Package ‘mogsa’

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Type Package

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Description This package provide a method for doing gene set analysis based on multiple omics data.

License GPL-2

Depends R (>= 3.4.0)

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Contents

mogsa-package 3
annotate.gs 4

biSoftK . . . 5
bootMbpca . . . 6
bootMbpcaK . . . 7
bootMoa . . . 8
box.gs.feature . . . 9
combine-methods . . . 11
decompose.gs.group . . . 12
decompose.gs.ind . . . 13
deflat . . . 14
distMoa . . . 15
getmgsa . . . 16
GIS . . . 17
matpower . . . 19
mbpca . . . 20
mgsa-class . . . 22
moa . . . 24
moa-class . . . 25
moa.sup-class . . . 27
moaCoef . . . 28
moaScore . . . 29
moGap . . . 30
mogsa . . . 32
msvd . . . 34
NCI60_4arrays . . . 35
NCI60_4array_supdata . . . 36
nipalsSoftK . . . 36
pairwise.rv . . . 37
plot-methods . . . 38
plotGS . . . 39
prepGraphite . . . 40
prepMsigDB . . . 41
prepSupMoa . . . 42
print-methods . . . 43
processOpt . . . 43
show-methods . . . 44
softK . . . 44
summary-methods . . . 45
sup.moa . . . 45
toMoa . . . 46
wsvd . . . 47

Index **49**

`mogsa-package` *Multiple omics clustering and gene set analysis*

Description

Modern "omics" technologies enable quantitative monitoring of the abundance of various biological molecules in a high-throughput manner, accumulating an unprecedented amount of quantitative information on a genomic scale. Gene set analysis is a particularly useful method in high throughput data analysis since it can summarize single gene level information into the biological informative gene set levels. This package provide a method do the gene set analysis based on multiple omics data that describing the same set of observations/samples.

Details

Package:	mogsa
Type:	Package
Version:	1.3.1
Date:	2016-01-19
License:	GPL-2
Depends:	methods

The main function in the package is "mogsa", see the function help manu for more details.

Author(s)

Chen Meng Maintainer: Chen Meng <chen.meng@tum.de>

References

Chen Meng, Dominic Helm, Martin Frejno, and Bernhard Kuster. moCluster: Identifying Joint Patterns Across Multiple Omics Data Sets. Journal of Proteome Research 2016.

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)

# using a list of data.frame as input
mgsa1 <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
               proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
# using moa as input
ana <- moa(NCI60_4arrays, proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
smoa <- sup.moa(ana, sup=NCI60_4array_supdata, nf=3)
mgsa2 <- mogsa(x = ana, sup=NCI60_4array_supdata, nf=9)
mgsa3 <- mogsa(x = ana, sup=smoa)
```

annotate.gs *Summary annotation information of a gene set*

Description

Retrive variables/features (genes) mapped to the annotated data sets in a gene set. Also returns the the information about presence and absence of a feature for a specific data set.

Usage

```
annotate.gs(mgsa, gs)
```

Arguments

mgsa	An object of class mgsa-class or moa.sup-class.
gs	The name of a geneset

Value

This function returns a data.frame. The first column shows the name of features. The last column is for the count of how many data sets has the corresponding features. Columns in the middle contains logical value indicating whether a feature is presented in a particular data set.

Author(s)

Chen Meng

See Also

see GIS

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)
mgsa <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
allgs <- colnames(NCI60_4array_supdata[[1]])
annotate.gs(mgsa, allgs[1])
```

biSoftK *NIPALS algorithm with soft thresholding operator on rows and columns*

Description

An internal function called by mbpca.

Usage

```
biSoftK(x, maxiter, kp, kt, weight.p, weight.t, pos = FALSE, unit.pb = TRUE, unit.tb = FALSE)
```

Arguments

x	The input matrix, rows are observations, columns are variables
maxiter	Number of maximum interation the algorithm can run
kp	The number (>=1) or proportion (<1) of variables want to keep. It could be a single value or a vector has the same length as x so the sparsity of individual matrix could be different.
kt	The number (>=1) or proportion (<1) of non-zero scores for obvservations.
weight.p	The weight of variables. It could be 1) a vector has the same length as x, one value for each table/block; 2) one number, all variables share the same weight or 3) a list of vectors, the length of each vector should be the same with the columns numbers of the corresponding table/block, so every variables has a unique weight.
weight.t	The weight for observation. For accepted values or formats, see weight.p.
pos	Logical value, if only non-negaitve values in the loading and score vectors.
unit.pb	Logical value, whether the length of table/block loading should be unit length.
unit.tb	Logical value, whether the length of table/block score should be unit length.

Details

This function also use the NIPALS algorithm, but it generalized nipalsSoftK from several aspects: 1. Allowing sparsity on both columns and rows of matrices 2. Allowing weights for columns and rows 3. Allowing loading and/or score vectors of blocks to be unit length 4. Allowing only positive number in loading and score vectors

Value

an `list` object contains the following elements:

`tb` - the block scores

`pb` - the block loadings

`t` - the global scores

`w` - the wegihts of block scores to construct the global score.

Author(s)

Chen Meng

See Also

msvd

---

bootMbpca *Bootstrap mbpca to estimate the coherence of different data sets*

Description

Bootstrap mbpca to estimate the coherence of different data sets and estimate the number of components should be included in an analysis.

Usage

```
bootMbpca(moa, mc.cores = 1, B = 100, replace = TRUE,
  resample = c("sample", "gene", "total"), log = "y", ncomp = NULL, method = NULL,
   maxiter = 1000, svd.solver = c("svd", "fast.svd", "propack"), plot = TRUE)
```

Arguments

moa	An object of moa returned by mbpca.
mc.cores	Integer; number of cores used in bootstrap. This value is passed to function mclapply
B	Integer; number of bootstrap
replace	Logical; sampling with or without replacement
resample	Could be one of "sample", "gene" or "total". "sample" and "gene" means sample-wise and variable-wise resampling, repectively. "total" means total resampling.
log	Could be "x", "y" or "xy" for plot log axis
ncomp	Passed to function mbpca. In most of cases, user do not need to specify this argument because it could be inferred from moa.
method	Passed to function mbpca.In most of cases, user do not need to specify this argument because it could be inferred from moa.
maxiter	Passed to function mbpca.In most of cases, user do not need to specify this argument because it could be inferred from moa.
svd.solver	Passed to function mbpca.In most of cases, user do not need to specify this argument because it could be inferred from moa.
plot	Logical; whether the result should be plotted.

Details

Bootstrap method were used to determine the components that are presenting significant concordant structure between datasets.

Value

It returns a matrix, columns are eigenvalues for different components. Each rows is a bootstramp sample.

Author(s)

Chen Meng

Examples

```
# see examples in \code{\link{mbpca}}
```

---

bootMbpcaK — *An internal function called by* bootMbpca.

Description

An internal function called by bootMbpca.

Usage

```
bootMbpcaK(data, replace, B = 100, mc.cores = 1, resample = c("sample", "total", "gene"),
 ncomp, method, k, center = FALSE, scale = FALSE, option = "uniform", maxiter = 1000,
  svd.solver = c("svd", "fast.svd", "propack"))
```

Arguments

data	A list of matrix to bootstrap.
replace	A logical variable to indicate sampling with or without replacement
B	Integer; number of bootstrap.
mc.cores	Integer; number of cores used in bootstrap. This value is passed to function mclapply
resample	Could be one of "sample", "gene" or "total". "sample" and "gene" means sample-wise and variable-wise resampling, repectively. "total" means total resampling.
ncomp	passed to mbpca.
method	passed to mbpca.
k	passed to mbpca.
center	passed to mbpca.
scale	passed to mbpca.
option	passed to mbpca.
maxiter	passed to mbpca.
svd.solver	passed to mbpca.

Value

A matrix of mbpca eigenvalues resulted from bootstrap samples

Author(s)

Chen Meng

See Also

bootMbpca

---

bootMoa *Significant components in "moa" returned by function "moa".*

Description

Using bootstrap method to extract the components representing significant concordance structures between datasets from "moa" (returned by function "moa").

