

# Package ‘trena’

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trena-package

*Inferring Transcriptional Regulation with TReNA*


---

## Description

'trena' provides a framework for using gene expression data to infer relationships between a target gene and a set of transcription factors. It does so using a several classes and their associated methods, briefly documented below

## Details

### #' Solver Class Objects

The `Solver` class is a base class used within 'trena'. A particular `Solver` object also contains the name of the selected solver and dispatches the correct feature selection method when `run` is called on the object. It is inherited by all the following subclasses, representing the different feature selection methods: `BayesSpikeSolver`, `EnsembleSolver`, `LassoPVSolver`, `LassoSolver`, `PearsonSolver`, `RandomForestSolver`, `RidgeSolver`, `SpearmanSolver`, `SqrtLassoSolver`.

### CandidateFilter Class Objects

The `CandidateFilter` class is a base class that is generally used to filter the transcription factors in the expression matrix to obtain a set of candidate regulators. Filtering method depends on the filter type chosen; there are currently the following subclasses: `FootprintFilter`, `HumanDHSFilter`, `GeneOntologyFilter`, and `VarianceFilter`. The filters are applied using the `getCandidates` method on a given `CandidateFilter` object.

### FootprintFinder Class Objects

The `FootprintFinder` class is designed to allow extraction of gene footprinting information from existing PostgreSQL or SQLite databases. In standard use of the 'trena' package, it is used solely by the `getCandidates` method for a `FootprintFilter` object. However, a `FootprintFinder` object has many more available methods that allow it to extract information more flexibly.

---

addStats,PCAMax-method

*add PCA-based summary stats on all TFs in the model*


---

## Description

add PCA-based summary stats on all TFs in the model

## Usage

```
## S4 method for signature 'PCAMax'
addStats(obj, varianceToInclude = 0.75, scalePCA = FALSE)
```

## Arguments

<code>obj</code>	An object of the class <code>PCAMax</code>
<code>varianceToInclude</code>	numeric variance to include in the PCA
<code>scalePCA</code>	logical

**Value**

the original model with extra columns: pcaMax, cov, PC1, PC2,

---

addStatsSimple,PCAMax-method

*add PCA-based summary stats on all TFs in the model*

---

**Description**

add PCA-based summary stats on all TFs in the model

**Usage**

```
## S4 method for signature 'PCAMax'
addStatsSimple(
  obj,
  varianceToInclude = 0.75,
  scalePCA = FALSE,
  excludeLasso = TRUE,
  quiet = TRUE
)
```

**Arguments**

obj	An object of the class PCAMax
varianceToInclude	numeric variance to include in the PCA
scalePCA	logical
excludeLasso	logical excluding lasso avoids dropping TFs due to shrinkage
quiet	logical

**Value**

the original model with extra columns: pcaMax, cov, PC1, PC2,

---

assessSnp,Trena-method

*Assess the effect of a SNP using a Trena object*

---

**Description**

Assess the effect of a SNP using a Trena object

**Usage**

```
## S4 method for signature 'Trena'
assessSnp(
  obj,
  pfms,
  variant,
  shoulder,
  pwmMatchMinimumAsPercentage,
  relaxedMatchDelta = 25
)
```

**Arguments**

obj	An object of class Trena
pfms	A set of motif matrices, generally retrieved using MotifDb
variant	A variant of interest
shoulder	A distance from the TSS to use as a window
pwmMatchMinimumAsPercentage	A minimum match percentage for the motifs
relaxedMatchDelta	A numeric indicating the degree of the match (default = 25)

**Value**

A data frame containing the gene model

**Examples**

```
## Not run:
# Create a Trena object for human, assign a variant, then assess the effects of the variant
trena <- Trena("hg38")

library(MotifDb)
jaspar.human.pfms <- as.list(query(query(MotifDb, "jaspar2016"), "sapiens"))[21:25]

variant <- "rs3875089" # chr18:26865469 T->C

tbl <- assessSnp(trena, jaspar.human.pfms, variant, shoulder = 3,
pwmMatchMinimumAsPercentage = 65)

## End(Not run)
```

---

BayesSpikeSolver

*Create a Solver class object using the Bayes Spike Solver*

---

**Description**

Create a Solver class object using the Bayes Spike Solver

**Usage**

```
BayesSpikeSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  nOrderings = 10,
  quiet = TRUE
)
```

**Arguments**

<code>mtx.assay</code>	An assay matrix of gene expression data
<code>targetGene</code>	A designated target gene that should be part of the <code>mtx.assay</code> data
<code>candidateRegulators</code>	The designated set of transcription factors that could be associated with the target gene
<code>nOrderings</code>	An integer denoting the number of random starts to use for the Bayes Spike method (default = 10)
<code>quiet</code>	A logical denoting whether or not the solver should print output

