

Package ‘LinkedMatrix’

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Title Column-Linked and Row-Linked Matrices

Description A class that links matrix-like objects (nodes) by rows or by columns while behaving similarly to a base R matrix. Very large matrices are supported if the nodes are memory-mapped objects.

URL <https://github.com/QuantGen/LinkedMatrix>

BugReports <https://github.com/QuantGen/LinkedMatrix/issues>

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LinkedMatrix-package *A Package for Linking Matrices by Columns or Rows.*

Description

The `LinkedMatrix` package provides classes that behave similarly to regular matrices, but represent a sequence of matrix-like objects linked together by columns or rows. This approach is particularly useful for very large datasets that are distributed in chunks and can be mapped into memory using packages such as [bigmemory](#), [ff](#), and [BEDMatrix::BEDMatrix](#).

See Also

The [ColumnLinkedMatrix](#) and [RowLinkedMatrix](#) classes.

as.ColumnLinkedMatrix *Converts an Object to a LinkedMatrix Object.*

Description

Converts an Object to a `LinkedMatrix` Object.

Usage

```
as.ColumnLinkedMatrix(x, ...)
```

```
## S3 method for class 'list'
as.ColumnLinkedMatrix(x, ...)
```

```
as.RowLinkedMatrix(x, ...)
```

```
## S3 method for class 'list'
as.RowLinkedMatrix(x, ...)
```

Arguments

`x` An object to convert to a [LinkedMatrix](#) object.
`...` Additional arguments.

Value

A [LinkedMatrix](#) object.

Examples

```
m1 <- ff::ff(initdata = rnorm(50), dim = c(5, 10))
m2 <- bigmemory::big.matrix(init = rnorm(50), nrow = 5, ncol = 10)
m3 <- matrix(data = rnorm(50), nrow = 5, ncol = 10)

myList <- list(m1, m2, m3)

m <- as.ColumnLinkedMatrix(myList)
```

as.matrix.LinkedMatrix

Converts a LinkedMatrix Instance to a Matrix (if Small Enough).

Description

Converts a [LinkedMatrix](#) Instance to a Matrix (if Small Enough).

Usage

```
## S3 method for class 'LinkedMatrix'
as.matrix(x, ...)
```

Arguments

`x` Either a [ColumnLinkedMatrix](#) or a [RowLinkedMatrix](#) object.
`...` Additional arguments (unused).

Value

A matrix.

cbind.ColumnLinkedMatrix

Combine Matrix-Like Objects by Columns.

Description

Compared to the [initialize\(\)](#) method, nested [LinkedMatrix](#) objects that are passed via `...` will not be treated as matrix-like objects, but their nodes will be extracted and merged with the new [ColumnLinkedMatrix](#) object for a more compact representation. This method will currently only work for [ColumnLinkedMatrix](#) objects.

Usage

```
## S3 method for class 'ColumnLinkedMatrix'
cbind(..., deparse.level = 0L)

## S3 method for class 'RowLinkedMatrix'
cbind(..., deparse.level = 0L)
```

Arguments

... Matrix-like objects to be combined by columns.
deparse.level Currently unused, defaults to 0.

ColumnLinkedMatrix-class

A Class for Linking Matrices by Columns or Rows.

Description

This class treats a list of matrix-like objects that are linked together by columns (`ColumnLinkedMatrix`) or rows (`RowLinkedMatrix`) and have the same number of rows similarly to a regular matrix by implementing key methods such as `[]` and `[]<-` for extracting and replacing matrix elements, `dim` to retrieve dimensions, and `dimnames` and `dimnames<-` to retrieve and set dimnames. Each list element is called a node and can be extracted or replaced using `[[` and `[[<-`. A matrix-like object is one that has two dimensions and implements at least `dim` and `[]`.

Details

Internally, this class is an S4 class that contains list. Each node can be accessed using the `[[` operator. `lapply` is also possible. `ColumnLinkedMatrix` and `RowLinkedMatrix` form a class union called [LinkedMatrix](#).

Methods

- `[]`
- `[]<-`
- `dim`
- `dimnames`
- `dimnames<-`
- `as.matrix`
- `is.matrix`
- `length`
- `print`
- `str`
- `cbind` (for `ColumnLinkedMatrix`)
- `rbind` (for `RowLinkedMatrix`)

See Also

`initialize()` to create a ColumnLinkedMatrix or RowLinkedMatrix object from scratch, `as.ColumnLinkedMatrix()` to create a ColumnLinkedMatrix or RowLinkedMatrix object from other objects, `LinkedMatrix()` to create an empty, prespecified LinkedMatrix object, `nNodes()` to get the number of nodes of a LinkedMatrix object.

