Octave C++ Classes

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2 A Brief Introduction to Octave

This manual documents how to run, install and port Octave's C++ classes, and how to report bugs.

3 Arrays

3.1 Constructors and Assignment

Array<T>::Array (`void`) Constructor

Create an array with no elements.

Array<T>::Array (`int` *n* [`, const T &`*val*]) Constructor

Create an array with *n* elements. If the optional argument *val* is supplied, the elements are initialized to *val*; otherwise, they are left uninitialized. If *n* is less than zero, the current error handler is invoked (see Chapter 13 [Error Handling], page 45).

Array<T>::Array (`const Array<T> &`*a*) Constructor

Create a copy of the *Array*<*T*> object *a*. Memory for the *Array*<*T*> class is managed using a reference counting scheme, so the cost of this operation is independent of the size of the array.

`Array<T>&` **Array<T>::operator =** (`const Array<T> &`*a*) Operator

Assignment operator. Memory for the *Array*<*T*> class is managed using a reference counting scheme, so the cost of this operation is independent of the size of the array.

`int` **Array<T>::capacity** (`void`) `const` Method
`int` **Array<T>::length** (`void`) `const` Method

Return the length of the array.

`T&` **Array<T>::elem** (`int` *n*) Method
`T&` **Array<T>::checkelem** (`int` *n*) Method
`T&` **Array<T>::operator** () (`int` *n*) Method

If *n* is within the bounds of the array, return a reference to the element indexed by *n*; otherwise, the current error handler is invoked (see Chapter 13 [Error Handling], page 45).

`T` **Array<T>::elem** (`int` *n*) `const` Method
`T` **Array<T>::checkelem** (`int` *n*) `const` Method
`T` **Array<T>::operator** () (`int` *n*) `const` Method

If *n* is within the bounds of the array, return the value indexed by *n*; otherwise, call the current error handler. See Chapter 13 [Error Handling], page 45.

`T&` **Array<T>::xelem** (`int` *n*) Method
`T` **Array<T>::xelem** (`int` *n*) `const` Method

Return a reference to, or the value of, the element indexed by *n*. These methods never perform bounds checking.

`void` **Array<T>::resize** (`int` *n* [, `const T &`*val*]) Method

Change the size of the array to be *n* elements. All elements are unchanged, except that if *n* is greater than the current size and the optional argument *val* is provided, the additional elements are initialized to *val*; otherwise, any additional elements are left uninitialized. In the current implementation, if *n* is less than the current size, the length is updated but no memory is released.

`const T*` **Array<T>::data** (`void`) `const` Method

Array2 (`void`)
Array2 (`int` *n*, `int` *m*)
Array2 (`int` *n*, `int` *m*, `const T &`*val*)
Array2 (`const Array2<T> &`*a*)
Array2 (`const DiagArray<T> &`*a*)

`Array2<T>&` **operator =** (`const Array2<T> &`*a*)

`int` **dim1** (`void`) `const`
`int` **rows** (`void`) `const`

`int` **dim2** (`void`) `const`
`int` **cols** (`void`) `const`
`int` **columns** (`void`) `const`

`T&` **elem** (`int` *i*, `int` *j*)
`T&` **checkelem** (`int` *i*, `int` *j*)
`T&` **operator** () (`int` *i*, `int` *j*)

`void` **resize** (`int` *n*, `int` *m*)
`void` **resize** (`int` *n*, `int` *m*, `const T &`*val*)

`Array3` (**void**)
`Array3` (**int** *n*, `int` *m*, `int` *k*)
`Array3` (**int** *n*, `int` *m*, `int` *k*, `const T &`*val*)
`Array3` (**const** `Array3<T> &`*a*)

`Array3<T>&` **operator =** (`const Array3<T> &`*a*)

`int` **dim1** (`void`) `const`
`int` **dim2** (`void`) `const`
`int` **dim3** (`void`) `const`

`T&` **elem** (`int` *i*, `int` *j*, `int` *k*)
`T&` **checkelem** (`int` *i*, `int` *j*, `int` *k*)
`T&` **operator** () (`int` *i*, `int` *j*, `int` *k*)

`void` **resize** (`int` *n*, `int` *m*, `int` *k*)
`void` **resize** (`int` *n*, `int` *m*, `int` *k*, `const T &`*val*)

(void)
(int *n*)
(int *n*, `const T &`*val*)
(int *r*, `int` *c*)
(int *r*, `int` *c*, `const T &`*val*)
(const `Array<T> &`*a*)
(const `DiagArray<T> &`*a*)

`DiagArray<T>&` **operator =** (`const DiagArray<T> &`*a*)

`int` **dim1** (`void`) `const`
`int` **rows** (`void`) `const`

`int` **dim2** (`void`) `const`
`int` **cols** (`void`) `const`
`int` **columns** (`void`) `const`

`T&` **elem** (`int` *r*, `int` *c*)
`T&` **checkelem** (`int` *r*, `int` *c*)
`T&` **operator ()** (`int` *r*, `int` *c*)

`void` **resize** (`int` *n*, `int` *m*)
`void` **resize** (`int` *n*, `int` *m*, `const T &`*val*)

The real and complex `ColumnVector` and `RowVector` classes all have the following functions. These will eventually be part of an `MArray<T>` class, derived from the `Array<T>` class. Then the `ColumnVector` and `RowVector` classes will be derived from the `MArray<T>` class.

Element by element vector by scalar ops.

`RowVector` **operator +** (`const RowVector &`*a*, `const double &`*s*)
`RowVector` **operator -** (`const RowVector &`*a*, `const double &`*s*)
`RowVector` **operator *** (`const RowVector &`*a*, `const double &`*s*)
`RowVector` **operator /** (`const RowVector &`*a*, `const double &`*s*)

Element by element scalar by vector ops.

`RowVector` **operator +** (`const double &`*s*, `const RowVector &`*a*)
`RowVector` **operator -** (`const double &`*s*, `const RowVector &`*a*)
`RowVector` **operator *** (`const double &`*s*, `const RowVector &`*a*)
`RowVector` **operator /** (`const double &`*s*, `const RowVector &`*a*)

Element by element vector by vector ops.

`RowVector` **operator +** (`const RowVector &`*a*, `const RowVector &`*b*)
`RowVector` **operator -** (`const RowVector &`*a*, `const RowVector &`*b*)

`RowVector` **product** (`const RowVector &`*a*, `const RowVector &`*b*)
`RowVector` **quotient** (`const RowVector &`*a*, `const RowVector &`*b*)

Unary MArray ops.

`RowVector` **operator -** (`const RowVector &`*a*)

The `Matrix` classes share the following functions. These will eventually be part of an `MArray2<T>` class, derived from the `Array2<T>` class. Then the `Matrix` class will be derived from the `MArray<T>` class.

Element by element matrix by scalar ops.

`Matrix` **operator +** (`const Matrix &`a, `const double &`s)
`Matrix` **operator -** (`const Matrix &`a, `const double &`s)
`Matrix` **operator *** (`const Matrix &`a, `const double &`s)
`Matrix` **operator /** (`const Matrix &`a, `const double &`s)

Element by element scalar by matrix ops.

`Matrix` **operator +** (`const double &`s, `const Matrix &`a)
`Matrix` **operator -** (`const double &`s, `const Matrix &`a)
`Matrix` **operator *** (`const double &`s, `const Matrix &`a)
`Matrix` **operator /** (`const double &`s, `const Matrix &`a)

Element by element matrix by matrix ops.

`Matrix` **operator +** (`const Matrix &`a, `const Matrix &`b)
`Matrix` **operator -** (`const Matrix &`a, `const Matrix &`b)

`Matrix` **product** (`const Matrix &`a, `const Matrix &`b)
`Matrix` **quotient** (`const Matrix &`a, `const Matrix &`b)

Unary matrix ops.

`Matrix` **operator -** (`const Matrix &`a)

The `DiagMatrix` classes share the following functions. These will eventually be part of an `MDiagArray<T>` class, derived from the `DiagArray<T>` class. Then the `DiagMatrix` class will be derived from the `MDiagArray<T>` class.

Element by element MDiagArray by scalar ops.

`DiagMatrix` **operator *** (`const DiagMatrix &`a, `const double &`s)
`DiagMatrix` **operator /** (`const DiagMatrix &`a, `const double &`s)

Element by element scalar by MDiagArray ops.

`DiagMatrix` **operator *** (`const double &`s, `const DiagMatrix &`a)

Element by element MDiagArray by MDiagArray ops.

