

Package ‘CoGAPS’

April 17, 2023

Version 3.19.1

Date 2023-03-18

Title Coordinated Gene Activity in Pattern Sets

Author Jeanette Johnson, Ashley Tsang, Jacob Mitchell, Thomas Sherman, Wai-shing Lee, Conor Kelton, Ondrej Maxian, Jacob Carey, Genevieve Stein-O'Brien, Michael Considine, Maggie Wodicka, John Stansfield, Shawn Sivy, Carlo Colantuoni, Alexander Favorov, Mike Ochs, Elana Fertig

Description Coordinated Gene Activity in Pattern Sets (CoGAPS) implements a Bayesian MCMC matrix factorization algorithm, GAPS, and links it to gene set statistic methods to infer biological process activity. It can be used to perform sparse matrix factorization on any data, and when this data represents biomolecules, to do gene set analysis.

Maintainer Elana J. Fertig <ejfertig@jhmi.edu>, Thomas D. Sherman <tomsherman159@gmail.com>, Jeanette Johnson <jjohn450@jhmi.edu>

Depends R (>= 3.5.0)

Imports BiocParallel, cluster, methods, gplots, graphics, grDevices, RColorBrewer, Rcpp, S4Vectors, SingleCellExperiment, stats, SummarizedExperiment, tools, utils, rhdf5, biomaRt, dplyr, fgsea, forcats, ggplot2, msigdb

Suggests testthat, knitr, rmarkdown, BiocStyle

LinkingTo Rcpp, BH

VignetteBuilder knitr

LazyLoad true

License BSD_3_clause + file LICENSE

biocViews GeneExpression, Transcription, GeneSetEnrichment, DifferentialExpression, Bayesian, Clustering, TimeCourse, RNASeq, Microarray, MultipleComparison, DimensionReduction, ImmunoOncology

NeedsCompilation yes

RoxygenNote 7.2.3

Encoding UTF-8

Collate 'class-CogapsParams.R' 'CoGAPS.R' 'DistributedCogaps.R'
 'HelperFunctions.R' 'Package.R' 'RcppExports.R' 'SubsetData.R'
 'class-CogapsResult.R' 'methods-CogapsParams.R'
 'methods-CogapsResult.R'

git_url <https://git.bioconductor.org/packages/CoGAPS>

git_branch devel

git_last_commit b49bab1

git_last_commit_date 2023-04-10

Date/Publication 2023-04-17

R topics documented:

CoGAPS-package	3
binaryA	4
buildReport	5
calcCoGAPStat	5
calcGeneGStat	6
calcZ	7
callInternalCoGAPS	8
checkDataMatrix	8
checkInputs	9
checkpointsEnabled	9
CoGAPS	10
CogapsParams	11
CogapsParams-class	12
CogapsResult-class	13
compiledWithOpenMPSupport	13
computeGeneGStat	14
convertDataToMatrix	15
corcut	15
corrToMeanPattern	16
createCogapsResult	16
createSets	17
distributedCogaps	17
findConsensusMatrix	18
gapsCat	18
getAmplitudeMatrix	19
getClusteredPatterns	19
getCorrelationToMeanPattern	20
getDimNames	21
getFeatureLoadings	21
getGeneNames	22
getMeanChiSq	22
getOriginalParameters	23
getParam	23

getPatternMatrix	24
getRetinaSubset	25
getSampleFactors	25
getSampleNames	26
getSubsets	26
getUnmatchedPatterns	27
getValueOrRds	27
getVersion	28
GIST.data_frame	28
GIST.matrix	28
GIST.result	29
GIST.uncertainty	29
GWCoGAPS	29
initialize,CogapsParams-method	31
initialize,CogapsResult-method	31
isRdsFile	32
ncolHelper	33
nrowHelper	33
parseExtraParams	34
patternMarkers	34
patternMatch	35
plotPatternMarkers	35
plotResiduals	36
reconstructGene	37
sampleUniformly	37
sampleWithAnnotationWeights	38
sampleWithExplicitSets	38
scCoGAPS	39
setAnnotationWeights	40
setDistributedParams	41
setFixedPatterns	42
setParam	43
startupMessage	43
stitchTogether	44
supported	44
Index	45

Description

CoGAPS implements a Bayesian MCMC matrix factorization algorithm, GAPS, and links it to gene set statistic methods to infer biological process activity. It can be used to perform sparse matrix factorization on any data, and when this data represents biomolecules, to do gene set analysis.

Package: CoGAPS
 Type: Package
 Version: 2.99.0
 Date: 2018-01-24
 License: LGPL

Author(s)

Maintainer: Elana J. Fertig <ejfertig@jhmi.edu>, Michael F. Ochs <ochsm@tcnj.edu>

References

Fertig EJ, Ding J, Favorov AV, Parmigiani G, Ochs MF. CoGAPS: an R/C++ package to identify patterns and biological process activity in transcriptomic data. *Bioinformatics*. 2010 Nov 1;26(21):2792-3

binaryA

binary heatmap for standardized feature matrix

Description

creates a binarized heatmap of the A matrix in which the value is 1 if the value in Amean is greater than threshold * Asd and 0 otherwise

Usage

```

binaryA(object, threshold = 3)

## S4 method for signature 'CogapsResult'
binaryA(object, threshold = 3)

```

Arguments

object	an object of type CogapsResult
threshold	the number of standard deviations above zero that an element of Amean must be to get a value of 1

Value

plots a heatmap of the A Matrix

Examples

```

data(GIST)
# to expensive to call since it plots
# binaryA(GIST.result, threshold=3)

```

buildReport	<i>Information About Package Compilation</i>
-------------	--

Description

Information About Package Compilation

Usage

```
buildReport()
```

Details

returns information about how the package was compiled, i.e. which compiler/version was used, which compile time options were enabled, etc...

