Matrix Toolbox Manual

Chapter 1

Introduction

Chapter 1 - Introduction

A. The Matrix Toolbox

The Matrix toolbox contains matrix operators, and the kmatrix library, which are based on the LAPACK library. Operations include extracting rows, columns, and diagonals, computing eigenvectors and eigenvalues, computing the inverse matrix, computing the least-squares solution to a set of linear equations, LU decomposition, computing the matrix product, and singular value decomposition. All kmatrix operators are written to operate on width-height planes of the polymorphic data model. If the depth, time, or elements dimensions of data object are greater than one, the operation is repeated for each width-height plane. The kmatrix operators are implemented using the polymorphic data services, which is a part of the Khoros 2.0 kappserv library.

The kmatrix library depends on the LAPACK Fortran libraries lzlapack, ldlapack, and lblas, which are also included in the Matrix toolbox.

The Matrix toolbox requires that the bootstrap, dataserv, and datamanip toolboxes be installed.

B. Matrix Operators Organized by Category/Subcategory

The following table contains a listing of the matrix processing operators that are available in the Matrix toolbox. Table entries are organized by category and subcategory. A brief description of each operator is given, followed by name of the executable.

MATRIX — **Matrix Operators**

Category Subcategory	Operator	Description	Executable
Matrix	Invert Diagonal	Compute Inverse of Diagonal Matrix	`minvdiag`
Arithmetic	Invert Matrix	Compute Inverse Matrix	`minvert`
	Matrix Add	Output = Matrix 1 + Matrix 2	`madd`
	Matrix Conjugate	Compute the Complex Conjugate Matrix	`mconj`
	Matrix Multiply	Matrix Multiply (C=AB)	`mmul`
	Matrix Power	Compute the Positive Integral Power of a Square Matrix	`mpow`
	Matrix Subtract	Output = Matrix 1 - Matrix 2	`msub`
	Scalar ABS	Output = Absolute Value of Input (componentwise)	`mscalar_abs`
	Scalar Add	Output = Input Matrix + Constant	`mscalar_add`
	Scalar Divide	Output = Input Matrix / Constant	`mscalar_div`
	Scalar Multiply	Output = Input Matrix * Constant	`mscalar_mul`
	Scalar Power	Output = Input Raised to a Power (componentwise)	`mscalar_pow`
	Scalar Recip	Output = Reciprocal of Input (componentwise)	`mscalar_recip`
	Scalar Sqrt	Output = Sqrt of Input (componentwise)	`mscalar_sqrt`

`MATRIX` — **Matrix Operators**			
Category Subcategory	**Operator**	**Description**	**Executable**
	Scalar Subtract	Output = Input Matrix - Constant	`mscalar_sub`
	Transpose Matrix	Transpose Rows and Columns of Matrix	`mtranspose`
Matrix	LU Decomposition	Compute LU Decomposition of Matrix (Input = L*U)	`mlud`
Decomposition	SVD	Compute Singular Value Decomposition (SVD)	`msvd`
Matrix EigenValues/Vectors	Eigen	Compute Eigenvectors and Eigenvalues of a Square Matrix	`meigen`
Matrix	Gen Diag Matrix	Generate a Diagonal Matrix	`mgdiag`
Generation	Identity Matrix	Generate Identity or Unit Matrix	`mgident`
	Null Matrix	Generate Null or Zero Matrix	`mgnull`
Matrix	Covariance Matrix	Compute Covariance Matrix	`mcovar`
Linear Operators	Simultaneous Eqns	Least Squares Solution to System of Linear Equations	`mlse`
Matrix	Exchange row/col	Exchange Rows or Columns of a Matrix	`mexchg`
Utilities	Extract Col	Extract a Column from a Matrix	`mextract_col`
	Extract Row	Extract a Row from a Matrix	`mextract_row`
	Extract diag/row/col	Extract Matrix Diagonal, Row, or Column	`mextract_diag`
	Replicate Submatrix	Replicate a Given Matrix as Submatrices of a Larger Matrix	`mreplicate`
	Row/Col Sums	Compute Row or Column Sums for a Matrix	`mrcsum`

C. Alphabetical Listing of Matrix Operators

The following table contains a listing of the matrix processing operators that are available in the Matrix toolbox. Table entries are organized alphabetically by the binary name, followed by the name and a brief description of each operator.

`MATRIX` — **Matrix Operators**		
Executable	**Operator**	**Description**
`madd`	Matrix Add	Output = Matrix 1 + Matrix 2
`mconj`	Matrix Conjugate	Compute the Complex Conjugate Matrix
`mcovar`	Covariance Matrix	Compute Covariance Matrix
`meigen`	Eigen	Compute Eigenvectors and Eigenvalues of a Square Matrix
`mexchg`	Exchange row/col	Exchange Rows or Columns of a Matrix
`mextract_col`	Extract Col	Extract a Column from a Matrix
`mextract_diag`	Extract diag/row/col	Extract Matrix Diagonal, Row, or Column
`mextract_row`	Extract Row	Extract a Row from a Matrix
`mgdiag`	Gen Diag Matrix	Generate a Diagonal Matrix
`mgident`	Identity Matrix	Generate Identity or Unit Matrix
`mgnull`	Null Matrix	Generate Null or Zero Matrix

MATRIX — **Matrix Operators**		
Executable	**Operator**	**Description**
`minvdiag`	Invert Diagonal	Compute Inverse of Diagonal Matrix
`minvert`	Invert Matrix	Compute Inverse Matrix
`mlse`	Simultaneous Eqns	Least Squares Solution to System of Linear Equations
`mlud`	LU Decomposition	Compute LU Decomposition of Matrix (Input = L*U)
`mmul`	Matrix Multiply	Matrix Multiply (C=AB)
`mpow`	Matrix Power	Compute the Positive Integral Power of a Square Matrix
`mrcsum`	Row/Col Sums	Compute Row or Column Sums for a Matrix
`mreplicate`	Replicate Submatrix	Replicate a Given Matrix as Submatrices of a Larger Matrix
`mscalar_abs`	Scalar ABS	Output = Absolute Value of Input (componentwise)
`mscalar_add`	Scalar Add	Output = Input Matrix + Constant
`mscalar_div`	Scalar Divide	Output = Input Matrix / Constant
`mscalar_mul`	Scalar Multiply	Output = Input Matrix * Constant
`mscalar_pow`	Scalar Power	Output = Input Raised to a Power (componentwise)
`mscalar_recip`	Scalar Recip	Output = Reciprocal of Input (componentwise)
`mscalar_sqrt`	Scalar Sqrt	Output = Sqrt of Input (componentwise)
`mscalar_sub`	Scalar Subtract	Output = Input Matrix - Constant
`msub`	Matrix Subtract	Output = Matrix 1 - Matrix 2
`msvd`	SVD	Compute Singular Value Decomposition (SVD)
`mtranspose`	Transpose Matrix	Transpose Rows and Columns of Matrix

D. Installation Guide

This section is incomplete, and will be updated as we approach the cd release and become more familiar with what is involved with the installation process. For now, refer to the Khoros installation guide.

This page left intentionally blank

Table of Contents

This page left intentionally blank