Package ‘STRINGdb’

November 27, 2018

Type Package

Title STRINGdb (Search Tool for the Retrieval of Interacting proteins database)

Version 1.22.0

Date 2016-03-31

Author Andrea Franceschini <andrea.franceschini@isb-sib.ch>

Maintainer Damian Szklarczyk <damian.szklarczyk@imls.uzh.ch>

Description The STRINGdb package provides a R interface to the STRING protein-protein interactions database (http://www.string-db.org).

License GPL-2

Depends R (>= 2.14.0)

Imports png, sqldf, plyr, igraph, RCurl, methods, RColorBrewer, gplots, hash, plotrix

Suggests RUnit, BiocGenerics

biocViews Network

git_url https://git.bioconductor.org/packages/STRINGdb

git_branch RELEASE_3_8

git_last_commit d0d3549

git_last_commit_date 2018-10-30

Date/Publication 2018-11-26

R topics documented:

add_diff_exp_color .................................................... 2
add_proteins_description ........................................ 3
benchmark_ppi ......................................................... 4
benchmark_ppi_pathway_view ........................................ 5
coeffOfvar ............................................................... 5
delColDf ................................................................. 6
diff_exp_example1 ..................................................... 6
downloadAbsentFile .................................................. 7
downloadAbsentFileSTRING .......................................... 7
get_aliases ............................................................. 8
get_annotations ....................................................... 8
add_diff_exp_color

Description

Take in input a dataframe containing a logFC column that reports the logarithm of the difference in expression level. Add a "color" column to the data frame such that strongly downregulated genes are colored in green and strong upregulated genes are in red. When the down or up-regulation is instead weak the intensity of the color gets weaker as well, accordingly.
add_proteins_description

Usage

```r
## S4 method for signature 'STRINGdb'
add_diff_exp_color(screen, logFcColStr="logFC")
```

Arguments

- `screen`: Dataframe containing the results of the experiment (e.g. the analyzed results of a microarray or RNAseq experiment)
- `logFcColStr`: name of the column that contains the logFC of the expression

Value

vector containing the colors

Author(s)

Andrea Franceschini

---

add_proteins_description

_add_proteins_description_

Description

Add description columns to the proteins that are present in the data frame given in input. The data frame must contain a column named "STRING_id".

Usage

```r
## S4 method for signature 'STRINGdb'
add_proteins_description(screen)
```

Arguments

- `screen`: Dataframe containing the results of the experiment (e.g. the analyzed results of a microarray or RNAseq experiment)

Value

returns the same dataframe given in input with an additional columns containing a description of the proteins.

Author(s)

Andrea Franceschini
**Description**

benchmark a list of protein-protein interactions using pathways (e.g. KEGG). The function outputs a table where the interactions are mapped to KEGG and the number of TPs and FPs are counted.

**Usage**

```r
## S4 method for signature 'STRINGdb'
benchmark_ppi(interactions_dataframe, pathwayType = "KEGG", max_homology_bitscore = 60, precision_window = 400, exclude_pathways = "blacklist")
```

**Arguments**

- `interactions_dataframe` a data frame containing the sorted interactions to be benchmarked. The data frame should have the following column names: proteinA, proteinB, score
- `pathwayType` category to use to benchmark the interactions (default KEGG)
- `max_homology_bitscore` filter out pairs of homologous proteins, having a similarity bitscore higher than this parameter
- `precision_window` define the size of the precision window (i.e. the window used to scan the sorted interactions data frame in order to compute the benchmark precision). At the beginning and at the end of the sorted interactions data frame, the window is automatically enlarged (at the beginning) and reduced (at the end)
- `exclude_pathways` Exclude the terms that should not be used for benchmarking. If this parameter is set to "blacklist", a black list to be used maintained by our group is automatically downloaded from our servers (otherwise it is possible to specify a vector with the terms that have to be excluded).

**Value**

interactions data frame where the interactions are mapped to KEGG and the number of TPs and FPs are counted.

**Author(s)**

Andrea Franceschini
benchmark_ppi_pathway_view

Description
Takes in input the results of the benchmark_ppi function, and constructs a new table that provides a view at the pathway level (i.e. it list all the pathways to which the interactions belong).

Usage
```r
## S4 method for signature 'STRINGdb'
benchmark_ppi_pathway_view(benchmark_ppi_data_frame, precision_threshold=0.2, pathwayType = "KEGG")
```

Arguments
- `benchmark_ppi_data_frame`: data frame that comes out from the benchmark_ppi function.
- `precision_threshold`: threshold that specify where to stop taking considering the interactions in the sorted input data frame (the list is scanned until the precision goes below this value).
- `pathwayType`: the pathway category to use (KEGG by default).

