Package ‘compcodeR’

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Type  Package
Title  RNAseq data simulation, differential expression analysis and performance comparison of differential expression methods
Version  1.38.0
Description  This package provides extensive functionality for comparing results obtained by different methods for differential expression analysis of RNAseq data. It also contains functions for simulating count data. Finally, it provides convenient interfaces to several packages for performing the differential expression analysis. These can also be used as templates for setting up and running a user-defined differential analysis workflow within the framework of the package.
Depends  R (>= 4.0), sm
Imports  knitr (>= 1.2), markdown, ROCR, lattice (>= 0.16), gplots, gtools, caTools, grid, KernSmooth, MASS, ggplot2, stringr, modeest, edgeR, limma, vioplot, methods, stats, utils, ape, phylolm, matrixStats, grDevices, graphics, rmarkdown, shiny, shinydashboard
Suggests  BiocStyle, EBSeq, DESeq2 (>= 1.1.31), genefilter, NOISeq, TCC, NBPSeq (>= 0.3.0), phytools, phangorn, testthat, ggtree, tidytree, statmod, covr, sva, tcltk
Enhances  rpanel, DSS
License  GPL (>= 2)
VignetteBuilder  knitr
biocViews  ImmunoOncology, RNASeq, DifferentialExpression
RoxygenNote  7.2.3
URL  https://github.com/csoneson/compcodeR
BugReports  https://github.com/csoneson/compcodeR/issues
Encoding  UTF-8
git_url  https://git.bioconductor.org/packages/compcodeR
**R topics documented:**

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compcodeR-package

RNAseq data simulation, differential expression analysis and performance comparison of differential expression methods

Description

RNAseq data simulation, differential expression analysis and performance comparison of differential expression methods

Details

This package provides extensive functionality for comparing results obtained by different methods for differential expression analysis of RNAseq data. It also contains functions for simulating count data and interfaces to several packages for performing the differential expression analysis.
Author(s)
Charlotte Soneson

add_replicates
Add replicates to a tree

Description
Utility function to add replicates to a tree, as tips with zero length branches.

Usage
add_replicates(tree, r)

Arguments
- **tree**: A phylogenetic tree with n tips.
- **r**: the number of replicates too add at each species.

Value
A phylogenetic tree with n * r tips, and clusters of tips with zero branch lengths.

checkDataObject
Check a list or a compData object for compatibility with the differential expression functions interfaced by compcodeR

Description
Check if a list or a compData object contains the necessary slots for applying the differential expression functions interfaced by the compcodeR package. This function is provided for backward compatibility, see also check_compData and check_compData_results.

Usage
checkDataObject(data.obj)

Arguments
- **data.obj**: A list containing data and condition information, or a compData object.

Author(s)
Charlotte Soneson
checkParamMatrix

Examples

```r
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                           samples.per.cond = 5, n.diffexp = 100)
checkDataObject(mydata.obj)
```

description

Check that the parameters are compatible with the tree. Throws an error if not.

Usage

```r
checkParamMatrix(x, name, tree)
```

Arguments

- `x`: matrix of parameters being tested.
- `name`: name of the parameter.
- `tree`: A phylogenetic tree with n tips.

checkParamVector

Description

Check that the parameters are compatible with the tree. Throws an error if not.

Usage

```r
checkParamVector(x, name, tree)
```

Arguments

- `x`: vector of parameters being tested.
- `name`: name of the parameter.
- `tree`: A phylogenetic tree with n tips.
checkSpecies  

**Check Species**

**Description**
Check that the parameters are compatible with the tree. Throws an error if not.

**Usage**

```r
checkSpecies(x, name, tree, tol, check.id.species)
```

**Arguments**
- `x`: vector of parameters being tested.
- `name`: name of the parameter.
- `tree`: A phylogenetic tree with n tips.

---

checkTableConsistency  

**Check consistency of input table to runComparison**

**Description**
Check that the dataset, `nbr.samples`, `repl` and `de.methods` columns of a data frame are consistent with the information provided in the input files (given in the `input.files` column of the data frame). If there are inconsistencies or missing information in any of the columns, replace the given information with the information in the input files.

**Usage**

```r
checkTableConsistency(file.table)
```

**Arguments**
- `file.table`: A data frame with columns named `input.files` and (optionally) `datasets`, `nbr.samples`, `repl`, `de.methods`.

**Value**
Returns a consistent file table defining the result files that will be used as the basis for a method comparison.

**Author(s)**
Charlotte Soneson
check_compData

Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "voom.limma",
Rmdfunction = "voom.limma.createRmd", output.directory = tmpdir,
norm.method = "TMM")
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "edgeR.exact",
Rmdfunction = "edgeR.exact.createRmd", output.directory = tmpdir,
norm.method = "TMM",
trend.method = "movingave", disp.type = "tagwise")

## A correct table
file.table <- data.frame(input.files = file.path(tmpdir,
c("mydata_voom.limma.rds", "mydata_edgeR.exact.rds")),
datasets = c("mydata", "mydata"),
nbr.samples = c(5, 5),
repl = c(1, 1),
stringsAsFactors = FALSE)
new.table <- checkTableConsistency(file.table)
new.table

## An incorrect table
file.table <- data.frame(input.files = file.path(tmpdir,
c("mydata_voom.limma.rds", "mydata_edgeR.exact.rds")),
datasets = c("mydata", "mydata"),
nbr.samples = c(5, 3),
repl = c(2, 1),
stringsAsFactors = FALSE)
new.table <- checkTableConsistency(file.table)
new.table

## A table with missing information
file.table <- data.frame(input.files = file.path(tmpdir,
c("mydata_voom.limma.rds", "mydata_edgeR.exact.rds")),
stringsAsFactors = FALSE)
new.table <- checkTableConsistency(file.table)
new.table

check_compData

Check the validity of a compData object

Description

Check the validity of a compData object. An object that passes the check can be used as the input for the differential expression analysis methods interfaced by compcodeR.

Usage

check_compData(object)
Arguments
object A compData object

Author(s)
Charlotte Soneson

Examples
mydata <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                   samples.per.cond = 5, n.diffexp = 100)
check_compData(mydata)

## Check an object without differential expression results
check_compData_results(mydata)

runDiffExp(data.file = file.path(tmpdir, "mydata.rds"),
           result.extent = "voom.limma",
           Rmdfunction = "voom.limma.createRmd",
           output.directory = tmpdir, norm.method = "TMM")
resdata <- readRDS(file.path(tmpdir, "mydata_voom.limma.rds"))
## Check an object containing differential expression results
check_compData_results(resdata)

check_compData_results
Check the validity of a compData result object

Description
Check the validity of a compData object containing differential expression results. An object that passes the check can be used as the input for the method comparison functions in compcodeR.

Usage
check_compData_results(object)

Arguments
object A compData object

Author(s)
Charlotte Soneson

Examples
tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                 samples.per.cond = 5, n.diffexp = 100,
                                 output.file = file.path(tmpdir, "mydata.rds"))
## Check an object without differential expression results
check_compData_results(mydata)

runDiffExp(data.file = file.path(tmpdir, "mydata.rds"),
           result.extent = "voom.limma",
           Rmdfunction = "voom.limma.createRmd",
           output.directory = tmpdir, norm.method = "TMM")
resdata <- readRDS(file.path(tmpdir, "mydata_voom.limma.rds"))
## Check an object containing differential expression results
check_compData_results(resdata)
check_phyloCompData

Check the validity of a phyloCompData object

Description

Check the validity of a phyloCompData object. An object that passes the check can be used as the input for the differential expression analysis methods interfaced by compcodeR.

Usage

check_phyloCompData(object)

Arguments

object  A phyloCompData object

Author(s)

Charlotte Soneson, Paul Bastide

Examples

mydata <- generateSyntheticData(dataset = "mydata", n.vars = 1000, samples.per.cond = 5, n.diffexp = 100, id.species = factor(1:10), tree = ape::rphylo(10, 1, 0), lengths.relmeans = "auto", lengths.dispersions = "auto")

check_phyloCompData(mydata)

compData

Create a compData object

Description

The compData class is used to store information about the experiment, such as the count matrix, sample and variable annotations, information regarding the generation of the data and results from applying a differential expression analysis to the data. This constructor function creates a compData object.
Usage

compData(
  count.matrix,
  sample.annotations,
  info.parameters,
  variable.annotations = data.frame(),
  filtering = "no info",
  analysis.date = "",
  package.version = "",
  method.names = list(),
  code = "",
  result.table = data.frame()
)

Arguments

count.matrix       A count matrix, with genes as rows and observations as columns.
sample.annotations A data frame, containing at least one column named 'condition', encoding the
grouping of the observations into two groups. The row names should be the
same as the column names of the count.matrix.

info.parameters    A list containing information regarding simulation parameters etc. The only
mandatory entries are dataset and uID, but it may contain entries such as the
ones listed below (see generateSyntheticData for more detailed information
about each of these entries).

  • dataset: an informative name or identifier of the data set (e.g., summariz-
ing the simulation settings).
  • samples.per.cond
  • n.diffexp
  • repl.id
  • seqdepth
  • minfact
  • maxfact
  • fraction.upregulated
  • between.group.diffdisp
  • filter.threshold.total
  • filter.threshold.mediancpm
  • fraction.non.overdispersed
  • random.outlier.high.prob
  • random.outlier.low.prob
  • single.outlier.high.prob
  • single.outlier.low.prob
  • effect.size
**variable.annotations**
A data frame with variable annotations (with number of rows equal to the number of rows in count.matrix, that is, the number of variables in the data set). Not mandatory, but may contain columns such as the ones listed below. If present, the row names should be the same as the row names of the count.matrix.

- **truedispersions.S1**: the true dispersion for each gene in condition S1.
- **truedispersions.S2**: the true dispersion for each gene in condition S2.
- **truemanss.S1**: the true mean value for each gene in condition S1.
- **truemanss.S2**: the true mean value for each gene in condition S2.
- **n.random.outliers.up.S1**: the number of 'random' outliers with extremely high counts for each gene in condition S1.
- **n.random.outliers.up.S2**: the number of 'random' outliers with extremely high counts for each gene in condition S2.
- **n.random.outliers.down.S1**: the number of 'random' outliers with extremely low counts for each gene in condition S1.
- **n.random.outliers.down.S2**: the number of 'random' outliers with extremely low counts for each gene in condition S2.
- **n.single.outliers.up.S1**: the number of 'single' outliers with extremely high counts for each gene in condition S1.
- **n.single.outliers.up.S2**: the number of 'single' outliers with extremely high counts for each gene in condition S2.
- **n.single.outliers.down.S1**: the number of 'single' outliers with extremely low counts for each gene in condition S1.
- **n.single.outliers.down.S2**: the number of 'single' outliers with extremely low counts for each gene in condition S2.
- **M.value**: the M-value (observed log2 fold change between condition S1 and condition S2) for each gene.
- **A.value**: the A-value (observed average expression level across condition S1 and condition S2) for each gene.
- **true.log2.fold.changes**: the true (simulated) log2 fold changes between condition S1 and condition S2.
- **upregulation**: a binary vector indicating which genes are simulated to be upregulated in condition S2 compared to condition S1.
- **downregulation**: a binary vector indicating which genes are simulated to be downregulated in condition S2 compared to condition S1.
- **differential.expression**: a binary vector indicating which genes are simulated to be differentially expressed in condition S2 compared to condition S1.

**filtering**
A character string containing information about the filtering that has been applied to the data set.

**analysis.date**
If a differential expression analysis has been performed, a character string detailing when it was performed.
package.version
If a differential expression analysis has been performed, a character string giving
the version of the differential expression packages that were applied.

method.names
If a differential expression analysis has been performed, a list with entries full.name
and short.name, giving the full name of the differential expression method
(may including version number and parameter settings) and a short name or
abbreviation.

code
If a differential expression analysis has been performed, a character string con-
taining the code that was run to perform the analysis. The code should be in R
markdown format, and can be written to an HTML file using the generateCodeHTMLs
function.

result.table
If a differential expression analysis has been performed, a data frame containing
the results of the analysis. The number of rows should be equal to the number of
rows in count.matrix and if present, the row names should be identical. The
only mandatory column is score, which gives a score for each gene, where a
higher score suggests a "more highly differentially expressed" gene. Different
comparison functions use different columns of this table, if available. The list
below gives the columns that are used by the interfaced methods.