Value

string containing build report

Examples

```
CoGAPS::buildReport()
```

calcCoGAPSStat	<i>calculate statistic on sets of measurements (genes) or samples</i>
----------------	---

Description

calculates a statistic to determine if a pattern is enriched in a particular set of measurements or samples.

Usage

```
calcCoGAPSStat(  
  object,  
  sets = NULL,  
  whichMatrix = "featureLoadings",  
  numPerm = 1000,  
  ...  
)  
  
## S4 method for signature 'CogapsResult'  
calcCoGAPSStat(  
  object,  
  sets = NULL,
```

```

    whichMatrix = "featureLoadings",
    numPerm = 1000,
    ...
)

```

Arguments

object	an object of type CogapsResult
sets	list of sets of measurements/samples
whichMatrix	either "featureLoadings" or "sampleFactors" indicating which matrix to calculate the statistics for
numPerm	number of permutations to use when calculating p-value
...	handles old arguments for backwards compatibility

Value

gene set statistics for each column of A

calcGeneGSStat	<i>probability gene belongs in gene set</i>
----------------	---

Description

calculates the probability that a gene listed in a gene set behaves like other genes in the set within the given data set

Usage

```

calcGeneGSStat(
  object,
  GStoGenes,
  numPerm,
  Pw = rep(1, ncol(object@featureLoadings)),
  nullGenes = FALSE
)

## S4 method for signature 'CogapsResult'
calcGeneGSStat(
  object,
  GStoGenes,
  numPerm,
  Pw = rep(1, ncol(object@featureLoadings)),
  nullGenes = FALSE
)

```

Arguments

object	an object of type CogapsResult
GStoGenes	data.frame or list with gene sets
numPerm	number of permutations for null
Pw	weight on genes
nullGenes	logical indicating gene adjustment

Value

gene similarity statistic

calcZ	<i>compute z-score matrix</i>
-------	-------------------------------

Description

calculates the Z-score for each element based on input mean and standard deviation matrices

Usage

```
calcZ(object, whichMatrix)

## S4 method for signature 'CogapsResult'
calcZ(object, whichMatrix)
```

Arguments

object	an object of type CogapsResult
whichMatrix	either "featureLoadings" or "sampleFactors" indicating which matrix to calculate the z-score for

Value

matrix of z-scores

Examples

```
data(GIST)
featureZScore <- calcZ(GIST.result, "featureLoadings")
```

callInternalCoGAPS	<i>make correct call to internal CoGAPS dispatch function, CoGAPS could be called directly, but to avoid any re-entrant behavior this function is called instead. It is a light wrapper around cogaps_cpp that handles setting the distributed parameters</i>
--------------------	---

Description

make correct call to internal CoGAPS dispatch function, CoGAPS could be called directly, but to avoid any re-entrant behavior this function is called instead. It is a light wrapper around cogaps_cpp that handles setting the distributed parameters

Usage

```
callInternalCoGAPS(data, allParams, uncertainty, subsetIndices, workerID)
```

Arguments

data	data in a supported format
allParams	list of all parameters
uncertainty	uncertainty of data in the same format
index	index for which subset to run on
sets	list of all subsets
geneNames	names of all genes
sampleNames	names of all samples
fixedMatrix	matrix of matched patterns

Value

CogapsResult object

checkDataMatrix	<i>check that provided data is valid</i>
-----------------	--

Description

check that provided data is valid

Usage

```
checkDataMatrix(data, uncertainty, params)
```

Arguments

data	data matrix
uncertainty	uncertainty matrix, can be null
params	CogapsParams object

Value

throws an error if data has problems

checkInputs	<i>check that all inputs are valid</i>
-------------	--

Description

check that all inputs are valid

Usage

```
checkInputs(data, uncertainty, allParams)
```

Arguments

data	data matrix
uncertainty	uncertainty matrix, can be null
allParams	list of all parameters

Value

throws an error if inputs are invalid

checkpointsEnabled	<i>Check if package was built with checkpoints enabled</i>
--------------------	--

Description

Check if package was built with checkpoints enabled

Usage

```
checkpointsEnabled()
```

Value

true/false if checkpoints are enabled

Examples

```
CoGAPS::checkpointsEnabled()
```

Description

calls the C++ MCMC code and performs Bayesian matrix factorization returning the two matrices that reconstruct the data matrix

Usage

```
CoGAPS(
  data,
  params = new("CogapsParams"),
  nThreads = 1,
  messages = TRUE,
  outputFrequency = 1000,
  uncertainty = NULL,
  checkpointOutFile = "gaps_checkpoint.out",
  checkpointInterval = 0,
  checkpointInFile = NULL,
  transposeData = FALSE,
  BPPARAM = NULL,
  workerID = 1,
  asynchronousUpdates = TRUE,
  nSnapshots = 0,
  snapshotPhase = "sampling",
  ...
)
```