`DiagMatrix` **operator +** (`const DiagMatrix &`a, `const DiagMatrix &`b)
`DiagMatrix` **operator -** (`const DiagMatrix &`a, `const DiagMatrix &`b)

`DiagMatrix` **product** (`const DiagMatrix &`a, `const DiagMatrix &`b)

Unary MDiagArray ops.

`DiagMatrix` **operator -** (`const DiagMatrix &`a)

4 Matrix and Vector Operations

(void)
(int *r*, int *c*)
(int *r*, int *c*, double *val*)
(const Array2<double> &*a*)
(const Matrix &*a*)
(const DiagArray<double> &*a*)
(const DiagMatrix &*a*)

Matrix& **operator =** (const Matrix &*a*)

int **operator ==** (const Matrix &*a*) const
int **operator !=** (const Matrix &*a*) const

Matrix& **insert** (const Matrix &*a*, int *r*, int *c*)
Matrix& **insert** (const RowVector &*a*, int *r*, int *c*)
Matrix& **insert** (const ColumnVector &*a*, int *r*, int *c*)
Matrix& **insert** (const DiagMatrix &*a*, int *r*, int *c*)

Matrix& **fill** (double *val*)
Matrix& **fill** (double *val*, int r1, int c1, int r2, int c2)

Matrix **append** (const Matrix &*a*) const
Matrix **append** (const RowVector &*a*) const
Matrix **append** (const ColumnVector &*a*) const
Matrix **append** (const DiagMatrix &*a*) const

Matrix **stack** (const Matrix &*a*) const
Matrix **stack** (const RowVector &*a*) const
Matrix **stack** (const ColumnVector &*a*) const
Matrix **stack** (const DiagMatrix &*a*) const

Matrix **transpose** (void) const

Matrix **extract** (int r1, int c1, int r2, int c2) const

RowVector **row** (int *i*) const
RowVector **row** (char *s) const

ColumnVector **column** (int *i*) const
ColumnVector **column** (char *s) const

Matrix **inverse** (void) const
Matrix **inverse** (int &*info*) const
Matrix **inverse** (int &*info*, double &*rcond*) const

ComplexMatrix **fourier** (void) const
ComplexMatrix **ifourier** (void) const

DET **determinant** (void) const
DET **determinant** (int &*info*) const
DET **determinant** (int &*info*, double &*rcond*) const

Matrix **solve** (const Matrix &*b*) const
Matrix **solve** (const Matrix &*b*, int &*info*) const
Matrix **solve** (const Matrix &*b*, int &*info*, double &*rcond*) const

ComplexMatrix **solve** (const ComplexMatrix &*b*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*, double &*rcond*) const

ColumnVector **solve** (const ColumnVector &*b*) const
ColumnVector **solve** (const ColumnVector &*b*, int &*info*) const
ColumnVector **solve** (const ColumnVector &*b*, int &*info*, double &*rcond*) const

ComplexColumnVector **solve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int &*info*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int &*info*, double &*rcond*) const

Matrix **lssolve** (const Matrix &*b*) const
Matrix **lssolve** (const Matrix &*b*, int &*info*) const
Matrix **lssolve** (const Matrix &*b*, int &*info*, int &*rank*) const

ComplexMatrix **lssolve** (const ComplexMatrix &*b*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*, int &*rank*) const

ColumnVector **lssolve** (const ColumnVector &*b*) const
ColumnVector **lssolve** (const ColumnVector &*b*, int &*info*) const
ColumnVector **lssolve** (const ColumnVector &*b*, int &*info*, int &*rank*) const

ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*, int &*rank*) const

Matrix& **operator +=** (const Matrix &*a*)
Matrix& **operator -=** (const Matrix &*a*)

Matrix& **operator +=** (const DiagMatrix &*a*)
Matrix& **operator -=** (const DiagMatrix &*a*)

Matrix **operator !** (void) const

ComplexMatrix **operator +** (const Matrix &*a*, const Complex &*s*)
ComplexMatrix **operator -** (const Matrix &*a*, const Complex &*s*)
ComplexMatrix **operator *** (const Matrix &*a*, const Complex &*s*)
ComplexMatrix **operator /** (const Matrix &*a*, const Complex &*s*)

ComplexMatrix **operator +** (const Complex &s, const Matrix &a)
ComplexMatrix **operator -** (const Complex &s, const Matrix &a)
ComplexMatrix **operator *** (const Complex &s, const Matrix &a)
ComplexMatrix **operator /** (const Complex &s, const Matrix &a)

ColumnVector **operator *** (const Matrix &a, const ColumnVector &b)
ComplexColumnVector **operator *** (const Matrix &a, const ComplexColumnVector &b)

Matrix **operator +** (const Matrix &a, const DiagMatrix &b)
Matrix **operator -** (const Matrix &a, const DiagMatrix &b)
Matrix **operator *** (const Matrix &a, const DiagMatrix &b)

ComplexMatrix **operator +** (const Matrix &a, const ComplexDiagMatrix &b)
ComplexMatrix **operator -** (const Matrix &a, const ComplexDiagMatrix &b)
ComplexMatrix **operator *** (const Matrix &a, const ComplexDiagMatrix &b)

Matrix **operator *** (const Matrix &a, const Matrix &b)
ComplexMatrix **operator *** (const Matrix &a, const ComplexMatrix &b)

ComplexMatrix **operator +** (const Matrix &a, const ComplexMatrix &b)
ComplexMatrix **operator -** (const Matrix &a, const ComplexMatrix &b)

ComplexMatrix **product** (const Matrix &a, const ComplexMatrix &b)
ComplexMatrix **quotient** (const Matrix &a, const ComplexMatrix &b)

Matrix **map** (d_d_Mapper f, const Matrix &a)
void **map** (d_d_Mapper f)

Matrix **all** (void) const
Matrix **any** (void) const

Matrix **cumprod** (void) const
Matrix **cumsum** (void) const
Matrix **prod** (void) const
Matrix **sum** (void) const
Matrix **sumsq** (void) const

ColumnVector **diag** (void) const
ColumnVector **diag** (int k) const

ColumnVector **row_min** (void) const
ColumnVector **row_min_loc** (void) const

ColumnVector **row_max** (void) const
ColumnVector **row_max_loc** (void) const

RowVector **column_min** (void) const
RowVector **column_min_loc** (void) const

RowVector **column_max** (void) const
RowVector **column_max_loc** (void) const

ostream& **operator** << (ostream &*os*, const Matrix &*a*)
istream& **operator** >> (istream &*is*, Matrix &*a*)

(**void**)
(**int** *n*)
(**int** *n*, double *val*)
(**const** Array<double> &*a*)
(**const** ColumnVector &*a*)

ColumnVector& **operator** = (const ColumnVector &*a*)

int **operator** == (const ColumnVector &*a*) const
int **operator** != (const ColumnVector &*a*) const

ColumnVector& **insert** (const ColumnVector &*a*, int *r*)

ColumnVector& **fill** (double *val*)
ColumnVector& **fill** (double *val*, int r1, int r2)

ColumnVector **stack** (const ColumnVector &*a*) const

RowVector **transpose** (void) const

ColumnVector **extract** (int r1, int r2) const

ColumnVector& **operator** += (const ColumnVector &*a*)
ColumnVector& **operator** -= (const ColumnVector &*a*)

ComplexColumnVector **operator** + (const ColumnVector &*a*, const Complex &*s*)
ComplexColumnVector **operator** - (const ColumnVector &*a*, const Complex &*s*)
ComplexColumnVector **operator** * (const ColumnVector &*a*, const Complex &*s*)
ComplexColumnVector **operator** / (const ColumnVector &*a*, const Complex &*s*)

ComplexColumnVector **operator** + (const Complex &*s*, const ColumnVector &*a*)
ComplexColumnVector **operator** - (const Complex &*s*, const ColumnVector &*a*)
ComplexColumnVector **operator** * (const Complex &*s*, const ColumnVector &*a*)
ComplexColumnVector **operator** / (const Complex &*s*, const ColumnVector &*a*)

Matrix **operator** * (const ColumnVector &*a*, const RowVector &*a*)

ComplexMatrix **operator** * (const ColumnVector &*a*, const ComplexRowVector &*b*)

ComplexColumnVector **operator** + (const ComplexColumnVector &*a*, const ComplexColumnVector &*b*)

ComplexColumnVector **operator -** (const ComplexColumnVector &*a*,
const ComplexColumnVector &*b*)

ComplexColumnVector **product** (const ComplexColumnVector &*a*,
const ComplexColumnVector &*b*)

