Package ‘pcaExplorer’

May 3, 2024

Type Package

Title Interactive Visualization of RNA-seq Data Using a Principal Components Approach

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Description This package provides functionality for interactive visualization of RNA-seq datasets based on Principal Components Analysis. The methods provided allow for quick information extraction and effective data exploration. A Shiny application encapsulates the whole analysis.

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LazyData TRUE

Imports DESeq2, SummarizedExperiment, GenomicRanges, IRanges, S4Vectors, genefilter, ggplot2 (>= 2.0.0), heatmaply, plotly, scales, NMF, pplyr, topGO, limma, GOstats, GO.db, AnnotationDbi, shiny (>= 0.12.0), shinydashboard, shinyBS, ggrepel, DT, shinyAce, threejs, biomaRt, pheatmap, knitr, rmarkdown, base64enc, tidyr, grDevices, methods

Suggests testthat, BiocStyle, markdown, airway, org.Hs.eg.db, htmltools

URL https://github.com/federicomarini/pcaExplorer,
https://federicomarini.github.io/pcaExplorer/

BugReports https://github.com/federicomarini/pcaExplorer/issues

biocViews ImmunoOncology, Visualization, RNASeq, DimensionReduction, PrincipalComponent, QualityControl, GUI, ReportWriting, ShinyApps

VignetteBuilder knitr

RoxygenNote 7.3.1

Encoding UTF-8

NeedsCompilation no

git_url https://git.bioconductor.org/packages/pcaExplorer
**correlatePCs**

**Description**

Computes the significance of (cor)relations between PCA scores and the sample experimental covariates, using Kruskal-Wallis test for categorial variables and the `cor.test` based on Spearman’s correlation for continuous variables.

**Usage**

```r
correlatePCs(pcaobj, coldata, pcs = 1:4)
```
**distro_expr**

**Arguments**

- *pcaobj*: A `prcomp` object
- *coldata*: A `data.frame` object containing the experimental covariates
- *pcs*: A numeric vector, containing the corresponding PC number

**Value**

A `data.frame` object with computed p values for each covariate and for each principal component

**Examples**

```r
library(DESeq2)
.dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
.rl <- DESeq2::rlogTransformation(.dds)
.pcaobj <- prcomp(t(assay(.rl)))
correlatePCs(.pcaobj, colData(.dds))
```

---

**distro_expr**  
Plot distribution of expression values

**Description**

Plot distribution of expression values

**Usage**

`distro_expr(rld, plot_type = "density")`

**Arguments**

- *rld*: A `DESeqTransform` object.
- *plot_type*: Character, choose one of boxplot, violin or density. Defaults to density

**Value**

A plot with the distribution of the expression values

**Examples**

```r
dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
.rl <- DESeq2::rlogTransformation(.dds)
distro_expr(.rl)
```
geneprofiler  
*Extract and plot the expression profile of genes*

**Description**

Extract and plot the expression profile of genes

**Usage**

geneprofiler(se, genelist = NULL, intgroup = "condition", plotZ = FALSE)

**Arguments**

- `se`  
  A DESeqDataSet object, or a DESeqTransform object.
- `genelist`  
  An array of characters, including the names of the genes of interest of which the profile is to be plotted
- `intgroup`  
  A factor, needs to be in the colnames of colData(se)
- `plotZ`  
  Logical, whether to plot the scaled expression values. Defaults to FALSE

**Value**

A plot of the expression profile for the genes

**Examples**

dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
rlt <- DESeq2::rlogTransformation(dds)
geneprofiler(rlt, paste0("gene", sample(1:1000, 20)))
geneprofiler(rlt, paste0("gene", sample(1:1000, 20)), plotZ = TRUE)

---

genespca  
*Principal components analysis on the genes*

**Description**

Computes and plots the principal components of the genes, eventually displaying the samples as in a typical biplot visualization.
Usage

genespca(
  x,
  ntop,
  choices = c(1, 2),
  arrowColors = "steelblue",
  groupNames = "group",
  biplot = TRUE,
  scale = 1,
  pc.biplot = TRUE,
  obs.scale = 1 - scale,
  var.scale = scale,
  groups = NULL,
  ellipse = FALSE,
  ellipse.prob = 0.68,
  labels = NULL,
  labels.size = 3,
  alpha = 1,
  var.axes = TRUE,
  circle = FALSE,
  circle.prob = 0.69,
  varname.size = 4,
  varname.adjust = 1.5,
  varname.abbrev = FALSE,
  returnData = FALSE,
  coordEqual = FALSE,
  scaleArrow = 1,
  useRownamesAsLabels = TRUE,
  point_size = 2,
  annotation = NULL
)