Usage

```
bootMoa(moa, proc.row="center_ssq1", w.data="inertia", w.row=NULL, statis=FALSE,
   mc.cores=1, B = 100, replace=TRUE, resample=c("sample", "gene", "total"),
   plot=TRUE, log="y", tol = 1e-7)
```

Arguments

moa	An object of moa returned by moa.
proc.row	Preprocessing of rows of datasets, should be one of none - no preprocessing, center - center only, center_ssq1 - center and scale (sum of squred values equals 1), center_ssqN - center and scale (sum of squred values equals the number of columns), center_ssqNm1 - center and scale (sum of squred values equals the number of columns - 1) MFA corresponds to "proc.row=center_ssq1" and 'w.data="lambda1"'
w.data	The weights of each separate dataset, should be one of uniform - no weighting, lambda1 - weighted by the reverse of the first eigenvalue of each individual dataset or inertia - weighted by the reverse of the total inertia. See detail.
w.row	If it is not null, it should be a list of positive numerical vectors, the length of which should be the same with the number of rows of each dataset to indicated the weight of rows of datasets.
statis	A logical indicates whether STATIS method should be used. See details.
mc.cores	Integer; number of cores used in bootstrap. This value is passed to function mclapply

B	Integer; number of bootstrap
replace	Logical; sampling with or without replacement
resample	Could be one of "sample", "gene" or "total". "sample" and "gene" means sample-wise and variable-wise resampling, repectively. "total" means total resampling.
plot	Logical; whether the result should be plotted.
log	Could be "x", "y" or "xy" for plot log axis.
tol	The minimum eigenvalues shown in the plot.

Details

set plot=TRUE to help selecting significant components.

Value

A matrix where columns are components and rows are variance of PCs from bootstrap samples.

Author(s)

Chen Meng

References

Herve Abdi, Lynne J. Williams, Domininique Valentin and Mohammed Bennani-Dosse. STATIS and DISTATIS: optimum multitable principal component analysis and three way metric multidimensional scaling. WIREs Comput Stat 2012. Volume 4, Issue 2, pages 124-167 Herve Abdi, Lynne J. Williams, Domininique Valentin. Multiple factor analysis: principal component analysis for multitable and multiblock data sets. WIREs Comput Stat 2013

See Also

moa, sup.moa, mogsa. More about plot see moa-class.

Examples

```
# see function moa
```

---

box.gs.feature *boxplot of gene set variables across all samples.*

Description

boxplot to show the variables (e.g. gene expression) of a gene set across all samples.

Usage

```
box.gs.feature(x, gs, moa = NULL, col = 1, layout = NULL, plot = TRUE, obs.order = NULL, ...)
```

Arguments

x	An object of calss mgsa-class or moa.sup-class
gs	Gene set want to be explored
moa	An obejct of class moa. It is required if x is an object of class moa.sup-class
col	The coler code for samples
layout	The layout control, see examples.
plot	A logical indicates whether the result should be ploted. If FALSE, a list of expression matrix of the gene set genes is returned. Otherwise nothing returned.
obs.order	Can be used to reorder the martrix, could be used when clustering result is available.
...	The arguments passed to boxplot

Details

This is a convenient function used to explore the expression of a set of features/genes

Value

Do not return anything (plot=TRUE) or return a list of matrix (plot=FALSE) depends on plot arugment.

Author(s)

Chen meng

Examples

```
 # library(mogsa)
 # loading gene expression data and supplementary data
 data(NCI60_4array_supdata)
 data(NCI60_4arrays)
 mgsa <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
               proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)

 allgs <- colnames(NCI60_4array_supdata[[1]])
colcode <- as.factor(sapply(strsplit(colnames(NCI60_4arrays$agilent), split="\\."), "[", 1))
 a <- box.gs.feature(x=mgsa, gs=allgs[5], type=3, col=colcode, plot=FALSE)
box.gs.feature(x=mgsa, gs=allgs[5], type=3, col=colcode, plot=TRUE, layout=matrix(1:4, 2, 2))
```

`combine-methods` *Combine two objects of class* `mgsa` *into one.*

Description

This function could only be used to combine two "mgsa" objects at present; using "Reduce" function to combine more.

Usage

```
combine(x, y, ...)
```

Arguments

`x`	one mgsa object
`y`	another mgsa object
`...`	ignored. Only two mgsa objects could be combined, using "Reduce" to combine more than two sets.

Value

A combined object of class `mgsa` will be returned.

Methods

`signature(x = "mgsa", y = "mgsa")` To combine two objects of `mgsa`.

This function could only be used to combine two "mgsa" objects; using "Reduce" function to combine more.

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)
# split gene set annotation into two sets.
sup1 <- lapply(NCI60_4array_supdata, function(x) x[, 1:10])
sup2 <- lapply(NCI60_4array_supdata, function(x) x[, -(1:10)])
# project two sets of annotation
mgsa1 <- mogsa(x = NCI60_4arrays, sup=sup1, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
mgsa2 <- mogsa(x = NCI60_4arrays, sup=sup2, nf=9,
               proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
# combine two indenpendent mgsa sets
mgsa_comb <- combine(mgsa1, mgsa2)
dim(getmgsa(mgsa1, "score"))
dim(getmgsa(mgsa2, "score"))
dim(getmgsa(mgsa_comb, "score"))
```

`decompose.gs.group` *Data-wise or PC-wise decomposition of gene set scores for all observations.*

Description

Data-wise or PC-wise decomposition of gene set scores (GSS) across all observations. The predefined group/cluster information should be given so that the mean decomposed GSSs for each group are returned and plotted.

Usage

```
decompose.gs.group(x, gs, group, decomp = "data", nf = 2, x.legend = "bottomleft",
   y.legend = NULL, plot = TRUE, main = NULL, ...)
```

Arguments

`x`	An object of class `mgsa-class` or `moa.sup-class`
`gs`	The gene set want to exam.
`group`	An vector or factor to indicate the group of observations, such as clusters. See examples.
`decomp`	A charater string either "data" or "pc" to indicate how the gene set scores should be decomposed (with respect to data or PC.
`nf`	The number of axes/PCs to be calculated and plotted.
`x.legend`	Used to control the position of legends.
`y.legend`	Used to control the position of legends.
`plot`	A logical indicates if a plot should be drawn.
`main`	The main title of plot.
`...`	Other arguments passed to `barplot`.

Details

This function could be used when the number of observation is large and there are cluster/group information is available. In this case, the means of decomposed gene set scores over each group is calculated. The vertical bar on the end of each bar indicates the 95% confident interval of the means.

Value

Return nothing or a matrix depends on how argument `plot` is set.

Author(s)

Chen Meng

References

TBA

See Also

See Also decompose.gs.ind

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)

# using a list of data.frame as input
mgsa <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)

colcode <- as.factor(sapply(strsplit(colnames(NCI60_4arrays$agilent), split="\\."), "[", 1))
decompose.gs.group(x = mgsa, gs = 2, group = colcode, decomp = "data", plot = TRUE)
decompose.gs.group(x = mgsa, gs = 2, group = colcode, decomp = "pc", nf = 3, plot = TRUE)
```

---

decompose.gs.ind — *Data-wise or PC-wise decomposition of gene set scores for a single observation.*

Description

Barplot of decomposed gene set scores, either with respect to datasets or axes.

Usage

```
decompose.gs.ind(x, gs, obs, type = 3, nf = 2, plot=TRUE, col.data = NULL,
  col.pc = NULL, legend = TRUE)
```

Arguments

x	An object of class mgsa-class or moa.sup-class
gs	The gene set want to exam.
obs	The observations want to exam.
type	Which type of plot. type=1 - the data-pc mode; type=2 - the pc-data mode; type=3 - both. See detail.
nf	The number of axes/PCs to be calculated and plotted.
plot	A logical indicates if a plot should be drawn
col.data	The bar color of datasets
col.pc	The bar color of PCs
legend	A logical if legend should be shown

Details

type=1 (the data-pc mode), the axes/PCs are represented as the narrow bars with different colors and the background wide bars behind narrow bars are gene set scores for datasets, which is calculated from the sum of all underlying individual axes/PC scores. When type=2 (the pc-data mode) the interpreation of narrow and wide bars are in the other way around. If type=3, both are shown.

This function could only be used to check the decomposition of gene set scores of a single observation. So the function is not efficent when the number of observation is large. Another function `decompose.gs.group`, could be used in this case, particularly when the cluster information of the observation panel is available.

Value

Return nothing or a matrix depends on how argument `plot` is set.