ComplexColumnVector **quotient** (const ComplexColumnVector &*a*,
const ComplexColumnVector &*b*)

ColumnVector **map** (d_d_Mapper *f*, const ColumnVector &*a*)
void **map** (d_d_Mapper *f*)

double **min** (void) const
double **max** (void) const

ostream& **operator <<** (ostream &*os*, const ColumnVector &*a*)

(void)
(int *n*)
(int *n*, double *val*)
(const Array<double> &*a*)
(const RowVector &*a*)

RowVector& **operator =** (const RowVector &*a*)

int **operator ==** (const RowVector &*a*) const
int **operator !=** (const RowVector &*a*) const

RowVector& **insert** (const RowVector &*a*, int *c*)

RowVector& **fill** (double *val*)
RowVector& **fill** (double *val*, int c1, int c2)

RowVector **append** (const RowVector &*a*) const

ColumnVector **transpose** (void) const

RowVector **extract** (int c1, int c2) const

RowVector& **operator +=** (const RowVector &*a*)
RowVector& **operator -=** (const RowVector &*a*)

ComplexRowVector **operator +** (const RowVector &*a*, const Complex
&*s*)
ComplexRowVector **operator -** (const RowVector &*a*, const Complex
&*s*)
ComplexRowVector **operator *** (const RowVector &*a*, const Complex
&*s*)
ComplexRowVector **operator /** (const RowVector &*a*, const Complex
&*s*)

ComplexRowVector **operator +** (const Complex &*s*, const RowVector &*a*)
ComplexRowVector **operator -** (const Complex &*s*, const RowVector &*a*)
ComplexRowVector **operator *** (const Complex &*s*, const RowVector &*a*)
ComplexRowVector **operator /** (const Complex &*s*, const RowVector &*a*)

double **operator *** (const RowVector &*a*, ColumnVector &*b*)

Complex **operator *** (const RowVector &*a*, const ComplexColumnVector &*b*)

RowVector **operator *** (const RowVector &*a*, const Matrix &*b*)

ComplexRowVector **operator *** (const RowVector &*a*, const ComplexMatrix &*b*)

ComplexRowVector **operator +** (const RowVector &*a*, const ComplexRowVector &*b*)
ComplexRowVector **operator -** (const RowVector &*a*, const ComplexRowVector &*b*)

ComplexRowVector **product** (const RowVector &*a*, const ComplexRowVector &*b*)
ComplexRowVector **quotient** (const RowVector &*a*, const ComplexRowVector &*b*)

RowVector **map** (d_d_Mapper *f*, const RowVector &*a*)
void **map** (d_d_Mapper *f*)

double **min** (void) const
double **max** (void) const

ostream& **operator <<** (ostream &*os*, const RowVector &*a*)

(**void**)
(**int** *n*)
(**int** *n*, double *val*)
(**int** *r*, int *c*)
(**int** *r*, int *c*, double *val*)
(**const** RowVector &*a*)
(**const** ColumnVector &*a*)
(**const** DiagArray<double> &*a*)
(**const** DiagMatrix &*a*)

DiagMatrix& **operator =** (const DiagMatrix &*a*)

int **operator ==** (const DiagMatrix &*a*) const
int **operator !=** (const DiagMatrix &*a*) const

DiagMatrix& **fill** (double *val*)
DiagMatrix& **fill** (double *val*, int *beg*, int *end*)
DiagMatrix& **fill** (const ColumnVector &*a*)
DiagMatrix& **fill** (const RowVector &*a*)
DiagMatrix& **fill** (const ColumnVector &*a*, int *beg*)
DiagMatrix& **fill** (const RowVector &*a*, int *beg*)

DiagMatrix **transpose** (void) const

Matrix **extract** (int r1, int c1, int r2, int c2) const

RowVector **row** (int *i*) const
RowVector **row** (char *s) const

ColumnVector **column** (int *i*) const
ColumnVector **column** (char *s) const

DiagMatrix **inverse** (void) const
DiagMatrix **inverse** (int &*info*) const

DiagMatrix& **operator** += (const DiagMatrix &*a*)
DiagMatrix& **operator** -= (const DiagMatrix &*a*)

Matrix **operator** + (const DiagMatrix &*a*, double *s*)
Matrix **operator** - (const DiagMatrix &*a*, double *s*)

ComplexMatrix **operator** + (const DiagMatrix &*a*, const Complex &*s*)
ComplexMatrix **operator** - (const DiagMatrix &*a*, const Complex &*s*)

ComplexDiagMatrix **operator** * (const DiagMatrix &*a*, const Complex &*s*)
ComplexDiagMatrix **operator** / (const DiagMatrix &*a*, const Complex &*s*)

Matrix **operator** + (double *s*, const DiagMatrix &*a*)
Matrix **operator** - (double *s*, const DiagMatrix &*a*)

ComplexMatrix **operator** + (const Complex &*s*, const DiagMatrix &*a*)
ComplexMatrix **operator** - (const Complex &*s*, const DiagMatrix &*a*)

ComplexDiagMatrix **operator** * (const Complex &*s*, const DiagMatrix &*a*)

ColumnVector **operator** * (const DiagMatrix &*a*, const ColumnVector &*b*)

ComplexColumnVector **operator** * (const DiagMatrix &*a*, const ComplexColumnVector &*b*)

ComplexDiagMatrix **operator** + (const DiagMatrix &*a*, const ComplexDiagMatrix &*b*)
ComplexDiagMatrix **operator** - (const DiagMatrix &*a*, const ComplexDiagMatrix &*b*)

ComplexDiagMatrix **product** (const DiagMatrix &*a*, const ComplexDiagMatrix &*b*)

`Matrix` **operator +** (`const DiagMatrix &`*a*, `const Matrix &`*b*)
`Matrix` **operator -** (`const DiagMatrix &`*a*, `const Matrix &`*b*)
`Matrix` **operator *** (`const DiagMatrix &`*a*, `const Matrix &`*b*)

`ComplexMatrix` **operator +** (`const DiagMatrix &`*a*, `const ComplexMatrix &`*b*)
`ComplexMatrix` **operator -** (`const DiagMatrix &`*a*, `const ComplexMatrix &`*b*)
`ComplexMatrix` **operator *** (`const DiagMatrix &`*a*, `const ComplexMatrix &`*b*)

`ColumnVector` **diag** (`void`) `const`
`ColumnVector` **diag** (`int` *k*) `const`

`ostream&` **operator <<** (`ostream &`*os*, `const DiagMatrix &`*a*)

(**void**)
(**int** *r*, `int` *c*)
(**int** *r*, `int` *c*, `const Complex &`*val*)
(**const** `Matrix &`*a*)
(**const** `Array2<Complex> &`*a*)
(**const** `ComplexMatrix &`*a*)
(**const** `DiagMatrix &`*a*)
(**const** `DiagArray<Complex> &`*a*)
(**const** `ComplexDiagMatrix &`*a*)

`ComplexMatrix&` **operator =** (`const ComplexMatrix &`*a*)

`int` **operator ==** (`const ComplexMatrix &`*a*) `const`
`int` **operator !=** (`const ComplexMatrix &`*a*) `const`

`ComplexMatrix&` **insert** (`const Matrix &`*a*, `int` *r*, `int` *c*)
`ComplexMatrix&` **insert** (`const RowVector &`*a*, `int` *r*, `int` *c*)
`ComplexMatrix&` **insert** (`const ColumnVector &`*a*, `int` *r*, `int` *c*)
`ComplexMatrix&` **insert** (`const DiagMatrix &`*a*, `int` *r*, `int` *c*)

`ComplexMatrix&` **insert** (`const ComplexMatrix &`*a*, `int` *r*, `int` *c*)
`ComplexMatrix&` **insert** (`const ComplexRowVector &`*a*, `int` *r*, `int` *c*)
`ComplexMatrix&` **insert** (`const ComplexColumnVector &`*a*, `int` *r*, `int` *c*)
`ComplexMatrix&` **insert** (`const ComplexDiagMatrix &`*a*, `int` *r*, `int` *c*)

`ComplexMatrix&` **fill** (`double` *val*)
`ComplexMatrix&` **fill** (`const Complex &`*val*)
`ComplexMatrix&` **fill** (`double` *val*, `int r1, int c1, int r2, int c2`)
`ComplexMatrix&` **fill** (`const Complex &`*val*, `int r1, int c1, int r2, int c2`)

`ComplexMatrix` **append** (`const Matrix &`*a*) `const`
`ComplexMatrix` **append** (`const RowVector &`*a*) `const`
`ComplexMatrix` **append** (`const ColumnVector &`*a*) `const`
`ComplexMatrix` **append** (`const DiagMatrix &`*a*) `const`