  • pvalue nominal p-values
  • adjpvalue p-values adjusted for multiple comparisons
  • logFC estimated log-fold changes between the two conditions
  • score the score that will be used to rank the genes in order of significance.
    Note that high scores always signify differential expression, that is, a strong
    association with the predictor. For example, for methods returning a nominal
    p-value the score can be defined as 1 - pvalue.
  • FDR false discovery rate estimates
  • posterior.DE posterior probabilities of differential expression
  • prob.DE conditional probabilities of differential expression
  • lfdr local false discovery rates
  • statistic test statistics from the differential expression analysis
  • dispersion.S1 dispersion estimates in condition S1
  • dispersion.S2 dispersion estimates in condition S2

Value
A compData object.

Author(s)
Charlotte Soneson

Examples
```
count.matrix <- round(matrix(1000*runif(4000), 1000))
sample.annotations <- data.frame(condition = c(1, 1, 2, 2))
info.parameters <- list(dataset = "mydata", uID = "123456")
compdat <- compData(count.matrix, sample.annotations, info.parameters)
```
**compData-class  

Class compData  

Description  

The `compData` class is used to store information about the experiment, such as the count matrix, sample and variable annotations, information regarding the generation of the data and results from applying a differential expression analysis to the data.

Slots  

- `count.matrix`: The read count matrix, with genes as rows and samples as columns. Class `matrix`  
- `sample.annotations`: A data frame containing sample annotation information for all samples in the data set. Must contain at least a column named `condition`, encoding the division of the samples into two classes. The row names should be the same as the column names of `count.matrix`. Class `data.frame`  
- `info.parameters`: A list of parameters detailing the simulation process used to generate the data. Must contain at least two entries, named `dataset` (an informative name for the data set/simulation setting) and `uID` (a unique ID for the specific data set instance). Class `list`  
- `filtering`: A character string detailing the filtering process that has been applied to the data. Class `character`  
- `variable.annotations`: Contains information regarding the variables, such as the differential expression status, the true mean, dispersion and effect sizes. If present, the row names should be the same as those of `count.matrix`. Class `data.frame`  
- `analysis.date`: (If a differential expression analysis has been performed and the results are included in the `compData` object). Gives the date when the differential expression analysis was performed. Class `character`  
- `package.version`: (If a differential expression analysis has been performed and the results are included in the `compData` object). Gives the version numbers of the package(s) used for the differential expression analysis. Class `character`  
- `method.names`: (If a differential expression analysis has been performed and the results are included in the `compData` object). A list, containing the name of the method used for the differential expression analysis. The list should have two entries: `full.name` and `short.name`, where the `full.name` is the full (potentially long) name identifying the method, and `short.name` may be an abbreviation. Class `list`  
- `code`: (If a differential expression analysis has been performed and the results are included in the `compData` object). A character string containing the code that was used to run the differential expression analysis. The code should be in R markdown format. Class `character`  
- `result.table`: (If a differential expression analysis has been performed and the results are included in the `compData` object). Contains the results of the differential expression analysis, in the form of a data frame with one row per gene. Must contain at least one column named `score`, where a higher value corresponds to 'more strongly differentially expressed genes'. Class `data.frame`
Methods

**count.matrix** signature(x="compData")

count.matrix<- signature(x="compData", value="matrix"): Get or set the count matrix in a compData object. value should be a numeric matrix.

**sample.annotations** signature(x="compData")

sample.annotations<- signature(x="compData", value="data.frame"): Get or set the sample annotations data frame in a compData object. value should be a data frame with at least a column named 'condition'.

**info.parameters** signature(x="compData")

info.parameters<- signature(x="compData", value="list"): Get or set the list with info parameters in a compData object. value should be a list with at least elements named 'dataset' and 'uID'.

**filtering** signature(x="compData")

filtering<- signature(x="compData", value="character"): Get or set the information about the filtering in a compData object. value should be a character string describing the filtering that has been performed.

**variable.annotations** signature(x="compData")

variable.annotations<- signature(x="compData", value="data.frame"): Get or set the variable annotations data frame in a compData object. value should be a data frame.

**analysis.date** signature(x="compData")

analysis.date<- signature(x="compData", value="character"): Get or set the analysis date in a compData object. value should be a character string describing when the differential expression analysis of the data was performed.

**package.version** signature(x="compData")

package.version<- signature(x="compData", value="character"): Get or set the information about the package version in a compData object. value should be a character string detailing which packages and versions were used to perform the differential expression analysis of the data.

**method.names** signature(x="compData")

method.names<- signature(x="compData", value="list"): Get or set the method names in a compData object. value should be a list with slots full.name and short.name, giving the full name and an abbreviation for the method that was used to perform the analysis of the data.

**code** signature(x="compData")

code<- signature(x="compData", value="character"): Get or set the code slot in a compData object. value should be a character string in R markdown format, giving the code that was run to obtain the results from the differential expression analysis.

**result.table** signature(x="compData")

result.table<- signature(x="compData", value="data.frame"): Get or set the result table in a compData object. value should be a data frame with one row per gene, and at least a column named 'score'.

Construction

An object of the class compData can be constructed using the **compData** function.
**computeFactorLengths**  
*Compute Length Normalization Factors*

**Description**

Compute the factor to be applied for length normalization. Each column of the matrix (samples) is normalized by the weighted average of the column, with weights corresponding to the true probabilities of each gene.

**Usage**

```r
computeFactorLengths(length_matrix, prob.S1, sum.S1)
```

**Arguments**

- `length_matrix`: An n.vars times n.sample matrix of lengths of each gene in each sample.
- `sum.S1`: Sum of means for condition 1.

**Value**

A matrix of the same size as 'length_matrix', with normalization factors to be applied for each sample and each gene.

---

**convertcompDataToList**  
*Convert a compData object to a list*

**Description**

Given a compData object, convert it to a list.

**Usage**

```r
convertcompDataToList(cpd)
```

**Arguments**

- `cpd`: A compData object

**Author(s)**

Charlotte Soneson
convertListTophyloCompData

Examples
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 12500,
samples.per.cond = 5, n.diffexp = 1250)
mydata.list <- convertcompDataToList(mydata.obj)

convertListTophyloCompData  Convert a list with data and results to a phyloCompData object

Description
Given a list with data and results (resulting e.g. from compcodeR version 0.1.0), convert it to a phyloCompData object.

Usage
convertListTophyloCompData(inp.list)

Arguments
inp.list  A list with data and results, e.g. generated by compcodeR version 0.1.0.

Author(s)
Charlotte Soneson

Examples
convertListTophyloCompData(list(count.matrix = matrix(round(1000*runif(4000)), 1000),
sample.annotations = data.frame(condition = c(1,1,2,2)),
info.parameters = list(dataset = "mydata",
uID = "123456")))

convertListTophyloCompData

Description
Convert a list with data and results to a phyloCompData object

Usage
convertListTophyloCompData(inp.list)
convertphyloCompDataToList

Convert a phyloCompData object to a list

Arguments

inp.list A list with data and results, e.g. generated by compcodeR version 0.1.0.

Author(s)

Charlotte Soneson, Paul Bastide

Examples

tree <- ape::read.tree(
  text = "(((A1:0,A2:0,A3:0):1,B1:1):1,((C1:0,C2:0):1.5,(D1:0,D2:0):1.5):0.5);"
)
count.matrix <- round(matrix(1000*runif(8000), 1000))
sample.annotations <- data.frame(condition = c(1, 1, 1, 2, 2, 2, 2),
info.parameters <- list(dataset = "mydata", uID = "123456")
length.matrix <- round(matrix(1000*runif(8000), 1000))
colnames(count.matrix) <- colnames(length.matrix) <- rownames(sample.annotations) <- tree$tip.label
catalogueTophyloCompData(list(count.matrix = count.matrix,
  sample.annotations = sample.annotations,
  info.parameters = list(dataset = "mydata",
    uID = "123456"),
  tree = tree,
  length.matrix = length.matrix))
Examples

```r
tree <- ape::read.tree(
  text = "(((A1:0,A2:0,A3:0):1,B1:1):1,((C1:0,C2:0):1.5,(D1:0,D2:0):1.5):0.5);"
)

names(id.species) <- tree$tip.label

mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
  samples.per.cond = 4, n.diffexp = 100,
  tree = tree,
  id.species = id.species)

mydata.list <- convertcompDataToList(mydata.obj)
```

DESeq2.createRmd

**Generate a `.Rmd` file containing code to perform differential expression analysis with DESeq2**

Description

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the DESeq2 package. The code is written to a `.Rmd` file. This function is generally not called by the user, the main interface for performing differential expression analysis is the `runDiffExp` function.

Usage

```r
DESeq2.createRmd(
  data.path,
  result.path,
  codefile,
  fit.type,
  test,
  beta.prior = TRUE,
  independent.filtering = TRUE,
  cooks.cutoff = TRUE,
  impute.outliers = TRUE,
  nas.as.ones = FALSE
)
```

Arguments

- `data.path` The path to a `.rds` file containing the `compData` object that will be used for the differential expression analysis.
- `result.path` The path to the file where the result object will be saved.
- `codefile` The path to the file where the code will be written.
- `fit.type` The fitting method used to get the dispersion-mean relationship. Possible values are "parametric", "local" and "mean".
DESeq2.createRmd

**test**  
The test to use. Possible values are "Wald" and "LRT".

**beta.prior**  
Whether or not to put a zero-mean normal prior on the non-intercept coefficients. Default is TRUE.

**independent.filtering**  
Whether or not to perform independent filtering of the data. With independent filtering=TRUE, the adjusted p-values for genes not passing the filter threshold are set to NA.

**cooks.cutoff**  
The cutoff value for the Cook’s distance to consider a value to be an outlier. Set to Inf or FALSE to disable outlier detection. For genes with detected outliers, the p-value and adjusted p-value will be set to NA.

**impute.outliers**  
Whether or not the outliers should be replaced by a trimmed mean and the analysis rerun.

**nas.as.ones**  
Whether or not adjusted p values that are returned as NA by DESeq2 should be set to 1. This option is useful for comparisons with other methods. For more details, see section "I want to benchmark DESeq2 comparing to other DE tools" from the DESeq2 vignette (available by running vignette("DESeq2", package = "DESeq2")). Default to FALSE.

**Details**

For more information about the methods and the interpretation of the parameters, see the DESeq2 package and the corresponding publications.

**Value**

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

**Author(s)**

Charlotte Soneson

**References**


**Examples**

```r
try(
  if (require(DESeq2)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
      samples.per.cond = 5, n.diffexp = 100,
      output.file = file.path(tmpdir, "mydata.rds"))
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "DESeq2",
      Rmdfunction = "DESeq2.createRmd",
      output.directory = tmpdir, fit.type = "parametric",
      ...)}
```
DESeq2.length.createRmd

Generate a .Rmd file containing code to perform differential expression analysis with DESeq2 with custom model matrix

Description

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the DESeq2 package. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

Usage

DESeq2.length.createRmd(
  data.path,
  result.path,
  codefile,
  fit.type,
  test,
  beta.prior = TRUE,
  independent.filtering = TRUE,
  cooks.cutoff = TRUE,
  impute.outliers = TRUE,
  extra.design.covariates = NULL,
  nas.as.ones = FALSE
)

Arguments

data.path    The path to a .rds file containing the phyloCompData object that will be used for the differential expression analysis.
result.path  The path to the file where the result object will be saved.
codefile     The path to the file where the code will be written.
fit.type     The fitting method used to get the dispersion-mean relationship. Possible values are "parametric", "local" and "mean".
test         The test to use. Possible values are "Wald" and "LRT".
beta.prior   Whether or not to put a zero-mean normal prior on the non-intercept coefficients. Default is TRUE.
independent.filtering
             Whether or not to perform independent filtering of the data. With independent filtering=TRUE, the adjusted p-values for genes not passing the filter threshold are set to NA.
cooks.cutoff  
The cutoff value for the Cook’s distance to consider a value to be an outlier. Set to Inf or FALSE to disable outlier detection. For genes with detected outliers, the p-value and adjusted p-value will be set to NA.

impute.outliers  
Whether or not the outliers should be replaced by a trimmed mean and the analysis rerun.

eextra.design.covariates  
A vector containing the names of extra control variables to be passed to the design matrix of DESeq2. All the covariates need to be a column of the sample.annotations data frame from the phyloCompData object, with a matching column name. The covariates can be a numeric vector, or a factor. Note that "condition" factor column is always included, and should not be added here. See Details.

nas.as.ones  
Whether or not adjusted p values that are returned as NA by DESeq2 should be set to 1. This option is useful for comparisons with other methods. For more details, see section "I want to benchmark DESeq2 comparing to other DE tools" from the DESeq2 vignette (available by running vignette("DESeq2", package = "DESeq2")). Default to FALSE.

Details

For more information about the methods and the interpretation of the parameters, see the DESeq2 package and the corresponding publications.

