HI >::centre_pm4_qp4 (index_t & *p*, index_t & *q*) [private]

Subalgebra isomorphism: R_{p,q} to R_{p-4,q+4}.

Definition at line 1655 of file framed_multi_imp.h.

References glucat::index_set< LO, HI >::max().

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::fast_framed_multi(), and glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi().

6.13.4.2 template<typename Scalar_T , const index_t LO, const index_t HI> framed_multi< Scalar_T, LO, HI > & glucat::framed_multi< Scalar_T, LO, HI >::centre_pp4_qm4 (index_t & *p*, index_t & *q*) [private]

Subalgebra isomorphism: R_{p,q} to R_{p+4,q-4}.

Definition at line 1700 of file framed_multi_imp.h.

References glucat::index_set< LO, HI >::min().

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::fast_framed_multi(), and glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi().

6.13.4.3 template<typename Scalar_T , const index_t LO, const index_t HI> framed_multi< Scalar_T, LO, HI > & glucat::framed_multi< Scalar_T, LO, HI >::centre_qp1_pm1 (index_t & *p*, index_t & *q*) [private]

Subalgebra isomorphism: R_{p,q} to R_{q+1,p-1}.

Definition at line 1745 of file framed_multi_imp.h.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::fast_framed_multi(), and glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi().

6.13.4.4 template<typename Scalar_T , const index_t LO, const index_t HI> const std::string glucat::framed_multi< Scalar_T, LO, HI >::classname ( ) [static]

Class name used in messages.

Definition at line 53 of file framed_multi_imp.h.

6.13.4.5 template<typename Scalar_T , const index_t LO, const index_t HI> const std::pair< const framed_multi< Scalar_T, LO, HI >, const framed_multi< Scalar_T, LO, HI > > glucat::framed_multi< Scalar_T, LO, HI >::divide (const index_set_t *ist*) const [private]

Divide multivector into part divisible by index_set and remainder.

Divide multivector into quotient with terms divisible by index set, and remainder.

Definition at line 1781 of file framed_multi_imp.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fast().

6.13.4.6 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI >::matrix_t glucat::framed_multi< Scalar_T, LO, HI >::fast (const index_t *level,* const bool *odd*) const [private]

Generalized FFT from framed_multi_t to matrix_t.

Definition at line 1800 of file framed_multi_imp.h.

References glucat::framed_multi< Scalar_T, LO, HI >::divide(), glucat::framed_multi< Scalar_T, LO, HI >::fast(), glucat::matrix::kron(), and glucat::scalar().

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fast(), and glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi().

6.13.4.7 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::framed_multi< Scalar_T, LO, HI >::fast_framed_multi ( ) const [inline]

Use inverse generalized FFT to construct a framed_multi_t.

Definition at line 1898 of file framed_multi_imp.h.

6.13.4.8 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > const matrix_multi< Other_Scalar_T, LO, HI > glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi (const index_set_t *frm*) const

Use generalized FFT to construct a matrix_multi_t.

Definition at line 1866 of file framed_multi_imp.h.

References glucat::framed_multi< Scalar_T, LO, HI >::centre_pm4_qp4(), glucat::framed_multi< Scalar_T, LO, HI >::centre_pp4_qm4(), glucat::framed_multi< Scalar_T, LO, HI >::centre_qp1_pm1(), glucat::index_set< LO, HI >::count_neg(), glucat::index_set< LO, HI >::count_pos(), glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::even(), glucat::framed_multi< Scalar_T, LO, HI >::fast(), glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >::odd(), glucat::gen::offset_to_super, and glucat::pos_mod().

6.13.4.9 template<typename Scalar_T , const index_t LO, const index_t HI> framed_multi< Scalar_T, LO, HI > glucat::framed_multi< Scalar_T, LO, HI >::fold (const index_set_t *frm*) const [private]

Subalgebra isomorphism: fold each term within the given frame.

Definition at line 1614 of file framed_multi_imp.h.

References glucat::index_set< LO, HI >::is_contiguous().

6.13.4.10 template<typename Scalar_T , const index_t LO, const index_t HI> unsigned long glucat::framed_multi< Scalar_T, LO, HI >::nbr_terms ( ) const

Number of terms.

Definition at line 1545 of file framed_multi_imp.h.

6.13.4.11 template<typename Scalar_T , const index_t LO, const index_t HI> framed_multi< Scalar_T, LO, HI > & glucat::framed_multi< Scalar_T, LO, HI >::operator+= (const term_t & *term*) [inline]

Add a term, if non-zero.

Insert a term into a multivector, add terms with same index set.

Geometric sum.

Geometric sum of multivector and scalar.

Definition at line 329 of file framed_multi_imp.h.

6.13.4.12 template<typename Scalar_T , const index_t LO, const index_t HI> const framed_multi< Scalar_T, LO, HI > glucat::framed_multi< Scalar_T, LO, HI >::random (const index_set_t *frm,* Scalar_T *fill =* Scalar_T(1)) [static]

Random multivector within a frame.

Definition at line 1273 of file framed_multi_imp.h.

References glucat::index_set< LO, HI >::count(), and glucat::sqrt().

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::random().

6.13.4.13 template<typename Scalar_T , const index_t LO, const index_t HI> framed_multi< Scalar_T, LO, HI > glucat::framed_multi< Scalar_T, LO, HI >::unfold (const index_set_t *frm*) const [private]

Subalgebra isomorphism: unfold each term within the given frame.

Definition at line 1634 of file framed_multi_imp.h.

References glucat::index_set< LO, HI >::is_contiguous().

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::fast_framed_multi().

6.13.5 Friends And Related Function Documentation

6.13.5.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const framed_multi_t exp (const framed_multi_t & *val*) [friend]

6.13.5.2 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> friend class framed_multi [friend]

Definition at line 160 of file framed_multi.h.

6.13.5.3 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> friend class matrix_multi [friend]

Definition at line 158 of file framed_multi.h.

6.13.5.4 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const framed_multi_t operator% (const framed_multi_t & *lhs,* const framed_multi_t & *rhs*) [friend]

6.13.5.5 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const framed_multi_t operator& (const framed_multi_t & *lhs,* const framed_multi_t & *rhs*) [friend]

6.13.5.6 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const framed_multi_t operator* (const framed_multi_t & *lhs,* const framed_multi_t & *rhs*) [friend]

6.13.5.7 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const framed_multi_t operator/ (const framed_multi_t & *lhs,* const framed_multi_t & *rhs*) [friend]

6.13.5.8 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> std::ostream& operator<< (std::ostream & *os,* const multivector_t & *val*) [friend]

6.13.5.9 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> std::ostream& operator<< (std::ostream & *os,* const term_t & *term*) [friend]

6.13.5.10 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> std::istream& operator>> (std::istream & *s,* multivector_t & *val*) [friend]

6.13.5.11 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const framed_multi_t operator^ (const framed_multi_t & *lhs,* const framed_multi_t & *rhs*) [friend]

6.13.5.12 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const framed_multi_t operator| (const framed_multi_t & *lhs,* const framed_multi_t & *rhs*) [friend]

6.13.5.13 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> Scalar_T star (const framed_multi_t & *lhs,* const framed_multi_t & *rhs*) [friend]

The documentation for this singleton was generated from the following files:

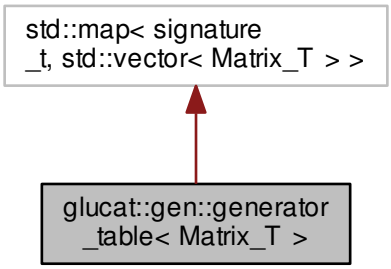
- glucat/framed_multi.h
- glucat/framed_multi_imp.h

6.14 glucat::gen::generator_table< Matrix_T > Class Template Reference

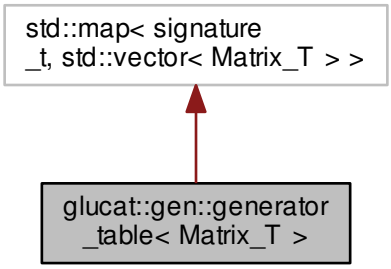
Table of generators for specific signatures.

`#include <generation.h>`

Inheritance diagram for glucat::gen::generator_table< Matrix_T >:



Collaboration diagram for glucat::gen::generator_table< Matrix_T >:



Public Member Functions

- const Matrix_T * operator() (const index_t p, const index_t q)

  Pointer to generators for a specific signature.

Static Public Member Functions

- static generator_table
  < Matrix_T > & generator ()

  Single instance of generator table.

Private Member Functions

- const std::vector< Matrix_T > & gen_vector (const index_t p, const index_t q)

  Construct a vector of generators for a specific signature.
- void gen_from_pm1_qm1 (const std::vector< Matrix_T > &old, const signature_t sig)

  Construct generators for p,q given generators for p-1,q-1.
- void gen_from_pm4_qp4 (const std::vector< Matrix_T > &old, const signature_t sig)

  Construct generators for p,q given generators for p-4,q+4.
- void gen_from_pp4_qm4 (const std::vector< Matrix_T > &old, const signature_t sig)

  Construct generators for p,q given generators for p+4,q-4.
- void gen_from_qp1_pm1 (const std::vector< Matrix_T > &old, const signature_t sig)

  Construct generators for p,q given generators for q+1,p-1.
- generator_table ()
- ~generator_table ()
- generator_table (const generator_table &)
- generator_table & operator= (const generator_table &)

Friends

- class friend_for_private_destructor

6.14.1 Detailed Description

template<class Matrix_T>class glucat::gen::generator_table< Matrix_T >

Table of generators for specific signatures.

Definition at line 47 of file generation.h.

6.14.2 Constructor & Destructor Documentation

6.14.2.1 template<class Matrix_T> glucat::gen::generator_table< Matrix_T >::generator_table ( ) [inline], [private]

Definition at line 69 of file generation.h.

6.14.2.2 template<class Matrix_T> glucat::gen::generator_table< Matrix_T >::~generator_table ( ) [inline], [private]

Definition at line 70 of file generation.h.

6.14.2.3 template<class Matrix_T> glucat::gen::generator_table< Matrix_T >::generator_table (const generator_table< Matrix_T > &) [private]

6.14.3 Member Function Documentation

6.14.3.1 template<class Matrix_T > void glucat::gen::generator_table< Matrix_T >::gen_from_pm1_qm1 (const std::vector< Matrix_T > & *old,* const signature_t *sig*) [private]

Construct generators for p,q given generators for p-1,q-1.

Definition at line 127 of file generation_imp.h.

References glucat::matrix::mono_kron().

6.14.3.2 template<class Matrix_T > void glucat::gen::generator_table< Matrix_T >::gen_from_pm4_qp4 (const std::vector< Matrix_T > & *old,* const signature_t *sig*) [private]

Construct generators for p,q given generators for p-4,q+4.

Definition at line 164 of file generation_imp.h.

References glucat::matrix::mono_prod().

6.14.3.3 template<class Matrix_T > void glucat::gen::generator_table< Matrix_T >::gen_from_pp4_qm4 (const std::vector< Matrix_T > & *old,* const signature_t *sig*) [private]

Construct generators for p,q given generators for p+4,q-4.

Definition at line 195 of file generation_imp.h.

References glucat::matrix::mono_prod().

6.14.3.4 template<class Matrix_T > void glucat::gen::generator_table< Matrix_T >::gen_from_qp1_pm1 (const std::vector< Matrix_T > & *old,* const signature_t *sig*) [private]

Construct generators for p,q given generators for q+1,p-1.

Definition at line 225 of file generation_imp.h.

References glucat::matrix::mono_prod().

6.14.3.5 template<class Matrix_T > const std::vector< Matrix_T > & glucat::gen::generator_table< Matrix_T >::gen_vector (const index_t *p*, const index_t *q*) [private]

Construct a vector of generators for a specific signature.

Definition at line 80 of file generation_imp.h.

References glucat::pos_mod().

6.14.3.6 template<class Matrix_T > generator_table< Matrix_T > & glucat::gen::generator_table< Matrix_T >::generator ( ) [static]

Single instance of generator table.

Definition at line 50 of file generation_imp.h.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::basis_element().

6.14.3.7 template<class Matrix_T > const Matrix_T * glucat::gen::generator_table< Matrix_T >::operator() (const index_t *p*, const index_t *q*) [inline]

Pointer to generators for a specific signature.

Definition at line 59 of file generation_imp.h.

References glucat::gen::offset_to_super, and glucat::pos_mod().

6.14.3.8 template<class Matrix_T> generator_table& glucat::gen::generator_table< Matrix_T >::operator= (const generator_table< Matrix_T > &) [private]

6.14.4 Friends And Related Function Documentation

6.14.4.1 template<class Matrix_T> friend class friend_for_private_destructor [friend]

Friend declaration to avoid compiler warning: "... only defines a private destructor and has no friends" Ref: Carlos O'Ryan, ACE http://doc.ece.uci.edu

Definition at line 77 of file generation.h.

The documentation for this class was generated from the following files:

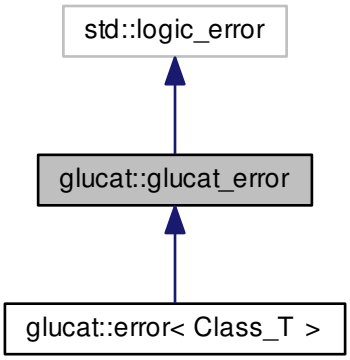
- glucat/generation.h
- glucat/generation_imp.h

6.15 glucat::glucat_error Class Reference

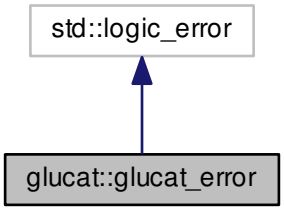
Abstract exception class.

`#include <errors.h>`

Inheritance diagram for glucat::glucat_error:



Collaboration diagram for glucat::glucat_error:



Public Member Functions

- glucat_error (const std::string &context, const std::string &msg)
- ~glucat_error () throw ()
- virtual const std::string heading () const =0 throw ()
- virtual const std::string classname () const =0 throw ()
- virtual void print_error_msg () const =0

Public Attributes

- std::string name

6.15.1 Detailed Description

Abstract exception class.

Definition at line 41 of file errors.h.

6.15.2 Constructor & Destructor Documentation

6.15.2.1 glucat::glucat_error::glucat_error (const std::string & *context,* const std::string & *msg*) [inline]

Definition at line 44 of file errors.h.

6.15.2.2 glucat::glucat_error::~glucat_error ( ) throw) [inline]

Definition at line 47 of file errors.h.

6.15.3 Member Function Documentation

6.15.3.1 virtual const std::string glucat::glucat_error::classname ( ) const throw) [pure virtual]

Implemented in glucat::error< Class_T >.

6.15.3.2 virtual const std::string glucat::glucat_error::heading ( ) const throw) [pure virtual]

Implemented in glucat::error< Class_T >.

6.15.3.3 virtual void glucat::glucat_error::print_error_msg ( ) const [pure virtual]

Implemented in glucat::error< Class_T >.

Referenced by glucat::try_catch().

6.15.4 Member Data Documentation

6.15.4.1 std::string glucat::glucat_error::name

Definition at line 52 of file errors.h.

The documentation for this class was generated from the following file:

- glucat/errors.h

6.16 glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t Class Reference

Public Member Functions

- hash_size_t (size_t hash_size)
- size_t operator() () const

Private Attributes

- size_t n

6.16.1 Detailed Description

template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI>class glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t

Definition at line 180 of file framed_multi.h.

6.16.2 Constructor & Destructor Documentation

6.16.2.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t::hash_size_t (size_t *hash_size*) [inline]

Definition at line 183 of file framed_multi.h.

6.16.3 Member Function Documentation

6.16.3.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> size_t glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t::operator() ( ) const [inline]

Definition at line 186 of file framed_multi.h.

References glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t::n.

6.16.4 Member Data Documentation

6.16.4.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> size_t glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t::n [private]

Definition at line 189 of file framed_multi.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t::operator()().

The documentation for this class was generated from the following file:

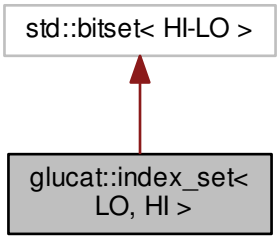
- glucat/framed_multi.h

6.17 glucat::index_set< LO, HI > Class Template Reference

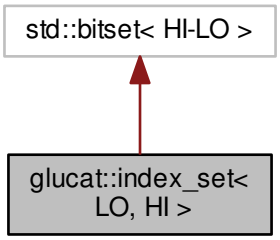
Index set class based on std::bitset<> in Gnu standard C++ library.

`#include <index_set.h>`

Inheritance diagram for glucat::index_set< LO, HI >:



Collaboration diagram for glucat::index_set< LO, HI >:



Classes

- class reference

  Index set member reference.

Public Types

- typedef index_set index_set_t
- typedef std::pair< index_t, index_t > index_pair_t

Public Member Functions

- index_set ()

  Default constructor creates an empty set.
- index_set (const bitset_t bst)

  Constructor from bitset_t.
- index_set (const index_t idx)

Constructor from index.

- index_set (const set_value_t folded_val, const index_set_t frm, const bool prechecked=false)

  Constructor from set value of an index set folded within the given frame.
- index_set (const index_pair_t &range, const bool prechecked=false)

  Constructor from range of indices from range.first to range.second.
- index_set (const std::string &str)

  Constructor from string.
- bool operator== (const index_set_t rhs) const

  Equality.
- bool operator!= (const index_set_t rhs) const

  Inequality.
- index_set_t operator∼ () const

  Set complement: not.
- index_set_t & operator^= (const index_set_t rhs)

  Symmetric set difference: exclusive or.
- index_set_t & operator&= (const index_set_t rhs)

  Set intersection: and.
- index_set_t & operator|= (const index_set_t rhs)

  Set union: or.
- bool operator[] (const index_t idx) const

  Subscripting: Test idx for membership: test value of bit idx.
- bool test (const index_t idx) const

  Test idx for membership: test value of bit idx.
- index_set_t & set ()

  Include all indices except 0: set all bits except 0.
- index_set_t & set (const index_t idx)

  Include idx: Set bit at idx if idx != 0.
- index_set_t & set (const index_t idx, const int val)

  Set membership of idx to val if idx != 0: Set bit at idx to val if idx != 0.
- index_set_t & reset ()

  Make set empty: Set all bits to 0.
- index_set_t & reset (const index_t idx)

  Exclude idx: Set bit at idx to 0.
- index_set_t & flip ()

  Set complement, except 0: flip all bits, except 0.
- index_set_t & flip (const index_t idx)

  Complement membership of idx if idx != 0: flip bit at idx if idx != 0.
- index_t count () const

  Cardinality: Number of indices included in set.
- index_t count_neg () const

  Number of negative indices included in set.
- index_t count_pos () const

  Number of positive indices included in set.
- index_t min () const

  Minimum member.
- index_t max () const

  Maximum member.
- bool operator< (const index_set_t rhs) const

  Less than operator used for comparisons, map, etc.
- bool is_contiguous () const

  Determine if the index set is contiguous, ie. has no gaps.

- const index_set_t fold () const
  Fold this index set within itself as a frame.
- const index_set_t fold (const index_set_t frm, const bool prechecked=false) const
  Fold this index set within the given frame.
- const index_set_t unfold (const index_set_t frm, const bool prechecked=false) const
  Unfold this index set within the given frame.
- set_value_t value_of_fold (const index_set_t frm) const
  The set value of the fold of this index set within the given frame.
- int sign_of_mult (const index_set_t ist) const
  Sign of geometric product of two Clifford basis elements.
- int sign_of_square () const
  Sign of geometric square of a Clifford basis element.
- size_t hash_fn () const
  Hash function.
- reference operator[] (index_t idx)
  Subscripting: Element access.

Static Public Member Functions

- static const std::string classname ()

Static Public Attributes

- static const index_t v_lo = LO
- static const index_t v_hi = HI

Private Types

- typedef std::bitset< HI-LO > bitset_t
- typedef error< index_set > error_t

Private Member Functions

- BOOST_STATIC_ASSERT ((LO<=0)&&(0<=HI)&&(LO< HI)&&(-LO< _GLUCAT_BITS_PER_ULONG)&&(HI< _GLUCAT_BITS_PER_ULONG)&&(HI-LO<=_GLUCAT_BITS_PER_ULONG))
- bool lex_less_than (const index_set_t rhs) const
  Lexicographic ordering of two sets: $*this < rhs$.

Friends

- class reference
- const index_set_t operator^ (const index_set_t &lhs, const index_set_t &rhs)
- const index_set_t operator& (const index_set_t &lhs, const index_set_t &rhs)
- const index_set_t operator| (const index_set_t &lhs, const index_set_t &rhs)
- int compare (const index_set_t &lhs, const index_set_t &rhs)

6.17.1 Detailed Description

template<const index_t LO, const index_t HI>class glucat::index_set< LO, HI >

Index set class based on std::bitset<> in Gnu standard C++ library.

Definition at line 45 of file index_set.h.

6.17.2 Member Typedef Documentation

6.17.2.1 template<const index_t LO, const index_t HI> typedef std::bitset<HI-LO> glucat::index_set< LO, HI >::bitset_t [private]

Definition at line 81 of file index_set.h.

6.17.2.2 template<const index_t LO, const index_t HI> typedef error<index_set> glucat::index_set< LO, HI >::error_t [private]

Definition at line 82 of file index_set.h.

6.17.2.3 template<const index_t LO, const index_t HI> typedef std::pair<index_t,index_t> glucat::index_set< LO, HI >::index_pair_t

Definition at line 85 of file index_set.h.

6.17.2.4 template<const index_t LO, const index_t HI> typedef index_set glucat::index_set< LO, HI >::index_set_t

Definition at line 84 of file index_set.h.

6.17.3 Constructor & Destructor Documentation

6.17.3.1 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::index_set ( ) [inline]

Default constructor creates an empty set.

Definition at line 92 of file index_set.h.

6.17.3.2 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::index_set (const bitset_t *bst*)

Constructor from bitset_t.

Definition at line 61 of file index_set_imp.h.

6.17.3.3 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::index_set (const index_t *idx*)

Constructor from index.

Constructor from index value.

Definition at line 55 of file index_set_imp.h.

6.17.3.4 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::index_set (const set_value_t *folded_val,* const index_set_t *frm,* const bool *prechecked* = false)

Constructor from set value of an index set folded within the given frame.

Definition at line 68 of file index_set_imp.h.

References glucat::index_set< LO, HI >::count(), glucat::index_set< LO, HI >::fold(), glucat::index_set< LO, HI >::min(), and glucat::index_set< LO, HI >::unfold().

6.17.3.5 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::index_set (const index_pair_t & *range,* const bool *prechecked* = false)

Constructor from range of indices from range.first to range.second.

Definition at line 82 of file index_set_imp.h.

6.17.3.6 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::index_set (const std::string & *str*)

Constructor from string.

Definition at line 102 of file index_set_imp.h.

6.17.4 Member Function Documentation

6.17.4.1 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::BOOST_STATIC_ASSERT ((LO<=0)&&(0<=HI)&&(LO< HI)&&(-LO< _GLUCAT_BITS_PER_ULONG)&&(HI< _GLUCAT_BITS_PER_ULONG)&&(HI-LO<=_GLUCAT_BITS_PER_ULONG)) [private]

6.17.4.2 template<const index_t LO, const index_t HI> const std::string glucat::index_set< LO, HI >::classname ( ) [inline], [static]

Definition at line 49 of file index_set_imp.h.

6.17.4.3 template<const index_t LO, const index_t HI> index_t glucat::index_set< LO, HI >::count ( ) const [inline]

Cardinality: Number of indices included in set.

Definition at line 344 of file index_set_imp.h.

Referenced by glucat::index_set< LO, HI >::count_neg(), glucat::index_set< LO, HI >::count_pos(), glucat::framed_multi< Scalar_T, LO, HI >::framed_multi(), glucat::index_set< LO, HI >::index_set(), glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi(), glucat::index_set< LO, HI >::operator<(), and glucat::framed_multi< Scalar_T, LO, HI >::random().

6.17.4.4 template<const index_t LO, const index_t HI> index_t glucat::index_set< LO, HI >::count_neg ( ) const [inline]

Number of negative indices included in set.

Definition at line 364 of file index_set_imp.h.

References glucat::index_set< LO, HI >::count().

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi(), and glucat::folded_dim().

6.17.4.5 template<const index_t LO, const index_t HI> index_t glucat::index_set< LO, HI >::count_pos ( ) const [inline]

Number of positive indices included in set.

Definition at line 376 of file index_set_imp.h.