ComplexMatrix **append** (const ComplexMatrix &*a*) const
ComplexMatrix **append** (const ComplexRowVector &*a*) const
ComplexMatrix **append** (const ComplexColumnVector &*a*) const
ComplexMatrix **append** (const ComplexDiagMatrix &*a*) const

ComplexMatrix **stack** (const Matrix &*a*) const
ComplexMatrix **stack** (const RowVector &*a*) const
ComplexMatrix **stack** (const ColumnVector &*a*) const
ComplexMatrix **stack** (const DiagMatrix &*a*) const

ComplexMatrix **stack** (const ComplexMatrix &*a*) const
ComplexMatrix **stack** (const ComplexRowVector &*a*) const
ComplexMatrix **stack** (const ComplexColumnVector &*a*) const
ComplexMatrix **stack** (const ComplexDiagMatrix &*a*) const

ComplexMatrix **transpose** (void) const

Matrix **real** (const ComplexMatrix &*a*)
Matrix **imag** (const ComplexMatrix &*a*)
ComplexMatrix **conj** (const ComplexMatrix &*a*)

ComplexMatrix **extract** (int r1, int c1, int r2, int c2) const

ComplexRowVector **row** (int *i*) const
ComplexRowVector **row** (char *s) const

ComplexColumnVector **column** (int *i*) const
ComplexColumnVector **column** (char *s) const

ComplexMatrix **inverse** (void) const
ComplexMatrix **inverse** (int &*info*) const
ComplexMatrix **inverse** (int &*info*, double &*rcond*) const

ComplexMatrix **fourier** (void) const
ComplexMatrix **ifourier** (void) const

ComplexDET **determinant** (void) const
ComplexDET **determinant** (int &*info*) const
ComplexDET **determinant** (int &*info*, double &*rcond*) const

ComplexMatrix **solve** (const Matrix &*b*) const
ComplexMatrix **solve** (const Matrix &*b*, int &*info*) const
ComplexMatrix **solve** (const Matrix &*b*, int &*info*, double &*rcond*)
const

ComplexMatrix **solve** (const ComplexMatrix &*b*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*, double
&*rcond*) const

ComplexColumnVector **solve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int
&*info*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int
&*info*, double &*rcond*) const

ComplexMatrix **lssolve** (const ComplexMatrix &*b*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*, int &*rank*) const

ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*, int &*rank*) const

ComplexMatrix& **operator +=** (const DiagMatrix &*a*)
ComplexMatrix& **operator -=** (const DiagMatrix &*a*)

ComplexMatrix& **operator +=** (const ComplexDiagMatrix &*a*)
ComplexMatrix& **operator -=** (const ComplexDiagMatrix &*a*)

ComplexMatrix& **operator +=** (const Matrix &*a*)
ComplexMatrix& **operator -=** (const Matrix &*a*)

ComplexMatrix& **operator +=** (const ComplexMatrix &*a*)
ComplexMatrix& **operator -=** (const ComplexMatrix &*a*)

Matrix **operator !** (void) const

ComplexMatrix **operator +** (const ComplexMatrix &*a*, double *s*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, double *s*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, double *s*)
ComplexMatrix **operator /** (const ComplexMatrix &*a*, double *s*)

ComplexMatrix **operator +** (double *s*, const ComplexMatrix &*a*)
ComplexMatrix **operator -** (double *s*, const ComplexMatrix &*a*)
ComplexMatrix **operator *** (double *s*, const ComplexMatrix &*a*)
ComplexMatrix **operator /** (double *s*, const ComplexMatrix &*a*)

ComplexColumnVector **operator *** (const ComplexMatrix &*a*, const ColumnVector &*b*)

ComplexColumnVector **operator *** (const ComplexMatrix &*a*, const ComplexColumnVector &*b*)

ComplexMatrix **operator +** (const ComplexMatrix &*a*, const DiagMatrix &*b*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, const DiagMatrix &*b*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, const DiagMatrix &*b*)

ComplexMatrix **operator +** (const ComplexMatrix &*a*, const ComplexDiagMatrix &*b*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, const ComplexDiagMatrix &*b*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, const ComplexDiagMatrix &*b*)

ComplexMatrix **operator +** (const ComplexMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, const Matrix &*b*)

ComplexMatrix **operator *** (const ComplexMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, const ComplexMatrix &*b*)

ComplexMatrix **product** (const ComplexMatrix &*a*, const Matrix &*b*)
ComplexMatrix **quotient** (const ComplexMatrix &*a*, const Matrix &*b*)

ComplexMatrix **map** (c_c_Mapper *f*, const ComplexMatrix &*a*)
Matrix **map** (d_c_Mapper *f*, const ComplexMatrix &*a*)
void **map** (c_c_Mapper *f*)

Matrix **all** (void) const
Matrix **any** (void) const

ComplexMatrix **cumprod** (void) const
ComplexMatrix **cumsum** (void) const
ComplexMatrix **prod** (void) const
ComplexMatrix **sum** (void) const
ComplexMatrix **sumsq** (void) const

ComplexColumnVector **diag** (void) const
ComplexColumnVector **diag** (int *k*) const

ComplexColumnVector **row_min** (void) const
ComplexColumnVector **row_min_loc** (void) const

ComplexColumnVector **row_max** (void) const
ComplexColumnVector **row_max_loc** (void) const

ComplexRowVector **column_min** (void) const
ComplexRowVector **column_min_loc** (void) const

ComplexRowVector **column_max** (void) const
ComplexRowVector **column_max_loc** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexMatrix &*a*)
istream& **operator >>** (istream &*is*, ComplexMatrix &*a*)

(**void**)
(**int** *n*)
(**int** *n*, const Complex &*val*)
(**const** ColumnVector &*a*)
(**const** Array<Complex> &*a*)
(**const** ComplexColumnVector &*a*)

ComplexColumnVector& **operator =** (const ComplexColumnVector &*a*)

int **operator ==** (const ComplexColumnVector &*a*) const
int **operator !=** (const ComplexColumnVector &*a*) const

ComplexColumnVector& **insert** (const ColumnVector &*a*, int *r*)
ComplexColumnVector& **insert** (const ComplexColumnVector &*a*, int *r*)

ComplexColumnVector& **fill** (double *val*)
ComplexColumnVector& **fill** (const Complex &*val*)
ComplexColumnVector& **fill** (double *val*, int r1, int r2)
ComplexColumnVector& **fill** (const Complex &*val*, int r1, int r2)

ComplexColumnVector **stack** (const ColumnVector &*a*) const
ComplexColumnVector **stack** (const ComplexColumnVector &*a*) const

ComplexRowVector **transpose** (void) const

ColumnVector **real** (const ComplexColumnVector &*a*)
ColumnVector **imag** (const ComplexColumnVector &*a*)
ComplexColumnVector **conj** (const ComplexColumnVector &*a*)

ComplexColumnVector **extract** (int r1, int r2) const

ComplexColumnVector& **operator +=** (const ColumnVector &*a*)
ComplexColumnVector& **operator -=** (const ColumnVector &*a*)

ComplexColumnVector& **operator +=** (const ComplexColumnVector &*a*)
ComplexColumnVector& **operator -=** (const ComplexColumnVector &*a*)

ComplexColumnVector **operator +** (const ComplexColumnVector &*a*,
double *s*)
ComplexColumnVector **operator -** (const ComplexColumnVector &*a*,
double *s*)
ComplexColumnVector **operator *** (const ComplexColumnVector &*a*,
double *s*)
ComplexColumnVector **operator /** (const ComplexColumnVector &*a*,
double *s*)

ComplexColumnVector **operator +** (double *s*, const
ComplexColumnVector &*a*)
ComplexColumnVector **operator -** (double *s*, const
ComplexColumnVector &*a*)
ComplexColumnVector **operator *** (double *s*, const
ComplexColumnVector &*a*)
ComplexColumnVector **operator /** (double *s*, const
ComplexColumnVector &*a*)

ComplexMatrix **operator *** (const ComplexColumnVector &*a*, const
ComplexRowVector &*b*)

ComplexColumnVector **operator +** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)
ComplexColumnVector **operator -** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)

ComplexColumnVector **product** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)
ComplexColumnVector **quotient** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)

ComplexColumnVector **map** (c_c_Mapper *f*, const
ComplexColumnVector &*a*)
ColumnVector **map** (d_c_Mapper *f*, const ComplexColumnVector &*a*)
void **map** (c_c_Mapper *f*)

