Package ‘oposSOM’

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Title Comprehensive analysis of transcriptome data

Version 2.22.0

Description This package translates microarray expression data into metadata of reduced dimension. It provides various sample-centered and group-centered visualizations, sample similarity analyses and functional enrichment analyses. The underlying SOM algorithm combines feature clustering, multidimensional scaling and dimension reduction, along with strong visualization capabilities. It enables extraction and description of functional expression modules inherent in the data.

Depends R (>= 4.0.0), igraph (>= 1.0.0)

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LinkingTo RcppParallel, Rcpp

License GPL (>=2)

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Contents

oposSOM-package ......................................................... 2
opossom.genesets ...................................................... 3
opossom.new ............................................................ 4
opossom.run ............................................................. 6
opossom.tissues ......................................................... 7

Index 9

oposSOM-package

Comprehensive analysis of transcriptome data

Description

This package translates microarray expression data into metadata of reduced dimension. It provides various sample-centered and group-centered visualizations, sample similarity analyses and functional enrichment analyses. The underlying SOM algorithm combines feature clustering, multidimensional scaling and dimension reduction, along with strong visualization capabilities. It enables extraction and description of functional expression modules inherent in the data. The results are given within a separate folder and can be browsed using the summary HTML file.

Details

Package: oposSOM
Type: Package
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References

Loeffler-Wirth, Kalcher, Binder: oposSOM: R-package for high-dimensional portraying of genome-wide expression landscapes on Bioconductor. (Bioinformatics 2015)
### Examples

```r
# Example with artificial data
env <- opossom.new(list(dataset.name="Example",
dim.1stLvlSom=20))
env$indata <- matrix(rnorm(10000), 1000, 10)
env$group.labels <- "auto"
opossom.run(env)
```

```r
# Real Example - This will take several minutes
# env <- opossom.new(list(dataset.name="Tissues",
# dim.1stLvlSom=30,
# geneset.analysis=TRUE,
# pairwise.comparison.list=list(
# list("Homeostasis"=c(1, 2), "Imune System"=c(9, 10)),
# list("Homeostasis"=c(1, 2), "Muscle"=c(8))
# ))
# )
# data(opossom.tissues)
# env$indata <- opossom.tissues
#
# env$group.labels <- c(rep("Homeostasis", 2),
# "Endocrine",
# "Digestion",
# "Exocrine",
# "Epithelium",
# "Reproduction",
# "Muscle",
# rep("Imune System", 2),
# rep("Nervous System", 2))
#
# opossom.run(env)
```

---

### Description

Genesets collected from publications and independent analyses.

### Usage

```r
data(opossom.genesets)
```

### Format

The data set is stored in RData (binary) format. Each element of the list represents one distinct gene set and contains the Ensembl-IDs of the member genes.
Details

The oposSOM package allows for analysing the biological background of the samples using prede
fined sets of genes of known biological context. A large and diverse collection of such gene sets is
automatically derived from the Gene Ontology (GO) annotation database using biomaRt interface.
opossom.genesets contains more than 4,500 additional gene sets collected from Biocarta, KEGG
and Reactome databases, from literature on chemical and genetic perturbations, from literature on
cancer types and subtypes, and from previous analyses using the oposSOM pipeline.

opossom.new

Initialize the oposSOM pipeline.

Description

This function initializes the oposSOM environment and sets the preferences.

Usage

opossom.new(preferences)

Arguments

preferences list with the following optional values:

• indata: input data matrix containing the expression values or an Biobase::ExpressionSet
  object (see 'Details' and 'Examples')
• group.labels: sample assignment to a distinct group, subtype or class (char-
  acter; "auto" or one label for each sample; may be given with indata
  ExpressionSet)
• group.colors: colors of the samples for diverse visualizations (character;
  one color for each sample; may be given with indata ExpressionSet)
• dataset.name: name of the dataset; used to name results folder and environ-
  ment image (character).
• note a short note shown in html summary file to give some keywords about
  the data or analysis parameters (character).
• dim.1stLvlSom: dimension of primary SOM; use "auto" to apply automatic
  size estimation (integer, >5)
• dim.2ndLvlSom: dimensions of second level SOM (integer, >5)
• training.extension: factor to extend the number of iterations in SOM train-
  ing (numerical, >0)
• rotate.SOM.portraits: number of rotations of the primary SOM in counter-
  clockwise fashion (integer {0,1,2,3})
• flip.SOM.portraits: mirroring the primary SOM along the bottom-left to
  top-right diagonal (boolean)
• database.dataset: type of ensemble dataset addressed with biomaRt inter-
  face; use "auto" to detect parameter automatically (character)
• database.id.type: type of rowname identifier in biomaRt database; obsolete if database.dataset="auto" (character)
• activated.modules (list): activates/deactivates pipeline functionalities:
  – reporting (boolean): enables or disables output of pdf and csv results and html summaries (default: TRUE). When deactivated, only R workspace will be stored after analysis.
  – primary.analysis (boolean): enables or disables data preprocessing and SOM training (default: TRUE). When deactivated, prior SOM training results are required to be contained in the workspace environment.
  – sample.similarity.analysis (boolean): enables or disables diversity analyses such as clustering heatmaps, correlation networks and ICA (default: TRUE).
  – geneset.analysis (boolean): enables or disables geneset analysis (default: TRUE).
  – psf.analysis (boolean): enables or disables pathway signal flow (PSF) analysis (default: TRUE). Human gene expression data is required as input data.
  – group.analysis (boolean): enables or disables group centered analyses such as group portraits and functional mining (default: TRUE).
  – difference.analysis (boolean): enables or disables pairwise comparisons of the groups and of pairs provided by pairwise.comparison.list as described below (default: TRUE).
• standard.spot.modules: spot modules utilized in diverse downstream analyses (character, one of "overexpression", "group.overexpression", "underexpression", "kmeans", "correlation", "dmap")
• spot.coresize.modules: spot detection in summary maps, minimum size (numerical, >0)
• spot.threshold.modules: spot detection in summary maps, expression threshold (numerical, between 0 and 1)
• spot.coresize.groupmap: spot detection in group-specific summary maps, minimum size (numerical, >0)
• spot.threshold.groupmap: spot detection in group-specific summary maps, expression threshold (numerical, between 0 and 1)
• feature.centralization: enables centralization of the features (boolean)
• sample.quantile.normalization: enables quantile normalization of the samples (boolean)
• pairwise.comparison.list: group list for pairwise analyses (list of group lists, see 'Examples') or NULL otherwise