Author(s)

Chen Meng

References

TBA

See Also

See Also as `decompose.gs.group`

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)
mgsa <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)

allgs <- colnames(NCI60_4array_supdata[[1]])
# plot
decompose.gs.ind(x=mgsa, gs=allgs[5], obs="BR.MDA_MB_231", type=2, nf=5)
# or
decompose.gs.ind(x=getmgsa(mgsa, "sup"), gs=allgs[5], obs="BR.MDA_MB_231", type=3, nf=5)
```

`deflat` *deflat function used by* `mbpca`

Description

An internal function called by `mbpca`.

Usage

```
deflat(x, t, tb, pb, method = "globalScore")
```

Arguments

x	A list of matrix want to deflat
t	The global scores returned by msvd or nipalsSoftK
tb	The block scores returned by msvd or nipalsSoftK
pb	The block loadings returned by msvd or nipalsSoftK
method	A charater to specify the deflation strateg, could be one of c("globalScore", "blockLoading", "blockScore").

Value

A list of deflated matrix

Author(s)

Chen Meng

---

distMoa — *Calculate the distance matrix from an object of class moa-class.*

Description

A convenient function to calculate the distance matrix from an object of class moa-class.

Usage

```
distMoa(x, nf = NA, tol = 1e-05, method = "euclidean",
  diag = FALSE, upper = FALSE, p = 2)
```

Arguments

x	An object of class moa-class.
nf	Integer; the number of component used to calculate the distance. Default setting (NA) will keep all the axes.
tol	Numerical; the tolerance of component with low variance.
method	passed to function dist
diag	passed to function dist
upper	passed to function dist
p	passed to function dist

Value

An object of class `dist`, see function "dist".

Author(s)

Chen Meng

Examples

```
# see examples in \code{\link{mbpca}}

data("NCI60_4arrays")
moa <- mbpca(NCI60_4arrays, ncomp = 10, k = "all", method = "globalScore", option = "lambda1",
             center=TRUE, scale=FALSE)

dst <- distMoa(moa)
```

---

getmgsa — *get values in an object of class "mgsa".*

Description

get values/slot in an object of class "mgsa". The "mgsa" consists of two S4 class objects, `moa-class` and `moa.sup-class`. This function could extract values in these two components directly.

Usage

```
getmgsa(mgsa, value)
```

Arguments

`mgsa`	An object of class `mgsa-class`.
`value`	The name of the value want to extract from "mgsa". See detail for options.

Details

if value in c("call", "moa", "sup"), the function equal function `slot`.

if value in c("eig", "tau", "partial.eig", "eig.vec", "loading", "fac.scr", "partial.fs", "ctr.obs", "ctr.var", "ctr.tab", "RV"), the function extact corresponding value from `moa-class`.

if value in c("data", "coord.sep", "coord.comb", "score", "score.data", "score.pc", "score.sep", "p.val"), the function extract value from `moa.sup-class`.

Value

The function return the selected value in "mgsa".

Author(s)

Chen Meng

References

TBA

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)
mgsa <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
part.eig <- getmgsa(mgsa, "partial.eig")
barplot(as.matrix(part.eig))
```

GIS — *calculate gene influential scores of genes in a gene set.*

Description

Calculate the gene influential score of individual feature to the overall variance of GS score. Using a leave-one-out procedure (See detail).

Usage

```
GIS(x, geneSet, nf=NA, barcol=NA, topN=NA, plot=TRUE, Fvalue=FALSE, ff=NA, cor=FALSE)
```

Arguments

x	An object of class mgsa-class.
geneSet	A charater string or number to indicated the gene sets under conserderation.
nf	The number of PCs used in the caluculation of gene set scores. The default is NA, which means using all the PCs in the mogsa. This should work for most of the cases.
barcol	The color of the bars, which is used to distinguish features/genes from different datasets, so its length should be the same as the number of data sets.
topN	An positive integer specify the number of top influencers that should to returned.
plot	A logical indicate if the result should be plotted.
Fvalue	A logical indicate if the GIS should be calculated in a supervised manner.
ff	The vector indicates the group of columns for calculating the F-ratio when Fvalue=TRUE.
cor	A logical indicates whether use correlation between reconstructed expression with GSS. This is faster than the standard GIS.

Details

The evaluation of the importance of a single feature is calculated in the supervised or unsupervised manner.

In the unsupervise manner, the value is calculated by:

log2(var(GS_-i)/var(GS))

where GS is the gene set score, and the GS_-i is a recalculate of gene set score without i'th feature. var() is the variance.

In the supervised manner, the value is caluclated as the F-ratio over a class vector:

log2(F(GS_-i)/F(GS))

Where F() is the calculation of F-ratio. The unsupervised GIS is encouraged since it works better for most of the cases in practice.

Value

An object of class `data.frame` contains three columns. The first column is the feature name, the second columns is the gene influential score. The third columns indicates from where the feature/gene is selected.

Author(s)

Chen Meng

References

TBA

See Also

see `annotate.gs`

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)
mgsa <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
allgs <- colnames(NCI60_4array_supdata[[1]])

# unsupervised measurement
GIS(mgsa, allgs[1], topN = 5)

# supervised measurement
tissueType <- as.factor(sapply(strsplit(colnames(NCI60_4arrays$agilent), split="\\."), "[", 1))
GIS(mgsa, allgs[1], topN = 5, Fvalue = TRUE, ff = tissueType)
# more PCs to calcualte
GIS(mgsa, allgs[1], nf = 20, topN = 5, Fvalue = TRUE, ff = tissueType)
```

`matpower` *compute the power of a matrix*

Description

the power of a matrix

Usage

```
matpower(x, n, nf = min(dim(x)), tol = 1e-07)
```

Arguments

`x`	a numerical matrix object that the power of which should be calculated
`n`	The matrix to the power of
`nf`	The number of axes kept in the calculation of SVD and reconstruction
`tol`	The tolerance of the axis, singular vectors with singular value lower than tol will be ignored in the reconstruction.

Details

The power of a matrix is calculated in two steps: decompostion step: x=UDV' and the reconstruction step: x^n=U*D^n*V' In the reconstruction, the singular vectors with a singular value more than tol are kept.

Value

A matrix x^n

Note

Called by the wsvd function.

Author(s)

Chen Meng

See Also

See Also `wsvd`

Examples

```
set.seed(56)
m <- matrix(rnorm(15), 5, 3)
s <- matpower(m, 2)
s <- matpower(m, -2)
```

mbpca *Extension of PCA to analyze multiple data sets*

Description

Three approaches are supplied in this function, consensus PCA (CPCA), generalized CCA (GCCA) and multiple co-inertia analsyis (MCIA).

Usage

```
mbpca(x, ncomp, method, k = "all", center = TRUE,
    scale = FALSE, option = "uniform", maxiter = 1000,
    moa = TRUE, verbose = TRUE, svd.solver = c("svd", "fast.svd", "propack"),
    k.obs = "all", w = NA, w.obs = NA,
    unit.p = FALSE, unit.obs = FALSE, pos = FALSE)
```

Arguments

x	A `list` of `matrix` or `data.frame`, where rows are variables and columns are samples. The columns among the matrices need to be match but the variables do not need to be.
ncomp	An integer; the number of components to calculate. To calculate more components requires longer computational time.
method	A character string could be one of c("globalScore", "blockScore", "blockLoading"). The "globalScore" approach equals consensus PCA; The "blockScore" approach equals generalized canonical correlation analysis (GCCA); The "blockLoading" approach equals multiple co-inertia anaysis (MCIA);
k	The absolute number (if k >= 1) or the proportion (if 0<k<1) of non-zero coefficients for the variable loading vectors. It could be a single value or a vector has the same length as x so the sparsity of individual matrix could be different.
center	Logical; if the variables should be centered
scale	Logical; if the variables should be scaled
option	A charater string could be one of c("lambda1", "inertia", "uniform") to indicate how the different matrices should be normalized. If "lambda1", the matrix is divided by its the first singular value, if "inertia", the matrix is divided by its total inertia (sum of square), if "uniform", none of them would be done.
maxiter	Integer; Maximum number of iterations in the algorithm
moa	Logical; whether the output should be converted to an object of class `moa-class`
verbose	Logical; whether the process (# of PC) should be printed
svd.solver	A charater string could be one of c("svd", "fast.svd", "propack"). The default "fast.svd " has a good compromise between the robustness and speed. "propack" is the fastest but may failed to converge in practice.

k.obs	The absolute number (if k >= 1) or the proportion (if 0<k<1) of non-zero coefficients for the observations. Sparse factor scores for observation are used by sparse concordance analysis. (New arguments from v1.12)
w	The weight of variables. It could be given in the following format: 1) NA or a numeric value: all variables have the same weight; 2) A vector of numeric values, the vecter has the same length as x: variables in each block shares the same weight; 3) A list of vector, each vector in the list has the same length as the number of row in the corresponding table/block, then each variable use a different weight. See detail how to select weight. (New arguments from v1.12)
w.obs	The weight of observations, see w. (New arguments from v1.12)
unit.p	A logical value, whether the loading vectors (for variables) for each table/block should be unit length.
unit.obs	A logical value, whether the score vectors (for observations) for each table/block should be unit length. (New arguments from v1.12)
pos	A logical value, whether only retain non-negative coefficients in loading and score vectors. (New arguments from v1.12)

Details

Select of weight for variables: In omics data, it is often true that low intensity variables suffers more noise. Therefore, The variables with higher intensities are more reliable. If we consider this, we can use the total sum intensity of a variable (or a tranform of it) as weight, the model would prefer to select high intensity variables.

Value

An object of class moa-class (if moa=TRUE) or an list object contains the following elements:

tb - the block scores

pb - the block loadings

t - the global scores

w - the wegihts of block scores to construct the global scor

Note

no note

Author(s)

Chen Meng

References

For clustering problem: Meng et al. 2015 moCluster: Identifying Joint Patterns Across Multiple Omics Data Sets. Journal of proteome research.

See Also

see moa for non-iterative algorithms for multi-block PCA.

Examples