Complex **min** (void) const
Complex **max** (void) const

ostream& **operator** << (ostream &*os*, const ComplexColumnVector &*a*)

(**void**)
(**int** *n*)
(**int** *n*, const Complex &*val*)
(**const** RowVector &*a*)
(**const** Array<Complex> &*a*)
(**const** ComplexRowVector &*a*)

ComplexRowVector& **operator** = (const ComplexRowVector &*a*)

int **operator** == (const ComplexRowVector &*a*) const
int **operator** != (const ComplexRowVector &*a*) const

ComplexRowVector& **insert** (const RowVector &*a*, int *c*)
ComplexRowVector& **insert** (const ComplexRowVector &*a*, int *c*)

ComplexRowVector& **fill** (double *val*)
ComplexRowVector& **fill** (const Complex &*val*)
ComplexRowVector& **fill** (double *val*, int c1, int c2)
ComplexRowVector& **fill** (const Complex &*val*, int c1, int c2)

ComplexRowVector **append** (const RowVector &*a*) const
ComplexRowVector **append** (const ComplexRowVector &*a*) const

ComplexColumnVector **transpose** (void) const

RowVector **real** (const ComplexRowVector &*a*)
RowVector **imag** (const ComplexRowVector &*a*)
ComplexRowVector **conj** (const ComplexRowVector &*a*)

ComplexRowVector **extract** (int c1, int c2) const

ComplexRowVector& **operator** += (const RowVector &*a*)
ComplexRowVector& **operator** -= (const RowVector &*a*)

ComplexRowVector& **operator** += (const ComplexRowVector &*a*)
ComplexRowVector& **operator** -= (const ComplexRowVector &*a*)

ComplexRowVector **operator +** (const ComplexRowVector &*a*, double *s*)

ComplexRowVector **operator -** (const ComplexRowVector &*a*, double *s*)

ComplexRowVector **operator *** (const ComplexRowVector &*a*, double *s*)

ComplexRowVector **operator /** (const ComplexRowVector &*a*, double *s*)

ComplexRowVector **operator +** (double *s*, const ComplexRowVector &*a*)
ComplexRowVector **operator -** (double *s*, const ComplexRowVector &*a*)
ComplexRowVector **operator *** (double *s*, const ComplexRowVector &*a*)
ComplexRowVector **operator /** (double *s*, const ComplexRowVector &*a*)

Complex **operator *** (const ComplexRowVector &*a*, const ColumnVector &*b*)

Complex **operator *** (const ComplexRowVector &*a*, const ComplexColumnVector &*b*)

ComplexRowVector **operator *** (const ComplexRowVector &*a*, const ComplexMatrix &*b*)

ComplexRowVector **operator +** (const ComplexRowVector &*a*, const RowVector &*b*)
ComplexRowVector **operator -** (const ComplexRowVector &*a*, const RowVector &*b*)

ComplexRowVector **product** (const ComplexRowVector &*a*, const RowVector &*b*)
ComplexRowVector **quotient** (const ComplexRowVector &*a*, const RowVector &*b*)

ComplexRowVector **map** (c_c_Mapper *f*, const ComplexRowVector &*a*)
RowVector **map** (d_c_Mapper *f*, const ComplexRowVector &*a*)
void **map** (c_c_Mapper *f*)

Complex **min** (void) const
Complex **max** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexRowVector &*a*)

(**void**)
(**int** *n*)
(**int** *n*, const Complex &*val*)
(**int** *r*, int *c*)
(**int** *r*, int *c*, const Complex &*val*)
(**const** RowVector &*a*)
(**const** ComplexRowVector &*a*)
(**const** ColumnVector &*a*)
(**const** ComplexColumnVector &*a*)
(**const** DiagMatrix &*a*)
(**const** DiagArray<Complex> &*a*)
(**const** ComplexDiagMatrix &*a*)

ComplexDiagMatrix& **operator =** (const ComplexDiagMatrix &*a*)

int **operator ==** (const ComplexDiagMatrix &*a*) const
int **operator !=** (const ComplexDiagMatrix &*a*) const

ComplexDiagMatrix& **fill** (double *val*)
ComplexDiagMatrix& **fill** (const Complex &*val*)
ComplexDiagMatrix& **fill** (double *val*, int *beg*, int *end*)
ComplexDiagMatrix& **fill** (const Complex &*val*, int *beg*, int *end*)
ComplexDiagMatrix& **fill** (const ColumnVector &*a*)
ComplexDiagMatrix& **fill** (const ComplexColumnVector &*a*)
ComplexDiagMatrix& **fill** (const RowVector &*a*)
ComplexDiagMatrix& **fill** (const ComplexRowVector &*a*)
ComplexDiagMatrix& **fill** (const ColumnVector &*a*, int *beg*)
ComplexDiagMatrix& **fill** (const ComplexColumnVector &*a*, int *beg*)
ComplexDiagMatrix& **fill** (const RowVector &*a*, int *beg*)
ComplexDiagMatrix& **fill** (const ComplexRowVector &*a*, int *beg*)

ComplexDiagMatrix **transpose** (void) const

DiagMatrix **real** (const ComplexDiagMatrix &*a*)
DiagMatrix **imag** (const ComplexDiagMatrix &*a*)
ComplexDiagMatrix **conj** (const ComplexDiagMatrix &*a*)

ComplexMatrix **extract** (int r1, int c1, int r2, int c2) const

ComplexRowVector **row** (int *i*) const
ComplexRowVector **row** (char *s) const

ComplexColumnVector **column** (int *i*) const
ComplexColumnVector **column** (char *s) const

ComplexDiagMatrix **inverse** (int &*info*) const
ComplexDiagMatrix **inverse** (void) const

ComplexDiagMatrix& **operator +=** (const DiagMatrix &*a*)
ComplexDiagMatrix& **operator -=** (const DiagMatrix &*a*)

ComplexDiagMatrix& **operator +=** (const ComplexDiagMatrix &*a*)
ComplexDiagMatrix& **operator -=** (const ComplexDiagMatrix &*a*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, double *s*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, double *s*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, const Complex &*s*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, const Complex &*s*)

ComplexDiagMatrix **operator *** (const ComplexDiagMatrix &*a*, double *s*)
ComplexDiagMatrix **operator /** (const ComplexDiagMatrix &*a*, double *s*)

ComplexMatrix **operator +** (double *s*, const ComplexDiagMatrix &*a*)
ComplexMatrix **operator -** (double *s*, const ComplexDiagMatrix &*a*)

ComplexMatrix **operator +** (const Complex &*s*, const ComplexDiagMatrix &*a*)
ComplexMatrix **operator -** (const Complex &*s*, const ComplexDiagMatrix &*a*)

ComplexDiagMatrix **operator *** (double *s*, const ComplexDiagMatrix &*a*)

ComplexColumnVector **operator *** (const ComplexDiagMatrix &*a*, const ColumnVector &*b*)

ComplexColumnVector **operator *** (const ComplexDiagMatrix &*a*, const ComplexColumnVector &*b*)

ComplexDiagMatrix **operator +** (const ComplexDiagMatrix &*a*, const DiagMatrix &*b*)
ComplexDiagMatrix **operator -** (const ComplexDiagMatrix &*a*, const DiagMatrix &*b*)

ComplexDiagMatrix **product** (const ComplexDiagMatrix &*a*, const DiagMatrix &*b*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator *** (const ComplexDiagMatrix &*a*, const Matrix &*b*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, const ComplexMatrix &*b*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, const ComplexMatrix &*b*)
ComplexMatrix **operator *** (const ComplexDiagMatrix &*a*, const ComplexMatrix &*b*)

ComplexColumnVector **diag** (void) const
ComplexColumnVector **diag** (int *k*) const

`ostream&` **operator** `<<` (`ostream &`*os*, `const ComplexDiagMatrix &`*a*)

5 Matrix Factorizations

(void)
(const Matrix &*a*, const char **balance_job*)
(const AEPBALANCE &*a*)

AEPBALANCE& **operator =** (const AEPBALANCE &*a*)

Matrix **balanced_matrix** (void) const
Matrix **balancing_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const AEPBALANCE &*a*)

ComplexAEPBALANCE **(void)**
ComplexAEPBALANCE **(const** ComplexMatrix &*a*, const char
balance_job)
ComplexAEPBALANCE **(const** ComplexAEPBALANCE &*a*)

ComplexAEPBALANCE& **operator =** (const ComplexAEPBALANCE &*a*)

ComplexMatrix **balanced_matrix** (void) const
ComplexMatrix **balancing_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexAEPBALANCE &*a*)

