

Package ‘PRISMA’

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Type Package

Title Protocol Inspection and State Machine Analysis

Version 0.2-7

Date 2018-05-26

Depends R (>= 2.10), Matrix, gplots, methods, ggplot2

Suggests tm (>= 0.6)

Author Tammo Krueger, Nicole Kraemer

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Description Loads and processes huge text corpora processed with the sally toolbox (<<http://www.mlsec.org/sally/>>). sally acts as a very fast preprocessor which splits the text files into tokens or n-grams. These output files can then be read with the PRISMA package which applies testing-based token selection and has some replicate-aware, highly tuned non-negative matrix factorization and principal component analysis implementation which allows the processing of very big data sets even on desktop machines.

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PRISMA-package	<i>Protocol Inspection and State Machine Analysis</i>
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Description

Loads and processes huge text corpora processed with the sally toolbox (<<http://www.mlsec.org/sally/>>). sally acts as a very fast preprocessor which splits the text files into tokens or n-grams. These output files can then be read with the PRISMA package which applies testing-based token selection and has some replicate-aware, highly tuned non-negative matrix factorization and principal component analysis implementation which allows the processing of very big data sets even on desktop machines.

Details

Package: PRISMA
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 Title: Protocol Inspection and State Machine Analysis
 Version: 0.2-7
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 Depends: Matrix, gplots, methods, ggplot2
 Suggests: tm (>= 0.6)
 Author: Tammo Krueger, Nicole Kraemer
 Maintainer: Tammo Krueger <tammokrueger@googlemail.com>
 Description: Loads and processes huge text corpora processed with the sally toolbox (<<http://www.mlsec.org/sally/>>). sally
 License: GPL (>=2.0)

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Further information is available in the following vignettes:

PRISMA Quick introduction (source)

Author(s)

Tammo Krueger, Nicole Kraemer

Maintainer: Tammo Krueger <tammokrueger@googlemail.com>

References

Krueger, T., Gascon, H., Kraemer, N., Rieck, K. (2012) Learning Stateful Models for Network Honey pots *5th ACM Workshop on Artificial Intelligence and Security (AISEC 2012)*, accepted

Krueger, T., Kraemer, N., Rieck, K. (2011) ASAP: Automatic Semantics-Aware Analysis of Network Payloads *Privacy and Security Issues in Data Mining and Machine Learning - International ECML/PKDD Workshop. Lecture Notes in Computer Science 6549*, Springer. 50 - 63

Examples

please see the vignette for examples

asap	<i>The ASAP Data Set</i>
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Description

Toy data set to show the capabilities of the PRISMA package.

Usage

asap

Format

A prisma object.

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

References

Krueger, T., Kraemer, N., Rieck, K. (2011) ASAP: Automatic Semantics-Aware Analysis of Network Payloads *Privacy and Security Issues in Data Mining and Machine Learning - International ECML/PKDD Workshop. Lecture Notes in Computer Science 6549*, Springer. 50 - 63

corpusToPrisma	<i>Convert tm copus to PRISMA</i>
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Description

Converts a tm corpus object to a PRISMA object.

Usage

```
corpusToPrisma(corpus, alpha = 0.05, skipFeatureCorrelation = FALSE)
```

Arguments

corpus	a tm corpus
alpha	significance level for the feature tests. If NULL, all features are kept.
skipFeatureCorrelation	should the grouping of features based on correlation analysis be skipped.

Value

prismaData	data object representing the tokenized documents as features x samples matrix.
------------	--

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

Examples

```
if (require("tm") && packageVersion("tm") >= '0.6') {  
  data(thesis)  
  thesis  
  thesis = corpusToPrisma(thesis, NULL, TRUE)  
  thesis  
}
```

estimateDimension	<i>Estimate Inner Dimension</i>
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Description

Matrix factorization methods compress the original data matrix $A \in R^{f,N}$ with f features and N samples into two parts, namely $A = BC$ with $B \in R^{f,k}$, $C \in R^{k,N}$. The function estimateDimension estimates k based on a noise model estimated from a scrambled version of the original data matrix.