```
data("NCI60_4arrays")
tumorType <- sapply(strsplit(colnames(NCI60_4arrays$agilent), split="\\."), "[", 1)
colcode <- as.factor(tumorType)
levels(colcode) <- c("red", "green", "blue", "cyan", "orange",
                     "gray25", "brown", "gray75", "pink")
colcode <- as.character(colcode)



moa <- mbpca(NCI60_4arrays, ncomp = 10, k = "all", method = "globalScore", option = "lambda1",
             center=TRUE, scale=FALSE)
plot(moa, value="eig", type=2)
r <- bootMbpca(moa, mc.cores = 1, B=6, replace = FALSE, resample = "sample")

moas <- mbpca(NCI60_4arrays, ncomp = 3, k = 0.1, method = "globalScore", option = "lambda1",
              center=TRUE, scale=FALSE)


scr <- moaScore(moa)
scrs <- moaScore(moas)
diag(cor(scr[, 1:3], scrs))

layout(matrix(1:2, 1, 2))
plot(scrs[, 1:2], col=colcode, pch=20)
legend("topright", legend = unique(tumorType), col=unique(colcode), pch=20)
plot(scrs[, 2:3], col=colcode, pch=20)

gap <- moGap(moas, K.max = 12, cluster = "hcl")
gap$nClust


hcl <- hclust(dist(scrs))
cls <- cutree(hcl, k=4)
clsColor <- as.factor(cls)
levels(clsColor) <- c("red", "blue", "orange", "pink")
clsColor <- as.character((clsColor))

heatmap(t(scrs[hcl$order, ]), ColSideColors = colcode[hcl$order], Rowv = NA, Colv=NA)
heatmap(t(scrs[hcl$order, ]), ColSideColors = clsColor[hcl$order], Rowv = NA, Colv=NA)

genes <- moaCoef(moas)
genes$nonZeroCoef$agilent.V1.neg
```

---

mgsa-class *Class* "mgsa"

Description

mgsa class here.

Objects from the Class

Objects can be created by calls of the form `new("mgsa", ...)`.

Slots

`call`: call

`moa`: Object of class `moa`

`sup`: Object of class `moa.sup`

Methods

combine `signature(x = "mgsa", y = "mgsa")` To combine two objects of class "mgsa"

This function could only be used to combine two "mgsa" objects, using "Reduce" function to combine more.

show `signature(x = "moa", y = "missing")`: show the "mgsa" result.

Author(s)

Chen Meng

See Also

`moa` and `moa.sup`

Examples

```
showClass("mgsa")
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)
# split gene set annotation into two sets.
sup1 <- lapply(NCI60_4array_supdata, function(x) x[, 1:10])
sup2 <- lapply(NCI60_4array_supdata, function(x) x[, -(1:10)])
# project two sets of annotation
mgsa1 <- mogsa(x = NCI60_4arrays, sup=sup1, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
mgsa2 <- mogsa(x = NCI60_4arrays, sup=sup2, nf=9,
               proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
# combine two indenpendent mgsa sets
mgsa_comb <- combine(mgsa1, mgsa2)
dim(getmgsa(mgsa1, "fac.scr"))
dim(getmgsa(mgsa2, "fac.scr"))
dim(getmgsa(mgsa_comb, "fac.scr"))
```

moa *Multiple omics data analysis using MFA or STATIS*

Description

Analysis multiple omics data using MFA or STATIS. The input multiple tables are in a form that columns are samples and rows are variables/features.

Usage

```
moa(data, proc.row="center_ssq1", w.data="inertia", w.row=NULL, statis=FALSE, moa=TRUE)
```

Arguments

`data`	A list of `data.frame` or `matrix` that contains the input datas, the columns in all datasets should be samples/observations (which need to be matched) and rows should be variables.
`proc.row`	Preprocessing of rows of datasets, should be one of `none` - no preprocessing, `center` - center only, `center_ssq1` - center and scale (sum of squred values equals 1), `center_ssqN` - center and scale (sum of squred values equals the number of columns), `center_ssqNm1` - center and scale (sum of squred values equals the number of columns - 1) MFA corresponds to "proc.row=center_ssq1" and 'w.data="lambda1"'
`w.data`	The weights of each separate dataset, should be one of `uniform` - no weighting, `lambda1` - weighted by the reverse of the first eigenvalue of each individual dataset or `inertia` - weighted by the reverse of the total inertia. See detail.
`w.row`	If it is not null, it should be a list of positive numerical vectors, the length of which should be the same with the number of rows of each dataset to indicated the weight of rows of datasets.
`statis`	A logical indicates whether STATIS method should be used. See details.
`moa`	Logical; whether the output should be converted to an object of class `moa-class`

Details

Different methods employs different precessing of row and datasets. For multipple factorial analysis (MFA), the rows of each dataset are first centered and scaled, then each dataset is weighted by the reverse of its first eigenvalue (proc.row=center_ssq1, w.data="lambda1"). This algorithm does not have a well defined criterion to be optimized (see reference).

If statis=TRUE, the statis algorithm will be used, that is, each dataset will be further weighted so that datasets closer to the overall structure will receive a higher weight.

Value

An object of class `moa-class`.

Author(s)

Chen Meng

References

Herve Abdi, Lynne J. Williams, Domininique Valentin and Mohammed Bennani-Dosse. STATIS and DISTATIS: optimum multitable principal component analysis and three way metric multidimensional scaling. WIREs Comput Stat 2012. Volume 4, Issue 2, pages 124-167 Herve Abdi, Lynne J. Williams, Domininique Valentin. Multiple factor analysis: principal component analysis for multitable and multiblock data sets. WIREs Comput Stat 2013

See Also

`sup.moa`, `mogsa`. More about plot see `moa-class`.

Examples

```
 # library(mogsa)
 # loading data
 data(NCI60_4arrays)
 # run analysis
 ana <- moa(NCI60_4arrays, proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
 # plot
 # plot eigen value
 plot(ana, value = "eig", type = 2)
 # plot the normalized (percentage) eigen value
 plot(ana, value = "tau", type = 2)
 # ploting the observations
colcode <- as.factor(sapply(strsplit(colnames(NCI60_4arrays$agilent), split="\\."), "[", 1))
 plot(ana, type = 1, value = "obs", col=colcode)
 plot(ana, type = 2, value = "obs", col=colcode, data.pch=1:4)
 # plot variables/features in each data sets
 plot(ana, value = "var", layout=matrix(1:4, 2, 2))
 # plot the RV coefficients for the data sets
 plot(ana, value = "RV")