Value
data frame containing the pathways (i.e. terms) of the input proteins. Several parameters are reported: pathway coverage (i.e. number of interactions in the list belonging to the pathway / maximum number of interactions between the pathay proteins (i.e. proteins * (proteins-1)/2 ) ) total_representation (i.e. number of interactions in the list belonging to the pathway / size of the input data frame )

Author(s)
Andrea Franceschini

coeffOfvar

Description
coefficient of variation

Usage
coeffOfvar(x)

Arguments
- `x`: input number
Details

coefficient of variation

Value

coefficient of variation

Author(s)

Andrea Franceschini

delColDf
delColDf

Description

delete a column in the data frame

Usage

delColDf(df, colName)

Arguments

df
data frame

colName
name of the column to be deleted

Value

data frame

Author(s)

Andrea Franceschini

diff_exp_example1

Description

example of microarray data (data processed from GEO GSE9008)

Usage

data(diff_exp_example1)
**Format**

Data frames with 20861 observations on the following 3 variables.

- gene: a character vector
- pvalue: a numeric vector
- logFC: a numeric vector

**Source**


---

**downloadAbsentFile**

**downloadAbsentFile**

**Description**

Download a file only if it is not present.

**Usage**

```r
downloadAbsentFile(urlStr, oD = tempdir())
```

**Arguments**

- `urlStr`: url from which to download the file
- `oD`: directory where to store the file

**Author(s)**

Andrea Franceschini

---

**downloadAbsentFileSTRING**

**downloadAbsentFileSTRING**

**Description**

Download a STRING file only if it is not present or if it is corrupted.

**Usage**

```r
downloadAbsentFileSTRING(urlStr, oD = tempdir())
```

**Arguments**

- `urlStr`: url from which to download the file
- `oD`: directory where to store the file

**Author(s)**

Andrea Franceschini
get_aliases

Description

Loads and returns the STRING alias table.

Usage

```r
## S4 method for signature 'STRINGdb'
get_aliases()
```

Value

a data frame containing the STRING alias table

Author(s)

Andrea Franceschini

get_annotations

Description

Loads and returns STRING annotations (i.e. GO annotations, KEGG pathways, domain databases). The annotations are stored in the "annotations" variable.

Usage

```r
## S4 method for signature 'STRINGdb'
get_annotations()
```

Value

a data frame containing the annotations to the STRING proteins (e.g. GeneOntology, KEGG pathways, InterPro domains)

Author(s)

Andrea Franceschini
get_annotations_desc

Description

Returns a data frame with the description of every STRING annotation term (it downloads and
 caches the information the first time that is called).

Usage

```r
## S4 method for signature 'STRINGdb'
get_annotations_desc()
```

Value

data frame with the description of every STRING annotation term.

Author(s)

Andrea Franceschini

get_bioc_graph

Description

Returns the interaction graph as an object of the graph package in Bioconductor.

Usage

```r
## S4 method for signature 'STRINGdb'
get_bioc_graph()
```

Value

interaction graph as an object of the graph package in Bioconductor.

Author(s)

Andrea Franceschini
**get_clusters**

**Description**

Returns a list of clusters of interacting proteins. See the igraph (http://igraph.sourceforge.net/) documentation for additional information on the algorithms.

**Usage**

```r
## S4 method for signature 'STRINGdb'
get_clusters(string_ids, algorithm="fastgreedy")
```

**Arguments**

- `string_ids`: a vector of STRING identifiers.
- `algorithm`: algorithm to use for the clustering. You can choose between "fastgreedy", "walktrap", "spinglass" and "edge.betweenness".

**Value**

list of clusters of interacting proteins.

**Author(s)**

Andrea Franceschini

---

**get_enrichment**

**Description**

Returns the enrichment in pathways of the vector of STRING proteins that is given in input.

**Usage**

```r
## S4 method for signature 'STRINGdb'
get_enrichment(string_ids, category = "Process", methodMT = "fdr", iea = TRUE, minScore=NULL)
```

**Arguments**

- `string_ids`: a vector of STRING identifiers.
- `category`: category for which to compute the enrichment (i.e. "Process", "Component", "Function", "KEGG", "Pfam", "InterPro"). The default category is "Process".
- `methodMT`: method to be used for the multiple testing correction (i.e. "fdr", "bonferroni"). The default is "fdr".
- `iea`: specify whether you also want to use electronic inference annotations
- `minScore`: with Tissue and Disease categories is possible to filter the annotations having an annotation score higher than this threshold (from 0 to 5)
get_graph

Value

Data frame containing the enrichment in pathways of the vector of STRING proteins that is given in input.