References glucat::index_set< LO, HI >::count().

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fast_matrix_multi(), and glucat::folded_dim().

6.17.4.6 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::flip ( ) [inline]

Set complement, except 0: flip all bits, except 0.

Definition at line 319 of file index_set_imp.h.

6.17.4.7 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::flip (const index_t *idx*) [inline]

Complement membership of idx if idx != 0: flip bit at idx if idx != 0.

Definition at line 330 of file index_set_imp.h.

6.17.4.8 template<const index_t LO, const index_t HI> const index_set< LO, HI > glucat::index_set< LO, HI >::fold ( ) const [inline]

Fold this index set within itself as a frame.

Definition at line 748 of file index_set_imp.h.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::basis_element(), glucat::index_set< LO, HI >::index_set(), and glucat::index_set< LO, HI >::value_of_fold().

6.17.4.9 template<const index_t LO, const index_t HI> const index_set< LO, HI > glucat::index_set< LO, HI >::fold (const index_set_t *frm,* const bool *prechecked* = false) const

Fold this index set within the given frame.

Definition at line 756 of file index_set_imp.h.

References glucat::index_set< LO, HI >::max(), glucat::index_set< LO, HI >::min(), glucat::index_set< LO, HI >::set(), and glucat::index_set< LO, HI >::test().

6.17.4.10 template<const index_t LO, const index_t HI> size_t glucat::index_set< LO, HI >::hash_fn ( ) const [inline]

Hash function.

Definition at line 948 of file index_set_imp.h.

Referenced by glucat::index_set_hash< LO, HI >::operator()().

6.17.4.11 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::is_contiguous ( ) const [inline]

Determine if the index set is contiguous, ie. has no gaps.

Determine if the index set is contiguous, ie. has no gaps when 0 is included.

Definition at line 732 of file index_set_imp.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::fold(), and glucat::framed_multi< Scalar_T, LO, HI >::unfold().

6.17.4.12 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::lex_less_than (const index_set_t *rhs*) const [inline], [private]

Lexicographic ordering of two sets: $*$this $<$ rhs.

Definition at line 588 of file index_set_imp.h.

Referenced by glucat::compare().

6.17.4.13 template<const index_t LO, const index_t HI> index_t glucat::index_set< LO, HI >::max ( ) const

Maximum member.

Maximum member, or 0 if none.

Definition at line 550 of file index_set_imp.h.

Referenced by PyClical.index_set::__iter__(), glucat::matrix_multi< Scalar_T, LO, HI >::basis_element(), glucat::framed_multi< Scalar_T, LO, HI >::centre_pm4_qp4(), glucat::index_set< LO, HI >::fold(), glucat::framed_multi< Scalar_T, LO, HI >::framed_multi(), glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi(), glucat::max_pos(), and glucat::index_set< LO, HI >::unfold().

6.17.4.14 template<const index_t LO, const index_t HI> index_t glucat::index_set< LO, HI >::min ( ) const

Minimum member.

Minimum member, or 0 if none.

Definition at line 461 of file index_set_imp.h.

Referenced by PyClical.index_set::__iter__(), glucat::matrix_multi< Scalar_T, LO, HI >::basis_element(), glucat::framed_multi< Scalar_T, LO, HI >::centre_pp4_qm4(), glucat::index_set< LO, HI >::fold(), glucat::framed_multi< Scalar_T, LO, HI >::framed_multi(), glucat::index_set< LO, HI >::index_set(), glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi(), glucat::min_neg(), glucat::index_set< LO, HI >::unfold(), and glucat::index_set< LO, HI >::value_of_fold().

6.17.4.15 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::operator!= (const index_set_t *rhs*) const [inline]

Inequality.

Definition at line 130 of file index_set_imp.h.

6.17.4.16 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::operator&= (const index_set_t *rhs*) [inline]

Set intersection: and.

Definition at line 174 of file index_set_imp.h.

6.17.4.17 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::operator< (const index_set_t *rhs*) const [inline]

Less than operator used for comparisons, map, etc.

Definition at line 597 of file index_set_imp.h.

References glucat::index_set< LO, HI >::count().

6.17.4.18 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::operator== (const index_set_t *rhs*) const [inline]

Equality.

Definition at line 119 of file index_set_imp.h.

6.17.4.19 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::operator[] (const index_t *idx*) const [inline]

Subscripting: Test idx for membership: test value of bit idx.

Definition at line 232 of file index_set_imp.h.

6.17.4.20 template<const index_t LO, const index_t HI> index_set< LO, HI >::reference glucat::index_set< LO, HI >::operator[] (index_t *idx*) [inline]

Subscripting: Element access.

Definition at line 224 of file index_set_imp.h.

6.17.4.21 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::operator^= (const index_set_t *rhs*) [inline]

Symmetric set difference: exclusive or.

Definition at line 149 of file index_set_imp.h.

6.17.4.22 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::operator|= (const index_set_t *rhs*) [inline]

Set union: or.

Definition at line 199 of file index_set_imp.h.

6.17.4.23 template<const index_t LO, const index_t HI> index_set< LO, HI > glucat::index_set< LO, HI >::operator~ ( ) const [inline]

Set complement: not.

Definition at line 141 of file index_set_imp.h.

6.17.4.24 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::reset ( ) [inline]

Make set empty: Set all bits to 0.

Definition at line 294 of file index_set_imp.h.

6.17.4.25 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::reset (const index_t *idx*) [inline]

Exclude idx: Set bit at idx to 0.

Definition at line 305 of file index_set_imp.h.

6.17.4.26 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::set ( ) [inline]

Include all indices except 0: set all bits except 0.

Definition at line 255 of file index_set_imp.h.

Referenced by glucat::index_set< LO, HI >::fold(), glucat::operator>>(), and glucat::index_set< LO, HI >::unfold().

6.17.4.27 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::set (const index_t *idx*) [inline]

Include idx: Set bit at idx if idx != 0.

Definition at line 266 of file index_set_imp.h.

6.17.4.28 template<const index_t LO, const index_t HI> index_set< LO, HI > & glucat::index_set< LO, HI >::set (const index_t *idx,* const int *val*) [inline]

Set membership of idx to val if idx != 0: Set bit at idx to val if idx != 0.

Definition at line 280 of file index_set_imp.h.

6.17.4.29 template<const index_t LO, const index_t HI> int glucat::index_set< LO, HI >::sign_of_mult (const index_set_t *ist*) const

Sign of geometric product of two Clifford basis elements.

Definition at line 879 of file index_set_imp.h.

References glucat::inverse_gray(), and glucat::inverse_reversed_gray().

6.17.4.30 template<const index_t LO, const index_t HI> int glucat::index_set< LO, HI >::sign_of_square ( ) const [inline]

Sign of geometric square of a Clifford basis element.

Definition at line 928 of file index_set_imp.h.

6.17.4.31 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::test (const index_t *idx*) const [inline]

Test idx for membership: test value of bit idx.

Definition at line 240 of file index_set_imp.h.

Referenced by glucat::index_set< LO, HI >::fold(), and glucat::index_set< LO, HI >::unfold().

6.17.4.32 template<const index_t LO, const index_t HI> const index_set< LO, HI > glucat::index_set< LO, HI >::unfold (const index_set_t *frm,* const bool *prechecked* = false) const

Unfold this index set within the given frame.

Definition at line 794 of file index_set_imp.h.

References glucat::index_set< LO, HI >::max(), glucat::index_set< LO, HI >::min(), glucat::index_set< LO, HI >::set(), and glucat::index_set< LO, HI >::test().

Referenced by glucat::index_set< LO, HI >::index_set().

6.17.4.33 template<const index_t LO, const index_t HI> set_value_t glucat::index_set< LO, HI >::value_of_fold (const index_set_t *frm*) const [inline]

The set value of the fold of this index set within the given frame.

Definition at line 828 of file index_set_imp.h.

References glucat::index_set< LO, HI >::fold(), and glucat::index_set< LO, HI >::min().

6.17.5 Friends And Related Function Documentation

6.17.5.1 template<const index_t LO, const index_t HI> int compare (const index_set_t & *lhs*, const index_set_t & *rhs*) [friend]

6.17.5.2 template<const index_t LO, const index_t HI> const index_set_t operator& (const index_set_t & *lhs*, const index_set_t & *rhs*) [friend]

6.17.5.3 template<const index_t LO, const index_t HI> const index_set_t operator^ (const index_set_t & *lhs*, const index_set_t & *rhs*) [friend]

6.17.5.4 template<const index_t LO, const index_t HI> const index_set_t operator| (const index_set_t & *lhs*, const index_set_t & *rhs*) [friend]

6.17.5.5 template<const index_t LO, const index_t HI> friend class reference [friend]

Definition at line 173 of file index_set.h.

6.17.6 Member Data Documentation

6.17.6.1 template<const index_t LO, const index_t HI> const index_t glucat::index_set< LO, HI >::v_hi = HI [static]

Definition at line 88 of file index_set.h.

6.17.6.2 template<const index_t LO, const index_t HI> const index_t glucat::index_set< LO, HI >::v_lo = LO [static]

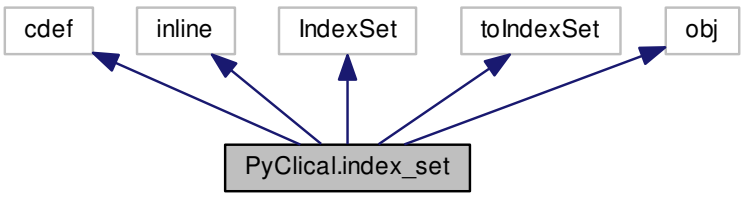
Definition at line 87 of file index_set.h.

The documentation for this class was generated from the following files:

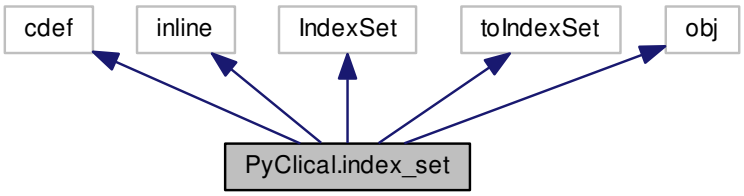
- glucat/index_set.h
- glucat/index_set_imp.h

6.18 PyClical.index_set Class Reference

Inheritance diagram for PyClical.index_set:



Collaboration diagram for PyClical.index_set:



Public Member Functions

- def __cinit__
- def __dealloc__
- def __richcmp__
- def __setitem__
- def __getitem__
- def __contains__
- def __iter__
- def __invert__
- def __xor__
- def __ixor__
- def __and__
- def __iand__
- def __or__
- def __ior__
- def count
- def count_neg
- def count_pos
- def min
- def max
- def hash_fn
- def sign_of_mult
- def sign_of_square
- def __repr__
- def __str__

Public Attributes

- instance

6.18.1 Detailed Description

```
Return the C++ IndexSet instance wrapped by index_set(obj).

Python class index_set wraps C++ class IndexSet.
```

Definition at line 39 of file PyClical.pyx.

6.18.2 Member Function Documentation

6.18.2.1 def PyClical.index_set.__and__ (*lhs, rhs*)

```
Set intersection: and.

>>> print index_set({1}) & index_set({2})
{}
>>> print index_set({1,2}) & index_set({2})
{2}
```

Definition at line 269 of file PyClical.pyx.

6.18.2.2 def PyClical.index_set.__cinit__ (*self, other* = 0)

```
Construct an object of type index_set.

>>> print index_set(1)
{1}
>>> print index_set({1,2})
{1,2}
>>> print index_set(index_set({1,2}))
{1,2}
>>> print index_set({1,2})
{1,2}
>>> print index_set({1,2,1})
{1,2}
>>> print index_set("{1,2,1}")
{1,2}
>>> print index_set("")
{}
```

Definition at line 73 of file PyClical.pyx.

6.18.2.3 def PyClical.index_set.__contains__ (*self, idx*)

```
Check that an index_set object contains the index idx: idx in self.

>>> 1 in index_set({1})
True
>>> 2 in index_set({1})
False
>>> -1 in index_set({2})
False
>>> 1 in index_set({2})
False
>>> 2 in index_set({2})
True
>>> 33 in index_set({2})
False
```

Definition at line 208 of file PyClical.pyx.

6.18.2.4 def PyClical.index_set.__dealloc__ (*self*)

```
Clean up by deallocating the instance of C++ class IndexSet.
```

Definition at line 114 of file PyClical.pyx.

References PyClical.index_set.instance.

6.18.2.5 def PyClical.index_set.__getitem__ (*self, idx*)

```
Get the value of an index_set object at an index.

>>> index_set({1})[1]
True
>>> index_set({1})[2]
False
>>> index_set({2})[-1]
False
>>> index_set({2})[1]
False
>>> index_set({2})[2]
True
>>> index_set({2})[33]
False
```

Definition at line 189 of file PyClical.pyx.

6.18.2.6 def PyClical.index_set.__iand__ (*self, rhs*)

```
Set intersection: and.

>>> x = index_set({1}); x &= index_set({2}); print x
{}
>>> x = index_set({1,2}); x &= index_set({2}); print x
{2}
```

Definition at line 280 of file PyClical.pyx.

6.18.2.7 def PyClical.index_set.__invert__ (*self*)

```
Set complement: not.

>>> print ~index_set({-16,-15,-14,-13,-12,-11,-10,-9,-8,-7,-6,-5,-4,-3,-2,-1,1,2,3,4,5,6,7,8,9,10,11,12,13,14,
{-32,-31,-30,-29,-28,-27,-26,-25,-24,-23,-22,-21,-20,-19,-18,-17,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,
```

Definition at line 238 of file PyClical.pyx.

6.18.2.8 def PyClical.index_set.__ior__ (*self, rhs*)

```
Set union: or.

>>> x = index_set({1}); x |= index_set({2}); print x
{1,2}
>>> x = index_set({1,2}); x |= index_set({2}); print x
{1,2}
```

Definition at line 302 of file PyClical.pyx.

6.18.2.9 def PyClical.index_set.__iter__ (*self*)

```
Iterate over the indices of an index_set.

>>> for i in index_set({-3,4,7}): print i,
-3 4 7
```

Definition at line 227 of file PyClical.pyx.

References glucat::index_set< LO, HI >.max(), PyClical.index_set.max(), glucat::index_set< LO, HI >.min(), and PyClical.index_set.min().

6.18.2.10 def PyClical.index_set.__ixor__ (*self, rhs*)

```
Symmetric set difference: exclusive or.

>>> x = index_set({1}); x ^= index_set({2}); print x
{1,2}
>>> x = index_set({1,2}); x ^= index_set({2}); print x
{1}
```

Definition at line 258 of file PyClical.pyx.

6.18.2.11 def PyClical.index_set.__or__ (*lhs, rhs*)

```
Set union: or.

>>> print index_set({1}) | index_set({2})
{1,2}
>>> print index_set({1,2}) | index_set({2})
{1,2}
```

Definition at line 291 of file PyClical.pyx.

6.18.2.12 def PyClical.index_set.__repr__ (*self*)

```
The "official" string representation of self.

>>> index_set({1,2}).__repr__()
'index_set({1,2})'
>>> repr(index_set({1,2}))
'index_set({1,2})'
```

Definition at line 382 of file PyClical.pyx.

References index_set_to_repr().

6.18.2.13 def PyClical.index_set.__richcmp__ (*lhs, rhs, int, op*)

```
Compare two objects of class index_set.

>>> index_set(1) == index_set({1})
True
>>> index_set({1}) != index_set({1})
False
>>> index_set({1}) != index_set({2})
True
>>> index_set({1}) == index_set({2})
False
>>> index_set({1}) < index_set({2})
True
>>> index_set({1}) <= index_set({2})
True
>>> index_set({1}) > index_set({2})
False
>>> index_set({1}) >= index_set({2})
False
```

Definition at line 120 of file PyClical.pyx.

6.18.2.14 def PyClical.index_set.__setitem__ (*self, idx, val*)

```
Set the value of an index_set object at index idx to value val.

>>> s=index_set({1}); s[2] = True; print s
```

```
{1,2}
>>> s=index_set({1,2}); s[1] = False; print s
{2}
```

Definition at line 177 of file PyClical.pyx.

6.18.2.15 def PyClical.index_set.__str__ (*self*)

```
The "informal" string representation of self.

>>> index_set({1,2}).__str__()
'{1,2}'
>>> str(index_set({1,2}))
'{1,2}'
```

Definition at line 393 of file PyClical.pyx.

References index_set_to_str().

6.18.2.16 def PyClical.index_set.__xor__ (*lhs, rhs*)

```
Symmetric set difference: exclusive or.

>>> print index_set({1}) ^ index_set({2})
{1,2}
>>> print index_set({1,2}) ^ index_set({2})
{1}
```

Definition at line 247 of file PyClical.pyx.

6.18.2.17 def PyClical.index_set.count (*self*)

```
Cardinality: Number of indices included in set.

>>> index_set({-1,1,2}).count()
3
```

Definition at line 313 of file PyClical.pyx.

6.18.2.18 def PyClical.index_set.count_neg (*self*)

```
Number of negative indices included in set.

>>> index_set({-1,1,2}).count_neg()
1
```

Definition at line 322 of file PyClical.pyx.

6.18.2.19 def PyClical.index_set.count_pos (*self*)

```
Number of positive indices included in set.

>>> index_set({-1,1,2}).count_pos()
2
```

Definition at line 331 of file PyClical.pyx.

6.18.2.20 def PyClical.index_set.hash_fn (*self*)

```
Hash function.
```

Definition at line 358 of file PyClical.pyx.

6.18.2.21 def PyClical.index_set.max (*self*)

```
Maximum member.

>>> index_set({-1,1,2}).max()
2
```

Definition at line 349 of file PyClical.pyx.

Referenced by PyClical.index_set.__iter__().

6.18.2.22 def PyClical.index_set.min (*self*)

```
Minimum member.

>>> index_set({-1,1,2}).min()
-1
```

Definition at line 340 of file PyClical.pyx.

Referenced by PyClical.index_set.__iter__().

6.18.2.23 def PyClical.index_set.sign_of_mult (*self, rhs*)

```
Sign of geometric product of two Clifford basis elements.

>>> s = index_set({1,2}); t=index_set({-1}); s.sign_of_mult(t)
1
```

Definition at line 364 of file PyClical.pyx.

6.18.2.24 def PyClical.index_set.sign_of_square (*self*)

```
Sign of geometric square of a Clifford basis element.

>>> s = index_set({1,2}); s.sign_of_square()
-1
```

Definition at line 373 of file PyClical.pyx.

6.18.3 Member Data Documentation

6.18.3.1 PyClical.index_set.instance

Definition at line 94 of file PyClical.pyx.

Referenced by PyClical.index_set.__dealloc__(), and PyClical.clifford.__dealloc__().

The documentation for this class was generated from the following file:

- pyclical/PyClical.pyx

6.19 glucat::index_set_hash< LO, HI > Class Template Reference

`#include <framed_multi.h>`

Public Types

- typedef index_set< LO, HI > index_set_t

Public Member Functions

- size_t operator() (index_set_t val) const

6.19.1 Detailed Description

template<const index_t LO, const index_t HI>class glucat::index_set_hash< LO, HI >

Definition at line 126 of file framed_multi.h.

6.19.2 Member Typedef Documentation

6.19.2.1 template<const index_t LO, const index_t HI> typedef index_set<LO,HI> glucat::index_set_hash< LO, HI >::index_set_t

Definition at line 129 of file framed_multi.h.

6.19.3 Member Function Documentation

6.19.3.1 template<const index_t LO, const index_t HI> size_t glucat::index_set_hash< LO, HI >::operator() (index_set_t *val*) const [inline]

Definition at line 130 of file framed_multi.h.

References glucat::index_set< LO, HI >::hash_fn().

The documentation for this class was generated from the following file:

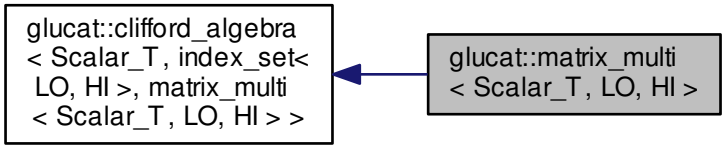
- glucat/framed_multi.h

6.20 glucat::matrix_multi< Scalar_T, LO, HI > Class Template Reference

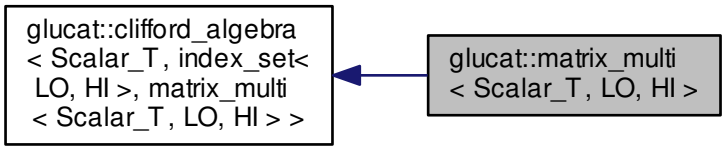
A matrix_multi<Scalar_T,LO,HI> is a matrix approximation to a multivector.

`#include <framed_multi.h>`

Inheritance diagram for glucat::matrix_multi< Scalar_T, LO, HI >:



Collaboration diagram for glucat::matrix_multi< Scalar_T, LO, HI >:



Public Types

- typedef matrix_multi multivector_t
- typedef multivector_t matrix_multi_t
- typedef Scalar_T scalar_t
- typedef index_set< LO, HI > index_set_t
- typedef std::pair< const index_set_t, Scalar_T > term_t
- typedef std::vector< Scalar_T > vector_t
- typedef error< multivector_t > error_t
- typedef framed_multi< Scalar_T, LO, HI > framed_multi_t

Public Member Functions

- ~matrix_multi ()

  Destructor.
- matrix_multi ()

  Default constructor.
- template<typename Other_Scalar_T >
  matrix_multi (const matrix_multi< Other_Scalar_T, LO, HI > &val)

  Construct a multivector from a multivector with a different scalar type.
- template<typename Other_Scalar_T >
  matrix_multi (const matrix_multi< Other_Scalar_T, LO, HI > &val, const index_set_t frm, const bool prechecked=false)

Construct a multivector, within a given frame, from a given multivector.

- matrix_multi (const multivector_t &val, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a given multivector.

- matrix_multi (const index_set_t ist, const Scalar_T &crd=Scalar_T(1))

  Construct a multivector from an index set and a scalar coordinate.

- matrix_multi (const index_set_t ist, const Scalar_T &crd, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from an index set and a scalar coordinate.

- matrix_multi (const Scalar_T &scr, const index_set_t frm=index_set_t())

  Construct a multivector from a scalar (within a frame, if given)

- matrix_multi (const int scr, const index_set_t frm=index_set_t())

  Construct a multivector from an int (within a frame, if given)

- matrix_multi (const vector_t &vec, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a given vector.

- matrix_multi (const std::string &str)

  Construct a multivector from a string: eg: "3+2{1,2}-6.1e-2{2,3}".

- matrix_multi (const std::string &str, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a string: eg: "3+2{1,2}-6.1e-2{2,3}".

- matrix_multi (const char *str)

  Construct a multivector from a char: eg: "3+2{1,2}-6.1e-2{2,3}".*

- matrix_multi (const char *str, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a char: eg: "3+2{1,2}-6.1e-2{2,3}".*

- template<typename Other_Scalar_T >
  matrix_multi (const framed_multi< Other_Scalar_T, LO, HI > &val)

  Construct a multivector from a framed_multi_t.

- template<typename Other_Scalar_T >
  matrix_multi (const framed_multi< Other_Scalar_T, LO, HI > &val, const index_set_t frm, const bool prechecked=false)

  Construct a multivector, within a given frame, from a framed_multi_t.

- const matrix_multi_t fast_matrix_multi (const index_set_t frm) const

  Use generalized FFT to construct a matrix_multi_t.

- template<typename Other_Scalar_T >
  const framed_multi
  < Other_Scalar_T, LO, HI > fast_framed_multi () const

  Use inverse generalized FFT to construct a framed_multi_t.

- _GLUCAT_CLIFFORD_ALGEBRA_OPERATIONS
  multivector_t & operator= (const multivector_t &rhs)

  Assignment operator.

- multivector_t & operator+= (const term_t &rhs)

  Add a term, if non-zero.

Static Public Member Functions

- static const std::string classname ()

  Class name used in messages.

- static const matrix_multi_t random (const index_set_t frm, Scalar_T fill=Scalar_T(1))

  Random multivector within a frame.

Private Types

- typedef ublas::row_major orientation_t
- typedef ublas::compressed_matrix< int, orientation_t > basis_matrix_t
- typedef ublas::compressed_matrix < Scalar_T, orientation_t > matrix_t
- typedef matrix_t::size_type matrix_index_t

Private Member Functions

- template<typename Matrix_T >
  matrix_multi (const Matrix_T &mtx, const index_set_t frm)

  Construct a multivector within a given frame from a given matrix.
- matrix_multi (const matrix_t &mtx, const index_set_t frm)

  Construct a multivector within a given frame from a given matrix.
- const basis_matrix_t basis_element (const index_set< LO, HI > &ist) const

  Create a basis element matrix within the current frame.