Details
The package accepts the indata parameter in two formats:<br> Firstly a simple two-dimensional numerical matrix, where the columns and rows represent the samples and genes, respectively. The expression values are usually obtained by calibration and summarization algorithms (e.g. MAS5, VSN or RMA), and transformed into logarithmic scale prior to utilizing them in the pipeline. Secondly the input data can also be given as Biobase::ExpressionSet object. Please check the vignette for more details on the parameters.
Value

A new oposSOM environment which is passed to opossom.run.

Examples

```r
env <- opossom.new(list(dataset.name="Example",
    note="a test with 10 random samples",
    dim.1stLvlSom="auto",
    dim.2ndLvlSom=10,
    training.extension=1,
    rotate.SOM.portraits=0,
    flip.SOM.portraits=FALSE,
    database.dataset="auto",
    activated.modules = list(
        "reporting" = TRUE,
        "primary.analysis" = TRUE,
        "sample.similarity.analysis" = TRUE,
        "geneset.analysis" = TRUE,
        "psf.analysis" = TRUE,
        "group.analysis" = TRUE,
        "difference.analysis" = TRUE ),
    standard.spot.modules="dmap",
    spot.coresize.modules=4,
    spot.threshold.modules=0.9,
    spot.coresize.groupmap=4,
    spot.threshold.groupmap=0.7,
    feature.centralization=TRUE,
    sample.quantile.normalization=TRUE,
    pairwise.comparison.list=list(
        list("groupA"=c("sample1", "sample2"),
            "groupB"=c("sample3", "sample4"))))

# definition of indata, group.labels and group.colors
env$indata = matrix( runif(1000), 100, 10 )
env$group.labels = c( rep("class 1", 5), rep("class 2", 4), "class 3" )
env$group.colors = c( rep("red", 5), rep("blue", 4), "green" )

# alternative definition of indata, group.labels and group.colors using Biobase::ExpressionSet
library(Biobase)

env$indata = ExpressionSet( assayData=matrix(runif(1000), 100, 10),
    phenoData=AnnotatedDataFrame(data.frame(      group.labels = c( rep("class 1", 5), rep("class 2", 4), "class 3" ),
            group.colors = c( rep("red", 5), rep("blue", 4), "green" ) ))
```

oppossom.run

Execute the oposSOM pipeline.
Description

This function realizes the complete pipeline functionality: single gene expression values are cul-
stered to metagenes using a self-organizing map. Based on these metagenes, visualizations (e.g.
expression portraits), downstreaming sample similarity analyses (e.g. hierarchical clustering, ICA)
and functional enrichment analyses are performed. The results are given within a separate folder
and can be browsed using the summary HTML file.

Usage

opossom.run(env)

Arguments

data

the opossom environment created with opossom.new according to the users’
preferences

Examples

# Example with artificial data
env <- opossom.new(list(dataset.name="Example",
dim.1stLvlSom=20))

env$indata <- matrix(rnorm(1000), 100, 10)

opossom.run(env)

opossom.tissues

Example data set.

Description

A data set comprising of 12 selected human tissues.

Usage

data(opossom.tissues)

Format

The data set is stored in RData (binary) format.

Details

The data set was downloaded from Gene Expression Omnibus repository (http://www.ncbi.nlm.nih.gov/geo,
GEO accession no. GSE7307). About 20,000 genes in more than 650 samples were measured using
the Affymetrix HGU133-Plus2 microarray. A subset of 12 selected tissues from different categories
is used as example data set for the oposSOM-package.
Source

Index

* package
  oposSOM-package, 2

oposSOM (oposSOM-package), 2
oposSOM-package, 2
opossom.genesets, 3
opossom.new, 4
opossom.run, 6
opossom.tissues, 7