Arguments

x A DESeqTransform object, with data in assay(x), produced for example by either rlog or varianceStabilizingTransformation

ntop Number of top genes to use for principal components, selected by highest row variance

choices Vector of two numeric values, to select on which principal components to plot

arrowColors Vector of character, either as long as the number of the samples, or one single value

groupNames Factor containing the groupings for the input data. Is efficiently chosen as the (interaction of more) factors in the colData for the object provided

biplot Logical, whether to additionally draw the samples labels as in a biplot representation
scale

Covariance biplot (scale = 1), form biplot (scale = 0). When scale = 1, the inner product between the variables approximates the covariance and the distance between the points approximates the Mahalanobis distance.

pc.biplot

Logical, for compatibility with biplot.princomp()

obs.scale

Scale factor to apply to observations

var.scale

Scale factor to apply to variables

groups

Optional factor variable indicating the groups that the observations belong to. If provided the points will be colored according to groups

ellipse

Logical, draw a normal data ellipse for each group

ellipse.prob

Size of the ellipse in Normal probability

labels

optional Vector of labels for the observations

labels.size

Size of the text used for the labels

alpha

Alpha transparency value for the points (0 = transparent, 1 = opaque)

var.axes

Logical, draw arrows for the variables?

circle

Logical, draw a correlation circle? (only applies when prcomp was called with scale = TRUE and when var.scale = 1)

circle.prob

Size of the correlation circle in Normal probability

varname.size

Size of the text for variable names

varname.adjust

Adjustment factor the placement of the variable names, >= 1 means farther from the arrow

varname.abbrev

Logical, whether or not to abbreviate the variable names

returnData

Logical, if TRUE returns a data.frame for further use, containing the selected principal components for custom plotting

coordEqual

Logical, default FALSE, for allowing brushing. If TRUE, plot using equal scale cartesian coordinates

scaleArrow

Multiplicative factor, usually >=1, only for visualization purposes, to allow for distinguishing where the variables are plotted

useRownamesAsLabels

Logical, if TRUE uses the row names as labels for plotting

point_size

Size of the points to be plotted for the observations (genes)

annotation

A data.frame object, with row.names as gene identifiers (e.g. ENSEMBL ids) and a column, gene_name, containing e.g. HGNC-based gene symbols

Details

The implementation of this function is based on the beautiful ggbiplot package developed by Vince Vu, available at https://github.com/vqv/ggbiplot. The adaptation and additional parameters are tailored to display typical genomics data such as the transformed counts of RNA-seq experiments

Value

An object created by ggplot2, which can be assigned and further customized.
get_annotation

Examples

library(DESeq2)
dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
rlt <- rlogTransformation(dds)
groups <- colData(dds)$condition
groups <- factor(groups, levels = unique(groups))
cols <- scales::hue_pal()(2)[groups]
genespca(rlt, ntop=100, arrowColors = cols, groupNames = groups)

groups_multi <- interaction(as.data.frame(colData(rlt)[, c("condition", "tissue")]))
groups_multi <- factor(groups_multi, levels = unique(groups_multi))
cols_multi <- scales::hue_pal()(length(levels(groups_multi)))[factor(groups_multi)]
genespca(rlt, ntop = 100, arrowColors = cols_multi, groupNames = groups_multi)

get_annotation

Get an annotation data frame from biomaRt

Description

Get an annotation data frame from biomaRt

Usage

get_annotation(dds, biomart_dataset, idtype)

Arguments

dds A DESeqDataSet object
biomart_dataset A biomaRt dataset to use. To see the list, type
idtype Character, the ID type of the genes as in the row names of dds, to be used for

Value

A data frame for ready use in pcaExplorer, retrieved from biomaRt.

