

Package ‘DOSE’

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Type Package

Title Disease Ontology Semantic and Enrichment analysis

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Description This package implements five methods proposed by Resnik, Schlicker, Jiang, Lin and Wang respectively for measuring semantic similarities among DO terms and gene products. Enrichment analyses including hypergeometric model and gene set enrichment analysis are also implemented for discovering disease associations of high-throughput biological data.

Depends R (>= 3.5.0)

Imports AnnotationDbi, BiocParallel, fgsea, ggplot2, GOSemSim (>= 2.31.2), methods, qvalue, reshape2, stats, utils, yulab.utils (>= 0.1.6)

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URL <https://yulab-smu.top/contribution-knowledge-mining/>

BugReports <https://github.com/GuangchuangYu/DOSE/issues>

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DOSE-package

DOSE: Disease Ontology Semantic and Enrichment analysis

Description

This package implements five methods proposed by Resnik, Schlicker, Jiang, Lin and Wang respectively for measuring semantic similarities among DO terms and gene products. Enrichment analyses including hypergeometric model and gene set enrichment analysis are also implemented for discovering disease associations of high-throughput biological data.

Author(s)

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See Also

Useful links:

- <https://yulab-smu.top/biomedical-knowledge-mining-book/>
- Report bugs at <https://github.com/GuangchuangYu/DOSE/issues>

clusterSim

clusterSim

Description

semantic similarity between two gene clusters

Usage

```
clusterSim(  
  cluster1,  
  cluster2,  
  ont = "HDO",  
  organism = "hsa",  
  measure = "Wang",  
  combine = "BMA"  
)
```

Arguments

| | |
|----------|--|
| cluster1 | a vector of gene IDs |
| cluster2 | another vector of gene IDs |
| ont | one of "HDO", "HPO" and "MPO" |
| organism | one of "hsa" and "mmu" |
| measure | One of "Resnik", "Lin", "Rel", "Jiang" and "Wang" methods. |
| combine | One of "max", "avg", "rcmax", "BMA" methods, for combining |

Details

given two gene clusters, this function calculates semantic similarity between them.

Value

similarity

Author(s)

Yu Guangchuang

Examples

```
## Not run:
cluster1 <- c("835", "5261", "241", "994")
cluster2 <- c("307", "308", "317", "321", "506", "540", "378", "388", "396")
clusterSim(cluster1, cluster2)

## End(Not run)
```

compareClusterResult-class

Class "compareClusterResult" This class represents the comparison result of gene clusters by GO categories at specific level or GO enrichment analysis.

Description

Class "compareClusterResult" This class represents the comparison result of gene clusters by GO categories at specific level or GO enrichment analysis.

Slots

compareClusterResult cluster comparing result
geneClusters a list of genes
fun one of groupGO, enrichGO and enrichKEGG
gene2Symbol gene ID to Symbol
keytype Gene ID type
readable logical flag of gene ID in symbol or not.
.call function call
termsim Similarity between term
method method of calculating the similarity between nodes
dr dimension reduction result

Author(s)

Guangchuang Yu <https://yulab-smu.top>

See Also

[enrichResult](#)

computeIC *compute information content*

Description

compute information content

Usage

```
computeIC(ont = "HDO")
```

Arguments

ont one of "DO", "HPO" and "MPO"

Author(s)

Guangchuang Yu <https://yulab-smu.top>

 DataSet

Datasets

Description

Information content and DO term to entrez gene IDs mapping

doseSim

*doseSim***Description**

measuring similarities between two DO term vectors.

Usage

```
doseSim(DO1, DO2, measure = "Wang", ont = "HDO")
```

```
doSim(DO1, DO2, measure = "Wang", ont = "HDO")
```

Arguments

| | |
|---------|---|
| DO1 | DO term, MPO term or HPO term vector |
| DO2 | DO term, MPO term or HPO term vector |
| measure | one of "Wang", "Resnik", "Rel", "Jiang", "Lin", and "TCSS". |
| ont | one of "HDO", "HPO" and "MPO" |

Details

provide two term vectors, this function will calculate their similarities.

