

Package ‘nipalsMCIA’

September 12, 2024

Title Multiple Co-Inertia Analysis via the NIPALS Method

Version 1.2.1

Description Computes Multiple Co-Inertia Analysis (MCIA), a dimensionality reduction (jDR) algorithm, for a multi-block dataset using a modification to the Nonlinear Iterative Partial Least Squares method (NIPALS) proposed in (Hanafi et. al, 2010). Allows multiple options for row- and table-level preprocessing, and speeds up computation of variance explained. Vignettes detail application to bulk- and single cell- multi-omics studies.

License GPL-3

URL <https://github.com/Muunraker/nipalsMCIA>

BugReports <https://github.com/Muunraker/nipalsMCIA/issues>

Depends R (>= 4.3.0)

Imports ComplexHeatmap, dplyr, fgsea, ggplot2 (>= 3.0.0), graphics, grid, methods, MultiAssayExperiment, SummarizedExperiment, pracma, rlang, RSpectra, scales, stats

Suggests BiocFileCache, BiocStyle, circlize, ggpubr, KernSmooth, knitr, piggyback, reshape2, rmarkdown, rpart, Seurat (>= 4.0.0), spatstat.explore, stringr, survival, tidyverse, testthat (>= 3.0.0)

VignetteBuilder knitr

biocViews Software, Clustering, Classification, MultipleComparison, Normalization, Preprocessing, SingleCell

Encoding UTF-8

RoxygenNote 7.3.1

Config/testthat/edition 3

git_url <https://git.bioconductor.org/packages/nipalsMCIA>

git_branch RELEASE_3_19

git_last_commit 45a40f6

git_last_commit_date 2024-08-31

Repository Bioconductor 3.19

Date/Publication 2024-09-11

Author Maximilian Mattessich [cre] (<<https://orcid.org/0000-0002-1233-1240>>),
 Joaquin Reyna [aut] (<<https://orcid.org/0000-0002-8468-2840>>),
 Edel Aron [aut] (<<https://orcid.org/0000-0002-8683-4772>>),
 Ferhat Ay [aut] (<<https://orcid.org/0000-0002-0708-6914>>),
 Steven Kleinstein [aut] (<<https://orcid.org/0000-0003-4957-1544>>),
 Anna Konstorum [aut] (<<https://orcid.org/0000-0003-4024-2058>>)

Maintainer Maximilian Mattessich <maximilian.mattessich@northwestern.edu>

Contents

nipalsMCIA-package	3
block_preproc	3
block_weights_heatmap	4
cc_preproc	5
col_preproc	6
data_blocks	7
deflate_block_bl	7
deflate_block_gs	8
extract_from_mae	9
get_colors	9
get_metadata_colors	10
get_tv	11
global_scores_eigenvalues_plot	11
global_scores_heatmap	12
gsea_report	13
metadata_NCI60	13
NipalsResult-class	14
nipals_iter	14
nipals_multiblock	15
nmb_get_bl	17
nmb_get_bs	18
nmb_get_bs_weights	18
nmb_get_eigs	19
nmb_get_gl	19
nmb_get_gs	20
nmb_get_metadata	21
ord_loadings	21
predict_gs	22
projection_plot	23
simple_mae	24
vis_load_ord	25
vis_load_plot	26

Index

27

Description

Computes Multiple Co-Inertia Analysis (MCIA), a dimensionality reduction (jDR) algorithm, for a multi-block dataset using a modification to the Nonlinear Iterative Partial Least Squares method (NIPALS) proposed in (Hanafi et. al, 2010). Allows multiple options for row- and table-level preprocessing, and speeds up computation of variance explained. Vignettes detail application to bulk- and single cell- multi-omics studies.

Author(s)

Maintainer: Maximilian Mattessich <maximilian.mattessich@northwestern.edu> ([ORCID](#))

Authors:

- Joaquin Reyna <joreyna@live.com> ([ORCID](#))
- Edel Aron <edel.aron@yale.edu> ([ORCID](#))
- Anna Konstorum <konstorum.anna@gmail.com> ([ORCID](#))

See Also

Useful links:

- <https://github.com/Muunraker/nipalsMCIA>
- Report bugs at <https://github.com/Muunraker/nipalsMCIA/issues>

Description

A function that normalizes an input dataset (data block) according to a variety of options. Intended to be used after column/row-level normalization.