The lengths matrix is used as a normalization factor and applied to the DESeq2 model in the way explained in normalizationFactors (see examples of this function). The provided matrix will be multiplied by the default normalization factor obtained through the estimateSizeFactors function.

The design model used in the DESeqDataSetFromMatrix uses the "condition" column of the sample.annotations data frame from the phyloCompData object as well as all the covariates named in extra.design.covariates. For example, if extra.design.covariates = c("var1", "var2"), then sample.annotations must have two columns named "var1" and "var2", and the design formula in the DESeqDataSetFromMatrix function will be: ~ condition + var1 + var2.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson, Paul Bastide, Mélina Gallopin

References


Examples

```r
try(
  if (require(DESeq2)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    ## Simulate data
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                         samples.per.cond = 5, n.diffexp = 100,
                                         id.species = 1:10,
                                         lengths.relmeans = rpois(1000, 1000),
                                         lengths.dispersions = rgamma(1000, 1, 1),
                                         output.file = file.path(tmpdir, "mydata.rds"))
    ## Add covariates
    sample.annotations(mydata.obj)$test_factor <- factor(rep(1:2, each = 5))
    sample.annotations(mydata.obj)$test_reg <- rnorm(10, 0, 1)
    saveRDS(mydata.obj, file.path(tmpdir, "mydata.rds"))
    ## Diff Exp
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "DESeq2",
                Rmdfunction = "DESeq2.length.createRmd",
                output.directory = tmpdir, fit.type = "parametric",
                test = "Wald",
                extra.design.covariates = c("test_factor", "test_reg"))
  }
)
```

DSS.createRmd

`DSS.createRmd` generates an `.Rmd` file containing code to perform differential expression analysis with DSS.

**Description**

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the DSS package. The code is written to a `.Rmd` file. This function is generally not called by the user, the main interface for performing differential expression analysis is the `runDiffExp` function.

**Usage**

`DSS.createRmd(data.path, result.path, codefile, norm.method, disp.trend)`

**Arguments**

- `data.path`: The path to a `.rds` file containing the `compData` object that will be used for the differential expression analysis.
- `result.path`: The path to the file where the result object will be saved.
- `codefile`: The path to the file where the code will be written.
- `norm.method`: The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. Possible values are "quantile", "total" and "median".
disp.trend A logical parameter indicating whether or not to include a trend in the dispersion estimation.

Details

For more information about the methods and the interpretation of the parameters, see the DSS package and the corresponding publications.

Author(s)

Charlotte Soneson

References


Examples

```r
try(
  if (require(DSS)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                              samples.per.cond = 5, n.diffexp = 100,
                              output.file = file.path(tmpdir, "mydata.rds"))
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "DSS",
                Rmdfunction = "DSS.createRmd",
                output.directory = tmpdir, norm.method = "quantile",
                disp.trend = TRUE)
  }
)
```

**EBSeq.createRmd**

Generate a .Rmd file containing code to perform differential expression analysis with EBSeq

**Description**

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the EBSeq package. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

**Usage**

```
EBSeq.createRmd(data.path, result.path, codefile, norm.method)
```
EBSeq.createRmd

Arguments

data.path  The path to a .rds file containing the compData object that will be used for the differential expression analysis.
result.path  The path to the file where the result object will be saved.
codefile  The path to the file where the code will be written.
norm.method  The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. Possible values are "median" and "quantile".

Details

For more information about the methods and the meaning of the parameters, see the EBSeq package and the corresponding publications.

Value

The function generates a .Rmd file containing the differential expression code. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson

References


Examples

```r
try(
  if (require(EBSeq)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                          samples.per.cond = 5, n.diffexp = 100,
                                          output.file = file.path(tmpdir, "mydata.rds"))
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "EBSeq",
               Rmdfunction = "EBSeq.createRmd",
               output.directory = tmpdir, norm.method = "median")
  }
)
```
edgeR.exact.createRmd

Generate a .Rmd file containing code to perform differential expression analysis with the edgeR exact test

Description

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the exact test functionality from the edgeR package. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

Usage

edgeR.exact.createRmd(
  data.path,
  result.path,
  codefile,
  norm.method,
  trend.method,
  disp.type
)

Arguments

data.path The path to a .rds file containing the compData object that will be used for the differential expression analysis.
result.path The path to the file where the result object will be saved.
codefile The path to the file where the code will be written.
norm.method The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. Possible values are "TMM", "RLE", "upperquartile" and "none".
trend.method The method used to estimate the trend in the mean-dispersion relationship. Possible values are "none", "movingave" and "loess".
disp.type The type of dispersion estimate used. Possible values are "common", "trended" and "tagwise".

Details

For more information about the methods and the interpretation of the parameters, see the edgeR package and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.
**Author(s)**

Charlotte Soneson

**References**


**Examples**

```r
tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "edgeR.exact",
Rmdfunction = "edgeR.exact.createRmd",
output.directory = tmpdir, norm.method = "TMM",
trend.method = "movingave", disp.type = "tagwise")
```

**Description**

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the GLM functionality from the edgeR package. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the `runDiffExp` function.

**Usage**

```r
edgeR.GLM.createRmd(
  data.path,
  result.path,
  codefile,
  norm.method,
  disp.type,
  disp.method,
  trended
)
```

**Arguments**

- `data.path` The path to a .rds file containing the compData object that will be used for the differential expression analysis.
- `result.path` The path to the file where the result object will be saved.
codefile The path to the file where the code will be written.

norm.method The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. Possible values are "TMM", "RLE", "upperquartile" and "none".

disp.type The type of dispersion estimate used. Possible values are "common", "trended" and "tagwise".

disp.method The method used to estimate the dispersion. Possible values are "CoxReid", "Pearson" and "deviance".

trended Logical parameter indicating whether or not a trended dispersion estimate should be used.

Details

For more information about the methods and the interpretation of the parameters, see the edgeR package and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson

References


Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "edgeR.GLM",
Rmdfunction = "edgeR.GLM.createRmd",
output.directory = tmpdir, norm.method = "TMM",
disp.type = "tagwise", disp.method = "CoxReid",
trended = TRUE)
extract_results_phyloLm

Extract phyloLm results

Description

Extract results from a phyloLm object. The coefficient of interest must be named "condition".

Usage

extract_results_phyloLm(phylo_lm_obj)

Arguments

phylo_lm_obj a phyloLm object.

Value

A list, with:

- pvalue the p value of the differential expression.
- logFC the log fold change of the differential expression.
- score 1 - pvalue.

generateCodeHTMLs

Generate HTML file(s) containing code used to run differential expression analysis.

Description

A function to extract the code used to generate differential expression results from saved compData result objects (typically obtained by runDiffExp), and to write the code to HTML files. This requires that the code was saved as a character string in R markdown format in the code slot of the result object, which is done automatically by runDiffExp. If the differential expression analysis was performed with functions outside compcodeR, the code has to be added manually to the result object.

Usage

generateCodeHTMLs(input.files, output.directory)
generateLengths

Arguments

input.files A vector with paths to one or several .rds files containing compData objects with the results from differential expression analysis. One code HTML file is generated for each file in the vector.

output.directory The path to the directory where the code HTML files will be saved.

Author(s)
Charlotte Soneson

Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "voom.limma",
Rmdfunction = "voom.limma.createRmd", output.directory = tmpdir,
norm.method = "TMM")
generateCodeHTMLs(file.path(tmpdir, "mydata_voom.limma.rds"), tmpdir)

generateLengths (Simulate a length matrix)

Description
Simulate a length matrix of size n.vars times n.sample, with the length of each gene in each sample.

Usage

generateLengths(id.species, lengths.relmeans, lengths.dispersions)

Arguments

id.species An n.sample vector, indicating the species of each sample.
lengths.relmeans A vector of mean values to use in the simulation of lengths from the Negative Binomial distribution.
lengths.dispersions A vector or matrix of dispersions to use in the simulation of data from the Negative Binomial distribution.

Value
A matrix of lengths, with as many columns as the number of species (length of id.species) and as many rows as the number of parameters in lengths.relmeans.
generateLengthsPhylo  Simulate a length matrix with a phylo model

Description

Simulate a length matrix of size n.vars times n.sample, with the length of each gene in each sample.

Usage

generateLengthsPhylo(tree, id.species, lengths.relmeans, lengths.dispersions)

Arguments

tree  The phylogenetic tree.
id.species  An n.sample vector, indicating the species of each sample.
lengths.relmeans  A vector of mean values to use in the simulation of lengths from the Negative Binomial distribution.
lengths.dispersions  A vector or matrix of dispersions to use in the simulation of data from the Negative Binomial distribution.
lengths.lambda  A vector of heritability parameters to use in the simulation of data from the lambda model.

Value

A matrix of the same size as 'length_matrix', with normalization factors to be applied for each sample and each gene.

generateSyntheticData  Generate synthetic count data sets

Description

Generate synthetic count data sets, following the simulation strategy detailed in Soneson and Delorenzi (2013).
Usage

generateSyntheticData(
  dataset,
  n.vars,
  samples.per.cond,
  n.diffexp,
  repl.id = 1,
  seqdepth = 1e+07,
  minfact = 0.7,
  maxfact = 1.4,
  relmeans = "auto",
  dispersions = "auto",
  fraction.upregulated = 1,
  between.group.diffdisp = FALSE,
  filter.threshold.total = 1,
  filter.threshold.mediancpm = 0,
  fraction.non.overdispersed = 0,
  random.outlier.high.prob = 0,
  random.outlier.low.prob = 0,
  single.outlier.high.prob = 0,
  single.outlier.low.prob = 0,
  effect.size = 1.5,
  output.file = NULL,
  tree = NULL,
  prop.var.tree = 1,
  model.process = c("BM", "OU"),
  selection.strength = 0,
  id.condition = NULL,
  id.species = as.factor(rep(1, 2 * samples.per.cond)),
  check.id.species = TRUE,
  lengths.relmeans = NULL,
  lengths.dispersions = NULL,
  lengths.phylo = TRUE
)

Arguments

dataset A name or identifier for the data set/simulation settings.
n.vars The initial number of genes in the simulated data set. Based on the filtering conditions (filter.threshold.total and filter.threshold.mediancpm), the number of genes in the final data set may be lower than this number.
samples.per.cond The number of samples in each of the two conditions.
n.diffexp The number of genes simulated to be differentially expressed between the two conditions.
repl.id A replicate ID for the specific simulation instance. Useful for example when generating multiple count matrices with the same simulation settings.
seqdepth

The base sequencing depth (total number of mapped reads). This number is multiplied by a value drawn uniformly between minfact and maxfact for each sample to generate data with different actual sequencing depths.

minfact, maxfact

The minimum and maximum for the uniform distribution used to generate factors that are multiplied with seqdepth to generate individual sequencing depths for the simulated samples.

relmeans

A vector of mean values to use in the simulation of data from the Negative Binomial distribution, or "auto". Note that these values may be scaled in order to comply with the given sequencing depth. With the default value ("auto"), the mean values are sampled from values estimated from the Pickrell and Cheung data sets. If relmeans is a vector, the provided values will be used as mean values in the simulation for the samples in the first condition. The mean values for the samples in the second condition are generated by combining the relmeans and effect.size arguments.

dispersions

A vector or matrix of dispersions to use in the simulation of data from the Negative Binomial distribution, or "auto". With the default value ("auto"), the dispersion values are sampled from values estimated from the Pickrell and Cheung data sets. If both relmeans and dispersions are set to "auto", the means and dispersion values are sampled in pairs from the values in these data sets. If dispersions is a single vector, the provided dispersions will be used for simulating data from both conditions. If it is a matrix with two columns, the values in the first column are used for condition 1, and the values in the second column are used for condition 2.

fraction.upregulated

The fraction of the differentially expressed genes that is upregulated in condition 2 compared to condition 1.

between.group.diffdisp

Whether or not the dispersion should be allowed to be different between the conditions. Only applicable if dispersions is "auto".

filter.threshold.total

The filter threshold on the total count for a gene across all samples. All genes for which the total count across all samples is less than the threshold will be filtered out.

filter.threshold.mediancpm

The filter threshold on the median count per million (cpm) for a gene across all samples. All genes for which the median cpm across all samples is less than the threshold will be filtered out.

fraction.non.overdispersed

The fraction of the genes that should be simulated according to a Poisson distribution, without overdispersion. The non-overdispersed genes will be divided proportionally between the upregulated, downregulated and non-differentially expressed genes.

random.outlier.high.prob

The fraction of 'random' outliers with unusually high counts.

random.outlier.low.prob

The fraction of 'random' outliers with unusually low counts.
single.outlier.high.prob
The fraction of 'single' outliers with unusually high counts.

single.outlier.low.prob
The fraction of 'single' outliers with unusually low counts.