Usage

```
estimateDimension(prismaData, alpha = 0.05, nScrambleSamples = NULL)
```

Arguments

prismaData	A prismaData object loaded via loadPrismaData
alpha	Error probability for confidence intervals
nScrambleSamples	The number of scrambled samples that should be used to estimate the noise model. NULL means to use the complete data set.

Value

estDim	prismaDimension object that can be printed and plotted.
--------	---

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

References

R. Schmidt. Multiple emitter location and signal parameter estimation. *IEEE Transactions on Antennas and Propagation*, 34(3):276 – 280, 1986.

Examples

```
# please see the vignette for examples
```

getDuplicateData *Restores Data with Duplicates*

Description

The `loadPrismaData` function triggers a feature selection and data combination methods which subsequently remove duplicate entries for efficient representation of the data. The `getDuplicateData` rebuilds the data matrix with explicit representation of all duplicate entries.

Usage

```
getDuplicateData(prismaData)
```

Arguments

`prismaData` prisma data loaded via `loadPrismaData`

Value

`dataWithDuplicates`
Data matrix containing explicit copies of all duplicates.

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

Examples

```
data(asap)  
dataWithDuplicates = getDuplicateData(asap)
```

getMatrixFactorizationLabels
Convert Coordinates of Matrix Factorization to Labels

Description

Given a matrix factorization object $A = BC$, this function returns for each document the index of the inner dimension which has the maximal coordinate. Thus, it converts the fuzzy clustering found in the columns of the C matrix into a hard clustering by returning the position with the maximal coordinate value.

Usage

```
getMatrixFactorizationLabels(prismaMF)
```

Arguments

prismaMF a matrix factorization object.

Value

labels vector containing the label assignment for each document.

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

See Also

[prismaNMF](#)

loadPrismaData	<i>Load PRISMA Data Files</i>
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Description

Loads files generated by the sally tool (see <http://www.mlsec.org/sally/>) and represents the data as binary token/ngrams x documents matrix. After loading, statistical tests are applied to find features which are not volatile nor constant. Co-occurring features are grouped to further compactify the data. See `system.file("extdata", "sallyPreprocessing.py", package="PRISMA")` for a Python script which generates the corresponding .fsally file from a .sally file which reduce the loading time via [loadPrismaData](#) considerably.

Usage

```
loadPrismaData(path, maxLines = -1, fastSally = TRUE,
               alpha = 0.05, skipFeatureCorrelation=FALSE)
```

Arguments

path path of the data file without the .sally extension. loadPrisma loads path.sally or path.fsally depending on the fastSally switch.

maxLines maximal number of lines to read from the data file. -1 means to read all lines.

fastSally should the fsally file be used, which drastically decreases loading time.

alpha significance level for the feature tests. If NULL, all features are kept.

skipFeatureCorrelation should the grouping of features based on correlation analysis be skipped.

Value

prismaData data object representing the tokenized documents as features x samples matrix.

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

References

See <http://www.mlsec.org/sally/> for the sally utility.

Examples

```
# please see the vingette for examles
# please see system.file("extdata","asap.tar.gz", package="PRISMA") for
# an example sally output
```

plot.prisma

Generics For PRISMA Objects

Description

Print and plot generic for the PRISMA objects.

Usage

```
## S3 method for class 'prisma'
print(x, ...)
## S3 method for class 'prisma'
plot(x, ...)
```

Arguments

x	PRISMA data loaded via loadPrismaData
...	not used

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

See Also

[estimateDimension](#), [prismaHclust](#), [prismaDuplicatePCA](#), [prismaNMF](#)

Examples

```
data(asap)
print(asap)
plot(asap)
```

plot.prismaDimension *Generics For PRISMA Objects*

Description

Print and plot generic for the PRISMA dimension objects.

Usage

```
## S3 method for class 'prismaDimension'  
print(x, ...)  
## S3 method for class 'prismaDimension'  
plot(x, ...)
```

Arguments

x	PRISMA dimension object generated via estimateDimension
...	not used

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

See Also

[estimateDimension](#), [prismaHclust](#), [prismaDuplicatePCA](#), [prismaNMF](#)

Examples

```
# please see the vignette for examples
```

plot.prismaMF *Generics For PRISMA Objects*

Description

Print and plot generic for the PRISMA matrix factorization objects.

