Package ‘smartid’

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Title Scoring and Marker Selection Method Based on Modified TF-IDF

Version 1.5.0

Description This package enables automated selection of group specific signature, especially for rare population. The package is developed for generating specifc lists of signature genes based on Term Frequency-Inverse Document Frequency (TF-IDF) modified methods. It can also be used as a new gene-set scoring method or data transformation method. Multiple visualization functions are implemented in this package.

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`cal_score` *calculate combined score*

Description

compute TF (term/feature frequency), IDF (inverse document/cell frequency), IAE (inverse average expression of features) and combine the the final score

Usage

```
cal_score(
  data,
  tf = c("logtf", "tf"),
  idf = "prob",
  iae = "prob",
  slot = "counts",
  new.slot = "score",
  par.idf = NULL,
  par.iae = NULL
)

## S4 method for signature 'AnyMatrix'
cal_score(
  data,
  tf = c("logtf", "tf"),
  idf = "prob",
  iae = "prob",
  par.idf = NULL,
  par.iae = NULL
)

## S4 method for signature 'SummarizedExperiment'
cal_score(
  data,
  tf = c("logtf", "tf"),
  idf = "prob",
  iae = "prob",
  slot = "counts",
  new.slot = "score",
  par.idf = NULL,
  par.iae = NULL
)
```

Arguments

`data`	an expression object, can be matrix or SummarizedExperiment
`tf`	a character, specify the TF method to use, can be "tf" or "logtf"
`idf`	a character, specify the IDF method to use. Available methods can be accessed using `idf_iae_methods()`
`iae`	a character, specify the IAE method to use. Available methods can be accessed using `idf_iae_methods()`
`slot`	a character, specify which slot to use when data is se object, optional, default 'counts'
`new.slot`	a character, specify the name of slot to save score in se object, optional, default 'score'
`par.idf`	other parameters for specified IDF methods
`par.iae`	other parameters for specified IAE methods

Value

A list of matrices or se object containing combined score

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
cal_score(
  data,
  par.idf = list(label = sample(c("A", "B"), 10, replace = TRUE)),
  par.iae = list(label = sample(c("A", "B"), 10, replace = TRUE))
)
```

`cal_score_init` *Calculate score for each feature in each cell*

Description

Calculate score for each feature in each cell

Usage

```
cal_score_init(
  expr,
  tf = c("logtf", "tf"),
  idf = "prob",
  iae = "prob",
  par.idf = NULL,
  par.iae = NULL
)
```

Arguments

`expr`	a count matrix, features in row and cells in column
`tf`	a character, specify the TF method to use, can be "tf" or "logtf"
`idf`	a character, specify the IDF method to use. Available methods can be accessed using `idf_iae_methods()`
`iae`	a character, specify the IAE method to use. Available methods can be accessed using `idf_iae_methods()`
`par.idf`	other parameters for specified IDF methods
`par.iae`	other parameters for specified IAE methods

Value

a list of combined score, tf, idf and iae

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
label <- sample(c("A", "B"), 10, replace = TRUE)
smartid:::cal_score_init(data,
  par.idf = list(label = label),
  par.iae = list(label = label)
)
```

`gs_score` *compute overall score based on the given marker list*

Description

compute overall score based on the given marker list

Usage

```
gs_score(data, features = NULL, slot = "score", suffix = "score")

## S4 method for signature 'AnyMatrix,ANY'
gs_score(data, features = NULL)

## S4 method for signature 'AnyMatrix,list'
gs_score(data, features = NULL, suffix = "score")

## S4 method for signature 'SummarizedExperiment,ANY'
gs_score(data, features = NULL, slot = "score", suffix = "score")
```

Arguments

`data`	an expression object, can be matrix or SummarizedExperiment
`features`	vector or named list, feature names to compute score
`slot`	a character, specify which slot to use when data is se object, optional, default 'score'
`suffix`	a character, specify the name suffix to save score when features is a named list

Value

A vector of overall score for each sample

Examples

```
data <- matrix(rnorm(100), 10, dimnames = list(seq_len(10)))
gs_score(data, features = seq_len(3))
```

`gs_score_init` *Calculate scores of each cell on given features*

Description

Calculate scores of each cell on given features

Usage

```
gs_score_init(score, features = NULL)
```

Arguments

`score`	matrix, features in row and samples in column
`features`	vector, feature names to compute score

Value

a vector of score

Examples

```
data <- matrix(rnorm(100), 10, dimnames = list(1:10))
gs_score_init(data, 1:5)
```