effect.size
The strength of the differential expression, i.e., the effect size, between the two conditions. If this is a single number, the effect sizes will be obtained by simulating numbers from an exponential distribution (with rate 1) and adding the results to the effect.size. For genes that are upregulated in the second condition, the mean in the first condition is multiplied by the effect size. For genes that are downregulated in the second condition, the mean in the first condition is divided by the effect size. It is also possible to provide a vector of effect sizes (one for each gene), which will be used as provided. In this case, the fraction.upregulated and n.diffexp arguments will be ignored and the values will be derived from the effect.size vector.

output.file
If not NULL, the path to the file where the data object should be saved. The extension should be .rds, if not it will be changed.

tree
A dated phylogenetic tree of class phylo with 'samples.per.cond * 2' species.

prop.var.tree
the proportion of the common variance explained by the tree for each gene. It can be a scalar, in which case the same parameter is used for all genes. Otherwise it needs to be a vector with length n.vars. Default to 1.

model.process
the process to be used for phylogenetic simulations. One of "BM" or "OU", default to "BM".

selection.strength
if the process is "OU", the selection strength parameter.

id.condition
A named vector, indicating which species is in each condition. Default to first 'samples.per.cond' species in condition '1' and others in condition '2'.

id.species
A factor giving the species for each sample. If a tree is used, should be a named vector with names matching the taxa of the tree. Default to rep(1, 2*samples.per.cond), i.e. all the samples come from the same species.

check.id.species
Should the species vector be checked against the tree lengths (if provided) ? If TRUE, the function checks that all the samples that share a factor value in id.species that their distance on the tree is zero, i.e. that they are on the same tip of the tree. Default to TRUE.

lengths.relmeans
An optional vector of mean values to use in the simulation of lengths from the Negative Binomial distribution. Should be of length n.vars. Default to NULL: the lengths are not taken into account for the simulation. If set to "auto", the mean length values are sampled from values estimated from the Stern & Crandall (2018) data set.

lengths.dispersions
An optional vector of dispersions to use in the simulation of data from the Negative Binomial distribution. Should be of length n.vars. Default to NULL: the lengths are not taken into account for the simulation. If set to "auto", the dispersion length values are sampled from values estimated from the Stern & Crandall (2018) data set.
lengths.phylo If TRUE, the lengths are simulated according to a phylogenetic Poisson Log-Normal model on the tree, with a BM process. If FALSE, they are simulated according to an iid negative binomial distribution. In both cases, lengths.relmeans and lengths.dispersions are used. Default to TRUE if a tree is provided.

Details

In the comparison function, only results obtained for data sets with the same value of the dataset parameter will be compared. Hence, it is important to give the same value of this parameter e.g. to different replicates generated with the same simulation settings.

For more detailed information regarding the different types of outliers, see Soneson and Delorenzi (2013).

Mean and dispersion parameters (if relmeans and/or dispersions is set to ”auto”) are sampled from values estimated from the data sets by Pickrell et al (2010) and Cheung et al (2010). The data sets were downloaded from the ReCount web page (Frazee et al (2011)) and processed as detailed by Soneson and Delorenzi (2013).

To get the actual mean value for the Negative Binomial distribution used for the simulation of counts for a given sample, take the column truemeans.S1 (or truemeans.S2, if the sample is in condition S2) of the variable. annotations slot, divide by the sum of the same column and multiply with the base sequencing depth (provided in the info.parameters list) and the depth factor for the sample (given in the sample.annotations data frame). Thus, if you have a vector of mean values that you want to provide as the relmeans argument and make sure to use it ‘as-is’ in the simulation (for condition S1), make sure to set the seqdepth argument to the sum of the values in the relmeans vector, and to set minfact and maxfact equal to 1.

When the tree argument is provided (not NULL), then the ”phylogenetic Poisson log-Normal” model is used for the simulations, possibly with varying gene lengths across species (both lengths.relmeans and lengths.dispersions must be specified or set to ”auto”). Phylogenetic simulations use the rTrait function from package phylolm.

Value

A compData object. If output.file is not NULL, the object is saved in the given output.file (which should have an .rds extension).

Author(s)

Charlotte Soneson

References

getNegativeBinomialDispersion


Examples

```r
## RNA-Seq data
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                     samples.per.cond = 5, n.diffexp = 100)

## Inter-species RNA-Seq data
library(ape)
tree <- read.tree(text = "(((A1:0,A2:0,A3:0):1,B1:1):1,((C1:0,C2:0):1.5,(D1:0,D2:0):1.5):0.5);")
names(id.species) <- tree$tip.label
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                     samples.per.cond = 4, n.diffexp = 100,
                                     tree = tree,
                                     id.species = id.species,
                                     lengths.relmeans = "auto",
                                     lengths.dispersions = "auto")
```

getNegativeBinomialDispersion

Get NB dispersion

Description

Get the NB dispersion for one gene in one sample

Usage

```r
getNegativeBinomialDispersion(
  i,
  j,
  S1,
  truedispersions.S1,
  S2,
  truedispersions.S2
)
```
getNegativeBinomialMean

Arguments

- **i**: gene index.
- **j**: sample index.
- **S1**: Indices in condition 1.
- **truedispersions.S1**: Vector of dispersions for condition 1.
- **S2**: Indices in condition 2.
- **truedispersions.S2**: Vector of dispersions for condition 2.

Value

The dispersion for gene i in sample j.

---

getNegativeBinomialMean

*Get NB mean*

Description

Get the NB mean for one gene in one sample

Usage

```r
getNegativeBinomialMean(
  i,
  j,
  S1,
  prob.S1,
  sum.S1,
  nfact_length.S1,
  S2,
  prob.S2,
  sum.S2,
  nfact_length.S2,
  seq.depths
)
```

Arguments

- **i**: gene index.
- **j**: sample index.
- **S1**: Indices in condition 1.
- **prob.S1**: Vector of means for condition 1.
- **sum.S1**: Sum of means for condition 1.
getNegativeBinomialParameters

$nfact\_length. S1$

Matrix of length factors for condition 1.

$S2$

Indices in condition 2.

$prob. S2$

Vector of means for condition 2.

$sum. S2$

Sum of means for condition 2.

$nfact\_length. S2$

Matrix of length factors for condition 2.

Value

The mean for gene $i$ in sample $j$.

description

Get both the mean and the dispersions of the NB as matrices for all indices.

Usage

getNegativeBinomialParameters(
  n.vars,
  S1,
  prob.S1,
  sum.S1,
  truedispersions.S1,
  nfact_length.S1,
  S2,
  prob.S2,
  sum.S2,
  truedispersions.S2,
  nfact_length.S2,
  seq.depths
)

Arguments

n.vars

The initial number of genes in the simulated data set. Based on the filtering conditions ($\text{filter.threshold.total}$ and $\text{filter.threshold.mediancpm}$), the number of genes in the final data set may be lower than this number.

S1

Indices in condition 1.

prob.S1

Vector of means for condition 1.

sum.S1

Sum of means for condition 1.
getTree

Value

A list of parameters for each entry of the count matrix:

- **count_means**  a matrix of mean for each gene and sample.
- **count_dispersions** a matrix of dispersions for each gene and sample.

---

getTree  *Get the tree from a phyloCompData object*

Description

Return the tree of a phyloCompData object. If no tree, return a star tree with unit height, and throw a warning.

Usage

getTree(cdata)

Arguments

- **cdata**  a phyloCompData object.

Value

A tree of class phylo
get_model_factor

Get the scaling factor

Description
Get the scaling factors.

Usage
get_model_factor(model.process, selection.strength, tree)

Arguments
- model.process: the process to be used for phylogenetic simulations. One of "BM" or "OU", default to "BM".
- selection.strength: if the process is "OU", the selection strength parameter.
- tree: a dated phylogenetic tree of class phylo with ‘samples.per.cond * 2’ species.

Value
A vector N of factors.

get_poisson_log_normal_parameters

Compute log means and variances

Description
From the parameters of a negative binomial (count_means and count_dispersions), compute the parameters of a phylogenetic Poisson log-normal with the same expectations and variances.

Usage
get_poisson_log_normal_parameters(
  count_means,
  count_dispersions,
  prop.var.tree
)

Arguments
- count_means: a matrix with the number of genes p rows and the number of species n columns. Column names should match the tree taxa names.
- count_dispersions: a matrix of size p x n, for each gene and species. Column names should match the tree taxa names.
Value

A list, with:

- **log_means** the p x n matrix of log-means for Poisson-lognormal simulations.
- **log_variance_phylo** the p vector of phylogenetic log-variances for Poisson-lognormal simulations.
- **log_variance_sample** the p x n matrix of environmental log-variances for Poisson-lognormal simulations.

Description

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) by applying a length normalizing transformation followed by differential expression analysis with limma. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the `runDiffExp` function.

Usage

```r
lengthNorm.limma.createRmd(
  data.path,
  result.path,
  codefile,
  norm.method,
  extra.design.covariates = NULL,
  length.normalization = "RPKM",
  data.transformation = "log2",
  trend = FALSE,
  block.factor = NULL
)
```

Arguments

- **data.path** The path to a .rds file containing the phyloCompData object that will be used for the differential expression analysis.
- **result.path** The path to the file where the result object will be saved.
- **codefile** The path to the file where the code will be written.
- **norm.method** The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the `calcNormFactors` of the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none"
extra.design.covariates
A vector containing the names of extra control variables to be passed to the design matrix of limma. All the covariates need to be a column of the sample.annotations data frame from the phyloCompData object, with a matching column name. The covariates can be a numeric vector, or a factor. Note that "condition" factor column is always included, and should not be added here. See Details.

length.normalization
one of "none" (no length correction), "TPM", or "RPKM" (default). See details.
data.transformation
one of "log2", "asin(sqrt)" or "sqrt". Data transformation to apply to the normalized data.
trend
should an intensity-trend be allowed for the prior variance? Default to FALSE.
block.factor
Name of the factor specifying a blocking variable, to be passed to duplicateCorrelation function of the limma package. All the factors need to be a sample.annotations from the phyloCompData object. Default to null (no block structure).

Details
For more information about the methods and the interpretation of the parameters, see the limma package and the corresponding publications.

The length.matrix field of the phyloCompData object is used to normalize the counts, using one of the following formulas:

- length.normalization="none": \( CPM_{gi} = \frac{N_{gi} + 0.5}{NF_i \times \sum_g N_{gi} + 1} \times 10^6 \)
- length.normalization="TPM": \( TPM_{gi} = \frac{(N_{gi} + 0.5)/L_{gi}}{NF_i \times \sum_g N_{gi}/L_{gi} + 1} \times 10^6 \)
- length.normalization="RPKM": \( RPKM_{gi} = \frac{(N_{gi} + 0.5)/L_{gi}}{NF_i \times \sum_g N_{gi}/L_{gi} + 1} \times 10^9 \)

where \( N_{gi} \) is the count for gene \( g \) and sample \( i \), where \( L_{gi} \) is the length of gene \( g \) in sample \( i \), and \( NF_i \) is the normalization for sample \( i \), normalized using calcNormFactors of the edgeR package.

The function specified by the data.transformation is then applied to the normalized count matrix.

The "+0.5" and "+1" are taken from Law et al 2014, and dropped from the normalization when the transformation is something else than log2.

The "\( \times 10^6 \)" and "\( \times 10^9 \)" factors are omitted when the asin(sqrt) transformation is taken, as \( asin \) can only be applied to real numbers smaller than 1.

The design model used in the lmFit uses the "condition" column of the sample.annotations data frame from the phyloCompData object as well as all the covariates named in extra.design.covariates. For example, if extra.design.covariates = c("var1", "var2"), then sample.annotations must have two columns named "var1" and "var2", and the design formula in the lmFit function will be: ~ condition + var1 + var2.

