

# Package ‘Biobase’

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**Title** Biobase: Base functions for Bioconductor

**Version** 2.26.0

**Author** R. Gentleman, V. Carey, M. Morgan, S. Falcon

**Description** Functions that are needed by many other packages or which replace R functions.

**Suggests** tools, tkWidgets, ALL, RUnit, golubEsets

**Depends** R (>= 2.10), BiocGenerics (>= 0.3.2), utils

**Imports** methods

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**License** Artistic-2.0

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AllGenerics.R VersionsClass.R VersionedClasses.R  
methods-VersionsNull.R methods-VersionedClass.R DataClasses.R  
methods-aggregator.R methods-container.R methods-MIAxE.R  
methods-MIAME.R methods-AssayData.R  
methods-AnnotatedDataFrame.R methods-eSet.R  
methods-ExpressionSet.R methods-MultiSet.R methods-SnpSet.R  
methods-NChannelSet.R anyMissing.R rowOp-methods.R  
updateObjectTo.R methods-ScalarObject.R zzz.R

**LazyLoad** yes

**biocViews** Infrastructure

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Biobase-package	<i>Biobase Package Overview</i>
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## Description

Biobase Package Overview

## Details

Important data classes: [ExpressionSet](#), [AnnotatedDataFrame](#) [MIAME](#). Full help on methods and associated functions is available from within class help pages.

Additional data classes: [eSet](#), [MIAXE](#), [MultiSet](#). Additional manipulation and data structuring classes: [Versioned](#), [VersionedBiobase](#), [aggregator](#), [container](#).

Vignette routines: [openVignette](#), [getPkgVigs](#), [openPDF](#).

Package manipulation functions: [createPackage](#) and [package.version](#)

Data sets: [aaMap](#), [sample.ExpressionSet](#), [geneData](#).

Introductory information is available from vignettes, type `openVignette()`.

Full listing of documented articles is available in HTML view by typing `help.start()` and selecting Biobase package from the Packages menu or via `library(help="Biobase")`.

**Author(s)**

O. Sklyar

---

abstract

*Retrieve Meta-data from eSets and ExpressionSets.*

---

**Description**

These generic functions access generic data, abstracts, PubMed IDs and experiment data from instances of the [eSet-class](#) or [ExpressionSet-class](#).

**Usage**

```
abstract(object)
pubMedIds(object)
pubMedIds(object) <- value
experimentData(object)
experimentData(object) <- value
```

**Arguments**

object	Object, possibly derived from <a href="#">eSet-class</a> or <a href="#">MIAME-class</a>
value	Value to be assigned; see class of object (e.g., <a href="#">eSet-class</a> ) for specifics.

**Value**

`abstract` returns a character vector containing the abstract (as in a published paper) associated with `object`.

`pubMedIds` returns a character vector of PUBMED IDs associated with the experiment.

`experimentData` returns an object representing the description of an experiment, e.g., an object of [MIAME-class](#)

**Author(s)**

Biocore

**See Also**

[ExpressionSet-class](#), [eSet-class](#), [MIAME-class](#)

---

addVigs2WinMenu	<i>Add Menu Items to an Existing/New Menu of Window</i>
-----------------	---

---

**Description**

This function adds a menu item for a package's vignettes.

**Usage**

```
addVigs2WinMenu(pkgName)
```

**Arguments**

pkgName            pkgName - a character string for the name of an R package

**Details**

The original functions addVig2Menu, addVig4Win, addVig4Unix, addNonExisting, addPDF2Vig have been replaced by addVigs2WinMenu, please use those instead.

**Value**

The functions do not return any value.

**Author(s)**

Jianhua Zhang and Jeff Gentry

**Examples**

```
# Only works for windows now
if(interactive() && .Platform$OS.type == "windows" &&
  .Platform$GUI == "Rgui"){
  addVigs2WinMenu("Biobase")
}
```

---

Aggregate	<i>A Simple Aggregation Mechanism.</i>
-----------	--

---

**Description**

Given an environment and an aggregator (an object of class aggregate simple aggregations are made.

**Usage**

```
Aggregate(x, agg)
```

**Arguments**

`x`                    The data to be aggregated.  
`agg`                    The aggregator to be used.

**Details**

Given some data, `x` the user can accumulate (or aggregate) information in `env` using the two supplied functions. See the accompanying documentation for a more complete example of this function and its use.

**Value**

No value is returned. This function is evaluated purely for side effects. The symbols and values in `env` are altered.

**Author(s)**

R. Gentleman

**See Also**

[new.env](#), [class:aggregator](#)

**Examples**

```
agg1 <- new("aggregator")
Aggregate(letters[1:10], agg1)
# the first 10 letters should be symbols in env1 with values of 1
Aggregate(letters[5:11], agg1)
# now letters[5:10] should have value 2
bb <- mget(letters[1:11], env=aggenv(agg1), ifnotfound=NA)
t1 <- as.numeric(bb); names(t1) <- names(bb)
t1
# a b c d e f g h i j k
# 1 1 1 1 2 2 2 2 2 2 1
```

---

aggregator

*A Simple Class for Aggregators*


---

**Description**

A class of objects designed to help aggregate calculations over an iterative computation. The aggregator consists of three objects. An environment to hold the values. A function that sets up an initial value the first time an object is seen. An aggregate function that increments the value of an object seen previously.

## Details

This class is used to help aggregate different values over function calls. A very simple example is to use leave one out cross-validation for prediction. At each stage we first perform feature selection and then cross-validate. To keep track of how often each feature is selected we can use an aggregator. At the end of the cross-validation we can extract the names of the features chosen from `aggenv`.

## Creating Objects

```
new(aggregator, aggenv = [environment], initfun = [function], aggfun = [function])
```

## Slots

`aggenv`: Object of class 'environment', holds the values between iterations

`initfun`: Object of class 'function' specifies how to initialize the value for a name the first time it is encountered

`aggfun`: Object of class 'function' used to increment (or perform any other function) on a name

## Methods

`aggenv(aggregator)`: Used to access the environment of the aggregator

`aggfun(aggregator)`: Used to access the function that aggregates

`initfun(aggregator)`: Used to access the initializer function

## See Also

[Aggregate](#)

---

AnnotatedDataFrame	<i>Class Containing Measured Variables and Their Meta-Data Description.</i>
--------------------	---

---

## Description

An `AnnotatedDataFrame` consists of two parts. There is a collection of samples and the values of variables measured on those samples. There is also a description of each variable measured. The components of an `AnnotatedDataFrame` can be accessed with [pData](#) and [varMetadata](#).

## Extends

Versioned

## Creating Objects

```
AnnotatedDataFrame(data, varMetadata, dimLabels=c("rowNames", "columnNames"), ...)
```

AnnotatedDataFrame instances are created using AnnotatedDataFrame. The function can take three arguments, data is a data.frame of the samples (rows) and measured variables (columns). varMetadata is a data.frame with the number of rows equal to the number of columns of the data argument. varMetadata describes aspects of each measured variable. dimLabels provides aesthetic control for labeling rows and columns in the show method. varMetadata and dimLabels can be missing.

as(data.frame, "AnnotatedDataFrame") coerces a data.frame to an AnnotatedDataFrame.

[annotatedDataFrameFrom](#) may be a convenient way to create an AnnotatedDataFrame from [AssayData-class](#).

## Slots

Class-specific slots:

**data:** A data.frame containing samples (rows) and measured variables (columns).

**dimLabels:** A character vector of length 2 that provides labels for the rows and columns in the show method.

**varMetadata:** A data.frame with number of rows equal number of columns in data, and at least one column, named labelDescription, containing a textual description of each variable.

**.\_\_classVersion\_\_:** A Versions object describing the R and Biobase version numbers used to created the instance. Intended for developer use.

## Methods

Class-specific methods.

as(annotatedDataFrame, "data.frame") Coerce objects of AnnotatedDataFrame to data.frame.

combine(<AnnotatedDataFrame>, <AnnotatedDataFrame>): Bind data from one AnnotatedDataFrame to a second AnnotatedDataFrame, returning the result as an AnnotatedDataFrame. Row (sample) names in each argument must be unique. Variable names present in both arguments occupy a single column in the resulting AnnotatedDataFrame. Variable names unique to either argument create columns with values assigned for those samples where the variable is present. varMetadata in the returned AnnotatedDataFrame is updated to reflect the combination.

pData(<AnnotatedDataFrame>), pData(<AnnotatedDataFrame>)<-<data.frame>: Set and retrieve the data (samples and variables) in the AnnotatedDataFrame

varMetadata(<AnnotatedDataFrame>), varMetadata(<AnnotatedDataFrame>)<-<data.frame>: Set and retrieve the meta-data (variables and their descriptions) in the AnnotatedDataFrame

featureNames(<AnnotatedDataFrame>), featureNames(<AnnotatedDataFrame>)<-<ANY>: Set and retrieve the feature names in AnnotatedDataFrame; a synonym for sampleNames.

sampleNames(<AnnotatedDataFrame>), sampleNames(<AnnotatedDataFrame>)<-<ANY>: Set and retrieve the sample names in AnnotatedDataFrame

varLabels(<AnnotatedDataFrame>), varLabels(<AnnotatedDataFrame>)<-<data.frame>: Set and retrieve the variable labels in the AnnotatedDataFrame



`dimLabels(<AnnotatedDataFrame>), dimLabels(<AnnotatedDataFrame>) <- <character>`  
 Retrieve labels used for display of AnnotatedDataFrame, e.g., 'rowNames', 'columnNames'.

Standard generic methods:

`initialize(<AnnotatedDataFrame>)`: Object instantiation, used by `new`; not to be called directly by the user.

`as(<data.frame>, "AnnotatedDataFrame")`: Convert a `data.frame` to an `AnnotatedDataFrame`.

`as(<phenoData>, <AnnotatedDataFrame>)`: Convert old-style `phenoData-class` objects to `AnnotatedDataFrame`, issuing warnings as appropriate.

`validObject(<AnnotatedDataFrame>)`: Validity-checking method, ensuring coordination between `data` and `varMetadata` elements

`updateObject(object, ..., verbose=FALSE)` Update instance to current version, if necessary. See [updateObject](#)

`isCurrent(object)` Determine whether version of object is current. See [isCurrent](#)

`isVersioned(object)` Determine whether object contains a 'version' string describing its structure. See [isVersioned](#)

`show(<AnnotatedDataFrame>)` Abbreviated display of object

`[<sample>, <variable>]`: Subset operation, taking two arguments and indexing the sample and variable. Returns an `AnnotatedDataFrame`, i.e., including relevant metadata. Unlike a `data.frame`, setting `drop=TRUE` generates an error.

`[[<variable>, $<variable>]`: Selector returning a variable (column of `pData`).

`[[<variable>, ...]]<-<new_value>, $<variable> <- <new_value>`: Replace or add a variable to `pData`. ... can include named arguments (especially `labelDescription`) to be added to `varMetadata`.

`dim(<AnnotatedDataFrame>), ncol(<AnnotatedDataFrame>)`: Number of samples and variables (`dim`) and variables (`ncol`) in the argument.

`dimnames(<AnnotatedDataFrame>), rownames(<AnnotatedDataFrame>), colnames(<AnnotatedDataFrame>)`: row and column names.

### Author(s)

V.J. Carey, after initial design by R. Gentleman

### See Also

[eSet](#), [ExpressionSet](#), [read.AnnotatedDataFrame](#)

### Examples

```
df <- data.frame(x=1:6,
                 y=rep(c("Low", "High"),3),
                 z=I(LETTERS[1:6]),
                 row.names=paste("Sample", 1:6, sep="_"))
metaData <-
  data.frame(labelDescription=c(
    "Numbers",
```

```
      "Factor levels",
      "Characters"))

AnnotatedDataFrame()
AnnotatedDataFrame(data=df)
AnnotatedDataFrame(data=df, varMetadata=metaData)
as(df, "AnnotatedDataFrame")

obj <- AnnotatedDataFrame()
pData(obj) <- df
varMetadata(obj) <- metaData
validObject(obj)
```

---

annotatedDataFrameFrom-methods

*Methods for Function annotatedDataFrameFrom in Package  
'Biobase'*

---

## Description

annotatedDataFrameFrom is a convenience for creating [AnnotatedDataFrame](#) objects.

## Methods

Use the method with `annotatedDataFrameFrom(object, byrow=FALSE, ...)`; the argument `byrow` *must* be specified.

`signature(object="assayData")` This method creates an `AnnotatedDataFrame` using sample (when `byrow=FALSE`) or feature (`byrow=TRUE`) names and dimensions of an `AssayData` object as a template.

`signature(object="matrix")` This method creates an `AnnotatedDataFrame` using column (when `byrow=FALSE`) or row (`byrow=TRUE`) names and dimensions of a `matrix` object as a template.

`signature(object="NULL")` This method (called with 'NULL' as the object) creates an empty `AnnotatedDataFrame`; provides `dimLabels` based on value of `byrow`.

## Author(s)

Biocore team

---

anyMissing	<i>Checks if there are any missing values in an object or not</i>
------------	---

---

**Description**

Checks if there are any missing values in an object or not.

**Usage**

```
anyMissing(x=NULL)
```

**Arguments**

x                    A [vector](#).

**Details**

The implementation of this method is optimized for both speed and memory.

**Value**

Returns [TRUE](#) if a missing value was detected, otherwise [FALSE](#).

**Author(s)**

Henrik Bengtsson (<http://www.braju.com/R/>)

**Examples**

```
x <- rnorm(n=1000)
x[seq(300,length(x),by=100)] <- NA
stopifnot(anyMissing(x) == any(is.na(x)))
```

---

assayData	<i>Retrieve assay data from eSets and ExpressionSets.</i>
-----------	---

---

**Description**

This generic function accesses assay data stored in an object derived from the [eSet](#) or [ExpressionSet](#) class.

**Usage**

```
assayData(object)
assayData(object) <- value
```

**Arguments**

object	Object derived from class eSet
value	Named list or environment containing one or more matrices with identical dimensions

**Value**

assayData applied to eSet-derived classes returns a list or environment; applied to ExpressionSet, the method returns an environment. See the class documentation for specific details.

**Author(s)**

Biocore

**See Also**

[eSet-class](#), [ExpressionSet-class](#), [SnpSet-class](#)

---

AssayData-class	<i>Class "AssayData"</i>
-----------------	--------------------------

---

**Description**

Container class defined as a class union of list and environment. Designed to contain one or more matrices of the same dimension.