Arguments

<code>data</code>	File name or R object (see details for supported types)
<code>params</code>	CogapsParams object
<code>nThreads</code>	maximum number of threads to run on
<code>messages</code>	T/F for displaying output
<code>outputFrequency</code>	number of iterations between each output (set to 0 to disable status updates, other output is controlled by @code messages)
<code>uncertainty</code>	uncertainty matrix - either a matrix or a supported file type
<code>checkpointOutFile</code>	name of the checkpoint file to create
<code>checkpointInterval</code>	number of iterations between each checkpoint (set to 0 to disable checkpoints)
<code>checkpointInFile</code>	if this is provided, CoGAPS runs from the checkpoint contained in this file

transposeData	T/F for transposing data while reading it in - useful for data that is stored as samples x genes since CoGAPS requires data to be genes x samples
BPPARAM	BiocParallel backend
workerID	if calling CoGAPS in parallel the worker ID can be specified, only worker 1 prints output and each worker outputs when it finishes, this is not necessary when using the default parallel methods (i.e. distributed CoGAPS) but only when the user is manually calling CoGAPS in parallel
asynchronousUpdates	enable asynchronous updating which allows for multi-threaded runs
nSnapshots	how many snapshots to take in each phase, setting this to 0 disables snapshots
snapshotPhase	which phase to take snapshots in e.g. "equilibration", "sampling", "all"
...	allows for overwriting parameters in params

Details

The supported R types are: matrix, data.frame, SummarizedExperiment, SingleCellExperiment. The supported file types are csv, tsv, and mtx.

Value

CogapsResult object

Examples

```
# Running from R object
data(GIST)
resultA <- CoGAPS(GIST.data_frame, nIterations=25)

# Running from file name
gist_path <- system.file("extdata/GIST.mtx", package="CoGAPS")
resultB <- CoGAPS(gist_path, nIterations=25)

# Setting Parameters
params <- new("CogapsParams")
params <- setParam(params, "nPatterns", 3)
resultC <- CoGAPS(GIST.data_frame, params, nIterations=25)
```

CogapsParams

CogapsParams constructor

Description

create a CogapsParams object

Usage

```
CogapsParams(...)
```

Arguments

... parameters for the initialization method

Value

CogapsParams object

Examples

```
params <- CogapsParams(nPatterns=10)
params
```

CogapsParams-class	<i>CogapsParams</i>
--------------------	---------------------

Description

Encapsulates all parameters for the CoGAPS algorithm

Slots

nPatterns number of patterns CoGAPS will learn
 nIterations number of iterations for each phase of the algorithm
 alphaA sparsity parameter for feature matrix
 alphaP sparsity parameter for sample matrix
 maxGibbsMassA atomic mass restriction for feature matrix
 maxGibbsMassP atomic mass restriction for sample matrix
 seed random number generator seed
 sparseOptimization speeds up performance with sparse data (roughly >80 default uncertainty
 distributed either "genome-wide" or "single-cell" indicating which distributed algorithm should
 be used
 nSets [distributed parameter] number of sets to break data into
 cut [distributed parameter] number of branches at which to cut dendrogram used in pattern match-
 ing
 minNS [distributed parameter] minimum of individual set contributions a cluster must contain
 maxNS [distributed parameter] maximum of individual set contributions a cluster can contain
 explicitSets [distributed parameter] specify subsets by index or name
 samplingAnnotation [distributed parameter] specify categories along the rows (cols) to use for
 weighted sampling
 samplingWeight [distributed parameter] weights associated with samplingAnnotation
 subsetIndices set of indices to use from the data
 subsetDim which dimension (1=rows, 2=cols) to subset

geneNames vector of names of genes in data
 sampleNames vector of names of samples in data
 fixedPatterns fix either 'A' or 'P' matrix to these values, in the context of distributed CoGAPS (GWCoGAPS/scCoGAPS), the first phase is skipped and fixedPatterns is used for all sets - allowing manual pattern matching, as well as fixed runs of standard CoGAPS
 whichMatrixFixed either 'A' or 'P', indicating which matrix is fixed
 takePumpSamples whether or not to take PUMP samples

CogapsResult-class	<i>CogapsResult</i>
--------------------	---------------------

Description

Contains all output from Cogaps run

Slots

factorStdDev std dev of the sampled P matrices
 loadingStdDev std dev of the sampled A matrices

compiledWithOpenMPSupport	<i>Check if compiler supported OpenMP</i>
---------------------------	---

Description

Check if compiler supported OpenMP

Usage

compiledWithOpenMPSupport()

Value

true/false if OpenMP was supported

Examples

CoGAPS::compiledWithOpenMPSupport()

computeGeneGSProb	<i>compute gene probability</i>
-------------------	---------------------------------

Description

Computes the p-value for gene set membership using the CoGAPS-based statistics developed in Fertig et al. (2012). This statistic refines set membership for each candidate gene in a set specified in GSGenes by comparing the inferred activity of that gene to the average activity of the set.

Usage

```
computeGeneGSProb(
  object,
  GStoGenes,
  numPerm = 500,
  Pw = rep(1, ncol(object@featureLoadings)),
  PwNull = FALSE
)

## S4 method for signature 'CogapsResult'
computeGeneGSProb(
  object,
  GStoGenes,
  numPerm = 500,
  Pw = rep(1, ncol(object@featureLoadings)),
  PwNull = FALSE
)
```

Arguments

object	an object of type CogapsResult
GStoGenes	data.frame or list with gene sets
numPerm	number of permutations for null
Pw	weight on genes
PwNull	- logical indicating gene adjustment

Value

A vector of length GSGenes containing the p-values of set membership for each gene contained in the set specified in GSGenes.

convertDataToMatrix	<i>convert any acceptable data input to a numeric matrix</i>
---------------------	--

Description

convert supported R objects containing the data to a numeric matrix, if data is a file name do nothing. Exits with an error if data is not a supported type.