`iae` *standard inverse average expression*

Description

standard inverse average expression

Usage

```
iae(expr, features = NULL, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IAE_i} = log(1 + \frac{n}{\hat{N}_{i,j} + 1})$$

where n is the total number of cells, $N_{i,j}$ is the counts of feature i in cell j.

Value

a vector of inverse average expression score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::iae(data)
```

`iae_hdb` *inverse average expression using hdbscan cluster as label*

Description

inverse average expression using hdbscan cluster as label

Usage

```
iae_hdb(expr, features = NULL, multi = TRUE, thres = 0, minPts = 2, ...)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`multi`	logical, if to compute based on binary (FALSE) or multi-class (TRUE)
`thres`	numeric, cell only counts when expr > threshold, default 0
`minPts`	integer, minimum size of clusters, default 2. Details in `dbscan::hdbscan()`.
`...`	parameters for `dbscan::hdbscan()`

Details

Details as `iae_prob()`.

Value

a matrix of inverse average expression score

Examples

```
set.seed(123)
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::iae_hdb(data)
```

`iae_igm` *labeled inverse average expression: IGM*

Description

labeled inverse average expression: IGM

Usage

```
iae_igm(expr, features = NULL, label, lambda = 7, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`label`	vector, group label of each cell
`lambda`	numeric, hyperparameter for IGM
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IGM_i} = log(1 + \lambda \frac{max(mean(N_{i,j \in D})_k)}{\sum_k^K (mean(N_{i,j \in D})_k * r_k) + e^{-8}})$$

where λ is the hyper parameter, $N_{i,j \in D}$ is the counts of feature i in cell j within class D, and r_k is the rank of $mean(N_{i,j \in D})$.

Value

a vector of inverse gravity moment score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::iae_igm(data, label = sample(c("A", "B"), 10, replace = TRUE))
```

`iae_m` *inverse average expression: max*

Description

inverse average expression: max

Usage

```
iae_m(expr, features = NULL, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IAE_{i,j}} = log(1 + \frac{max_{\{i^{'} \in j\}}(n_{i^{'}})}{\sum_{j=1}^{n} max(0, N_{i,j} - threshold) + 1})$$

where i is the feature i and $i^{'}$ is the feature except i, $N_{i,j}$ is the counts of feature i in cell j, and $n_{i^{'}}$ is $\sum_{j=1}^{n} sign(N_{i,j} > threshold)$.

Value

a matrix of inverse average expression score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::iae_m(data)
```

`iae_prob` *labeled inverse average expression: probability based*

Description

labeled inverse average expression: probability based

Usage

```
iae_prob(expr, features = NULL, label, multi = TRUE, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`label`	vector, group label of each cell
`multi`	logical, if to compute based on binary (FALSE) or multi-class (TRUE)
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IAE_{i,j}} = log(1 + \frac{mean(N_{i,j \in D})}{max(mean(N_{i,j \in \hat{D}})) + e^{-8}} * mean(N_{i,j \in D}))$$

where $N_{i,j \in D}$ is the counts of feature i in cell j within class D, and $\hat{D}$ is the class except D.

Value

a matrix of inverse average expression score

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::iae_prob(data, label = sample(c("A", "B"), 10, replace = TRUE))
```

`iae_rf` *labeled inverse average expression: relative frequency*

Description

labeled inverse average expression: relative frequency

Usage

```
iae_rf(expr, features = NULL, label, multi = TRUE, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`label`	vector, group label of each cell
`multi`	logical, if to compute based on binary (FALSE) or multi-class (TRUE)
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IAE} = log(1 + \frac{mean(N_{i,j \in D})}{max(mean(N_{i,j \in \hat{D}})) + e^{-8}})$$

where $N_{i,j \in D}$ is the counts of feature i in cell j within class D, and $\hat{D}$ is the class except D.

Value

a matrix of inverse average expression score

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::iae_rf(data, label = sample(c("A", "B"), 10, replace = TRUE))
```

`iae_sd` *inverse average expression using standard deviation (SD)*

Description

inverse average expression using standard deviation (SD)

Usage

```
iae_sd(expr, features = NULL, log = FALSE, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`log`	logical, if to do log-transformation
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IAE} = log(1 + sd(tf_i) * \frac{n}{\sum_{j=1}^{n} max(0, N_{i,j}) + 1})$$

where tf_i is the term frequency of feature i, see details in `tf()`, n is the total number of cells and $N_{i,j}$ is the counts of feature i in cell j.