Examples

library(airway)
data(airway)
airway
dds_airway <- DESeq2::DESeqDataSetFromMatrix(assay(airway),
          colData = colData(airway),
          design = ~dex+cell)

## Not run:
get_annotation_orgdb

get_annotation(dds_airway, "hsapiens_gene_ensembl", "ensembl_gene_id")

## End(Not run)

get_annotation_orgdb  Get an annotation data frame from org db packages

Description

Get an annotation data frame from org db packages

Usage

generate_get_annotation_orgdb(dds, orgdb_species, idtype, key_for_genenames = "SYMBOL")

Arguments

- `dds`: A DESeqDataSet object
- `orgdb_species`: Character string, named as the org.XX.eg.db package which should be available in Bioconductor
- `idtype`: Character, the ID type of the genes as in the row names of dds, to be used for the call to mapIds
- `key_for_genenames`: Character, corresponding to the column name for the key in the orgDb package containing the official gene name (often called gene symbol). This parameter defaults to "SYMBOL", but can be adjusted in case the key is not found in the annotation package (e.g. for org.Sc.sgd.db).

Value

A data frame for ready use in pcaExplorer, retrieved from the org db packages

Examples

library(airway)
data(airway)
airway
dds_airway <- DESeq2::DESeqDataSetFromMatrix(assay(airway),
colData = colData(airway),
design = ~dex+cell)
anno_df <- generate_get_annotation_orgdb(dds_airway, "org.Hs.eg.db", "ENSMBL")
head(anno_df)
**hi_loadings**

*Extract genes with highest loadings*

**Description**

Extract genes with highest loadings

**Usage**

```r
hi_loadings(
  pcaobj,
  whichpc = 1,
  topN = 10,
  exprTable = NULL,
  annotation = NULL,
  title = "Top/bottom loadings"
)
```

**Arguments**

- `pcaobj`: A `prcomp` object
- `whichpc`: An integer number, corresponding to the principal component of interest
- `topN`: Integer, number of genes with top and bottom loadings
- `exprTable`: A matrix object, e.g. the counts of a `DESeqDataSet`. If not NULL, returns the counts matrix for the selected genes
- `annotation`: A `data.frame` object, with row names as gene identifiers (e.g. ENSEMBL ids) and a column, `gene_name`, containing e.g. HGNC-based gene symbols
- `title`: The title of the plot

**Value**

A `ggplot2` object, or a matrix, if `exprTable` is not null

**Examples**

```r
dds <- makeExampleDESeqDataSet_multifac(betaSD = 3, betaSD_tissue = 1)
rlt <- DESeq2::rlogTransformation(dds)
pcaobj <- prcomp(t(SummarizedExperiment::assay(rlt)))
hi_loadings(pcaobj, topN = 20)
hi_loadings(pcaobj, topN = 10, exprTable = dds)
hi_loadings(pcaobj, topN = 10, exprTable = counts(dds))
```
limmaquickpca2go

Functional interpretation of the principal components, based on simple overrepresentation analysis

Description

Extracts the genes with the highest loadings for each principal component, and performs functional enrichment analysis on them using the simple and quick routine provided by the limma package.

Usage

```r
limmaquickpca2go(
  se,
  pca_ngenes = 10000,
  inputType = "ENSEMBL",
  organism = "Mm",
  loadings_ngenes = 500,
  background_genes = NULL,
  scale = FALSE,
  ...
)
```

Arguments

- `se`: A DESeqTransform object, with data in `assay(se)`, produced for example by either `rlog` or `varianceStabilizingTransformation`.
- `pca_ngenes`: Number of genes to use for the PCA.
- `inputType`: Input format type of the gene identifiers. Defaults to "ENSEMBL", that then will be converted to ENTREZ ids. Can assume values such as "ENTREZID", "GENENAME" or "SYMBOL", like it is normally used with the `select` function of `AnnotationDbi`.
- `organism`: Character abbreviation for the species, using `org.XX.eg.db` for annotation.
- `loadings_ngenes`: Number of genes to extract the loadings (in each direction).
- `background_genes`: Which genes to consider as background.
- `scale`: Logical, defaults to `FALSE`, scale values for the PCA.
- `...`: Further parameters to be passed to the goana routine.