Value
The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.
Author(s)

Charlotte Soneson, Paul Bastide, Mélina Gallopin

References


Examples

```r
try(
  if (require(limma)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    ## Simulate data
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                         samples.per.cond = 5, n.diffexp = 100,
                                         id.species = factor(1:10),
                                         lengths.relmeans = rpois(1000, 1000),
                                         lengths.dispersions = rgamma(1000, 1, 1),
                                         output.file = file.path(tmpdir, "mydata.rds"))
    ## Add covariates
    ## Model fitted is count.matrix ~ condition + test_factor + test_reg
    sample.annotations(mydata.obj)$test_factor <- factor(rep(1:2, each = 5))
    sample.annotations(mydata.obj)$test_reg <- rnorm(10, 0, 1)
    saveRDS(mydata.obj, file.path(tmpdir, "mydata.rds"))
    ## Diff Exp
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "length.limma",
               RmdFunction = "lengthNorm.limma.createRmd",
               output.directory = tmpdir, norm.method = "TMM",
               extra.design.covariates = c("test_factor", "test_reg"))
  })
```

lengthNorm.sva.limma.createRmd

Generate a .Rmd file containing code to perform differential expression analysis with length normalized counts + SVA + limma
Description
A function to generate code that can be run to perform differential expression analysis of RNASeq data (comparing two conditions) by applying a length normalizing transformation, followed by a surrogate variable analysis (SVA), and then a differential expression analysis with limma. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

Usage
lengthNorm.sva.limma.createRmd(
  data.path,
  result.path,
  codefile,
  norm.method,
  extra.design.covariates = NULL,
  length.normalization = "RPKM",
  data.transformation = "log2",
  trend = FALSE,
  n.sv = "auto"
)

Arguments
data.path The path to a .rds file containing the phyloCompData object that will be used for the differential expression analysis.
result.path The path to the file where the result object will be saved.
codefile The path to the file where the code will be written.
norm.method The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the calcNormFactors of the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none".
extra.design.covariates A vector containing the names of extra control variables to be passed to the design matrix of limma. All the covariates need to be a column of the sample.annotations data frame from the phyloCompData object, with a matching column name. The covariates can be a numeric vector, or a factor. Note that "condition" factor column is always included, and should not be added here. See Details.
length.normalization one of "none" (no length correction), "TPM", or "RPKM" (default). See details.
data.transformation one of "log2", "asin(sqrt)" or "sqrt". Data transformation to apply to the normalized data.
trend should an intensity-trend be allowed for the prior variance? Default to FALSE.
n.sv The number of surrogate variables to estimate (see sva). Default to "auto": will be estimated with num.sv.
Details

For more information about the methods and the interpretation of the parameters, see the sva and limma packages and the corresponding publications.

See the details section of `lengthNorm.limma.createRmd` for details on the normalization and the extra design covariates.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson, Paul Bastide, Mélina Gallopin

References


Examples

```r
try(
  if (require(limma) && require(sva)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    ## Simulate data
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
      samples.per.cond = 5, n.diffexp = 100,
      id.species = factor(1:10),
      lengths.relmeans = rpois(1000, 1000),
      lengths.dispersions = rgamma(1000, 1, 1),
      output.file = file.path(tmpdir, "mydata.rds"))
    ## Add covariates
    ## Model fitted is count.matrix ~ condition + test_factor + test_reg
    sample.annnotations(mydata.obj)$test_factor <- factor(rep(1:2, each = 5))
    sample.annnotations(mydata.obj)$test_reg <- rnorm(10, 0, 1)
    saveRDS(mydata.obj, file.path(tmpdir, "mydata.rds"))
    ## Diff Exp
  }
)
```
listcreateRmd

List available *.createRmd functions

Description
Print a list of all *.createRmd functions that are available in the search path. These functions can be used together with the runDiffExp function to perform differential expression analysis. Consult the help pages for the respective functions for more information.

Usage
listcreateRmd()

Author(s)
Charlotte Soneson

Examples
listcreateRmd()

logcpm.limma.createRmd

Generate a .Rmd file containing code to perform differential expression analysis with limma after log-transforming the counts per million (cpm)

Description
A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using limma, after preprocessing the counts by computing the counts per million (cpm) and applying a logarithmic transformation. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

Usage
logcpm.limma.createRmd(data.path, result.path, codefile, norm.method)
Arguments

data.path The path to a .rds file containing the compData object that will be used for the differential expression analysis.

result.path The path to the file where the result object will be saved.

codefile The path to the file where the code will be written.

norm.method The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the calcNormFactors function from the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none".

Details

For more information about the methods and the interpretation of the parameters, see the edgeR and limma packages and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson

References


Examples

```r
tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "logcpm.limma",
Rmdfunction = "logcpm.limma.createRmd",
output.directory = tmpdir, norm.method = "TMM")
```
Description

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using NBPSeq. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

Usage

NBPSeq.createRmd(data.path, result.path, codefile, norm.method, disp.method)

Arguments

data.path The path to a .rds file containing the compData object that will be used for the differential expression analysis.
result.path The path to the file where the result object will be saved.
codefile The path to the file where the code will be written.
norm.method The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the calcNormFactors function from the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none".
disp.method The method to use to estimate the dispersion values. Possible values are "NBP" and "NB2".

Details

For more information about the methods and the interpretation of the parameters, see the NBPSeq and edgeR packages and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson
References


Examples

```r
try(
  if (require(NBPSeq)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                        samples.per.cond = 5, n.diffexp = 100,
                                        output.file = file.path(tmpdir, "mydata.rds"))
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "NBPSeq",
               Rmdfunction = "NBPSeq.createRmd",
               output.directory = tmpdir, norm.method = "TMM", disp.method = "NBP")
  })
```

---

**NB_to_PLN**

*Negative Binomial to Poisson Log-Normal*

**Description**

From the parameters of a negative binomial (mean and dispersion), compute the parameters of a Poisson log-normal with the same expectation and variance.

**Usage**

```r
NB_to_PLN(mean, dispersion)
```

**Arguments**

- **mean**: mean of the negative binomial.
- **dispersion**: dispersion of the negative binomial.

**Value**

A list, with:

- **log_means_pln**: Mean of the Poisson log normal in the log space.
- **log_variances_pln**: Variance of the Poisson log normal in the log space.
**nEffNaive**  
*Effective Sample Size*

**Description**
Sample size so that the variance of the estimator is $\sigma^2 / n_{\text{Eff}}$.

**Usage**
nEffNaive(tree, id.condition, model, selection.strength)

**Arguments**
- **tree**: A phylogenetic tree. If `NULL`, samples are assumed to be iid.
- **id.condition**: A named vector giving the state of each tip (sample).
- **model**: The trait evolution model. One of "BM" or "OU".
- **selection.strength**: If `model="OU"`, the selection strength parameter.

**Value**
The effective sample size.

---

**nEffRatio**  
*Effective Sample Size Ratio*

**Description**
Ratio between the tree sample size and the sample size of the equivalent problem with independent measures. A result larger than one indicates a problem that is made "easier" by the tree structure. Note that it strongly depends on the tip conditions (see examples).

**Usage**
nEffRatio(tree, id.condition, model, selection.strength)

**Arguments**
- **tree**: A phylogenetic tree. If `NULL`, samples are assumed to be iid.
- **id.condition**: A named vector giving the state of each tip (sample).
- **model**: The trait evolution model. One of "BM" or "OU".
- **selection.strength**: If `model="OU"`, the selection strength parameter.
Value
The ratio of sample sizes.

Examples
set.seed(1289)
## Ballanced tree
ntips <- 2^5
tree <- ape::compute.brlen(ape::stree(ntips, "balanced"))
## Alt cond : nEff greater than 1
id_cond <- rep(rep(0:1, each = 2), ntips / 4)
names(id_cond) <- tree$tip.label
plot(tree); ape::tiplabels(pch = 21, col = id_cond, bg = id_cond)
compcodeR:::nEffRatio(tree, id_cond, "BM", 0)
## Bloc cond : nEff smaller than 1
id_cond <- rep(0:1, each = ntips / 2)
names(id_cond) <- tree$tip.label
plot(tree); ape::tiplabels(pch = 21, col = id_cond, bg = id_cond)
compcodeR:::nEffRatio(tree, id_cond, "BM", 0)

NOISeq.prenorm.createRmd

Generate a .Rmd file containing code to perform differential expression analysis with NOISeq

Description
A function to generate code that can be run to perform differential expression analysis of RNAseq
data (comparing two conditions) using NOISeq. The code is written to a .Rmd file. This function is
generally not called by the user, the main interface for performing differential expression analysis
is the runDiffExp function.

Usage
NOISeq.prenorm.createRmd(data.path, result.path, codefile, norm.method)

Arguments
data.path The path to a .rds file containing the compData object that will be used for the
differential expression analysis.
result.path The path to the file where the result object will be saved.
codefile The path to the file where the code will be written.
norm.method The between-sample normalization method used to compensate for varying li-
brary sizes and composition in the differential expression analysis. The nor-
malization factors are calculated using the calcNormFactors function from
the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and
"none".
Details

For more information about the methods and the interpretation of the parameters, see the NOISeq package and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson

References


Examples

```r
try(
  if (require(NOISeq)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
      samples.per.cond = 5, n.diffexp = 100,
      output.file = file.path(tmpdir, "mydata.rds"))
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "NOISeq",
      Rmdfunction = "NOISeq.prenorm.createRmd",
      output.directory = tmpdir, norm.method = "TMM")
  }
)
```

Description

The `phyloCompData` class extends the `compData` class with sequence length and phylogeny related information.
phyloCompData

Usage

phyloCompData(
  count.matrix,
  sample.annotations,
  info.parameters,
  variable.annotations = data.frame(),
  filtering = "no info",
  analysis.date = "",
  package.version = "",
  method.names = list(),
  code = "",
  result.table = data.frame(),
  tree = list(),
  length.matrix = matrix(NA_integer_, 0, 0)
)

Arguments

count.matrix  A count matrix, with genes as rows and observations as columns.
sample.annotations  A data frame, containing at least one column named 'condition', encoding the grouping of the observations into two groups, and one column named id.species of factors giving the species for each sample if the tree is specified. The row names should be the same as the column names of count.matrix. Class data.frame.
info.parameters  A list containing information regarding simulation parameters etc. The only mandatory entries are dataset and uID, but it may contain entries such as the ones listed below (see generateSyntheticData for more detailed information about each of these entries).
  • dataset: an informative name or identifier of the data set (e.g., summarizing the simulation settings).
  • samples.per.cond
  • n.diffexp
  • repl.id
  • seqdepth
  • minfact
  • maxfact
  • fraction.upregulated
  • between.group.diffdisp
  • filter.threshold.total
  • filter.threshold.mediancpm
  • fraction.non.overdispersed
  • random.outlier.high.prob
  • random.outlier.low.prob
  • single.outlier.high.prob
• single.outlier.low.prob
• effect.size
• uID: a unique ID for the data set. In contrast to dataset, the uID is unique e.g. for each instance of replicated data sets generated with the same simulation settings.

variable.annotations
A data frame with variable annotations (with number of rows equal to the number of rows in count.matrix, that is, the number of variables in the data set). Not mandatory, but may contain columns such as the ones listed below. If present, the row names should be the same as the row names of the count.matrix.

• truedispersions.S1: the true dispersion for each gene in condition S1.
• truedispersions.S2: the true dispersion for each gene in condition S2.
• truemeans.S1: the true mean value for each gene in condition S1.
• truemeans.S2: the true mean value for each gene in condition S2.
• n.random.outliers.up.S1: the number of 'random' outliers with extremely high counts for each gene in condition S1.
• n.random.outliers.up.S2: the number of 'random' outliers with extremely high counts for each gene in condition S2.
• n.random.outliers.down.S1: the number of 'random' outliers with extremely low counts for each gene in condition S1.
• n.random.outliers.down.S2: the number of 'random' outliers with extremely low counts for each gene in condition S2.
• n.single.outliers.up.S1: the number of 'single' outliers with extremely high counts for each gene in condition S1.
• n.single.outliers.up.S2: the number of 'single' outliers with extremely high counts for each gene in condition S2.
• n.single.outliers.down.S1: the number of 'single' outliers with extremely low counts for each gene in condition S1.
• n.single.outliers.down.S2: the number of 'single' outliers with extremely low counts for each gene in condition S2.
• M.value: the M-value (observed log2 fold change between condition S1 and condition S2) for each gene.
• A.value: the A-value (observed average expression level across condition S1 and condition S2) for each gene.
• truelog2foldchanges: the true (simulated) log2 fold changes between condition S1 and condition S2.
• upregulation: a binary vector indicating which genes are simulated to be upregulated in condition S2 compared to condition S1.
• downregulation: a binary vector indicating which genes are simulated to be downregulated in condition S2 compared to condition S1.
• differential.expression: a binary vector indicating which genes are simulated to be differentially expressed in condition S2 compared to condition S1.

filtering
A character string containing information about the filtering that has been applied to the data set.
If a differential expression analysis has been performed, a character string detailing when it was performed.

If a differential expression analysis has been performed, a character string giving the version of the differential expression packages that were applied.

If a differential expression analysis has been performed, a list with entries full.name and short.name, giving the full name of the differential expression method (may including version number and parameter settings) and a short name or abbreviation.

If a differential expression analysis has been performed, a character string containing the code that was run to perform the analysis. The code should be in R markdown format, and can be written to an HTML file using the `generateCodeHTMLs` function.