Author(s)

Andrea Franceschini

get_graph get_graph

Description

Return an igraph object with the STRING network (for information about iGraph visit http://igraph.sourceforge.net)

Usage

## S4 method for signature 'STRINGdb'
get_graph()

Value

igraph object with the STRING network

Author(s)

Andrea Franceschini

References


See Also

In order to simplify the most common tasks, we do also provide convenient functions that wrap some iGraph functions. get_interactions(string_ids) # returns the interactions in between the input proteins get_neighbors(string_ids) # Get the neighborhoods of a protein (or of a vector of proteins) that is given in input. get_subnetwork(string_ids) # returns a subgraph from the given input proteins
get_homologs

Description

Returns the homologs of the given input identifiers that are present in the given target_species_id.

Usage

```r
## S4 method for signature 'STRINGdb'
get_homologs(string_ids, target_species_id, bitscore_threshold=NULL)
```

Arguments

- `string_ids`: a vector of STRING identifiers.
- `target_species_id`: NCBI taxonomy identifier of the species to query for homologs (the species must be present in the STRING database).
- `bitscore_threshold`: threshold on the bitscore of the blast alignment.

Value

Data frame containing the homologs of the given input identifiers and that are present in the given target_species_id.

Author(s)

Andrea Franceschini

---

get_homologs_besthits

Description

Returns the best blast hits x species of the given input identifiers.

Usage

```r
## S4 method for signature 'STRINGdb'
get_homologs_besthits(string_ids, symbets = FALSE, target_species_id = NULL, bitscore_threshold=NULL)
```

Arguments

- `string_ids`: a vector of STRING identifiers.
- `target_species_id`: NCBI taxonomy identifier of the species to query for homologs (the species must be present in the STRING database).
- `bitscore_threshold`: threshold on the bitscore of the blast alignment.
- `symbets`: specify whether you want only symmetrical best hits.
**get_interactions**

**Value**
Data frame containing the best blast hits x species of the given input identifiers.

**Author(s)**
Andrea Franceschini

---

**Description**
Shows the interactions in between the proteins that are given in input.

**Usage**
```r
## S4 method for signature 'STRINGdb'
get_interactions(string_ids)
```

**Arguments**
- `string_ids`: a vector of STRING identifiers

**Value**
Data frame containing the interactions in between the input proteins.

**Author(s)**
Andrea Franceschini

---

**get_link**

**Description**
Returns a short link to the network page of our STRING website that shows the protein interactions between the given identifiers.

**Usage**
```r
## S4 method for signature 'STRINGdb'
get_link(string_ids, required_score=NULL, network_flavor="evidence", payload_id = NULL)
```
get_neighbors

Arguments

- **string_ids**: a vector of STRING identifiers.
- **required_score**: minimum STRING combined score of the interactions (if left NULL we get the combined score of the object, which is 400 by default).
- **network_flavor**: specify the flavor of the network ("evidence", "confidence" or "actions". default "evidence").
- **payload_id**: an identifier of payload data on the STRING server (see method post_payload for additional informations)

Value

short link to the network page of our STRING website that shows the protein interactions between the input identifiers.

Author(s)

Andrea Franceschini

Description

Get the neighborhoods of a protein (or of a vector of proteins) that is given in input.

Usage

```r
## S4 method for signature 'STRINGdb'
get_neighbors(string_ids)
```

Arguments

- **string_ids**: a vector of STRING identifiers

Value

- vector containing the neighborhoods of a protein (or of a vector of proteins) that is given in input.

Author(s)

Andrea Franceschini
### get_png

#### Description
Returns a png image of a STRING protein network with the given identifiers.

#### Usage
```r
## S4 method for signature 'STRINGdb'
get_png(string_ids, required_score=NULL, network_flavor="evidence", file=NULL, payload_id=NULL)
```

#### Arguments
- `string_ids`: a vector of STRING identifiers.
- `required_score`: minimum STRING combined score of the interactions (if left NULL we get the combined score of the object, which is 400 by default).
- `network_flavor`: specify the flavor of the network ("evidence", "confidence" or "actions". default "evidence").
- `file`: file where to save the image
- `payload_id`: identifier of the payload

#### Value
Returns a png image of a STRING protein network with the given identifiers.

#### Author(s)
Andrea Franceschini

### get_ppi_enrichment

#### Description
Returns a pvalue representing the enrichment in interactions of the list of proteins (i.e. the probability to obtain such a number of interactions by chance).