Value

A nested list object containing for each principal component the terms enriched in each direction. This object is to be thought in combination with the displaying feature of the main `pcaExplorer` function.
Examples

```r
library(airway)
library(DESeq2)
library(limma)
data(airway)
airway
dds_airway <- DESeqDataSet(airway, design = ~ cell + dex)
## Not run:
rld_airway <- rlogTransformation(dds_airway)
goquick_airway <- limmaquickpca2go(rld_airway,
  pca_ngenes = 10000,
  inputType = "ENSEMBL",
  organism = "Hs")
## End(Not run)
```

Description

Constructs a simulated dataset of Negative Binomial data from different conditions. The fold changes between the conditions can be adjusted with the `betaSD_condition` and the `betaSD_tissue` arguments.

Usage

```r
makeExampleDESeqDataSet_multifac(
  n = 1000,
  m = 12,
  betaSD_condition = 1,
  betaSD_tissue = 3,
  interceptMean = 4,
  interceptSD = 2,
  dispMeanRel = function(x) 4/x + 0.1,
  sizeFactors = rep(1, m)
)
```

Arguments

- `n`: number of rows (genes)
- `m`: number of columns (samples)
- `betaSD_condition`: the standard deviation for condition betas, i.e. beta ~ N(0,betaSD)
- `betaSD_tissue`: the standard deviation for tissue betas, i.e. beta ~ N(0,betaSD)
pair_corr

- interceptMean: the mean of the intercept betas (log2 scale)
- interceptSD: the standard deviation of the intercept betas (log2 scale)
- dispMeanRel: a function specifying the relationship of the dispersions on 2^trueIntercept
- sizeFactors: multiplicative factors for each sample

Details
This function is designed and inspired following the proposal of `makeExampleDESeqDataSet` from the DESeq2 package. Credits are given to Mike Love for the nice initial implementation.

Value
A `DESeqDataSet` with true dispersion, intercept for two factors (condition and tissue) and beta values in the metadata columns. Note that the true betas are provided on the log2 scale.

Examples
```r
def <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
def
def2 <- makeExampleDESeqDataSet_multifac(betaSD_condition = 1, betaSD_tissue = 4)
def2
```

Description
Pairwise scatter and correlation plot of counts

Usage
```r
pair_corr(df, log = FALSE, method = "pearson", use_subset = TRUE)
```

Arguments
- df: A data frame, containing the (raw/normalized/transformed) counts
- log: Logical, whether to convert the input values to log2 (with addition of a pseudo-count). Defaults to FALSE.
- method: Character string, one of Pearson (default), kendall, or spearman as in `cor`
- use_subset: Logical value. If TRUE, only 1000 values per sample will be used to speed up the plotting operations.

Value
A plot with pairwise scatter plots and correlation coefficients.
Examples

```r
library(airway)
data(airway)
airway
dds_airway <- DESeq2::DESeqDataSetFromMatrix(assay(airway),
   colData = colData(airway),
   design = ~dex+cell)
pair_corr(counts(dds_airway)[1:100, ]) # use just a subset for the example
```

---

**pca2go**

*Functional interpretation of the principal components*

**Description**

Extracts the genes with the highest loadings for each principal component, and performs functional enrichment analysis on them using routines and algorithms from the topGO package.

**Usage**

```r
pca2go(
  se,
  pca_ngenes = 10000,
  annotation = NULL,
  inputType = "geneSymbol",
  organism = "Mm",
  ensToGeneSymbol = FALSE,
  loadings_ngenes = 500,
  background_genes = NULL,
  scale = FALSE,
  return_ranked_gene_loadings = FALSE,
  annopkg = NULL,
  ...
)
```

**Arguments**

- `se` A `DESeqTransform` object, with data in `assay(se)`, produced for example by either `rlog` or `varianceStabilizingTransformation`
- `pca_ngenes` Number of genes to use for the PCA
- `annotation` A `data.frame` object, with row.names as gene identifiers (e.g. ENSEMBL ids) and a column, `gene_name`, containing e.g. HGNC-based gene symbols
- `inputType` Input format type of the gene identifiers. Will be used by the routines of topGO
- `organism` Character abbreviation for the species, using `org.XX.eg.db` for annotation
- `ensToGeneSymbol` Logical, whether to expect ENSEMBL gene identifiers, to convert to gene symbols with the annotation provided
loadings_ngenes
   Number of genes to extract the loadings (in each direction)
background_genes
   Which genes to consider as background.
scale
   Logical, defaults to FALSE, scale values for the PCA
return_ranked_gene_loadings
   Logical, defaults to FALSE. If TRUE, simply returns a list containing the top
   ranked genes with hi loadings in each PC and in each direction
annopkg
   String containing the name of the organism annotation package. Can be used to
   override the organism parameter, e.g. in case of alternative identifiers used in
   the annotation package (Arabidopsis with TAIR)
...
   Further parameters to be passed to the topGO routine