**Methods**

**combine** signature(x = "AssayData", y = "AssayData"): This method uses cbind to create new AssayData elements that contain the samples of both arguments x and y.

Both AssayData arguments to combine must have the same collection of elements. The elements must have identical numbers of rows (features). The numerical contents of any columns (samples) present in the same element of different AssayData must be identical. The storageMode of the AssayData arguments must be identical, and the function returns an AssayData with storageMode matching the incoming mode. See also [combine](#), [eSet](#), [eSet-method](#)

**featureNames** signature(object = "AssayData")

**featureNames<-** signature(object = "AssayData", value = "ANY"): Return or set the feature names as a character vector. These are the row names of the AssayData elements. value can be a character or numeric vector; all entries must be unique.

**sampleNames** signature(object = "AssayData")

**sampleNames<-** signature(object = "AssayData", value="ANY"): Return or set the sample names. These are the column names of the the AssayData elements and the row names of phenoData. value can be a character or numeric vector.

**storageMode** signature(object = "AssayData")

**storageMode**`<-` signature(object = "AssayData",value="character"): Return or set the storage mode for the instance. value can be one of three choices: "lockedEnvironment", "environment", and "list". Environments offer a mechanism for storing data that avoids some of the copying that occurs when using lists. Locked environment help to ensure data integrity. Note that environments are one of the few R objects that are pass-by-reference. This means that if you modify a copy of an environment, you also modify the original. For this reason, we recommend using lockedEnvironment whenever possible.

Additional functions operating on AssayData include:

**assayData[[name ]]** Select element name from assayData.

**assayDataNew(storage.mode = c("lockedEnvironment", "environment", "list"), ...)** Use storage.mode to create a new list or environment containing the named elements in . . .

**assayDataValidMembers(assayData, required)** Validate assayData, ensuring that the named elements required are present, matrices are of the same dimension, and featureNames (row-names) are consistent (identical or NULL) across entries.

**assayDataElement(object, element)** See [eSet-class](#)

**assayDataElementReplace(object, element, value)** See [eSet-class](#)

**assayDataElementNames(object)** See [eSet-class](#)

#### Author(s)

Biocore

#### See Also

[eSet-class ExpressionSet-class](#)

---

cache

*Evaluate an expression if its value is not already cached.*

---

#### Description

Cache the evaluation of an expression in the file system.

#### Usage

```
cache(expr, dir=".", prefix="tmp_R_cache_", name)
```

#### Arguments

expr	An expression of the form LHS <- RHS, Where LHS is a variable name, RHS is any valid expression, and <- must be used (= will not work).
dir	A string specifying the directory into which cache files should be written (also where to go searching for an appropriate cache file).
prefix	A string giving the prefix to use when naming and searching for cache files. The default is "tmp_R_cache_"
name	Unused. This argument is present as a compatibility layer for the deprecated calling convention.

**Details**

This function can be useful during the development of computationally intensive workflows, for example in vignettes or scripts. The function uses a cache file in `dir` which defaults to the current working directory whose name is obtained by `paste(prefix, name, ".RData", sep="")`.

When `cache` is called and the cache file exists, it is loaded and the object whose name is given on the left of `<-` in `expr` is returned. In this case, `expr` is *not* evaluated.

When `cache` is called and the cache file does not exist, `expr` is evaluated, its value is saved into a cache file, and then its value is returned.

The `expr` argument must be of the form of `someVar <- {expressions}`. That is, the left hand side must be a single symbol name and the next syntactic token must be `<-`.

To flush the cache and force recomputation, simply remove the cache files. You can use `file.remove` to do this.

**Value**

The (cached) value of `expr`.

**Note**

The first version of this function had a slightly different interface which is now deprecated (but still functional). The old version has arguments `name` and `expr` and the intended usage is: `foo <- cache("foo", expr)`.

**Author(s)**

Wolfgang Huber, <huber@ebi.ac.uk> Seth Falcon, <sfalcon@fhcrc.org>

**Examples**

```
bigCalc <- function() runif(10)
cache(myComplicatedObject <- bigCalc())
aCopy <- myComplicatedObject
remove(myComplicatedObject)
cache(myComplicatedObject <- bigCalc())
stopifnot(all.equal(myComplicatedObject, aCopy))
allCacheFiles <-
  list.files(".", pattern="^tmp_R_cache_.*\\.RData$", full.name=TRUE)
file.remove(allCacheFiles)
```

---

channel

*Create a new ExpressionSet instance by selecting a specific channel*

---

**Description**

This generic function extracts a specific element from an object, returning a instance of the `ExpressionSet` class.

**Usage**

```
channel(object, name, ...)
```

**Arguments**

object	An S4 object, typically derived from class <a href="#">eSet</a>
name	The name of the channel, a (length one) character vector.
...	Additional arguments.

**Value**

An instance of class [ExpressionSet](#).

**Author(s)**

Biocore

**Examples**

```
obj <- NChannelSet(  
  R=matrix(runif(100), 20, 5),  
  G=matrix(runif(100), 20, 5))  
## G channel as ExpressionSet  
channel(obj, "G")
```

---

channelNames

*Retrieve and set channel names from object*

---

**Description**

This generic function reports or updates the channels in an object.

**Usage**

```
channelNames(object, ...)  
channelNames(object, ...) <- value
```

**Arguments**

object	An S4 object, typically derived from class <a href="#">eSet</a>
value	Replacement value, either a character vector (to re-order existing channel names or a named character vector or list (to change channel names from the vector elements to the corresponding names).
...	Additional argument, not currently used.

## Details

channelNames returns the names of the channels in a defined order. Change the order using the replacement method with a permutation of the channel names as value. Rename channels using the replacement method with a named list, where the vector elements are a permutation of the current channels, with corresponding names the new identifier for the channel.

## Value

character.

## Author(s)

Biocore

## Examples

```
## channelNames default to alphabetical order of channels
obj <- NChannelSet(
  R=matrix(runif(100), 20, 5),
  G=matrix(-runif(100), 20, 5))
channelNames(obj)
channelNames(obj) <- c(Gn="G", Rd="R") ## rename
channelNames(obj)
channelNames(obj) <- c("Rd", "Gn") ## reorder
channelNames(obj)
all(assayData(obj)[["Gn"]] <= 0)
all(assayData(obj)[["Rd"]] >= 0)
```

---

class:characterORMIAME

*Class to Make Older Versions Compatible*

---

## Description

This class can be either character or MIAME.

## Methods

No methods defined with class "characterORMIAME" in the signature.

## See Also

See also [MIAME](#)



---

classVersion	<i>Retrieve information about versioned classes</i>
--------------	---

---

### Description

These generic functions return version information for classes derived from [Versioned-class](#), or [VersionsNull-class](#) for unversioned objects. The version information is an object of [Versions-class](#).

By default, classVersion has the following behaviors:

classVersion(Versioned-instance) Returns a Versions-class object obtained from the object.

classVersion{"class"} Consults the definition of class and return the current version information, if available.

classVersion(ANY) Return a [VersionsNull-class](#) object to indicate no version information available.

By default, the classVersion<- method has the following behavior:

classVersion(Versioned-instance)["id"] <- value Assign (update or add) value to Versions-instance. value is coerced to a valid version description. see [Versions-class](#) for additional access methods.

### Usage

```
classVersion(object)
classVersion(object) <- value
```

### Arguments

object	Object whose version is to be determined, as described above.
value	Version-class object to assign to object of Versioned-class object.

### Value

classVersion returns an instance of [Versions-class](#)

### Author(s)

Biocore team

### See Also

[Versions-class](#)

**Examples**

```
obj <- new("VersionedBiobase")

classVersion(obj)
classVersion(obj)["Biobase"]
classVersion(1:10) # no version
classVersion("ExpressionSet") # consult ExpressionSet prototype

classVersion(obj)["MyVersion"] <- "1.0.0"
classVersion(obj)
```

---

 container

---

*A Lockable List Structure with Constraints on Content*


---

**Description**

Container class that specializes the list construct of R to provide content and access control

**Creating Objects**

```
new(container, x = [list], content = [character], locked = [logical])
```

**Slots**

**x** list of entities that are guaranteed to share a certain property

**content** tag describing container contents

**locked** boolean indicator of locked status. Value of TRUE implies assignments into the container are not permitted

**Methods**

Class-specific methods:

content(container) returns content slot of argument

locked(container) returns locked slot of argument

Standard methods defined for 'container':

show(container) prints container

length(container) returns number of elements in the container

[[ (index) **and** [[ (index, value) access and replace elements in the container

[(index) make a subset of a container (which will itself be a container)

**Examples**

```
x1 <- new("container", x=vector("list", length=3), content="lm")
lm1 <- lm(rnorm(10)~runif(10))
x1[[1]] <- lm1
```

---

contents	<i>Function to retrieve contents of environments</i>
----------	--

---

## Description

The contents method is used to retrieve the values stored in an environment.

## Usage

```
contents(object, all.names)
```

## Arguments

object	The environment (data table) that you want to get all contents from
all.names	a logical indicating whether to copy all values in <code>as.list.environment</code>

## Value

A named list is returned, where the elements are the objects stored in the environment. The names of the elements are the names of the objects.

The `all.names` argument is identical to the one used in `as.list.environment`.

## Author(s)

R. Gentleman

## See Also

[as.list.environment](#)

## Examples

```
z <- new.env()
multiassign(letters, 1:26, envir=z)
contents(z)
```

---

`copyEnv`*List-Environment interactions*

---

### Description

These functions can be used to make copies of environments, or to get/assign all of the objects inside of an environment.

### Usage

```
copyEnv(oldEnv, newEnv, all.names=FALSE)
```

### Arguments

<code>oldEnv</code>	An environment to copy from
<code>newEnv</code>	An environment to copy to. If missing, a new environment with the same parent environment as <code>oldEnv</code> .
<code>all.names</code>	Whether to retrieve objects with names that start with a dot.

### Details

`copyEnv`: This function will make a copy of the contents from `oldEnv` and place them into `newEnv`.

### Author(s)

Jeff Gentry and R. Gentleman

### See Also

[environment](#), [as.list](#)

### Examples

```
z <- new.env(hash=TRUE, parent=emptyenv(), size=29L)
multiassign(c("a","b","c"), c(1,2,3), z)

a <- copyEnv(z)
ls(a)
```

---

copySubstitute	<i>Copy Between Connections or Files with Configure-Like Name-Value Substitution</i>
----------------	--

---

### Description

Copy files, directory trees or between connections and replace all occurrences of a symbol by the corresponding value.

### Usage

```
copySubstitute(src, dest, symbolValues, symbolDelimiter="@", allowUnresolvedSymbols=FALSE,
               recursive = FALSE, removeExtension = "\\\.in$")
```

### Arguments

src	Source, either a character vector with filenames and/or directory names, or a connection object.
dest	Destination, either a character vector of length 1 with the name of an existing, writable directory, or a connection object. The class of the dest argument must match that of the src argument.
symbolValues	A named list of character strings.
symbolDelimiter	A character string of length one with a single character in it.
allowUnresolvedSymbols	Logical. If FALSE, then the function will execute <a href="#">stop</a> if it comes across symbols that are not defined in symbolValues.
recursive	Logical. If TRUE, the function works recursively down a directory tree (see details).
removeExtension	Character. Matches to this regular expression are removed from filenames and directory names.

### Details

Symbol substitution: this is best explained with an example. If the list symbolValues contains an element with name FOO and value bar, and symbolDelimiter is @, then any occurrence of @FOO@ is replaced by bar. This applies both the text contents of the files in src as well as to the filenames. See examples.

If recursive is FALSE, both src and dest must be connection or a filenames. The text in src is read through the function [readLines](#), symbols are replaced by their values, and the result is written to dest through the function [writeLines](#).

If recursive is TRUE, [copySubstitute](#) works recursively down a directory tree (see details and example). src must be a character vector with multiple filenames or directory names, dest a directory name.

One use of this function is in `createPackage` for the automatic generation of packages from a template package directory.

### Value

None. The function is called for its side effect.

### Author(s)

Wolfgang Huber <http://www.dkfz.de/mga/whuber>

### Examples

```
## create an example file
infile = tempfile()
outfile = tempfile()

writeLines(text=c("We will perform in @WHAT@",
  "So, thanks to @WHOM@ at once and to each one,",
  "Whom we invite to see us crowd at @WHERE@"),
  con = infile)

## create the symbol table
z = list(WHAT="measure, time and place", WHOM="all", WHERE="Scone")

## run copySubstitute
copySubstitute(infile, outfile, z)

## display the results
readLines(outfile)

##-----
## This is a slightly more complicated example that demonstrates
## how copySubstitute works on nested directories
##-----
d = tempdir()
my.dir.create = function(x) {dir.create(x); return(x)}

unlink(file.path(d, "src"), recursive=TRUE)
unlink(file.path(d, "dest"), recursive=TRUE)

## create some directories and files:
src = my.dir.create(file.path(d, "src"))
dest = file.path(d, "dest")
d1 = my.dir.create(file.path(src, "dir1.in"))
d2 = my.dir.create(file.path(src, "dir2@F00@.in"))
d3 = my.dir.create(file.path(d2, "dir3"))
d4 = my.dir.create(file.path(d3, "dir4"))
d5 = my.dir.create(file.path(d4, "dir5@BAR@"))
writeLines(c("File1:", "F00: @F00@"), file.path(d1, "file1.txt.in"))
```

```

writeLines(c("File2:", "BAR: @BAR@"), file.path(d2, "file2.txt.in"))
writeLines(c("File3:", "SUN: @SUN@"), file.path(d3, "file3.txt.in"))
writeLines(c("File4:", "MOON: @MOON@"), file.path(d4, "@SUN@.txt"))

## call copySubstitute
copySubstitute(src, dest, recursive=TRUE,
               symbolValues = list(FOO="thefoo", BAR="thebar",
                                   SUN="thesun", MOON="themoon"))

## view the result
listsrc = dir(src, full.names=TRUE, recursive=TRUE)
listdest = dir(dest, full.names=TRUE, recursive=TRUE)
listsrc
listdest

cat(unlist(lapply(listsrc, readLines)), sep="\n")
cat(unlist(lapply(listdest, readLines)), sep="\n")

```

---

createPackage

*Create a Package Directory from a Template*


---

## Description

Create a package directory from a template, with symbol-value substitution

## Usage

```
createPackage(pkgname, destinationDir, originDir, symbolValues, unlink=FALSE, quiet=FALSE)
```

## Arguments

pkgname	Character. The name of the package to be written.
destinationDir	Character. The path to a directory where the package is to be written.
originDir	Character. The path to a directory that contains the template package. Usually, this will contain a file named DESCRIPTION, and subdirectories R, man, data. In all files and filenames, symbols will be replaced by their respective values, see the parameter symbolValues.
symbolValues	Named list of character strings. The symbol-to-value mapping. See <a href="#">copySubstitute</a> for details.
unlink	Logical. If TRUE, and destinationDir already contains a file or directory with the name pkgname, try to unlink (remove) it.
quiet	Logical. If TRUE, do not print information messages.