Value

a vector of inverse average expression score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::iae_sd(data)
```

`idf` *standard inverse cell frequency*

Description

standard inverse cell frequency

Usage

```
idf(expr, features = NULL, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IDF_i} = log(1 + \frac{n}{n_i + 1})$$

where n is the total number of cells, n_i is the number of cells containing feature i.

Value

a vector of inverse cell frequency score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::idf(data)
```

`idf_hdb` *inverse document frequency using hdbscan cluster as label*

Description

inverse document frequency using hdbscan cluster as label

Usage

```
idf_hdb(expr, features = NULL, multi = TRUE, thres = 0, minPts = 2, ...)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`multi`	logical, if to compute based on binary (FALSE) or multi-class (TRUE)
`thres`	numeric, cell only counts when expr > threshold, default 0
`minPts`	integer, minimum size of clusters, default 2. Details in `dbscan::hdbscan()`.
`...`	parameters for `dbscan::hdbscan()`

Details

Details as `idf_prob()`.

Value

a matrix of inverse cell frequency score

Examples

```
set.seed(123)
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::idf_hdb(data)
```

`idf_iae_methods` *Get names of available IDF and IAE methods*

Description

Returns a named vector of IDF/IAE methods

Usage

```
idf_iae_methods()
```

Value

names of methods implemented

Examples

```
idf_iae_methods()
```

`idf_igm` *labeled inverse cell frequency: IGM*

Description

labeled inverse cell frequency: IGM

Usage

```
idf_igm(expr, features = NULL, label, lambda = 7, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`label`	vector, group label of each cell
`lambda`	numeric, hyperparameter for IGM
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IGM_i} = log(1 + \lambda \frac{max(n_{i,j \in D})_k}{\sum_k^K ((n_{i,j \in D})_k * r_k) + e^{-8}})$$

where λ is the hyper parameter, $n_{i,j \in D}$ is the number of cells containing feature i in class D, r_k is the rank of $n_{i,j \in D}$.

Value

a vector of inverse gravity moment score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::idf_igm(data, label = sample(c("A", "B"), 10, replace = TRUE))
```

`idf_m` *inverse cell frequency: max*

Description

inverse cell frequency: max

Usage

```
idf_m(expr, features = NULL, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IDF_{i,j}} = log(\frac{max_{\{i^{'} \in j\}}(n_{i^{'}})}{n_i + 1})$$

where i is the feature i and $i^{'}$ is the feature except i, n_i is the number of cells containing feature i, and $n_{i^{'}}$ is the number of cells containing feature $i^{'}$.

Value

a matrix of inverse cell frequency score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::idf_m(data)
```

`idf_prob` *labeled inverse cell frequency: probability based*

Description

labeled inverse cell frequency: probability based

Usage

```
idf_prob(expr, features = NULL, label, multi = TRUE, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`label`	vector, group label of each cell
`multi`	logical, if to compute based on binary (FALSE) or multi-class (TRUE)
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IDF_{i,j}} = log(1 + \frac{\frac{n_{i,j\in D}}{n_{j\in D}}}{max(\frac{n_{i,j\in \hat{D}}}{n_{j\in \hat{D}}}) + e^{-8}} \frac{n_{i,j\in D}}{n_{j\in D}})$$

where $n_{i,j\in D}$ is the number of cells containing feature i in class D, $n_{j\in D}$ is the total number of cells in class D, $\hat{D}$ is the class except D.

Value

a matrix of inverse cell frequency score

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::idf_prob(data, label = sample(c("A", "B"), 10, replace = TRUE))
```

`idf_rf` *labeled inverse cell frequency: relative frequency*

Description

labeled inverse cell frequency: relative frequency

Usage

```
idf_rf(expr, features = NULL, label, multi = TRUE, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`label`	vector, group label of each cell
`multi`	logical, if to compute based on binary (FALSE) or multi-class (TRUE)
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IDF_{i,j}} = log(1 + \frac{\frac{n_{i,j\in D}}{n_{j\in D}}}{max(\frac{n_{i,j\in \hat{D}}}{n_{j\in \hat{D}}}) + e^{-8}})$$

where $n_{i,j\in D}$ is the number of cells containing feature i in class D, $n_{j\in D}$ is the total number of cells in class D, $\hat{D}$ is the class except D.

Value

a matrix of inverse cell frequency score

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::idf_rf(data, label = sample(c("A", "B"), 10, replace = TRUE))
```

`idf_sd` *inverse cell frequency using standard deviation (SD)*

Description

inverse cell frequency using standard deviation (SD)

Usage

```
idf_sd(expr, features = NULL, log = FALSE, thres = 0)
```

Arguments

`expr`	a matrix, features in row and cells in column
`features`	vector, feature names or indexes to compute
`log`	logical, if to do log-transformation
`thres`	numeric, cell only counts when expr > threshold, default 0

Details

$$\mathbf{IDF_i} = log(1 + sd(tf_i) * \frac{n}{n_i + 1})$$

where tf_i is the term frequency of feature i, see details in `tf()`, n is the total number of cells and n_i is the number of cells containing feature i.