Value

A nested list object containing for each principal component the terms enriched in each direction.
This object is to be thought in combination with the displaying feature of the main pcaExplorer
function

Examples

library(airway)
library(DESeq2)
data(airway)
    airway
    dds_airway <- DESeqDataSet(airway, design= ~ cell + dex)
    ## Not run:
    rld_airway <- rlogTransformation(dds_airway)
    # constructing the annotation object
    anno_df <- data.frame(gene_id = rownames(dds_airway),
                          stringsAsFactors = FALSE)
    library("AnnotationDbi")
    library("org.Hs.eg.db")
    anno_df$gene_name <- mapIds(org.Hs.eg.db,
                                 keys = anno_df$gene_id,
                                 column = "SYMBOL",
                                 keytype = "ENSEMBL",
                                 multiVals = "first")
    rownames(anno_df) <- anno_df$gene_id
    bg_ids <- rownames(dds_airway)[rowSums(counts(dds_airway)) > 0]
    library(topGO)
    pca2go_airway <- pca2go(rld_airway,
                             annotation = anno_df,
                             organism = "Hs",
                             enstogeneSymbol = TRUE,
                             background_genes = bg_ids)

    ## End(Not run)
pcaExplorer

Explore a dataset from a PCA perspective

Description

Launch a Shiny App for interactive exploration of a dataset from the perspective of Principal Components Analysis

Usage

pcaExplorer(
  dds = NULL,
  dst = NULL,
  countmatrix = NULL,
  cldata = NULL,
  pca2go = NULL,
  annotation = NULL,
  runLocal = TRUE
)

Arguments

dds A DESeqDataSet object. If not provided, then a countmatrix and a cldata need to be provided. If none of the above is provided, it is possible to upload the data during the execution of the Shiny App

dst A DESeqTransform object. Can be computed from the dds object if left NULL. If none is provided, then a countmatrix and a cldata need to be provided. If none of the above is provided, it is possible to upload the data during the execution of the Shiny App

countmatrix A count matrix, with genes as rows and samples as columns. If not provided, it is possible to upload the data during the execution of the Shiny App

cldata A data.frame containing the info on the covariates of each sample. If not provided, it is possible to upload the data during the execution of the Shiny App

pca2go An object generated by the pca2go function, which contains the information on enriched functional categories in the genes that show the top or bottom loadings in each principal component of interest. If not provided, it is possible to compute live during the execution of the Shiny App

annotation A data.frame object, with row.names as gene identifiers (e.g. ENSEMBL ids) and a column, gene_name, containing e.g. HGNC-based gene symbols

runLocal A logical indicating whether the app is to be run locally or remotely on a server, which determines how documentation will be accessed.

Value

A Shiny App is launched for interactive data exploration
Examples

```r
library(airway)
data(airway)
airway
dds_airway <- DESeq2::DESeqDataSetFromMatrix(assay(airway),
                                             colData = colData(airway),
                                             design = ~dex+cell)

## Not run:
rld_airway <- DESeq2::rlogTransformation(dds_airway)

pcaExplorer(dds_airway, rld_airway)

pcaExplorer(countmatrix = counts(dds_airway), coldata = colData(dds_airway))

pcaExplorer() # and then upload count matrix, covariate matrix (and eventual annotation)

## End(Not run)
```

Description

pcaExplorer provides functionality for interactive visualization of RNA-seq datasets based on Principal Components Analysis. The methods provided allow for quick information extraction and effective data exploration. A Shiny application encapsulates the whole analysis.

Details

pcaExplorer provides functionality for interactive visualization of RNA-seq datasets based on Principal Components Analysis. The methods provided allow for quick information extraction and effective data exploration. A Shiny application encapsulates the whole analysis.