Usage

```
convertDataToMatrix(data)
```

Arguments

data	data input
------	------------

Value

data matrix

corcut	<i>cluster patterns together</i>
--------	----------------------------------

Description

cluster patterns together

Usage

```
corcut(allPatterns, cut, minNS)
```

Arguments

allPatterns	matrix of all patterns across subsets
cut	number of branches at which to cut dendrogram
minNS	minimum of individual set contributions a cluster must contain

Value

patterns listed by which cluster they belong to

corrToMeanPattern	<i>calculate correlation of each pattern in a cluster to the cluster mean</i>
-------------------	---

Description

calculate correlation of each pattern in a cluster to the cluster mean

Usage

```
corrToMeanPattern(cluster)
```

Value

correlation of each pattern

createCogapsResult	<i>convert list output from c++ code to a CogapsResult object</i>
--------------------	---

Description

convert list output from c++ code to a CogapsResult object

Usage

```
createCogapsResult(returnList, allParams)
```

Arguments

returnList	list from cogaps_cpp
allParams	list of all parameters

Value

CogapsResult object

createSets	<i>partition genes/samples into subsets</i>
------------	---

Description

either genes or samples or partitioned depending on the type of distributed CoGAPS (i.e. genome-wide or single-cell)

Usage

```
createSets(data, allParams)
```

Arguments

data	either file name or matrix
allParams	list of all CoGAPS parameters

Value

list of sorted subsets of either genes or samples

distributedCogaps	<i>CoGAPS Distributed Matrix Factorization Algorithm</i>
-------------------	--

Description

runs CoGAPS over subsets of the data and stitches the results back together

Usage

```
distributedCogaps(data, allParams, uncertainty)
```

Arguments

data	File name or R object (see details for supported types)
allParams	list of all parameters used in computation
uncertainty	uncertainty matrix (same supported types as data)

Details

For file types CoGAPS supports csv, tsv, and mtx

Value

list

findConsensusMatrix	<i>find the consensus pattern matrix across all subsets</i>
---------------------	---

Description

find the consensus pattern matrix across all subsets

Usage

```
findConsensusMatrix(unmatchedPatterns, gapsParams)
```

Arguments

unmatchedPatterns	list of all unmatched pattern matrices from initial run of CoGAPS
gapsParams	list of all CoGAPS parameters

Value

matrix of consensus patterns

gapsCat	<i>wrapper around cat</i>
---------	---------------------------

Description

cleans up message printing

Usage

```
gapsCat(allParams, ...)
```

Arguments

allParams	all cogaps parameters
...	arguments forwarded to cat

Value

conditionally print message

getAmplitudeMatrix	<i>return Amplitude matrix from CogapsResult object</i>
--------------------	---

Description

return Amplitude matrix from CogapsResult object

Usage

```
getAmplitudeMatrix(object)

## S4 method for signature 'CogapsResult'
getAmplitudeMatrix(object)
```

Arguments

object	an object of type CogapsResult
--------	--------------------------------

Value

amplitude matrix

Examples

```
data(GIST)
amplitudeMatrix <- getAmplitudeMatrix(GIST.result)
```

getClusteredPatterns	<i>return clustered patterns from set of all patterns across all subsets</i>
----------------------	--

Description

return clustered patterns from set of all patterns across all subsets

Usage

```
getClusteredPatterns(object)

## S4 method for signature 'CogapsResult'
getClusteredPatterns(object)
```

Arguments

object	an object of type CogapsResult
--------	--------------------------------

Value

CogapsParams object

Examples

```
data(GIST)
clusteredPatterns <- getClusteredPatterns(GIST.result)
```

getCorrelationToMeanPattern

return correlation between each pattern and the cluster mean

Description

return correlation between each pattern and the cluster mean

Usage

```
getCorrelationToMeanPattern(object)

## S4 method for signature 'CogapsResult'
getCorrelationToMeanPattern(object)
```

Arguments

object an object of type CogapsResult

Value

CogapsParams object

Examples

```
data(GIST)
corrToMeanPattern <- getCorrelationToMeanPattern(GIST.result)
```

getDimNames	<i>extracts gene/sample names from the data</i>
-------------	---

Description

extracts gene/sample names from the data

Usage

```
getDimNames(data, allParams)
```

Arguments

data	data matrix
allParams	list of all parameters

Value

list of all parameters with added gene names

getFeatureLoadings	<i>return featureLoadings matrix from CogapsResult object</i>
--------------------	---

Description

return featureLoadings matrix from CogapsResult object

Usage

```
getFeatureLoadings(object)

## S4 method for signature 'CogapsResult'
getFeatureLoadings(object)
```

Arguments

object	an object of type CogapsResult
--------	--------------------------------

Value

featureLoadings matrix

Examples

```
data(GIST)
fLoadings <- getFeatureLoadings(GIST.result)
```

getGeneNames	<i>extract gene names from data</i>
--------------	-------------------------------------

Description

extract gene names from data

Usage

```
getGeneNames(data, transpose)
```

Value

vector of gene names

getMeanChiSq	<i>return chi-sq of final matrices</i>
--------------	--

Description

return chi-sq of final matrices

Usage

```
getMeanChiSq(object)

## S4 method for signature 'CogapsResult'
getMeanChiSq(object)
```

Arguments

object	an object of type CogapsResult
--------	--------------------------------

Value

chi-sq error

Examples

```
data(GIST)
getMeanChiSq(GIST.result)
```

getOriginalParameters *return original parameters used to generate this result*

Description

return original parameters used to generate this result

Usage

```
getOriginalParameters(object)

## S4 method for signature 'CogapsResult'
getOriginalParameters(object)
```

Arguments

object an object of type CogapsResult

Value

CogapsParams object

Examples

```
data(GIST)
params <- getOriginalParameters(GIST.result)
```

getParam *get the value of a parameter*

Description

get the value of a parameter

Usage

```
getParam(object, whichParam)

## S4 method for signature 'CogapsParams'
getParam(object, whichParam)
```

Arguments

object an object of type CogapsParams
whichParam a string with the name of the requested parameter