### Details

The intended use of this function is for the automated mass production of data packages, such as the microarray annotation, CDF, and probe sequence packages.

No syntactic or other checking of the package is performed. For this, use R CMD check.

The symbols @PKGNAME@ and @DATE@ are automatically defined with the values of pkgname and date(), respectively.

### Value

The function returns a list with one element pkgdir: the path to the package.

### Author(s)

Wolfgang Huber <http://www.dkfz.de/mga/whuber>

### See Also

[copySubstitute](#), the reference manual *Writing R extensions*.

### Examples

```
sym = list(AUTHOR = "Hesiod", VERSION = "1.0",
          TITLE = "the nine muses",
          FORMAT = "Character vector containg the names of the 9 muses.")

res = createPackage("muses",
                  destinationDir = tempdir(),
                  originDir      = system.file("Code", package="Biobase"),
                  symbolValues   = sym,
                  unlink         = TRUE, quiet = FALSE)

muses = c("Calliope", "Clio", "Erato", "Euterpe", "Melpomene",
          "Polyhymnia", "Terpsichore", "Thalia", "Urania")

dir.create(file.path(res$pkgdir, "data"))

save(muses, file = file.path(res$pkgdir, "data", "muses.rda"))

res$pkgdir
```

---

data:aaMap

*Dataset: Names and Characteristics of Amino Acids*

---

### Description

The aaMap data frame has 20 rows and 6 columns. Includes elementary information about amino acids.



**Usage**

```
data(aaMap)
```

**Format**

This data frame contains the following columns:

**name** amino acid name

**let.1** one-letter code

**let.3** three-letter code

**scProp** side chain property at pH 7 (polar/nonpolar)

**hyPhilic** logical: side chain is hydrophilic at pH 7

**acidic** logical: side chain is acidic at pH 7

**Source**

Nei M and Kumar S: Molecular evolution and phylogenetics (Oxford 2000), Table 1.2

**Examples**

```
data(aaMap)
```

---

data:geneData

*Sample expression matrix and phenotype data.frames.*

---

**Description**

The geneData data.frame has 500 rows and 26 columns. It consists of a subset of real expression data from an Affymetrix U95v2 chip. The data are anonymous. The covariate data geneCov and geneCovariate are made up. The standard error data seD is also made up.

**Usage**

```
data(geneData)
```

**Format**

A 500 by 26 data frame.

**Source**

The J. Ritz Laboratory (S. Chiaretti).

**Examples**

```
data(geneData)
data(geneCovariate)
data(seD)
```

---

```
data:sample.ExpressionSet
```

*Dataset of class 'ExpressionSet'*

---

### Description

The expression data are real but anonymized. The data are from an experiment that used Affymetrix U95v2 chips. The data were processed by dChip and then exported to R for analysis.

The data illustrate `ExpressionSet-class`, with `assayData` containing the required matrix element `exprs` and an additional matrix `se.exprs`. `se.exprs` has the same dimensions as `exprs`.

The `phenoData` and standard error estimates (`se.exprs`) are made up. The information in the "description" slot is fake.

### Usage

```
data(sample.ExpressionSet)
```

### Format

The data for 26 cases, labeled A to Z and 500 genes. Each case has three covariates: sex (male/female); type (case/control); and score (testing score).

### Examples

```
data(sample.ExpressionSet)
```

---

```
data:sample.MultiSet  Data set of class 'MultiSet'
```

---

### Description

The expression data are real but anonymized. The data are from an experiment that used Affymetrix U95v2 chips. The data were processed by dChip and then exported to R for analysis.

The `phenoData`, standard error estimates, and description data are fake.

### Usage

```
data(sample.MultiSet)
```

### Format

The data for 4 cases, labeled a to d and 500 genes. Each case has five covariates: SlideNumber: number; FileName: name; Cy3: genotype labeled Cy3; Cy5: genotype labeled Cy5; Date: date.

### Examples

```
data(sample.MultiSet)
```

---

description	<i>Retrieve and set overall experimental information eSet-like classes.</i>
-------------	---

---

**Description**

These generic functions access experimental information associated with [eSet-class](#).

**Usage**

```
description(object, ...)  
description(object) <- value
```

**Arguments**

object	Object, possibly derived from class <a href="#">eSet-class</a> .
value	Structured information describing the experiment, e.g., of <a href="#">MIAME-class</a> .
...	Further arguments to be used by other methods.

**Value**

description returns an object of [MIAME-class](#).

**Author(s)**

Biocore

**See Also**

[eSet-class](#), [MIAME-class](#)

---

dims	<i>Retrieve dimensions of all elements in a list or environment</i>
------	---

---

**Description**

This function returns the dimensions of element members in lists or environments such as [AssayData-class](#).

**Usage**

```
dims(object)
```

**Arguments**

object	List or environment object containing one or several matrices
--------	---

**Value**

matrix of row and column dimensions, (in rows) for each element in object (columns).

**Author(s)**

Biocore

**See Also**

[eSet-class](#)

---

dumpPackTxt

*Dump Textual Description of a Package*

---

**Description**

Dump textual description of a package

**Usage**

```
dumpPackTxt(package)
```

**Arguments**

package            Character string naming an R package

**Details**

dumps DESCRIPTION and INDEX files from package sources

**Value**

stdout output

**Note**

Other approaches using formatDL are feasible

**Author(s)**

<stvj@channing.harvard.edu>

**Examples**

```
dumpPackTxt("stats")
```

---

`esApply`*An apply-like function for ExpressionSet and related structures.*

---

**Description**

`esApply` is a wrapper to `apply` for use with `ExpressionSets`. The application of a function to rows of an expression array usually involves variables in `pData`. `esApply` uses a special evaluation paradigm to make this easy. The function `FUN` may reference any data in `pData` by name.

**Usage**

```
esApply(X, MARGIN, FUN, ...)
```

**Arguments**

<code>X</code>	An instance of class <code>ExpressionSet</code> .
<code>MARGIN</code>	The margin to apply to, either 1 for rows (samples) or 2 for columns (features).
<code>FUN</code>	Any function
<code>...</code>	Additional parameters for <code>FUN</code> .

**Details**

The `pData` from `X` is installed in an environment. This environment is installed as the environment of `FUN`. This will then provide bindings for any symbols in `FUN` that are the same as the names of the `pData` of `X`. If `FUN` has an environment already it is retained but placed after the newly created environment. Some variable shadowing could occur under these circumstances.

**Value**

The result of `with(pData(x), apply(exprs(X), MARGIN, FUN, ...))`.

**Author(s)**

V.J. Carey <stvjc@channing.harvard.edu>, R. Gentleman

**See Also**

[apply](#), [ExpressionSet](#)

**Examples**

```
data(sample.ExpressionSet)
## sum columns of exprs
res <- esApply(sample.ExpressionSet, 1, sum)

## t-test, splitting samples by sex
f <- function(x) {
  xx <- split(x, sex)
```

```

    t.test(xx[[1]], xx[[2]])$p.value
  }
res <- esApply(sample.ExpressionSet, 1, f)

## same, but using a variable passed in the function call

f <- function(x, s) {
  xx <- split(x, s)
  mean(xx[[1]]) - mean(xx[[2]])
}
sex <- sample.ExpressionSet[["sex"]]
res <- esApply(sample.ExpressionSet, 1, f, s = sex)

# obtain the p-value of the t-test for sex difference
mytt.demo <- function(y) {
  ys <- split(y, sex)
  t.test(ys[[1]], ys[[2]])$p.value
}
sexPValue <- esApply(sample.ExpressionSet, 1, mytt.demo)

# obtain the p-value of the slope associated with score, adjusting for sex
# (if we were concerned with sign we could save the z statistic instead at coef[3,3])
myreg.demo <- function(y) {
  summary(lm(y ~ sex + score))$coef[3,4]
}
scorePValue <- esApply(sample.ExpressionSet, 1, myreg.demo)

# a resampling method
resamp <- function(ESET) {
  ntiss <- ncol(exprs(ESET))
  newind <- sample(1:ntiss, size = ntiss, replace = TRUE)
  ESET[newind,]
}

# a filter
q3g100filt <- function(eset) {
  apply(exprs(eset), 1, function(x) quantile(x,.75) > 100)
}

# filter after resampling and then apply
set.seed(123)
rest <- esApply({bool <- q3g100filt(resamp(sample.ExpressionSet)); sample.ExpressionSet[bool,]},
  1, mytt.demo)

```

## Description

Container for high-throughput assays and experimental metadata. Classes derived from eSet contain one or more identical-sized matrices as assayData elements. Derived classes (e.g., [ExpressionSet-class](#), [SnpSet-class](#)) specify which elements must be present in the assayData slot.

eSet object cannot be instantiated directly; see the examples for usage.

## Creating Objects

eSet is a virtual class, so instances cannot be created.

Objects created under previous definitions of eSet-class can be coerced to the current classes derived from eSet using updateOldESet.

## Slots

Introduced in eSet:

**assayData:** Contains matrices with equal dimensions, and with column number equal to nrow(phenoData).

Class: [AssayData-class](#)

**phenoData:** Contains experimenter-supplied variables describing sample (i.e., columns in assayData) phenotypes. Class: [AnnotatedDataFrame-class](#)

**featureData:** Contains variables describing features (i.e., rows in assayData) unique to this experiment. Use the annotation slot to efficiently reference feature data common to the annotation package used in the experiment. Class: [AnnotatedDataFrame-class](#)

**experimentData:** Contains details of experimental methods. Class: [MIAME-class](#)

**annotation:** Label associated with the annotation package used in the experiment. Class: character

**protocolData:** Contains microarray equipment-generated variables describing sample (i.e., columns in assayData) phenotypes. Class: [AnnotatedDataFrame-class](#)

**.\_\_classVersion\_\_:** A Versions object describing the R and Biobase version numbers used to created the instance. Intended for developer use.

## Methods

Methods defined in derived classes (e.g., [ExpressionSet-class](#), [SnpSet-class](#)) may override the methods described here.

Class-specific methods:

**sampleNames(object) and sampleNames(object)<-value:** Coordinate accessing and setting sample names in assayData and phenoData

**featureNames(object), featureNames(object) <- value:** Coordinate accessing and setting of feature names (e.g, genes, probes) in assayData.

**dimnames(object), dimnames(object) <- value:** Also rownames and colnames; access and set feature and sample names.

**dims(object):** Access the common dimensions (dim) or column numbers (ncol), or dimensions of all members (dims) of assayData.

**phenoData(object), phenoData(object) <- value:** Access and set phenoData. Adding new columns to phenoData is often more easily done with eSetObject[["columnName"]] <- value.

`pData(object), pData(object) <- value`: Access and set sample data information. Adding new columns to `pData` is often more easily done with `eSetObject[["columnName"]] <- value`.  
`varMetadata(object), varMetadata(eSet, value)` Access and set metadata describing variables reported in `pData`  
`varLabels(object), varLabels(eSet, value)<-`: Access and set variable labels in `phenoData`.  
`featureData(object), featureData(object) <- value`: Access and set `featureData`.  
`fData(object), fData(object) <- value`: Access and set feature data information.  
`fvarMetadata(object), fvarMetadata(eSet, value)` Access and set metadata describing features reported in `fData`  
`fvarLabels(object), fvarLabels(eSet, value)<-`: Access and set variable labels in `featureData`.  
`assayData(object), assayData(object) <- value`: signature(object = "eSet", value = "AssayData"): Access and replace the `AssayData` slot of an `eSet` instance. `assayData` returns a list or environment; elements in `assayData` not accessible in other ways (e.g., via `exprs` applied directly to the `eSet`) can most reliably be accessed with, e.g., `assayData(obj)[["se.exprs"]]`.  
`experimentData(object), experimentData(object) <- value`: Access and set details of experimental methods  
`description(object), description(object) <- value`: Synonymous with `experimentData`.  
`notes(object), notes(object) <- value`: signature(object="eSet", value="list") Retrieve and set unstructured notes associated with `eSet`. signature(object="eSet", value="character") As with value="list", but *append* value to current list of notes.  
`pubMedIds(object), pubMedIds(eSet, value)` Access and set PMIDs in `experimentData`.  
`abstract(object)`: Access abstract in `experimentData`.  
`annotation(object), annotation(object) <- value` Access and set annotation label indicating package used in the experiment.  
`protocolData(object), protocolData(object) <- value` Access and set the protocol data.  
`preproc(object), preproc(object) <- value`: signature(object="eSet", value="list") Access and set preprocessing information in the `MIAME-class` object associated with this `eSet`.  
`combine(eSet, eSet)`: Combine two `eSet` objects. To be combined, `eSets` must have identical numbers of `featureNames`, distinct `sampleNames`, and identical annotation.  
`storageMode(object), storageMode(eSet, character)<-`: Change storage mode of `assayData`. Can be used to 'unlock' environments, or to change between `list` and environment modes of storing `assayData`.  
Standard generic methods:  
`initialize(object)`: Object instantiation, can be called by derived classes but not usually by the user.  
`validObject(object)`: Validity-checking method, ensuring (1) all `assayData` components have the same number of features and samples; (2) the number and names of `phenoData` rows match the number and names of `assayData` columns  
`as(eSet, "ExpressionSet")` Convert instance of class "eSet" to instance of `ExpressionSet-class`, if possible.



as(eSet, "MultiSet") Convert instance of class "eSet" to instance of [MultiSet-class](#), if possible.

updateObject(object, ..., verbose=FALSE) Update instance to current version, if necessary. Usually called through class inheritance rather than directly by the user. See [updateObject](#)

updateObjectTo(object, template, ..., verbose=FALSE) Update instance to current version by updating slots in template, if necessary. Usually call by class inheritance, rather than directly by the user. See [updateObjectTo](#)

isCurrent(object) Determine whether version of object is current. See [isCurrent](#)

isVersioned(object) Determine whether object contains a 'version' string describing its structure. See [isVersioned](#)

show(object) Informatively display object contents.

dim(object), ncol Access the common dimensions (dim) or column numbers (ncol), of all members (dims) of assayData.

object[(index): Conducts subsetting of matrices and phenoData components

object\$name, object\$name<-value Access and set name column in phenoData

object[[i, ...]], object[[i, ...]]<-value Access and set column i (character or numeric index) in phenoData. The ... argument can include named variables (especially labelDescription) to be added to varMetadata.