# to extract the components representing significant concordance structures between datasets
bt <- bootMoa(moa = ana, proc.row = "center_ssq1", w.data = "inertia", statis = TRUE, B = 20)
```

---

moa-class *Class* "moa"

Description

moa class object

Objects from the Class

Objects can be created by calls of the form `new("moa", ...)`.

Slots

`eig`: eigen values

`tau`: The percentage of explained variance by each datasets sparately.

`partial.eig`: matrix, rows indicate the partial eigenvalues from each data.

`eig.vec`: a matrix, eigenvectors.

`loading`: the coordinate of variables/features.

`fac.scr`: factor score of observations.

`partial.fs`: partial factor score.

`ctr.obs`: contribution of each observation to the total factor score.

`ctr.var`: contribution of each variables to the total variance.

`ctr.tab`: contribution of each data to the total variance.

`RV`: pairwise RV coefficients

`w.row`: weight of rows

`w.data`: weight of datasets

`data`: the original input data

`tab.dim`: the dimension of each input data

`call`: call

Methods

plot `signature(x = "moa", y = "missing")`: Argument "value" sould be one of "eig", "tau", "obs", "var" and "RV"

if value = "eig", the eigenvalue would be plotted as scree plot. The following arguments could be set:

type=1 - The type of plot to show eigenvalues. (type=1: the eigenvalue are plotted; type=2: partial eigenvalue shown as concatenated bars; type=3: partial eigenvalue shown as bars side by side; type=4: matplot view of eigenvales, lty need to be set; type=5; the two dimensional plot of partial eigenvalues, axes and pch need to be set in this case.)

axes=NULL - The axes selected to plot

n=NULL - Top n eigenvalues to be drawn

tol=1e-5 - The tolerance of eigenvalue, eigenvalues lower than this value will not be shown.

legend=NULL - legend to put, a character string as calling legend function

col=NULL - The color of partial eigenvalues from each data set

lty=1 - The line type used in the matplot, used when type =4

pch=NULL - the pch to draw 2D partial eigen plot, when type = 5 used

lg.x="topright" - The position of legend

lg.y=NULL - Poistion argument passed to function "legend"

... - other arguemnts passed to functions

if value = "tau", the same with eig, but in the eigenvalues are scaled to 1

if value = "obs", the observation space will be shown, the following argument could be set:

axes=1:2 - Which axes should be draw

type=1 - Which type, see below (for type=1: the center points draw; type=2: the separate factor scores linked by lines; ... will be passed to function "points")

data.pch=20 - the pch of dataset, if type=1, the first one is used

col=1 - the color of observations, recycled used by data.frame

label=FALSE - A logical indicates if labels should be shown

lg.x="topright" - Position of legend

lg.y=NULL - Position of legend

xlim=NULL - The x limit

ylim=NULL - The y limit

label.cex=1 - the cex of text

...

var - the separate gene view, layout can be specified

RV - the heatmap of RV coefficients

show `signature(x = "moa", y = "missing")`: show "moa" object

Author(s)

Chen Meng

References

Herve Abdi, Lynne J. Williams, Domininique Valentin and Mohammed Bennani-Dosse. STATIS and DISTATIS: optimum multitable principal component analysis and three way metric multidimensional scaling. WIREs Comput Stat 2012. Volume 4, Issue 2, pages 124-167

Herve Abdi, Lynne J. Williams, Domininique Valentin. Multiple factor analysis: principal component analysis for multitable and multiblock data sets. WIREs Comput Stat 2013

Examples

```
showClass("moa")
# load("R/mogsa/data/NCI60_4arrays.rda")
data(NCI60_4arrays)
ana <- moa(NCI60_4arrays, proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)

plot(ana, value="eig")
plot(ana, value="tau", type=2)
```

`moa.sup-class` *Class* "moa.sup"

Description

moa.sup class desc.

Objects from the Class

Objects can be created by calls of the form `new("moa.sup", ...)`.

Slots

`sup`: Object of class `"list"`, the matrix of supplementary data.

`coord.sep`: The projection of geneset infromation on each separate data.

`coord.comb`: The projection of geneset infromation on total dataset.

`score`: the gene set-sample pathway score

`score.data`: the gene set-sample pathway score, data separate

`score.pc`: the gene set-sample pathway score, PC separate

`score.sep`: the gene set-sample pathway score, separate.

`p.val`: the p value matrix have the same dimension with score matrix.

`p.val.corrected`: the matrix of corrected p values.

Methods

There is no generic function for objects of "moa.sup", but have specific function, including: - decompose.gs.ind - box.gs.feature - plotGS - decompose.gs.group

Author(s)

Chen Meng

See Also

objects to See Also as `decompose.gs.ind`, `box.gs.feature`, `plotGS`, `decompose.gs.group`.

Examples

```
showClass("moa.sup")
data(NCI60_4array_supdata)
data(NCI60_4arrays)

sapply(NCI60_4array_supdata, dim)
ana <- moa(NCI60_4arrays, proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
plot(ana, value="eig")
smoa <- sup.moa(ana, sup=NCI60_4array_supdata, nf=5)
```

---

moaCoef — *Extract the loadings/coefficients from an object of class* `moa-class`.

Description

Extract the loadings/coefficients from an object of class `moa-class`.

Usage

```
moaCoef(moa)
```

Arguments

moa	An object of class moa-class.

Value

It returns a list consist of two components:

coefMat - the loading matrix

nonZeroCoef - it is a list of data.frame to list the non-zero coefficient variable in each of loading vectors and data sets. The element names are in a format as

"xxxx.yy.zzz"

xxxx - are the data names, tells the data set where a varirable is from

yy - the number of Axes, for example, "V1" indicate the variable has a non-zero coefficient in the first loading vector.

zzz - could be either "pos" (coefficient >0) or "neg" (coefficient < 0)

The data.frame has two columns, the first column is the ID of a variable the second column is the coefficient/loading.

Author(s)

Chen Meng

See Also

moaScore

Examples

```
# see examples in \code{\link{mbpca}}

data("NCI60_4arrays")
moa <- mbpca(NCI60_4arrays, ncomp = 10, k = "all", method = "globalScore", option = "lambda1",
             center=TRUE, scale=FALSE)

genes <- moaCoef(moa)
scr <- moaScore(moa)
```

---

moaScore — *Extract global scores from an object of class moa-class.*

Description

Extract global scores from an object of class moa-class.

Usage

```
moaScore(moa)
```

Arguments

moa	An object of class moa-class

Value

A matrix of global score

Author(s)

Chen Meng

See Also

moaCoef

Examples

```
# see examples in \code{\link{mbpca}}

data("NCI60_4arrays")
moa <- mbpca(NCI60_4arrays, ncomp = 10, k = "all", method = "globalScore", option = "lambda1",
             center=TRUE, scale=FALSE)

genes <- moaCoef(moa)
scr <- moaScore(moa)
```

---

moGap — *Gap statistic for clustering latent variables in* moa-class.

Description

Gap statitistic is a measurement of goodness of clustering result. This is a convenient function to calculate the gap statistic of clustering "moa".

Usage

```
moGap(x, K.max, B = 100, cluster = c("kmeans", "hclust"), plot = TRUE,
  dist.method = "euclidean", dist.diag = FALSE, dist.upper = FALSE, dist.p = 2,
  hcl.method = "complete", hcl.members = NULL,
  km.iter.max = 10, km.nstart = 10,
 km.algorithm = c("Hartigan-Wong", "Lloyd", "Forgy", "MacQueen"), km.trace = FALSE)
```

Arguments

x	An object of class moa-class returned by mbpca.
K.max	The maximum number of clusters to consider, passed to clusGap
B	The number of bootstrap, passed to clusGap
cluster	A charater string could be either "kmeans" or "hclust" to specify the clustering algorithm.
plot	Logical; whether return the gap statistic plot.
dist.method	Distance meaurement, passed to function "dist".
dist.diag	Passed to function "dist".
dist.upper	Passed to function "dist".
dist.p	Passed to function "dist".
hcl.method	Hierarchical clustering method, passed to "hclust"
hcl.members	Passed to "hclust"
km.iter.max	Maximum number of iteration in kmeans, passed to "kmeans".
km.nstart	An integer to specify how many random sets should be chosen. passed to "kmeans".
km.algorithm	Kmeans algorithm, passed to "kmeans".
km.trace	See function "kmeans".

Value

It returns a list consists of five components:

"Tab", "n", "B", "FUNcluster" - see clusGap

"nClust" - the estimated number of clusters using different method, see maxSE

Author(s)

Chen Meng

References

Tibshirani, R., Walther, G. and Hastie, T. (2001). Estimating the number of data clusters via the Gap statistic. Journal of the Royal Statistical Society B, 63, 411-423.

Maechler, M., Rousseeuw, P., Struyf, A., Hubert, M., Hornik, K.(2015). cluster: Cluster Analysis Basics and Extensions. R package version 2.0.1.

See Also

Function "clusGap" in "cluster" package Function "dist", "hclust", "kmeans"

Examples

```
# see examples in \code{\link{mbpca}}


data("NCI60_4arrays")
moa <- mbpca(NCI60_4arrays, ncomp = 10, k = "all", method = "globalScore", option = "lambda1",
             center=TRUE, scale=FALSE)
gap <- moGap(moa, K.max = 12, cluster = "hcl")

genes <- moaCoef(moa)
scr <- moaScore(moa)

moa2 <- moa(NCI60_4arrays, proc.row="center_ssq1", w.data="inertia", w.row=NULL, statis=FALSE)
gap2 <- moGap(moa, K.max = 12, cluster = "hcl")
```

`mogsa` *multiple omics data integration and gene set analysis*

Description

The main function called by users, omics data analysis and gene set annotation. A wrapper function of `moa` and `sup.moa`.

Usage