Value

a vector of inverse cell frequency score for each feature

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::idf_sd(data)
```

`markers_hdbscan` *select markers using HDBSCAN method*

Description

select markers using HDBSCAN method

Usage

```
markers_hdbscan(
  top_markers,
  column = ".dot",
  s_thres = NULL,
  method = c("max.one", "remove.min"),
  minPts = 5,
  plot = FALSE,
  ...
)
```

Arguments

`top_markers`	output of `top_markers()`
`column`	character, specify which column used as group label
`s_thres`	NULL or numeric, only features with score > threshold will be returned, if NULL will use 2 * average probability as threshold
`method`	can be "max.one" or "remove.min", if to only keep features in 1st component or return features not in the last component
`minPts`	integer, minimum size of clusters for `dbscan::hdbscan()`
`plot`	logical, if to plot mixture density and hist
`...`	other params for `dbscan::hdbscan()`

Value

a list of markers for each group

Examples

```
data <- matrix(rnorm(100), 10, dimnames = list(1:10))
top_n <- top_markers(data, label = rep(c("A", "B"), 5))
markers_hdbscan(top_n, minPts = 2)
```

`markers_mclust` *select markers using mclust EM method*

Description

select markers using mclust EM method

Usage

```
markers_mclust(
  top_markers,
  column = ".dot",
  prob = 0.99,
  s_thres = NULL,
  method = c("max.one", "remove.min"),
  plot = FALSE,
  ...
)
```

Arguments

`top_markers`	output of `top_markers()`
`column`	character, specify which column used as group label
`prob`	numeric, probability cutoff for 1st component classification
`s_thres`	NULL or numeric, only features with score > threshold will be returned, if NULL will use 2 * average probability as threshold
`method`	can be "max.one" or "remove.min", if to only keep features in 1st component or return features not in the last component
`plot`	logical, if to plot mixture density and hist
`...`	other params for `mclust::densityMclust()`

Value

a list of markers for each group

Examples

```
data <- matrix(rnorm(100), 10, dimnames = list(1:10))
top_n <- top_markers(data, label = rep(c("A", "B"), 5))
markers_mclust(top_n)
```

`markers_mixmdl` *select markers using mixtools EM method*

Description

select markers using mixtools EM method

Usage

```
markers_mixmdl(
  top_markers,
  column = ".dot",
  prob = 0.99,
  k = 3,
  ratio = 2,
  dist = c("norm", "gamma"),
  maxit = 1e+05,
  plot = FALSE,
  ...
)
```

Arguments

`top_markers`	output of `top_markers()`
`column`	character, specify which column used as group label
`prob`	numeric, probability cutoff for 1st component classification
`k`	integer, number of components of mixtures
`ratio`	numeric, ratio cutoff of 1st component mu to 2nd component mu, only when ratio > cutoff will return markers for the group
`dist`	can be one of "norm" and "gamma", specify if to use `mixtools::normalmixEM()` or `mixtools::gammamixEM()`
`maxit`	integer, maximum number of iterations for EM
`plot`	logical, if to plot mixture density and hist
`...`	other params for `mixtools::normalmixEM()` or `mixtools::gammamixEM()`

Value

a list of markers for each group

Examples

```
set.seed(1000)
data <- matrix(rnorm(100), 10, dimnames = list(1:10))
top_n <- top_markers(data, label = rep(c("A", "B"), 5))
markers_mixmdl(top_n, k = 3)
```

`ova_score_boxplot` *boxplot of features overall score*

Description

boxplot of features overall score

Usage

```
ova_score_boxplot(data, features, ref.group, label, method = "t.test")
```

Arguments

`data`	matrix, features in row and samples in column
`features`	vector, feature names to plot
`ref.group`	character, reference group name
`label`	vector, group labels
`method`	character, statistical test to use, details in `ggpubr::stat_compare_means()`

Value

ggplot object

Examples