Value

score matrix

Author(s)

Guangchuang Yu <https://yulab-smu.top>

enrichDGN *Enrichment analysis based on the DisGeNET* (<http://www.disgenet.org/>)

Description

given a vector of genes, this function will return the enrichment NCG categories with FDR control

Usage

```
enrichDGN(  
  gene,  
  pvalueCutoff = 0.05,  
  pAdjustMethod = "BH",  
  universe,  
  minGSSize = 10,  
  maxGSSize = 500,  
  qvalueCutoff = 0.2,  
  readable = FALSE  
)
```

Arguments

| | |
|---------------|--|
| gene | a vector of entrez gene id |
| pvalueCutoff | pvalue cutoff |
| pAdjustMethod | one of "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", "none" |
| universe | background genes |
| minGSSize | minimal size of genes annotated by NCG category for testing |
| maxGSSize | maximal size of each geneSet for analyzing |
| qvalueCutoff | qvalue cutoff |
| readable | whether mapping gene ID to gene Name |

Value

A enrichResult instance

Author(s)

Guangchuang Yu

References

Janet et al. (2015) DisGeNET: a discovery platform for the dynamical exploration of human diseases and their genes. *Database* bav028 <http://database.oxfordjournals.org/content/2015/bav028.long>

`enrichDGNv`*enrichDGN*

Description

Enrichment analysis based on the DisGeNET (<http://www.disgenet.org/>)

Usage

```
enrichDGNv(  
  snp,  
  pvalueCutoff = 0.05,  
  pAdjustMethod = "BH",  
  universe,  
  minGSSize = 10,  
  maxGSSize = 500,  
  qvalueCutoff = 0.2,  
  readable = FALSE  
)
```

Arguments

| | |
|----------------------------|--|
| <code>snp</code> | a vector of SNP |
| <code>pvalueCutoff</code> | pvalue cutoff |
| <code>pAdjustMethod</code> | one of "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", "none" |
| <code>universe</code> | background genes |
| <code>minGSSize</code> | minimal size of genes annotated by NCG category for testing |
| <code>maxGSSize</code> | maximal size of each geneSet for analyzing |
| <code>qvalueCutoff</code> | qvalue cutoff |
| <code>readable</code> | whether mapping gene ID to gene Name |

Details

given a vector of genes, this function will return the enrichment NCG categories with FDR control

Value

A `enrichResult` instance

Author(s)

Guangchuang Yu

References

Janet et al. (2015) DisGeNET: a discovery platform for the dynamical exploration of human diseases and their genes. *Database* bav028 <http://database.oxfordjournals.org/content/2015/bav028.long>

enrichDO

DO Enrichment Analysis

Description

Given a vector of genes, this function will return the enrichment DO categories with FDR control.

Usage

```
enrichDO(
  gene,
  ont = "HDO",
  organism = "hsa",
  pvalueCutoff = 0.05,
  pAdjustMethod = "BH",
  universe,
  minGSSize = 10,
  maxGSSize = 500,
  qvalueCutoff = 0.2,
  readable = FALSE
)
```

Arguments

| | |
|---------------|--|
| gene | a vector of entrez gene id |
| ont | one of "HDO", "HPO" or "MPO". |
| organism | one of "hsa" and "mmu" |
| pvalueCutoff | pvalue cutoff |
| pAdjustMethod | one of "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", "none" |
| universe | background genes |
| minGSSize | minimal size of genes annotated by NCG category for testing |
| maxGSSize | maximal size of each geneSet for analyzing |
| qvalueCutoff | qvalue cutoff |
| readable | whether mapping gene ID to gene Name |

Value

A enrichResult instance.

Author(s)

Guangchuang Yu <https://yulab-smu.top>

See Also

[enrichResult-class](#)

Examples

```
data(geneList)
gene = names(geneList)[geneList > 1]
yy = enrichD0(gene, pvalueCutoff=0.05)
summary(yy)
```

enricher_internal *enrich.internal*

Description

internal method for enrichment analysis

Usage

```
enricher_internal(
  gene,
  pvalueCutoff,
  pAdjustMethod = "BH",
  universe = NULL,
  minGSSize = 10,
  maxGSSize = 500,
  qvalueCutoff = 0.2,
  USER_DATA
)
```

Arguments

| | |
|---------------|--|
| gene | a vector of entrez gene id. |
| pvalueCutoff | Cutoff value of pvalue. |
| pAdjustMethod | one of "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", "none" |
| universe | background genes, default is the intersection of the 'universe' with genes that have annotations. Users can set 'options(enrichment_force_universe = TRUE)' to force the 'universe' untouched. |
| minGSSize | minimal size of genes annotated by Ontology term for testing. |
| maxGSSize | maximal size of each geneSet for analyzing |
| qvalueCutoff | cutoff of qvalue |
| USER_DATA | ontology information |

Details

using the hypergeometric model

Value

A `enrichResult` instance.