Author(s)

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Maintainer: Federico Marini <marinif@uni-mainz.de>

See Also

Useful links:

- https://github.com/federicomarini/pcaExplorer
- https://federicomarini.github.io/pcaExplorer/
- Report bugs at https://github.com/federicomarini/pcaExplorer/issues
pcaplot

Sample PCA plot for transformed data

Description
Plots the results of PCA on a 2-dimensional space

Usage
pcaplot(
  x,
  intgroup = "condition",
  ntop = 500,
  returnData = FALSE,
  title = NULL,
  pcX = 1,
  pcY = 2,
  text_labels = TRUE,
  point_size = 3,
  ellipse = TRUE,
  ellipse.prob = 0.95
)

Arguments
  x                          A DESeqTransform object, with data in assay(x), produced for example by either rlog or varianceStabilizingTransformation
  intgroup                   Interesting groups: a character vector of names in colData(x) to use for grouping
  ntop                       Number of top genes to use for principal components, selected by highest row variance
  returnData                logical, if TRUE returns a data.frame for further use, containing the selected principal components and intgroup covariates for custom plotting
  title                     The plot title
  pcX                        The principal component to display on the x axis
  pcY                        The principal component to display on the y axis
  text_labels                Logical, whether to display the labels with the sample identifiers
  point_size                 Integer, the size of the points for the samples
  ellipse                    Logical, whether to display the confidence ellipse for the selected groups
  ellipse.prob               Numeric, a value in the interval [0;1)

Value
An object created by ggplot, which can be assigned and further customized.
Examples

```r
dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
rlt <- DESeq2::rlogTransformation(dds)
pcaplot(rlt, ntop = 200)
```

---

**pcaplot3d**  
*Sample PCA plot for transformed data*

**Description**

Plots the results of PCA on a 3-dimensional space, interactively

**Usage**

```r
pcaplot3d(
  x,  
  intgroup = "condition",  
  ntop = 500,  
  returnData = FALSE,  
  title = NULL,  
  pcX = 1,  
  pcY = 2,  
  pcZ = 3,  
  text_labels = TRUE,  
  point_size = 3
)
```

**Arguments**

- **x** A `DESeqTransform` object, with data in `assay(x)`, produced for example by either `rlog` or `varianceStabilizingTransformation`
- **intgroup** Interesting groups: a character vector of names in `colData(x)` to use for grouping
- **ntop** Number of top genes to use for principal components, selected by highest row variance
- **returnData** logical, if TRUE returns a data.frame for further use, containing the selected principal components and intgroup covariates for custom plotting
- **title** The plot title
- **pcX** The principal component to display on the x axis
- **pcY** The principal component to display on the y axis
- **pcZ** The principal component to display on the z axis
- **text_labels** Logical, whether to display the labels with the sample identifiers
- **point_size** Integer, the size of the points for the samples
**Value**

A html-based visualization of the 3d PCA plot

**Examples**

```r
dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
rlt <- DESeq2::rlogTransformation(dds)
pcaplot3d(rlt, ntop = 200)
```

---

**Description**

Produces a scree plot for investigating the proportion of explained variance, or alternatively the cumulative value

**Usage**

```r
pcascree(obj, type = c("pev", "cev"), pc_nr = NULL, title = NULL)
```

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>obj</td>
<td>A prcomp object</td>
</tr>
<tr>
<td>type</td>
<td>Display absolute proportions or cumulative proportion. Possible values: &quot;pev&quot; or &quot;cev&quot;</td>
</tr>
<tr>
<td>pc_nr</td>
<td>How many principal components to display max</td>
</tr>
<tr>
<td>title</td>
<td>Title of the plot</td>
</tr>
</tbody>
</table>

**Value**

An object created by ggplot, which can be assigned and further customized.

**Examples**

```r
dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
rlt <- DESeq2::rlogTransformation(dds)
pcaobj <- prcomp(t(SummarizedExperiment::assay(rlt)))
pcascree(pcaobj, type = "pev")
pcascree(pcaobj, type = "cev", title = "Cumulative explained proportion of variance - Test dataset")
```
plotPCcorrs | Plot significance of (cor)relations of covariates VS principal components

Description

Plots the significance of the (cor)relation of each covariate vs a principal component

Usage

plotPCcorrs(pccorrs, pc = 1, logp = TRUE)

Arguments

- pccorrs: A data.frame object generated by `correlatePCs`
- pc: An integer number, corresponding to the principal component of interest
- logp: Logical, defaults to TRUE, displays the -log10 of the pvalue instead of the pvalue itself