Private Attributes

- index_set_t m_frame

  Index set representing the frame for the subalgebra which contains the multivector.
- matrix_t m_matrix

  Matrix value representing the multivector within the folded frame.

Friends

- template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI>
  class framed_multi
- template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI>
  class matrix_multi
- const matrix_multi_t operator* (const matrix_multi_t &lhs, const matrix_multi_t &rhs)
- const matrix_multi_t operator^ (const matrix_multi_t &lhs, const matrix_multi_t &rhs)
- const matrix_multi_t operator& (const matrix_multi_t &lhs, const matrix_multi_t &rhs)
- const matrix_multi_t operator% (const matrix_multi_t &lhs, const matrix_multi_t &rhs)
- Scalar_T star (const matrix_multi_t &lhs, const matrix_multi_t &rhs)
- const matrix_multi_t operator/ (const matrix_multi_t &lhs, const matrix_multi_t &rhs)
- const matrix_multi_t operator| (const matrix_multi_t &lhs, const matrix_multi_t &rhs)
- std::istream & operator>> (std::istream &s, multivector_t &val)
- std::ostream & operator<< (std::ostream &os, const multivector_t &val)
- std::ostream & operator<< (std::ostream &os, const term_t &term)
- template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI>
  const index_set< Other_LO, Other_HI > reframe (const matrix_multi< Other_Scalar_T, Other_LO, Other_HI > &lhs, const matrix_multi< Other_Scalar_T, Other_LO, Other_HI > &rhs, matrix_multi< Other_Scalar_T, Other_LO, Other_HI > &lhs_reframed, matrix_multi< Other_Scalar_T, Other_LO, Other_HI > &rhs_reframed)
- template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI>
  const matrix_multi < Other_Scalar_T, Other_LO, Other_HI > matrix_sqrt (const matrix_multi< Other_Scalar_T, Other_LO, Other_HI > &val, const matrix_multi< Other_Scalar_T, Other_LO, Other_HI > &i)

- template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI>
  const matrix_multi
  < Other_Scalar_T, Other_LO,
  Other_HI > matrix_log (const matrix_multi< Other_Scalar_T, Other_LO, Other_HI > &val, const matrix_↩
  multi< Other_Scalar_T, Other_LO, Other_HI > &i)

6.20.1 Detailed Description

**template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI>class glucat::matrix↩
_multi< Scalar_T, LO, HI >**

A matrix_multi<Scalar_T,LO,HI> is a matrix approximation to a multivector.

Definition at line 68 of file framed_multi.h.

6.20.2 Member Typedef Documentation

6.20.2.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef ublas::compressed_matrix< int, orientation_t > glucat::matrix_multi< Scalar_T, LO, HI >::basis_matrix_t [private]

Definition at line 152 of file matrix_multi.h.

6.20.2.2 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef error<multivector_t> glucat::matrix_multi< Scalar_T, LO, HI >::error_t

Definition at line 142 of file matrix_multi.h.

6.20.2.3 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef framed_multi<Scalar_T,LO,HI> glucat::matrix_multi< Scalar_T, LO, HI >::framed_multi_t

Definition at line 143 of file matrix_multi.h.

6.20.2.4 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef index_set<LO,HI> glucat::matrix_multi< Scalar_T, LO, HI >::index_set_t

Definition at line 139 of file matrix_multi.h.

6.20.2.5 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef matrix_t::size_type glucat::matrix_multi< Scalar_T, LO, HI >::matrix_index_t [private]

Definition at line 159 of file matrix_multi.h.

6.20.2.6 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef multivector_t glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi_t

Definition at line 137 of file matrix_multi.h.

6.20.2.7 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef ublas::compressed_matrix< Scalar_T, orientation_t > glucat::matrix_multi< Scalar_T, LO, HI >::matrix_t [private]

Definition at line 157 of file matrix_multi.h.

6.20.2.8 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef matrix_multi glucat::matrix_multi< Scalar_T, LO, HI >::multivector_t

Definition at line 136 of file matrix_multi.h.

6.20.2.9 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef ublas::row_major glucat::matrix_multi< Scalar_T, LO, HI >::orientation_t [private]

Definition at line 150 of file matrix_multi.h.

6.20.2.10 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef Scalar_T glucat::matrix_multi< Scalar_T, LO, HI >::scalar_t

Definition at line 138 of file matrix_multi.h.

6.20.2.11 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::pair<const index_set_t, Scalar_T> glucat::matrix_multi< Scalar_T, LO, HI >::term_t

Definition at line 140 of file matrix_multi.h.

6.20.2.12 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::vector<Scalar_T> glucat::matrix_multi< Scalar_T, LO, HI >::vector_t

Definition at line 141 of file matrix_multi.h.

6.20.3 Constructor & Destructor Documentation

6.20.3.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::matrix_multi< Scalar_T, LO, HI >::~matrix_multi ( ) [inline]

Destructor.

Definition at line 165 of file matrix_multi.h.

6.20.3.2 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi ( )

Default constructor.

Definition at line 97 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi().

6.20.3.3 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const matrix_multi< Other_Scalar_T, LO, HI > & *val*)

Construct a multivector from a multivector with a different scalar type.

Definition at line 106 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix.

6.20.3.4 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const matrix_multi< Other_Scalar_T, LO, HI > & *val,* const index_set_t *frm,* const bool *prechecked* = `false`)

Construct a multivector, within a given frame, from a given multivector.

Definition at line 128 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_frame, and glucat::matrix_multi< Scalar_T, LO, HI >::m↩ _matrix.

6.20.3.5 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const multivector_t & *val,* const index_set_t *frm,* const bool *prechecked* = `false`)

Construct a multivector, within a given frame, from a given multivector.

Definition at line 156 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_frame, and glucat::matrix_multi< Scalar_T, LO, HI >::m↩ _matrix.

6.20.3.6 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const index_set_t *ist,* const Scalar_T & *crd* = `Scalar_T(1)`)

Construct a multivector from an index set and a scalar coordinate.

Definition at line 168 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_frame, and glucat::matrix_multi< Scalar_T, LO, HI >::m↩ _matrix.

6.20.3.7 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const index_set_t *ist,* const Scalar_T & *crd,* const index_set_t *frm,* const bool *prechecked* = `false`)

Construct a multivector, within a given frame, from an index set and a scalar coordinate.

Definition at line 180 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix.

6.20.3.8 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const Scalar_T & *scr,* const index_set_t *frm* = index_set_t`()`)

Construct a multivector from a scalar (within a frame, if given)

Definition at line 194 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix.

6.20.3.9 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const int *scr,* const index_set_t *frm* = index_set_t())

Construct a multivector from an int (within a frame, if given)

Definition at line 206 of file matrix_multi_imp.h.

6.20.3.10 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const vector_t & *vec,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from a given vector.

Definition at line 212 of file matrix_multi_imp.h.

References glucat::index_set< LO, HI >::count(), glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix, glucat::index_set< LO, HI >::max(), and glucat::index_set< LO, HI >::min().

6.20.3.11 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const std::string & *str*)

Construct a multivector from a string: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 239 of file matrix_multi_imp.h.

6.20.3.12 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const std::string & *str,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from a string: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 245 of file matrix_multi_imp.h.

6.20.3.13 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const char * *str*) [inline]

Construct a multivector from a char*: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 196 of file matrix_multi.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi().

6.20.3.14 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const char * *str,* const index_set_t *frm,* const bool *prechecked* = false) [inline]

Construct a multivector, within a given frame, from a char*: eg: "3+2{1,2}-6.1e-2{2,3}".

Definition at line 199 of file matrix_multi.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi().

6.20.3.15 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const framed_multi< Other_Scalar_T, LO, HI > & *val*)

Construct a multivector from a framed_multi_t.

Definition at line 252 of file matrix_multi_imp.h.

References PyClical::e(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_↩ Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::fast_size_threshold, glucat::matrix_multi< Scalar_T, LO, HI >::m_frame, and glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix.

6.20.3.16 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const framed_multi< Other_Scalar_T, LO, HI > & *val,* const index_set_t *frm,* const bool *prechecked* = false)

Construct a multivector, within a given frame, from a framed_multi_t.

Definition at line 279 of file matrix_multi_imp.h.

References PyClical::e(), glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_↩ Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::fast_size_threshold, and glucat::clifford_algebra< Scalar_T, index_set< LO, HI >, framed_multi< Scalar_T, LO, HI > >::frame().

6.20.3.17 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Matrix_T > glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const Matrix_T & *mtx,* const index_set_t *frm*) [private]

Construct a multivector within a given frame from a given matrix.

Definition at line 307 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix.

6.20.3.18 template<typename Scalar_T , const index_t LO, const index_t HI> glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi (const matrix_t & *mtx,* const index_set_t *frm*) [private]

Construct a multivector within a given frame from a given matrix.

Definition at line 328 of file matrix_multi_imp.h.

6.20.4 Member Function Documentation

6.20.4.1 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI >::basis_matrix_t glucat::matrix_multi< Scalar_T, LO, HI >::basis_element (const index_set< LO, HI > & *ist*) const [private]

Create a basis element matrix within the current frame.

Definition at line 1243 of file matrix_multi_imp.h.

References glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_↩ Threshold, Function_Precision >::basis_max_count, PyClical::e(), glucat::index_set< LO, HI >::fold(), glucat↩ ::gen::generator_table< Matrix_T >::generator(), glucat::index_set< LO, HI >::max(), glucat::index_set< LO, HI >::min(), glucat::matrix::mono_prod(), and glucat::offset_level().

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::framed_multi().

6.20.4.2 template<typename Scalar_T , const index_t LO, const index_t HI> const std::string glucat::matrix_multi< Scalar_T, LO, HI >::classname ( ) [static]

Class name used in messages.

Definition at line 69 of file matrix_multi_imp.h.

6.20.4.3 template<typename Scalar_T , const index_t LO, const index_t HI> template<typename Other_Scalar_T > const framed_multi< Other_Scalar_T, LO, HI > glucat::matrix_multi< Scalar_T, LO, HI >::fast_framed_multi ( ) const

Use inverse generalized FFT to construct a framed_multi_t.

Definition at line 1166 of file matrix_multi_imp.h.

References glucat::framed_multi< Scalar_T, LO, HI >::centre_pm4_qp4(), glucat::framed_multi< Scalar_T, LO, HI >::centre_pp4_qm4(), glucat::framed_multi< Scalar_T, LO, HI >::centre_qp1_pm1(), glucat::gen::offset_to_↩ super, glucat::pos_mod(), and glucat::framed_multi< Scalar_T, LO, HI >::unfold().

6.20.4.4 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::matrix_multi< Scalar_T, LO, HI >::fast_matrix_multi (const index_set_t *frm*) const [inline]

Use generalized FFT to construct a matrix_multi_t.

Definition at line 1153 of file matrix_multi_imp.h.

6.20.4.5 template<typename Scalar_T , const index_t LO, const index_t HI> matrix_multi< Scalar_T, LO, HI > & glucat::matrix_multi< Scalar_T, LO, HI >::operator+= (const term_t & *rhs*) [inline]

Add a term, if non-zero.

Geometric sum.

Geometric sum of multivector and scalar.

Definition at line 470 of file matrix_multi_imp.h.

6.20.4.6 template<typename Scalar_T , const index_t LO, const index_t HI> matrix_multi< Scalar_T, LO, HI > & glucat::matrix_multi< Scalar_T, LO, HI >::operator= (const multivector_t & *rhs*)

Assignment operator.

Definition at line 336 of file matrix_multi_imp.h.

References glucat::matrix_multi< Scalar_T, LO, HI >::m_frame, and glucat::matrix_multi< Scalar_T, LO, HI >::m↩ _matrix.

6.20.4.7 template<typename Scalar_T , const index_t LO, const index_t HI> const matrix_multi< Scalar_T, LO, HI > glucat::matrix_multi< Scalar_T, LO, HI >::random (const index_set_t *frm,* Scalar_T *fill* = `Scalar_T(1)`) [static]

Random multivector within a frame.

Definition at line 996 of file matrix_multi_imp.h.

References glucat::framed_multi< Scalar_T, LO, HI >::random().

6.20.5 Friends And Related Function Documentation

6.20.5.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> friend class framed_multi [friend]

Definition at line 145 of file matrix_multi.h.

6.20.5.2 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> const **matrix_multi**<Other_Scalar_T,Other_LO,Other_HI> matrix_log (const **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *val,* const **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *i*) [friend]

6.20.5.3 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> friend class **matrix_multi** [friend]

Definition at line 147 of file matrix_multi.h.

6.20.5.4 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> const **matrix_multi**<Other_Scalar_T,Other_LO,Other_HI> matrix_sqrt (const **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *val,* const **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *i*) [friend]

6.20.5.5 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const **matrix_multi_t** operator% (const **matrix_multi_t** & *lhs,* const **matrix_multi_t** & *rhs*) [friend]

6.20.5.6 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const **matrix_multi_t** operator& (const **matrix_multi_t** & *lhs,* const **matrix_multi_t** & *rhs*) [friend]

6.20.5.7 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const **matrix_multi_t** operator∗ (const **matrix_multi_t** & *lhs,* const **matrix_multi_t** & *rhs*) [friend]

6.20.5.8 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const **matrix_multi_t** operator/ (const **matrix_multi_t** & *lhs,* const **matrix_multi_t** & *rhs*) [friend]

6.20.5.9 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> std::ostream& operator<< (std::ostream & *os,* const **multivector_t** & *val*) [friend]

6.20.5.10 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> std::ostream& operator<< (std::ostream & *os,* const **term_t** & *term*) [friend]

6.20.5.11 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> std::istream& operator>> (std::istream & *s,* **multivector_t** & *val*) [friend]

6.20.5.12 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const **matrix_multi_t** operator^ (const **matrix_multi_t** & *lhs,* const **matrix_multi_t** & *rhs*) [friend]

6.20.5.13 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> const **matrix_multi_t** operator| (const **matrix_multi_t** & *lhs,* const **matrix_multi_t** & *rhs*) [friend]

6.20.5.14 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> template<typename Other_Scalar_T , const index_t Other_LO, const index_t Other_HI> const **index_set**<Other_LO,Other_HI> reframe (const **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *lhs,* const **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *rhs,* **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *lhs_reframed,* **matrix_multi**< Other_Scalar_T, Other_LO, Other_HI > & *rhs_reframed*) [friend]

6.20.5.15 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> Scalar_T star (const **matrix_multi_t** & *lhs,* const **matrix_multi_t** & *rhs*) [friend]

6.20.6 Member Data Documentation

6.20.6.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> index_set_t glucat::matrix_multi< Scalar_T, LO, HI >::m_frame [private]

Index set representing the frame for the subalgebra which contains the multivector.

Definition at line 275 of file matrix_multi.h.

Referenced by glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi(), glucat::operator*(), glucat::operator/(), glucat::matrix_multi< Scalar_T, LO, HI >::operator=(), and glucat::reframe().

6.20.6.2 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> matrix_t glucat::matrix_multi< Scalar_T, LO, HI >::m_matrix [private]

Matrix value representing the multivector within the folded frame.

Definition at line 277 of file matrix_multi.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::framed_multi(), glucat::matrix_multi< Scalar_T, LO, HI >::matrix_multi(), glucat::operator*(), and glucat::matrix_multi< Scalar_T, LO, HI >::operator=().

The documentation for this class was generated from the following files:

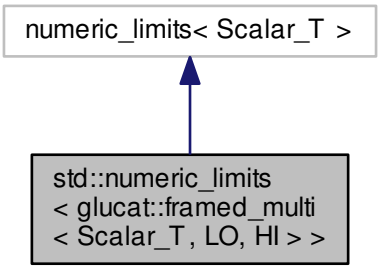
- glucat/framed_multi.h
- glucat/matrix_multi.h
- glucat/matrix_multi_imp.h

6.21 std::numeric_limits< glucat::framed_multi< Scalar_T, LO, HI > > Struct Template Reference

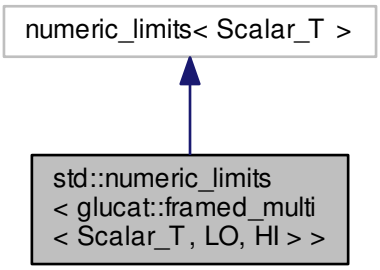
Numeric limits for framed_multi inherit limits for the corresponding scalar type.

`#include <framed_multi.h>`

Inheritance diagram for std::numeric_limits< glucat::framed_multi< Scalar_T, LO, HI > >:



Collaboration diagram for std::numeric_limits< glucat::framed_multi< Scalar_T, LO, HI > >:



6.21.1 Detailed Description

template<typename Scalar_T, const glucat::index_t LO, const glucat::index_t HI>struct std::numeric_limits< glucat::framed_multi< Scalar_T, LO, HI > >

Numeric limits for framed_multi inherit limits for the corresponding scalar type.

Definition at line 374 of file framed_multi.h.

The documentation for this struct was generated from the following file:

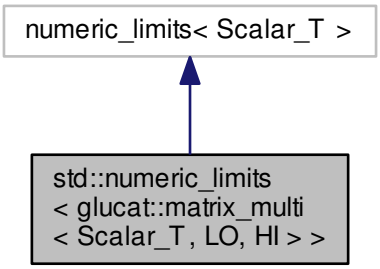
- glucat/framed_multi.h

6.22 std::numeric_limits< glucat::matrix_multi< Scalar_T, LO, HI > > Struct Template Reference

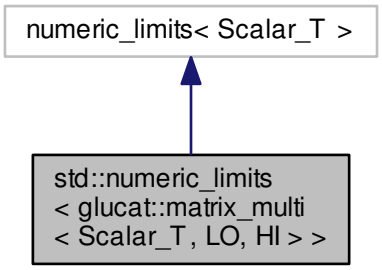
Numeric limits for matrix_multi inherit limits for the corresponding scalar type.

`#include <matrix_multi.h>`

Inheritance diagram for std::numeric_limits< glucat::matrix_multi< Scalar_T, LO, HI > >:



Collaboration diagram for std::numeric_limits< glucat::matrix_multi< Scalar_T, LO, HI > >:



6.22.1 Detailed Description

template<typename Scalar_T, const glucat::index_t LO, const glucat::index_t HI>struct std::numeric_limits< glucat::matrix_multi< Scalar_T, LO, HI > >

Numeric limits for matrix_multi inherit limits for the corresponding scalar type.

Definition at line 293 of file matrix_multi.h.

The documentation for this struct was generated from the following file:

- glucat/matrix_multi.h

6.23 glucat::numeric_traits< Scalar_T > Class Template Reference

Extra traits which extend numeric limits.

`#include <scalar.h>`

Classes

- struct demoted
  Demoted type for long double.
- struct promoted
  Promoted type.

Public Member Functions

- template<>
  long double pi ()
- template<>
  long double ln_2 ()
- template<>
  float to_scalar_t (const Other_Scalar_T &val)
- template<>
  double to_scalar_t (const Other_Scalar_T &val)

- template<>
  long double to_scalar_t (const dd_real &val)
- template<>
  long double to_scalar_t (const qd_real &val)
- template<>
  dd_real to_scalar_t (const long double &val)
- template<>
  dd_real to_scalar_t (const qd_real &val)
- template<>
  qd_real to_scalar_t (const long double &val)
- template<>
  qd_real to_scalar_t (const dd_real &val)

Static Public Member Functions

- static bool isInf (const Scalar_T &val)

  Smart isinf.
- static bool isNaN (const Scalar_T &val)

  Smart isnan.
- static bool isNaN_or_isInf (const Scalar_T &val)

  Smart isnan or isinf.
- static Scalar_T NaN ()

  Smart NaN.
- static int to_int (const Scalar_T &val)

  Cast to int.
- static double to_double (const Scalar_T &val)

  Cast to double.
- template<typename Other_Scalar_T >
  static Scalar_T to_scalar_t (const Other_Scalar_T &val)

  Cast to Scalar_T.
- static Scalar_T fmod (const Scalar_T &lhs, const Scalar_T &rhs)

  Modulo function for scalar.
- static Scalar_T conj (const Scalar_T &val)

  Complex conjugate of scalar.
- static Scalar_T real (const Scalar_T &val)

  Real part of scalar.
- static Scalar_T imag (const Scalar_T &val)

  Imaginary part of scalar.
- static Scalar_T abs (const Scalar_T &val)

  Absolute value of scalar.
- static Scalar_T pi ()

  Pi.
- static Scalar_T ln_2 ()

  log(2)
- static Scalar_T pow (const Scalar_T &val, int n)

  Integer power.
- static Scalar_T sqrt (const Scalar_T &val)

  Square root of scalar.
- static Scalar_T exp (const Scalar_T &val)

  Exponential.
- static Scalar_T log (const Scalar_T &val)

  Logarithm of scalar.

- static Scalar_T log2 (const Scalar_T &val)

  Log base 2.
- static Scalar_T cos (const Scalar_T &val)

  Cosine of scalar.
- static Scalar_T acos (const Scalar_T &val)

  Inverse cosine of scalar.
- static Scalar_T cosh (const Scalar_T &val)

  Hyperbolic cosine of scalar.
- static Scalar_T sin (const Scalar_T &val)

  Sine of scalar.
- static Scalar_T asin (const Scalar_T &val)

  Inverse sine of scalar.
- static Scalar_T sinh (const Scalar_T &val)

  Hyperbolic sine of scalar.
- static Scalar_T tan (const Scalar_T &val)

  Tangent of scalar.
- static Scalar_T atan (const Scalar_T &val)

  Inverse tangent of scalar.
- static Scalar_T tanh (const Scalar_T &val)

  Hyperbolic tangent of scalar.

Static Private Member Functions

- static bool isInf (const Scalar_T &val, bool_to_type< false >)

  Smart isinf specialised for Scalar_T without infinity.
- static bool isInf (const Scalar_T &val, bool_to_type< true >)

  Smart isinf specialised for Scalar_T with infinity.
- static bool isNaN (const Scalar_T &val, bool_to_type< false >)

  Smart isnan specialised for Scalar_T without quiet NaN.
- static bool isNaN (const Scalar_T &val, bool_to_type< true >)

  Smart isnan specialised for Scalar_T with quiet NaN.

6.23.1 Detailed Description

template<typename Scalar_T>class glucat::numeric_traits< Scalar_T >

Extra traits which extend numeric limits.

Definition at line 46 of file scalar.h.

6.23.2 Member Function Documentation

6.23.2.1 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::abs (const Scalar_T & *val*) [inline], [static]

Absolute value of scalar.

Definition at line 181 of file scalar.h.

References UBLAS_ABS.

6.23.2.2 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::acos (const Scalar_T & *val*) [inline], [static]

Inverse cosine of scalar.

Definition at line 244 of file scalar.h.

References glucat::acos().

6.23.2.3 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::asin (const Scalar_T & *val*) [inline], [static]

Inverse sine of scalar.

Definition at line 265 of file scalar.h.

References glucat::asin().

6.23.2.4 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::atan (const Scalar_T & *val*) [inline], [static]

Inverse tangent of scalar.

Definition at line 286 of file scalar.h.

References glucat::atan().

6.23.2.5 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::conj (const Scalar_T & *val*) [inline], [static]

Complex conjugate of scalar.

Definition at line 160 of file scalar.h.

6.23.2.6 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::cos (const Scalar_T & *val*) [inline], [static]

Cosine of scalar.

Definition at line 237 of file scalar.h.

References glucat::cos().

6.23.2.7 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::cosh (const Scalar_T & *val*) [inline], [static]

Hyperbolic cosine of scalar.

Definition at line 251 of file scalar.h.

References glucat::cosh().

6.23.2.8 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::exp (const Scalar_T & *val*) [inline], [static]

Exponential.

Definition at line 216 of file scalar.h.

References glucat::exp().

6.23.2.9 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::fmod (const Scalar_T & *lhs,* const Scalar_T & *rhs*) [inline], [static]

Modulo function for scalar.

Definition at line 153 of file scalar.h.

6.23.2.10 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::imag (const Scalar_T & *val*) [inline], [static]

Imaginary part of scalar.

Definition at line 174 of file scalar.h.

6.23.2.11 template<typename Scalar_T > static bool glucat::numeric_traits< Scalar_T >::isInf (const Scalar_T & *val,* bool_to_type< false >) [inline], [static], [private]

Smart isinf specialised for Scalar_T without infinity.