Author(s)

Guangchuang Yu <https://yulab-smu.top>

enrichNCG

enrichNCG

Description

Enrichment analysis based on the Network of Cancer Genes database (<http://ncg.kcl.ac.uk/>)

Usage

```
enrichNCG(
  gene,
  pvalueCutoff = 0.05,
  pAdjustMethod = "BH",
  universe,
  minGSSize = 10,
  maxGSSize = 500,
  qvalueCutoff = 0.2,
  readable = FALSE
)
```

Arguments

| | |
|----------------------------|--|
| <code>gene</code> | a vector of entrez gene id |
| <code>pvalueCutoff</code> | pvalue cutoff |
| <code>pAdjustMethod</code> | one of "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", "none" |
| <code>universe</code> | background genes |
| <code>minGSSize</code> | minimal size of genes annotated by NCG category for testing |
| <code>maxGSSize</code> | maximal size of each <code>geneSet</code> for analyzing |
| <code>qvalueCutoff</code> | qvalue cutoff |
| <code>readable</code> | whether mapping gene ID to gene Name |

Details

given a vector of genes, this function will return the enrichment NCG categories with FDR control

Value

A enrichResult instance

Author(s)

Guangchuang Yu

| | |
|--------------------|--|
| enrichResult-class | <i>Class "enrichResult" This class represents the result of enrichment analysis.</i> |
|--------------------|--|

Description

Class "enrichResult" This class represents the result of enrichment analysis.

Slots

result enrichment analysis
 pvalueCutoff pvalueCutoff
 pAdjustMethod pvalue adjust method
 qvalueCutoff qvalueCutoff
 organism only "human" supported
 ontology biological ontology
 gene Gene IDs
 keytype Gene ID type
 universe background gene
 gene2Symbol mapping gene to Symbol
 geneSets gene sets
 readable logical flag of gene ID in symbol or not.
 termsim Similarity between term
 method method of calculating the similarity between nodes
 dr dimension reduction result

Author(s)

Guangchuang Yu <https://yulab-smu.top>

See Also

[enrichDO](#)

| | |
|------------|-------------------|
| EXTID2NAME | <i>EXTID2NAME</i> |
|------------|-------------------|

Description

mapping gene ID to gene Symbol

Usage

```
EXTID2NAME(OrgDb, geneID, keytype)
```

Arguments

| | |
|---------|----------------|
| OrgDb | OrgDb |
| geneID | entrez gene ID |
| keytype | keytype |

Value

gene symbol

Author(s)

Guangchuang Yu <https://yulab-smu.top>

| | |
|---------|------------------------------------|
| gene2DO | <i>convert Gene ID to DO Terms</i> |
|---------|------------------------------------|

Description

provide gene ID, this function will convert to the corresponding DO Terms

Usage

```
gene2DO(gene, organism = "hsa", ont = "HDO")
```

Arguments

| | |
|----------|----------------|
| gene | entrez gene ID |
| organism | organism |
| ont | ont |

Value

DO Terms

Author(s)

Guangchuang Yu <https://yulab-smu.top>

| | |
|--------|-----------------------|
| geneID | <i>geneID generic</i> |
|--------|-----------------------|

Description

geneID generic

Usage

```
geneID(x)
```

Arguments

x enrichResult object

Value

'geneID' return the 'geneID' column of the enriched result which can be converted to data.frame via 'as.data.frame'

Examples

```
data(geneList, package="DOSE")
de <- names(geneList)[1:100]
x <- enrichDO(de)
geneID(x)
```

| | |
|----------------|-------------------------------|
| geneInCategory | <i>geneInCategory generic</i> |
|----------------|-------------------------------|

Description

geneInCategory generic

Usage

```
geneInCategory(x)
```

Arguments

x enrichResult

Value

'geneInCategory' return a list of genes, by splitting the input gene vector to enriched functional categories

Examples

```
data(geneList, package="DOSE")
de <- names(geneList)[1:100]
x <- enrichDO(de)
geneInCategory(x)
```

 geneSim

geneSim

Description

measuring similarities bewteen two gene vectors.

Usage

```
geneSim(
  geneID1,
  geneID2 = NULL,
  ont = "HDO",
  organism = "hsa",
  measure = "Wang",
  combine = "BMA"
)
```

Arguments

| | |
|----------|--|
| geneID1 | entrez gene vector |
| geneID2 | entrez gene vector |
| ont | one of "HDO" and "MPO" |
| organism | one of "hsa" and "mmu" |
| measure | one of "Wang", "Resnik", "Rel", "Jiang", and "Lin". |
| combine | One of "max", "avg", "rcmax", "BMA" methods, for combining semantic similarity scores of multiple DO terms associated with gene/protein. |

Details

provide two entrez gene vectors, this function will calculate their similarity.