```
mogsa(x, sup, nf=NULL, factors = NULL, proc.row=NULL, w.data=NULL, w.row=NULL, statis=FALSE, ks.stat=
```

Arguments

`x`	An object of class `list` or `moa-class`. A list would be a list of data frame.
`sup`	An object of class `list` or `moa.sup-class`. A list would be a list of supplementary data.
`nf`	The number of principal components used to reconstruct, only used when x is a an object of `list`.
`factors`	The index of principal components used in the projection, used when non-consecutive PC to be included in the analysis.
`proc.row`	Preprocessing of rows. If x is a object of `list`, it is passed `moa`
`w.data`	Weights of datasets. If x is a object of `list`, it is passed `moa`
`w.row`	Weight of row. If x is a object of `list`, it is passed `moa`
`statis`	A logical indicates if statis algrithm should be used. If x is a object of `list`, it is passed `moa`
`ks.stat`	The logical indicates if the p-value should be calculated using K-S statistic (the method used in "ssgsea" in GSVA package). Default is FALSE, which means using the z-score method. See `sup.moa`.

`ks.B` An integer to indicate the number of bootstrapping samples to calculated the p-value of KS statistic.

`ks.cores` An integer indicate the number of cores to be used in bootstrapping. It is passed to function `mclapply` in the `parallel` package.

`p.adjust.method` The method of p value adjustment, passed to `p.adjust` function.

Details

A wrapper function of `moa` and `sup.moa`.

Value

An object of class `mgsa-class`.

Note

This function will be changed to a generic function for "S4-style" programming.

Author(s)

Chen Meng

References

Preprint: Meng, C., Kuster, B., Peters, B., Culhane, AC., Moghaddas Gholami, A., moGSA: integrative single sample gene-set analysis of multiple omics data. doi: http://dx.doi.org/10.1101/046904 Haenzelmann, S., Castelo, R. and Guinney, J. GSVA: Gene set variation analysis for microarray and RNA-Seq data. BMC Bioinformatics, 14:7, 2013. Barbie, D.A. et al. Systematic RNA interference reveals that oncogenic KRAS-driven cancers require TBK1. Nature, 462(5):108-112, 2009.

See Also

`moa` and `sup.moa`

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)

# using a list of data.frame as input
mgsa1 <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
               proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
mgsa1x <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, factors = c(1,3,6),
               proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
# using moa as input
ana <- moa(NCI60_4arrays, proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
smoa <- sup.moa(ana, sup=NCI60_4array_supdata, nf=3)
mgsa2 <- mogsa(x = ana, sup=NCI60_4array_supdata, nf=9)
```

```
mgsa3 <- mogsa(x = ana, sup=smoa)
```

`msvd` *SVD based algorithm to calculate block Score and global scores for* `mbpca`.

Description

An internal function called by `mbpca`. It returns the result comparable with nipalsSoftK, but way faster since it uses the SVD algorithm. No sparse opertors in this function.

Usage

```
msvd(x, svd.sol = svd)
```

Arguments

`x`	The input matrix, rows are observations, columns are variables
`svd.sol`	A function object to specify the preferred SVD solver, default is `svd`.

Value

an `list` object contains the following elements:

`tb` - the block scores

`pb` - the block loadings

`t` - the global scores

`w` - the wegihts of block scores to construct the global scor

Author(s)

Chen Meng

See Also

`nipalsSoftK`

NCI60_4arrays *Microarray gene expression profiles of the NCI 60 cell lines from 4 different platforms*

Description

The 60 human tumour cell lines are derived from patients with leukaemia, melanoma, lung, colon, central nervous system, ovarian, renal, breast and prostate cancers. The cell line panel is widely used in anti-cancer drug screen. In this dataset, a subset of microarray gene expression of the NCI 60 cell lines from four different platforms are combined in a list, which could be used as input to `mcia` directly.

Usage

```
data(NCI60_4arrays)
```

Format

The format is: List of 4 `data.frames`

- \$agilent:`data.frame` containing 300 rows and 60 columns. 300 gene expression log ratio measurements of the NCI60 cell lines, by Agilent platform.
- \$hgu133:`data.frame` containing 298 rows and 60 columns. 298 gene expression log ratio measurements of the NCI60 cell lines, by H-GU133 platform.
- \$hgu133p2:`data.frame` containing 268 rows and 60 columns. 268 gene expression log ratio measurements of the NCI60 cell lines, by H-GU133 plus 2.0 platform.
- \$hgu95:`data.frame` containing 288 rows and 60 columns. 288 gene expression log ratio measurements of the NCI60 cell lines, by H-GU95 platform.

Value

`NCI60_4arrays` will be loaded in your working space.

Source

Cell Miner http://discover.nci.nih.gov/cellminer/

References

Reinhold WC, Sunshine M, Liu H, Varma S, Kohn KW, Morris J, Doroshow J, Pommier Y CellMiner: A Web-Based Suite of Genomic and Pharmacologic Tools to Explore Transcript and Drug Patterns in the NCI-60 Cell Line Set. Cancer Research. 2012 Jul, 15;72(14):3499-511

NCI60_4array_supdata — *supp data for Microarray gene expression profiles of the NCI 60 cell lines from 4 different platforms*

Description

Supplmentary to NCI60_4arrays.

Usage

```
data(NCI60_4arrays)
```

Format

The format is: List of 4 `matrix`

- \$agilent:`matrix` containing 300 rows and 60 columns. 300 gene expression log ratio measurements of the NCI60 cell lines, by Agilent platform.
- \$hgu133:`matrix` containing 298 rows and 60 columns. 298 gene expression log ratio measurements of the NCI60 cell lines, by H-GU133 platform.
- \$hgu133p2:`matrix` containing 268 rows and 60 columns. 268 gene expression log ratio measurements of the NCI60 cell lines, by H-GU133 plus 2.0 platform.
- \$hgu95:`matrix` containing 288 rows and 60 columns. 288 gene expression log ratio measurements of the NCI60 cell lines, by H-GU95 platform.

Value

`NCI60_4array_supdata` will be loaded in your working space.

nipalsSoftK — *NIPALS algorithm with soft thresholding operator*

Description

An internal function called by `mbpca`.

Usage

```
nipalsSoftK(x, maxiter, k)
```

Arguments

`x`	The input matrix, rows are observations, columns are variables
`maxiter`	# of maximum interation the algorithm can run
`k`	The number (>=1) or proportion (<1) of variables want to keep. It could be a single value or a vector has the same length as x so the sparsity of individual matrix could be different.

Value

an `list` object contains the following elements:

`tb` - the block scores

`pb` - the block loadings

`t` - the global scores

`w` - the wegihts of block scores to construct the global score.

Author(s)

Chen Meng

See Also

`msvd`

`pairwise.rv` *pairwise RV coefficients.*

Description

Calculating pairwise RV coefficients for a list of matrices or data.frame.

Usage

```
pairwise.rv(data.list, match="col")
```

Arguments

`data.list`	A list of data.frame or matrix, either rows or columns in each data set should be matched.
`match`	Whether columns or rows of data.frame/matrix should be matched.

Details

The RV coefficient for each pair of matrices is calculated as Rv = trace(XX'YY')/sqrt(trace(XX'XX')*trace(YY'YY'))

Value

The function will return a matrix containing the pairwise RV coefficients.

Note

The variable in matrices are not automatically centered or scaled in this function. So these step may need to be performed before calling this function.

Author(s)

Chen Meng

References

Robert, P.; Escoufier, Y. (1976). A Unifying Tool for Linear Multivariate Statistical Methods: The RV-Coefficient. Applied Statistics 25 (3): 257-265.