```
data <- matrix(rnorm(100), 10, dimnames = list(1:10))
ova_score_boxplot(data, 1:5, ref.group = "A", label = rep(c("A", "B"), 5))
```

`scale_mgm` *scale by mean of group mean for imbalanced data*

Description

scale by mean of group mean for imbalanced data

Usage

```
scale_mgm(expr, label, pooled.sd = FALSE)
```

Arguments

`expr`	matrix
`label`	a vector of group label
`pooled.sd`	logical, if to use pooled SD for scaling

Details

$$z = \frac{x - \frac{\sum_k^{n_D}(\mu_k)}{n_D}}{s}$$

where μ_k is the mean of x in k^{th} class, and n_D is the number of classes, s is the standard deviation of x, when `pooled.sd` is set to be TRUE, s will be replaced with s_{pooled}, $s_{pooled} = \sqrt{\frac{\sum_k^{n_D}(n_k-1){s_k}^2}{\sum_k^{n_D} n_k - k}}$

Value

scaled matrix

Examples

```
scale_mgm(matrix(rnorm(100), 10), label = rep(letters[1:2], 5))
```

`score_barplot` *barplot of processed score*

Description

barplot of processed score

Usage

```
score_barplot(top_markers, column = ".dot", f_list, n = 30)
```

Arguments

`top_markers`	output of `top_markers()`
`column`	character, specify which column used as group label
`f_list`	a named list of markers
`n`	numeric, number of returned top genes for each group

Value

ggplot object

Examples

```
data <- matrix(rnorm(100), 10, dimnames = list(1:10))
top_n <- top_markers(data, label = rep(c("A", "B"), 5))
score_barplot(top_n)
```

`sim_sce_test` *scRNA-seq test data of 4 groups simulated by* `splatter`.

Description

A SingleCellExperiment object containing 4 groups with each group up-regulated DEGs saved in metadata.

Usage

```
data(sim_sce_test)
```

Format

A SingleCellExperiment object of 100genes * 400 cells.

Value

SingleCellExperiment

Source

`splatter::splatSimulate()`

`sin_score_boxplot` *boxplot of split single feature score*

Description

boxplot of split single feature score

Usage

```
sin_score_boxplot(data, features = NULL, ref.group, label, method = "t.test")
```

Arguments

`data`	matrix, features in row and samples in column
`features`	vector, feature names to plot
`ref.group`	character, reference group name
`label`	vector, group labels
`method`	character, statistical test to use, details in `ggpubr::stat_compare_means()`

Value

faceted ggplot object

Examples

```
data <- matrix(rnorm(100), 10, dimnames = list(1:10))
sin_score_boxplot(data, 1:2, ref.group = "A", label = rep(c("A", "B"), 5))
```

`smartid_Package` *Scoring and Marker Selection method based on modified TF-IDF*

Description

`smartid` This package enables automated selection of group specific signature, especially for rare population. The package is developed for generating specific lists of signature genes based on TF-IDF modified methods. It can also be used as a new gene-set scoring method or data transformation method. Multiple visualization functions are implemented in this package.

Value

Marker list and scores

Author(s)

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See Also

Useful links:

- `https://davislaboratory.github.io/smartid`
- Report bugs at `https://github.com/DavisLaboratory/smartid/issues`

`tf` *compute term/feature frequency within each cell*

Description

compute term/feature frequency within each cell

Usage

```
tf(expr, log = FALSE)
```

Arguments

`expr`	a count matrix, features in row and cells in column
`log`	logical, if to do log-transformation

Details

$$\mathbf{TF_{i,j}} = \frac{N_{i,j}}{\sum_j N_{i,j}}$$

where $N_{i,j}$ is the counts of feature i in cell j.

Value

a matrix of term/gene frequency

Examples

```
data <- matrix(rpois(100, 2), 10, dimnames = list(1:10))
smartid:::tf(data)
```

`top_markers` *scale score and return top markers*

Description

scale and transform score and output top markers for groups

Usage

```
top_markers(
  data,
  label,
  n = 10,
  use.glm = TRUE,
  batch = NULL,
  scale = TRUE,
  use.mgm = TRUE,
  softmax = TRUE,
  slot = "score",
  ...
)

## S4 method for signature 'AnyMatrix'
top_markers(
  data,
  label,
  n = 10,
  use.glm = TRUE,
  batch = NULL,
  scale = TRUE,
  use.mgm = TRUE,
  softmax = TRUE,
  slot = "score",
  ...
)