Value

score matrix

Author(s)

Guangchuang Yu <https://yulab-smu.top>

Examples

```
g <- c("835", "5261", "241", "994")
geneSim(g)
```

gseaResult-class

Class "gseaResult" This class represents the result of GSEA analysis

Description

Class "gseaResult" This class represents the result of GSEA analysis

Slots

result GSEA analysis

organism organism

setType setType

geneSets geneSets

geneList order rank geneList

keytype ID type of gene

permScores permutation scores

params parameters

gene2Symbol gene ID to Symbol

readable whether convert gene ID to symbol

dr dimension reduction result

Author(s)

Guangchuang Yu <https://yulab-smu.top>

GSEA_internal *GSEA_internal*

Description

generic function for gene set enrichment analysis

Usage

```
GSEA_internal(
  geneList,
  exponent,
  minGSSize,
  maxGSSize,
  eps,
  pvalueCutoff,
  pAdjustMethod,
  verbose,
  seed = FALSE,
  USER_DATA,
  by = "fgsea",
  ...
)
```

Arguments

| | |
|---------------|---|
| geneList | order ranked geneList |
| exponent | weight of each step |
| minGSSize | minimal size of each geneSet for analyzing |
| maxGSSize | maximal size of each geneSet for analyzing |
| eps | This parameter sets the boundary for calculating the p value. |
| pvalueCutoff | p value Cutoff |
| pAdjustMethod | p value adjustment method |
| verbose | print message or not |
| seed | set seed inside the function to make result reproducible. FALSE by default. |
| USER_DATA | annotation data |
| by | one of 'fgsea' or 'DOSE' |
| ... | other parameter |

Value

gseaResult object

Author(s)

Yu Guangchuang

gseDGN

DisGeNET Gene Set Enrichment Analysis

Description

perform gsea analysis

Usage

```
gseDGN(  
  geneList,  
  exponent = 1,  
  minGSSize = 10,  
  maxGSSize = 500,  
  pvalueCutoff = 0.05,  
  pAdjustMethod = "BH",  
  verbose = TRUE,  
  seed = FALSE,  
  by = "fgsea",  
  ...  
)
```

Arguments

| | |
|---------------|--|
| geneList | order ranked geneList |
| exponent | weight of each step |
| minGSSize | minimal size of each geneSet for analyzing |
| maxGSSize | maximal size of each geneSet for analyzing |
| pvalueCutoff | pvalue Cutoff |
| pAdjustMethod | p value adjustment method |
| verbose | print message or not |
| seed | logical |
| by | one of 'fgsea' or 'DOSE' |
| ... | other parameter |

Value

gseaResult object

Author(s)

Yu Guangchuang

gseDO

*DO Gene Set Enrichment Analysis***Description**

perform gsea analysis

Usage

```

gseDO(
  geneList,
  ont = "HDO",
  organism = "hsa",
  exponent = 1,
  minGSSize = 10,
  maxGSSize = 500,
  pvalueCutoff = 0.05,
  pAdjustMethod = "BH",
  verbose = TRUE,
  seed = FALSE,
  by = "fgsea",
  ...
)

```

Arguments

| | |
|---------------|--|
| geneList | order ranked geneList |
| ont | one of "HDO", "HPO" or "MPO" |
| organism | one of "hsa" and "mmu" |
| exponent | weight of each step |
| minGSSize | minimal size of each geneSet for analyzing |
| maxGSSize | maximal size of each geneSet for analyzing |
| pvalueCutoff | pvalue Cutoff |
| pAdjustMethod | p value adjustment method |
| verbose | print message or not |
| seed | logical |
| by | one of 'fgsea' or 'DOSE' |
| ... | other parameter |

Value

gseaResult object

Author(s)

Yu Guangchuang

gseNCG

NCG Gene Set Enrichment Analysis

Description

perform gsea analysis

Usage

```
gseNCG(  
  geneList,  
  exponent = 1,  
  minGSSize = 10,  
  maxGSSize = 500,  
  pvalueCutoff = 0.05,  
  pAdjustMethod = "BH",  
  verbose = TRUE,  
  seed = FALSE,  
  by = "fgsea",  
  ...  
)
```

Arguments

| | |
|---------------|--|
| geneList | order ranked geneList |
| exponent | weight of each step |
| minGSSize | minimal size of each geneSet for analyzing |
| maxGSSize | maximal size of each geneSet for analyzing |
| pvalueCutoff | pvalue Cutoff |
| pAdjustMethod | p value adjustment method |
| verbose | print message or not |
| seed | logical |
| by | one of 'fgsea' or 'DOSE' |
| ... | other parameter |