Examples

```
# Create various matrix-like objects that correspond in dimensions
m1 <- ff::ff(initdata = rnorm(50), dim = c(5, 10))
m2 <- bigmemory::big.matrix(init = rnorm(50), nrow = 5, ncol = 10)
m3 <- matrix(data = rnorm(50), nrow = 5, ncol = 10)

# Link random matrices by columns
cm <- ColumnLinkedMatrix(m1, m2, m3)
dim(cm)

# Link random matrices by rows
rm <- RowLinkedMatrix(m1, m2, m3)
dim(rm)

# Get the number of nodes of each linked matrix
nNodes(cm)
nNodes(rm)

# Extract specific rows of linked matrix
cm[1, ]
cm[1:3, ]
rm[1, ]
rm[1:3, ]

# Extract specific columns of linked matrix
cm[, 1]
cm[, 1:3]
rm[, 1]
rm[, 1:3]

# Extract specific rows and columns of linked matrix
cm[1, 1]
cm[1:3, 1:3]
rm[1, 1]
rm[1:3, 1:3]

# Get a reference to one of the nodes
n <- cm[[2]]
class(n) == "big.matrix"

# LinkedMatrix objects are matrix-like and can be nested
rcm <- RowLinkedMatrix(cm, cm)
```

index	<i>Maps Each Column or Row Index of a Linked Matrix to the Column or Row Index of Its Corresponding Node.</i>
-------	---

Description

If *j* for [ColumnLinkedMatrix](#) or *i* for [RowLinkedMatrix](#) is passed, it will only generate entries for the given indices. `sort`, which is set by default, determines whether *j* or *i* should be sorted before building the index.

Usage

```
index(x, ...)
```

Arguments

<i>x</i>	Either a ColumnLinkedMatrix or a RowLinkedMatrix object.
<i>...</i>	Additional arguments (see Details).

Value

A matrix.

initialize,ColumnLinkedMatrix-method	<i>Create a LinkedMatrix Object.</i>
--------------------------------------	--------------------------------------

Description

This function constructs a new [ColumnLinkedMatrix](#) or [RowLinkedMatrix](#) object from a list of matrix-like objects.

Usage

```
## S4 method for signature 'ColumnLinkedMatrix'
initialize(.Object, ...)
```

```
## S4 method for signature 'RowLinkedMatrix'
initialize(.Object, ...)
```

Arguments

<i>.Object</i>	Internal, used by <code>methods::initialize()</code> generic.
<i>...</i>	A sequence of matrix-like objects of the same row-dimension (for ColumnLinkedMatrix) or column-dimension (for RowLinkedMatrix).

Details

A matrix-like object is one that has two dimensions and implements at least `dim` and `[`. Each object needs to have the same number of rows (for `ColumnLinkedMatrix`) or columns (for `RowLinkedMatrix`) to be linked together. If no matrix-like objects are given, a single 1x1 node of type `matrix` filled with NA is returned. `LinkedMatrix` objects can be nested as long as they are conformable.

Value

Either a `ColumnLinkedMatrix` or a `RowLinkedMatrix` object.

See Also

`LinkedMatrix()` to create an empty, prespecified `LinkedMatrix` object.

Examples

```
# Create various matrix-like objects that correspond in dimensions
m1 <- ff::ff(initdata = rnorm(50), dim = c(5, 10))
m2 <- bigmemory::big.matrix(init = rnorm(50), nrow = 5, ncol = 10)
m3 <- matrix(data = rnorm(50), nrow = 5, ncol = 10)

# Create a ColumnLinkedMatrix object
cm1 <- ColumnLinkedMatrix(m1, m2, m3)

# Create a RowLinkedMatrix object
rm1 <- RowLinkedMatrix(m1, m2, m3)

# Alternatively, a LinkedMatrix object can also be created using the `new`
# function
cm2 <- new("ColumnLinkedMatrix", m1, m2, m3)

# To specify the matrix-like objects as a list, use the `do.call` function
rm2 <- do.call(RowLinkedMatrix, list(m1, m2, m3))
```

LinkedMatrix

Create an Empty, Prespecified LinkedMatrix Object.

Description

This function creates an empty `LinkedMatrix` object of a certain size, a certain number of nodes, and certain types of nodes.

Usage

```
LinkedMatrix(nrow, ncol, nNodes, linkedBy, nodeInitializer, ...)
```

Arguments

nrow	The number of rows of the whole matrix.
ncol	The number of columns of the whole matrix.
nNodes	The number of nodes.
linkedBy	Whether the matrix is linked by columns or rows.
nodeInitializer	The name of a function or a function (nodeIndex, nrow, ncol, ...) where nodeIndex is the index of the node, nrow is a partition of the total number of rows, ncol is a partition of the total number of columns, and ... are additional parameters passed into the function. The function is expected to return a matrix-like object of dimensions nrow and ncol. Pre-defined node initializers include matrixNodeInitializer to initialize matrices and ffNodeInitializer to initialize ff objects.
...	Additional arguments passed into the nodeInitializer function.