Value

the value of the parameter

Examples

```
params <- new("CogapsParams")
getParam(params, "seed")
```

getPatternMatrix	<i>return pattern matrix from CogapsResult object</i>
------------------	---

Description

return pattern matrix from CogapsResult object

Usage

```
getPatternMatrix(object)

## S4 method for signature 'CogapsResult'
getPatternMatrix(object)
```

Arguments

object an object of type CogapsResult

Value

pattern matrix

Examples

```
data(GIST)
patternMatrix <- getPatternMatrix(GIST.result)
```

getRetinaSubset	<i>get specified number of retina subsets</i>
-----------------	---

Description

combines retina subsets from extdata directory

Usage

```
getRetinaSubset(n = 1)
```

Arguments

n	number of subsets to use
---	--------------------------

Value

matrix of RNA counts

Examples

```
retSubset <- getRetinaSubset()
dim(retSubset)
```

getSampleFactors	<i>return sampleFactors matrix from CogapsResult object</i>
------------------	---

Description

return sampleFactors matrix from CogapsResult object

Usage

```
getSampleFactors(object)

## S4 method for signature 'CogapsResult'
getSampleFactors(object)
```

Arguments

object	an object of type CogapsResult
--------	--------------------------------

Value

sampleFactors matrix

Examples

```
data(GIST)
sFactors <- getSampleFactors(GIST.result)
```

getSampleNames	<i>extract sample names from data</i>
----------------	---------------------------------------

Description

extract sample names from data

Usage

```
getSampleNames(data, transpose)
```

Value

vector of sample names

getSubsets	<i>return the names of the genes (samples) in each subset</i>
------------	---

Description

return the names of the genes (samples) in each subset

Usage

```
getSubsets(object)

## S4 method for signature 'CogapsResult'
getSubsets(object)
```

Arguments

object an object of type CogapsResult

Value

CogapsParams object

Examples

```
data(GIST)
subsets <- getSubsets(GIST.result)
```

getUnmatchedPatterns *return unmatched patterns from each subset*

Description

return unmatched patterns from each subset

Usage

```
getUnmatchedPatterns(object)

## S4 method for signature 'CogapsResult'
getUnmatchedPatterns(object)
```

Arguments

object an object of type CogapsResult

Value

CogapsParams object

Examples

```
data(GIST)
unmatchedPatterns <- getUnmatchedPatterns(GIST.result)
```

getValueOrRds *get input that might be an RDS file*

Description

get input that might be an RDS file

Usage

```
getValueOrRds(input)
```

Arguments

input some user input

Value

if input is an RDS file, read it - otherwise return input

getVersion	<i>return version number used to generate this result</i>
------------	---

Description

return version number used to generate this result

Usage

```
getVersion(object)  
  
## S4 method for signature 'CogapsResult'  
getVersion(object)
```

Arguments

object an object of type CogapsResult

Value

version number

Examples

```
data(GIST)  
getVersion(GIST.result)
```

GIST.data_frame	<i>GIST gene expression data from Ochs et al. (2009)</i>
-----------------	--

Description

GIST gene expression data from Ochs et al. (2009)

GIST.matrix	<i>GIST gene expression data from Ochs et al. (2009)</i>
-------------	--

Description

GIST gene expression data from Ochs et al. (2009)

GIST.result

*CoGAPS result from running on GIST dataset***Description**

CoGAPS result from running on GIST dataset

GIST.uncertainty

*GIST gene expression uncertainty matrix from Ochs et al. (2009)***Description**

GIST gene expression uncertainty matrix from Ochs et al. (2009)

GWCoGAPS

*Genome Wide CoGAPS***Description**

wrapper around genome-wide distributed algorithm for CoGAPS

Usage

```

GWCoGAPS(
  data,
  params = new("CogapsParams"),
  nThreads = 1,
  messages = TRUE,
  outputFrequency = 500,
  uncertainty = NULL,
  checkpointOutFile = "gaps_checkpoint.out",
  checkpointInterval = 1000,
  checkpointInFile = NULL,
  transposeData = FALSE,
  BPPARAM = NULL,
  workerID = 1,
  asynchronousUpdates = FALSE,
  ...
)

```

Arguments

<code>data</code>	File name or R object (see details for supported types)
<code>params</code>	CogapsParams object
<code>nThreads</code>	maximum number of threads to run on
<code>messages</code>	T/F for displaying output
<code>outputFrequency</code>	number of iterations between each output (set to 0 to disable status updates, other output is controlled by @code messages)
<code>uncertainty</code>	uncertainty matrix - either a matrix or a supported file type
<code>checkpointOutFile</code>	name of the checkpoint file to create
<code>checkpointInterval</code>	number of iterations between each checkpoint (set to 0 to disable checkpoints)
<code>checkpointInFile</code>	if this is provided, CoGAPS runs from the checkpoint contained in this file
<code>transposeData</code>	T/F for transposing data while reading it in - useful for data that is stored as samples x genes since CoGAPS requires data to be genes x samples
<code>BPPARAM</code>	BiocParallel backend
<code>workerID</code>	if calling CoGAPS in parallel the worker ID can be specified, only worker 1 prints output and each worker outputs when it finishes, this is not necessary when using the default parallel methods (i.e. distributed CoGAPS) but only when the user is manually calling CoGAPS in parallel
<code>asynchronousUpdates</code>	enable asynchronous updating which allows for multi-threaded runs
<code>...</code>	allows for overwriting parameters in params