Usage

```
## S3 method for class 'prismaMF'  
plot(x, nLines = NULL, baseIndex = NULL, sampleIndex = NULL,  
minValue = NULL, noRowClustering = FALSE, noColClustering = FALSE, type  
= c("base", "coordinates"), ...)
```

Arguments

x	PRISMA matrix factorization object
nLines	number of lines that should be plotted
baseIndex	which bases should be plotted
sampleIndex	which samples should be plotted
minValue	cut-off value, i.e., every value smaller than minValue won't be shown
noRowClustering	don't cluster the rows
noColClustering	don't cluster the columns
type	show the base (type = "base", i.e. the B matrix) or show the coordinate (type = "coordinates", i.e. the C matrix).
...	not used

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

See Also

[estimateDimension](#), [prismaHclust](#), [prismaDuplicatePCA](#), [prismaNMF](#)

Examples

```
# please see the vignette for examples
```

prismaDuplicatePCA *Matrix Factorization Based on Replicate-Aware PCA*

Description

Efficient implementation of a replicate-aware principal component analysis (PCA).

Usage

```
prismaDuplicatePCA(prismaData)
```

Arguments

prismaData	PRISMA data for which a PCA should be calculated
------------	--

Value

prismaPCA	Matrix factorization object $A = B C^T$, in which the factors are calculate by a replicate-aware PCA
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Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

Examples

```
# please see the vignette for examples
```

prismaHclust

Matrix Factorization Based on Hierarchical Clustering

Description

A matrix factorization $A = BC$ based on the results of `hclust` is constructed, which holds the mean feature values for each cluster in the matrix B and the indication of the cluster in the matrix C for each data point (i.e. each data point is represented by its assigned cluster center).

Usage

```
prismaHclust(prismaData, ncomp, method = "single")
```

Arguments

<code>prismaData</code>	PRISMA data for which a clustering should be calculated.
<code>ncomp</code>	the number of components that should be extracted.
<code>method</code>	the method used for clustering.

Value

<code>prismaHclust</code>	Matrix factorization object containing B and C resulting from the hierarchical clustering of the data.
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Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

See Also

[hclust](#)

Examples

```
# please see the vignette for examples
```

prismaNMF

*Matrix Factorization Based on Replicate-Aware NMF***Description**

Matrix factorization $A = BC$ with strictly positive matrices B, C which minimize the reconstruction error $\|A - BC\|$. This replicate-aware version of the non-negative matrix factorization (NMF) is based on the alternating least squares approach and exploits the replicate information to speed up the calculation.

Usage

```
prismaNMF(prismaData, ncomp, time = 60, pca.init = TRUE, doNorm = TRUE, oldResult = NULL)
```

Arguments

prismaData	PRISMA data for which a NMF should be calculated.
ncomp	either an integer or prismaDimension object specifying the inner dimension of the matrix factorization.
time	seconds after which the calculation should end.
pca.init	should the B matrix be initialized by a PCA.
doNorm	should the B matrix normalized (i.e. all columns have the Euclidean length of 1).
oldResult	re-use results of a previous run, i.e. B and C are pre-initialized with the values of this previous matrix factorization object.

Value

prismaNMF Matrix factorization object containing the B and C matrix.

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

References

Krueger, T., Gascon, H., Kraemer, N., Rieck, K. (2012) Learning Stateful Models for Network Honeypots *5th ACM Workshop on Artificial Intelligence and Security (AISEC 2012)*, accepted

R. Albright, J. Cox, D. Duling, A. Langville, and C. Meyer. (2006) Algorithms, initializations, and convergence for the nonnegative matrix factorization. *Technical Report 81706, North Carolina State University*

Examples

```
# please see the vignette for examples
```

thesis

The Thesis Data Set

Description

The 15 sections of a thesis (see references) as a tm-corpus.

Usage

thesis

Format

A tm-corpus.

Author(s)

Tammo Krueger <tammokrueger@googlemail.com>

References

Tammo Krueger. *Probabilistic Methods for Network Security. From Analysis to Response*. PhD thesis, TU Berlin, 2013. <http://opus.kobv.de/tuberlin/volltexte/2013/3881/>

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