Usage

```
block_preproc(df, block_preproc_method)
```

Arguments

- `df` dataset to preprocess (must be in data matrix form)
- `block_preproc_method` method which is used to normalize blocks, with options:
- ‘unit_var’ FOR CENTERED MATRICES ONLY - divides each block by the square root of its variance
 - ‘num_cols’ divides each block by the number of variables in the block.
 - ‘largest_sv’ divides each block by its largest singular value.
 - ‘none’ performs no preprocessing

Value

the preprocessed dataset

Examples

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
preprocessed_dataframe <- block_preproc(df, "unit_var")
```

block_weights_heatmap *block_weights_heatmap*

Description

Function to plot heatmap of block score weights

Usage

```
block_weights_heatmap(mcia_results)
```

Arguments

`mcia_results` MCIA results object returned from ‘nipals_multiblock’

Details

Plotting function for heatmap of block score weights

Value

heatmap object containing the block weights as a heatmap

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                 plots = "none", tol = 1e-12)
block_weights_heatmap(mcia_results)
```

cc_preproc

Centered Column Profile Pre-processing

Description

Converts data blocks into centered column profiles where each block has unit variance. Mimics the pre-processing in the Omicade4 package (Meng et al. 2014)

Usage

```
cc_preproc(df)
```

Arguments

df the data frame to apply pre-processing to, in "sample" x "variable" format

Details

Performs the following steps on a given data frame:

- Offsets data to make whole matrix non-negative
- Divides each column by its sum
- Subtracts (row sum/total sum) from each row
- Multiplies each column by $\sqrt{\text{column sum/total sum}}$
- Divides the whole data frame by its total variance (the sqrt of the sum of singular values)

Value

the processed data frame

Examples

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
preprocessed_dataframe <- cc_preproc(df)
```

`col_preproc`*Centered Column Profile Pre-processing*

Description

Converts data blocks into centered column profiles where each block has unit variance. Mimics the pre-processing in the Omicade4 package (Meng et al. 2014)

Usage

```
col_preproc(df, col_preproc_method)
```

Arguments

`df` the data frame to apply pre-processing to, in "sample" x "variable" format

`col_preproc_method`

denotes the type of column-centered preprocessing. Options are:

- 'colprofile' Performs the following steps on a given data frame:
 - Offsets data to make whole matrix non-negative
 - Divides each column by its sum
 - Subtracts (row sum/total sum) from each row
 - Multiplies each column by $\sqrt{\text{column sum/total sum}}$
- 'standardized' centers each column and divides by its standard deviation.
- 'centered_only' ONLY centers data

Details

Performs preprocessing on a sample/variable (row/column) level according to the parameter given.

Value

the processed data frame

Examples

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
preprocessed_dataframe <- col_preproc(df, col_preproc_method = 'colprofile')
```

`data_blocks`*NCI-60 Multi-Omics Data*

Description

A dataset of measurements of 12,895 mRNA, 537 miRNA, and 7,016 protein variables (columns) on 21 cancer cell lines (rows) from the NCI-60 cancer cell line database.

Value

Large list with 3 elements (one for each omic)

Source

Meng et. al, 2016 supplementary materials <https://doi.org/10.1093/bib/bbv108>

References

<https://github.com/aedin/NCI60Example>

`deflate_block_bl`*Deflation via block loadings*

Description

Removes data from a data frame in the direction of a given block loadings vector.

Usage

```
deflate_block_bl(df, bl)
```

Arguments

`df` a data frame in "sample" x "variable" format

`bl` a block loadings vector in variable space

Details

Subtracts the component of each row in the direction of a given block loadings vector to yield a 'deflated' data matrix.