If a differential expression analysis has been performed, a data frame containing the results of the analysis. The number of rows should be equal to the number of rows in `count.matrix` and if present, the row names should be identical. The only mandatory column is `score`, which gives a score for each gene, where a higher score suggests a "more highly differentially expressed" gene. Different comparison functions use different columns of this table, if available. The list below gives the columns that are used by the interfaced methods.

- `pvalue` nominal p-values
- `adjpvalue` p-values adjusted for multiple comparisons
- `logFC` estimated log-fold changes between the two conditions
- `score` the score that will be used to rank the genes in order of significance. Note that high scores always signify differential expression, that is, a strong association with the predictor. For example, for methods returning a nominal p-value the score can be defined as `1 - pvalue`.
- `FDR` false discovery rate estimates
- `posterior.DE` posterior probabilities of differential expression
- `prob.DE` conditional probabilities of differential expression
- `1fdr` local false discovery rates
- `statistic` test statistics from the differential expression analysis
- `dispersion.S1` dispersion estimates in condition S1
- `dispersion.S2` dispersion estimates in condition S2

The phylogenetic tree describing the relationships between samples. The taxa names of the tree should be the same as the column names of the `count.matrix`.

The length matrix, with genes as rows and samples as columns. The column names of the `length.matrix` should be the same as the column names of the `count.matrix`.

A `phyloCompData` object.

Charlotte Soneson, Paul Bastide
phyloCompData-class

Examples

tree <- ape::read.tree(  
  text = "(((A1:0,A2:0,A3:0):1,B1:1):1,((C1:0,C2:0):1.5,(D1:0,D2:0):1.5):0.5);"
)
count.matrix <- round(matrix(1000*runif(8000), 1000))
sample.annotations <- data.frame(condition = c(1, 1, 1, 1, 2, 2, 2, 2),  
info.parameters <- list(dataset = "mydata", uID = "123456")
length.matrix <- round(matrix(1000*runif(8000), 1000))
colnames(count.matrix) <- colnames(length.matrix) <- rownames(sample.annotations) <- tree$tip.label
cpd <- phyloCompData(count.matrix, sample.annotations, info.parameters,  
  tree = tree, length.matrix = length.matrix)

phyloCompData-class  Class phyloCompData

Description

The phyloCompData class extends the compData class with sequence length and phylogeny related information.

Slots

tree: The phylogenetic tree describing the relationships between samples. The taxa names of the tree should be the same as the column names of the count.matrix. Class phylo.

length.matrix: The length matrix, with genes as rows and samples as columns. The column names of the length.matrix should be the same as the column names of the count.matrix. Class matrix.

sample.annotations: In addition to the columns described in the compData class, if the tree is specified, it should contain an extra column named id.species of factors giving the species for each sample. The row names should be the same as the column names of count.matrix. Class data.frame.

Methods

phylo.tree signature(x="phyloCompData")
phylo.tree<- signature(x="phyloCompData", value="phylo"): Get or set the tree in a phyloCompData object. value should be a phylo object.

length.matrix signature(x="phyloCompData")
length.matrix<- signature(x="phyloCompData", value="matrix"): Get or set the length matrix in a phyloCompData object. value should be a numeric matrix.

Construction

An object of the class phyloCompData can be constructed using the phyloCompData function.
Author(s)
Charlotte Soneson, Paul Bastide

phyloCompDataFromCompData

Create a phyloCompData object

Description
The phyloCompData class extends the compData class with sequence length and phylogeny related information.

Usage

phyloCompDataFromCompData(
  compDataObject, 
  tree = list(), 
  length.matrix = matrix(NA_integer_, 0, 0) 
)

Arguments

compDataObject An object of class compData.

Tree A phylogenetic tree describing the relationships between samples.

length.matrix A length matrix, with genes as rows and observations as columns.

Value

A phyloCompData object.

Author(s)
Charlotte Soneson, Paul Bastide
**Description**

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the phylolm package. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the `runDiffExp` function.

**Usage**

```r
phylolm.createRmd(
  data.path,
  result.path,
  codefile,
  norm.method,
  model = "BM",
  measurement_error = TRUE,
  extra.design.covariates = NULL,
  length.normalization = "RPKM",
  data.transformation = "log2",
  ...
)
```

**Arguments**

- `data.path`: The path to a .rds file containing the `phyloCompData` object that will be used for the differential expression analysis.
- `result.path`: The path to the file where the result object will be saved.
- `codefile`: The path to the file where the code will be written.
- `norm.method`: The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the `calcNormFactors` of the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none".
- `model`: The model for trait evolution on the tree. Default to "BM".
- `measurement_error`: A logical value indicating whether there is measurement error. Default to TRUE.
- `extra.design.covariates`: A vector containing the names of extra control variables to be passed to the design matrix of `phyolm`. All the covariates need to be a column of the `sample.annotations` data frame from the `phyloCompData` object, with a matching column name. The covariates can be a numeric vector, or a factor. Note that "condition" factor column is always included, and should not be added here. See Details.
length.normalization
one of "none" (no correction), "TPM" or "RPKM" (default). See details.

data.transformation
one of "log2", "asin(sqrt)" or "sqrt". Data transformation to apply to the normalized data.

Further arguments to be passed to function phylolm.

Details

For more information about the methods and the interpretation of the parameters, see the phylolm package and the corresponding publications.

The length.matrix field of the phyloCompData object is used to normalize the counts, using one of the following formulas: * length.normalization="none": \[ CPM_{gi} = \frac{N_{gi} + 0.5}{NF_i \times \sum_g N_{gi} + 1} \times 10^6 \]

length.normalization="TPM": \[ TPM_{gi} = \frac{(N_{gi} + 0.5)/L_{gi}}{NF_i \times \sum_g N_{gi} / L_{gi} + 1} \times 10^6 \]

length.normalization="RPKM": \[ RPKM_{gi} = \frac{(N_{gi} + 0.5)/L_{gi}}{NF_i \times \sum_g N_{gi} / L_{gi} + 1} \times 10^9 \]

where \( N_{gi} \) is the count for gene g and sample i, where \( L_{gi} \) is the length of gene g in sample i, and \( NF_i \) is the normalization for sample i, normalized using calcNormFactors of the edgeR package.

The function specified by the data.transformation is then applied to the normalized count matrix.

The "+0.5" and "+1" are taken from Law et al 2014, and dropped from the normalization when the transformation is something else than log2.

The "\( \times 10^6 \)" and "\( \times 10^9 \)" factors are omitted when the asin(sqrt) transformation is taken, as asin can only be applied to real numbers smaller than 1.

The design model used in the phylolm uses the "condition" column of the sample.annotations data frame from the phyloCompData object as well as all the covariates named in extra.design.covariates. For example, if extra.design.covariates = c("var1", "var2"), then sample.annotations must have two columns named "var1" and "var2", and the design formula in the phylolm function will be: \( \sim \) condition + var1 + var2.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson, Paul Bastide, Mélina Gallopin

References


Examples

```r
try(
  if (require(ape) && require(phylolm)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    set.seed(20200317)
    tree <- rphylo(10, 0.1, 0)
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
      samples.per.cond = 5, n.diffexp = 100,
      tree = tree,
      id.species = 1:10,
      lengths.relmeans = rpois(1000, 1000),
      lengths.dispersions = rgamma(1000, 1, 1),
      output.file = file.path(tmpdir, "mydata.rds"))
    ## Add covariates
    ## Model fitted is count.matrix ~ condition + test_factor + test_reg
    sample.annotations(mydata.obj)$test_factor <- factor(rep(1:2, each = 5))
    sample.annotations(mydata.obj)$test_reg <- rnorm(10, 0, 1)
    saveRDS(mydata.obj, file.path(tmpdir, "mydata.rds"))
    ## Diff Exp
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "DESeq2",
      Rmdfunction = "phylolm.createRmd",
      output.directory = tmpdir,
      norm.method = "TMM",
      extra.design.covariates = c("test_factor", "test_reg"),
      length.normalization = "RPKM")
  })
```

---

**phylolm_analysis**

Perform the phylolm analysis

**Description**

Perform the phylolm analysis for a given gene.

**Usage**

```r
phylolm_analysis(
  dat,
  design_data,
  design_formula,
  tree,
  model,
  measurement_error,
  ...
)
```
runComparison

Arguments

dat the data associated with a gene
design_data design matrix
design_formula design formula
tree phylogenetic tree
model the model to be used in phylolm
measurement_error boolean

Value

A list, with:

pvalue the p value of the differential expression.
logFC the log fold change of the differential expression.
score 1 - pvalue.

runComparison Run the performance comparison between differential expression methods.

Description

The main function for performing comparisons among differential expression methods and generating a report in HTML format. It is assumed that all differential expression results have been generated in advance (using e.g. the function runDiffExp) and that the result compData object for each data set and each differential expression method is saved separately in files with the extension .rds. Note that the function can also be called via the runComparisonGUI function, which lets the user set parameters and select input files using a graphical user interface.

Usage

runComparison(
  file.table, parameters, output.directory,
  check.table = TRUE, out.width = NULL, save.result.table = FALSE,
  knit.results = TRUE
)
Arguments

file.table  A data frame with at least a column input.files, potentially also columns named datasets, nbr.samples, repl and de.methods.

parameters  A list containing parameters for the comparison study. The following entries are supported, and used by different comparison methods:

• incl.nbr.samples  An array with sample sizes (number of samples per condition) to consider in the comparison. If set to NULL, all sample sizes will be included.
• incl.dataset  A dataset name (corresponding to the dataset slot of the results or data objects), indicating the dataset that will be used for the comparison. Only one dataset can be chosen.
• incl.replicates  An array with replicate numbers to consider in the comparison. If set to NULL, all replicates will be included.
• incl.de.methods  An array with differential expression methods to be compared. If set to NULL, all differential expression methods will be included.
• fdr.threshold  The adjusted p-value threshold for FDR calculations. Default 0.05.
• tpr.threshold  The adjusted p-value threshold for TPR calculations. Default 0.05.
• mcc.threshold  The adjusted p-value threshold for MCC calculations. Default 0.05.
• typeI.threshold  The nominal p-value threshold for type I error calculations. Default 0.05.
• fdc.maxvar  The maximal number of variables to include in false discovery curve plots. Default 1500.
• overlap.threshold  The adjusted p-value for overlap analysis. Default 0.05.
• fracsign.threshold  The adjusted p-value for calculation of the fraction/number of genes called significant. Default 0.05.
• nbrtpfp.threshold  The adjusted p-value for calculation of the number of TP, FP, TN, FN genes. Default 0.05.
• ma.threshold  The adjusted p-value threshold for coloring genes in MA plots. Default 0.05.
• signal.measure  Either 'mean' or 'snr', determining how to define the signal strength for a gene which is expressed in only one condition.
• upper.limits, lower.limits  Lists that can be used to manually set the upper and lower plot limits for boxplots of fdr, tpr, auc, mcc, fracsign, nbrtpfp and typeerror.
• comparisons  Array containing the comparison methods to be applied. The entries must be chosen among the following abbreviations:
  - "auc" - Compute the area under the ROC curve
  - "mcc" - Compute Matthew's correlation coefficient
  - "tpr" - Compute the true positive rate at a given adjusted p-value threshold (tpr.threshold)
runComparison

- "fdr" - Compute the false discovery rate at a given adjusted p-value threshold (fdr.threshold)
- "fdrsexpr" - Compute the false discovery rate as a function of the expression level.
- "typeIerror" - Compute the type I error rate at a given nominal p-value threshold (typeI.threshold)
- "fracsing" - Compute the fraction of genes called significant at a given adjusted p-value threshold (fracsing.threshold).
- "nbrsing" - Compute the number of genes called significant at a given adjusted p-value threshold (fracsing.threshold).
- "nbrtpfp" - Compute the number of true positives, false positives, true negatives and false negatives at a given adjusted p-value threshold (nbrtpfp.threshold).
- "maplot" - Construct MA plots, depicting the average expression level and the log fold change for the genes and indicating the genes called differentially expressed at a given adjusted p-value threshold (ma.threshold).
- "fdcurvesall" - Construct false discovery curves for each of the included replicates.
- "fdcurvesone" - Construct false discovery curves for a single replicate only
- "rocall" - Construct ROC curves for each of the included replicates
- "rocone" - Construct ROC curves for a single replicate only
- "overlap" - Compute the overlap between collections of genes called differentially expressed by the different methods at a given adjusted p-value threshold (overlap.threshold)
- "sorensen" - Compute the Sorensen index, quantifying the overlap between collections of genes called differentially expressed by the different methods, at a given adjusted p-value threshold (overlap.threshold)
- "correlation" - Compute the Spearman correlation between gene scores assigned by different methods
- "scorevsoutlier" - Visualize the distribution of the gene scores as a function of the number of outlier counts introduced for the genes
- "scoresexpr" - Visualize the gene scores as a function of the average expression level of the genes
- "scoressignal" - Visualize the gene score as a function of the 'signal strength' (see the signal.measure parameter above) for genes that are expressed in only one condition

output.directory

The directory where the results should be written. The subdirectory structure will be created automatically. If the directory already exists, it will be overwritten.

check.table

Logical, should the input table be checked for consistency. Default TRUE.

out.width

The width of the figures in the final report. Will be passed on to knitr when the HTML is generated.
runComparison

save.result.table
Logical, should the intermediate result table be saved for future use? Default to FALSE.

knit.results
Logical, should the Rmd be generated and knitted? Default to TRUE. If FALSE, no comparison report is generated, and only the intermediate result table is saved (if save.result.table=TRUE).