Value

A [ColumnLinkedMatrix](#) object if linkedBy is columns or a [RowLinkedMatrix](#) object if linkedBy is rows.

See Also

[initialize\(\)](#) to create a [ColumnLinkedMatrix](#) or [RowLinkedMatrix](#) object from a list of matrix-like objects.

Examples

```
# Create an empty 15x10 RowLinkedMatrix with 3 matrix nodes
m1 <- LinkedMatrix(nrow = 15, ncol = 10, nNodes = 3, linkedBy = "rows",
                  nodeInitializer = "matrixNodeInitializer")

dim(m1)
nNodes(m1)
all(sapply(m1, class) == "matrix")

# Create an empty 15x10 RowLinkedMatrix with 3 ff nodes
m2 <- LinkedMatrix(nrow = 15, ncol = 10, nNodes = 3, linkedBy = "rows",
                  nodeInitializer = "ffNodeInitializer", vmode = "byte")

dim(m2)
nNodes(m2)
all(sapply(m2, inherits, "ff_matrix"))

# Create an empty 15x10 RowLinkedMatrix with 3 big.matrix nodes
m3 <- LinkedMatrix(nrow = 15, ncol = 10, nNodes = 3, linkedBy = "rows",
                  nodeInitializer = function(nodeIndex, nrow, ncol, ...) {
                    bigmemory::big.matrix(nrow = nrow, ncol = ncol)
                  })

dim(m3)
nNodes(m3)
all(sapply(m3, class) == "big.matrix")
```

LinkedMatrix-class *A Class Union of ColumnLinkedMatrix and RowLinkedMatrix.*

Description

This class is abstract and no objects can be created from it. It can be used to check whether an object is either of type [ColumnLinkedMatrix](#) or of type [RowLinkedMatrix](#) using `is(x, "LinkedMatrix")` and to assign methods for both [ColumnLinkedMatrix](#) and [RowLinkedMatrix](#) classes, e.g. `show`.

Methods

- `length`
- `as.matrix`
- `show`

See Also

[ColumnLinkedMatrix](#) and [RowLinkedMatrix](#) for implementations of column-linked and row-linked matrices, respectively.

Examples

```
# Create an example RowLinkedMatrix from various matrix-like objects that
# correspond in dimensions
m <- RowLinkedMatrix(
  ff::ff(initdata = rnorm(50), dim = c(5, 10)),
  bigmemory::big.matrix(init = rnorm(50), nrow = 5, ncol = 10),
  matrix(data = rnorm(50), nrow = 5, ncol = 10)
)

# Test if m is an object of either type ColumnLinkedMatrix or RowLinkedMatrix
if (is(m, "LinkedMatrix")) {
  message("m is a LinkedMatrix")
}
```

`nNodes` *Returns the Number of Nodes.*

Description

Returns the Number of Nodes.

Usage

```
nNodes(x)
```

Arguments

x Either a [ColumnLinkedMatrix](#) or a [RowLinkedMatrix](#) object.

Value

The number of nodes.

Examples

```
# Create an example RowLinkedMatrix from various matrix-like objects that
# correspond in dimensions
m <- RowLinkedMatrix(
  ff::ff(initdata = rnorm(50), dim = c(5, 10)),
  bigmemory::big.matrix(init = rnorm(50), nrow = 5, ncol = 10),
  matrix(data = rnorm(50), nrow = 5, ncol = 10)
)

# Get the number of nodes of the RowLinkedMatrix
nNodes(m)
```

nodes	<i>Returns the Column or Row Indexes at Which Each Node Starts and Ends.</i>
-------	--

Description

Returns the Column or Row Indexes at Which Each Node Starts and Ends.

Usage

```
nodes(x)
```

Arguments

x Either a [ColumnLinkedMatrix](#) or a [RowLinkedMatrix](#) object.

Value

A matrix.

`rbind.ColumnLinkedMatrix`*Combine Matrix-Like Objects by Rows.*

Description

Compared to the `initialize()` method, nested `LinkedMatrix` objects that are passed via `...` will not be treated as matrix-like objects, but their nodes will be extracted and merged with the new `RowLinkedMatrix` object for a more compact representation. This method will currently only work for `RowLinkedMatrix` objects.

Usage

```
## S3 method for class 'ColumnLinkedMatrix'  
rbind(..., deparse.level = 1L)
```

```
## S3 method for class 'RowLinkedMatrix'  
rbind(..., deparse.level = 1L)
```

Arguments

`...` Matrix-like objects to be combined by rows.
`deparse.level` Currently unused, defaults to 0.

`show,LinkedMatrix-method`*Show a LinkedMatrix Object.*

Description

Display the object, by printing, plotting or whatever suits its class.

Usage

```
## S4 method for signature 'LinkedMatrix'  
show(object)
```

Arguments

`object` A `LinkedMatrix` object.

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