Definition at line 53 of file scalar.h.

Referenced by glucat::numeric_traits< Scalar_T >::isInf(), and glucat::numeric_traits< Scalar_T >::isNaN_or_is↩Inf().

6.23.2.12 template<typename Scalar_T > static bool glucat::numeric_traits< Scalar_T >::isInf (const Scalar_T & *val,* bool_to_type< true >) [inline], [static], [private]

Smart isinf specialised for Scalar_T with infinity.

Definition at line 60 of file scalar.h.

References _GLUCAT_ISINF.

6.23.2.13 template<typename Scalar_T > static bool glucat::numeric_traits< Scalar_T >::isInf (const Scalar_T & *val*) [inline], [static]

Smart isinf.

Definition at line 82 of file scalar.h.

References glucat::numeric_traits< Scalar_T >::isInf().

6.23.2.14 template<typename Scalar_T > static bool glucat::numeric_traits< Scalar_T >::isNaN (const Scalar_T & *val,* bool_to_type< false >) [inline], [static], [private]

Smart isnan specialised for Scalar_T without quiet NaN.

Definition at line 67 of file scalar.h.

Referenced by glucat::numeric_traits< Scalar_T >::isNaN(), and glucat::numeric_traits< Scalar_T >::isNaN_or↩_isInf().

6.23.2.15 template<typename Scalar_T > static bool glucat::numeric_traits< Scalar_T >::isNaN (const Scalar_T & *val,* bool_to_type< true >) [inline], [static], [private]

Smart isnan specialised for Scalar_T with quiet NaN.

Definition at line 74 of file scalar.h.

References _GLUCAT_ISNAN.

6.23.2.16 template<typename Scalar_T > static bool glucat::numeric_traits< Scalar_T >::isNaN (const Scalar_T & *val*) [inline], [static]

Smart isnan.

Definition at line 92 of file scalar.h.

References glucat::numeric_traits< Scalar_T >::isNaN().

6.23.2.17 template<typename Scalar_T > static bool glucat::numeric_traits< Scalar_T >::isNaN_or_isInf (const Scalar_T & *val*) [inline], [static]

Smart isnan or isinf.

Definition at line 102 of file scalar.h.

References glucat::numeric_traits< Scalar_T >::isInf(), and glucat::numeric_traits< Scalar_T >::isNaN().

6.23.2.18 template<> long double glucat::numeric_traits< long double >::ln_2 ( ) [inline]

Definition at line 83 of file long_double.h.

References glucat::l_ln2.

6.23.2.19 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::ln_2 ( ) [inline], [static]

log(2)

Definition at line 195 of file scalar.h.

Referenced by glucat::numeric_traits< Scalar_T >::log2().

6.23.2.20 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::log (const Scalar_T & *val*) [inline], [static]

Logarithm of scalar.

Definition at line 223 of file scalar.h.

References glucat::log().

Referenced by glucat::numeric_traits< Scalar_T >::log2().

6.23.2.21 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::log2 (const Scalar_T & *val*) [inline], [static]

Log base 2.

Definition at line 230 of file scalar.h.

References glucat::numeric_traits< Scalar_T >::ln_2(), and glucat::numeric_traits< Scalar_T >::log().

Referenced by glucat::log2().

6.23.2.22 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::NaN ( ) [inline], [static]

Smart NaN.

Definition at line 114 of file scalar.h.

References glucat::log().

Referenced by glucat::matrix::trace().

6.23.2.23 template<> long double glucat::numeric_traits< long double >::pi ( ) [inline]

Definition at line 75 of file long_double.h.

References glucat::l_pi.

6.23.2.24 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::pi ( ) [inline], [static]

Pi.

Definition at line 188 of file scalar.h.

Referenced by glucat::matrix::classify_eigenvalues().

6.23.2.25 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::pow (const Scalar_T & *val,* int *n*) [inline], [static]

Integer power.

Definition at line 202 of file scalar.h.

References glucat::pow().

6.23.2.26 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::real (const Scalar_T & *val*) [inline], [static]

Real part of scalar.

Definition at line 167 of file scalar.h.

6.23.2.27 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::sin (const Scalar_T & *val*) [inline], [static]

Sine of scalar.

Definition at line 258 of file scalar.h.

References glucat::sin().

6.23.2.28 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::sinh (const Scalar_T & *val*) [inline], [static]

Hyperbolic sine of scalar.

Definition at line 272 of file scalar.h.

References glucat::sinh().

6.23.2.29 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::sqrt (const Scalar_T & *val*) [inline], [static]

Square root of scalar.

Definition at line 209 of file scalar.h.

References UBLAS_SQRT.

Referenced by glucat::abs().

6.23.2.30 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::tan (const Scalar_T & *val*) [inline], [static]

Tangent of scalar.

Definition at line 279 of file scalar.h.

References glucat::tan().

6.23.2.31 template<typename Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::tanh (const Scalar_T & *val*) [inline], [static]

Hyperbolic tangent of scalar.

Definition at line 293 of file scalar.h.

References glucat::tanh().

6.23.2.32 template<typename Scalar_T > static double glucat::numeric_traits< Scalar_T >::to_double (const Scalar_T & *val*) [inline], [static]

Cast to double.

Definition at line 132 of file scalar.h.

Referenced by glucat::operator<<(), and glucat::numeric_traits< Scalar_T >::to_scalar_t().

6.23.2.33 template<typename Scalar_T > static int glucat::numeric_traits< Scalar_T >::to_int (const Scalar_T & *val*) [inline], [static]

Cast to int.

Definition at line 125 of file scalar.h.

6.23.2.34 template<> float glucat::numeric_traits< float >::to_scalar_t (const Other_Scalar_T & *val*) [inline]

Cast to float

Definition at line 52 of file scalar_imp.h.

References glucat::numeric_traits< Scalar_T >::to_double().

6.23.2.35 template<> double glucat::numeric_traits< double >::to_scalar_t (const Other_Scalar_T & *val*) [inline]

Definition at line 61 of file scalar_imp.h.

References glucat::numeric_traits< Scalar_T >::to_double().

6.23.2.36 template<> long double glucat::numeric_traits< long double >::to_scalar_t (const dd_real & *val*) [inline]

Definition at line 71 of file scalar_imp.h.

6.23.2.37 template<> long double glucat::numeric_traits< long double >::to_scalar_t (const qd_real & *val*) [inline]

Definition at line 80 of file scalar_imp.h.

6.23.2.38 template<> dd_real glucat::numeric_traits< dd_real >::to_scalar_t (const long double & *val*) [inline]

Definition at line 89 of file scalar_imp.h.

6.23.2.39 template<> dd_real glucat::numeric_traits< dd_real >::to_scalar_t (const qd_real & *val*) [inline]

Definition at line 98 of file scalar_imp.h.

6.23.2.40 template<> qd_real glucat::numeric_traits< qd_real >::to_scalar_t (const long double & *val*) [inline]

Definition at line 107 of file scalar_imp.h.

6.23.2.41 template<> qd_real glucat::numeric_traits< qd_real >::to_scalar_t (const dd_real & *val*) [inline]

Definition at line 116 of file scalar_imp.h.

6.23.2.42 template<typename Scalar_T > template<typename Other_Scalar_T > static Scalar_T glucat::numeric_traits< Scalar_T >::to_scalar_t (const Other_Scalar_T & *val*) [inline], [static]

Cast to Scalar_T.

Definition at line 140 of file scalar.h.

Referenced by glucat::matrix::nork_range(), glucat::to_demote(), and glucat::to_promote().

The documentation for this class was generated from the following file:

- glucat/scalar.h

6.24 glucat::numeric_traits< Scalar_T >::promoted Struct Reference

Promoted type.

`#include <scalar.h>`

Public Types

- typedef double type

6.24.1 Detailed Description

template<typename Scalar_T>struct glucat::numeric_traits< Scalar_T >::promoted

Promoted type.

Definition at line 144 of file scalar.h.

6.24.2 Member Typedef Documentation

6.24.2.1 template<typename Scalar_T > typedef double glucat::numeric_traits< Scalar_T >::promoted::type

Definition at line 144 of file scalar.h.

The documentation for this struct was generated from the following file:

- glucat/scalar.h

6.25 glucat::random_generator< Scalar_T > Class Template Reference

Random number generator with single instance per Scalar_T.

`#include <random.h>`

Public Member Functions

- Scalar_T uniform ()
- Scalar_T normal ()

Static Public Member Functions

- static random_generator & generator ()

  Single instance of Random number generator.

Private Member Functions

- random_generator (const random_generator &)
- random_generator & operator= (const random_generator &)
- random_generator ()
- ~random_generator ()

Private Attributes

- std::mt19937 uint_gen
- std::uniform_real_distribution
  < double > uniform_dist
- std::normal_distribution< double > normal_dist

Static Private Attributes

- static const unsigned long seed = 19590921UL

Friends

- class friend_for_private_destructor

6.25.1 Detailed Description

template<typename Scalar_T>class glucat::random_generator< Scalar_T >

Random number generator with single instance per Scalar_T.

Definition at line 47 of file random.h.

6.25.2 Constructor & Destructor Documentation

6.25.2.1 template<typename Scalar_T > glucat::random_generator< Scalar_T >::random_generator (const random_generator< Scalar_T > &) [private]

6.25.2.2 template<typename Scalar_T > glucat::random_generator< Scalar_T >::random_generator ( ) [inline], [private]

Definition at line 83 of file random.h.

6.25.2.3 template<typename Scalar_T > glucat::random_generator< Scalar_T >::~random_generator ( ) [inline], [private]

Definition at line 87 of file random.h.

6.25.3 Member Function Documentation

6.25.3.1 template<typename Scalar_T > static random_generator& glucat::random_generator< Scalar_T >::generator ( ) [inline], [static]

Single instance of Random number generator.

Definition at line 51 of file random.h.

6.25.3.2 template<typename Scalar_T > Scalar_T glucat::random_generator< Scalar_T >::normal ( ) [inline]

Definition at line 93 of file random.h.

References glucat::random_generator< Scalar_T >::normal_dist.

6.25.3.3 template<typename Scalar_T > random_generator& glucat::random_generator< Scalar_T >::operator= (const random_generator< Scalar_T > &) [private]

6.25.3.4 template<typename Scalar_T > Scalar_T glucat::random_generator< Scalar_T >::uniform ( ) [inline]

Definition at line 91 of file random.h.

References glucat::random_generator< Scalar_T >::uniform_dist.

6.25.4 Friends And Related Function Documentation

6.25.4.1 template<typename Scalar_T > friend class friend_for_private_destructor [friend]

Friend declaration to avoid compiler warning: "... only defines a private destructor and has no friends" Ref: Carlos O'Ryan, ACE http://doc.ece.uci.edu

Definition at line 56 of file random.h.

6.25.5 Member Data Documentation

6.25.5.1 template<typename Scalar_T > std::normal_distribution<double> glucat::random_generator< Scalar_T >::normal_dist [private]

Definition at line 81 of file random.h.

Referenced by glucat::random_generator< Scalar_T >::normal().

6.25.5.2 template<typename Scalar_T > const unsigned long glucat::random_generator< Scalar_T >::seed = 19590921UL [static], [private]

Definition at line 59 of file random.h.

6.25.5.3 template<typename Scalar_T > std::mt19937 glucat::random_generator< Scalar_T >::uint_gen [private]

Definition at line 79 of file random.h.

6.25.5.4 template<typename Scalar_T > std::uniform_real_distribution<double> glucat::random_generator< Scalar_T >::uniform_dist [private]

Definition at line 80 of file random.h.

Referenced by glucat::random_generator< Scalar_T >::uniform().

The documentation for this class was generated from the following file:

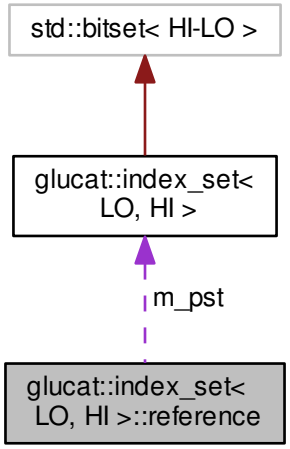
- glucat/random.h

6.26 glucat::index_set< LO, HI >::reference Class Reference

Index set member reference.

`#include <index_set.h>`

Collaboration diagram for glucat::index_set< LO, HI >::reference:



Public Member Functions

- reference (index_set_t &ist, index_t idx)
  index_set reference
- ∼reference ()
- reference & operator= (const bool x)
  for b[i] = x;
- reference & operator= (const reference &j)
  for b[i] = b[j];
- bool operator∼ () const
  Flips a bit.
- operator bool () const
  for x = b[i];
- reference & flip ()
  for b[i].flip();

Private Member Functions

- reference ()
  Private default constructor is left undefined.

Private Attributes

- index_set_t ∗ m_pst
- index_t m_idx

Friends

- class index_set

6.26.1 Detailed Description

template<const index_t LO, const index_t HI>class glucat::index_set< LO, HI >::reference

Index set member reference.

Definition at line 177 of file index_set.h.

6.26.2 Constructor & Destructor Documentation

6.26.2.1 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::reference::reference ( ) [private]

Private default constructor is left undefined.

6.26.2.2 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::reference::reference (index_set_t & *ist*, index_t *idx*) [inline]

index_set reference

Definition at line 983 of file index_set_imp.h.

6.26.2.3 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::reference::~reference ( ) [inline]

Definition at line 184 of file index_set.h.

6.26.3 Member Function Documentation

6.26.3.1 template<const index_t LO, const index_t HI> index_set< LO, HI >::reference & glucat::index_set< LO, HI >::reference::flip ( ) [inline]

for b[i].flip();

Definition at line 1036 of file index_set_imp.h.

References glucat::index_set< LO, HI >::reference::flip().

Referenced by glucat::index_set< LO, HI >::reference::flip().

6.26.3.2 template<const index_t LO, const index_t HI> glucat::index_set< LO, HI >::reference::operator bool ( ) const [inline]

for x = b[i];

Definition at line 1028 of file index_set_imp.h.

6.26.3.3 template<const index_t LO, const index_t HI> index_set< LO, HI >::reference & glucat::index_set< LO, HI >::reference::operator= (const bool *x*) [inline]

for b[i] = x;

Definition at line 993 of file index_set_imp.h.

6.26.3.4 template<const index_t LO, const index_t HI> index_set< LO, HI >::reference & glucat::index_set< LO, HI >::reference::operator= (const reference & *j*) [inline]

for b[i] = b[j];

Definition at line 1007 of file index_set_imp.h.

References glucat::index_set< LO, HI >::reference::m_idx, and glucat::index_set< LO, HI >::reference::m_pst.

6.26.3.5 template<const index_t LO, const index_t HI> bool glucat::index_set< LO, HI >::reference::operator~ ( ) const [inline]

Flips a bit.

flips the bit

Definition at line 1021 of file index_set_imp.h.

6.26.4 Friends And Related Function Documentation

6.26.4.1 template<const index_t LO, const index_t HI> friend class index_set [friend]

Definition at line 178 of file index_set.h.

6.26.5 Member Data Documentation

6.26.5.1 template<const index_t LO, const index_t HI> index_t glucat::index_set< LO, HI >::reference::m_idx [private]

Definition at line 198 of file index_set.h.

Referenced by glucat::index_set< LO, HI >::reference::operator=().

6.26.5.2 template<const index_t LO, const index_t HI> index_set_t* glucat::index_set< LO, HI >::reference::m_pst [private]

Definition at line 197 of file index_set.h.

Referenced by glucat::index_set< LO, HI >::reference::operator=().

The documentation for this class was generated from the following files:

- glucat/index_set.h
- glucat/index_set_imp.h

6.27 glucat::sorted_range< Map_T, Sorted_Map_T > Class Template Reference

Sorted range for use with output.

`#include <framed_multi_imp.h>`

Public Types

- typedef Map_T map_t
- typedef Sorted_Map_T sorted_map_t
- typedef Sorted_Map_T::const_iterator sorted_iterator

Public Member Functions

- sorted_range (Sorted_Map_T &sorted_val, const Map_T &val)

Public Attributes

- sorted_iterator sorted_begin
- sorted_iterator sorted_end

6.27.1 Detailed Description

template<typename Map_T, typename Sorted_Map_T>class glucat::sorted_range< Map_T, Sorted_Map_T >

Sorted range for use with output.

Definition at line 1326 of file framed_multi_imp.h.

6.27.2 Member Typedef Documentation

6.27.2.1 template<typename Map_T, typename Sorted_Map_T> typedef Map_T glucat::sorted_range< Map_T, Sorted_Map_T >::map_t

Definition at line 1329 of file framed_multi_imp.h.

6.27.2.2 template<typename Map_T, typename Sorted_Map_T> typedef Sorted_Map_T::const_iterator glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_iterator

Definition at line 1331 of file framed_multi_imp.h.

6.27.2.3 template<typename Map_T, typename Sorted_Map_T> typedef Sorted_Map_T glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_map_t

Definition at line 1330 of file framed_multi_imp.h.

6.27.3 Constructor & Destructor Documentation

6.27.3.1 template<typename Map_T, typename Sorted_Map_T> glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_range (Sorted_Map_T & *sorted_val,* const Map_T & *val*) [inline]

Definition at line 1333 of file framed_multi_imp.h.

References glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_begin, and glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_end.

6.27.4 Member Data Documentation

6.27.4.1 template<typename Map_T, typename Sorted_Map_T> sorted_iterator glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_begin

Definition at line 1343 of file framed_multi_imp.h.

Referenced by glucat::operator<<(), and glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_range().

6.27.4.2 template<typename Map_T, typename Sorted_Map_T> sorted_iterator glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_end

Definition at line 1344 of file framed_multi_imp.h.

Referenced by glucat::operator<<(), and glucat::sorted_range< Map_T, Sorted_Map_T >::sorted_range().

The documentation for this class was generated from the following file:

- glucat/framed_multi_imp.h

6.28 glucat::sorted_range< Sorted_Map_T, Sorted_Map_T > Class Template Reference

`#include <framed_multi_imp.h>`

Public Types

- typedef Sorted_Map_T map_t
- typedef Sorted_Map_T sorted_map_t
- typedef Sorted_Map_T::const_iterator sorted_iterator

Public Member Functions

- sorted_range (Sorted_Map_T &sorted_val, const Sorted_Map_T &val)

Public Attributes

- sorted_iterator sorted_begin
- sorted_iterator sorted_end

6.28.1 Detailed Description

template<typename Sorted_Map_T>class glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >

Definition at line 1348 of file framed_multi_imp.h.

6.28.2 Member Typedef Documentation

6.28.2.1 template<typename Sorted_Map_T > typedef Sorted_Map_T glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >::map_t

Definition at line 1351 of file framed_multi_imp.h.

6.28.2.2 template<typename Sorted_Map_T > typedef Sorted_Map_T::const_iterator glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >::sorted_iterator

Definition at line 1353 of file framed_multi_imp.h.

6.28.2.3 template<typename Sorted_Map_T > typedef Sorted_Map_T glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >::sorted_map_t

Definition at line 1352 of file framed_multi_imp.h.

6.28.3 Constructor & Destructor Documentation

6.28.3.1 template<typename Sorted_Map_T > glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >::sorted_range (Sorted_Map_T & *sorted_val,* const Sorted_Map_T & *val*) [inline]

Definition at line 1355 of file framed_multi_imp.h.

6.28.4 Member Data Documentation

6.28.4.1 template<typename Sorted_Map_T > sorted_iterator glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >::sorted_begin

Definition at line 1359 of file framed_multi_imp.h.

6.28.4.2 template<typename Sorted_Map_T > sorted_iterator glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >::sorted_end

Definition at line 1360 of file framed_multi_imp.h.

The documentation for this class was generated from the following file:

- glucat/framed_multi_imp.h

6.29 glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision > Struct Template Reference

Tuning policy.

`#include <global.h>`

Public Types

- enum { mult_matrix_threshold = Mult_Matrix_Threshold }
  Minimum index count needed to invoke matrix multiplication algorithm.
- enum { div_max_steps = Div_Max_Steps }
  Maximum steps of iterative refinement in division algorithm.
- enum { sqrt_max_steps = Sqrt_Max_Steps }
  Maximum number of steps in square root iteration.
- enum { log_max_outer_steps = Log_Max_Outer_Steps }
  Maximum number of incomplete square roots in cascade log algorithm.
- enum { log_max_inner_steps = Log_Max_Inner_Steps }
  Maximum number of steps in incomplete square root within cascade log algorithm.
- enum { basis_max_count = Basis_Max_Count }
  Maximum index count of folded frames in basis cache.

- enum { fast_size_threshold = Fast_Size_Threshold }

  Minimum map size needed to invoke generalized FFT.
- enum { inv_fast_dim_threshold = Inv_Fast_Dim_Threshold }

  Minimum matrix dimension needed to invoke inverse generalized FFT.
- enum { products_size_threshold = Products_Size_Threshold }

  Minimum size needed for to invoke faster products algorithms.

Static Public Attributes

- static const precision_t function_precision = Function_Precision

  Precision used for exp, log and sqrt functions.

6.29.1 Detailed Description

template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision>struct glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >

Tuning policy.

Definition at line 151 of file global.h.

6.29.2 Member Enumeration Documentation

6.29.2.1 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Minimum matrix dimension needed to invoke inverse generalized FFT.

Enumerator

inv_fast_dim_threshold

Definition at line 174 of file global.h.

6.29.2.2 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Minimum size needed for to invoke faster products algorithms.

Enumerator

products_size_threshold

Definition at line 177 of file global.h.

6.29.2.3 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Minimum index count needed to invoke matrix multiplication algorithm.

Enumerator

mult_matrix_threshold

Definition at line 155 of file global.h.

6.29.2.4 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Maximum steps of iterative refinement in division algorithm.

Enumerator

div_max_steps

Definition at line 158 of file global.h.

6.29.2.5 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Maximum number of steps in square root iteration.

Enumerator

sqrt_max_steps

Definition at line 161 of file global.h.

6.29.2.6 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Maximum number of incomplete square roots in cascade log algorithm.

Enumerator

log_max_outer_steps

Definition at line 164 of file global.h.

6.29.2.7 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Maximum number of steps in incomplete square root within cascade log algorithm.

Enumerator

log_max_inner_steps

Definition at line 166 of file global.h.

6.29.2.8 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Maximum index count of folded frames in basis cache.

Enumerator

basis_max_count

Definition at line 169 of file global.h.

6.29.2.9 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> anonymous enum

Minimum map size needed to invoke generalized FFT.

Enumerator

fast_size_threshold

Definition at line 172 of file global.h.

6.29.3 Member Data Documentation

6.29.3.1 template<unsigned int Mult_Matrix_Threshold = DEFAULT_Mult_Matrix_Threshold, unsigned int Div_Max_Steps = DEFAULT_Div_Max_Steps, unsigned int Sqrt_Max_Steps = DEFAULT_Sqrt_Max_Steps, unsigned int Log_Max_Outer_Steps = DEFAULT_Log_Max_Outer_Steps, unsigned int Log_Max_Inner_Steps = DEFAULT_Log_Max_Inner_Steps, unsigned int Basis_Max_Count = DEFAULT_Basis_Max_Count, unsigned int Fast_Size_Threshold = DEFAULT_Fast_Size_Threshold, unsigned int Inv_Fast_Dim_Threshold = DEFAULT_Inv_Fast_Dim_Threshold, unsigned int Products_Size_Threshold = DEFAULT_Products_Size_Threshold, precision_t Function_Precision = DEFAULT_Function_Precision> const precision_t glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_Size_Threshold, Function_Precision >::function_precision = Function_Precision [static]

Precision used for exp, log and sqrt functions.

Definition at line 180 of file global.h.

Referenced by glucat::exp(), glucat::log(), and glucat::sqrt().

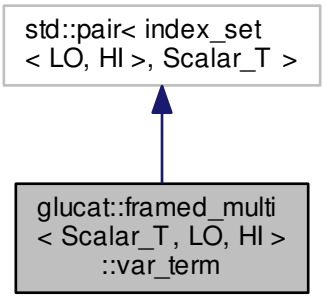
The documentation for this struct was generated from the following file:

- glucat/global.h

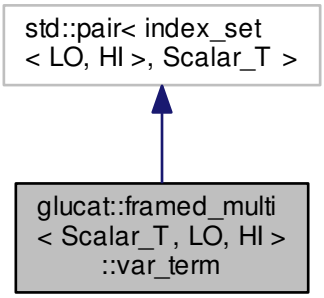
6.30 glucat::framed_multi< Scalar_T, LO, HI >::var_term Class Reference

Variable term.