Examples

```
data(NCI60_4arrays)
pairwise.rv(NCI60_4arrays)
```

---

plot-methods *Methods for function* `plot`

Description

Methods for function `plot`

Methods

`signature(x = "moa", y = "missing")` plot "moa" object

Argument "value" sould be one of "eig", "tau", "obs", "var" and "RV"\

if value = "eig", the eigenvalue would be plotted as scree plot. The following arguments could be set:\

type=1 - The type of plot to show eigenvalues. (type=1: the eigenvalue are plotted; type=2: partial eigenvalue shown as concatenated bars; type=3: partial eigenvalue shown as bars side by side; type=4: matplot view of eigenvales, lty need to be set; type=5; the two dimensional plot of partial eigenvalues, axes and pch need to be set in this case.) \ axes=NULL - The axes selected to plot \ n=NULL - Top n eigenvalues to be drawn \ tol=1e-5 - The tolerance of eigenvalue, eigenvalues lower than this value will not be shown. \ legend=NULL - legend to put, a character string as calling legend function \ col=NULL - The color of partial eigenvalues from each data set \ lty=1 - The line type used in the matplot, used when type =4 \ pch=NULL - the pch to draw 2D partial eigen plot, when type = 5 used \ lg.x="topright" - The position of legend \ lg.y=NULL - Poistion argument passed to function "legend" \ ... - other arguemnts passed to functions \ \

if value = "tau", the same with eig, but in the eigenvalues are scaled to 1 \

if value = "obs", the observation space will be shown, the following argument could be set:\

axes=1:2 - Which axes should be draw\ type=1 - Which type, see below (for type=1: the center points draw; type=2: the separate factor scores linked by lines; ... will be passed to function "points")\ data.pch=20 - the pch of dataset, if type=1, the first one is used\ col=1 - the color of observations, recycled used by data.frame\ label=FALSE - A logical indicates if labels should be shown\ lg.x="topright" - Position of legend \ lg.y=NULL - Position of legend \ xlim=NULL - The x limit \ ylim=NULL - The y limit \ label.cex=1 - the cex of text \ ... \

var - the separate gene view, layout can be specified \

RV - the heatmap of RV coefficients

plotGS *Plot the gene set space*

Description

Plot the gene set space of objects of "moa" and "mgsa"

Usage

```
plotGS(x, axes=1:2, center.only=FALSE, topN=1, data.pch=20, data.col=1, highlight.col = 2,
        label=NULL, label.cex=1, layout=NULL, ...)
```

Arguments

x	An object of class mgsa-class or moa.sup-class
axes	An integer vector in the length 2 to indicate the axes to be drawn.
center.only	A logical to indicate whether the separate gene set spaces from each of the data set should be plotted. Default is FALSE.
topN	An integer specify N gene set from the most positive and negative end of axes to be labeled
data.pch	The shape for plotting each data set. This argument is passed to points function, so only used when separate gene set spaces are plotted (i.e. center.only = FALSE).
data.col	The col for plotting each data set. This argument is passed to points function, so only used when separate gene set spaces are plotted (i.e. center.only = FALSE).
highlight.col	The color used to highlight the selected gene sets
label	Either a character vector or NULL (default). The character vector should be the name of some gene sets want ot be labeled.
label.cex	Passed to text function to adjust the the labels
layout	A matrix passed to the layout function.
...	Other arguments passed to points

Details

This is a convenience function to explore the gene set space so not very flexible. For customized plot, please use the object of data@coord.comb and data@coord.sep.

Value

If assign to variable, A list of selected/highlighted gene set at the (positve and negative) end of each axis will be returned.

Author(s)

Chen Meng

Examples

```
# library(mogsa)
# loading gene expression data and supplementary data
data(NCI60_4array_supdata)
data(NCI60_4arrays)
mgsa <- mogsa(x = NCI60_4arrays, sup=NCI60_4array_supdata, nf=9,
              proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)

plotGS(mgsa, center.only = TRUE, topN=5)
res <- plotGS(mgsa, center.only = FALSE, data.pch=1:4, data.col=1:4)
res
```

`prepGraphite` *Prepare pathway gene sets from graphite package*

Description

Prepare pathway gene sets from "graphite" package, which could be passed to "prepSupMoa" function.

Usage

```
prepGraphite(db, id = c("entrez", "symbol"))
```

Arguments

db	The database to be used, an object of class either 'PathwayList' create by "pathways" function.
id	Which identifier for output, either "entrez" or "symbol".

Details

Only support "entrez" or "symbol" output currently.

Value

This function returns an object of list containing gene set information, which could be further processed by function "prepSupMoa" to convert to the object that can be used as input of "sup.moa" or "mogsa".

Author(s)

Chen Meng

References

Sales G, Calura E and Romualdi C (2014). graphite: GRAPH Interaction from pathway Topological Environment. R package version 1.10.1.

See Also

See Also as prepMsigDB and prepSupMoa.

Examples

```
library(graphite)
keggdb <- prepGraphite(db = pathways("hsapiens", "kegg")[1:3], id = "entrez")
```

---

prepMsigDB *Conver gmt format file to a list*

Description

Convert a gmt file (Could be downloaded from MSigDB) to a list of gene sets information.

Usage

```
prepMsigDB(file)
```

Arguments

file	The directory and file name of the gmt file.

Value

This function returns an object of list containing gene set information, which could be further processed by function "prepSupMoa" to convert to the object that can be used as input of "sup.moa" or "mogsa".

Author(s)

Chen Meng

See Also

See Also as prepGraphite and prepSupMoa.

Examples

```
# not run
dir <- system.file(package = "mogsa")
preGS <- prepMsigDB(file=paste(dir,
"/extdata/example_msigdb_data.gmt.gz", sep = ""))
```

prepSupMoa *Prepare sumpplementary tables for projection by sup.moa or mogsa.*

Description

Convert a list of gene set information to a set of sumpplementary tables that can be used as input of function "sup.moa" or "mogsa".

Usage

```
prepSupMoa(X, geneSets, minMatch = 10, maxMatch = 500)
```

Arguments

X	A matrix/data.frame or a list of matrix/data.frame or a list of character vector. If it is a list of matrix/data.frame, row names of matrix/data.frame will be used to create the projection matrix. Otherwise the charater vectors will used to create the supplementary matirx.
geneSets	Gene sets list or an object of class "GeneSet" or "GeneSetCollection". A gene set list could be returned by prepGraphite or prepMolsigDB.
minMatch	The minimum match of geneset.
maxMatch	The maximum match genesets.

Details

Details here

Value

A list of matrix could used as supplementary tables by "sup.moa" or "mogsa".

Author(s)

Chen Meng

See Also

See Also as prepGraphite and prepMsigDB.

Examples

```
library(graphite)
data(NCI60_4arrays)
kegg <- pathways(species = "hsapiens", "kegg")
pw <- c("Purine metabolism", "MAPK signaling pathway")
gss <- prepGraphite(db = kegg[pw], id="symbol")
gss <- lapply(gss, function(x) sub("SYMBOL:", "", x))
sup_data1 <- prepSupMoa(NCI60_4arrays, geneSets=gss)
```

```
gene_list <- lapply(NCI60_4arrays, rownames)
sup_data2 <- prepSupMoa(gene_list, geneSets=gss)
```

`print-methods` *Methods for function* `print`

Description

Methods for function `print`

Methods

`signature(object = "moa")` print "moa" class

`signature(object = "moa.sup")` print "sup.moa" class

`signature(object = "mgsa")` print "mgsa" class

`processOpt` *preprocessing of input data in* `mbpca`.

Description

An internal function called by `mbpca`.

Usage

```
processOpt(x, center = TRUE, scale = FALSE, option = c("lambda1", "inertia", "uniform"))
```

Arguments

`x`	A list of matrices, rows are observations and columns are variables
`center`	A logical variable indicates whether columns should be centered
`scale`	A logical variable indicates whether columns should be scaled
`option`	A charater string could be one of c("lambda1", "inertia", "uniform") to indicate how the different matrices should be normalized. If "lambda1", the matrix is divided by its the first singular value, if "inertia", the matrix is divided by its total inertia (sum of square), if "uniform", none of them would be done.

Value

A `list` of normalized matrix.

Author(s)

Chen Meng

show-methods *Methods for function* show

Description

Methods for function show

Methods

signature(object = "moa") show "moa" class

signature(object = "moa.sup") show "sup.moa" class

signature(object = "mgsa") show "mgsa" class

softK *Soft-thresholding operator*

Description

Weighted soft-thresholding operator, which is called by mbpca.

Usage

```
softK(x, k, w = 1, pos = FALSE)
```

Arguments

x	A numerical vector
k	Number of non-zero elements want to keep
w	weight for each element. The actual thresholding is base on x*w, the default setting equals to ordinary soft thresholding.
pos	A logical value, if only positive values are retained.

Value

A thresholded numerical vector

Author(s)

Chen Meng

Examples

```
v <- rnorm(10)
softK(v, k = 2)
```

summary-methods *Methods for function* summary

Description

Methods for function summary

Methods

signature(object = "moa") summary "moa" class

signature(object = "moa.sup") summary "sup.moa" class

signature(object = "mgsa") summary "mgsa" class

sup.moa *Projecting supplementary tables on object of class* moa-class.