Details
The input to runComparison is a data frame with at least a column named input.files, containing paths to .rds files containing result objects (of the class compData), such as those generated by runDiffExp. Other columns that can be included in the data frame are datasets, nbr.samples, repl and de.methods. They have to match the information contained in the corresponding result objects. If these columns are not present, they will be added to the data frame automatically.

Value
If knit.results=TRUE, the function will create a comparison report, named compcodeR_report<timestamp>.html, in the output.directory. It will also create subfolders named compcodeR_code and compcodeR_figure, where the code used to perform the differential expression analysis and the figures contained in the report, respectively, will be stored. Note that if these directories already exists, they will be overwritten. If save.result.table=TRUE, the function will also create a comparison report, named compcodeR_result_table_<timestamp>.rds in the output.directory, containing the result table.

Author(s)
Charlotte Soneson

Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "voom.limma",
Rmdfunction = "voom.limma.createRmd", output.directory = tmpdir,
norm.method = "TMM")
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "edgeR.exact",
Rmdfunction = "edgeR.exact.createRmd", output.directory = tmpdir,
norm.method = "TMM",
trend.method = "movingave", disp.type = "tagwise")
file.table <- data.frame(input.files = file.path(tmpdir,
c("mydata_voom.limma.rds", "mydata_edgeR.exact.rds")),
stringsAsFactors = FALSE)
parameters <- list(incl.nbr.samples = 5, incl.replicates = 1, incl.dataset = "mydata",
incl.de.methods = NULL,
fdr.threshold = 0.05, tpr.threshold = 0.05, typeI.threshold = 0.05,
ma.threshold = 0.05, fdc.maxvar = 1500, overlap.threshold = 0.05,
fracsign.threshold = 0.05, mcc.threshold = 0.05,
nbrtfpf.threshold = 0.05,
runComparisonGUI

comparisons = c("auc", "fdr", "tpr", "ma", "correlation")
if (interactive()) {
  runComparison(file.table = file.table, parameters = parameters, output.directory = tmpdir)
}

runComparisonGUI

A GUI to the main function for running the performance comparison between differential expression methods.

Description

This function provides a GUI to the main function for performing comparisons among differential expression methods and generating a report in HTML format (runComparison). It is assumed that all differential expression results have been generated in advance (using e.g. the function runDiffExp) and that the result compData object for each data set and each differential expression method is saved separately in files with the extension .rds. The function opens a graphical user interface where the user can set parameter values and choose the files to be used as the basis of the comparison. It is, however, possible to circumvent the GUI and call the comparison function runComparison directly.

Usage

runComparisonGUI(
  inputdirectories,
  output.directory,
  recursive,
  out.width = NULL,
  upper.limits = NULL,
  lower.limits = NULL
)

Arguments

inputdirectories

A list of directories containing the result files (*.rds). All results in the provided directories will be available for inclusion in the comparison, and the selection is performed through a graphical user interface. All result objects saved in the files should be of the compData class, although list objects created by earlier versions of compcodeR are supported.

output.directory

The directory where the results should be written. The subdirectory structure will be created automatically. If the directory already exists, it will be overwritten.

recursive

A logical parameter indicating whether or not the search should be extended recursively to subfolders of the inputdirectories.
out.width

The width of the figures in the final report. Will be passed on to knitr when the HTML is generated. Can be for example "800px" (see knitr documentation for more information)

upper.limits, lower.limits

Lists that can be used to manually set upper and lower limits for boxplots of fdr, tpr, auc, mcc, fracsign, nhrtpfp, nbrsign and typeIerror.

Details

This function requires that the rpanel package is installed. If this package can not be installed, please use the runComparison function directly.

Value

The function will create a comparison report, named compcodeR_report<timestamp>.html, in the output.directory. It will also create subfolders named compcodeR_code and compcodeR_figure, where the code used to perform the differential expression analysis and the figures contained in the report, respectively, will be saved. Note that if these directories already exist they will be overwritten.

Author(s)

Charlotte Soneson

Examples

```r
if (interactive()) {
  mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 12500,
      samples.per.cond = 5, n.diffexp = 1250,
      output.file = "mydata.rds")
  runDiffExp(data.file = "mydata.rds", result.extent = "voom.limma",
      Rmdfunction = "voom.limma.createRmd", output.directory = ".",
      norm.method = "TMM")
  runDiffExp(data.file = "mydata.rds", result.extent = "ttest",
      Rmdfunction = "ttest.createRmd", output.directory = ".",
      norm.method = "TMM")
  runComparisonGUI(input.directories = ".", output.directory = ".", recursive = FALSE)
}
```

---

**runComparisonShiny**

A shiny-based GUI to the main function for running the performance comparison between differential expression methods.
**Description**

This function provides a GUI to the main function for performing comparisons among differential expression methods and generating a report in HTML format (runComparison). It is assumed that all differential expression results have been generated in advance (using e.g. the function runDiffExp) and that the result compData object for each data set and each differential expression method is saved separately in files with the extension .rds. The function opens a graphical user interface where the user can set parameter values and choose the files to be used as the basis of the comparison. It is, however, possible to circumvent the GUI and call the comparison function runComparison directly.

**Usage**

```r
runComparisonShiny(
  input.directories,
  output.directory,
  recursive,
  out.width = NULL,
  upper.limits = NULL,
  lower.limits = NULL
)
```

**Arguments**

- `input.directories`:
  A list of directories containing the result files (*.rds). All results in the provided directories will be available for inclusion in the comparison, and the selection is performed through a graphical user interface. All result objects saved in the files should be of the compData class, although list objects created by earlier versions of compcodeR are supported.

- `output.directory`:
  The directory where the results should be written. The subdirectory structure will be created automatically. If the directory already exists, it will be overwritten.

- `recursive`:
  A logical parameter indicating whether or not the search should be extended recursively to subfolders of the `input.directories`.

- `out.width`:
  The width of the figures in the final report. Will be passed on to knitr when the HTML is generated. Can be for example "800px" (see knitr documentation for more information).

- `upper.limits, lower.limits`:
  Lists that can be used to manually set upper and lower limits for boxplots of fdr, tpr, auc, mcc, fracsign, nbrtpfp, nbrsign and typeIerror.

**Value**

The function will create a comparison report, named `compcodeR_report<timestamp>.html`, in the `output.directory`. It will also create subfolders named `compcodeR_code` and `compcodeR_figure`, where the code used to perform the differential expression analysis and the figures contained in the
report, respectively, will be saved. Note that if these directories already exist they will be overwritten.

Author(s)

Charlotte Soneson

Examples

```r
if (interactive()) {
  mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 12500,
                       samples.per.cond = 5, n.diffexp = 1250,
                       output.file = "mydata.rds")
  runDiffExp(data.file = "mydata.rds", result.extent = "voom.limma",
              Rmdfunction = "voom.limma.createRmd", output.directory = ".",
              norm.method = "TMM")
  runDiffExp(data.file = "mydata.rds", result.extent = "ttest",
              Rmdfunction = "ttest.createRmd", output.directory = ".",
              norm.method = "TMM")
  runComparisonShiny(input.directories = ".", output.directory = ".", recursive = FALSE)
}
```

---

**runDiffExp**

The main function to run differential expression analysis

**Description**

The main function for running differential expression analysis (comparing two conditions), using one of the methods interfaced through compcodeR or a user-defined method. Note that the interface functions are provided for convenience and as templates for other, user-defined workflows, and there is no guarantee that the included differential expression code is kept up-to-date with the latest recommendations and best practices for running each of the interfaced methods, or that the chosen settings are suitable in all situations. The user should make sure that the analysis is performed in the way they intend, and check the code that was run, using e.g. the generateCodeHTMLs() function.

**Usage**

```r
runDiffExp(
  data.file,
  result.extent,
  Rmdfunction,
  output.directory = ".",
  norm.path = TRUE,
  ...
)
```
Arguments

data.file  The path to a .rds file containing the data on which the differential expression analysis will be performed, for example a compData object returned from `generateSyntheticData`.

result.extent  The extension that will be added to the data file name in order to construct the result file name. This can be for example the differential expression method together with a version number.

Rmdfunction  A function that creates an Rmd file containing the code that should be run to perform the differential expression analysis. All functions available through compcodeR can be listed using the `listcreateRmd` function.

output.directory  The directory in which the result object will be saved.

norm.path  Logical, whether to include the full (absolute) path to the output object in the saved code.

...  Additional arguments that will be passed to the Rmdfunction, such as parameter choices for the differential expression method.

Author(s)

Charlotte Soneson

Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
listcreateRmd()
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "voom.limma",
Rmdfunction = "voom.limma.createRmd",
output.directory = tmpdir, norm.method = "TMM")

if (interactive()) {
## The following list covers the currently available
differential expression methods:
runDiffExp(data.file = "mydata.rds", result.extent = "DESeq2",
Rmdfunction = "DESeq2.createRmd",
output.directory = ".", fit.type = "parametric",
test = "Wald", beta.prior = TRUE,
independent.filtering = TRUE, cooks.cutoff = TRUE,
impute.outliers = TRUE)
runDiffExp(data.file = "mydata.rds", result.extent = "DSS",
Rmdfunction = "DSS.createRmd",
output.directory = ".", norm.method = "quantile",
disp.trend = TRUE)
runDiffExp(data.file = "mydata.rds", result.extent = "EBSeq",
Rmdfunction = "EBSeq.createRmd",
output.directory = ".", norm.method = "median")
runDiffExp(data.file = "mydata.rds", result.extent = "edgeR.exact"
Rmdfunction = "edgeR.exact.createRmd", output.directory = ".", norm.method = "TMM", trend.method = "movingave", disp.type = "tagwise")
runDiffExp(data.file = "mydata.rds", result.extent = "edgeR.GLM", Rmdfunction = "edgeR.GLM.createRmd", output.directory = ".", norm.method = "TMM", trended = TRUE)
runDiffExp(data.file = "mydata.rds", result.extent = "logcpm.limma", Rmdfunction = "logcpm.limma.createRmd", output.directory = ".", norm.method = "TMM")
runDiffExp(data.file = "mydata.rds", result.extent = "NBSeq", Rmdfunction = "NBSeq.createRmd", output.directory = ".", norm.method = "TMM", disp.method = "CoxReid")
runDiffExp(data.file = "mydata.rds", result.extent = "NOISeq", Rmdfunction = "NOISeq.prenorm.createRmd", output.directory = ".", norm.method = "TMM")
runDiffExp(data.file = "mydata.rds", result.extent = "sqrtcpm.limma", Rmdfunction = "sqrtcpm.limma.createRmd", output.directory = ".", norm.method = "TMM")
runDiffExp(data.file = "mydata.rds", result.extent = "TCC", Rmdfunction = "TCC.createRmd", output.directory = ".", norm.method = "tmm", test.method = "edger", iteration = 3, normFDR = 0.1, floorPDEG = 0.05)
runDiffExp(data.file = "mydata.rds", result.extent = "ttest", Rmdfunction = "ttest.createRmd", output.directory = ".", norm.method = "TMM")
runDiffExp(data.file = "mydata.rds", result.extent = "voom.limma", Rmdfunction = "voom.limma.createRmd", output.directory = ".", norm.method = "TMM")
runDiffExp(data.file = "mydata.rds", result.extent = "voom.ttest", Rmdfunction = "voom.ttest.createRmd", output.directory = ".", norm.method = "TMM")
}

scale_variance_process

Scale the variances

Description
Scale the variances of the process simulation so that they are equal to log_variance_phylo.

Usage
scale_variance_process(
  log_variance_phylo,
  tree,
Arguments

- **tree**: a dated phylogenetic tree of class `phylo` with `samples.per.cond * 2` species.
- **model.process**: the process to be used for phylogenetic simulations. One of "BM" or "OU", default to "BM".
- **selection.strength**: if the process is "OU", the selection strength parameter.