(void)
(const DET &*a*)

DET& **operator =** (const DET &*a*)

int **value_will_overflow** (void) const
int **value_will_underflow** (void) const

double **coefficient** (void) const
int **exponent** (void) const
double **value** (void) const

ostream& **operator <<** (ostream &*os*, const DET &*a*)

(void)
(const ComplexDET &*a*)

ComplexDET& **operator =** (const ComplexDET &*a*)

int **value_will_overflow** (void) const
int **value_will_underflow** (void) const

Complex **coefficient** (void) const
int **exponent** (void) const
Complex **value** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexDET &*a*)

(void)
(const Matrix &*a*, const Matrix &, const char **balance_job*)
(const GEPBALANCE &*a*)

GEPBALANCE& **operator** = (const GEPBALANCE &*a*)

Matrix **balanced_a_matrix** (void) const
Matrix **balanced_b_matrix** (void) const
Matrix **left_balancing_matrix** (void) const
Matrix **right_balancing_matrix** (void) const

ostream& **operator** << (ostream &*os*, const GEPBALANCE &*a*)

(void)
(const Matrix &*a*)
(const Matrix &*a*, int &*info*)
(const CHOL &*a*)

CHOL& **operator** = (const CHOL &*a*)

Matrix **chol_matrix** (void) const

ostream& **operator** << (ostream &*os*, const CHOL &*a*)

(void)
(const ComplexMatrix &*a*)
(const ComplexMatrix &*a*, int &*info*)
(const ComplexCHOL &*a*)

ComplexCHOL& **operator** = (const ComplexCHOL &*a*)

ComplexMatrix **chol_matrix** (void) const

ostream& **operator** << (ostream &*os*, const ComplexCHOL &*a*)

(void)
(const Matrix &*a*)
(const Matrix&a, int &*info*)
(const HESS &*a*)

HESS& **operator** = (const HESS &*a*)

Matrix **hess_matrix** (void) const
Matrix **unitary_hess_matrix** (void) const

ostream& **operator** << (ostream &*os*, const HESS &*a*)

(void)
(const ComplexMatrix &*a*)
(const ComplexMatrix &*a*, int &*info*)
(const ComplexHESS &*a*)

ComplexHESS& **operator** = (const ComplexHESS &*a*)

ComplexMatrix **hess_matrix** (void) const
ComplexMatrix **unitary_hess_matrix** (void) const

ostream& **operator** << (ostream &*os*, const ComplexHESS &*a*)

(void)
(const Matrix &*a*, const char **ord*)
(const Matrix &*a*, const char **ord*, int &*info*)
(const SCHUR &*a*, const char **ord*)

SCHUR& **operator =** (const SCHUR &*a*)

Matrix **schur_matrix** (void) const
Matrix **unitary_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const SCHUR &*a*)

(**void**)
(**const** ComplexMatrix &*a*, const char **ord*)
(**const** ComplexMatrix &*a*, const char **ord*, int &*info*)
(**const** ComplexSCHUR &*a*, const char **ord*)

ComplexSCHUR& **operator =** (const ComplexSCHUR &*a*)

ComplexMatrix **schur_matrix** (void) const
ComplexMatrix **unitary_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexSCHUR &*a*)

(**void**)
(**const** Matrix &*a*)
(**const** Matrix &*a*, int &*info*)
(**const** SVD &*a*)

SVD& **operator =** (const SVD &*a*)

DiagMatrix **singular_values** (void) const
Matrix **left_singular_matrix** (void) const
Matrix **right_singular_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const SVD &*a*)

(**void**)
(**const** ComplexMatrix &*a*)
(**const** ComplexMatrix &*a*, int &*info*)
(**const** ComplexSVD &*a*)

ComplexSVD& **operator =** (const ComplexSVD &*a*)

DiagMatrix **singular_values** (void) const
ComplexMatrix **left_singular_matrix** (void) const
ComplexMatrix **right_singular_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexSVD &*a*)

(**void**)
(**const** Matrix &*a*)
(**const** Matrix &*a*, int &*info*)
(**const** ComplexMatrix &*a*)
(**const** ComplexMatrix &*a*, int &*info*)
(**const** EIG &*a*)

EIG& **operator =** (const EIG &*a*)

ComplexColumnVector **eigenvalues** (void) const

ComplexMatrix **eigenvectors** (void) const

`ostream&` **operator** `<<` (`ostream &`*os*, `const EIG &`*a*)

(**void**)
(**const** `Matrix &`*a*)
(**const** `LU &`*a*)

`LU&` **operator** `=` (`const LU &`*a*)

`Matrix` **L** (`void`) `const`
`Matrix` **U** (`void`) `const`
`Matrix` **P** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const LU &`*a*)

(**void**)
(**const** `ComplexMatrix &`*a*)
(**const** `ComplexLU &`*a*)

`ComplexLU&` **operator** `=` (`const ComplexLU &`*a*)

`ComplexMatrix` **L** (`void`) `const`
`ComplexMatrix` **U** (`void`) `const`
`Matrix` **P** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const ComplexLU &`*a*)

(**void**)
(**const** `Matrix &`*A*)
(**const** `QR &`*a*)

`QR&` **operator** `=` (`const QR &`*a*)

`Matrix` **Q** (`void`) `const`
`Matrix` **R** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const QR &`*a*)

(**void**)
(**const** `ComplexMatrix &`*A*)
(**const** `ComplexQR &`*a*)

`ComplexQR&` **operator** `=` (`const ComplexQR &`*a*)

`ComplexMatrix` **Q** (`void`) `const`
`ComplexMatrix` **R** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const ComplexQR &`*a*)

6 Ranges

(**void**)
(**const** `Range &`*r*)
(**double** *b*, `double` *l*)
(**double** *b*, `double` *l*, `double` *i*)

`double` **base** (`void`) `const`
`double` **limit** (`void`) `const`
`double` **inc** (`void`) `const`

`void` **set_base** (`double` *b*)
`void` **set_limit** (`double` *l*)
`void` **set_inc** (`double` *i*)

`int` **nelem** (`void`) `const`

`double` **min** (`void`) `const`
`double` **max** (`void`) `const`

`void` **sort** (`void`)

`ostream&` **operator** `<<` (`ostream &`*os*, `const Range &`*r*)
`istream&` **operator** `>>` (`istream &`*is*, `Range &`*r*)

`void` **print_range** (`void`)

7 Nonlinear Functions

(void)
(const *nonlinear_fcn*)
(const *nonlinear_fcn*, `const` *jacobian_fcn*)
(const `NLFunc &`*a*)

`NLFunc&` **operator =** (`const NLFunc &`*a*)

`nonlinear_fcn` **function** (`void`) `const;`

`NLFunc&` **set_function** (`const nonlinear_fcn` *f*)

`jacobian_fcn` **jacobian_function** (`void`) `const;`

`NLFunc&` **set_jacobian_function** (`const jacobian_fcn` *j*)

8 Nonlinear Equations

(void)
(const `NLEqn_options &`*opt*)

`NLEqn_options&` **operator =** (`const NLEqn_options &`*opt*)

`void` **init** (`void`)

`void` **copy** (`const NLEqn_options &`*opt*)

`void` **set_default_options** (`void`)

`void` **set_tolerance** (`double` *val*)

`double` **tolerance** (`void`)

(void)
(const `ColumnVector&, const` *NLFunc*)
(const `NLEqn &`*a*)

`NLEqn&` **operator =** (`const NLEqn &`*a*)

`void` **resize** (`int` *n*)

`void` **set_states** (`const ColumnVector &`*x*)

`ColumnVector` **states** (`void`) `const`

`int` **size** (`void`) `const`

`ColumnVector` **solve** (`void`)
`ColumnVector` **solve** (`const ColumnVector &`*x*)

`ColumnVector` **solve** (`int &`*info*)
`ColumnVector` **solve** (`const ColumnVector &`*x*, `int &`*info*)

9 Optimization

9.1 Objective Functions

(void)
(const *objective_fcn*)
(const *objective_fcn*, `const` *gradient_fcn*)
(const `Objective &`*a*)

`Objective&` **operator =** (`const Objective &`*a*)

`objective_fcn` **objective_function** (`void`) `const;`

`Objective&` **set_objective_function** (`const` *objective_fcn*)

`gradient_fcn` **gradient_function** (`void`) `const;`

`Objective&` **set_gradient_function** (`const` *gradient_fcn*)

9.2 Bounds

(void)
(int *n*)
(const `ColumnVector` *lb*, `const ColumnVector` *ub*)
(const `Bounds &`*a*)