Value

gseaResult object

Author(s)

Yu Guangchuang

| | |
|----------|-----------------|
| gsfilter | <i>gsfilter</i> |
|----------|-----------------|

Description

filter enriched result by gene set size or gene count

Usage

```
gsfilter(x, by = "GSSize", min = NA, max = NA)
```

Arguments

| | |
|-----|--|
| x | instance of enrichResult or compareClusterResult |
| by | one of 'GSSize' or 'Count' |
| min | minimal size |
| max | maximal size |

Value

update object

Author(s)

Guangchuang Yu

| | |
|-------------|--------------------|
| mclusterSim | <i>mclusterSim</i> |
|-------------|--------------------|

Description

Pairwise semantic similarity for a list of gene clusters

Usage

```
mclusterSim(  
  clusters,  
  ont = "HDO",  
  organism = "hsa",  
  measure = "Wang",  
  combine = "BMA"  
)
```

Arguments

| | |
|----------|--|
| clusters | A list of gene clusters |
| ont | one of "HDO", "HPO" and "MPO" |
| organism | organism |
| measure | one of "Wang", "Resnik", "Rel", "Jiang", and "Lin". |
| combine | One of "max", "avg", "rcmax", "BMA" methods, for combining semantic similarity scores of multiple DO terms associated with gene/protein. |

Value

similarity matrix

Author(s)

Guangchuang Yu

Examples

```
## Not run:
cluster1 <- c("835", "5261", "241")
cluster2 <- c("578", "582")
cluster3 <- c("307", "308", "317")
clusters <- list(a=cluster1, b=cluster2, c=cluster3)
mclusterSim(clusters, measure="Wang")

## End(Not run)
```

parse_ratio

parse_ratio

Description

parse character ratio to double value, such as 1/5 to 0.2

Usage

```
parse_ratio(ratio)
```

Arguments

| | |
|-------|------------------------------------|
| ratio | character vector of ratio to parse |
|-------|------------------------------------|

Value

A numeric vector (double) of parsed ratio

Author(s)

Guangchuang Yu

| | |
|-----------|---|
| reexports | <i>Objects exported from other packages</i> |
|-----------|---|

Description

These objects are imported from other packages. Follow the links below to see their documentation.

ggplot2 [facet_grid](#)

| | |
|-------------|--------------------|
| setReadable | <i>setReadable</i> |
|-------------|--------------------|

Description

mapping geneID to gene Symbol

Usage

```
setReadable(x, OrgDb, keyType = "auto")
```

Arguments

| | |
|---------|---------------------|
| x | enrichResult Object |
| OrgDb | OrgDb |
| keyType | keyType of gene |

Value

enrichResult Object

Author(s)

Yu Guangchuang

show *show method*

Description

show method for gseaResult instance
show method for enrichResult instance

Usage

```
show(object)
```

```
show(object)
```

Arguments

object A enrichResult instance.

Value

message

message

Author(s)

Guangchuang Yu <https://yulab-smu.top>

simplot *simplot*

Description

plotting similarity matrix

Usage

```
simplot(  
  sim,  
  xlab = "",  
  ylab = "",  
  color.low = "white",  
  color.high = "red",  
  labs = TRUE,  
  digits = 2,  
  labs.size = 3,  
  font.size = 14  
)
```


Arguments

| | |
|------------|--------------------------------|
| sim | similarity matrix |
| xlab | xlab |
| ylab | ylab |
| color.low | color of low value |
| color.high | color of high value |
| labs | logical, add text label or not |
| digits | round digit numbers |
| labs.size | lable size |
| font.size | font size |

Value

ggplot object

Author(s)

Yu Guangchuang

summary

summary method

Description

summary method for gseaResult instance
summary method for enrichResult instance

Usage

summary(object, ...)

summary(object, ...)

Arguments

| | |
|--------|--------------------------|
| object | A enrichResult instance. |
| ... | additional parameter |

Value

A data frame

A data frame

Author(s)

Guangchuang Yu <https://guangchuangyu.github.io>

Guangchuang Yu <http://guangchuangyu.github.io>

theme_dose

theme_dose

Description

ggplot theme of DOSE

Usage

```
theme_dose(font.size = 14)
```

Arguments

font.size font size

Value

ggplot theme

Examples

```
library(ggplot2)
qplot(1:10) + theme_dose()
```

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