Additional functions:

**assayDataElement(object, element)** Return matrix element from assayData slot of object.

**assayDataElement(object, element) <- value)** Set element element in assayData slot of object to matrix value

**assayDataElementReplace(object, element, value)** Set element element in assayData slot of object to matrix value

**assayDataElementNames(object)** Return element names in assayData slot of object

updateOldESet Update versions of eSet constructed using listOrEnv as assayData slot (before May, 2006).

### Author(s)

Biocore team

### See Also

Method use in [ExpressionSet-class](#). Related classes [AssayData-class](#), [AnnotatedDataFrame-class](#), [MIAME-class](#). Derived classes [ExpressionSet-class](#), [SnpSet-class](#). To update objects from previous class versions, see [updateOldESet](#).

### Examples

```
# update previous eSet-like class oldESet to existing derived class
## Not run: updateOldESet(oldESet, "ExpressionSet")
```

```

# create a new, ad hoc, class, for personal use
# all methods outlined above are available automatically
.MySet <- setClass("MySet", contains="eSet")
.MySet()

# Create a more robust class, with constructor and validation methods
# to ensure assayData contains specific matrices
.TwoColorSet <- setClass("TwoColorSet", contains="eSet")

TwoColorSet <-
  function(phenoData=AnnotatedDataFrame(), experimentData=MIAME(),
           annotation=character(), R=new("matrix"), G=new("matrix"),
           Rb=new("matrix"), Gb=new("matrix"), ...)
  {
    .TwoColorSet(phenoData=phenoData, experimentData=experimentData,
                  annotation=annotation, R=R, G=G, Rb=Rb, Gb=Gb, ...)
  }

setValidity("TwoColorSet", function(object) {
  assayDataValidMembers(assayData(object), c("R", "G", "Rb", "Gb"))
})

TwoColorSet()

# eSet objects cannot be instantiated directly, only derived objects
try(new("eSet"))

removeClass("MySet")
removeClass("TwoColorSet")

```

---

ExpressionSet

*Class to Contain and Describe High-Throughput Expression Level Assays.*

---

## Description

Container for high-throughput assays and experimental metadata. ExpressionSet class is derived from [eSet](#), and requires a matrix named `exprs` as `assayData` member.

## Usage

```

## Instance creation
ExpressionSet(assayData,
              phenoData=annotatedDataFrameFrom(assayData, byrow=FALSE),
              featureData=annotatedDataFrameFrom(assayData, byrow=TRUE),
              experimentData=MIAME(), annotation=character(),
              protocolData=annotatedDataFrameFrom(assayData, byrow=FALSE),
              ...)

## Additional methods documented below

```

**Arguments**

assayData	<p>A matrix of expression values, or an environment.</p> <p>When assayData is a matrix, the rows represent probe sets ('features' in ExpressionSet parlance). Columns represent samples. When present, row names identify features and column names identify samples. Row and column names must be unique, and consistent with row names of featureData and phenoData, respectively. The assay data can be retrieved with <code>exprs()</code>.</p> <p>When assayData is an environment, it contains identically dimensioned matrices like that described in the previous paragraph. One of the elements of the environment must be named 'exprs'; this element is returned with <code>exprs()</code>.</p>
phenoData	<p>An optional AnnotatedDataFrame containing information about each sample. The number of rows in phenoData must match the number of columns in assayData. Row names of phenoData must match column names of the matrix / matrices in assayData.</p>
featureData	<p>An optional AnnotatedDataFrame containing information about each feature. The number of rows in featureData must match the number of rows in assayData. Row names of featureData must match row names of the matrix / matrices in assayData.</p>
experimentData	<p>An optional MIAME instance with meta-data (e.g., the lab and resulting publications from the analysis) about the experiment.</p>
annotation	<p>A character describing the platform on which the samples were assayed. This is often the name of a Bioconductor chip annotation package, which facilitated down-stream analysis.</p>
protocolData	<p>An optional AnnotatedDataFrame containing equipment-generated information about protocols. The number of rows and row names of protocolData must agree with the dimension and column names of assayData.</p>
...	<p>Additional arguments, passed to <code>new("ExpressionSet", ...)</code> and available for classes that extend ExpressionSet.</p>

**Extends**

Directly extends class [eSet](#).

**Creating Objects**

ExpressionSet instances are usually created through `ExpressionSet()`.

**Slots**

Inherited from `eSet`:

**assayData:** Contains matrices with equal dimensions, and with column number equal to `nrow(phenoData)`. assayData must contain a matrix `exprs` with rows representing features (e.g., probe sets) and columns representing samples. Additional matrices of identical size (e.g., representing measurement errors) may also be included in assayData. Class:[AssayData-class](#)

**phenoData:** See [eSet](#)

featureData: See [eSet](#)  
 experimentData: See [eSet](#)  
 annotation: See [eSet](#)  
 protocolData: See [eSet](#)

## Methods

Class-specific methods.

`as(exprSet, "ExpressionSet")` Coerce objects of [exprSet-class](#) to `ExpressionSet`  
`as(object, "data.frame")` Coerce objects of [ExpressionSet-class](#) to `data.frame` by transposing the expression matrix and concatenating `phenoData`  
`exprs(ExpressionSet), exprs(ExpressionSet, matrix)<-` Access and set elements named `exprs` in the `AssayData-class` slot.  
`esApply(ExpressionSet, MARGIN, FUN, ...)` 'apply'-like function to conveniently operate on `ExpressionSet` objects. See [esApply](#).  
`write.exprs(ExpressionSet)` Write expression values to a text file. It takes the same arguments as `write.table`

Derived from [eSet](#):

`updateObject(object, ..., verbose=FALSE)` Update instance to current version, if necessary. See [updateObject](#) and [eSet](#)  
`isCurrent(object)` Determine whether version of object is current. See [isCurrent](#)  
`isVersioned(object)` Determine whether object contains a 'version' string describing its structure. See [isVersioned](#)  
`assayData(ExpressionSet)`: See [eSet](#)  
`sampleNames(ExpressionSet)` **and** `sampleNames(ExpressionSet)<-`: See [eSet](#)  
`featureNames(ExpressionSet), featureNames(ExpressionSet, value)<-`: See [eSet](#)  
`dims(ExpressionSet)`: See [eSet](#)  
`phenoData(ExpressionSet), phenoData(ExpressionSet, value)<-`: See [eSet](#)  
`varLabels(ExpressionSet), varLabels(ExpressionSet, value)<-`: See [eSet](#)  
`varMetadata(ExpressionSet), varMetadata(ExpressionSet, value)<-`: See [eSet](#)  
`pData(ExpressionSet), pData(ExpressionSet, value)<-`: See [eSet](#)  
`varMetadata(ExpressionSet), varMetadata(ExpressionSet, value)` See [eSet](#)  
`experimentData(ExpressionSet), experimentData(ExpressionSet, value)<-`: See [eSet](#)  
`pubMedIds(ExpressionSet), pubMedIds(ExpressionSet, value)` See [eSet](#)  
`abstract(ExpressionSet)`: See [eSet](#)  
`annotation(ExpressionSet), annotation(ExpressionSet, value)<-` See [eSet](#)  
`protocolData(ExpressionSet), protocolData(ExpressionSet, value)<-` See [eSet](#)  
`combine(ExpressionSet, ExpressionSet)`: See [eSet](#)  
`storageMode(ExpressionSet), storageMode(ExpressionSet, character)<-`: See [eSet](#)

Standard generic methods:

`initialize(ExpressionSet)`: Object instantiation, used by `new`; not to be called directly by the user.

`updateObject(ExpressionSet)`: Update outdated versions of `ExpressionSet` to their current definition. See [updateObject](#), [Versions-class](#).

`validObject(ExpressionSet)`: Validity-checking method, ensuring that `exprs` is a member of `assayData`. `checkValidity(ExpressionSet)` imposes this validity check, and the validity checks of `eSet`.

`makeDataPackage(object, author, email, packageName, packageVersion, license, biocViews, filePath, d`  
Create a data package based on an `ExpressionSet` object. See [makeDataPackage](#).

`as(exprSet, ExpressionSet)`: Coerce `exprSet` to `ExpressionSet`.

`as(eSet, ExpressionSet)`: Coerce the `eSet` portion of an object to `ExpressionSet`.

`show(ExpressionSet)` See [eSet](#)

`dim(ExpressionSet), ncol` See [eSet](#)

`ExpressionSet[(index)]`: See [eSet](#)

`ExpressionSet$, ExpressionSet$<-` See [eSet](#)

`ExpressionSet[[i]], ExpressionSet[[i]]<-` See [eSet](#)

### Author(s)

Biocore team

### See Also

[eSet-class](#), [ExpressionSet-class](#).

### Examples

```
# create an instance of ExpressionSet
ExpressionSet()

ExpressionSet(assayData=matrix(runif(1000), nrow=100, ncol=10))

# update an existing ExpressionSet
data(sample.ExpressionSet)
updateObject(sample.ExpressionSet)

# information about assay and sample data
featureNames(sample.ExpressionSet)[1:10]
sampleNames(sample.ExpressionSet)[1:5]
experimentData(sample.ExpressionSet)

# subset: first 10 genes, samples 2, 4, and 10
expressionSet <- sample.ExpressionSet[1:10,c(2,4,10)]

# named features and their expression levels
subset <- expressionSet[c("AFFX-BioC-3_at", "AFFX-BioDn-5_at"),]
```

```
exprs(subset)

# samples with above-average score in phenoData
highScores <- expressionSet$score > mean(expressionSet$score)
expressionSet[,highScores]

# (automatically) coerce to data.frame
lm(score~AFFX.BioDn.5_at + AFFX.BioC.3_at, data=subset)
```

---

exprs

*Retrieve expression data from eSets.*

---

## Description

These generic functions access the expression and error measurements of assay data stored in an object derived from the [eSet-class](#).

## Usage

```
exprs(object)
exprs(object) <- value
se.exprs(object)
se.exprs(object) <- value
```

## Arguments

object	Object derived from class eSet.
value	Matrix with rows representing features and columns samples.

## Value

exprs returns a (usually large!) matrix of expression values; se.exprs returns the corresponding matrix of standard errors, when available.

## Author(s)

Biocore

## See Also

[eSet-class](#), [ExpressionSet-class](#), [SnpSet-class](#)

---

featureData	<i>Retrieve information on features recorded in eSet-derived classes.</i>
-------------	---

---

### Description

These generic functions access feature data (experiment specific information about features) and feature meta-data (e.g., descriptions of feature covariates).

### Usage

```
featureData(object)
featureData(object) <- value
fData(object)
fData(object) <- value
fvarLabels(object)
fvarLabels(object) <- value
fvarMetadata(object)
fvarMetadata(object) <- value
```

### Arguments

object	Object, possibly derived from <a href="#">eSet-class</a> or <a href="#">AnnotatedDataFrame-class</a> .
value	Value to be assigned to corresponding object.

### Value

featureData returns an object containing information on both variable values and variable meta-data. fvarLabels returns a character vector of measured variable names. fData returns a data frame with features as rows, variables as columns. fvarMetadata returns a data frame with variable names as rows, description tags (e.g., unit of measurement) as columns.

### Author(s)

Biocore

### See Also

[eSet](#), [ExpressionSet](#)

---

featureNames	<i>Retrieve feature and sample names from eSets.</i>
--------------	--

---

**Description**

These generic functions access the feature names (typically, gene or SNP identifiers) and sample names stored in an object derived from the [eSet-class](#).

**Usage**

```
featureNames(object)
featureNames(object) <- value
sampleNames(object)
sampleNames(object) <- value
```

**Arguments**

object	Object, possibly derived from class eSet.
value	Character vector containing feature or sample names.

**Value**

featureNames returns a (usually long!) character vector uniquely identifying each feature. sampleNames returns a (usually shorter) character vector identifying samples.

**Author(s)**

Biocore

**See Also**

[ExpressionSet-class](#), [SnpSet-class](#)

---

getPkgVigs	<i>List Vignette Files for a Package</i>
------------	--

---

**Description**

This function will return a listing of all vignettes stored in a package's doc directory.

**Usage**

```
getPkgVigs(package = NULL)
```



**Arguments**

package            A character vector of packages to search or NULL. The latter is for all attached packages (in [search\(\)](#)).

**Value**

A data.frame with columns package, filename, title.

**Author(s)**

Jeff Gentry, modifications by Wolfgang Huber.

**See Also**

[openVignette](#)

**Examples**

```
z <- getPkgVigs()
z # and look at them
```

---

isCurrent

*Use version information to test whether class is current*


---

**Description**

This generic function uses [Versioned-class](#) information to ask whether an instance of a class (e.g., read from disk) has current version information.

By default, isCurrent has the following behaviors:

isCurrent(Versioned-instance) Returns a vector of logicals, indicating whether each version matches the current version from the class prototype.

isCurrent(ANY) Return NA, indicating that the version cannot be determined

isCurrent(Versioned-instance, "class") Returns a logical vector indicating whether version identifiers shared between Versioned-instance and "class" are current.

Starting with R-2.6 / Bioconductor 2.1 / Biobase 1.15.1, isCurrent(Versioned-instance, ...) returns an element S4 indicating whether the class has the 'S4' bit set; a value of FALSE indicates that the object needs to be recreated.

**Usage**

```
isCurrent(object, value)
```

**Arguments**

object            Object whose version is to be determined, as described above.

value            (Optional) character string identifying a class with which to compare versions.

**Value**

isCurrent returns a logical vector.