Value

the deflated data frame

Examples

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
block_loading <- rbinom(3, 1, prob = 0.3)
deflated_data <- deflate_block_bl(df, block_loading)
```

deflate_block_gs *Deflation via global scores*

Description

Removes data from a data frame in the direction of a given global scores vector.

Usage

```
deflate_block_gs(df, gs)
```

Arguments

df a data frame in "sample" x "variable" format
gs a global scores vector in sample space

Details

Subtracts the component of each column in the direction of a given global scores vector to yield a 'deflated' data matrix.

Value

the deflated data frame

Examples

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
global_score <- rbinom(5, 1, prob = 0.3)
deflated_data <- deflate_block_gs(df, global_score)
```

extract_from_mae	<i>Extract a list of harmonized data matrices from an MAE object</i>
------------------	--

Description

Extract a list of harmonized data matrices for input into `nipals_multiblock()` from an MAE object

Usage

```
extract_from_mae(MAE_object, subset_data = "all")
```

Arguments

MAE_object	an MAE object containing experiment data for extraction <code>colData</code> field optional experiments should either be <code>SummarizedExperiment</code> , <code>SingleCellExperiment</code> , or <code>RangedSummarizedExperiment</code> classes
subset_data	<ul style="list-style-type: none">• 'all' use all experiments in MAE object• 'c(omic1,omic2,...)' list of omics from <code>names(MAE_object)</code>

Value

List of harmonized data matrices for input into `nipals_multiblock()`

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
NCI60_input = extract_from_mae(data_blocks_mae,subset='all')
```

get_colors	<i>Assigning colors to different omics</i>
------------	--

Description

Creates a list of omics and associated colors for plotting. The default palette was chosen to be color-blindness friendly.

Usage

```
get_colors(
  mcia_results,
  color_pal = scales::viridis_pal,
  color_pal_params = list()
)
```

Arguments

`mcia_results` object returned from `nipals_multiblock()` function
`color_pal` a function which returns color palettes (e.g. scales)
`color_pal_params`
 list of parameters for the corresponding function

Value

List of omics with assigned colors

Examples

```

data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                 plots = "none", tol = 1e-12)
colors_omics <- get_colors(mcia_results)
  
```

`get_metadata_colors` *Assigning colors to different values of a metadata column*

Description

Creates a list of metadata columns and associated colors for plotting. The default palette was chosen to be color-blindness friendly.

Usage

```

get_metadata_colors(
  mcia_results,
  color_col,
  color_pal = scales::viridis_pal,
  color_pal_params = list()
)
  
```

Arguments

`mcia_results` object returned from `nipals_multiblock()` function
`color_col` an integer or string specifying the column that will be used for `color_col`
`color_pal` a function which returns color palettes (e.g. scales)
`color_pal_params`
 list of parameters for the corresponding function

Value

List of metadata columns with assigned colors

Examples

```

data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                              colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                 plots = "none", tol = 1e-12)
colors_omics <- get_metadata_colors(mcia_results, "cancerType",
                                   color_pal_params = list(option = "E"))

```

get_tv

Computes the total variance of a multi-omics dataset

Description

Computes the total variances of all data blocks in a multi-omics dataset, intended for datasets that do not use ‘CCpreproc’

Usage

```
get_tv(ds)
```

Arguments

ds a list of multi-omics dataframes/matrices in "sample x variable" format

Value

the total variance of the dataset (i.e. sum of block variances)

Examples

```

data(NCI60)
tot_var <- get_tv(data_blocks)

```

global_scores_eigenvalues_plot

global_scores_eigenvalues_plot

Description

Function to plot eigenvalues of scores up to num_PCs

Usage

```
global_scores_eigenvalues_plot(mcia_results)
```

Arguments

`mcia_results` MCI A results object returned from ‘`nipals_multiblock`’

Details

Plotting function for eigenvalues of scores up to `num_PCs`

Value

Displays the contribution plot using eigenvalues

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                              colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                 plots = "none", tol=1e-12)
global_scores_eigenvalues_plot(mcia_results)
```

`global_scores_heatmap` *Plotting a heatmap of global factors scores (sample v. factors)*

Description

Plots a heatmap of MCI A global scores

Usage

```
global_scores_heatmap(
  mcia_results,
  color_col = NULL,
  color_pal = scales::viridis_pal,
  color_pal_params = list(option = "D")
)
```

Arguments

`mcia_results` the `mcia` object matrix after running MCI A, must also contain metadata with columns corresponding to `color_col`