Value

A matrix N * P of factors to multiply the simulated phylogenetic residuals.

Description

Show method for `compData` object.

Usage

```r
## S4 method for signature 'compData'
show(object)
```

Arguments

- **object**: A `compData` object

Author(s)

Charlotte Soneson

Examples

```r
mydata <- generateSyntheticData(dataset = "mydata", n.vars = 12500,
samples.per.cond = 5, n.diffexp = 1250)
mydata
```
**show.phyloCompData-method**

*Show method for phyloCompData object*

---

**Description**

Show method for phyloCompData object.

**Usage**

```r
## S4 method for signature 'phyloCompData'
show(object)
```

**Arguments**

- `object` A phyloCompData object

**Author(s)**

Charlotte Soneson, Paul Bastide

**Examples**

```r
mydata <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                              samples.per.cond = 5, n.diffexp = 100,
                              id.species = factor(1:10),
                              tree = ape::rphylo(10, 1, 0),
                              lengths.relmeans = "auto", lengths.dispersions = "auto")
mydata
```

---

**show.compData**

*Show function for compData object*

---

**Description**

Show function for compData object.

**Usage**

```r
show_compData(object)
```

**Arguments**

- `object` A compData object
Simulate the Data

**Description**

Use the Poisson or Negative Binomial model to simulate the data.

**Usage**

```r
simulateData(
  n.vars,
  S1,
  prob.S1,
  sum.S1,
  truedispersions.S1,
  nfact_length.S1,
  S2,
  prob.S2,
  sum.S2,
  truedispersions.S2,
  nfact_length.S2,
  seq.depths,
  overdispersed
)
```

**Arguments**

- `n.vars` The initial number of genes in the simulated data set. Based on the filtering conditions (`filter.threshold.total` and `filter.threshold.mediancpm`), the number of genes in the final data set may be lower than this number.
- `S1` Indices in condition 1.
- `prob.S1` Vector of means for condition 1.
- `sum.S1` Sum of means for condition 1.
- `truedispersions.S1` Vector of dispersions for condition 1.
- `nfact_length.S1` Matrix of length factors for condition 1.
- `S2` Indices in condition 2.
- `prob.S2` Vector of means for condition 2.
- `sum.S2` Sum of means for condition 2.
- `truedispersions.S2` Vector of dispersions for condition 2.
- `nfact_length.S2` Matrix of length factors for condition 2.
- `overdispersed` Indices that are overdispersed.
simulateDataPhylo

**Value**

$Z$ a n.var times 2*samples.per.cond matrix with the simulated data.

**Description**

Use the Phylogenetic Poisson Log Normal model to simulate the data.

**Usage**

```r
simulateDataPhylo(
  count_means,
  count_dispersions,
  tree,
  prop.var.tree,
  model.process = "BM",
  selection.strength = 0
)
```

**Arguments**

- `tree` a dated phylogenetic tree of class `phylo` with `samples.per.cond * 2` species.
- `prop.var.tree` the proportion of the common variance explained by the tree for each gene. It can be a scalar, in which case the same parameter is used for all genes. Otherwise it needs to be a vector with length `n.vars`. Default to 1.
- `model.process` the process to be used for phylogenetic simulations. One of "BM" or "OU", default to "BM".
- `selection.strength` if the process is "OU", the selection strength parameter.

**Value**

$Z$ a matrix with the data
simulatePhyloPoissonLogNormal

_Simulate Tree Structured Counts_

**Description**

Simulate a tree structured matrix of counts according to a Poisson-lognormal model, with the log parameter of the poisson following a Brownian Motion (BM) on the tree with noise.

**Usage**

```r
simulatePhyloPoissonLogNormal(
  tree,
  log_means,
  log_variance_phylo,
  log_variance_sample,
  model.process = "BM",
  selection.strength = 0
)
```

**Arguments**

- `tree` A phylogenetic tree with n tips.
- `log_means` a matrix with the number of genes p rows and the number of species n columns. Column names should match the tree taxa names.
- `log_variance_phylo` a vector of length p of phylogenetic variances for the BM in the log space for each gene.
- `log_variance_sample` a matrix of size p x n of environmental variances for individual variations in the log space, for each gene and species. Column names should match the tree taxa names.

**Details**

For each gene, the log-lambda parameter evolves like a BM on the tree, with an extra independent variance noise that can depend on the species. Each gene has its own tree variance for the BM. Each gene and each species has its own mean. The counts for each gene and each species are then obtained as a Poisson draw with a different lambda parameter, as generated by the BM.

**Value**

A list, with:

- `log_lambda` the p x n matrix of log-lambda simulated by the BM on the tree.
- `counts` the p x n matrix of counts with corresponding Poisson draws.
Generate a .Rmd file containing code to perform differential expression analysis with limma after square root-transforming the counts per million (cpm)

**Description**

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using limma, after preprocessing the counts by computing the counts per million (cpm) and applying a square-root transformation. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the `runDiffExp` function.

**Usage**

```
sqrtcpm.limma.createRmd(data.path, result.path, codefile, norm.method)
```

**Arguments**

- `data.path`: The path to a .rds file containing the `compData` object that will be used for the differential expression analysis.
- `result.path`: The path to the file where the result object will be saved.
- `codefile`: The path to the file where the code will be written.
- `norm.method`: The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the `calcNormFactors` function from the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none".

**Details**

For more information about the methods and the interpretation of the parameters, see the edgeR and limma packages and the corresponding publications.

**Value**

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

**Author(s)**

Charlotte Soneson
References


Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "sqrtcpm.limma",
Rmdfunction = "sqrtcpm.limma.createRmd",
output.directory = tmpdir, norm.method = "TMM")

summarizeSyntheticDataSet

*Summarize a synthetic data set by some diagnostic plots*

Description

Summarize a synthetic data set (generated by `generateSyntheticData`) by some diagnostic plots.

Usage

`summarizeSyntheticDataSet(data.set, output.filename)`

Arguments

- `data.set`: A data set, either a `compData` object or a path to an `.rds` file where such an object is stored.
- `output.filename`: The filename of the resulting html report (including the path).

Author(s)

Charlotte Soneson
Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))

if (interactive()) {
  summarizeSyntheticDataSet(data.set = file.path(tmpdir, "mydata.rds"),
                            output.filename = file.path(tmpdir, "mydata_check.html"))
}

TCC.createRmd

Generate a .Rmd file containing code to perform differential expression analysis with TCC

Description

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using the TCC package. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

Usage

TCC.createRmd(
  data.path,
  result.path,
  codefile,
  norm.method,
  test.method,
  iteration = 3,
  normFDR = 0.1,
  floorPDEG = 0.05
)

Arguments

data.path  The path to a .rds file containing the compData object that will be used for the differential expression analysis.
result.path The path to the file where the result object will be saved.
codefile   The path to the file where the code will be written.
norm.method The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. Possible values are "tmm", and "deseq".
test.method The method used in TCC to find differentially expressed genes. Possible values are "edger", "deseq" and "bayseq".
iteration The number of iterations used to find the normalization factors. Default value is 3.

normFDR The FDR cutoff for calling differentially expressed genes in the computation of the normalization factors. Default value is 0.1.

floorPDEG The minimum value to be eliminated as potential differentially expressed genes before performing step 3 in the TCC algorithm. Default value is 0.05.

Details
For more information about the methods and the interpretation of the parameters, see the TCC package and the corresponding publications.

Author(s)
Charlotte Soneson

References

Examples
try(
  if (require(TCC)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                        samples.per.cond = 5, n.diffexp = 100,
                                        output.file = file.path(tmpdir, "mydata.rds"))
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "TCC",
               Rmdfunction = "TCC.createRmd",
               output.directory = tmpdir, norm.method = "tmm",
               test.method = "edger")
  }
)

Description
A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) using a t-test, applied to the normalized counts. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.
ttest.createRmd

Usage

\[ \text{ttest.createRmd(data.path, result.path, codefile, norm.method)} \]

Arguments

- **data.path**: The path to a .rds file containing the compData object that will be used for the differential expression analysis.
- **result.path**: The path to the file where the result object will be saved.
- **codefile**: The path to the file where the code will be written.
- **norm.method**: The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the calcNormFactors function from the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none".

Details

For more information about the methods and the interpretation of the parameters, see the edgeR package and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson

References


Examples

\[
\begin{align*}
\text{try(} & \text{if (require(genefilter)) \{} \\
& \text{tmpdir <- normalizePath(tempdir(), winslash = "/")} \\
& \text{mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,} \\
& \text{samples.per.cond = 5, n.diffexp = 100,} \\
& \text{output.file = file.path(tmpdir, "mydata.rds"))} \\
& \text{runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "ttest",} \\
& \text{Rmdfunction = "ttest.createRmd",} \\
& \text{output.directory = tmpdir, norm.method = "TMM"}) \\
\end{align*}
\]

Generate a .Rmd file containing code to perform differential expression analysis with voom+limma

Description

A function to generate code that can be run to perform differential expression analysis of RNAseq data (comparing two conditions) by applying the voom transformation (from the limma package) followed by differential expression analysis with limma. The code is written to a .Rmd file. This function is generally not called by the user, the main interface for performing differential expression analysis is the runDiffExp function.

Usage

voom.limma.createRmd(data.path, result.path, codefile, norm.method)

Arguments

- **data.path**: The path to a .rds file containing the compData object that will be used for the differential expression analysis.
- **result.path**: The path to the file where the result object will be saved.
- **codefile**: The path to the file where the code will be written.
- **norm.method**: The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the calcNormFactors of the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none".

Details

For more information about the methods and the interpretation of the parameters, see the limma package and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression analysis. This file can be executed using e.g. the knitr package.

Author(s)

Charlotte Soneson

References


Examples

tmpdir <- normalizePath(tempdir(), winslash = "/")
mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
samples.per.cond = 5, n.diffexp = 100,
output.file = file.path(tmpdir, "mydata.rds"))
runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "voom.limma",
Rmdfunction = "voom.limma.createRmd",
output.directory = tmpdir, norm.method = "TMM")

voom.ttest.createRmd  Generate a .Rmd file containing code to perform differential expression
analysis with voom+t-test

Description

A function to generate code that can be run to perform differential expression analysis of RNAseq
data (comparing two conditions) by applying the voom transformation (from the limma package)
followed by differential expression analysis with a t-test. The code is written to a .Rmd file. This
function is generally not called by the user, the main interface for performing differential expression
analysis is the runDiffExp function.

Usage

voom.ttest.createRmd(data.path, result.path, codefile, norm.method)

Arguments

data.path The path to a .rds file containing the compData object that will be used for the
differential expression analysis.
result.path The path to the file where the result object will be saved.
codefile The path to the file where the code will be written.
norm.method The between-sample normalization method used to compensate for varying li-
brary sizes and composition in the differential expression analysis. The nor-
malization factors are calculated using the calcNormFactors function from
the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and
"none".

Details

For more information about the methods and the interpretation of the parameters, see the limma and
edgeR packages and the corresponding publications.

Value

The function generates a .Rmd file containing the code for performing the differential expression
analysis. This file can be executed using e.g. the knitr package.
Author(s)

Charlotte Soneson

References


Examples

try(
  if (require(genefilter)) {
    tmpdir <- normalizePath(tempdir(), winslash = "/")
    mydata.obj <- generateSyntheticData(dataset = "mydata", n.vars = 1000,
                                         samples.per.cond = 5, n.diffexp = 100,
                                         output.file = file.path(tmpdir, "mydata.rds"))
    runDiffExp(data.file = file.path(tmpdir, "mydata.rds"), result.extent = "voom.ttest",
               Rmdfunction = "voom.ttest.createRmd",
               output.directory = tmpdir, norm.method = "TMM")
  }
)

writeNormalization

Generate a .Rmd file containing code to normalize data.

Description

Generate a .Rmd file containing code to normalize data.

Usage

writeNormalization(
  norm.method,
  length.normalization,
  data.transformation,
  codefile
)

Arguments

norm.method The between-sample normalization method used to compensate for varying library sizes and composition in the differential expression analysis. The normalization factors are calculated using the calcNormFactors of the edgeR package. Possible values are "TMM", "RLE", "upperquartile" and "none"

length.normalization one of "none" (no correction), "TPM", "RPKM" (default). See details.
**writeNormalization**

```r
data.transformation
  one of "log2", "asin(sqrt)" or "sqrt." Data transformation to apply to the normalized data.
```

codefile

**Details**

The `length.matrix` field of the `phyloCompData` object is used to normalize the counts.

- **none**: No length normalization.
- **TPM**: The raw counts are divided by the length of their associated genes before normalization by `voom`.
- **RPKM**: The log2 length is subtracted to the log2 CPM computed by `voom` for each gene and sample.
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