Inheritance diagram for glucat::framed_multi< Scalar_T, LO, HI >::var_term:



Collaboration diagram for glucat::framed_multi< Scalar_T, LO, HI >::var_term:



Public Types

- typedef std::pair< index_set
  < LO, HI >, Scalar_T > var_pair_t

Public Member Functions

- ~var_term ()

  Destructor.
- var_term ()

  Default constructor.
- var_term (const index_set_t ist, const Scalar_T &crd=Scalar_T(1))

  Construct a variable term from an index set and a scalar coordinate.
- var_term_t & operator*= (const term_t &rhs)

  Product of variable term and term.

Static Public Member Functions

- static const std::string classname ()

  Class name used in messages.

6.30.1 Detailed Description

template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI>class glucat::framed_multi< Scalar_T, LO, HI >::var_term

Variable term.

Definition at line 308 of file framed_multi.h.

6.30.2 Member Typedef Documentation

6.30.2.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> typedef std::pair<index_set<LO,HI>, Scalar_T> glucat::framed_multi< Scalar_T, LO, HI >::var_term::var_pair_t

Definition at line 312 of file framed_multi.h.

6.30.3 Constructor & Destructor Documentation

6.30.3.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::framed_multi< Scalar_T, LO, HI >::var_term::~var_term ( ) [inline]

Destructor.

Definition at line 318 of file framed_multi.h.

6.30.3.2 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::framed_multi< Scalar_T, LO, HI >::var_term::var_term ( ) [inline]

Default constructor.

Definition at line 320 of file framed_multi.h.

6.30.3.3 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> glucat::framed_multi< Scalar_T, LO, HI >::var_term::var_term (const index_set_t *ist,* const Scalar_T & *crd* = Scalar_T(1)) [inline]

Construct a variable term from an index set and a scalar coordinate.

Definition at line 324 of file framed_multi.h.

6.30.4 Member Function Documentation

6.30.4.1 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> static const std::string glucat::framed_multi< Scalar_T, LO, HI >::var_term::classname ( ) [inline], [static]

Class name used in messages.

Definition at line 315 of file framed_multi.h.

6.30.4.2 template<typename Scalar_T = double, const index_t LO = DEFAULT_LO, const index_t HI = DEFAULT_HI> var_term_t& glucat::framed_multi< Scalar_T, LO, HI >::var_term::operator*= (const term_t & *rhs*) [inline]

Product of variable term and term.

Definition at line 328 of file framed_multi.h.

The documentation for this class was generated from the following file:

- glucat/framed_multi.h

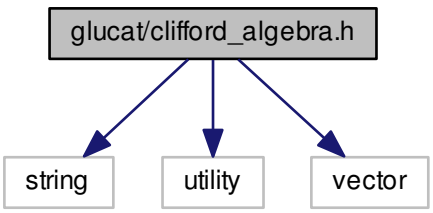
Chapter 7

File Documentation

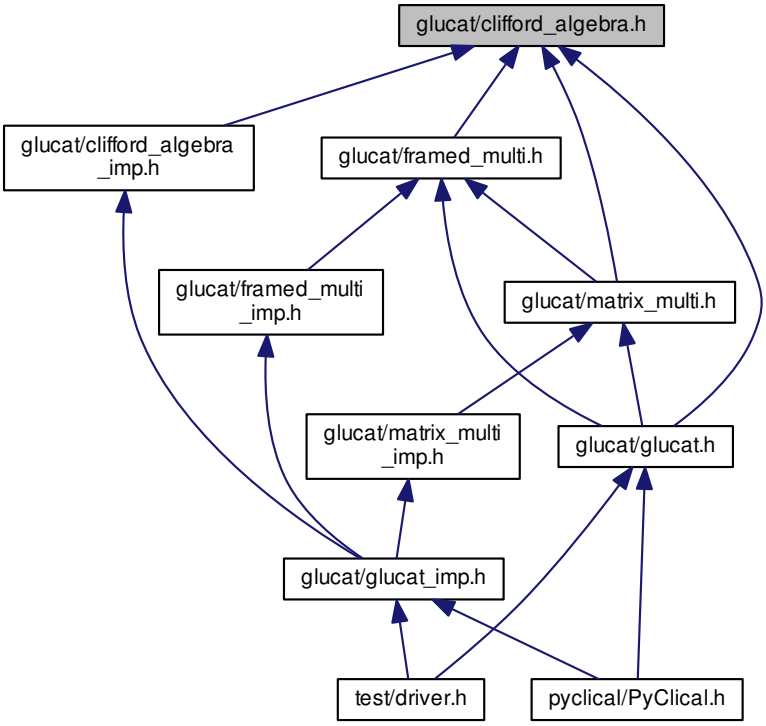
7.1 glucat/clifford_algebra.h File Reference

```
#include <string>
#include <utility>
#include <vector>
```

Include dependency graph for clifford_algebra.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::clifford_algebra< Scalar_T, Index_Set_T, Multivector_T >

  clifford_algebra<> declares the operations of a Clifford algebra

Namespaces

- glucat

Macros

- #define _GLUCAT_CLIFFORD_ALGEBRA_OPERATIONS

Functions

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  bool glucat::operator!= (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Test for inequality of multivectors.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  bool glucat::operator!= (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

Test for inequality of multivector and scalar.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  bool glucat::operator!= (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Test for inequality of scalar and multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator+ (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Geometric sum of multivector and scalar.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator+ (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Geometric sum of scalar and multivector.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator+ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric sum.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator- (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Geometric difference of multivector and scalar.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator- (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Geometric difference of scalar and multivector.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator- (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric difference.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator* (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Product of multivector and scalar.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator* (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Product of scalar and multivector.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T, LO, HI > glucat::operator* (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric product.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator^ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Outer product.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator& (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Inner product.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator% (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Left contraction.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::star (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator/ (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Quotient of multivector and scalar.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator/ (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Quotient of scalar and multivector.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator/ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric quotient.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator| (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::inv (const Multivector< Scalar_T, LO, HI > &val)

  Geometric multiplicative inverse.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::pow (const Multivector< Scalar_T, LO, HI > &lhs, int rhs)

  Integer power of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::pow (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Multivector power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::outer_pow (const Multivector< Scalar_T, LO, HI > &lhs, int rhs)

  Outer product power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::scalar (const Multivector< Scalar_T, LO, HI > &val)

  Scalar part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::real (const Multivector< Scalar_T, LO, HI > &val)

  Real part: synonym for scalar part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::imag (const Multivector< Scalar_T, LO, HI > &val)

  Imaginary part: deprecated (always 0)
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::pure (const Multivector< Scalar_T, LO, HI > &val)

  Pure part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::even (const Multivector< Scalar_T, LO, HI > &val)

  Even part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::odd (const Multivector< Scalar_T, LO, HI > &val)

  Odd part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const std::vector< Scalar_T > glucat::vector_part (const Multivector< Scalar_T, LO, HI > &val)

  Vector part of multivector, as a vector_t with respect to frame()
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::involute (const Multivector< Scalar_T, LO, HI > &val)

  Main involution, each {i} is replaced by -{i} in each term, eg. {1}{2} -> (-{2})*(-{1})*
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::reverse (const Multivector< Scalar_T, LO, HI > &val)

  Reversion, eg. {1}{2} -> {2}*{1}.*
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::conj (const Multivector< Scalar_T, LO, HI > &val)

Conjugation, rev o invo == invo o rev.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::quad (const Multivector< Scalar_T, LO, HI > &val)

  Scalar_T quadratic form == (rev(x)∗x)(0)

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::norm (const Multivector< Scalar_T, LO, HI > &val)

  Scalar_T norm == sum of norm of coordinates.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::abs (const Multivector< Scalar_T, LO, HI > &val)

  Absolute value == sqrt(norm)

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::max_abs (const Multivector< Scalar_T, LO, HI > &val)

  Maximum of absolute values of components of multivector: multivector infinity norm.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::complexifier (const Multivector< Scalar_T, LO, HI > &val)

  Square root of -1 which commutes with all members of the frame of the given multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::elliptic (const Multivector< Scalar_T, LO, HI > &val)

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sqrt (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Square root of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sqrt (const Multivector< Scalar_T, LO, HI > &val)

  Square root of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::clifford_exp (const Multivector< Scalar_T, LO, HI > &val)

  Exponential of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::log (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Natural logarithm of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::log (const Multivector< Scalar_T, LO, HI > &val)

  Natural logarithm of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::cos (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Cosine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::cos (const Multivector< Scalar_T, LO, HI > &val)

  Cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acos (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse cosine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acos (const Multivector< Scalar_T, LO, HI > &val)

  Inverse cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::cosh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acosh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic cosine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acosh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sin (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Sine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sin (const Multivector< Scalar_T, LO, HI > &val)

  Sine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asin (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse sine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asin (const Multivector< Scalar_T, LO, HI > &val)

  Inverse sine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sinh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic sine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asinh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic sine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asinh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic sine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::tan (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Tangent of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::tan (const Multivector< Scalar_T, LO, HI > &val)

  Tangent of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atan (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse tangent of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atan (const Multivector< Scalar_T, LO, HI > &val)

  Inverse tangent of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::tanh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic tangent of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atanh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic tangent of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atanh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic tangent of multivector.

7.1.1 Macro Definition Documentation

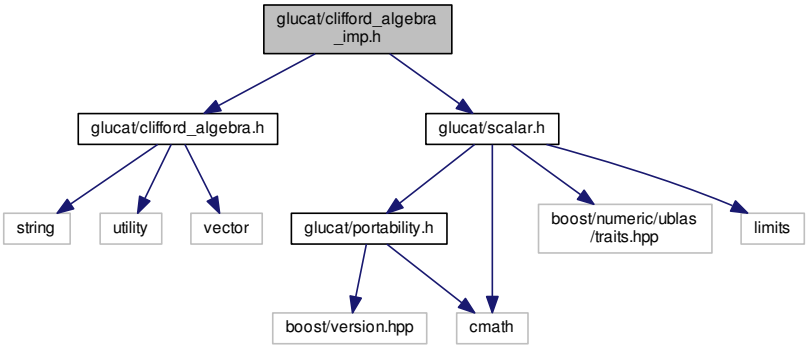
7.1.1.1 #define _GLUCAT_CLIFFORD_ALGEBRA_OPERATIONS

Definition at line 134 of file clifford_algebra.h.

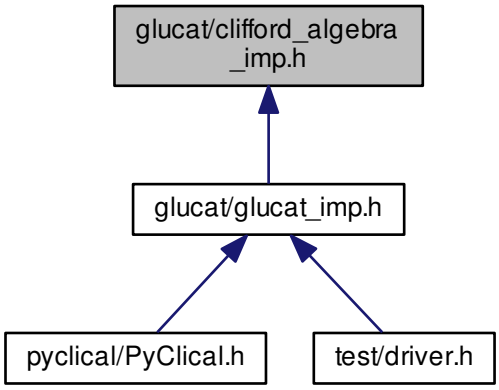
7.2 glucat/clifford_algebra_imp.h File Reference

```
#include <glucat/clifford_algebra.h>
#include <glucat/scalar.h>
```

Include dependency graph for clifford_algebra_imp.h:



This graph shows which files directly or indirectly include this file:



Namespaces

- glucat

Functions

- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  bool glucat::operator!= (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)
  Test for inequality of multivectors.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  bool glucat::operator!= (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)
  Test for inequality of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  bool glucat::operator!= (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)
  Test for inequality of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator+ (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)
  Geometric sum of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator+ (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)
  Geometric sum of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator+ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

Geometric sum.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator- (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Geometric difference of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator- (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Geometric difference of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator- (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric difference.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator* (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Product of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator* (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Product of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator* (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric product.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator^ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Outer product.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator& (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Inner product.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator% (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Left contraction.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::star (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator/ (const Multivector< Scalar_T, LO, HI > &lhs, const Scalar_T &scr)

  Quotient of multivector and scalar.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator/ (const Scalar_T &scr, const Multivector< Scalar_T, LO, HI > &rhs)

  Quotient of scalar and multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator/ (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Geometric quotient.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::operator| (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::inv (const Multivector< Scalar_T, LO, HI > &val)

  Geometric multiplicative inverse.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::pow (const Multivector< Scalar_T, LO, HI > &lhs, int rhs)

  Integer power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, template< typename, const index_t, const index_t > class RHS, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::pow (const Multivector< Scalar_T, LO, HI > &lhs, const RHS< Scalar_T, LO, HI > &rhs)

  Multivector power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::outer_pow (const Multivector< Scalar_T, LO, HI > &lhs, int rhs)

  Outer product power of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::scalar (const Multivector< Scalar_T, LO, HI > &val)

  Scalar part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::real (const Multivector< Scalar_T, LO, HI > &val)

  Real part: synonym for scalar part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::imag (const Multivector< Scalar_T, LO, HI > &val)

  Imaginary part: deprecated (always 0)

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::pure (const Multivector< Scalar_T, LO, HI > &val)

  Pure part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::even (const Multivector< Scalar_T, LO, HI > &val)

  Even part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::odd (const Multivector< Scalar_T, LO, HI > &val)

  Odd part.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const std::vector< Scalar_T > glucat::vector_part (const Multivector< Scalar_T, LO, HI > &val)

  Vector part of multivector, as a vector_t with respect to frame()
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::involute (const Multivector< Scalar_T, LO, HI > &val)

  Main involution, each {i} is replaced by -{i} in each term, eg. {1}{2} -> (-{2})*(-{1})*
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::reverse (const Multivector< Scalar_T, LO, HI > &val)

  Reversion, eg. {1}{2} -> {2}*{1}.*
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::conj (const Multivector< Scalar_T, LO, HI > &val)

  Conjugation, rev o invo == invo o rev.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::quad (const Multivector< Scalar_T, LO, HI > &val)

  *Scalar_T quadratic form == (rev(x)*x)(0)*
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::norm (const Multivector< Scalar_T, LO, HI > &val)

  Scalar_T norm == sum of norm of coordinates.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::abs (const Multivector< Scalar_T, LO, HI > &val)

  Absolute value == sqrt(norm)
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::max_abs (const Multivector< Scalar_T, LO, HI > &val)

  Maximum of absolute values of components of multivector: multivector infinity norm.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::complexifier (const Multivector< Scalar_T, LO, HI > &val)

  Square root of -1 which commutes with all members of the frame of the given multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::elliptic (const Multivector< Scalar_T, LO, HI > &val)
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  static void glucat::check_complex (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Check that i is a valid complexifier for val.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sqrt (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Square root of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sqrt (const Multivector< Scalar_T, LO, HI > &val)

  Square root of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::clifford_exp (const Multivector< Scalar_T, LO, HI > &val)

  Exponential of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::log (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Natural logarithm of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::log (const Multivector< Scalar_T, LO, HI > &val)

  Natural logarithm of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::cosh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acosh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic cosine of multivector with specified complexifier.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acosh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic cosine of multivector.
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::cos (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

Cosine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::cos (const Multivector< Scalar_T, LO, HI > &val)

  Cosine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acos (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse cosine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::acos (const Multivector< Scalar_T, LO, HI > &val)

  Inverse cosine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sinh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asinh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic sine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asinh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sin (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Sine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::sin (const Multivector< Scalar_T, LO, HI > &val)

  Sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asin (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse sine of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::asin (const Multivector< Scalar_T, LO, HI > &val)

  Inverse sine of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::tanh (const Multivector< Scalar_T, LO, HI > &val)

  Hyperbolic tangent of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atanh (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse hyperbolic tangent of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atanh (const Multivector< Scalar_T, LO, HI > &val)

  Inverse hyperbolic tangent of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::tan (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Tangent of multivector with specified complexifier.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::tan (const Multivector< Scalar_T, LO, HI > &val)

  Tangent of multivector.

- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atan (const Multivector< Scalar_T, LO, HI > &val, const Multivector< Scalar_T, LO, HI > &i, const bool prechecked=false)

  Inverse tangent of multivector with specified complexifier.

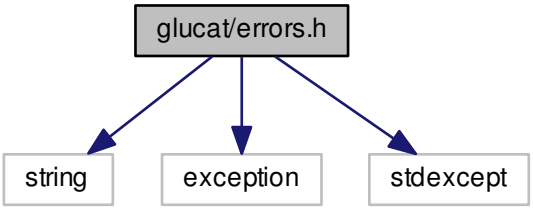
- template<template< typename, const index_t, const index_t > class Multivector, typename Scalar_T , const index_t LO, const index_t HI>
  const Multivector< Scalar_T,
  LO, HI > glucat::atan (const Multivector< Scalar_T, LO, HI > &val)

  Inverse tangent of multivector.

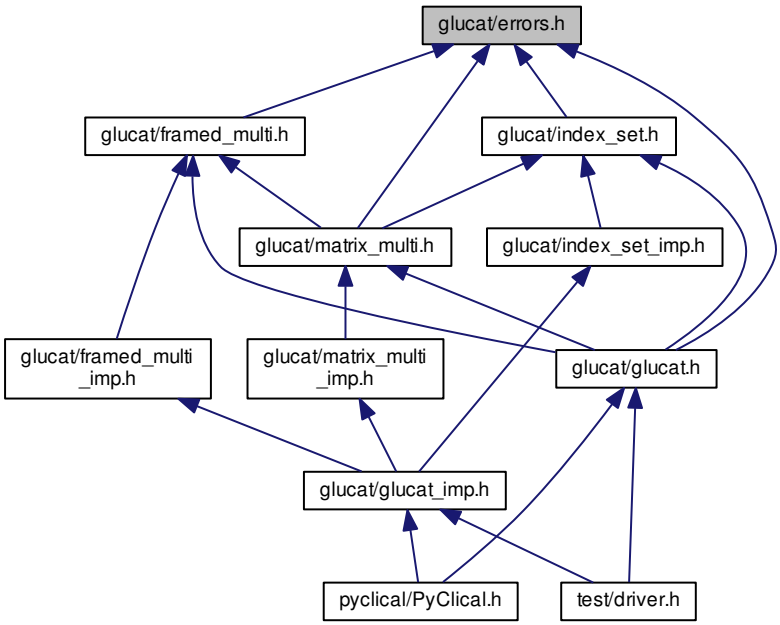
7.3 glucat/errors.h File Reference

```
#include <string>
#include <exception>
#include <stdexcept>
```

Include dependency graph for errors.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::glucat_error

  Abstract exception class.
- class glucat::error< Class_T >

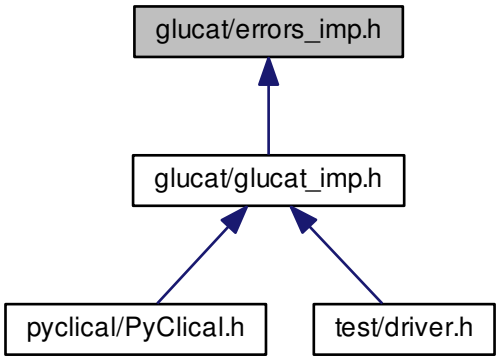
  Specific exception class.

Namespaces

- glucat

7.4 glucat/errors_imp.h File Reference

This graph shows which files directly or indirectly include this file:



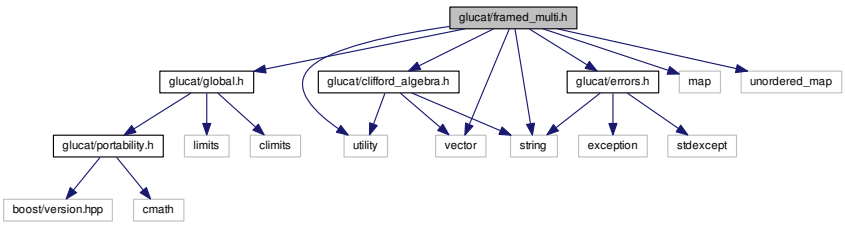
Namespaces

- glucat

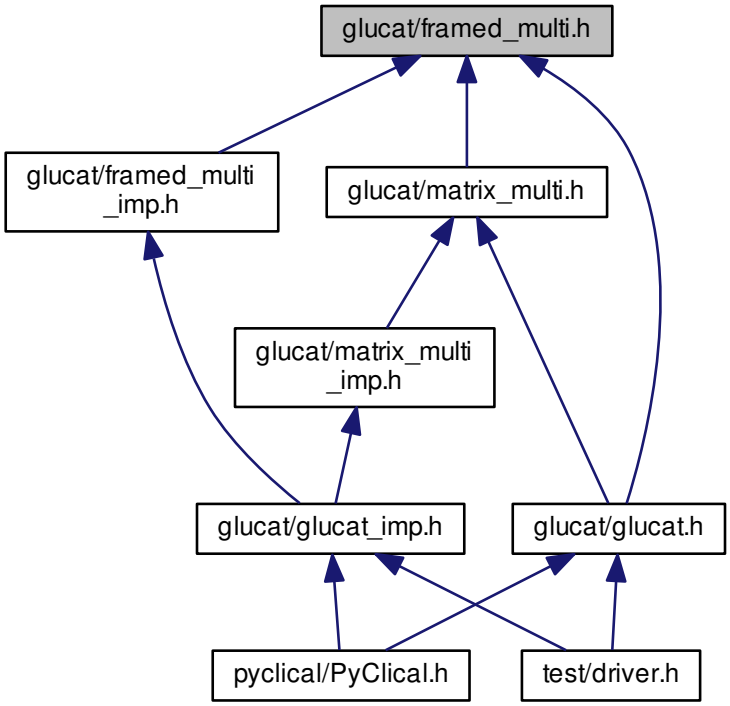
7.5 glucat/framed_multi.h File Reference

```
#include "glucat/global.h"
#include "glucat/errors.h"
#include "glucat/clifford_algebra.h"
#include <string>
#include <utility>
#include <map>
#include <vector>
#include <unordered_map>
```

Include dependency graph for framed_multi.h:



This graph shows which files directly or indirectly include this file:



Classes

- singleton glucat::framed_multi< Scalar_T, LO, HI >

  A framed_multi<Scalar_T,LO,HI> is a framed approximation to a multivector.
- class glucat::matrix_multi< Scalar_T, LO, HI >

  A matrix_multi<Scalar_T,LO,HI> is a matrix approximation to a multivector.
- class glucat::index_set_hash< LO, HI >
- singleton glucat::framed_multi< Scalar_T, LO, HI >

  A framed_multi<Scalar_T,LO,HI> is a framed approximation to a multivector.
- class glucat::framed_multi< Scalar_T, LO, HI >::hash_size_t
- class glucat::framed_multi< Scalar_T, LO, HI >::var_term

  Variable term.
- struct std::numeric_limits< glucat::framed_multi< Scalar_T, LO, HI > >

  Numeric limits for framed_multi inherit limits for the corresponding scalar type.

Namespaces

- glucat
- std

Macros

- #define _GLUCAT_MAP_IS_HASH

Functions

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator* (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Geometric product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator^ (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Outer product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator& (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Inner product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator% (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Left contraction.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::star (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator/ (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Geometric quotient.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator| (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::istream & glucat::operator>> (std::istream &s, framed_multi< Scalar_T, LO, HI > &val)

  Read multivector from input.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::ostream & glucat::operator<< (std::ostream &os, const framed_multi< Scalar_T, LO, HI > &val)

  Write multivector to output.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::ostream & glucat::operator<< (std::ostream &os, const std::pair< const index_set< LO, HI >, Scalar_T > &term)

  Write term to output.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::exp (const framed_multi< Scalar_T, LO, HI > &val)

  Exponential of multivector.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static Scalar_T glucat::crd_of_mult (const std::pair< const index_set< LO, HI >, Scalar_T > &lhs, const std::pair< const index_set< LO, HI >, Scalar_T > &rhs)

  Coordinate of product of terms.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const std::pair< const
  index_set< LO, HI >, Scalar_T > glucat::operator* (const std::pair< const index_set< LO, HI >, Scalar_T > &lhs, const std::pair< const index_set< LO, HI >, Scalar_T > &rhs)

  Product of terms.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::sqrt (const framed_multi< Scalar_T, LO, HI > &val, const framed_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Square root of multivector with specified complexifier.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::log (const framed_multi< Scalar_T, LO, HI > &val, const framed_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Natural logarithm of multivector with specified complexifier.