Description

Projecting supplementary tables on moa-class

Usage

```
sup.moa(X, sup, nf = 2, factors = NULL, ks.stat=FALSE, ks.B = 1000, ks.cores = NULL, p.adjust.method =
```

Arguments

X	An object of class moa-class
sup	A list of data.frames contains supplementary data.
nf	The number of principal components used in the projection.
factors	The index of principal components used in the projection, used when non-consecutive PC to be included in the analysis.
ks.stat	The logical indicates if the p-value should be calculated using K-S statistic (the method used in "ssgsea" in GSVA package). Default is FALSE, which means using the z-score method.
ks.B	An integer to indicate the number of bootstrapping samples to calculated the p-value of KS statistic.
ks.cores	An integer indicate the number of cores to be used in bootstrapping. It is passed to function mclapply in the parallel package.
p.adjust.method	The method of p value adjustment, passed to p.adjust function.

Details

Projecting supplementary tables on moa-class, for details see reference.

Value

An object of class moa.sup-class.

Author(s)

Chen Meng

References

Herve Abdi, Lynne J. Williams, Domininique Valentin and Mohammed Bennani-Dosse. STATIS and DISTATIS: optimum multitable principal component analysis and three way metric multidimensional scaling. WIREs Comput Stat 2012. Volume 4, Issue 2, pages 124-167 Haenzelmann, S., Castelo, R. and Guinney, J. GSVA: Gene set variation analysis for microarray and RNA-Seq data. BMC Bioinformatics, 14:7, 2013. Barbie, D.A. et al. Systematic RNA interference reveals that oncogenic KRAS-driven cancers require TBK1. Nature, 462(5):108-112, 2009.

Examples

```
 # library(mogsa)
 # loading gene expression data and supplementary data
 data(NCI60_4array_supdata)
 data(NCI60_4arrays)
# check the dimension of each supplementary data to see how many gene set annotated the data
 sapply(NCI60_4array_supdata, dim)
 # run analysis
ana <- moa(NCI60_4arrays, proc.row = "center_ssq1", w.data = "inertia", statis = TRUE)
 plot(ana, value="eig")
 # projectin supplementary data
 smoa <- sup.moa(ana, sup=NCI60_4array_supdata, nf=3)
 # heatmap visualize the gene set scores
 heatmap(slot(smoa, "score"))
```

---

toMoa — *convert* mbpca *result to* moa-class

Description

An internal function called by mbpca.

Usage

```
toMoa(data, x, call)
```

Arguments

data	The preprocessed data in mbpca
x	The object calculated in mbpca
call	The call of mbpca

Value

An object of `moa-class`.

Author(s)

Chen Meng

`wsvd` *Weighted singular value decomposition (SVD)*

Description

The weighted version of singular value decomposition.

Usage

```
wsvd(X, D1 = diag(1, nrow(X)), D2 = diag(1, ncol(X)))
```

Arguments

`X`	A numeric matrix whose wSVD decomposition is to be computed.
`D1`	A square matrix or vector. The left constraint/weight matrix (symmetric and positive in diagonal). The dimension of D1 should be the same with the number of rows in X. A vector input will be converted to a diagnal matrix.
`D2`	A square matrix or vector. The right constraint/weight matrix (symmetric, positive in diagonal). The dimension of D1 should be the same with the number of columns in X. A vector input will be converted to a diagnal matrix.

Details

The weighted version of generalized singular value decomposition (SVD) of matrix A = UDV' with the constraints U'D1U = I and V'D2V = I D1 and D2 are two matrices express constraints imposed on the rows and the columns of matrix A.

Value

d - singular values

u - left singular vectors

v - right singular vectors

D1 - the left weight matrix (directly from input)

D2 - the right weight matrix (directly from input)

Author(s)

Chen Meng

References

Herve Abdi. Singular Value Decomposition (SVD) and Generalized Singular Value Decomposition (GSVD) http://www.utdallas.edu/~herve/Abdi-SVD2007-pretty.pdf

See Also

svd

Examples

```
set.seed(56)
m <- matrix(rnorm(15), 5, 3)
wl <- rnorm(5)
wr <- runif(3)
s <- wsvd(X=m, D1=wl, D2=wr)
# t(s$u) %*% diag(wl) %*% s$u
# t(s$v) %*% diag(wr) %*% s$v
# all.equal(m, as.matrix(s$u) %*% diag(s$d) %*% t(s$v))
```

Index

∗ **CPCA**
mbpca, 20
∗ **GCCA**
mbpca, 20
∗ **MCIA**
mbpca, 20
∗ **MFA**
moa, 24
∗ **MVA**
moa, 24
mogsa, 32
∗ **Microarray**
NCI60_4array_supdata, 36
NCI60_4arrays, 35
∗ **NCI-60**
NCI60_4array_supdata, 36
NCI60_4arrays, 35
∗ **PCA**
moa, 24
∗ **RV coefficent**
pairwise.rv, 37
∗ **STATIS**
moa, 24
∗ **SVD**
wsvd, 47
∗ **classes**
mgsa-class, 22
moa-class, 25
moa.sup-class, 27
∗ **combine**
combine-methods, 11
∗ **data projection**
sup.moa, 45
∗ **datasets**
NCI60_4array_supdata, 36
NCI60_4arrays, 35
∗ **gap statistic**
moGap, 30
∗ **generalized SVD**
wsvd, 47
∗ **graphite**
prepGraphite, 40
∗ **methods**
plot-methods, 38
print-methods, 43
show-methods, 44
summary-methods, 45
∗ **mgsa-class**
combine-methods, 11
print-methods, 43
show-methods, 44
summary-methods, 45
∗ **moa-class**
plot-methods, 38
print-methods, 43
show-methods, 44
summary-methods, 45
∗ **moa**
moGap, 30
∗ **mogsa**
combine-methods, 11
∗ **multi-blcok PCA**
mbpca, 20
∗ **pahtways**
prepGraphite, 40
∗ **soft thresholding**
softK, 44
∗ **soft threshold**
softK, 44
∗ **sup.moa-class**
print-methods, 43
show-methods, 44
summary-methods, 45
∗ **supplementary data projection**
mogsa, 32
∗ **supplementary data**
sup.moa, 45
∗ **weighted SVD**

wsvd, 47
∗ **weighted soft thresholding**
softK, 44
∗ **weighted soft threshold**
softK, 44

annotate.gs, 4, *18*

biSoftK, 5
bootMbpca, 6, *7, 8*
bootMbpcaK, 7
bootMoa, 8
box.gs.feature, 9, *28*
boxplot, *10*

combine *(*combine-methods*)*, 11
combine,mgsa,mgsa-method *(*combine-methods*)*, 11
combine-methods, 11

decompose.gs.group, 12, *14*, *28*
decompose.gs.ind, *13*, 13, *28*
deflat, 14
distMoa, 15

getmgsa, 16
GIS, *4*, 17

matpower, 19
mbpca, *5–7*, *14*, 20, *31*, *34*, *36*, *43, 44*, *46*
mgsa-class, 22
moa, *6*, *8–10*, *21*, *23*, 24, *32, 33*
moa-class, *15*, 25, *28–30*, *46*
moa.sup, *23*
moa.sup-class, 27
moaCoef, 28, *30*
moaScore, *29*, 29
moGap, 30
mogsa, *9*, *25*, 32
mogsa-package, 3
msvd, *6*, *15*, 34, *37*

NCI60_4array_supdata, 36
NCI60_4arrays, 35
nipalsSoftK, *15*, *34*, 36

pairwise.rv, 37
plot,moa,missing-method *(*moa-class*)*, 25
plot-methods, 38
plotGS, *28*, 39
points, *39*
prepGraphite, 40, *41, 42*
prepMsigDB, *41*, 41, *42*
prepSupMoa, *41*, 42
print *(*print-methods*)*, 43
print,mgsa-method *(*print-methods*)*, 43
print,moa-method *(*print-methods*)*, 43
print,moa.sup-method *(*print-methods*)*, 43
print-methods, 43
processOpt, 43

show *(*show-methods*)*, 44
show,mgsa-method *(*show-methods*)*, 44
show,moa-method *(*show-methods*)*, 44
show,moa.sup-method *(*show-methods*)*, 44
show-methods, 44
slot, *16*
softK, 44
summary *(*summary-methods*)*, 45
summary,mgsa-method *(*summary-methods*)*, 45
summary,moa-method *(*summary-methods*)*, 45
summary,moa.sup-method *(*summary-methods*)*, 45
summary-methods, 45
sup.moa, *9*, *25*, *32, 33*, 45

text, *39*
toMoa, 46

wsvd, *19*, 47