## S4 method for signature 'SummarizedExperiment'
top_markers(
  data,
  label,
  n = 10,
  use.glm = TRUE,
  batch = NULL,
```

```
  scale = TRUE,
  use.mgm = TRUE,
  softmax = TRUE,
  slot = "score",
  ...
)
```

Arguments

`data`	an expression object, can be matrix or SummarizedExperiment
`label`	a vector of group label
`n`	integer, number of returned top genes for each group
`use.glm`	logical, if to use `stats::glm()` to compute group mean score, if TRUE, also compute mean score difference as output
`batch`	a vector of batch labels, default NULL
`scale`	logical, if to scale data by row
`use.mgm`	logical, if to scale data using `scale_mgm()`
`softmax`	logical, if to apply softmax transformation on output
`slot`	a character, specify which slot to use when data is se object, optional, default 'score'
`...`	params for `top_markers_abs()` or `top_markers_glm()`

Value

A tibble with top n feature names, group labels and ordered scores

Examples

```
data <- matrix(rgamma(100, 2), 10, dimnames = list(1:10))
top_markers(data, label = rep(c("A", "B"), 5))
```

`top_markers_abs` *calculate group median, MAD or mean score and order genes based on scores*

Description

calculate group median, MAD or mean score and order genes based on scores

Usage

```
top_markers_abs(
  data,
  label,
  n = 10,
  pooled.sd = FALSE,
  method = c("median", "mad", "mean"),
  scale = TRUE,
  use.mgm = TRUE,
  softmax = TRUE,
  tau = 1
)
```

Arguments

`data`	matrix, features in row and samples in column
`label`	a vector of group label
`n`	integer, number of returned top genes for each group
`pooled.sd`	logical, if to use pooled SD for scaling
`method`	character, specify metric to compute, can be one of "median", "mad", "mean"
`scale`	logical, if to scale data by row
`use.mgm`	logical, if to scale data using `scale_mgm()`
`softmax`	logical, if to apply softmax transformation on output
`tau`	numeric, hyper parameter for softmax

Value

a tibble with feature names, group labels and ordered processed scores

Examples

```
data <- matrix(rgamma(100, 2), 10, dimnames = list(1:10))
top_markers_abs(data, label = rep(c("A", "B"), 5))
```

`top_markers_glm` *calculate group mean score using glm and order genes based on scores difference*

Description

calculate group mean score using glm and order genes based on scores difference

Usage

```
top_markers_glm(
  data,
  label,
  n = 10,
  family = gaussian(),
  batch = NULL,
  scale = TRUE,
  use.mgm = TRUE,
  pooled.sd = FALSE,
  softmax = TRUE,
  tau = 1
)
```

Arguments

`data`	matrix, features in row and samples in column
`label`	a vector of group label
`n`	integer, number of returned top genes for each group
`family`	family for glm, details in `stats::glm()`
`batch`	a vector of batch labels, default NULL
`scale`	logical, if to scale data by row
`use.mgm`	logical, if to scale data using `scale_mgm()`
`pooled.sd`	logical, if to use pooled SD for scaling
`softmax`	logical, if to apply softmax transformation on output
`tau`	numeric, hyper parameter for softmax

Value

a tibble with feature names, group labels and ordered processed scores

Examples

```
data <- matrix(rgamma(100, 2), 10, dimnames = list(1:10))
top_markers_glm(data, label = rep(c("A", "B"), 5))
```

`top_markers_init` *compute group summarized score and order genes based on processed scores*

Description

compute group summarized score and order genes based on processed scores

Usage

```
top_markers_init(
  data,
  label,
  n = 10,
  use.glm = TRUE,
  batch = NULL,
  scale = TRUE,
  use.mgm = TRUE,
  softmax = TRUE,
  ...
)
```

Arguments

`data`	matrix, features in row and samples in column
`label`	a vector of group label
`n`	integer, number of returned top genes for each group
`use.glm`	logical, if to use `stats::glm()` to compute group mean score, if TRUE, also compute mean score difference as output
`batch`	a vector of batch labels, default NULL
`scale`	logical, if to scale data by row
`use.mgm`	logical, if to scale data using `scale_mgm()`
`softmax`	logical, if to apply softmax transformation on output
`...`	params for `top_markers_abs()` or `top_markers_glm()`

Value

a tibble with feature names, group labels and ordered processed scores

Examples

```
data <- matrix(rgamma(100, 2), 10, dimnames = list(1:10))
top_markers_init(data, label = rep(c("A", "B"), 5))
```

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