#### Usage
```r
## S4 method for signature 'STRINGdb'
get_ppi_enrichment(string_ids)
```

#### Arguments
- `string_ids`: a vector of STRING identifiers
**get_ppi_enrichment_full**

**Value**

Returns a pvalue representing the enrichment in interactions of the list of proteins (i.e. the probability to obtain such a number of interactions by chance).

**Author(s)**

Andrea Franceschini

---

**get_ppi_enrichment_full**

**Description**

Returns a vector showing the enrichment in protein interactions in various positions of the list of genes in input. In practice, a list of 3 vectors is returned: 1) enrichment (i.e. enrichment computed in the window from 1 to x) 2) enrichmentWindow (i.e. enrichment computed in a sliding window of size determined by the "edgeWindow" parameters and the sliding steps determined by the "sliceWindow" parameter) 3) enrichmentWindowExtended (i.e. like the enrichmentWindow, but it also includes an initial window of size "windowExtendedReferenceThreshold" with respect to which to compute the enrichment)

**Usage**

```r
## S4 method for signature 'STRINGdb'
get_ppi_enrichment_full(string_ids, sliceWindow = 20, edgeWindow = 140, windowExtendedReferenceThreshold = 260, growingWindowLimit = NULL)
```

**Arguments**

- `string_ids`: a vector of STRING identifiers
- `sliceWindow`: defines the interval in proteins after which to compute the enrichment, scanning the list (i.e. the resolution)
- `edgeWindow`: size of the window that we use to compute the enrichment (i.e. the window pvalue is computed using the proteins inside this "edgeWindow")
- `windowExtendedReferenceThreshold`: defines the size of a window at the beginning of the list. The enrichment will be computed always including the proteins in this window
- `growingWindowLimit`: threshold where to stop the computation of the enrichment

**Value**

Returns a vector showing the enrichment in protein interactions in various positions of the list of genes in input.

**Author(s)**

Andrea Franceschini
Description

Returns the STRING proteins data frame. (it downloads and caches the information the first time that is called).

Usage

```r
## S4 method for signature 'STRINGdb'
get_proteins()
```

Value

STRING proteins data frame.

Author(s)

Andrea Franceschini

Description

Returns vector with the PUBMED IDs of the publications that contain the names of the proteins in the input vector.

Usage

```r
## S4 method for signature 'STRINGdb'
get_pubmed(string_ids)
```

Arguments

- `string_ids`: a vector of STRING identifiers

Value

vector with the PUBMED IDs of the publications that contain the names of the proteins in the input vector.

Author(s)

Andrea Franceschini
get_STRING_species

get_pubmed_interaction

Description
Returns vector with the PUBMED IDs of the publications that contain the names of both the input proteins.

Usage
```r
## S4 method for signature 'STRINGdb'
get_pubmed_interaction(STRING_id_a, STRING_id_b )
```

Arguments
- `STRING_id_a`: STRING identifier
- `STRING_id_b`: STRING identifier

Value
vector with the PUBMED IDs of the publications that contain the names of both the input proteins.

Author(s)
Andrea Franceschini

get_STRING_species

Description
Returns a data frame with the species (i.e. organisms) that are present in STRING.

Usage
```r
get_STRING_species(version=NULL, species_name=NULL)
```

Arguments
- `version`: STRING version
- `species_name`: name of the species that you are searching

Value
data frame with the species (i.e. organisms) that are present in STRING.

Author(s)
Andrea Franceschini
get_subnetwork

Description

Returns the subgraph generated by the given input proteins.

Usage

```r
## S4 method for signature 'STRINGdb'
get_subnetwork(string_ids)
```

Arguments

- `string_ids`: a vector of STRING identifiers

Value

Returns the subgraph (i.e. an iGraph object) generated by the given input proteins.

Author(s)

Andrea Franceschini

---

get_summary

Description

Returns a summary of the STRING sub-network containing the identifiers provided in input.

Usage

```r
## S4 method for signature 'STRINGdb'
get_summary(string_ids)
```

Arguments

- `string_ids`: a vector of STRING identifiers

Value

Returns a summary (i.e. a text description) of the STRING sub-network containing the identifiers provided in input.

Author(s)

Andrea Franceschini
get_term_proteins

Description

Returns the proteins annotated to belong to a given term.