`Bounds&` **operator =** (`const Bounds &`*a*)

`Bounds&` **resize** (`int` *n*)

`double` **lower_bound** (`int` *index*) `const;`
`double` **upper_bound** (`int` *index*) `const;`

`ColumnVector` **lower_bounds** (`void`) `const;`
`ColumnVector` **upper_bounds** (`void`) `const;`

`int` **size** (`void`) `const;`

`Bounds&` **set_bound** (`int` *index*, `double` *low*, `double` *high*)

`Bounds&` **set_bounds** (`double` *low*, `double` *high*)
`Bounds&` **set_bounds** (`const ColumnVector` *lb*, `const ColumnVector` *ub*)

`Bounds&` **set_lower_bound** (`int` *index*, `double` *low*)
`Bounds&` **set_upper_bound** (`int` *index*, `double` *high*)

`Bounds&` **set_lower_bounds** (`double` *low*)
`Bounds&` **set_upper_bounds** (`double` *high*)

`Bounds&` **set_lower_bounds** (`const ColumnVector` *lb*)
`Bounds&` **set_upper_bounds** (`const ColumnVector` *ub*)

`ostream&` **operator <<** (`ostream &`*os*, `const Bounds &`*b*)

9.3 Linear Constraints

(void)
(int *nclin*, int *nx*)
(int *nclin_eq*, int *nclin_ineq*, int *nx*)
(const ColumnVector &*lb*, const Matrix &*A*, const ColumnVector &*ub*)
(const Matrix &*A_eq*, const ColumnVector &*b_eq*, const Matrix &*A_ineq*,
const ColumnVector &*b_ineq*)
(const LinConst &*a*)

LinConst& **operator =** (const LinConst &*a*)

LinConst& **resize** (int *nclin*, int *n*)

Matrix **constraint_matrix** (void) const;

LinConst& **set_constraint_matrix** (const Matrix &*A*)

Matrix **eq_constraint_matrix** (void) const;
Matrix **ineq_constraint_matrix** (void) const;

ColumnVector **eq_constraint_vector** (void) const;
ColumnVector **ineq_constraint_vector** (void) const;

ostream& **operator <<** (ostream &*os*, const LinConst &*b*)

9.4 Nonlinear Constraints

(void)
(int *n*)
(const ColumnVector *lb*, const NLFunc *f*, const ColumnVector *ub*)
(const NLConst &*a*)

NLConst& **operator =** (const NLConst &*a*)

9.5 Quadratic Programming

(void)
(const ColumnVector &*x*, const Matrix &*H*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*)
(const ColumnVector &*x*, const Matrix &*H*, const Bounds &*b*)
(const ColumnVector &*x*, const Matrix &*H*, const LinConst &*lc*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*,
const Bounds &*b*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*,
const LinConst &*lc*)
(const ColumnVector &*x*, const Matrix &*H*, const Bounds &*b*, const
LinConst &*lc*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*,
const Bounds &*b*, const LinConst &*lc*)

virtual ColumnVector **minimize** (void)
virtual ColumnVector **minimize** (double &*objf*)
virtual ColumnVector **minimize** (double &*objf*, int &*inform*)
virtual ColumnVector **minimize** (double &*objf*, int &*inform*, ColumnVector &*lambda*) = 0;

virtual ColumnVector **minimize** (const ColumnVector &*x*)
virtual ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*)
virtual ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*)
virtual ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*, ColumnVector &*lambda*)

ColumnVector **minimize** (double &*objf*, int &*inform*, ColumnVector &*lambda*)

9.6 Nonlinear Programming

(void)
(const ColumnVector &*x*, const Objective &*phi*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*, const LinConst &*lc*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*, const LinConst &*lc*, const NLConst &*nlc*)
(const ColumnVector &*x*, const Objective &*phi*, const LinConst &*lc*)
(const ColumnVector &*x*, const Objective &*phi*, const LinConst &*lc*, const NLConst &*nlc*)
(const ColumnVector &*x*, const Objective &*phi*, const NLConst &*nlc*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*, const NLConst &*nlc*)

NLP& **operator** = (const NLP &*a*)

int **size** (void) const

ColumnVector **minimize** (void)
ColumnVector **minimize** (double &*objf*)
ColumnVector **minimize** (double &*objf*, int &*inform*)
ColumnVector **minimize** (double &*objf*, int &*inform*, ColumnVector &*lambda*)

ColumnVector **minimize** (const ColumnVector &*x*)
ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*)
ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*)
ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*, ColumnVector &*lambda*)

10 Quadrature

(**integrand_fcn** *fcn*)
(**integrand_fcn** *fcn*, `double` *abs*, `double` *rel*)

`virtual double` **integrate** (`void`)
`virtual double` **integrate** (`int &`*ier*)
`virtual double` **integrate** (`int &`*ier*, `int &`*neval*)
`virtual double` **integrate** (`int &`*ier*, `int &`*neval*, `double &`*abserr*) `= 0`

`Quad_options` (**void**)
`Quad_options` (**const** `Quad_options &`*opt*)

`Quad_options&` **operator =** (`const Quad_options &`*opt*)

`void` **init** (`void`)

`void` **copy** (`const Quad_options &`*opt*)

`void` **set_default_options** (`void`)

`void` **set_absolute_tolerance** (`double` *val*)

`void` **set_relative_tolerance** (`double` *val*)

`double` **absolute_tolerance** (`void`)
`double` **relative_tolerance** (`void`)

(**integrand_fcn** *fcn*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*, `double` *abs*, `double` *rel*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*, `const ColumnVector &`*sing*)
(**integrand_fcn** *fcn*, `const ColumnVector &`*sing*, `double` *abs*, `double` *rel*)

(**integrand_fcn** *fcn*, `const ColumnVector &`*sing*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*, `const ColumnVector &`*sing*,
`double` *abs*, `double` *rel*)

(**integrand_fcn** *fcn*)
(**integrand_fcn** *fcn*, `double` *b*, `IntegralType` *t*)
(**integrand_fcn** *fcn*, `double` *b*, `IntegralType` *t*, `double` *abs*, `double` *rel*)

(**integrand_fcn** *fcn*, `double` *abs*, `double` *rel*)

10.1 Collocation Weights

(**void**)
(**int** *n*, `int` *inc_l*, `int` *inc_r*)
(**int** *n*, `int` *inc_l*, `int` *inc_r*, `double` *l*, `double` *r*)
(**int** *n*, `double` a, `double` *b*, `int` *inc_l*, `int` *inc_r*)
(**int** *n*, `int` *inc_l*, `int` *inc_r*, `double` *l*, `double` *r*)
(**const** `CollocWt&`)

`CollocWt&` **operator =** (`const CollocWt&`)

`CollocWt&` **resize** (`int` *ncol*)

`CollocWt&` **add_left** (`void`)
`CollocWt&` **add_right** (`void`)

`CollocWt&` **delete_left** (`void`)
`CollocWt&` **delete_right** (`void`)

`CollocWt&` **set_left** (`double` *val*)
`CollocWt&` **set_right** (`double` *val*)

`CollocWt&` **set_alpha** (`double` *val*)
`CollocWt&` **set_beta** (`double` *val*)

`int` **ncol** (`void`) `const`

`int` **left_included** (`void`) `const`
`int` **right_included** (`void`) `const`

`double` **left** (`void`) `const`
`double` **right** (`void`) `const`
`double` **width** (`void`) `const`

`double` **alpha** (`void`) `const`
`double` **beta** (`void`) `const`

`ColumnVector` **roots** (`void`)
`ColumnVector` **quad** (`void`)
`ColumnVector` **quad_weights** (`void`)

`Matrix` **first** (`void`)
`Matrix` **second** (`void`)

`ostream&` **operator <<** (`ostream &`*os*, `const CollocWt &`*c*)

11 Ordinary Differential Equations

(void)
(const `ODE_options` &*opt*)

`ODE_options&` **operator =** (`const ODE_options` &*opt*)

`void` **init** (`void`)

`void` **copy** (`const ODE_options` &*opt*)

`void` **set_default_options** (`void`)

`void` **set_absolute_tolerance** (`double` *val*)

`void` **set_initial_step_size** (`double` *val*)

`void` **set_maximum_step_size** (`double` *val*)

`void` **set_minimum_step_size** (`double` *val*)

`void` **set_relative_tolerance** (`double` *val*)

`double` **absolute_tolerance** (`void`)
`double` **initial_step_size** (`void`)
`double` **maximum_step_size** (`void`)
`double` **minimum_step_size** (`void`)
`double` **relative_tolerance** (`void`)