Value

CogapsResult object

Examples

```
## Not run:
data(GIST)
params <- new("CogapsParams")
params <- setDistributedParams(params, nSets=2)
params <- setParam(params, "nIterations", 100)
params <- setParam(params, "nPatterns", 3)
result <- GWCoGAPS(GIST.matrix, params, BPPARAM=BiocParallel::SerialParam())

## End(Not run)
```

```
initialize,CogapsParams-method
      constructor for CogapsParams
```

Description

constructor for CogapsParams

Usage

```
## S4 method for signature 'CogapsParams'
initialize(.Object, distributed = NULL, ...)
```

Arguments

.Object	CogapsParams object
distributed	either "genome-wide" or "single-cell" indicating which distributed algorithm should be used
...	initial values for slots

Value

initialized CogapsParams object

```
initialize,CogapsResult-method
      Constructor for CogapsResult
```

Description

Constructor for CogapsResult

Usage

```
## S4 method for signature 'CogapsResult'
initialize(
  .Object,
  Amean,
  Pmean,
  Asd,
  Psd,
  meanChiSq,
  geneNames,
  sampleNames,
  diagnostics = NULL,
  ...
)
```

Arguments

.Object	CogapsResult object
Amean	mean of sampled A matrices
Pmean	mean of sampled P matrices
Asd	std dev of sampled A matrices
Psd	std dev of sampled P matrices
meanChiSq	mean value of ChiSq statistic
geneNames	names of genes in data
sampleNames	names of samples in data
diagnostics	assorted diagnostic reports from the run
...	initial values for slots

Value

initialized CogapsResult object

isRdsFile	<i>checks if file is rds format</i>
-----------	-------------------------------------

Description

checks if file is rds format

Usage

```
isRdsFile(file)
```

Arguments

file	path to file
------	--------------

Value

TRUE if file is .rds, FALSE if not

ncolHelper	<i>get number of columns from supported file name or matrix</i>
------------	---

Description

get number of columns from supported file name or matrix

Usage

```
ncolHelper(data)
```

Arguments

data	either a file name or a matrix
------	--------------------------------

Value

number of columns

nrowHelper	<i>get number of rows from supported file name or matrix</i>
------------	--

Description

get number of rows from supported file name or matrix

Usage

```
nrowHelper(data)
```

Arguments

data	either a file name or a matrix
------	--------------------------------

Value

number of rows

parseExtraParams	<i>parse parameters passed through the ... variable</i>
------------------	---

Description

parse parameters passed through the ... variable

Usage

```
parseExtraParams(allParams, extraParams)
```

Arguments

allParams	list of all parameters
extraParams	list of parameters in ...

Value

allParams with any valid parameters in extraParams added

Note

will halt with an error if any parameters in extraParams are invalid

patternMarkers	<i>compute pattern markers statistic</i>
----------------	--

Description

calculate the most associated pattern for each gene

Usage

```
patternMarkers(object, threshold = "all", lp = NA, axis = 1)
```

```
## S4 method for signature 'CogapsResult'
```

```
patternMarkers(object, threshold = "all", lp = NA, axis = 1)
```

Arguments

object	an object of type CogapsResult
threshold	the type of threshold to be used. The default "all" will distribute genes into pattern with the lowest ranking. The "cut" thresholds by the first gene to have a lower ranking, i.e. better fit to, a pattern.
lp	a vector of weights for each pattern to be used for finding markers. If NA markers for each pattern of the A matrix will be used.
axis	either 1 or 2, specifying if pattern markers should be calculated using the rows of the data (1) or the columns of the data (2)

Value

By default a non-overlapping list of genes associated with each lp.

Examples

```
data(GIST)
pm <- patternMarkers(GIST.result)
```

patternMatch	<i>Match Patterns Across Multiple Runs</i>
--------------	--

Description

Match Patterns Across Multiple Runs

Usage

```
patternMatch(allPatterns, gapsParams)
```

Arguments

allPatterns	matrix of patterns stored in the columns
gapsParams	CoGAPS parameters object

Value

a matrix of consensus patterns

plotPatternMarkers	<i>heatmap of original data clustered by pattern markers statistic</i>
--------------------	--

Description

heatmap of original data clustered by pattern markers statistic

Usage

```
plotPatternMarkers(
  object,
  data,
  patternPalette,
  sampleNames,
  samplePalette = NULL,
  heatmapCol = bluered,
  colDenogram = TRUE,
  scale = "row",
  ...
)
```

Arguments

object	an object of type CogapsResult
data	the original data as a matrix
patternPalette	a vector indicating what color should be used for each pattern
sampleNames	names of the samples to use for labeling
samplePalette	a vector indicating what color should be used for each sample
heatmapCol	pallelet giving color scheme for heatmap
colDenogram	logical indicating whether to display sample denogram
scale	character indicating if the values should be centered and scaled in either the row direction or the column direction, or none. The default is "row".
...	additional graphical parameters to be passed to heatmap.2

Value

heatmap of the data values for the patternMarkers

See Also

[heatmap.2](#)

plotResiduals	<i>plot of residuals</i>
---------------	--------------------------

Description

calculate residuals and produce heatmap

Usage

```
plotResiduals(object, data, uncertainty = NULL)
```

```
## S4 method for signature 'CogapsResult'
plotResiduals(object, data, uncertainty = NULL)
```

Arguments

object	an object of type CogapsResult
data	original data matrix run through GAPS
uncertainty	original standard deviation matrix run through GAPS

Value

creates a residual plot

Examples

```
data(GIST)
# to expensive to call since it plots
# plotResiduals(GIST.result, GIST.matrix)
```

reconstructGene	<i>reconstruct gene</i>
-----------------	-------------------------

Description

reconstruct gene

Usage

```
reconstructGene(object, genes = NULL)

## S4 method for signature 'CogapsResult'
reconstructGene(object, genes = NULL)
```