`color_col` an integer or string specifying the column that will be used for `color_col`

`color_pal` a list of colors or function which returns a list of colors

`color_pal_params` a list of parameters for the color function

Value

ComplexHeatmap object

gsea_report	<i>Perform biological annotation-based comparison</i>
-------------	---

Description

Runs fgsea for the input gene vector

Usage

```
gsea_report(
  metagenes,
  path.database,
  factors = NULL,
  pval.thr = 0.05,
  nproc = 4
)
```

Arguments

metagenes	Vector of gene scores where the row names are HUGO symbols
path.database	path to a GMT annotation file
factors	vector of factors which should be analyzed
pval.thr	p-value threshold (default to 0.05)
nproc	number of processors to utilize

Value

data frame with the most significant p-value number of significant pathways
the selectivity scores across the given factors

metadata_NCI60	<i>NCI-60 Multi-Omics Metadata</i>
----------------	------------------------------------

Description

Metadata for the included multi-omics dataset, denoting the cancer type associated with each of the 21 cell lines.

Value

List with 21 elements

Source

Meng et. al, 2016 supplementary materials <https://doi.org/10.1093/bib/bbv108>

References

<https://github.com/aedin/NCI60Example>

NipalsResult-class *An S4 class to contain results computed with 'nipals_multiblock()'*

Description

An S4 class to contain results computed with 'nipals_multiblock()'

Value

A NipalsResult object.

Slots

global_scores A matrix containing global scores as columns.

global_loadings A matrix containing global loadings as columns.

block_score_weights A matrix containing block weights as columns.

block_scores A list of matrices. Each matrix contains the scores as columns for a given block.

block_loadings A list of matrices. Each matrix contains the loadings as columns for a given block.

eigvals A list of singular values of the data matrix at each deflation step.

col_preproc_method character for the column-level preprocessing method used. See 'col_preproc()'

block_preproc_method character for the block-level preprocessing method used. See 'block_preproc()'

block_variances A list of variances for each block.

metadata A data frame of metadata originally passed into 'nipals_multiblock()'

nipals_iter *NIPALS Iteration*

Description

Applies one iteration stage/loop of the NIPALS algorithm.

Usage

```
nipals_iter(ds, tol = 1e-12, maxIter = 1000)
```

Arguments

ds a list of data matrices, each in "sample" x "variable" format

tol a number for the tolerance on the stopping criterion for NIPALS

maxIter a number for the maximum number of times NIPALS should iterate

Details

Follows the NIPALS algorithm as described by Hanafi et. al. (2010). Starts with a random vector in sample space and repeatedly projects it onto the variable vectors and block scores to generate block and global loadings/scores/weights. The loop stops when either the stopping criterion is low enough, or the maximum number of iterations is reached. Intended as a utility function for 'nipals_multiblock' to be used between deflation steps.

Value

a list containing the global/block scores, loadings and weights for a given order

Examples

```
data(NCI60)
data_blocks <- lapply(data_blocks, as.matrix)
nipals_results <- nipals_iter(data_blocks, tol = 1e-7, maxIter = 1000)
```

nipals_multiblock	<i>Main NIPALS computation loop</i>
-------------------	-------------------------------------

Description

Applies the full adjusted NIPALS algorithm to generate block and global scores/loadings with the desired deflation method.

Usage

```
nipals_multiblock(
  data_blocks_mae,
  col_preproc_method = "colprofile",
  block_preproc_method = "unit_var",
  num_PCs = 10,
  tol = 1e-09,
  max_iter = 1000,
  color_col = NULL,
  deflationMethod = "block",
  plots = "all"
)
```

Arguments

`data_blocks_mae`
a MultiAssayExperiment class object (with sample metadata as a dataframe in the colData attribute).