**Author(s)**

Biocore team

**See Also**

[Versions-class](#)

**Examples**

```
obj <- new("VersionedBiobase")
isCurrent(obj)

isCurrent(1:10) # NA

A <- setClass("A", contains="VersionedBiobase",
              prototype=prototype(new("VersionedBiobase", versions=c(A="1.0.0"))))

a <- A()
classVersion(a)

isCurrent(a, "VersionedBiobase") # is the VersionedBiobase portion current?
classVersion(a)["A"] <- "1.0.1"
classVersion(a)
isCurrent(a, "VersionedBiobase")
isCurrent(a) # more recent, so does not match current defined by prototype

removeClass("A")
```

---

isUnique

*Determine Unique Elements*

---

**Description**

Determines which elements of a vector occur exactly once.

**Usage**

```
isUnique(x)
```

**Arguments**

x                    a vector

**Value**

A logical vector of the same length as x, in which TRUE indicates uniqueness.

**Author(s)**

Wolfgang Huber

**See Also**

[unique,duplicated](#).

**Examples**

```
x <- c(9:20, 1:5, 3:7, 0:8)
isUnique(x)
```

---

isVersioned

*Determine whether object or class contains versioning information*

---

**Description**

This generic function checks to see whether [Versioned-class](#) information is present. When the argument to isVersioned is a character string, the prototype of the class corresponding to the string is consulted.

By default, isVersioned has the following behaviors:

isVersioned(Versioned-instance) Returns TRUE when the instance have version information.

isCurrent("class-name") Returns TRUE when the named class extends [Versioned-class](#).

isVersioned(ANY) Returns FALSE

**Usage**

```
isVersioned(object)
```

**Arguments**

object            Object or class name to check for version information, as described above.

**Value**

isVersioned returns a logical indicating whether version information is present.

**Author(s)**

Biocore team

**See Also**[Versions-class](#)**Examples**

```
obj <- new("VersionedBiobase")
isVersioned(obj)

isVersioned(1:10) # FALSE

A <- setClass("A", contains="VersionedBiobase",
             prototype=prototype(new("VersionedBiobase", versions=c(A="1.0.0"))))
a <- A()
isVersioned(a)

removeClass("A")
```

---

**lcSuffix***Compute the longest common prefix or suffix of a string*

---

**Description**

These functions find the longest common prefix or suffix among the strings in a character vector.

**Usage**

```
lcPrefix(x, ignore.case=FALSE)
lcPrefixC(x, ignore.case=FALSE)
lcSuffix(x, ignore.case=FALSE)
```

**Arguments**

<code>x</code>	a character vector.
<code>ignore.case</code>	A logical value indicating whether or not to ignore the case in making comparisons.

**Details**

Computing the longest common suffix is helpful for truncating names of objects, like microarrays, that often have a common suffix, such as `.CEL`.

There are some potential problems with the approach used if multibyte character encodings are being used.

`lcPrefixC` is a faster implementation in C. It only handles ascii characters.

**Value**

The common prefix or suffix.

**Author(s)**

R. Gentleman

**See Also**[nchar](#), [nchar](#)**Examples**

```

s1 <- c("ABC.CEL", "DEF.CEL")
lcSuffix(s1)

s2 <- c("ABC.123", "ABC.456")
lcPrefix(s2)

CHK <- stopifnot

CHK(".CEL" == lcSuffix(s1))
CHK("bc" == lcSuffix(c("abc", "333abc", "bc")))
CHK("c" == lcSuffix(c("c", "abc", "xxxc")))
CHK("" == lcSuffix(c("c", "abc", "xxx")))

CHK("ABC." == lcPrefix(s2))
CHK("ab" == lcPrefix(c("abcd", "abcd123", "ab", "abc", "abc333333")))
CHK("a" == lcPrefix(c("abcd", "abcd123", "ax")))
CHK("a" == lcPrefix(c("a", "abcd123", "ax")))
CHK("" == lcPrefix(c("a", "abc", "xxx")))

CHK("ab" == lcPrefixC(c("abcd", "abcd123", "ab", "abc", "abc333333")))
CHK("a" == lcPrefixC(c("abcd", "abcd123", "ax")))
CHK("a" == lcPrefixC(c("a", "abcd123", "ax")))
CHK("" == lcPrefixC(c("a", "abc", "xxx")))

```

listLen

*Lengths of list elements***Description**

This function returns an integer vector with the length of the elements of its argument, which is expected to be a list.

**Usage**

listLen(x)

**Arguments**

x                    A list

**Details**

This function returns a vector of the same length as the list `x` containing the lengths of each element. The current implementation is intended for lists containing vectors and the C-level length function is used to determine length. This means no dispatch is done for the elements of the list. If your list contains S4 objects, you should use `sapply(x, length)` instead.

**Author(s)**

Jeff Gentry and R. Gentleman

**See Also**

[sapply](#)

**Examples**

```
foo = lapply(1:8, rnorm)
listLen(foo)
```

---

makeDataPackage	<i>Make an R package from a data object</i>
-----------------	---

---

**Description**

This generic creates a valid R package from an R data object.

**Usage**

```
makeDataPackage(object, author, email,
                packageName=deparse(substitute(object)),
                packageVersion=package_version("1.0.0"),
                license="Artistic-2.0",
                biocViews="ExperimentData",
                filePath=tempdir(),
                ...)
```

**Arguments**

<code>object</code>	An instance of an R data object.
<code>author</code>	The author, as a character string.
<code>email</code>	A valid email address for the maintainer, as a character string.
<code>packageName</code>	The name of the package, defaults to the name of the object instance.
<code>packageVersion</code>	The version number, as a character string.
<code>license</code>	The license, as a character string.
<code>biocViews</code>	A character vector of valid biocViews views.
<code>filePath</code>	The location to create the package.
<code>...</code>	Additional arguments to specific methods.

**Details**

The function makes use of various tools in R and Bioconductor to automatically generate the source files for a valid R package.

**Value**

The return value is that from a call to `link{createPackage}` which is invoked once the default arguments are set up. The data instance is stored in the data directory with a name the same as that of the resulting package.

**Note**

Developers implementing derived methods might force correct package name evaluation by including 'packageName' in any `callNextMethod()`.

**Author(s)**

R. Gentleman

**See Also**

[createPackage](#)

**Examples**

```
data(sample.ExpressionSet)
## package created in tempdir()
s1 <- makeDataPackage(sample.ExpressionSet,
  author = "Foo Author",
  email = "foo@bar",
  packageName = "FooBarPkg",
  packageVersion = "1.0.0")
```

---

matchpt

*Nearest neighbor search.*

---

**Description**

Find the nearest neighbors of a set of query points in the same or another set of points in an n-dimensional real vector space, using the Euclidean distance.

**Usage**

```
matchpt(x, y)
```

### Arguments

- x** A matrix (or vector) of coordinates. Each row represents a point in an  $\text{ncol}(x)$ -dimensional real vector space.
- y** Optional, matrix (or vector) with the same number of columns as **x**.

### Details

If **y** is provided, the function searches for each point in **x** its nearest neighbor in **y**. If **y** is missing, it searches for each point in **x** its nearest neighbor in **x**, excluding that point itself. In the case of ties, only the neighbor with the smaller index is given.

The implementation is simple and of complexity  $\text{nrow}(x)$  times  $\text{nrow}(y)$ . For larger problems, please consider one of the many more efficient nearest neighbor search algorithms.

### Value

A data.frame with two columns and  $\text{nrow}(x)$  rows. The first column is the index of the nearest neighbor, the second column the distance to the nearest neighbor. If **y** was given, the index is a row number in **y**, otherwise, in **x**. The row names of the result are those of **x**.

### Author(s)

Oleg Sklyar <osklyar@ebi.ac.uk>

### Examples

```
a <- matrix(c(2,2,3,5,1,8,-1,4,5,6), ncol=2L, nrow=5L)
rownames(a) = LETTERS[seq_len(nrow(a))]
matchpt(a)
b <- c(1,2,4,5,6)
d <- c(5.3, 3.2, 8.9, 1.3, 5.6, -6, 4.45, 3.32)
matchpt(b, d)
matchpt(d, b)
```

---

MIAME

*Class for Storing Microarray Experiment Information*

---

### Description

Class MIAME covers MIAME entries that are not covered by other classes in Bioconductor. Namely, experimental design, samples, hybridizations, normalization controls, and pre-processing information. The MIAME class is derived from [MIAXE](#).



**Slots**

- name: Object of class character containing the experimenter name
- lab: Object of class character containing the laboratory where the experiment was conducted
- contact: Object of class character containing contact information for lab and/or experimenter
- title: Object of class character containing a single-sentence experiment title
- abstract: Object of class character containing an abstract describing the experiment
- url: Object of class character containing a URL for the experiment
- samples: Object of class list containing information about the samples
- hybridizations: Object of class list containing information about the hybridizations
- normControls: Object of class list containing information about the controls such as house keeping genes
- preprocessing: Object of class list containing information about the pre-processing steps used on the raw data from this experiment
- pubMedIds: Object of class character listing strings of PubMed identifiers of papers relevant to the dataset
- other: Object of class list containing other information for which none of the above slots does not applies

**Methods**

Constructor methods:

MIAME(): MIAME(name = "", lab = "", contact = "", title = "", abstract = "", url = "",  
Creates a new MIAME object with slots as defined above.

Class-specific methods:

abstract(MIAME): An accessor function for abstract.

combine(MIAME,MIAME): Combine two objects of MIAME-class, issuing warnings when ambiguities encountered.

expinfo(MIAME): An accessor function for name, lab, contact, title, and url.

hybridizations(MIAME): An accessor function for hybridizations.

normControls(MIAME): An accessor function for normControls.

notes(MIAME), notes(MIAME) <- value: Accessor functions for other. notes(MIAME) <- character  
*appends* character to notes; use notes(MIAME) <- list to replace the notes entirely.

otherInfo(MIAME): An accessor function for other.

preproc(MIAME): An accessor function for preprocessing.

pubMedIds(MIAME), pubMedIds(MIAME) <- value: Accessor function for pubMedIds.

samples(MIAME): An accessor function for samples.

Standard generic methods:

updateObject(object, ..., verbose=FALSE) Update instance to current version, if necessary.  
See [updateObject](#)

`isCurrent(object)` Determine whether version of object is current. See [isCurrent](#)  
`isVersioned(object)` Determine whether object contains a 'version' string describing its structure. See [isVersioned](#)  
`show(MIAME):` Renders information about the MIAME information

**Author(s)**

Rafael A. Irizarry

**References**

[http://www.mged.org/Workgroups/MIAME/miame\\_1.1.html](http://www.mged.org/Workgroups/MIAME/miame_1.1.html)

**See Also**

[class:characterORMIAME](#), [read.MIAME](#)

---

MIAXE

*MIAXE objects*

---

**Description**

The MIAXE virtual class is a general container for storing experiment metadata. Information such as experimental design, samples, normalization methods and pre-processing information can be stored in these objects.

The MIAXE class is virtual and MIAXE objects cannot be instantiated directly. The following classes derive directly from the MIAXE class: MIAME.

**Slots**

Introduced in MIAXE:

`._classVersion_`: A Versions object describing the MIAXE version number. Intended for developer use.

**Methods**

Standard generic methods:

`show(object)` Informatively display object contents.

**Author(s)**

Biocore team

**See Also**

Related classes [MIAME-class](#), [ExpressionSet-class](#). Derived classes [MIAME-class](#).

## Examples

```
# Create a new class
MyData <- setClass("MyData", contains="MIAxE")
MyData()

# MIAxE objects cannot be instantiated directly
try(new("MIAxE"))
```

---

multiassign

*Assign Values to a Names*

---

## Description

Assign values to names in an environment.

## Usage

```
multiassign(x, value, envir = parent.frame(), inherits=FALSE)
```

## Arguments

x	A vector or list of names, represented by strings.
value	a vector or list of values to be assigned.
envir	the <a href="#">environment</a> to use. See the details section.
inherits	should the enclosing frames of the environment be inspected?

## Details

The pos argument can specify the environment in which to assign the object in any of several ways: as an integer (the position in the [search](#) list); as the character string name of an element in the search list; or as an [environment](#) (including using [sys.frame](#) to access the currently active function calls). The envir argument is an alternative way to specify an environment, but is primarily there for back compatibility.

If value is missing and x has names then the values in each element of x are assigned to the names of x.

## Value

This function is invoked for its side effect, which is assigning the values to the variables in x. If no envir is specified, then the assignment takes place in the currently active environment.

If inherits is TRUE, enclosing environments of the supplied environment are searched until the variable x is encountered. The value is then assigned in the environment in which the variable is encountered. If the symbol is not encountered then assignment takes place in the user's workspace (the global environment).

If inherits is FALSE, assignment takes place in the initial frame of envir.

**Examples**

```

#-- Create objects r1, r2, ... r6 --
nam <- paste("r",1:6, sep=".")

multiassign(nam, 11:16)
ls(pat="^r..$")

#assign the values in y to variables with the names from y

y<-list(a=4,d=mean,c="aaa")
multiassign(y)

```

MultiSet

*Class to Contain and Describe High-Throughput Expression Level Assays.*

**Description**

Container for high-throughput assays and experimental metadata. MutliSet is derived from [eSet-class](#). MultiSet differs from [ExpressionSet-class](#) because MultiSet can contain any element(s) in assayData (ExpressionSet must have an element named exprs).

**Extends**

Directly extends class [eSet](#).

**Creating Objects**

```
new(MultiSet, phenoData = [AnnotatedDataFrame], experimentData = [MIAME], annotation = [character])
```

```
updateOldESet(oldESet, "MultiSet")
```

MultiSet instances are usually created through `new("MultiSet", ...)`. The ... arguments to new are matrices of expression data (with features corresponding to rows and samples to columns), phenoData, experimentData, annotation, and protocolData. phenoData, experimentData, annotation, and protocolData can be missing, in which case they are assigned default values.

[updateOldESet](#) will take a serialized instance (e.g., saved to a disk file with save object created with earlier definitions of the eSet-class, and update the object to MultiSet. Warnings are issued when direct translation is not possible; incorrectly created oldESet instances may not be updated.