Usage

```r
## S4 method for signature 'STRINGdb'
get_term_proteins(term_ids, string_ids=NULL, enableIEA=TRUE)
```

Arguments

- `term_ids`: vector of terms
- `string_ids`: a vector of STRING identifiers. If the variable is set, the method returns only the proteins that are present in this vector.
- `enableIEA`: whether to consider also Electronic Inferred Annotations

Value

Returns the proteins annotated to belong to a given term.

Author(s)

Andrea Franceschini

interactions_example

example of a protein-protein interactions sorted data frame

Description

example of a sorted list of protein-protein interactions, resulta our cooccurrence algorithm (SVD_Phy)

Usage

```r
data(interactions_example)
```

Format

Data frames with 20861 observations on the following 3 variables.

- `proteinA`: a character vector
- `proteinB`: a character vector
- `score`: a numeric vector
Description

Downloads and returns the STRING network (the network is set also in the graph variable of the STRING_db object).

It makes use of the variables: "backgroundV" vector containing STRING identifiers to be used as background (i.e. the STRING network loaded will contain only the proteins that are present also in this vector) "score_threshold" STRING combined score threshold (the network loaded contains only interactions having a combined score greater than this threshold)

Usage

```r
## S4 method for signature 'STRINGdb'
load()
```

Value

STRING network (i.e. an iGraph object. For info look to http://igraph.sourceforge.net)

Author(s)

Andrea Franceschini

Description

Force download and loading of all the files (so that you can later store the object on the hard disk if you like). It makes use of the variables: "backgroundV" vector containing STRING identifiers to be used as background (i.e. the STRING network loaded will contain only the proteins that are present also in this vector) "score_threshold" STRING combined score threshold (the network loaded contains only interactions having a combined score greater than this threshold)

Usage

```r
## S4 method for signature 'STRINGdb'
load_all()
```

Author(s)

Andrea Franceschini
Description

Maps the gene identifiers of the input dataframe to STRING identifiers. It returns the input dataframe with the "STRING_id" additional column.

Usage

## S4 method for signature 'STRINGdb'
map(my_data_frame, my_data_frame_id_col_names, takeFirst=TRUE, removeUnmappedRows=FALSE, quiet=FALSE)

Arguments

my_data_frame data frame provided as input.
my_data_frame_id_col_names vector containing the names of the columns of "my_data_frame" that have to be used for the mapping.
takeFirst boolean indicating what to do in case of multiple STRING proteins that map to the same name. If TRUE, only the first of those is taken. Otherwise all of them are used. (default TRUE)
removeUnmappedRows remove the rows that cannot be mapped to STRING (by default those lines are left and their STRING_id is set to NA).
quiet Setting this variable to TRUE we can avoid printing the warning relative to the unmapped values.

Value

Returns the dataframe that is given in input with the "STRING_id" additional column.

Author(s)

Andrea Franceschini

Description

Maps the gene identifiers of the input vector to STRING identifiers (using a take first approach). It returns a vector with the STRING identifiers of the mapped proteins.

Usage

## S4 method for signature 'STRINGdb'
mp(protein_aliases)
Arguments

protein_aliases

vector of protein aliases that we want to convert to STRING identifiers

Value

It returns a vector with the STRING identifiers of the mapped proteins.

Author(s)

Andrea Franceschini

Description

mapping function (it add the possibility to map using more than one column of the data frame)

Usage

multi_map_df(dfToMap, dfMap, strColsFrom, strColFromDfMap, strColToDfMap, caseSensitive=FALSE)

Arguments

dfToMap

input data frame (that contains the columns that need to be mapped)

dfMap

data frame containing the mapping data

strColsFrom

sorted vector containing the names of the columns to be used in the input data frame for the mapping (the order of the elements in the vector defines the priority for the mapping)

strColFromDfMap

name of the column in the mapping data frame to be used as source for the mapping

strColToDfMap

name of the column in the mapping data frame to be used as target for the mapping

caseSensitive

specify whether the mapping should be case sensitive

Value

data frame with an additional column containing the result of the mapping

Author(s)

Andrea Franceschini
plot_network

Description

Plots an image of the STRING network with the given proteins.