7.5.1 Macro Definition Documentation

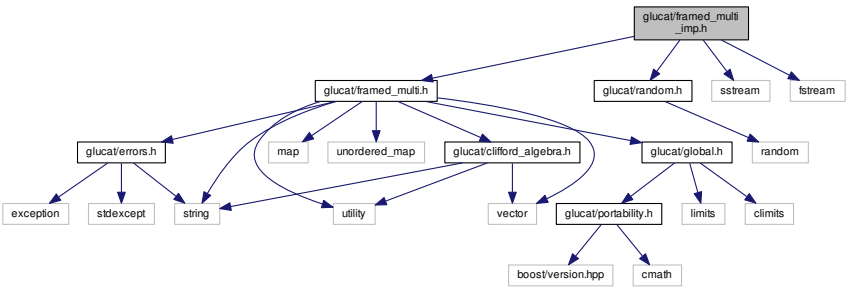
7.5.1.1 #define _GLUCAT_MAP_IS_HASH

Definition at line 55 of file framed_multi.h.

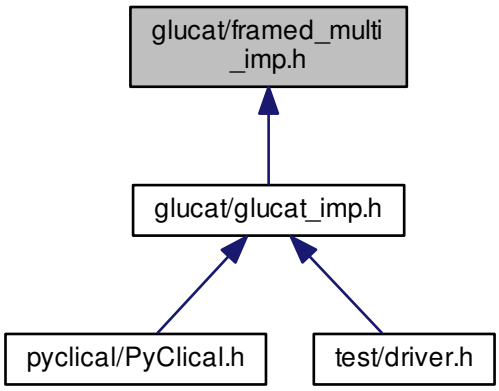
7.6 glucat/framed_multi_imp.h File Reference

```
#include "glucat/framed_multi.h"
#include "glucat/random.h"
#include <sstream>
#include <fstream>
```

Include dependency graph for framed_multi_imp.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::sorted_range< Map_T, Sorted_Map_T >

  Sorted range for use with output.
- class glucat::sorted_range< Sorted_Map_T, Sorted_Map_T >

Namespaces

- glucat

Macros

- #define _GLUCAT_HASH_N(x)
- #define _GLUCAT_HASH_SIZE_T(x)

Functions

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator* (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Geometric product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator^ (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Outer product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const framed_multi< Scalar_T,
  LO, HI > glucat::operator& (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

Inner product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
const framed_multi< Scalar_T,
LO, HI > glucat::operator% (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Left contraction.

- template<typename Scalar_T , const index_t LO, const index_t HI>
Scalar_T glucat::star (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
const framed_multi< Scalar_T,
LO, HI > glucat::operator/ (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Geometric quotient.

- template<typename Scalar_T , const index_t LO, const index_t HI>
const framed_multi< Scalar_T,
LO, HI > glucat::operator| (const framed_multi< Scalar_T, LO, HI > &lhs, const framed_multi< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.

- template<typename Scalar_T , const index_t LO, const index_t HI>
std::ostream & glucat::operator<< (std::ostream &os, const framed_multi< Scalar_T, LO, HI > &val)

  Write multivector to output.

- template<typename Scalar_T , const index_t LO, const index_t HI>
std::ostream & glucat::operator<< (std::ostream &os, const std::pair< const index_set< LO, HI >, Scalar_T > &term)

  Write term to output.

- template<typename Scalar_T , const index_t LO, const index_t HI>
std::istream & glucat::operator>> (std::istream &s, framed_multi< Scalar_T, LO, HI > &val)

  Read multivector from input.

- template<typename Scalar_T , const index_t LO, const index_t HI>
static Scalar_T glucat::crd_of_mult (const std::pair< const index_set< LO, HI >, Scalar_T > &lhs, const std::pair< const index_set< LO, HI >, Scalar_T > &rhs)

  Coordinate of product of terms.

- template<typename Scalar_T , const index_t LO, const index_t HI>
const std::pair< const
index_set< LO, HI >, Scalar_T > glucat::operator* (const std::pair< const index_set< LO, HI >, Scalar_T > &lhs, const std::pair< const index_set< LO, HI >, Scalar_T > &rhs)

  Product of terms.

- template<typename Scalar_T , const index_t LO, const index_t HI>
const framed_multi< Scalar_T,
LO, HI > glucat::sqrt (const framed_multi< Scalar_T, LO, HI > &val, const framed_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Square root of multivector with specified complexifier.

- template<typename Scalar_T , const index_t LO, const index_t HI>
const framed_multi< Scalar_T,
LO, HI > glucat::exp (const framed_multi< Scalar_T, LO, HI > &val)

  Exponential of multivector.

- template<typename Scalar_T , const index_t LO, const index_t HI>
const framed_multi< Scalar_T,
LO, HI > glucat::log (const framed_multi< Scalar_T, LO, HI > &val, const framed_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Natural logarithm of multivector with specified complexifier.

7.6.1 Macro Definition Documentation

7.6.1.1 #define _GLUCAT_HASH_N(*x*)

Definition at line 60 of file framed_multi_imp.h.

7.6.1.2 #define _GLUCAT_HASH_SIZE_T(*x*)

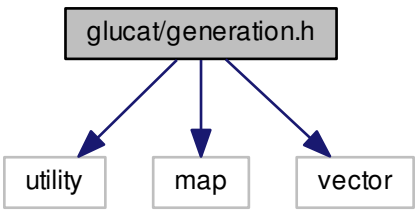
Definition at line 61 of file framed_multi_imp.h.

Referenced by glucat::framed_multi< Scalar_T, LO, HI >::framed_multi(), glucat::operator%(), glucat::operator&(), glucat::operator*(), and glucat::operator^().

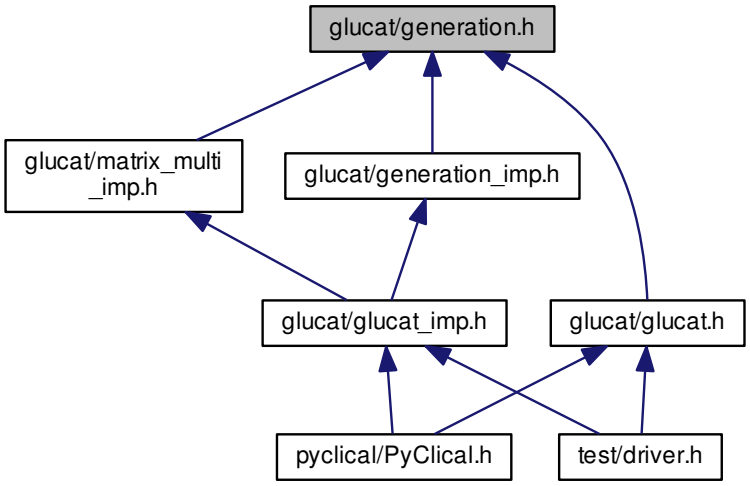
7.7 glucat/generation.h File Reference

```
#include <utility>
#include <map>
#include <vector>
```

Include dependency graph for generation.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::gen::generator_table< Matrix_T >

  Table of generators for specific signatures.

Namespaces

- glucat
- glucat::gen

Typedefs

- typedef std::pair< index_t,
  index_t > glucat::gen::signature_t

  A signature is a pair of indices, p, q, with p == frame.max(), q == -frame.min()

Variables

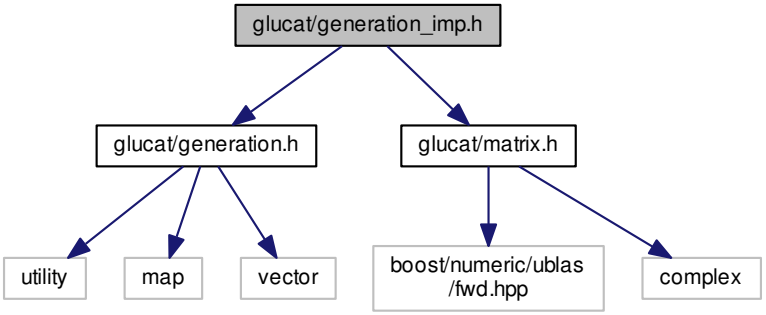
- static const index_t glucat::gen::offset_to_super [] = {0,-1, 0,-1,-2, 3, 2, 1}

  Offsets between the current signature and that of the real superalgebra.

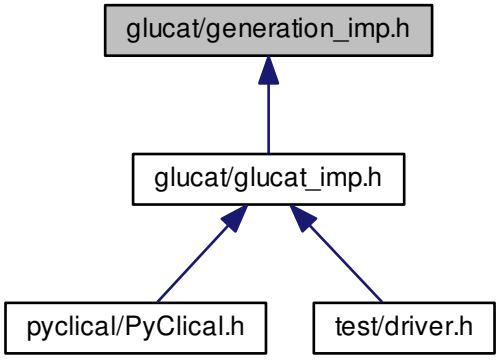
7.8 glucat/generation_imp.h File Reference

```
#include "glucat/generation.h"
#include "glucat/matrix.h"
```

Include dependency graph for generation_imp.h:



This graph shows which files directly or indirectly include this file:



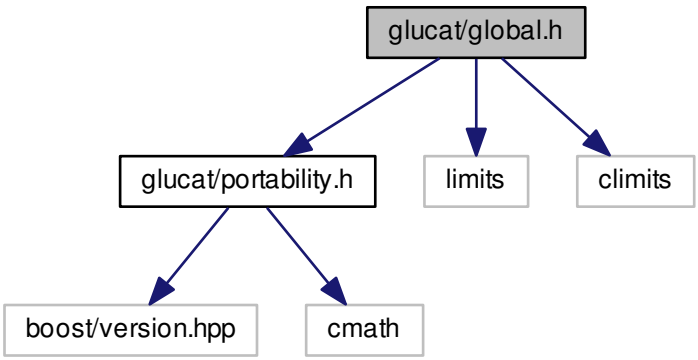
Namespaces

- glucat
- glucat::gen

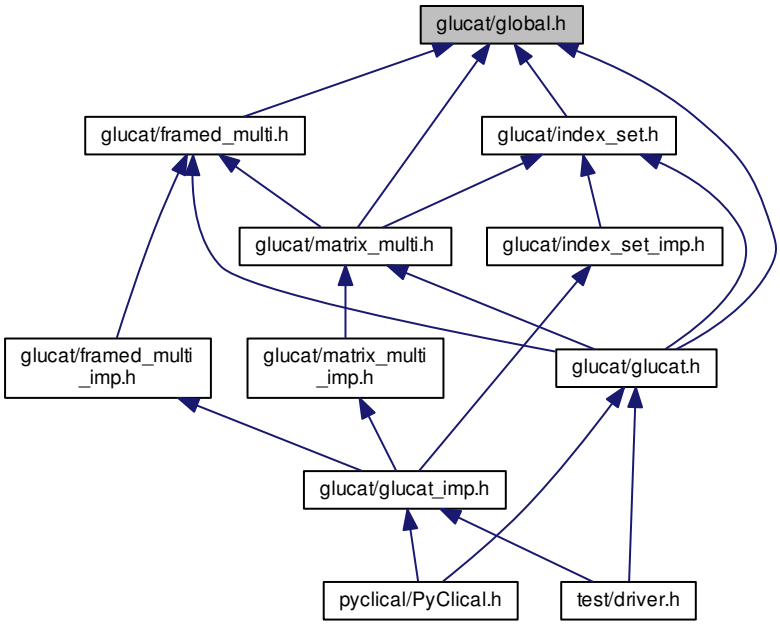
7.9 glucat/global.h File Reference

```
#include "glucat/portability.h"
#include <limits>
#include <climits>
```

Include dependency graph for global.h:



This graph shows which files directly or indirectly include this file:



Classes

- struct glucat::CTAssertion< bool >

  Compile time assertion.
- struct glucat::CTAssertion< true >
- class glucat::compare_types< LHS_T, RHS_T >

  Type comparison.

- class glucat::compare_types< T, T >
- class glucat::bool_to_type< truth_value >

  Bool to type.
- struct glucat::tuning< Mult_Matrix_Threshold, Div_Max_Steps, Sqrt_Max_Steps, Log_Max_Outer_Steps, Log_Max_Inner_Steps, Basis_Max_Count, Fast_Size_Threshold, Inv_Fast_Dim_Threshold, Products_↩ Size_Threshold, Function_Precision >

  Tuning policy.

Namespaces

- glucat

Macros

- #define _GLUCAT_CTAssert(expr, msg) namespace { struct msg { glucat::CTAssertion<(expr)> ERROR↩ _##msg; }; }

Typedefs

- typedef int glucat::index_t

  Size of index_t should be enough to represent LO, HI.
- typedef unsigned long glucat::set_value_t

  Size of set_value_t should be enough to contain index_set<LO,HI>

Enumerations

- enum glucat::precision_t { glucat::precision_demoted, glucat::precision_same, glucat::precision_promoted }

  Precision policy.

Functions

- glucat::_GLUCAT_CTAssert (std::numeric_limits< unsigned char >::radix==2, CannotDetermineBitsPer↩ Char) const index_t BITS_PER_CHAR

  If radix of unsigned char is not 2, we can't easily determine number of bits from sizeof.
- glucat::_GLUCAT_CTAssert (_GLUCAT_BITS_PER_ULONG==BITS_PER_SET_VALUE, BitsPerULong↩ DoesNotMatchSetValueT) const index_t DEFAULT_LO

  Default lowest index in an index set.
- template<typename LHS_T , typename RHS_T >
  LHS_T glucat::pos_mod (LHS_T lhs, RHS_T rhs)

  Modulo function which works reliably for lhs < 0.

Variables

- const double glucat::MS_PER_S = 1000.0

  Timing constant: deprecated here - moved to test/timing.h.
- const index_t glucat::BITS_PER_SET_VALUE = std::numeric_limits<set_value_t>::digits

  Number of bits in set_value_t.
- const index_t glucat::DEFAULT_HI = index_t(BITS_PER_SET_VALUE / 2)

  Default highest index in an index set.
- const double glucat::DEFAULT_TRUNCATION = std::numeric_limits<float>::epsilon()

Default for truncation.

- const unsigned int glucat::DEFAULT_Mult_Matrix_Threshold = 8
- const unsigned int glucat::DEFAULT_Div_Max_Steps = 4
- const unsigned int glucat::DEFAULT_Sqrt_Max_Steps = 256
- const unsigned int glucat::DEFAULT_Log_Max_Outer_Steps = 256
- const unsigned int glucat::DEFAULT_Log_Max_Inner_Steps = 32
- const unsigned int glucat::DEFAULT_Basis_Max_Count = 12
- const unsigned int glucat::DEFAULT_Fast_Size_Threshold = 1 << 6
- const unsigned int glucat::DEFAULT_Inv_Fast_Dim_Threshold = 1 << 3
- const unsigned int glucat::DEFAULT_Products_Size_Threshold = 1 << 22
- const precision_t glucat::DEFAULT_Function_Precision = precision_same

7.9.1 Macro Definition Documentation

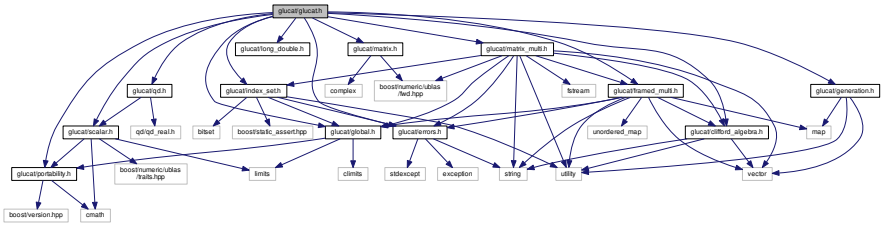
7.9.1.1 #define _GLUCAT_CTAssert(*expr, msg*) namespace { struct msg { glucat::CTAssertion<(expr)> ERROR_##msg; }; }

Definition at line 48 of file global.h.

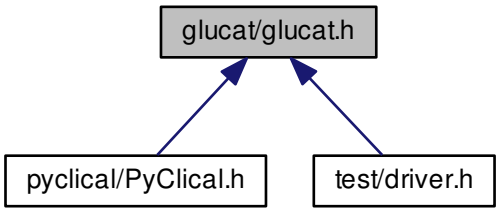
7.10 glucat/glucat.h File Reference

```
#include "glucat/portability.h"
#include "glucat/global.h"
#include "glucat/errors.h"
#include "glucat/index_set.h"
#include "glucat/scalar.h"
#include "glucat/long_double.h"
#include "glucat/qd.h"
#include "glucat/clifford_algebra.h"
#include "glucat/framed_multi.h"
#include "glucat/generation.h"
#include "glucat/matrix.h"
#include "glucat/matrix_multi.h"
```

Include dependency graph for glucat.h:

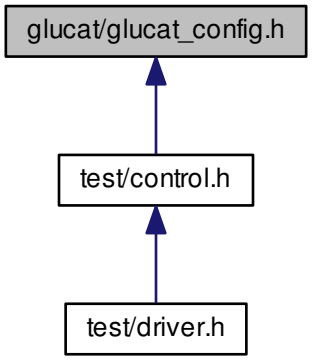


This graph shows which files directly or indirectly include this file:



7.11 glucat/glucat_config.h File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define GLUCAT_HAVE_INTTYPES_H 1
- #define GLUCAT_HAVE_MEMORY_H 1
- #define GLUCAT_HAVE_STDINT_H 1
- #define GLUCAT_HAVE_STDLIB_H 1
- #define GLUCAT_HAVE_STRINGS_H 1
- #define GLUCAT_HAVE_STRING_H 1
- #define GLUCAT_HAVE_SYS_STAT_H 1
- #define GLUCAT_HAVE_SYS_TYPES_H 1
- #define GLUCAT_HAVE_UNISTD_H 1
- #define GLUCAT_PACKAGE "glucat"
- #define GLUCAT_PACKAGE_BUGREPORT ""
- #define GLUCAT_PACKAGE_NAME "glucat"

- #define GLUCAT_PACKAGE_STRING "glucat 0.8.2"
- #define GLUCAT_PACKAGE_TARNAME "glucat"
- #define GLUCAT_PACKAGE_URL ""
- #define GLUCAT_PACKAGE_VERSION "0.8.2"
- #define GLUCAT_STDC_HEADERS 1
- #define GLUCAT_VERSION "0.8.2"

7.11.1 Macro Definition Documentation

7.11.1.1 #define GLUCAT_HAVE_INTTYPES_H 1

Definition at line 10 of file glucat_config.h.

7.11.1.2 #define GLUCAT_HAVE_MEMORY_H 1

Definition at line 18 of file glucat_config.h.

7.11.1.3 #define GLUCAT_HAVE_STDINT_H 1

Definition at line 23 of file glucat_config.h.

7.11.1.4 #define GLUCAT_HAVE_STDLIB_H 1

Definition at line 28 of file glucat_config.h.

7.11.1.5 #define GLUCAT_HAVE_STRING_H 1

Definition at line 38 of file glucat_config.h.

7.11.1.6 #define GLUCAT_HAVE_STRINGS_H 1

Definition at line 33 of file glucat_config.h.

7.11.1.7 #define GLUCAT_HAVE_SYS_STAT_H 1

Definition at line 43 of file glucat_config.h.

7.11.1.8 #define GLUCAT_HAVE_SYS_TYPES_H 1

Definition at line 48 of file glucat_config.h.

7.11.1.9 #define GLUCAT_HAVE_UNISTD_H 1

Definition at line 53 of file glucat_config.h.

7.11.1.10 #define GLUCAT_PACKAGE "glucat"

Definition at line 58 of file glucat_config.h.

7.11.1.11 #define GLUCAT_PACKAGE_BUGREPORT ""

Definition at line 63 of file glucat_config.h.

7.11.1.12 #define GLUCAT_PACKAGE_NAME "glucat"

Definition at line 68 of file glucat_config.h.

Referenced by glucat::control_t::control_t().

7.11.1.13 #define GLUCAT_PACKAGE_STRING "glucat 0.8.2"

Definition at line 73 of file glucat_config.h.

7.11.1.14 #define GLUCAT_PACKAGE_TARNAME "glucat"

Definition at line 78 of file glucat_config.h.

7.11.1.15 #define GLUCAT_PACKAGE_URL ""

Definition at line 83 of file glucat_config.h.

7.11.1.16 #define GLUCAT_PACKAGE_VERSION "0.8.2"

Definition at line 88 of file glucat_config.h.

7.11.1.17 #define GLUCAT_STDC_HEADERS 1

Definition at line 93 of file glucat_config.h.

7.11.1.18 #define GLUCAT_VERSION "0.8.2"

Definition at line 98 of file glucat_config.h.

Referenced by glucat::control_t::control_t().

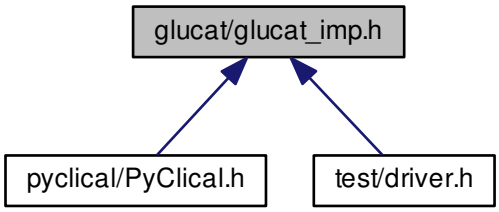
7.12 glucat/glucat_imp.h File Reference

```
#include "glucat/errors_imp.h"
#include "glucat/index_set_imp.h"
#include "glucat/scalar_imp.h"
#include "glucat/clifford_algebra_imp.h"
#include "glucat/random.h"
#include "glucat/framed_multi_imp.h"
#include "glucat/matrix_imp.h"
#include "glucat/generation_imp.h"
#include "glucat/matrix_multi_imp.h"
```

Include dependency graph for glucat_imp.h:



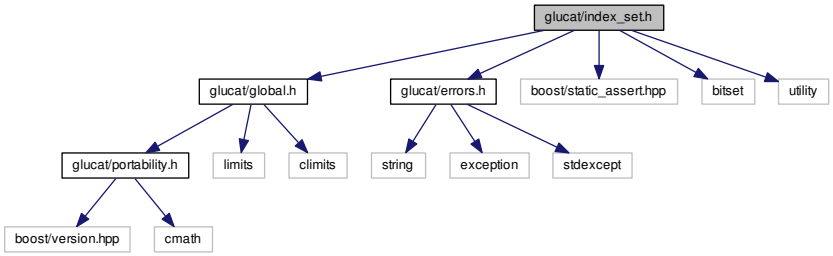
This graph shows which files directly or indirectly include this file:



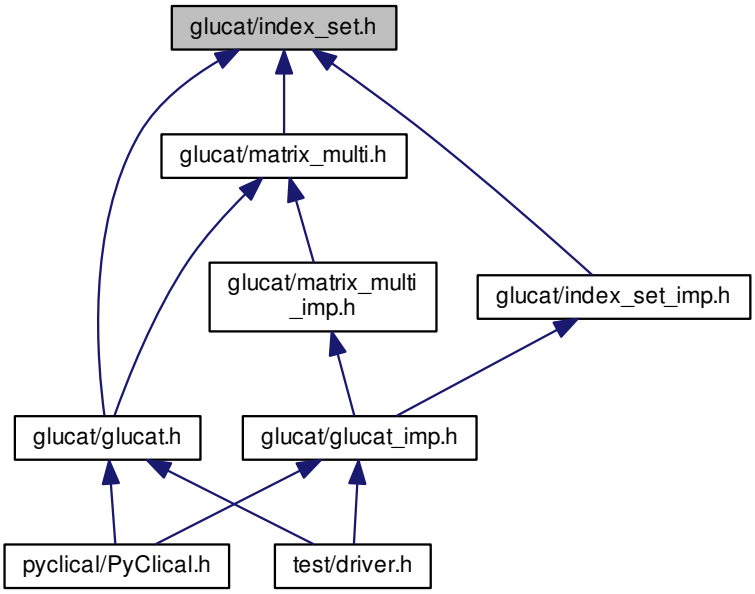
7.13 glucat/index_set.h File Reference

```
#include "glucat/global.h"
#include "glucat/errors.h"
#include <boost/static_assert.hpp>
#include <bitset>
#include <utility>
```

Include dependency graph for index_set.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::index_set< LO, HI >

  Index set class based on std::bitset<> in Gnu standard C++ library.
- class glucat::index_set< LO, HI >

  Index set class based on std::bitset<> in Gnu standard C++ library.
- class glucat::index_set< LO, HI >::reference

  Index set member reference.

Namespaces

- glucat

Functions

- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::operator^ (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

  Symmetric set difference: exclusive or.
- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::operator& (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

  Set intersection: and.
- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::operator| (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

Set union: or.

- template<const index_t LO, const index_t HI>
  int glucat::compare (const index_set< LO, HI > &a, const index_set< LO, HI > &b)

  "lexicographic compare" eg. {3,4,5} is less than {3,7,8}

- glucat::_GLUCAT_CTAssert (sizeof(set_value_t) >=sizeof(std::bitset< DEFAULT_HI-DEFAULT_LO >), Default_index_set_too_big_for_value) template< const index_t LO

  Size of set_value_t should be enough to contain bitset<DEFAULT_HI-DEFAULT_LO>

- const index_t HI std::ostream & glucat::operator<< (std::ostream &os, const index_set< LO, HI > &ist)

  Write out index set.