`col_preproc_method`
an option for the desired column-level data pre-processing, either:

- 'colprofile' applies column-centering, row and column weighting by contribution to variance.
- 'standardized' centers each column and divides by its standard deviation.
- 'centered_only' ONLY centers data

block_preproc_method

an option for the desired block-level data pre-processing, either:

- 'unit_var' FOR CENTERED MATRICES ONLY - divides each block by the square root of its variance
- 'num_cols' divides each block by the number of variables in the block.
- 'largest_sv' divides each block by its largest singular value.
- 'none' performs no preprocessing

num_PCs

the maximum order of scores/loadings

tol

a number for the tolerance on the stopping criterion for NIPALS

max_iter

a number for the maximum number of times NIPALS should iterate

color_col

Optional argument with the column name of the 'metadata' data frame used to define plotting colors

deflationMethod

an option for the desired deflation method, either:

- 'block' deflation via block loadings (for MCIA, default)
- 'global' deflation via global scores (for CPCA)

plots

an option to display various plots of results:

- 'all' displays plots of block scores, global scores, and eigenvalue scree plot
- 'global' displays only global score projections and eigenvalue scree plot
- 'none' does not display plots

Details

Follows the NIPALS algorithm as described by Hanafi et. al. (2010). For each order of scores/loadings, the vectors are computed via the 'nipals_iter' function, then used to deflate the data matrix according to the desired deflation method. This process is repeated up to the desired maximum order of scores/loadings.

Value

a 'nipalsResult' object with the following fields:

- 'global_scores' a matrix containing global scores as columns (NOT normalized to unit variance)
- 'global_loadings' a matrix containing global loadings as columns
- 'global_score_weights' a matrix of weights to express global scores as a combination of block scores. Has dimensions "num_Blocks" by "num_PCs"
- 'eigvals' a matrix containing the eigenvalue for each computed global score.
- 'block scores' a list of matrices, each contains the scores for one block
- 'block loadings' a list of matrices, each contains the loadings for one block (w/ unit length)

- ‘block score weights’ a matrix containing weights for each block score of each order used to construct the global scores.
- ‘col_preproc_method’ the column preprocessing method used on the data.
- ‘block_variances’ a list of variances of each block AFTER NORMALIZATION OPTION APPLIED
- ‘metadata’ the metadata dataframe supplied with the ‘metadata’ argument. Note: overrides metadata present in any MAE class object.

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                              colData=metadata_NCI60)
NIPALS_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                   tol = 1e-12, max_iter = 1000,
                                   col_preproc_method = "colprofile",
                                   deflationMethod = "block")
MCIA_results <- nipals_multiblock(data_blocks_mae, num_PCs = 4)
CPCA_results <- nipals_multiblock(data_blocks_mae, num_PCs = 4,
                                   deflationMethod = 'global')
```

nmb_get_bl

Accessor function for block loadings

Description

Retrieves the block loadings as a list of matrices from a ‘NipalsResult’ object, typically output from ‘nipals_multiblock()’.

Usage

```
nmb_get_bl(nmb_object)
```

Arguments

nmb_object A ‘NipalsResult’ object.

Value

a list of matrices containing block loadings.

Examples

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                              colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
block_loadings<- nmb_get_bl(mcia_out)
```

nmb_get_bs *Accessor function for block scores*

Description

Retrieves the block scores as a list of matrices from a ‘NipalsResult’ object, typically output from ‘nipals_multiblock()’.

Usage

```
nmb_get_bs(nmb_object)
```

Arguments

nmb_object A ‘NipalsResult’ object.

Value

a list of matrices containing block scores.

Examples

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
block_scores <- nmb_get_bs(mcia_out)
```

nmb_get_bs_weights *Accessor function for block score weights*

Description

Retrieves the block score weights from a ‘NipalsResult’ object, typically output from ‘nipals_multiblock()’.

Usage

```
nmb_get_bs_weights(nmb_object)
```

Arguments

nmb_object A ‘NipalsResult’ object.

Value

a matrix containing the block score weights.

Examples

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
block_score_weights <- nmb_get_bs_weights(mcia_out)
```

nmb_get_eigs *Accessor function for eigenvalues*

Description

Retrieves the eigenvalues from a ‘NipalsResult’ object, typically output from ‘nipals_multiblock()’.

Usage

```
nmb_get_eigs(nmb_object)
```

Arguments

nmb_object A ‘NipalsResult’ object.

Value

a matrix containing the eigenvalues for all global scores.