Arguments

object	an object of type CogapsResult
genes	an index of the gene or genes of interest

Value

the D' estimate of a gene or set of genes

Examples

```
data(GIST)
estimatedD <- reconstructGene(GIST.result)
```

sampleUniformly	<i>subset data by uniformly partitioning rows (cols)</i>
-----------------	--

Description

subset data by uniformly partitioning rows (cols)

Usage

```
sampleUniformly(allParams, total, setSize)
```

Arguments

allParams	list of all CoGAPS parameters
total	total number of rows (cols) that are being paritioned
setSize	the size of each subset of the total

Value

list of subsets

sampleWithAnnotationWeights	<i>subset rows (cols) proportional to the user provided weights</i>
-----------------------------	---

Description

subset rows (cols) proportional to the user provided weights

Usage

```
sampleWithAnnotationWeights(allParams, setSize)
```

Arguments

allParams	list of all CoGAPS parameters
setSize	the size of each subset of the total

Value

list of subsets

sampleWithExplicitSets	<i>use user provided subsets</i>
------------------------	----------------------------------

Description

use user provided subsets

Usage

```
sampleWithExplicitSets(allParams)
```

Arguments

allParams	list of all CoGAPS parameters
total	total number of rows (cols) that are being paritioned

Value

list of subsets

scCoGAPS

Single Cell CoGAPS

Description

wrapper around single-cell distributed algorithm for CoGAPS

Usage

```
scCoGAPS(
  data,
  params = new("CogapsParams"),
  nThreads = 1,
  messages = TRUE,
  outputFrequency = 500,
  uncertainty = NULL,
  checkpointOutFile = "gaps_checkpoint.out",
  checkpointInterval = 1000,
  checkpointInFile = NULL,
  transposeData = FALSE,
  BPPARAM = NULL,
  workerID = 1,
  asynchronousUpdates = FALSE,
  ...
)
```

Arguments

data	File name or R object (see details for supported types)
params	CogapsParams object
nThreads	maximum number of threads to run on
messages	T/F for displaying output
outputFrequency	number of iterations between each output (set to 0 to disable status updates, other output is controlled by @code messages)
uncertainty	uncertainty matrix - either a matrix or a supported file type
checkpointOutFile	name of the checkpoint file to create
checkpointInterval	number of iterations between each checkpoint (set to 0 to disable checkpoints)
checkpointInFile	if this is provided, CoGAPS runs from the checkpoint contained in this file

transposeData	T/F for transposing data while reading it in - useful for data that is stored as samples x genes since CoGAPS requires data to be genes x samples
BPPARAM	BiocParallel backend
workerID	if calling CoGAPS in parallel the worker ID can be specified, only worker 1 prints output and each worker outputs when it finishes, this is not necessary when using the default parallel methods (i.e. distributed CoGAPS) but only when the user is manually calling CoGAPS in parallel
asynchronousUpdates	enable asynchronous updating which allows for multi-threaded runs
...	allows for overwriting parameters in params

Value

CogapsResult object

Examples

```
## Not run:
data(GIST)
params <- new("CogapsParams")
params <- setDistributedParams(params, nSets=2)
params <- setParam(params, "nIterations", 100)
params <- setParam(params, "nPatterns", 3)
result <- scCoGAPS(t(GIST.matrix), params, BPPARAM=BiocParallel::SerialParam())

## End(Not run)
```

setAnnotationWeights *set the annotation labels and weights for subsetting the data*

Description

these parameters are interrelated so they must be set together

Usage

```
setAnnotationWeights(object, annotation, weights)
```

```
## S4 method for signature 'CogapsParams'
setAnnotationWeights(object, annotation, weights)
```

Arguments

object	an object of type CogapsParams
annotation	vector of labels
weights	vector of weights

Value

the modified params object

Examples

```
params <- new("CogapsParams")
params <- setAnnotationWeights(params, c('a', 'b', 'c'), c(1,2,1))
```

setDistributedParams *set the value of parameters for distributed CoGAPS*

Description

these parameters are interrelated so they must be set together

Usage

```
setDistributedParams(
  object,
  nSets = NULL,
  cut = NULL,
  minNS = NULL,
  maxNS = NULL
)

## S4 method for signature 'CogapsParams'
setDistributedParams(
  object,
  nSets = NULL,
  cut = NULL,
  minNS = NULL,
  maxNS = NULL
)
```

Arguments

object	an object of type CogapsParams
nSets	number of sets to break data into
cut	number of branches at which to cut dendrogram used in pattern matching
minNS	minimum of individual set contributions a cluster must contain
maxNS	maximum of individual set contributions a cluster can contain

Value

the modified params object

Examples

```
params <- new("CogapsParams")
params <- setDistributedParams(params, 5)
```

setFixedPatterns	<i>set the fixed patterns for either the A or the P matrix</i>
------------------	--

Description

these parameters are interrelated so they must be set together

Usage

```
setFixedPatterns(object, fixedPatterns, whichMatrixFixed)

## S4 method for signature 'CogapsParams'
setFixedPatterns(object, fixedPatterns, whichMatrixFixed)
```

Arguments

object	an object of type CogapsParams
fixedPatterns	values for either the A or P matrix
whichMatrixFixed	either 'A' or 'P' indicating which matrix is fixed

Value

the modified params object

Examples

```
params <- new("CogapsParams")
data(GIST)
params <- setFixedPatterns(params, getSampleFactors(GIST.result), 'P')
```

setParam	<i>set the value of a parameter</i>
----------	-------------------------------------

Description

set the value of a parameter

Usage

```
setParam(object, whichParam, value)
```

```
## S4 method for signature 'CogapsParams'  
setParam(object, whichParam, value)
```