- template<const index_t LO, const index_t HI>
  std::istream & glucat::operator>> (std::istream &s, index_set< LO, HI > &ist)

  Read in index set.

- int glucat::sign_of_square (index_t j)

  Square of generator {j}.

- template<const index_t LO, const index_t HI>
  index_t glucat::min_neg (const index_set< LO, HI > &ist)

  Minimum negative index, or 0 if none.

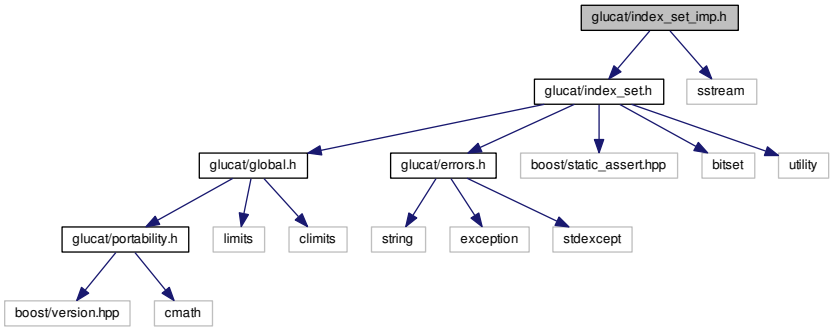
- template<const index_t LO, const index_t HI>
  index_t glucat::max_pos (const index_set< LO, HI > &ist)

  Maximum positive index, or 0 if none.

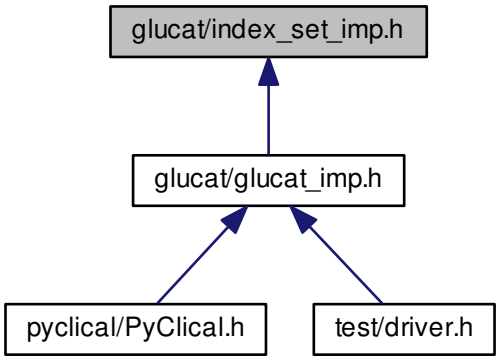
7.14 glucat/index_set_imp.h File Reference

```
#include "glucat/index_set.h"
#include <sstream>
```

Include dependency graph for index_set_imp.h:



This graph shows which files directly or indirectly include this file:



Namespaces

- glucat

Functions

- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::operator^ (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

  Symmetric set difference: exclusive or.
- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::operator& (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

  Set intersection: and.
- template<const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::operator| (const index_set< LO, HI > &lhs, const index_set< LO, HI > &rhs)

  Set union: or.
- template<const index_t LO, const index_t HI>
  int glucat::compare (const index_set< LO, HI > &a, const index_set< LO, HI > &b)

  "lexicographic compare" eg. {3,4,5} is less than {3,7,8}
- const index_t HI std::ostream & glucat::operator<< (std::ostream &os, const index_set< LO, HI > &ist)

  Write out index set.
- template<const index_t LO, const index_t HI>
  std::istream & glucat::operator>> (std::istream &s, index_set< LO, HI > &ist)

  Read in index set.
- static unsigned long glucat::inverse_reversed_gray (unsigned long x)

  Inverse reversed Gray code.
- static unsigned long glucat::inverse_gray (unsigned long x)

  Inverse Gray code.
- int glucat::sign_of_square (index_t j)

  Square of generator {j}.

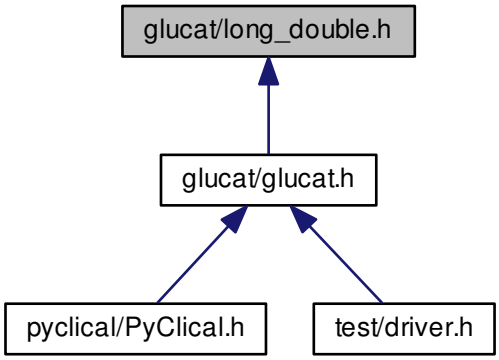
- template<const index_t LO, const index_t HI>
  index_t glucat::min_neg (const index_set< LO, HI > &ist)

  Minimum negative index, or 0 if none.
- template<const index_t LO, const index_t HI>
  index_t glucat::max_pos (const index_set< LO, HI > &ist)

  Maximum positive index, or 0 if none.

7.15 glucat/long_double.h File Reference

This graph shows which files directly or indirectly include this file:



Classes

- struct glucat::numeric_traits< Scalar_T >::demoted<>

  Demoted type for long double.

Namespaces

- glucat

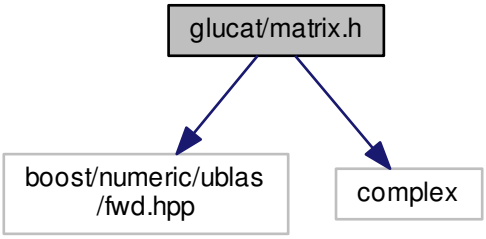
Variables

- static const long double glucat::l_pi = 3.14159265358979323846264338327950 29L
- static const long double glucat::l_ln2 = 0.69314718055994530941723212145817 66L

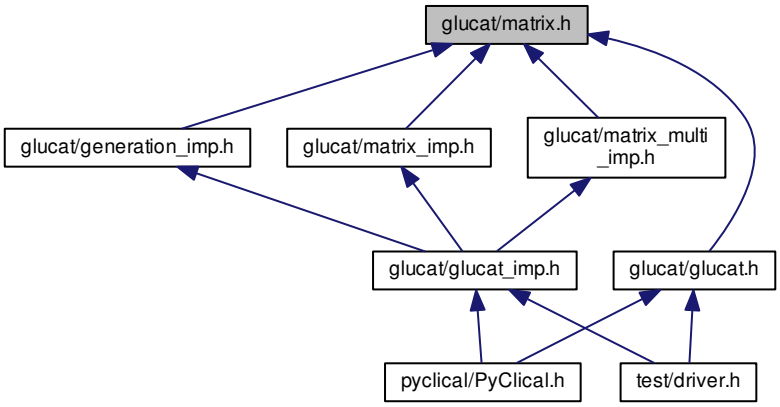
7.16 glucat/matrix.h File Reference

```
#include <boost/numeric/ublas/fwd.hpp>
#include <complex>
```

Include dependency graph for matrix.h:



This graph shows which files directly or indirectly include this file:



Classes

- struct glucat::matrix::eig_genus< Matrix_T >

  Structure containing classification of eigenvalues.

Namespaces

- glucat
- glucat::matrix

Enumerations

- enum glucat::matrix::eig_case_t { glucat::matrix::safe_eig_case, glucat::matrix::negative_eig_case, glucat::matrix::both_eig_case }

  Classification of eigenvalues of a matrix.

Functions

- template<typename LHS_T , typename RHS_T >
const RHS_T glucat::matrix::kron (const LHS_T &lhs, const RHS_T &rhs)

  Kronecker tensor product of matrices - as per Matlab kron.

- template<typename LHS_T , typename RHS_T >
const RHS_T glucat::matrix::mono_kron (const LHS_T &lhs, const RHS_T &rhs)

  Sparse Kronecker tensor product of monomial matrices.

- template<typename LHS_T , typename RHS_T >
const RHS_T glucat::matrix::nork (const LHS_T &lhs, const RHS_T &rhs, const bool mono=true)

  Left inverse of Kronecker product.

- template<typename LHS_T , typename RHS_T >
const RHS_T glucat::matrix::signed_perm_nork (const LHS_T &lhs, const RHS_T &rhs)

  Left inverse of Kronecker product where lhs is a signed permutation matrix.

- template<typename Matrix_T >
Matrix_T::size_type glucat::matrix::nnz (const Matrix_T &m)

  Number of non-zeros.

- template<typename Matrix_T >
bool glucat::matrix::isnan (const Matrix_T &m)

  Not a Number.

- template<typename Matrix_T >
const Matrix_T glucat::matrix::unit (const typename Matrix_T::size_type n)

  Unit matrix - as per Matlab eye.

- template<typename LHS_T , typename RHS_T >
const RHS_T::expression_type glucat::matrix::mono_prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas::matrix_expression< RHS_T > &rhs)

  Product of monomial matrices.

- template<typename LHS_T , typename RHS_T >
const RHS_T::expression_type glucat::matrix::sparse_prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas::matrix_expression< RHS_T > &rhs)

  Product of sparse matrices.

- template<typename LHS_T , typename RHS_T >
const RHS_T::expression_type glucat::matrix::prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas::matrix_expression< RHS_T > &rhs)

  Product of matrices.

- template<typename Scalar_T , typename LHS_T , typename RHS_T >
Scalar_T glucat::matrix::inner (const LHS_T &lhs, const RHS_T &rhs)

  Inner product: sum(x(i,j)∗y(i,j))/x.nrows()

- template<typename Matrix_T >
Matrix_T::value_type glucat::matrix::norm_frob2 (const Matrix_T &val)

  Square of Frobenius norm.

- template<typename Matrix_T >
Matrix_T::value_type glucat::matrix::trace (const Matrix_T &val)

  Matrix trace.

- template<typename Matrix_T >
ublas::vector< std::complex
< double > > glucat::matrix::eigenvalues (const Matrix_T &val)

  Eigenvalues of a matrix.

- template<typename Matrix_T >
eig_genus< Matrix_T > glucat::matrix::classify_eigenvalues (const Matrix_T &val)

  Classify the eigenvalues of a matrix.

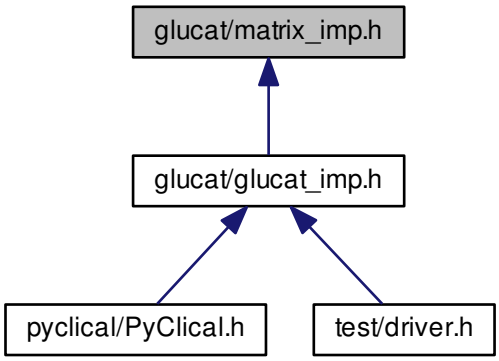
7.17 glucat/matrix_imp.h File Reference

```
#include "glucat/matrix.h"
#include <boost/numeric/ublas/vector.hpp>
#include <boost/numeric/ublas/vector_proxy.hpp>
#include <boost/numeric/ublas/matrix.hpp>
#include <boost/numeric/ublas/matrix_expression.hpp>
#include <boost/numeric/ublas/matrix_proxy.hpp>
#include <boost/numeric/ublas/matrix_sparse.hpp>
#include <boost/numeric/ublas/operation.hpp>
#include <boost/numeric/ublas/operation_sparse.hpp>
#include <boost/numeric/bindings/lapack/driver/gees.hpp>
#include <boost/numeric/bindings/ublas.hpp>
#include <set>
```

Include dependency graph for matrix_imp.h:



This graph shows which files directly or indirectly include this file:



Namespaces

- glucat
- glucat::matrix

Functions

- template<typename LHS_T , typename RHS_T >
  const RHS_T glucat::matrix::kron (const LHS_T &lhs, const RHS_T &rhs)

  Kronecker tensor product of matrices - as per Matlab kron.
- template<typename LHS_T , typename RHS_T >
  const RHS_T glucat::matrix::mono_kron (const LHS_T &lhs, const RHS_T &rhs)

Sparse Kronecker tensor product of monomial matrices.

- template<typename LHS_T , typename RHS_T >
  void glucat::matrix::nork_range (RHS_T &result, const typename LHS_T::const_iterator2 lhs_it2, const RHS_T &rhs, const typename RHS_T::size_type res_s1, const typename RHS_T::size_type res_s2)

  Utility routine for nork: calculate result for a range of indices.

- template<typename LHS_T , typename RHS_T >
  const RHS_T glucat::matrix::nork (const LHS_T &lhs, const RHS_T &rhs, const bool mono=true)

  Left inverse of Kronecker product.

- template<typename LHS_T , typename RHS_T >
  const RHS_T glucat::matrix::signed_perm_nork (const LHS_T &lhs, const RHS_T &rhs)

  Left inverse of Kronecker product where lhs is a signed permutation matrix.

- template<typename Matrix_T >
  Matrix_T::size_type glucat::matrix::nnz (const Matrix_T &m)

  Number of non-zeros.

- template<typename Matrix_T >
  bool glucat::matrix::isnan (const Matrix_T &m)

  Not a Number.

- template<typename Matrix_T >
  const Matrix_T glucat::matrix::unit (const typename Matrix_T::size_type n)

  Unit matrix - as per Matlab eye.

- template<typename LHS_T , typename RHS_T >
  const RHS_T::expression_type glucat::matrix::mono_prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas::matrix_expression< RHS_T > &rhs)

  Product of monomial matrices.

- template<typename LHS_T , typename RHS_T >
  const RHS_T::expression_type glucat::matrix::sparse_prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas::matrix_expression< RHS_T > &rhs)

  Product of sparse matrices.

- template<typename LHS_T , typename RHS_T >
  const RHS_T::expression_type glucat::matrix::prod (const ublas::matrix_expression< LHS_T > &lhs, const ublas::matrix_expression< RHS_T > &rhs)

  Product of matrices.

- template<typename Scalar_T , typename LHS_T , typename RHS_T >
  Scalar_T glucat::matrix::inner (const LHS_T &lhs, const RHS_T &rhs)

  *Inner product: sum(x(i,j)*y(i,j))/x.nrows()*

- template<typename Matrix_T >
  Matrix_T::value_type glucat::matrix::norm_frob2 (const Matrix_T &val)

  Square of Frobenius norm.

- template<typename Matrix_T >
  Matrix_T::value_type glucat::matrix::trace (const Matrix_T &val)

  Matrix trace.

- template<typename Matrix_T >
  static ublas::matrix< double, ublas::column_major > glucat::matrix::to_lapack (const Matrix_T &val)

  Convert matrix to LAPACK format.

- template<typename Matrix_T >
  ublas::vector< std::complex < double > > glucat::matrix::eigenvalues (const Matrix_T &val)

  Eigenvalues of a matrix.

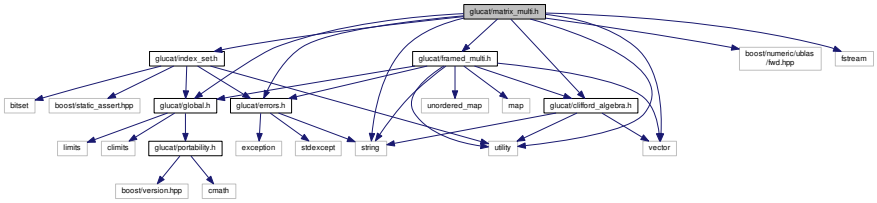
- template<typename Matrix_T >
  eig_genus< Matrix_T > glucat::matrix::classify_eigenvalues (const Matrix_T &val)

  Classify the eigenvalues of a matrix.

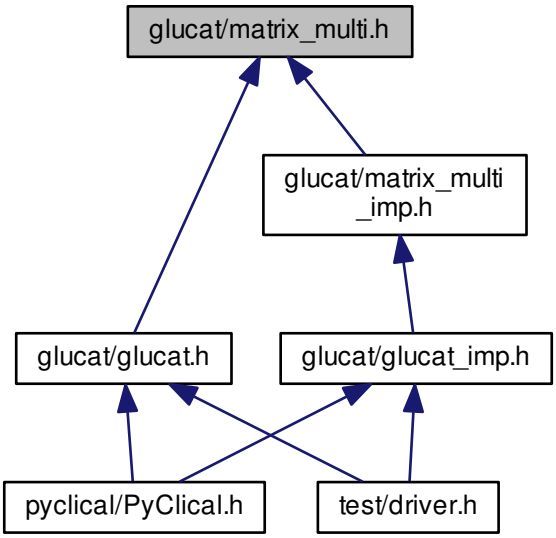
7.18 glucat/matrix_multi.h File Reference

```
#include "glucat/global.h"
#include "glucat/errors.h"
#include "glucat/index_set.h"
#include "glucat/clifford_algebra.h"
#include "glucat/framed_multi.h"
#include <boost/numeric/ublas/fwd.hpp>
#include <fstream>
#include <string>
#include <utility>
#include <vector>
```

Include dependency graph for matrix_multi.h:



This graph shows which files directly or indirectly include this file:



Classes

- singleton glucat::framed_multi< Scalar_T, LO, HI >

  A framed_multi<Scalar_T,LO,HI> is a framed approximation to a multivector.
- class glucat::matrix_multi< Scalar_T, LO, HI >

A matrix_multi<Scalar_T,LO,HI> is a matrix approximation to a multivector.

- class glucat::matrix_multi< Scalar_T, LO, HI >

  A matrix_multi<Scalar_T,LO,HI> is a matrix approximation to a multivector.

- struct std::numeric_limits< glucat::matrix_multi< Scalar_T, LO, HI > >

  Numeric limits for matrix_multi inherit limits for the corresponding scalar type.

Namespaces

- glucat
- std

Functions

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator* (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Geometric product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator^ (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Outer product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator& (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Inner product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator% (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Left contraction.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::star (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator/ (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Geometric quotient.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator| (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::istream & glucat::operator>> (std::istream &s, matrix_multi< Scalar_T, LO, HI > &val)

  Read multivector from input.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::ostream & glucat::operator<< (std::ostream &os, const matrix_multi< Scalar_T, LO, HI > &val)

  Write multivector to output.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::reframe (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs, matrix_multi< Scalar_T, LO, HI > &lhs_reframed, matrix_multi< Scalar_T, LO, HI > &rhs_reframed)

  Find a common frame for operands of a binary operator.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::sqrt (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Square root of multivector with specified complexifier.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::matrix_sqrt (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i)

  Square root of multivector with specified complexifier.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::log (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Natural logarithm of multivector with specified complexifier.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::matrix_log (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i)

  Natural logarithm of multivector with specified complexifier.

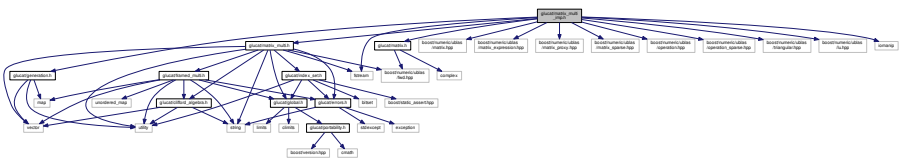
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::exp (const matrix_multi< Scalar_T, LO, HI > &val)

  Exponential of multivector.

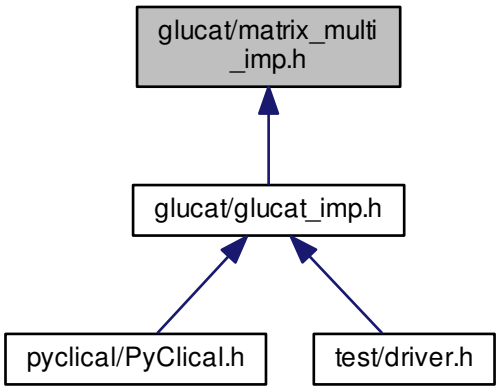
7.19 glucat/matrix_multi_imp.h File Reference

```
#include "glucat/matrix_multi.h"
#include "glucat/matrix.h"
#include "glucat/generation.h"
#include <boost/numeric/ublas/matrix.hpp>
#include <boost/numeric/ublas/matrix_expression.hpp>
#include <boost/numeric/ublas/matrix_proxy.hpp>
#include <boost/numeric/ublas/matrix_sparse.hpp>
#include <boost/numeric/ublas/operation.hpp>
#include <boost/numeric/ublas/operation_sparse.hpp>
#include <boost/numeric/ublas/triangular.hpp>
#include <boost/numeric/ublas/lu.hpp>
#include <fstream>
#include <iomanip>
```

Include dependency graph for matrix_multi_imp.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::basis_table< Scalar_T, LO, HI, Matrix_T >

  Table of basis elements used as a cache by basis_element()

Namespaces

- glucat

Functions

- index_t glucat::offset_level (const index_t p, const index_t q)

  Determine the log2 dim corresponding to signature p, q.

- template<typename Matrix_Index_T , const index_t LO, const index_t HI>
  static Matrix_Index_T glucat::folded_dim (const index_set< LO, HI > &sub)

  Determine the matrix dimension of the fold of a subalegbra.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const index_set< LO, HI > glucat::reframe (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs, matrix_multi< Scalar_T, LO, HI > &lhs_reframed, matrix_multi< Scalar_T, LO, HI > &rhs_reframed)

  Find a common frame for operands of a binary operator.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator* (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Geometric product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator^ (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Outer product.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator& (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Inner product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator% (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Left contraction.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  Scalar_T glucat::star (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Hestenes scalar product.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator/ (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Geometric quotient.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::operator| (const matrix_multi< Scalar_T, LO, HI > &lhs, const matrix_multi< Scalar_T, LO, HI > &rhs)

  Transformation via twisted adjoint action.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::ostream & glucat::operator<< (std::ostream &os, const matrix_multi< Scalar_T, LO, HI > &val)

  Write multivector to output.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  std::istream & glucat::operator>> (std::istream &s, matrix_multi< Scalar_T, LO, HI > &val)

  Read multivector from input.
- template<typename Multivector_T , typename Matrix_T , typename Basis_Matrix_T >
  static Multivector_T glucat::fast (const Matrix_T &X, index_t level)

  Inverse generalized Fast Fourier Transform.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > glucat::pade_approx (const int array_size, const Scalar_T a[], const Scalar_T b[], const matrix_multi< Scalar_T, LO, HI > &X)

  Pade' approximation.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static void glucat::db_step (matrix_multi< Scalar_T, LO, HI > &M, matrix_multi< Scalar_T, LO, HI > &Y)

  Single step of product form of Denman-Beavers square root iteration.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > glucat::db_sqrt (const matrix_multi< Scalar_T, LO, HI > &val)

  Product form of Denman-Beavers square root iteration.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::sqrt (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Square root of multivector with specified complexifier.
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::matrix_sqrt (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i)

  Square root of multivector with specified complexifier.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > glucat::pade_log (const matrix_multi< Scalar_T, LO, HI > &val)

  Pade' approximation of log.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  static const matrix_multi
  < Scalar_T, LO, HI > glucat::cascade_log (const matrix_multi< Scalar_T, LO, HI > &val)

  Incomplete square root cascade and Pade' approximation of log.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::log (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i, bool prechecked)

  Natural logarithm of multivector with specified complexifier.

- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::matrix_log (const matrix_multi< Scalar_T, LO, HI > &val, const matrix_multi< Scalar_T, LO, HI > &i)

  Natural logarithm of multivector with specified complexifier.

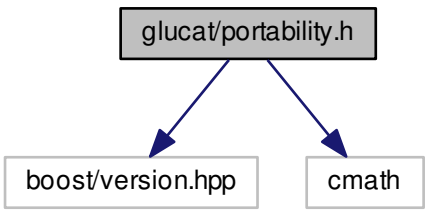
- template<typename Scalar_T , const index_t LO, const index_t HI>
  const matrix_multi< Scalar_T,
  LO, HI > glucat::exp (const matrix_multi< Scalar_T, LO, HI > &val)

  Exponential of multivector.

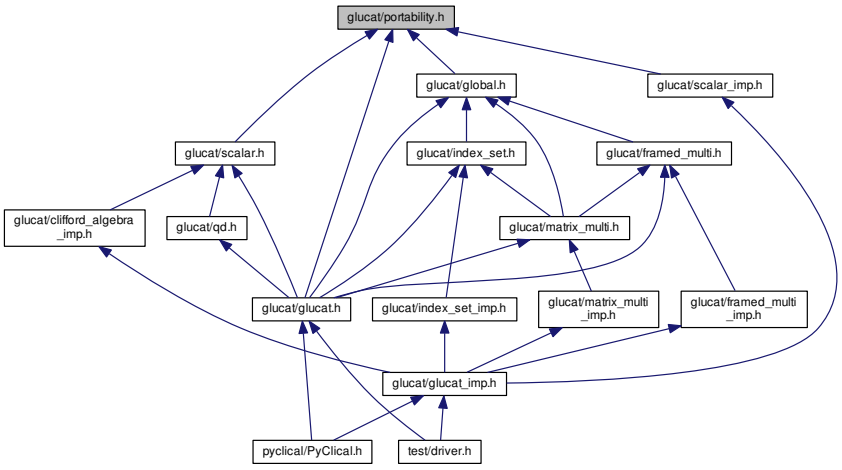
7.20 glucat/portability.h File Reference

```
#include <boost/version.hpp>
#include <cmath>
```

Include dependency graph for portability.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define _GLUCAT_ISNAN(x) (x != x)
- #define _GLUCAT_ISINF(x) (!_GLUCAT_ISNAN(x) && _GLUCAT_ISNAN(x-x))
- #define UBLAS_ABS abs
- #define UBLAS_SQRT sqrt

7.20.1 Macro Definition Documentation

7.20.1.1 #define _GLUCAT_ISINF(x) (!_GLUCAT_ISNAN(x) && _GLUCAT_ISNAN(x-x))

Definition at line 48 of file portability.h.