Usage

```r
## S4 method for signature 'STRINGdb'
plot_network(string_ids, payload_id=NULL, required_score=NULL, add_link=TRUE, add_summary=TRUE)
```

Arguments

- `string_ids` a vector of STRING identifiers
- `payload_id` an identifier of payload data on the STRING server (see method post_payload for additional informations)
- `required_score` a threshold on the score that overrides the default score_threshold, that we use only for the picture
- `add_link` parameter to specify whether you want to generate and add a short link to the relative page in STRING. As default this option is active but we suggest to deactivate it in case one is generating many images (e.g. in a loop). Deactivating this option avoids to generate and store a lot of short-urls on our server.
- `add_summary` parameter to specify whether you want to add a summary text to the picture. This summary includes a p-value and the number of proteins/interactions.

Author(s)

Andrea Franceschini

plot_ppi_enrichment

Description

Plots a graph showing the enrichment in protein interactions in various positions of the list of genes in input.

Usage

```r
## S4 method for signature 'STRINGdb'
plot_ppi_enrichment(string_ids, file=NULL, sliceWindow = 20, edgeWindow = 140,
                     windowExtendedReferenceThreshold = 260, minVal=0.0000000001, title=
```

plot_ppi_enrichment_graph

Arguments

string_ids  a vector of STRING identifiers
file  file where to save the graph as an image
sliceWindow  defines the interval in proteins after which to compute the enrichment, scanning the list (i.e. the resolution)
edgeWindow  size of the window that we use to compute the enrichment (i.e. the window pvalue is computed using the proteins inside this "edgeWindow")
windowExtendedReferenceThreshold  defines the size of a window at the beginning of the list. The enrichment will be computed always including the proteins in this window
title  title of the graph.
minVal  minimum value that the pvalue can assume in the log-scale graph. If the p-value is lower, we convert the value to this minimum value
quiet  if set to TRUE the method runs in quiet mode (turning off any output message)

Author(s)

Andrea Franceschini

Description

Plots a graph showing the enrichment in protein interactions in various positions of the list of genes in input.

Usage

plot_ppi_enrichment_graph(proteins, ppi_network, file, sliceWindow, edgeWindow, windowExtendedReferenceThreshold, title, minVal, quiet)

Arguments

proteins  a vector of protein identifiers
ppi_network  an igraph object containing the protein-protein interactions’ graph.
file  file where to save the graph as an image
sliceWindow  defines the interval in proteins after which to compute the enrichment, scanning the list (i.e. the resolution)
edgeWindow  size of the window that we use to compute the enrichment (i.e. the window pvalue is computed using the proteins inside this "edgeWindow")
windowExtendedReferenceThreshold  defines the size of a window at the beginning of the list. The enrichment will be computed always including the proteins in this window
title  title of the graph.
minVal  minimum value that the pvalue can assume in the log-scale graph. If the p-value is lower, we convert the value to this minimum value
quiet  if set to TRUE the method runs in quiet mode (turning off any output message)
post_payload

Author(s)
Andrea Franceschini

References

Description
Posts the input to STRING and returns an identifier that you can use to access the payload when you enter in our website.

Usage
## S4 method for signature 'STRINGdb'
post_payload(stringIds, colors=NULL, comments=NULL, links=NULL, iframe_urls=NULL, logo_imgF=NULL, legend_imgF=NULL)

Arguments

- `stringIds` vector of STRING identifiers.
- `colors` vector containing the colors to use for a every STRING identifier ( the order of the elements must match those in the string_ids vector)
- `comments` vector containing the comments to use for every STRING identifier (the order of the elements must match those in the string_ids vector)
- `links` vector containing the links to use for every STRING identifier (the order of the elements must match those in the string_ids vector)
- `iframe_urls` vector containing the urls of the iframes to use for every STRING identifier (the order of the elements must match those in the string_ids vector)
- `logo_imgF` path to a file containing the logo image to be display in the STRING website
- `legend_imgF` path to a file containing a legend image to be display in the STRING website

Value
identifier of the payload.

Author(s)
Andrea Franceschini
Description

compute the number of expected interactions between a set of proteins.

Usage

ppie.compLambda(degrees, edgeNum)

Arguments

degrees vector containing the degrees of the nodes of a set of proteins
edgeNum total number of edges of the entire graph

Value

number of expected interactions

Author(s)

Andrea Franceschini

References


Description

Compute lambda L1L2

Usage

ppie.compLambdaL1L2(degreesI, degreesJ, edgeNum)

Arguments

degreesI vector containing the degrees of the nodes present in nodeSet I
degreesJ vector containing the degrees of the nodes present in nodeSet J
edgeNum total number of edges of the entire graph
**Details**

compute the number of expected interactions between two sets of nodes

**Author(s)**

Andrea Franceschini

**Description**

Compute the pvalue of protein I to interact with protein J (look at the Pradines paper referenced below)