**Slots**

Inherited from eSet:

**assayData:** Contains zero or more matrices with equal dimensions, and with column number equal to `nrow(phenoData)`. Each matrix in assayData has rows representing features (e.g., reporters) and columns representing samples. Class:[AssayData-class](#)

phenoData: See [eSet-class](#)  
 experimentData: See [eSet-class](#)  
 annotation: See [eSet-class](#)  
 protocolData: See [eSet-class](#)

## Methods

Class-specific methods: none

Derived from [eSet-class](#):

updateObject(object, ..., verbose=FALSE) Update instance to current version, if necessary.  
 See [updateObject](#) and [eSet](#)

isCurrent(object) Determine whether version of object is current. See [isCurrent](#)

isVersioned(object) Determine whether object contains a 'version' string describing its structure. See [isVersioned](#)

sampleNames(MultiSet) **and** sampleNames(MultiSet)<=: See [eSet-class](#)

featureNames(MultiSet), featureNames(MultiSet, value)<=: See [eSet-class](#)

dims(MultiSet): See [eSet-class](#)

phenoData(MultiSet), phenoData(MultiSet, value)<=: See [eSet-class](#)

varLabels(MultiSet), varLabels(MultiSet, value)<=: See [eSet-class](#)

varMetadata(MultiSet), varMetadata(MultiSet, value)<=: See [eSet-class](#)

pData(MultiSet), pData(MultiSet, value)<=: See [eSet-class](#)

varMetadata(MultiSet), varMetadata(MultiSet, value) See [eSet-class](#)

experimentData(MultiSet), experimentData(MultiSet, value)<=: See [eSet-class](#)

pubMedIds(MultiSet), pubMedIds(MultiSet, value) See [eSet-class](#)

abstract(MultiSet): See [eSet-class](#)

annotation(MultiSet), annotation(MultiSet, value)<- See [eSet-class](#)

protocolData(MultiSet), protocolData(MultiSet, value)<- See [eSet-class](#)

combine(MultiSet, MultiSet): See [eSet-class](#)

storageMode(eSet), storageMode(eSet, character)<=: See [eSet-class](#)

Standard generic methods:

initialize(MultiSet): Object instantiation, used by new; not to be called directly by the user.

validObject(MultiSet): Validity-checking method, ensuring that all elements of assayData are matrices with equal dimensions.

as(eSet, MultiSet): Coerce the eSet portion of an object to MultiSet.

show(MultiSet) See [eSet-class](#)

dim(MultiSet), ncol See [eSet-class](#)

MultiSet[(index)]: See [eSet-class](#)

MultiSet\$, MultiSet\$<- See [eSet-class](#)

**Author(s)**

Biocore team

**See Also**

[eSet-class](#), [ExpressionSet-class](#)

**Examples**

```
# create an instance of ExpressionSet
new("MultiSet")
```

---

NChannelSet-class

*Class to contain data from multiple channel array technologies*

---

**Description**

Container for high-throughput assays and experimental meta-data. Data are from experiments where a single ‘chip’ contains several (more than 1) different ‘channels’. All channels on a chip have the same set of ‘features’. An experiment consists of a collection of several N-channel chips; each chip is a ‘sample’.

An NChannelSet provides a way to coordinate assay data (expression values) with phenotype information and references to chip annotation data; it extends the [eSet](#) class.

An NChannelSet allows channels to be extracted (using the `channels` method, mentioned below), and subsets of features or samples to be selected (using `[<features>, <samples>]`). Selection and subsetting occur so that relevant phenotypic data is maintained by the selection or subset.

**Objects from the Class**

Objects can be created by calls of the form `NChannelSet( assayData, phenoData, ...)`. See the examples below.

**Slots**

**assayData:** Object of class [AssayData](#), usually an environment containing matrices of identical size. Each matrix represents a single channel. Columns in each matrix correspond to samples, rows to features. Once created, NChannelSet manages coordination of samples and channels.

**phenoData:** Object of class [AnnotatedDataFrame](#).

The data component of the AnnotatedDataFrame is `data.frame` with number of rows equal to the number of samples. Columns of the data component correspond to measured covariates.

The `varMetadata` component consists of mandatory columns `labelDescription` (providing a textual description of each column label in the data component) and `channel`. The `channel` of `varMetadata` is a factor, with levels equal to the names of the `assayData` channels, plus the special symbol `_ALL_`. The `channel` column is used to indicate which channel(s) the corresponding column in the data component of AnnotatedDataFrame correspond; the

`_ALL_` symbol indicates that the data column is applicable to all channels. `varMetadata` may contain additional columns with arbitrary information.

Once created, `NChannelSet` coordinates selection and subsetting of channels in `phenoData`.

`featureData`: Object of class `AnnotatedDataFrame`, used to contain feature data that is unique to this experiment; feature-level descriptions common to a particular chip are usually referenced through the annotation slot.

`experimentData`: Object of class `MIAME` containing descriptions of the experiment.

`annotation`: Object of class "character". Usually a length-1 character string identifying the chip technology used during the experiment. The annotation string is used to retrieve information about features, e.g., using the `annotation` package.

`protocolData`: Object of class "character". A character vector identifying the dates the samples were scanned during the experiment.

`._classVersion_`: Object of class `Versions`, containing automatically created information about the class definition Biobase package version, and other information about the user system at the time the instance was created. See `classVersion` and `updateObject` for examples of use.

## Extends

Class "eSet", directly. Class "VersionedBiobase", by class "eSet", distance 2. Class "Versioned", by class "eSet", distance 3.

## Methods

Methods with class-specific functionality:

`channel(object, name, ...)` signature(object="NChannelSet", name="character"). Return an `ExpressionSet` created from the channel and corresponding phenotype of argument `name`. `name` must have length 1. Arguments `...` are rarely used, but are passed to the `ExpressionSet` constructor, for instance to influence `storage.mode`.

`channelNames(object)`, `channelNames(object) <- value` signature(object = "NChannelSet"). Obtain, reorder, or rename channels contained in `object`. See `channelNames`.

`selectChannels(object, names, ...)` signature(object = "NChannelSet", names = "character"). Create a new `NChannelSet` from `object`, containing only channels in `names`. The `...` is not used by this method.

`object[features, samples]` signature(object = "NChannelSet", features = "ANY", samples = "ANY"). Create a new `NChannelSet` from `object`, containing only elements matching `features` and `samples`; either index may be missing, or a character, numeric, or logical vector.

`sampleNames(object) <- value` signature(object = "NChannelSet", value = "list") assign each (named) element of `value` to the `sampleNames` of the correspondingly named elements of `assayData` in `object`.

Methods with functionality derived from `eSet`: `annotation`, `annotation<-`, `assayData`, `assayData<-`, `classVersion`, `classVersion<-`, `dim`, `dims`, `experimentData`, `experimentData<-`, `featureData`, `featureData<-`, `phenoData`, `phenoData<-`, `protocolData`, `protocolData<-`, `pubMedIds`, `pubMedIds<-`, `sampleNames`, `sampleNames<-`, `storageMode`, `storageMode<-`, `varMetadata`, `varMetadata<-`, `isCurrent`, `isVersioned`, `updateObject`.

Additional methods: `coerce` ('as', to convert between objects, if possible), `initialize` (used internally for creating objects), `show` (invoked automatically when the object is displayed to the screen)

### Author(s)

Martin Morgan <mtmorgan@fhcrc.org>

### See Also

[eSet](#), [ExpressionSet](#).

### Examples

```
## An empty NChannelSet
obj <- NChannelSet()

## An NChannelSet with two channels (R, G) and no phenotypic data
obj <- NChannelSet(R=matrix(0,10,5), G=matrix(0,10,5))

## An NChannelSet with two channels and channel-specific phenoData
R <- matrix(0, 10, 3, dimnames=list(NULL, LETTERS[1:3]))
G <- matrix(1, 10, 3, dimnames=list(NULL, LETTERS[1:3]))
assayData <- assayDataNew(R=R, G=G)
data <- data.frame(ChannelRData=numeric(ncol(R)),
                  ChannelGData=numeric(ncol(R)),
                  ChannelRAndG=numeric(ncol(R)))
varMetadata <- data.frame(labelDescription=c(
  "R-specific phenoData",
  "G-specific phenoData",
  "Both channel phenoData"),
  channel=factor(c("R", "G", "_ALL_")))
phenoData <- AnnotatedDataFrame(data=data, varMetadata=varMetadata)
obj <- NChannelSet(assayData=assayData, phenoData=phenoData)
obj

## G channel as NChannelSet
selectChannels(obj, "G")

## G channel as ExpressionSet
channel(obj, "G")

## Samples "A" and "C"
obj[,c("A", "C")]
```



**Description**

Generates an informational message that corresponds to its argument(s). Similar to `warning()` except prefaced by "Note:" instead of "Warning message:".

**Usage**

```
note(...)
```

**Arguments**

... character vectors (which are pasted together) or NULL

**Details**

This function essentially `cat()`'s the created string to the screen. It is intended for messages to the user that are deemed to be 'informational', as opposed to warnings, etc.

**Author(s)**

Jeff Gentry

**See Also**

[warning,stop](#)

**Examples**

```
note("This is an example of a note")
```

---

notes

*Retrieve and set eSet notes.*

---

**Description**

These generic functions access notes (unstructured descriptive data) associated [eSet-class](#).

`notes(<ExpressionSet>) <- <character>` is unusual, in that the character vector is appended to the list of notes; use `notes(<ExpressionSet>) <- <list>` to entirely replace the list.

**Usage**

```
notes(object)
notes(object) <- value
```

**Arguments**

`object` Object, possibly derived from class `eSet-class`.  
`value` Character vector containing unstructured information describing the experiment.

**Value**

notes returns a list.

**Author(s)**

Biocore

**See Also**

[ExpressionSet-class](#), [SnpSet-class](#)

---

openPDF

*Open PDF Files in a Standard Viewer*

---

**Description**

Displays the specified PDF file.

**Usage**

```
openPDF(file, bg=TRUE)
```

**Arguments**

file	A character string, indicating the file to view
bg	Should the pdf viewer be opened in the background.

**Details**

Currently this function works on Windows and Unix platforms. Under Windows, whatever program is associated with the file extension will be used. Under Unix, the function will use the program named in the

option "pdfviewer" (see `help(options)` for information on how this is set.)

The `bg` argument is only interpreted on Unix.

**Value**

This function is executed for its side effects. The specified PDF file is opened in the PDF viewer and TRUE is returned.

**Author(s)**

Jeff Gentry

**Examples**

```
## Not run: openPDF("annotate.pdf")
```

---

`openVignette`*Open a Vignette or Show Vignette Selection Menu*

---

**Description**

Using the data returned by `vignette` this function provides a simple easy to use interface for opening vignettes.

**Usage**

```
openVignette(package=NULL)
```

**Arguments**

`package` character string indicating the package to be used.

**Details**

If `package` is `NULL` then all packages are scanned for vignettes. The list of vignettes is presented to the user via the menu command. The user may select one of the vignettes to be opened in a PDF viewer.

**Value**

No value is returned; this function is run entirely for the side effect of opening the pdf document in the PDF viewer.

**Author(s)**

R. Gentleman

**See Also**

[vignette](#), [openPDF](#), [menu](#), [getPkgVigs](#)

**Examples**

```
if( interactive() )
  openVignette("Biobase")
```

---

package.version      *Report Version of a Package*

---

**Description**

Will report the version number of a requested installed package

**Usage**

```
package.version(pkg, lib.loc = NULL)
```

**Arguments**

pkg	The name of the package
lib.loc	a character vector describing the location of R library trees to search through, or 'NULL'. The default value of 'NULL' corresponds to all libraries currently known.

**Details**

This function is a convenience wrapper around `package.description`, and will report simply the version number of the requested package. If the package does not exist or if the DESCRIPTION file can not be read, then an error will be thrown.

**Value**

A character string reporting the version number.

**Author(s)**

Jeff Gentry

**See Also**

[package.description](#)

**Examples**

```
package.version("Biobase")
```

---

phenoData	<i>Retrieve information on experimental phenotypes recorded in eSet and ExpressionSet-derived classes.</i>
-----------	--

---

### Description

These generic functions access the phenotypic data (e.g., covariates) and meta-data (e.g., descriptions of covariates) associated with an experiment.

### Usage

```
phenoData(object)
phenoData(object) <- value
varLabels(object)
varLabels(object) <- value
varMetadata(object)
varMetadata(object) <- value
pData(object)
pData(object) <- value
```

### Arguments

object	Object, possibly derived from <a href="#">eSet-class</a> or <a href="#">AnnotatedDataFrame</a> .
value	Value to be assigned to corresponding object.

### Value

phenoData returns an object containing information on both variable values and variable meta-data. varLabels returns a character vector of measured variables. pData returns a data frame with samples as rows, variables as columns. varMetadata returns a data frame with variable names as rows, description tags (e.g., unit of measurement) as columns.

### Author(s)

Biocore

### See Also

[eSet-class](#), [ExpressionSet-class](#), [SnpSet-class](#)

---

protocolData	<i>Protocol Metadata</i>
--------------	--------------------------

---

**Description**

This generic function handles methods for adding and retrieving protocol metadata for the samples in eSets.

**Usage**

```
protocolData(object)
protocolData(object) <- value
```

**Arguments**

object	Object derived from class eSet
value	Object of class AnnotatedDataFrame

**Value**

protocolData(object) returns an AnnotatedDataFrame containing the protocol metadata for the samples.

**Author(s)**

Biocore

**See Also**

phenoData, [AnnotatedDataFrame-class](#), [eSet-class](#), [ExpressionSet-class](#), [SnpSet-class](#)

---

read.AnnotatedDataFrame	<i>Read 'AnnotatedDataFrame'</i>
-------------------------	----------------------------------

---

**Description**

Create an instance of class AnnotatedDataFrame by reading a file.

**Usage**

```
read.AnnotatedDataFrame(filename, path,
  sep = "\t", header = TRUE, quote = "", stringsAsFactors = FALSE,
  row.names = 1L,
  varMetadata.char="#",
  widget = getOption("BioC")$Base$use.widgets,
  sampleNames = character(0), ...)
```

## Arguments

filename	file or connection from which to read.
path	(optional) directory in which to find filename.
row.names	this argument gets passed on to <a href="#">read.table</a> and will be used for the row names of the phenoData slot.
varMetadata.char	lines beginning with this character are used for the varMetadata slot. See examples.
sep, header, quote, stringsAsFactors, ...	further arguments that get passed on to <a href="#">read.table</a> .
widget	logical. Currently this is <i>not</i> implemented, and setting this option to TRUE will result in an error. In a precursor of this function, <code>read.phenoData</code> , this option could be used to open an interactive GUI widget for entering the data.
sampleNames	optional argument that could be used in conjunction with <code>widget</code> ; do not use.