Referenced by glucat::numeric_traits< Scalar_T >::isInf().

7.20.1.2 #define _GLUCAT_ISNAN(x) (x != x)

Definition at line 47 of file portability.h.

Referenced by glucat::numeric_traits< Scalar_T >::isNaN().

7.20.1.3 #define UBLAS_ABS abs

Definition at line 56 of file portability.h.

Referenced by glucat::numeric_traits< Scalar_T >::abs().

7.20.1.4 #define UBLAS_SQRT sqrt

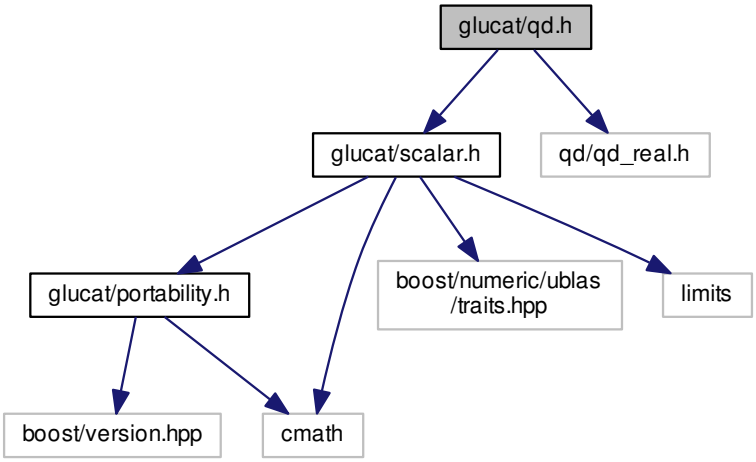
Definition at line 57 of file portability.h.

Referenced by glucat::numeric_traits< Scalar_T >::sqrt().

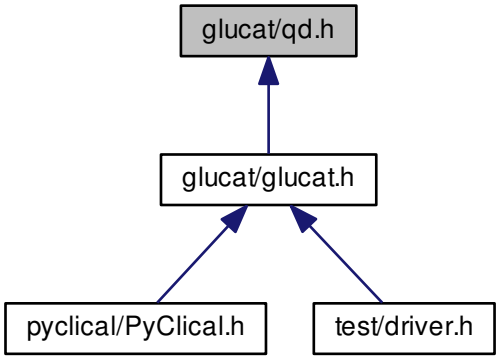
7.21 glucat/qd.h File Reference

```
#include "glucat/scalar.h"
#include <qd/qd_real.h>
```

Include dependency graph for qd.h:



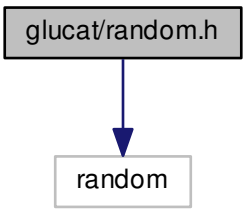
This graph shows which files directly or indirectly include this file:



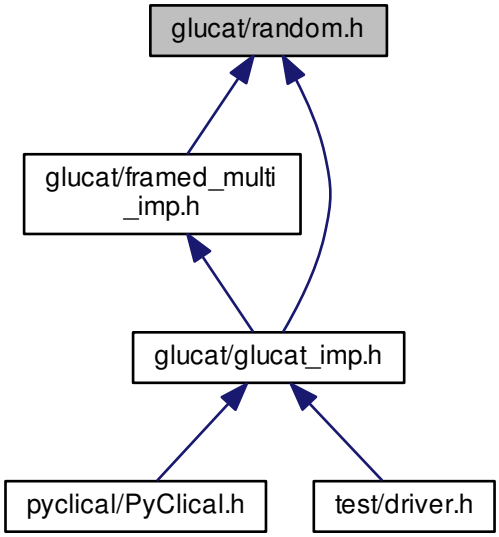
7.22 glucat/random.h File Reference

```
#include <random>
```

Include dependency graph for random.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::random_generator< Scalar_T >

  Random number generator with single instance per Scalar_T.

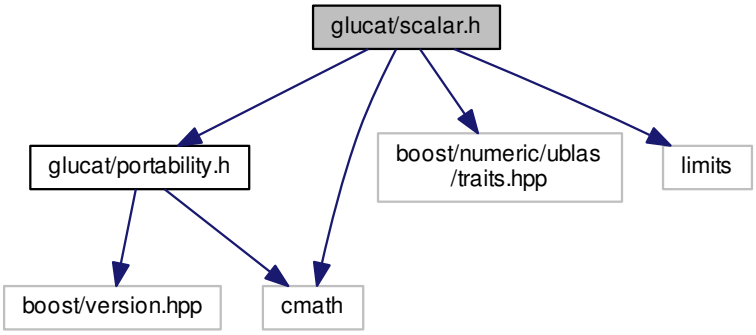
Namespaces

- glucat

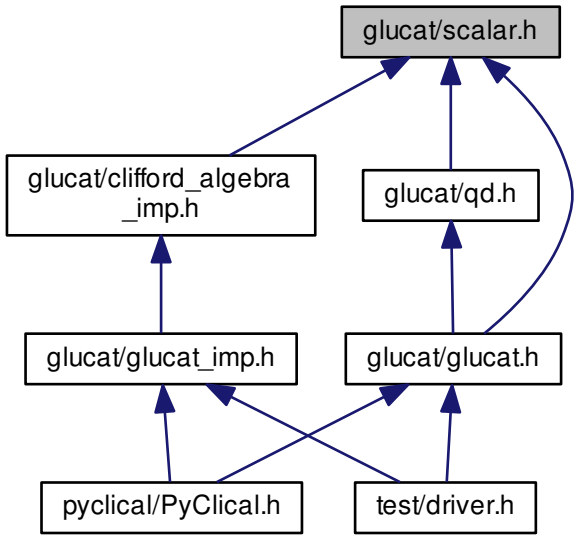
7.23 glucat/scalar.h File Reference

```
#include "glucat/portability.h"
#include <boost/numeric/ublas/traits.hpp>
#include <cmath>
#include <limits>
```

Include dependency graph for scalar.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::numeric_traits< Scalar_T >

Extra traits which extend numeric limits.

- struct glucat::numeric_traits< Scalar_T >::promoted

  Promoted type.

- struct glucat::numeric_traits< Scalar_T >::demoted<>

  Demoted type for long double.

Namespaces

- glucat

Functions

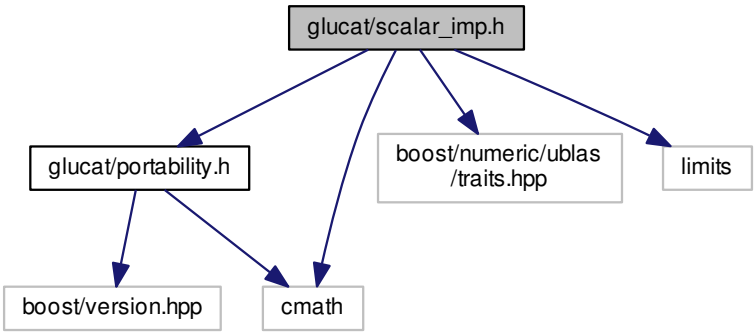
- template<typename Scalar_T >
  Scalar_T glucat::log2 (const Scalar_T &x)

  Log base 2 of scalar.

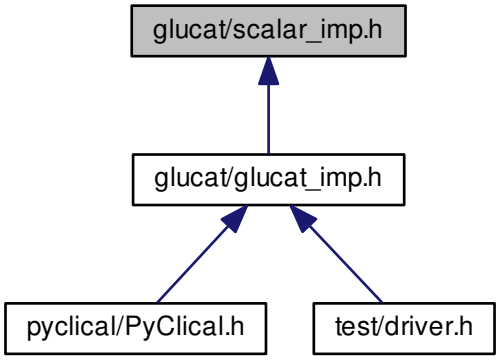
7.24 glucat/scalar_imp.h File Reference

```
#include "glucat/portability.h"
#include <boost/numeric/ublas/traits.hpp>
#include <cmath>
#include <limits>
```

Include dependency graph for scalar_imp.h:



This graph shows which files directly or indirectly include this file:



Namespaces

- glucat

Functions

- template<typename Scalar_T >
  numeric_traits< Scalar_T >
  ::promoted::type glucat::to_promote (const Scalar_T &val)

  Cast to promote.

- template<typename Scalar_T >
  numeric_traits< Scalar_T >
  ::demoted::type glucat::to_demote (const Scalar_T &val)

  Cast to demote.

7.25 pyclical/glucat.pxd File Reference

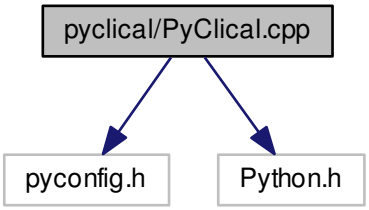
Namespaces

- glucat

7.26 pyclical/PyClical.cpp File Reference

```
#include "pyconfig.h"
#include "Python.h"
```

Include dependency graph for PyClical.cpp:



Macros

- #define PY_SSIZE_T_CLEAN
- #define CYTHON_USE_PYLONG_INTERNALS 0

7.26.1 Macro Definition Documentation

7.26.1.1 #define CYTHON_USE_PYLONG_INTERNALS 0

Definition at line 12 of file PyClical.cpp.

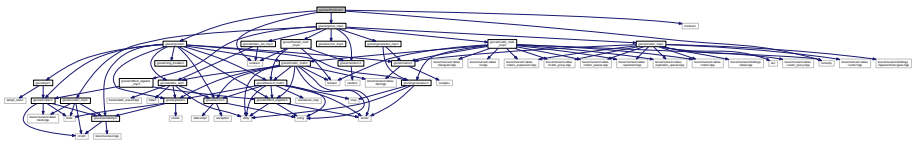
7.26.1.2 #define PY_SSIZE_T_CLEAN

Definition at line 3 of file PyClical.cpp.

7.27 pyclical/PyClical.h File Reference

```
#include "glucat/glucat.h"
#include "glucat/glucat_imp.h"
#include <iostream>
#include <sstream>
#include <iomanip>
```

Include dependency graph for PyClical.h:



Namespaces

- cga3

  Definitions for 3D Conformal Geometric Algebra [DL].

Typedefs

- typedef glucat::tuning < glucat::DEFAULT_Mult_Matrix_Threshold, glucat::DEFAULT_Div_Max_Steps, glucat::DEFAULT_Sqrt_Max_Steps, glucat::DEFAULT_Log_Max_Outer_Steps, glucat::DEFAULT_Log_Max_Inner_Steps, glucat::DEFAULT_Basis_Max_Count, glucat::DEFAULT_Fast_Size_Threshold, glucat::DEFAULT_Inv_Fast_Dim_Threshold, glucat::DEFAULT_Products_Size_Threshold, glucat::precision_promoted > Tune_P
- typedef std::string String
- typedef index_set< lo_ndx, hi_ndx > IndexSet
- typedef double scalar_t
- typedef matrix_multi< scalar_t > Clifford

Functions

- template<typename Scalar_T >
  PyObject * PyFloat_FromDouble (Scalar_T v)
- template<typename Index_Set_T >
  String index_set_to_repr (const Index_Set_T &ist)

  The "official" string representation of Index_Set_T ist.
- template<typename Index_Set_T >
  String index_set_to_str (const Index_Set_T &ist)

  The "informal" string representation of Index_Set_T ist.
- template<typename Multivector_T >
  String clifford_to_repr (const Multivector_T &mv)

  The "official" string representation of Multivector_T mv.
- template<typename Multivector_T >
  String clifford_to_str (const Multivector_T &mv)

  The "informal" string representation of Multivector_T mv.
- template<typename Multivector_T >
  Multivector_T cga3::cga3 (const Multivector_T &x)

  Convert Euclidean 3D vector to Conformal Geometric Algebra null vector [DL (10.50)].
- template<typename Multivector_T >
  Multivector_T cga3::cga3std (const Multivector_T &X)

  Convert CGA3 null vector to standard Conformal Geometric Algebra null vector [DL (10.52)].
- template<typename Multivector_T >
  Multivector_T cga3::agc3 (const Multivector_T &X)

  Convert CGA3 null vector to Euclidean 3D vector [DL (10.50)].

Variables

- const index_t lo_ndx = DEFAULT_LO
- const index_t hi_ndx = DEFAULT_HI

7.27.1 Typedef Documentation

7.27.1.1 typedef matrix_multi<scalar_t> Clifford

Definition at line 160 of file PyClical.h.

7.27.1.2 typedef index_set<lo_ndx,hi_ndx> IndexSet

Definition at line 157 of file PyClical.h.

7.27.1.3 typedef double scalar_t

Definition at line 159 of file PyClical.h.

7.27.1.4 typedef std::string String

Definition at line 65 of file PyClical.h.

7.27.1.5 typedef glucat::tuning< glucat::DEFAULT_Mult_Matrix_Threshold, glucat::DEFAULT_Div_↩ Max_Steps, glucat::DEFAULT_Sqrt_Max_Steps, glucat::DEFAULT_Log_Max_Outer_Steps, glucat::DEFAULT_Log_Max_Inner_Steps, glucat::DEFAULT_Basis_Max_Count, glucat::DEFAULT_Fast_Size_Threshold, glucat::DEFAULT_Inv_Fast_Dim_Threshold, glucat::DEFAULT_Products_Size_Threshold, glucat::precision_promoted > Tune_P

Definition at line 49 of file PyClical.h.

7.27.2 Function Documentation

7.27.2.1 template<typename Multivector_T > String clifford_to_repr (const Multivector_T & *mv*) [inline]

The “official” string representation of Multivector_T mv.

Definition at line 87 of file PyClical.h.

Referenced by PyClical.clifford::__repr__().

7.27.2.2 template<typename Multivector_T > String clifford_to_str (const Multivector_T & *mv*) [inline]

The "informal" string representation of Multivector_T mv.

Definition at line 98 of file PyClical.h.

References glucat::abs(), and PyClical::e().

Referenced by PyClical.clifford::__str__().

7.27.2.3 template<typename Index_Set_T > String index_set_to_repr (const Index_Set_T & *ist*) [inline]

The “official” string representation of Index_Set_T ist.

Definition at line 69 of file PyClical.h.

Referenced by PyClical.index_set::__repr__().

7.27.2.4 template<typename Index_Set_T > String index_set_to_str (const Index_Set_T & *ist*) [inline]

The "informal" string representation of Index_Set_T ist.

Definition at line 78 of file PyClical.h.

References PyClical::ist.

Referenced by PyClical.index_set::__str__().

7.27.2.5 template<typename Scalar_T > PyObject* PyFloat_FromDouble (Scalar_T *v*) [inline]

Create a PyFloatObject object from Scalar_T v. Needed because Scalar_T might not be the same as double.

Definition at line 59 of file PyClical.h.

7.27.3 Variable Documentation

7.27.3.1 const index_t hi_ndx = DEFAULT_HI

Definition at line 156 of file PyClical.h.

7.27.3.2 const index_t lo_ndx = DEFAULT_LO

Definition at line 155 of file PyClical.h.

7.28 pyclical/PyClical.pxd File Reference

Namespaces

- PyClical

7.29 pyclical/PyClical.pyx File Reference

Classes

- class PyClical.index_set
- class PyClical.index_set
- class PyClical.clifford
- class PyClical.clifford

Namespaces

- PyClical

Functions

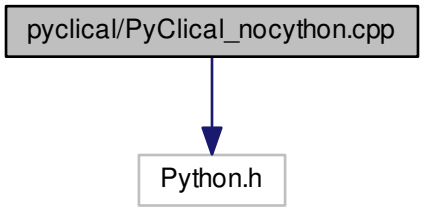
- def PyClical.index_set_hidden_doctests
- def PyClical.clifford_hidden_doctests
- def PyClical.e
- def PyClical.istpq
- def PyClical._test

Variables

- string PyClical.__version__ = "0.8.2"
- tuple PyClical.tau = atan(clifford(1.0))
- float PyClical.pi = tau/2.0
- PyClical.cl = clifford
- PyClical.ist = index_set
- tuple PyClical.ninf3 = e(4)
- tuple PyClical.nbar3 = e(4)

7.30 pyclical/PyClical_nocython.cpp File Reference

```
#include "Python.h"
```
Include dependency graph for PyClical_nocython.cpp:



Macros

- #define PY_SSIZE_T_CLEAN

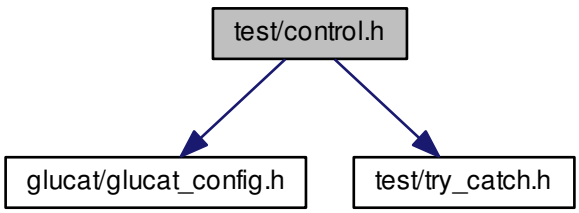
7.30.1 Macro Definition Documentation

7.30.1.1 #define PY_SSIZE_T_CLEAN

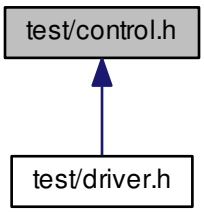
Definition at line 52 of file PyClical_nocython.cpp.

7.31 test/control.h File Reference

```
#include "glucat/glucat_config.h"
#include "test/try_catch.h"
```
Include dependency graph for control.h:



This graph shows which files directly or indirectly include this file:



Classes

- class glucat::control_t

  Parameters to control tests.

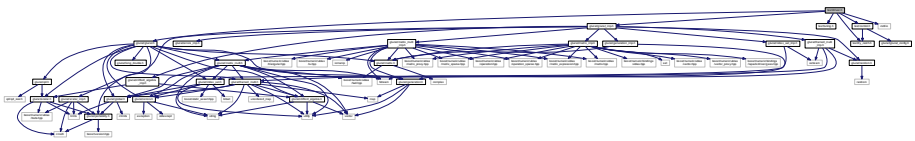
Namespaces

- glucat

7.32 test/driver.h File Reference

```
#include "glucat/glucat.h"
#include "test/tuning.h"
#include "glucat/glucat_imp.h"
#include "test/try_catch.h"
#include "test/control.h"
#include <cstdio>
```

Include dependency graph for driver.h:



7.33 test/timing.h File Reference

Namespaces

- glucat
- glucat::timing

Functions

- static double glucat::timing::elapsed (clock_t cpu_time)

  Elapsed time in milliseconds.

Variables

- const double glucat::timing::MS_PER_SEC = 1000.0

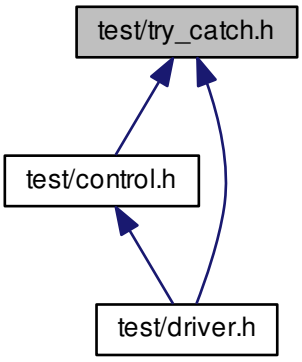
  Timing constant: milliseconds per second.
- const double glucat::timing::MS_PER_CLOCK = MS_PER_SEC / double(CLOCKS_PER_SEC)

  Timing constant: milliseconds per clock.
- const int glucat::timing::EXTRA_TRIALS = 2

  Timing constant: trial expansion factor.

7.34 test/try_catch.h File Reference

This graph shows which files directly or indirectly include this file:



Namespaces

- glucat

Typedefs

- typedef int(∗ glucat::intfn)()

  For exception catching: pointer to function returning int.
- typedef int(∗ glucat::intintfn)(int)

  For exception catching: pointer to function of int returning int.

Functions

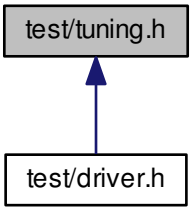
- int glucat::try_catch (intfn f)

  Exception catching for functions returning int.
- int glucat::try_catch (intintfn f, int arg)

  Exception catching for functions of int returning int.

7.35 test/tuning.h File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define __TEST_TUNING_DEFAULT_CONSTANT(SUFFIX) const unsigned int Test_Tuning_##SUFFIX = glucat::DEFAULT_##SUFFIX

Typedefs

- typedef glucat::precision_t precision_t
- typedef glucat::tuning
  < Test_Tuning_Mult_Matrix_Threshold,
  Test_Tuning_Div_Max_Steps,
  Test_Tuning_Sqrt_Max_Steps,
  Test_Tuning_Log_Max_Outer_Steps,
  Test_Tuning_Log_Max_Inner_Steps,
  Test_Tuning_Basis_Max_Count,
  Test_Tuning_Fast_Size_Threshold,
  Test_Tuning_Inv_Fast_Dim_Threshold,
  Test_Tuning_Products_Size_Threshold,
  Test_Tuning_Function_Precision > Tune_P

  Tuning policy.

Functions

- _GLUCAT_CTAssert (std::numeric_limits< unsigned int >::radix==2, CannotSetThresholds) const unsigned int Test_Tuning_Int_Digits
- __TEST_TUNING_DEFAULT_CONSTANT (Mult_Matrix_Threshold)
- __TEST_TUNING_DEFAULT_CONSTANT (Div_Max_Steps)

- __TEST_TUNING_DEFAULT_CONSTANT (Sqrt_Max_Steps)
- __TEST_TUNING_DEFAULT_CONSTANT (Log_Max_Outer_Steps)
- __TEST_TUNING_DEFAULT_CONSTANT (Log_Max_Inner_Steps)
- __TEST_TUNING_DEFAULT_CONSTANT (Basis_Max_Count)
- __TEST_TUNING_DEFAULT_CONSTANT (Fast_Size_Threshold)
- __TEST_TUNING_DEFAULT_CONSTANT (Inv_Fast_Dim_Threshold)
- __TEST_TUNING_DEFAULT_CONSTANT (Products_Size_Threshold)

Variables

- const unsigned int Test_Tuning_Max_Threshold = 1 << Test_Tuning_Int_Digits
- const precision_t Test_Tuning_Function_Precision = glucat::DEFAULT_Function_Precision

7.35.1 Macro Definition Documentation

7.35.1.1 #define __TEST_TUNING_DEFAULT_CONSTANT(*SUFFIX*) const unsigned int Test_Tuning_##SUFFIX = glucat::DEFAULT_##SUFFIX

Definition at line 41 of file tuning.h.

7.35.2 Typedef Documentation

7.35.2.1 typedef glucat::precision_t precision_t

Definition at line 39 of file tuning.h.

7.35.2.2 typedef glucat::tuning< Test_Tuning_Mult_Matrix_Threshold, Test_Tuning_Div_Max_Steps, Test_Tuning_Sqrt_Max_Steps, Test_Tuning_Log_Max_Outer_Steps, Test_Tuning_Log_Max_Inner_Steps, Test_Tuning_Basis_Max_Count, Test_Tuning_Fast_Size_Threshold, Test_Tuning_Inv_Fast_Dim_Threshold, Test_Tuning_Products_Size_Threshold, Test_Tuning_Function_Precision > Tune_P

Tuning policy.

Definition at line 126 of file tuning.h.

7.35.3 Function Documentation

7.35.3.1 __TEST_TUNING_DEFAULT_CONSTANT (Mult_Matrix_Threshold)

7.35.3.2 __TEST_TUNING_DEFAULT_CONSTANT (Div_Max_Steps)

7.35.3.3 __TEST_TUNING_DEFAULT_CONSTANT (Sqrt_Max_Steps)

7.35.3.4 __TEST_TUNING_DEFAULT_CONSTANT (Log_Max_Outer_Steps)

7.35.3.5 __TEST_TUNING_DEFAULT_CONSTANT (Log_Max_Inner_Steps)

7.35.3.6 __TEST_TUNING_DEFAULT_CONSTANT (Basis_Max_Count)

7.35.3.7 __TEST_TUNING_DEFAULT_CONSTANT (Fast_Size_Threshold)

7.35.3.8 __TEST_TUNING_DEFAULT_CONSTANT (Inv_Fast_Dim_Threshold)

7.35.3.9 __TEST_TUNING_DEFAULT_CONSTANT (Products_Size_Threshold)

7.35.3.10 _GLUCAT_CTAssert (std::numeric_limits< unsigned int >::radix == 2, CannotSetThresholds) const

7.35.4 Variable Documentation

7.35.4.1 const precision_t Test_Tuning_Function_Precision = glucat::DEFAULT_Function_Precision

Definition at line 110 of file tuning.h.

7.35.4.2 const unsigned int Test_Tuning_Max_Threshold = 1 << Test_Tuning_Int_Digits

Definition at line 37 of file tuning.h.

7.36 test/undefine.h File Reference

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