(void)
(int *n*)
(const `ColumnVector` &*state*, `double` *time*, `const ODEFunc` &*f*)

`virtual int` **size** (`void`) `const`

`virtual ColumnVector` **state** (`void`) `const`

`virtual double` **time** (`void`) `const`

`virtual void` **force_restart** (`void`)

`virtual void` **initialize** (`const ColumnVector` &*x*, `double` *t*)

`virtual void` **set_stop_time** (`double` *t*)

`virtual void` **clear_stop_time** (`void`)

`virtual ColumnVector` **integrate** (`double` *t*)

`void` **integrate** (`int` *nsteps*, `double` *tstep*, `ostream` &*s*)

`Matrix` **integrate** (`const ColumnVector` &*tout*)
`Matrix` **integrate** (`const ColumnVector` &*tout*, `const ColumnVector` &*tcrit*)

12 Differential Algebraic Equations

(void)
(int *n*)
(const `ColumnVector &`*x*, `double` *time*, `DAEFunc &`*f*)
(const `ColumnVector &`*x*, `ColumnVector &`*xdot*, `double` *time*, `DAEFunc &`*f*)

`ColumnVector` **deriv** (`void`)

`virtual void` **initialize** (`const ColumnVector &`*x*, `double` *t*)
`virtual void` **initialize** (`const ColumnVector &`*x*, `ColumnVector &`*xdot*, `double` *t*)

`ColumnVector` **integrate** (`double` *t*)

`Matrix` **integrate** (`const ColumnVector &`*tout*, `Matrix &`*xdot_out*)
`Matrix` **integrate** (`const ColumnVector &`*tout*, `Matrix &`*xdot_out*, `const ColumnVector &`*tcrit*)

13 Error Handling

14 Installation

15 Bugs

Concept Index

A

acknowledgements ... 1
arrays ... 10

B

bounds ... 38
bugs, known ... 47

C

collocation weights ... 41
contributors ... 1
copyright ... 1

D

DAE ... 44

F

factorizations ... 31

I

installation ... 46
installation trouble ... 47
integration ... 41
introduction ... 9

K

known causes of trouble ... 47

L

linear Constraints ... 39

M

matrix factorizations ... 31
matrix manipulations ... 14

N

NLP ... 40
nonlinear Constraints ... 39
nonlinear equations ... 37
nonlinear functions ... 36
nonlinear programming ... 40
numerical integration ... 41

O

objective functions ... 38
ODE ... 43
optimization ... 38
orthogonal collocation ... 41

Q

QP ... 39
quadratic programming ... 39
quadrature ... 41

R

ranges ... 35

T

troubleshooting ... 47

V

vector manipulations ... 14

W

warranty ... 1

Function Index

(

(const ... 11, 12, 14, 17, 18, 19, 21, 24, 26, 28, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 43, 44
(double ... 35
(int .. 11, 12, 14, 17, 18, 19, 21, 24, 26, 28, 38, 39, 41, 43, 44
(integrand_fcn ... 41
(void) ... 11, 14, 17, 18, 19, 21, 24, 26, 27, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 43, 44

A

absolute_tolerance ... 41, 43
add_left ... 42
add_right ... 42
all ... 16, 24
alpha ... 42
any ... 16, 24
append ... 14, 18, 21, 22, 26
Array<T>::Array ... 10
Array<T>::capacity ... 10
Array<T>::checkelem ... 10
Array<T>::data ... 11
Array<T>::elem ... 10
Array<T>::length ... 10
Array<T>::operator ... 10
Array<T>::resize ... 11
Array<T>::xelem ... 10
Array2 ... 11

B

balanced_a_matrix ... 32
balanced_b_matrix ... 32
balanced_matrix ... 31
balancing_matrix ... 31
base ... 35
beta ... 42

C

checkelem ... 11, 12
chol_matrix ... 32
clear_stop_time ... 43
coefficient ... 31
cols ... 11, 12
column ... 14, 20, 22, 28
column_max ... 17, 24
column_max_loc ... 17, 24
column_min ... 16, 24
column_min_loc ... 16, 24
columns ... 11, 12
conj ... 22, 25, 26, 28
constraint_matrix ... 39
copy ... 37, 41, 43
cumprod ... 16, 24
cumsum ... 16, 24

D

delete_left ... 42
delete_right ... 42
deriv ... 44
determinant ... 14, 22
diag ... 16, 21, 24, 29
dim1 ... 11, 12
dim2 ... 11, 12
dim3 ... 11

E

eigenvalues ... 33
eigenvectors ... 33
elem ... 11, 12
eq_constraint_matrix ... 39
eq_constraint_vector ... 39
exponent ... 31
extract ... 14, 17, 18, 20, 22, 25, 26, 28

F

fill ... 14, 17, 18, 19, 20, 21, 25, 26, 28
first ... 42
force_restart ... 43
fourier ... 14, 22
function ... 36

G

gradient_function ... 38

H

hess_matrix ... 32

I

ifourier ... 14, 22
imag ... 22, 25, 26, 28
inc ... 35
ineq_constraint_matrix ... 39
ineq_constraint_vector ... 39

init 37, 41, 43
initial_step_size 43
initialize 43, 44
insert 14, 17, 18, 21, 25, 26
integrate 41, 43, 44
inverse 14, 20, 22, 28

J

jacobian_function 36

L

L 34
left 42
left_balancing_matrix 32
left_included 42
left_singular_matrix 33
limit 35
lower_bound 38
lower_bounds 38
lssolve 15, 23

M

map 16, 18, 19, 24, 26, 27
max 18, 19, 26, 27, 35
maximum_step_size 43
min 18, 19, 26, 27, 35
minimize 40
minimum_step_size 43

N

ncol 42
nelem 35

O

objective_function 38
operator 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43

P

P 34
print_range 35
prod 16, 24
product 12, 13, 16, 18, 19, 20, 24, 25, 27, 29

Q

Q 34
quad 42
quad_weights 42
quotient 12, 13, 16, 18, 19, 24, 26, 27

R

R 34
real 22, 25, 26, 28
relative_tolerance 41, 43
resize 11, 12, 37, 38, 39, 42
right 42
right_balancing_matrix 32
right_included 42
right_singular_matrix 33
roots 42
row 14, 20, 22, 28
row_max 16, 24
row_max_loc 16, 24
row_min 16, 24
row_min_loc 16, 24
rows 11, 12

S

schur_matrix 33
second 42
set_absolute_tolerance 41, 43
set_alpha 42
set_base 35
set_beta 42
set_bound 38
set_bounds 38
set_constraint_matrix 39
set_default_options 37, 41, 43
set_function 36
set_gradient_function 38
set_inc 35
set_initial_step_size 43
set_jacobian_function 36
set_left 42
set_limit 35
set_lower_bound 38
set_lower_bounds 38
set_maximum_step_size 43
set_minimum_step_size 43
set_objective_function 38
set_relative_tolerance 41, 43
set_right 42
set_states 37
set_stop_time 43
set_tolerance 37
set_upper_bound 38
set_upper_bounds 38
singular_values 33

size 37, 38, 40, 43
solve 15, 22, 37
sort 35
stack 14, 17, 22, 25
state 43
states 37
sum 16, 24
sumsq 16, 24

T

time 43
tolerance 37
transpose 14, 17, 18, 20, 22, 25, 26, 28

U

U 34
unitary_hess_matrix 32
unitary_matrix 33
upper_bound 38
upper_bounds 38

V

value 31
value_will_overflow 31
value_will_underflow 31

W

width 42

Table of Contents

1 Acknowledgements 1

Contributors to Octave 1

GNU GENERAL PUBLIC LICENSE 2

Preamble 2

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION 3

Appendix: How to Apply These Terms to Your New Programs .. 7

2 A Brief Introduction to Octave 9

3 Arrays 10

3.1 Constructors and Assignment 10

4 Matrix and Vector Operations 14

5 Matrix Factorizations 31

6 Ranges 35

7 Nonlinear Functions 36

8 Nonlinear Equations 37

9 Optimization 38

9.1 Objective Functions 38

9.2 Bounds 38

9.3 Linear Constraints 39

9.4 Nonlinear Constraints 39

9.5 Quadratic Programming 39

9.6 Nonlinear Programming 40

10 Quadrature 41

10.1 Collocation Weights 41

11 Ordinary Differential Equations 43

12 Differential Algebraic Equations 44

13 Error Handling 45

14 Installation 46

15 Bugs 47

Concept Index 48

Function Index 49