## Details

The function [read.table](#) is used to read pData. The argument `varMetadata.char` is passed on to that function as its argument `comment.char`. Lines beginning with `varMetadata.char` are expected to contain further information on the column headers of pData. The format is of the form: `# variable: textual explanation of the variable, units, measurement method, etc.` (assuming that `#` is the value of `varMetadata.char`). See also examples.

## Value

An instance of class `AnnotatedDataFrame`

## Author(s)

Martin Morgan <[mtmorgan@fhcrc.org](mailto:mtmorgan@fhcrc.org)> and Wolfgang Huber, based on `read.phenoData` by Rafael A. Irizarry.

## See Also

[AnnotatedDataFrame](#) for additional methods, [read.table](#) for details of reading in phenotypic data

## Examples

```
exampleFile = system.file("extdata", "pData.txt", package="Biobase")

adf <- read.AnnotatedDataFrame(exampleFile)
adf
head(pData(adf))
head(noquote(readLines(exampleFile)), 11)
```

---

read.MIAME                      *Read MIAME Information into an Instance of Class 'MIAME'*

---

## Description

Reads MIAME information from a file or using a widget.

## Usage

```
read.MIAME(filename = NULL, widget = getOption("BioC")$Base$use.widgets, ...)
```

## Arguments

filename	Filename from which to read MIAME information.
widget	Logical. If TRUE and a filename is not given, a widget is used to enter information.
...	Further arguments to scan.

## Details

Notice that the [MIAME](#) class tries to cover the MIAME entries that are not covered by other classes in Bioconductor. Namely, experimental design, samples, hybridizations, normalization controls, and pre-processing information.

The function [scan](#) is used to read. The file must be a flat file with the different entries for the instance of MIAME class separated by carriage returns. The order should be: name, lab, contact, title, abstract, and url.

Alternatively a widget can be used.

## Value

An object of class [MIAME](#).

## Author(s)

Rafael Irizarry <rafa@jhu.edu>

## See Also

[MIAME](#), [tkMIAME](#)

## Examples

```
miame <- read.MIAME(widget=FALSE) ##creates an empty instance
show(miame)
```



---

readExpressionSet      *Read 'ExpressionSet'*

---

## Description

Create an instance of class ExpressionSet by reading data from files. 'widget' functionality is not implemented for readExpressionSet.

## Usage

```
readExpressionSet(exprsFile,
  phenoDataFile,
  experimentDataFile,
  notesFile,
  path,
  annotation,
  ## arguments to read.* methods
  exprsArgs=list(sep=sep, header=header, row.names=row.names,
    quote=quote, ...),
  phenoDataArgs=list(sep=sep, header=header, row.names=row.names,
    quote=quote, stringsAsFactors=stringsAsFactors, ...),
  experimentDataArgs=list(sep=sep, header=header,
    row.names=row.names, quote=quote,
    stringsAsFactors=stringsAsFactors, ...),
  sep = "\t", header = TRUE, quote = "", stringsAsFactors = FALSE,
  row.names = 1L,
  ## widget
  widget = getOption("BioC")$Base$use.widgets,
  ...)
```

## Arguments

exprsFile	(character) File or connection from which to read expression values. The file should contain a matrix with rows as features and columns as samples. <a href="#">read.table</a> is called with this as its file argument and further arguments given by exprsArgs.
phenoDataFile	(character) File or connection from which to read phenotypic data. <a href="#">read.AnnotatedDataFrame</a> is called with this as its file argument and further arguments given by phenoDataArgs.
experimentDataFile	(character) File or connection from which to read experiment data. <a href="#">read.MIAME</a> is called with this as its file argument and further arguments given by experimentDataArgs.
notesFile	(character) File or connection from which to read notes; <a href="#">readLines</a> is used to input the file.
path	(optional) directory in which to find all the above files.
annotation	(character) A single character string indicating the annotation associated with this ExpressionSet.

exprsArgs	A list of arguments to be used with <code>read.table</code> when reading in the expression matrix.
phenoDataArgs	A list of arguments to be used (with <code>read.AnnotatedDataFrame</code> ) when reading the phenotypic data.
experimentDataArgs	A list of arguments to be used (with <code>read.MIAME</code> ) when reading the experiment data.
sep, header, quote, stringsAsFactors, row.names	arguments used by the <code>read.table</code> -like functions.
widget	A boolean value indicating whether widgets can be used. Widgets are NOT yet implemented for <code>read.AnnotatedDataFrame</code> .
...	Further arguments that can be passed on to the <code>read.table</code> -like functions.

### Details

Expression values are read using the `read.table` function. Phenotypic data are read using the `read.AnnotatedDataFrame` function. Experiment data are read using the `read.MIAME` function. Notes are read using the `readLines` function. The return value must be a valid `ExpressionSet`. Only the `exprsFile` argument is required.

### Value

An instance of the `ExpressionSet` class.

### Author(s)

Martin Morgan <mtmorgan@fhcrc.org>

### See Also

`ExpressionSet` for additional methods.

### Examples

```
exprsFile = system.file("extdata", "exprsData.txt", package="Biobase")
phenoFile = system.file("extdata", "pData.txt", package="Biobase")

## Read ExpressionSet with appropriate parameters
obj = readExpressionSet(exprsFile, phenoFile, sep = "\t", header=TRUE)
obj
```

---

`reporter`*Example data.frame representing reporter information*

---

**Description**

The reporter object is a 500 by 1 data frame. The rows represent the 500 probe IDs in the geneData data. The values in reporter are the predefined probe types for the probes. reporter is used in conjunction with the geneData object and its associates.

**Usage**

```
data(reporter)
```

**Format**

A 500 by 1 data frame

**Details**

There are 10 predefined probe types:

- AFX- Quality Control (QC)
- \_f\_ SequenceFamily
- \_g\_ CommonGroups
- \_s\_ SimilarityConstraint
- \_r\_ RulesDropped
- \_i\_ Incomplete
- \_b\_ AmbiguousProbeSet
- \_l\_ LongProbeSet
- \_at AntiSenseTarget
- \_st SenseTarget

**Source**

Affymetrix GeneChip Expression Analysis Data Analysis Fundamentals ([http://www.affymetrix.com/Auth/support/downloads/manuals/data\\_analysis\\_fundamentals\\_manual.pdf](http://www.affymetrix.com/Auth/support/downloads/manuals/data_analysis_fundamentals_manual.pdf))

**Examples**

```
data(reporter)
## maybe str(reporter) ; plot(reporter) ...
```

---

`reverseSplit`*A function to reverse the role of names and values in a list.*

---

**Description**

Given a list with names `x` and values in a set `y` this function returns a list with names in `y` and values in `x`.

**Usage**

```
reverseSplit(inList)
```

**Arguments**

`inList`            A named list with values that are vectors.

**Details**

First the list is unrolled to provide a two long vectors, names are repeated, once for each of their values. Then the names are `split` by the values.

This turns out to be useful for inverting mappings between one set of identifiers and an other.

**Value**

A list with length equal to the number of distinct values in the input list and values from the names of the input list.

**Author(s)**

R. Gentleman

**See Also**

[split](#)

**Examples**

```
l1 = list(a=1:4, b=c(2,3), d=c(4,5))
reverseSplit(l1)
```

---

rowMedians	<i>Calculates the median for each row in a matrix</i>
------------	---

---

### Description

Calculates the median for each row in a matrix.

### Usage

```
rowMedians(x, na.rm=FALSE, ...)
```

### Arguments

x	A <a href="#">numeric NxK matrix</a> .
na.rm	If <a href="#">TRUE</a> , <a href="#">NAs</a> are excluded first, otherwise not.
...	Not use.

### Details

The implementation of `rowMedians()` is optimized for both speed and memory. To avoid coercing to [doubles](#) (and hence memory allocation), there is a special implementation for [integer](#) matrices. That is, if `x` is an [integer matrix](#), then `rowMedians(as.double(x))` would require three times the memory of `rowMedians(x)`, but all this is avoided.

### Value

Returns a [numeric vector](#) of length `N`.

### Missing values

Missing values are excluded before calculating the medians.

### Author(s)

Henrik Bengtsson

### See Also

See `rowMeans()` in `colSums()`.

### Examples

```
set.seed(1)
x <- rnorm(n=234*543)
x[sample(1:length(x), size=0.1*length(x))] <- NA
dim(x) <- c(234,543)
y1 <- rowMedians(x, na.rm=TRUE)
y2 <- apply(x, MARGIN=1, FUN=median, na.rm=TRUE)
```

```
stopifnot(all.equal(y1, y2))

x <- cbind(x1=3, x2=c(4:1, 2:5))
stopifnot(all.equal(rowMeans(x), rowMedians(x)))
```

---

rowQ

*A function to compute empirical row quantiles.*

---

## Description

This function computes the requested quantile for each row of a matrix, or of an ExpressionSet.

## Usage

```
rowQ(imat, which)
rowMax(imat)
rowMin(imat)
```

## Arguments

`imat`            Either a matrix or an ExpressionSet.  
`which`           An integer indicating which order statistic should be returned.

## Details

`rowMax`, `rowMin` and `rowMedians` simply call `rowQ` with the appropriate argument set.

The argument `which` takes values between 1, for the minimum per row, and `ncol(imat)`, for the maximum per row.

## Value

A vector of length equal to the number of rows of the input matrix containing the requested quantiles.

## Author(s)

R. Gentleman

## See Also

[rowMedians](#). [rowMeans\(\)](#) in [colSums\(\)](#).

## Examples

```
data(sample.ExpressionSet)
rowMin(sample.ExpressionSet)
rowQ(sample.ExpressionSet, 4)
```

---

ScalarObject-class      *Utility classes for length one (scalar) objects*

---

**Description**

These classes represent scalar quantities, such as a string or a number and are useful because they provide their own validity checking. The classes `ScalarCharacter`, `ScalarLogical`, `ScalarInteger`, and `ScalarNumeric` all extend their respective base vector types and can be used interchangeably (except they should always have length one).

The `mkScalar` factory function provides a convenient way of creating `Scalar<type>` objects (see the examples section below).

**Usage**

```
mkScalar(obj)
```

**Arguments**

`obj`                      An object of type character, logical, integer, or double

**Author(s)**

Seth Falcon

**Examples**

```
v <- list(mkScalar("a single string"),
         mkScalar(1),
         mkScalar(1L),
         mkScalar(TRUE))
sapply(v, class)
sapply(v, length)
```

---

`selectChannels`                      *Create a new NChannelSet instance by selecting specific channels*

---

**Description**

This generic function extracts specific elements from an object, returning a instance of that object.

**Usage**

```
selectChannels(object, names, ...)
```

**Arguments**

object	An S4 object, typically derived from class <a href="#">eSet</a>
names	Character vector of named channels.
...	Additional arguments.

**Value**

Instance of class object.

**Author(s)**

Biocore

**Examples**

```
obj <- NChannelSet(R=matrix(runif(100), 20, 5), G=matrix(runif(100), 20, 5))

## G channel as NChannelSet
selectChannels(obj, "G")
```

---

selectSome

*Extract elements of a vector for concise rendering*

---

**Description**

Extract the first and last several elements of a vector for concise rendering; insert ellipses to indicate elided elements. This function is primarily meant for developer rather than end-user use.

**Usage**

```
selectSome(obj, maxToShow=5)
```

**Arguments**

obj	A vector.
maxToShow	The number of elements (including "...") to render.

**Details**

This function can be used in 'show' methods to give users exemplars of the tokens used in a vector. For example, an [ExpressionSet](#) built from a yeast experiment might have features enumerated using systematic gene names (e.g., YPR181C) or standard gene names (e.g., SEC23). The [show](#) method for [ExpressionSet](#) uses `selectSome` to alert the user to the tokens used, and thereby to indicate what vocabulary must be understood to work with the feature names.



**Value**

A string vector with at most `maxToShow` plus 1 elements, where an ellipsis ("...") is included to indicate incompleteness of the excerpt.

**Author(s)**

Martin Morgan <mtmorgan@fhcrc.org>

**Examples**

```
selectSome(1:20)
```

---

snpCall

*Get and retrieve SNP call and call probability data.*

---

**Description**

These generic functions access the calls and call probabilities stored in objects.

**Usage**

```
snpCall(object, ...)  
snpCall(object, ...) <- value  
snpCallProbability(object, ...)  
snpCallProbability(object, ...) <- value
```

**Arguments**

<code>object</code>	Object, possibly derived from class <code>SnpSet</code> .
<code>value</code>	Matrix with rows representing SNP calls or call probabilities and columns samples.
<code>...</code>	Additional arguments available to methods.

**Value**

`snpCall` returns a matrix of SNP calls; `snpCallProbability` returns the corresponding matrix of standard errors, when available.

**Author(s)**

Biocore

**See Also**

[SnpSet-class](#)

SnpSet

*Class to Contain Objects Describing High-Throughput SNP Assays.***Description**

Container for high-throughput assays and experimental metadata. SnpSet class is derived from [eSet](#), and requires matrices `call`, `callProbability` as assay data members.

**Extends**

Directly extends class [eSet](#).

**Creating Objects**

```
new(SnpSet, phenoData = [AnnotatedDataFrame], experimentData = [MIAME], annotation = [character])
```

SnpSet instances are usually created through `new("SnpSet", ...)`. Usually the arguments to `new` include `call` (a matrix of genotypic calls, with features (SNPs) corresponding to rows and samples to columns), `phenoData`, `experimentData`, `annotation`, and `protocolData`. `phenoData`, `experimentData`, `annotation` and `protocolData` can be missing, in which case they are assigned default values.

**Slots**

Inherited from `eSet`:

**assayData:** Contains matrices with equal dimensions, and with column number equal to `nrow(phenoData)`. `assayData` must contain a matrix `call` with rows representing features (e.g., SNPs) and columns representing samples, and a matrix `callProbability` describing the certainty of the call. The content of `call` and `callProbability` are not enforced by the class. Additional matrices of identical size may also be included in `assayData`. Class:[AssayData-class](#)

**phenoData:** See [eSet](#)

**experimentData:** See [eSet](#)

**annotation:** See [eSet](#)

**protocolData:** See [eSet](#)

**Methods**

Class-specific methods:

`snpCall(SnpSet)`, `snpCall(SnpSet, matrix)` <- Access and set elements named `call` in the `AssayData` slot.