Examples

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
nipals_eigvals <- nmb_get_eigs(mcia_out)
```

nmb_get_gl *Accessor function for global loadings*

Description

Retrieves the global loadings as a matrix from a ‘NipalsResult’ object, typically output from ‘nipals_multiblock()’.

Usage

```
nmb_get_gl(nmb_object)
```

Arguments

nmb_object A 'NipalsResult' object.

Value

a matrix containing global loadings.

Examples

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
global_loadings <- nmb_get_gl(mcia_out)
```

nmb_get_gs

Accessor function for global scores

Description

Retrieves the global scores as a matrix from a 'NipalsResult' object, typically output from 'nipals_multiblock()'.

Usage

```
nmb_get_gs(nmb_object)
```

Arguments

nmb_object A 'NipalsResult' object.

Value

a matrix containing global scores.

Examples

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
global_scores <- nmb_get_gs(mcia_out)
```

nmb_get_metadata	<i>Accessor function for metadata</i>
------------------	---------------------------------------

Description

Retrieves the metadata from a 'NipalsResult' object, typically output from 'nipals_multiblock()'.

Usage

```
nmb_get_metadata(nmb_object)
```

Arguments

nmb_object A 'NipalsResult' object.

Value

a dataframe containing metadata associated with the 'NipalsResult' object.

Examples

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
nipals_metadata <- nmb_get_metadata(mcia_out)
```

ord_loadings	<i>Ranked global loadings dataframe</i>
--------------	---

Description

Creates a dataframe with ranked loadings for a given factor

Usage

```
ord_loadings(  
  mcia_results,  
  omic = "all",  
  factor = 1,  
  absolute = FALSE,  
  descending = TRUE  
)
```

Arguments

mcia_results	object returned from nipals_multiblock() function
omic	choose an omic to rank, or choose 'all' for all, ((omic = "all", omic = "miRNA", etc.))
factor	choose a factor (numeric value from 1 to number of factors in mcia_results)
absolute	whether to rank by absolute value
descending	whether to rank in descending or ascending order

Value

ranked dataframe

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                plots = "none", tol = 1e-12)
all_pos_1 <- ord_loadings(mcia_results = mcia_results, omic = "all",
                        absolute = FALSE, descending = TRUE, factor = 1)
```

predict_gs

Prediction of new global scores based on block loadings and weights

Description

Uses previously-computed block scores and weights to compute a global score for new data. Only validated for MCIA results, as CPCA loadings aren't compatible with un-deflated data.

Usage

```
predict_gs(mcia_results, test_data)
```

Arguments

mcia_results	an mcia object output by nipals_multiblock() containing block scores, weights, and pre-processing identifier.
test_data	an MAE object with the same block types and features as the training dataset. Feature and omic order must match 'bl'.

Details

Projects the new observations onto each block loadings vector, then weights the projection according to the corresponding block weights.

Value

a matrix of predicted global scores for the training data

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 2)
new_data <- data_blocks_mae # should update with a truly new dataset
preds <- predict_gs(mcia_results, new_data)
```

projection_plot	<i>projection_plot</i>
-----------------	------------------------

Description

Function to generate a projection plot of MCIA results.

Usage

```
projection_plot(
  mcia_results,
  projection,
  orders = c(1, 2),
  block_name = NULL,
  color_col = NULL,
  color_pal = scales::viridis_pal,
  color_pal_params = list(option = "E"),
  legend_loc = "bottomleft",
  color_override = NULL,
  cex = 0.5
)
```

Arguments

mcia_results	MCIA results object returned from ‘nipals_multiblock’
projection	of plot, with the following options <ul style="list-style-type: none"> • ‘all’ - scatter plot of two orders of global and block scores (aka factors). • ‘global’ - scatter plot of two orders of global scores only (aka factors). • ‘block’ - scatter plot of two orders of block scores only (aka factors) for given block.
orders	Option to select orders of factors to plot against each other (for projection plots)
block_name	Name of the block to be plotted (if ‘projection = block’ argument used).
color_col	an integer or string specifying the column that will be used for color_col

color_pal	a list of colors or function which returns a list of colors
color_pal_params	a list of parameters for the color function
legend_loc	Option for legend location, or "none" for no legend.
color_override	Option to override colors when necessary, helpful for projection = "global" or "block"
cex	Resizing parameter for drawing the points

Details

Plotting function for a projection plot.