Value

A base plot object

Examples

```r
library(DESeq2)
dds <- makeExampleDESeqDataSet_multifac(betaSD_condition = 3, betaSD_tissue = 1)
rlt <- rlogTransformation(dds)
pcaobj <- prcomp(t(assay(rlt)))
res <- correlatePCs(pcaobj, colData(dds))
plotPCcorrs(res)
```

topGOtable | Extract functional terms enriched in the DE genes, based on topGO

Description

A wrapper for extracting functional GO terms enriched in the DE genes, based on the algorithm and the implementation in the topGO package
topGOtable

Usage

topGOtable(
  DEgenes,
  BGgenes,
  ontology = "BP",
  annot = annFUN.org,
  mapping = "org.Mm.eg.db",
  geneID = "symbol",
  topTablerows = 200,
  fullNamesInRows = TRUE,
  addGeneToTerms = TRUE,
  plotGraph = FALSE,
  plotNodes = 10,
  writeOutput = FALSE,
  outputFile = "",
  topGO_method2 = "elim",
  do_padj = FALSE
)

Arguments

DEgenes A vector of (differentially expressed) genes
BGgenes A vector of background genes, e.g. all (expressed) genes in the assays
ontology Which Gene Ontology domain to analyze: BP (Biological Process), MF (Molecular Function), or CC (Cellular Component)
annot Which function to use for annotating genes to GO terms. Defaults to annFUN.org
mapping Which org.xx.eg.db to use for annotation - select according to the species
geneID Which format the genes are provided. Defaults to symbol, could also be entrez or ENSEMBL
topTablerows How many rows to report before any filtering
fullNamesInRows Logical, whether to display or not the full names for the GO terms
addGeneToTerms Logical, whether to add a column with all genes annotated to each GO term
plotGraph Logical, if TRUE additionally plots a graph on the identified GO terms
plotNodes Number of nodes to plot
writeOutput Logical, if TRUE additionally writes out the result to a file
outputFile Name of the file the result should be written into
topGO_method2 Character, specifying which of the methods implemented by topGO should be used, in addition to the classic algorithm. Defaults to elim
do_padj Logical, whether to perform the adjustment on the p-values from the specific topGO method, based on the FDR correction. Defaults to FALSE, since the assumption of independent hypotheses is somewhat violated by the intrinsic DAG-structure of the Gene Ontology Terms
Details

Allowed values assumed by the `topGO_method2` parameter are one of the following: `elim`, `weight`, `weight01`, `lea`, `parentchild`. For more details on this, please refer to the original documentation of the `topGO` package itself.

Value

A table containing the computed GO Terms and related enrichment scores.

Examples

```r
library(airway)
library(DESeq2)
data(airway)

dds_airway <- DESeqDataSet(airway, design= ~ cell + dex)

# Example, performing extraction of enriched functional categories in
# detected significantly expressed genes

## Not run:
dds_airway <- DESeq(dds_airway)
res_airway <- results(dds_airway)
library("AnnotationDbi")
library("org.Hs.eg.db")

res_airway$symbol <- mapIds(org.Hs.eg.db,
                           keys = row.names(res_airway),
                           column = "SYMBOL",
                           keytype = "ENSEMBL",
                           multiVals = "first")

res_airway$entrez <- mapIds(org.Hs.eg.db,
                           keys = row.names(res_airway),
                           column = "ENTREZID",
                           keytype = "ENSEMBL",
                           multiVals = "first")

resOrdered <- as.data.frame(res_airway[order(res_airway$padj),])
de_df <- resOrdered[resOrdered$padj < .05 & !is.na(resOrdered$padj),]
de_symbols <- de_df$symbol
bg_ids <- rownames(dds_airway)[rowSums(counts(dds_airway)) > 0]
bg_symbols <- mapIds(org.Hs.eg.db,
                       keys = bg_ids,
                       column = "SYMBOL",
                       keytype = "ENSEMBL",
                       multiVals = "first")

library(topGO)
topgoDE_airway <- topGOtable(de_symbols, bg_symbols,
                              ontology = "BP",
                              mapping = "org.Hs.eg.db",
                              geneID = "symbol")

## End(Not run)
```
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