**Usage**

```
ppie.compPij(degI, degJ, edgeNum)
```

**Arguments**

- `degI` degree of protein I
- `degJ` degree of protein J
- `edgeNum` total number of edges of the entire graph

**Value**

return the pvalue of protein I to interact with protein J (look at the Pradines paper referenced below)

**Author(s)**

Andrea Franceschini

**References**

ppie.getNumEdgesBetween

Description

find the number of interactions between two sets of nodes

Usage

ppie.getNumEdgesBetween(graph, nodesFrom, nodesTo)

Arguments

- graph: igraph object
- nodesFrom: list of nodes
- nodesTo: list of nodes

Value

return the number of interactions between two sets of nodes

Author(s)

Andrea Franceschini

ppi_enrichment

Description

Computes the enrichment in protein-protein interactions.

Usage

ppi_enrichment(hitList, ppi_network)

Arguments

- hitList: sorted list of proteins (from the most significant to the least significant)
- ppi_network: an igraph object containing the graph of the protein-protein interaction’s network.

Value

- enrichment: pvalue that describes the probability to get such a number of interactions by chance
- lambda: expected number of interactions
**Author(s)**

Andrea Franceschini

**References**


---

**Description**

Compute the enrichment in protein-protein interactions of a sorted list of proteins. The computation is repeated at different positions in the list.

**Usage**

```
ppi_enrichment_full(hitList, ppi_network, sliceWindow, edgeWindow, windowExtendedReferenceThreshold, growingWindowLimit, quiet)
```

**Arguments**

- **hitList**: sorted list of proteins (from the most significant to the least significant)
- **ppi_network**: an igraph object containing the protein-protein interactions’ graph.
- **sliceWindow**: defines the interval in proteins after which to compute the enrichment, scanning the list (i.e. the resolution)
- **edgeWindow**: size of the window that we use to compute the enrichment (i.e. the window pvalue is computed using the proteins inside this "edgeWindow")
- **windowExtendedReferenceThreshold**: when we compute the "windowExtended" pvalue we are computing the pvalue that considers the following interactions: 1) the interactions inside the edgeWindow (as we do with the edgeWindow pvalue) 2) the interactions that connects the proteins in the edgeWindow with the proteins in another window at the beginning of the list (i.e. the windowExtendedReference). windowExtendedReferenceThreshold defines the size of this windowExtendedReference window. In this way we can compute, in a reliable way, the enrichment of a sorted list of proteins, in various positions of the list.
- **growingWindowLimit**: stop to compute the enrichment (from position 1 to position n) after growingWindowLimit proteins in the sorted list. (this limit speeds up the computation of the 2 other types of enrichment)
- **quiet**: if set to TRUE the method runs in quiet mode (turning off any output message)
Value

enrichment vector containing the enrichments in protein-protein interactions of the input list of genes (the length of the vector is length(hitList)/sliceWindow).

enrichmentWindow vector containing the enrichments in protein-protein interactions of the input list of genes (the length of the vector is length(hitList)/sliceWindow). The enrichment is computed considering only the proteins inside the sliding window

enrichmentWindowExtended vector containing the enrichments in protein-protein interactions of the input list of genes (the length of the vector is length(hitList)/sliceWindow). Look at the description of the windowExtendedReferenceThreshold variable

Author(s)

Andrea Franceschini

References


Description

With this method it is possible to remove the interactions that are composed by a pair of homologous/similar proteins, having a similarity bitscore between each other higher than a threshold.

Usage

```r
## S4 method for signature 'STRINGdb'
remove_homologous_interactions(interactions_dataframe, bitscore_threshold = 60)
```

Arguments

interactions_dataframe a data frame containing the sorted interactions to be benchmarked. The data frame should have the following column names: proteinA, proteinB, score

bitscore_threshold filter out pairs of homologous proteins, having a similarity bitscore higher than this parameter

Value

interactions data frame where the homologous pairs have been removed, from the input interactions’ data frame
**renameColDf**

**Description**

Rename a column of a data frame

**Usage**

```r
renameColDf(df, colOldName, colNewName)
```

**Arguments**

- `df`: input data frame
- `colOldName`: column name to be changed
- `colNewName`: new column name

**Value**

data frame with the column name changed

**Author(s)**

Andrea Franceschini

---

**set_background**

**Description**

With this method you can specify a vector of proteins to be used as background. The network is reloaded and only the proteins that are present in the background vector are inserted in the graph. Besides, the background is taken in consideration for all the enrichment statistics.