Value

Displays the desired plots

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                plots = "none", tol = 1e-12)
projection_plot(mcia_results, projection = "all", orders = c(1,2),
               color_col = "cancerType", legend_loc = "bottomright")
```

simple_mae	<i>Create an MAE object from a list of data matrices and column data</i>
------------	--

Description

Create an MAE object from a set of data matrices and column data.

Usage

```
simple_mae(matrix_list, row_format = "feature", colData_input = NULL)
```

Arguments

matrix_list	named list of data matrices
row_format	for lists of data frames, indicates whether rows of datasets denote 'feature' (default) or 'sample'.
colData_input	a data frame containing sample metadata; sample names in the rownames should correspond to samples names in 'matrix_list'

Details

Requires that sample names match across experiments and are identical to primary names, will only convert data matrices to SummarizedExperiment class. If the data is more complex, please follow the guidelines for creating an MAE object outlined in ‘help(MultiAssayExperiment)’

Value

List of harmonized data matrices for input into nipals_multiblock()

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format = "sample",
                              colData = metadata_NCI60)
```

vis_load_ord

Visualize ranked loadings

Description

Visualize a scree plot of loadings recovered from nipalsMCIA() output loadings matrix ranked using the ord_loadings() functions

Usage

```
vis_load_ord(
  mcia_results,
  omic,
  factor = 1,
  n_feat = 15,
  absolute = TRUE,
  descending = TRUE,
  color_pal = scales::viridis_pal,
  color_pal_params = list()
)
```

Arguments

mcia_results	object returned from nipals_multiblock() function
omic	name of the given omic dataset
factor	choose a factor (numeric value from 1 to number of factors in mcia_results)
n_feat	number of features to visualize
absolute	whether to rank by absolute value
descending	whether to rank in descending or ascending order
color_pal	a list of colors or function which returns a list of colors
color_pal_params	a list of parameters for the color function

Value

Plot in features for a factor by rank

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                              colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                  plots = "none", tol = 1e-12)
vis_load_ord(mcia_results, omic="mrna")
```

vis_load_plot	<i>Visualize all loadings on two factor axes</i>
---------------	--

Description

Visualize all loadings recovered from nipalsMCIA() output loadings matrix ranked using across two factor axes

Usage

```
vis_load_plot(
  mcia_results,
  axes = c(1, 2),
  color_pal = scales::viridis_pal,
  color_pal_params = list()
)
```

Arguments

mcia_results	object returned from nipals_multiblock() function
axes	list of two numbers associated with two factors to visualize
color_pal	a list of colors or function which returns a list of colors
color_pal_params	a list of parameters for the color function

Value

Plot of MCIA feature loadings for chosen axes

Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                              colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                  plots = "none", tol = 1e-12)
vis_load_plot(mcia_results, axes = c(1, 4))
```

Index

- * **data**
 - data_blocks, 7
 - metadata_NCI60, 13
- * **internal**
 - nipalsMCIA-package, 3
- * **multi-omics**
 - data_blocks, 7
 - metadata_NCI60, 13

- block_preproc, 3
- block_weights_heatmap, 4

- cc_preproc, 5
- col_preproc, 6

- data_blocks, 7
- deflate_block_bl, 7
- deflate_block_gs, 8

- extract_from_mae, 9

- get_colors, 9
- get_metadata_colors, 10
- get_tv, 11
- global_scores_eigenvalues_plot, 11
- global_scores_heatmap, 12
- gsea_report, 13

- metadata_NCI60, 13

- nipals_iter, 14
- nipals_multiblock, 15
- nipalsMCIA (nipalsMCIA-package), 3
- nipalsMCIA-package, 3
- NipalsResult (NipalsResult-class), 14
- NipalsResult-class, 14
- nmb_get_bl, 17
- nmb_get_bs, 18
- nmb_get_bs_weights, 18
- nmb_get_eigs, 19
- nmb_get_gl, 19

- nmb_get_gs, 20
- nmb_get_metadata, 21

- ord_loadings, 21

- predict_gs, 22
- projection_plot, 23

- simple_mae, 24

- vis_load_ord, 25
- vis_load_plot, 26