`exprs(SnpSet)`, `exprs(SnpSet, matrix)` <- Synonym for `snpCall`.

`snpCallProbability(SnpSet)`, `snpCallProbability(SnpSet, matrix)` <- Access and set elements named `callProbability` in the `AssayData` slot.

Derived from [eSet](#):

`updateObject(object, ..., verbose=FALSE)` Update instance to current version, if necessary.

See [updateObject](#) and [eSet](#)

`isCurrent(object)` Determine whether version of object is current. See [isCurrent](#)

`isVersioned(object)` Determine whether object contains a 'version' string describing its structure. See [isVersioned](#)

`sampleNames(SnpSet)` **and** `sampleNames(SnpSet)<-`: See [eSet](#)

`featureNames(SnpSet)`, `featureNames(SnpSet, value)<-`: See [eSet](#)

`dims(SnpSet)`: See [eSet](#)

`phenoData(SnpSet)`, `phenoData(SnpSet, value)<-`: See [eSet](#)

`varLabels(SnpSet)`, `varLabels(SnpSet, value)<-`: See [eSet](#)

`varMetadata(SnpSet)`, `varMetadata(SnpSet, value)<-`: See [eSet](#)

`pData(SnpSet)`, `pData(SnpSet, value)<-`: See [eSet](#)

`varMetadata(SnpSet)`, `varMetadata(SnpSet, value)` See [eSet](#)

`experimentData(SnpSet)`, `experimentData(SnpSet, value)<-`: See [eSet](#)

`pubMedIds(SnpSet)`, `pubMedIds(SnpSet, value)` See [eSet](#)

`abstract(SnpSet)`: See [eSet](#)

`annotation(SnpSet)`, `annotation(SnpSet, value)<-` See [eSet](#)

`protocolData(SnpSet)`, `protocolData(SnpSet, value)<-` See [eSet](#)

`combine(SnpSet, SnpSet)`: See [eSet](#)

`storageMode(eSet)`, `storageMode(eSet, character)<-`: See [eSet](#)

Standard generic methods:

`initialize(SnpSet)`: Object instantiation, used by `new`; not to be called directly by the user.

`validObject(SnpSet)`: Validity-checking method, ensuring that `call` and `callProbability` is a member of `assayData`. `checkValidity(SnpSet)` imposes this validity check, and the validity checks of `eSet`.

`show(SnpSet)` See [eSet](#)

`dim(SnpSet)`, `ncol` See [eSet](#)

`SnpSet[(index)]`: See [eSet](#)

`SnpSet$`, `SnpSet$<-` See [eSet](#)

### Author(s)

Martin Morgan, V.J. Carey, after initial design by R. Gentleman

### See Also

[eSet](#), [ExpressionSet](#)

storageMode *Retrieve or set storage mode for eSets.*

---

### Description

These generic functions report or change the storage mode used for assayData.

### Usage

```
storageMode(object)
storageMode(object) <- value
```

### Arguments

object	Object, derived from class eSet
value	Character vector containing "lockedEnvironment", "environment", or "list". See AssayData-class for details.

### Value

storageMode returns a length-1 character vector

### Author(s)

Biocore

### See Also

[AssayData-class](#), [eSet-class](#) [ExpressionSet-class](#), [SnpSet-class](#)

---

strbreak *Break Character Strings to Fit Width*

---

### Description

Inserts line breaks (collapse) into input character strings. The main intention of this function is to prepare long strings for printing, so the output is not wider than width.

### Usage

```
strbreak(x, width=getOption("width"), exdent=2, collapse="\n")
```

**Arguments**

x	a character vector
width	a positive integer giving the width of the output.
exdent	a positive integer specifying the indentation of subsequent lines after the first line.
collapse	a character. This is inserted to break lines.

**Author(s)**

Wolfgang Huber <http://www.ebi.ac.uk/huber>

**See Also**

[strwrap](#), [substring](#)

**Examples**

```
longString = paste(rep(LETTERS, 10), collapse="", sep="")
cat(strbreak(longString))
```

---

subListExtract	<i>Extract the same element from the sublists of a list</i>
----------------	---

---

**Description**

Given a list of lists, this function can be used to extract a named element from each sublist.

**Usage**

```
subListExtract(L, name, simplify = FALSE, keep.names = TRUE)
```

**Arguments**

L	A list of named lists
name	The name of the element in the sublists that should be extracted. This should be a length one character vector.
simplify	When TRUE, the return value will be an atomic vector. If any extracted sublist value has length not equal to one and simplify=TRUE, an error will be raised. When FALSE, a list is returned containing the extracted elements.
keep.names	If TRUE (default), the names of L will be attached to the returned vector.

**Details**

This function is implemented in C and is intended to be faster than calling `lapply` or `sapply`.

**Value**

If `simplify=FALSE`, a list will be returned having the same length as `L`, but with each element containing the element named `name` from the corresponding inner list of `L`.

When `simplify=TRUE`, an atomic vector will be returned containing the extracted elements. If any of the inner list elements do not have length one or cannot be put inside an atomic vector, an error will be raised.

**Author(s)**

Seth Falcon

**Examples**

```
list_size = 500000
innerL = list(foo="foo", bar="bar")
L = rep(list(innerL), list_size)

system.time({j0 = sapply(L, function(x) x$foo)})
system.time({j1 = subListExtract(L, "foo", simplify=TRUE)})
stopifnot(all.equal(j0, j1))

LS = L[1:3]
names(LS) = LETTERS[1:3]
subListExtract(LS, "bar", simplify=TRUE)
subListExtract(LS, "bar", simplify=FALSE)
subListExtract(LS, "bar", simplify=TRUE, keep.names=FALSE)
```

---

testBioCConnection      *A function to check internet connectivity to Bioconductor*

---

**Description**

This function will attempt to determine if the user has internet connectivity to the Bioconductor website. This is useful in many situations dealing with code that uses automated downloads and other such things.

**Usage**

```
testBioCConnection()
```

**Value**

TRUE if a connection is possible, FALSE if not.

**Author(s)**

Jeff Gentry

**Examples**

```
z <- testBioCConnection()
```

---

updateObjectTo	<i>Update an object to the class definition of a template</i>
----------------	---

---

**Description**

The `updateObjectTo` generic function returns an instance of `object` updated to the class definition of `template`.

It requires that the class of the returned object be the same as the class of the `template` argument, and that the object is valid. Usually, updating proceeds by modifying slots in `template` with information from `object`, and returning `template`. Use [as](#) to coerce an object from one type to another; `updateObjectTo` might be useful to update a virtual superclass. By default, `updateObjectTo` has the following behavior:

```
updateObjectTo(ANY-object, ANY-template) Attempt as(ANY-object, class(ANY-template)).
```

**Usage**

```
updateObjectTo(object, template, ..., verbose=FALSE)
```

**Arguments**

<code>object</code>	Object to be updated.
<code>template</code>	Instance representing a template for updating object.
<code>...</code>	Additional arguments, for use in specific update methods.
<code>verbose</code>	A logical, indicating whether information about the update should be reported. Use <code>message</code> to report this.

**Value**

`updateObjectTo` returns a valid instance of `template`.

**Author(s)**

Biocore team

**See Also**

[updateObject](#), [Versions-class](#)

---

updateOldESet	<i>Update previously created eSet object to current eSet structure</i>
---------------	--

---

### Description

This function updates eSet objects created in previous versions of Biobase to the current class structure. Warnings indicate when coercions change how data in the from object are altered. If the from object was not a valid object of the original eSet class, then updateOldESet may fail.

### Usage

```
updateOldESet(from, toClass, ...)
```

### Arguments

from	Object created using a previous version of the eSet class.
toClass	Character string identifying new class, e.g., "ExpressionSet"
...	Additional arguments passed to the initialization method for class toClass

### Value

Valid object of class toClass.

### Author(s)

Biocore

### See Also

[eSet-class](#), [ExpressionSet-class](#), [SnpSet-class](#)

### Examples

```
## Not run:  
updateOldESet(oldESet, "ExpressionSet")  
  
## End(Not run)
```



---

userQuery	<i>A function to query the user for input</i>
-----------	---

---

**Description**

This function will output a given message and seek a response from the user, repeating the message until the input is from a valid set provided by the code.

**Usage**

```
userQuery(msg, allowed = c("y", "n"), default = "n", case.sensitive = FALSE)
```

**Arguments**

msg	The output message
allowed	Allowed input from the user
default	Default response if called in batch mode
case.sensitive	Is the response case sensitive? Defaults to FALSE

**Value**

The input from the user

**Author(s)**

Jeff Gentry

---

validMsg	<i>Conditionally append result to validity message</i>
----------	--

---

**Description**

This function facilitates constructing messages during S4 class validation, and is meant for developer rather than end-user use.

**Usage**

```
validMsg(msg, result)
```

**Arguments**

msg	A character vector or NULL.
result	Any vector.

**Details**

This function appends `result` to `msg`, but only if `result` is a character vector.

**Author(s)**

Martin Morgan <mtmorgan@fhcrc.org>

**Examples**

```
msg <- NULL
validMsg(msg, FALSE) # still NULL
msg <- validMsg(msg, "one")
validMsg(msg, "two")
```

---

Versioned

*Class "Versioned"*

---

**Description**

Use this class as a ‘superclass’ for classes requiring information about versions.

**Methods**

The following are defined; package developers may write additional methods.

`new("Versioned", ..., versions=list())` Create a new `Versioned`-class instance, perhaps with additional named version elements (the contents of `versions`) added. Named elements of `versions` are character strings that can be coerced using `package_version`, or `package_version` instances.

`classVersion(object)` Obtain version information about instance `object`. See `classVersion`.

`classVersion(object) <- value` Set version information on instance `object` to `value`; useful when `object` is an instance of a class that contains `VersionClass`. See `classVersion`.

`classVersion(object)["id"] <- value` Create or update version information "id" on instance `object` to `value`; useful when `object` is an instance of a class that contains `VersionClass`. See `classVersion`.

`show(object)` Default method returns `invisible`, to avoid printing confusing information when your own class does not have a `show` method defined. Use `classVersion(object)` to get or set version information.

**Author(s)**

Biocore

**See Also**

[Versions-class](#)

**Examples**

```

obj <- new("Versioned", versions=list(A="1.0.0"))
obj
classVersion(obj)

A <- setClass("A", contains="Versioned")

classVersion("A")
a <- A()
a # show nothing by default
classVersion(a)

B <- setClass("B", contains="Versioned",
              prototype=prototype(new("Versioned", versions=list(B="1.0.0"))))

classVersion("B")
b <- B()
classVersion(b)

classVersion(b)["B"] <- "1.0.1"
classVersion(b)
classVersion("B")

classVersion("B") < classVersion(b)
classVersion(b) == "1.0.1"

C <- setClass("C",
              representation(x="numeric"),
              contains=("VersionedBiobase"),
              prototype=prototype(new("VersionedBiobase", versions=c(C="1.0.1"))))

setMethod("show", signature(object="C"),
          function(object) print(object@x))

c <- C(x=1:10)
c

classVersion(c)

```

---

VersionedBiobase

*Class "VersionedBiobase"*


---

**Description**

Use this class as a ‘superclass’ for classes requiring information about versions. By default, the class contains versions for R and Biobase. See [Versioned-class](#) for additional details.

**Methods**

set [Versioned-class](#) for methods.

**Author(s)**

Biocore

**See Also**

[Versioned-class](#)

**Examples**

```
obj <- new("VersionedBiobase")
classVersion(obj)

obj <- new("VersionedBiobase", versions=list(A="1.0.0"))
classVersion(obj)

A <- setClass("A", contains="VersionedBiobase")

classVersion("A")
a <- A()
classVersion(a)

obj <- new("VersionedBiobase", versions=c(MyVersion="1.0.0"))
classVersion(obj)

B <- setClass("B", contains="VersionedBiobase",
              prototype=prototype(new("VersionedBiobase", versions=list(B="1.0.0"))))

classVersion("B")
b <- B()
classVersion(b)

removeClass("A")
removeClass("B")
```

---

Versions

*Class "Versions"*

---

**Description**

A class to record version number information. This class is used to report versions; to add version information to your own class, use [Versioned-class](#).

## Methods

The following are defined; package developers may write additional methods.

`new("Versions", ...)` Create a new Versions-class instance, perhaps with named version elements (the contents of ...) added. Named elements of versions are character strings that can be coerced using `package_version`, or `package_version` instances, Versions-class objects.

`object["id"]` Obtain version information "id" from object.

`object["id"] <- value` Create or update version information "id" on instance object.

`object[["id"]]` Obtain version information "id" from object. The result is a list of integers, corresponding to entries in the version string.

`object[["id"]] <- value` Create or update version information "id" on instance object.

`object$id` Obtain version information "id" from object. The result is a list of integers, corresponding to entries in the version string.

`object$id <- value` Create or update version information "id" on instance object.

`show(object)` Display version information.

`updateObject(object)` Update object to the current Versions-class representation. Note that this does *not* update another class that uses Versions-class to track the class version.

`as(object, "character")` Convert object to character representation, e.g., 1.0.0

`object1 < object2` Compare object1 and object2 using version class information. Symbols in addition to < are admissible; see ?Ops

## Author(s)

Biocore

## See Also

[classVersion](#) [isCurrent](#) [isVersioned](#)

## Examples

```
obj <- new("Versions", A="1.0.0")
obj
```

```
obj["A"] <- "1.0.1"
obj
obj["B"] <- "2.0"
obj
```

```
obj1 <- obj
obj1["B"] <- "2.0.1"
```

```
obj1 == obj
obj1["B"] > "2.0.0"
obj["B"] == "2.0" # TRUE!
```

---

VersionsNull

*Class "VersionsNull"*

---

**Description**

A class used to represent the ‘version’ of unversioned objects. Useful primarily for method dispatch.

**Methods**

The following are defined; package developers may write additional methods.

`new("VersionsNull", ...)` Create a new VersionsNull-class instance, ignoring any additional arguments.

`show(object)` Display “No version”.

**Author(s)**

Biocore

**See Also**

[classVersion](#)

**Examples**

```
obj <- new("VersionsNull")
obj
```

```
obj <- new("VersionsNull", A="1.0.0") # warning
obj
```

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