Arguments

object	an object of type CogapsParams
whichParam	a string with the name of the parameter to be changed
value	the value to set the parameter to

Value

the modified params object

Examples

```
params <- new("CogapsParams")  
params <- setParam(params, "seed", 123)
```

startupMessage	<i>write start up message</i>
----------------	-------------------------------

Description

write start up message

Usage

```
startupMessage(data, allParams)
```

Arguments

data	data set
allParams	list of all parameters

Value

message displayed to screen

stitchTogether	<i>concatenate final results across subsets</i>
----------------	---

Description

concatenate final results across subsets

Usage

stitchTogether(result, allParams, sets)

Arguments

- result list of CogapsResult object from all runs across subsets
- allParams list of all CoGAPS parameters
- sets indices of sets used to break apart data

Value

list with all CoGAPS output

supported	<i>checks if file is supported</i>
-----------	------------------------------------

Description

checks if file is supported

Usage

supported(file)

Arguments

- file path to file

Value

TRUE if file is supported, FALSE if not

Index

* internal

- callInternalCoGAPS, 8
- checkDataMatrix, 8
- checkInputs, 9
- convertDataToMatrix, 15
- corcut, 15
- corrToMeanPattern, 16
- createCogapsResult, 16
- createSets, 17
- distributedCogaps, 17
- gapsCat, 18
- getDimNames, 21
- getGeneNames, 22
- getSampleNames, 26
- getValueOrRds, 27
- isRdsFile, 32
- ncolHelper, 33
- nrowHelper, 33
- parseExtraParams, 34
- patternMatch, 35
- sampleUniformly, 37
- sampleWithAnnotationWeights, 38
- sampleWithExplicitSets, 38
- startupMessage, 43
- stitchTogether, 44
- supported, 44

binaryA, 4

binaryA, CogapsResult-method (binaryA), 4

buildReport, 5

calcCoGAPStat, 5

calcCoGAPStat, CogapsResult-method (calcCoGAPStat), 5

calcGeneGSStat, 6

calcGeneGSStat, CogapsResult-method (calcGeneGSStat), 6

calcZ, 7

calcZ, CogapsResult-method (calcZ), 7

callInternalCoGAPS, 8

checkDataMatrix, 8

checkInputs, 9

checkpointsEnabled, 9

CoGAPS, 10

CoGAPS-package, 3

CogapsParams, 11

CogapsParams-class, 12

CogapsResult-class, 13

compiledWithOpenMPSupport, 13

computeGeneGSProb, 14

computeGeneGSProb, CogapsResult-method (computeGeneGSProb), 14

convertDataToMatrix, 15

corcut, 15

corrToMeanPattern, 16

createCogapsResult, 16

createSets, 17

distributedCogaps, 17

findConsensusMatrix, 18

gapsCat, 18

getAmplitudeMatrix, 19

getAmplitudeMatrix, CogapsResult-method (getAmplitudeMatrix), 19

getClusteredPatterns, 19

getClusteredPatterns, CogapsResult-method (getClusteredPatterns), 19

getCorrelationToMeanPattern, 20

getCorrelationToMeanPattern, CogapsResult-method (getCorrelationToMeanPattern), 20

getDimNames, 21

getFeatureLoadings, 21

getFeatureLoadings, CogapsResult-method (getFeatureLoadings), 21

getGeneNames, 22

getMeanChiSq, 22

getMeanChiSq, CogapsResult-method
 (getMeanChiSq), 22
 getOriginalParameters, 23
 getOriginalParameters, CogapsResult-method
 (getOriginalParameters), 23
 getParam, 23
 getParam, CogapsParams-method
 (getParam), 23
 getPatternMatrix, 24
 getPatternMatrix, CogapsResult-method
 (getPatternMatrix), 24
 getRetinaSubset, 25
 getSampleFactors, 25
 getSampleFactors, CogapsResult-method
 (getSampleFactors), 25
 getSampleNames, 26
 getSubsets, 26
 getSubsets, CogapsResult-method
 (getSubsets), 26
 getUnmatchedPatterns, 27
 getUnmatchedPatterns, CogapsResult-method
 (getUnmatchedPatterns), 27
 getValueOrRds, 27
 getVersion, 28
 getVersion, CogapsResult-method
 (getVersion), 28
 GIST.data_frame, 28
 GIST.matrix, 28
 GIST.result, 29
 GIST.uncertainty, 29
 GWCoGAPS, 29

 heatmap.2, 36

 initialize, CogapsParams-method, 31
 initialize, CogapsResult-method, 31
 isRdsFile, 32

 ncolHelper, 33
 nrowHelper, 33

 parseExtraParams, 34
 patternMarkers, 34
 patternMarkers, CogapsResult-method
 (patternMarkers), 34
 patternMatch, 35
 plotPatternMarkers, 35
 plotResiduals, 36
 plotResiduals, CogapsResult-method
 (plotResiduals), 36

 reconstructGene, 37
 reconstructGene, CogapsResult-method
 (reconstructGene), 37

 sampleUniformly, 37
 sampleWithAnnotationWeights, 38
 sampleWithExplicitSets, 38
 scCoGAPS, 39
 setAnnotationWeights, 40
 setAnnotationWeights, CogapsParams-method
 (setAnnotationWeights), 40
 setDistributedParams, 41
 setDistributedParams, CogapsParams-method
 (setDistributedParams), 41
 setFixedPatterns, 42
 setFixedPatterns, CogapsParams-method
 (setFixedPatterns), 42
 setParam, 43
 setParam, CogapsParams-method
 (setParam), 43
 startupMessage, 43
 stitchTogether, 44
 supported, 44