**Usage**

```r
## S4 method for signature 'STRINGdb'
set_background(background_vector)
```

**Arguments**

- `background_vector`: vector of STRING protein identifiers

**Author(s)**

Andrea Franceschini
The R package STRINGdb provides a convenient interface to the STRING protein-protein interactions database for the R/bioconductor users. Please look at the manual/vignette to get additional information and examples on how to use the package. STRING is a database of known and predicted protein-protein interactions. It contains information from numerous sources, including experimental repositories, computational prediction methods and public text collections. Each interaction is associated with a combined confidence score that integrates the various evidences. STRING is regularly updated, the latest version 9.05 contains information on 5 millions proteins from more than 1100 species. The STRING web interface is freely accessible at: http://string-db.org/

Extends

All reference classes extend and inherit methods from "envRefClass".

Fields

annotations: Object of class data.frame
annotations_description: Object of class data.frame
graph: Object of class igraph
proteins: Object of class data.frame
speciesList: Object of class data.frame
species: Object of class numeric
version: Object of class character
input_directory: Object of class character
backgroundV: Object of class vector
score_threshold: Object of class numeric

Methods

set_background(background_vector): ~
post_payload(stringIds, colors, comments, links, iframe_urls, logo_imgF, legend_imgF): ~
plot_network(string_ids, payload_id, required_score): ~
plot_ppi_enrichment(string_ids, file, sliceWindow, edgeWindow, windowExtendedReferenceThreshold, ~
map(my_data_frame, my_data_frame_id_col_names, takeFirst, removeUnmappedRows, quiet): ~
load(): ~
get_term_proteins(term_ids, string_ids, enableIEA): ~
get_summary(string_ids): ~
get_subnetwork(string_ids): ~
STRINGdb-class

get_ppi_enrichment_full(string_ids, sliceWindow, edgeWindow, windowExtendedReferenceThreshold, growingWindowLimit)

get_ppi_enrichment(string_ids): ~
get_proteins(): ~
get_png(string_ids, required_score, network_flavor, file, payload_id): ~
get_neighbors(string_ids): ~
get_link(string_ids, required_score, network_flavor, payload_id): ~
get_interactions(string_ids): ~
get_homologs_besthits(string_ids, symbets, target_species_id, bitscore_threshold): ~
get_homologs(string_ids, target_species_id, bitscore_threshold): ~
get_graph(): ~
get_enrichment(string_ids, category, methodMT, iea): ~
get_clusters(string_ids, algorithm): ~
get_annotations_desc(): ~
get_annotations(): ~
load_all(): ~
initialize(...): ~
add_proteins_description(screen): ~
add_diff_exp_color(screen, logFcColStr): ~
show(): ~

Author(s)
Andrea Franceschini

References

See Also
http://stitch-db.org

Examples
showClass("STRINGdb")
Index

*Topic classes
  STRINGdb-class, 33

*Topic datasets
  *diff_exp_example1, 6
  *interactions_example, 20

add_diff_exp_color, 2
add_proteins_description, 3

benchmark_ppi, 4
benchmark_ppi_pathway_view, 5

coeffOfvar, 5

delColDF, 6
*diff_exp_example1, 6
downloadAbsentFile, 7
downloadAbsentFileSTRING, 7

envRefClass, 33

get_aliases, 8
get_annotations, 8
get_annotations_desc, 9
get_bioc_graph, 9
get_clusters, 10
get_enrichment, 10
get_graph, 11
get_homologs, 12
get_homologs_besthits, 12
get_interactions, 13
get_link, 13
get_neighbors, 14
get_png, 15
get_ppi_enrichment, 15
get_ppi_enrichment_full, 16
get_proteins, 17
get_pubmed, 17
get_pubmed_interaction, 18
get_STRING_species, 18
get_subnetwork, 19
get_summary, 19
get_term_proteins, 20

interactions_example, 20

load, 21
load_all, 21

map, 22
mp, 22
multi_map_df, 23

plot_network, 24
plot_ppi_enrichment, 24
plot_ppi_enrichment_graph, 25
post_payload, 26
ppi_enrichment, 29
ppi_enrichment_full, 30
ppie.compLambda, 27
ppie.compLambdaL1L2, 27
ppie.compPij, 28
ppie.getNumEdgesBetween, 29

remove_homologous_interactions, 31
renameColDF, 32

set_background, 32
STRINGdb (STRINGdb-class), 33
STRINGdb-class, 33