**Value**

A Solver class object with Bayes Spike as the solver

**See Also**

[solve.BayesSpike](#), [getAssayData](#)

Other Solver class objects: [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
bayes.solver <- BayesSpikeSolver(mtx.sub, target.gene, tfs)
```

---

BayesSpikeSolver-class

*An S4 class to represent a Bayes Spike solver*

---

**Description**

An S4 class to represent a Bayes Spike solver

---

CandidateFilter-class *CandidateFilter*

---

### Description

A CandidateFilter is an S4 class to represent a gene candidate filter. These filters can employ a variety of methods to reduce the number of transcription factors used as predictors for solving a Solver object.

### Usage

```
CandidateFilter(quiet = TRUE)
```

### Arguments

`quiet` A logical denoting whether or not the CandidateFilter object should print output

### Value

An object of the Candidate filter class

### Slots

`quiet` A logical denoting whether or not the CandidateFilter object should print output

### See Also

[getCandidates](#)

### Examples

```
# Create an empty candidate filter
candidate.filter <- CandidateFilter(quiet=TRUE)
```

---

closeDatabaseConnections, FootprintFinder-method

*Close a Footprint Database Connection*

---

### Description

This method takes a FootprintFinder object and closes connections to the footprint databases if they are currently open.

### Usage

```
## S4 method for signature 'FootprintFinder'
closeDatabaseConnections(obj)
```

### Arguments

`obj` An object of class FootprintFinder



**Value**

Closes the specified database connection

**See Also**

Other FootprintFinder methods: [FootprintFinder-class](#), [getChromLoc, FootprintFinder-method](#), [getFootprintsForGene, FootprintFinder-method](#), [getFootprintsInRegion, FootprintFinder-method](#), [getGenePromoterRegion, FootprintFinder-method](#), [getGtfGeneBioTypes, FootprintFinder-method](#), [getGtfMoleculeTypes, FootprintFinder-method](#), [getPromoterRegionsAllGenes, FootprintFinder-method](#)

---

createGeneModelFromRegulatoryRegions, Trena-method

*Create a model for a target gene using a Trena object*

---

**Description**

Create a model for a target gene using a Trena object

**Usage**

```
## S4 method for signature 'Trena'
createGeneModelFromRegulatoryRegions(
  obj,
  targetGene,
  solverNames,
  tbl.regulatoryRegions,
  mtx
)
```

**Arguments**

obj	An object of class Trena
targetGene	The name of a target gene to use for building a model
solverNames	A character vector containing the solver names to be used for building the model
tbl.regulatoryRegions	A data frame of regulatory regions, typically generated by using a filter
mtx	An assay matrix of expression data

**Value**

A data frame containing the gene model

**Examples**

```
if(interactive()){ # takes too long for the bioconductor build
  # Create a Trena object for human and make a gene model for "MEF2C" using a footprint filter
  trena <- Trena("hg38")
  chromosome <- "chr5"
  mef2c.tss <- 88904257
  loc.start <- mef2c.tss - 1000
  loc.end <- mef2c.tss + 1000
}
```

```

database.filename <- system.file(package="trena", "extdata", "mef2c.neighborhood.hg38.footprints.db")
database.uri <- sprintf("sqlite://%s", database.filename)
sources <- c(database.uri)
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))

motifs.list <- getRegulatoryChromosomalRegions(trena, chromosome, mef2c.tss-1000, mef2c.tss+1000,
sources, "MEF2C", mef2c.tss)

library(MotifDb)
tbl.motifs.tfs <- associateTranscriptionFactors(MotifDb, motifs.list[[1]], source="MotifDb", expand.rows=T)
model.mef2c <- createGeneModelFromRegulatoryRegions(trena, "MEF2C", c("lasso", "ridge", "randomforest"),
tbl.motifs.tfs, mtx.sub)

} # if interactive

```

---

```
createGeneModelFromTfList, Trena-method
```

*Create a model for a target gene using a Trena object*

---

## Description

Create a model for a target gene using a Trena object

## Usage

```
## S4 method for signature 'Trena'
createGeneModelFromTfList(obj, targetGene, solverNames, tfList, mtx)
```

## Arguments

obj	An object of class Trena
targetGene	The name of a target gene to use for building a model
solverNames	A character vector containing the solver names to be used for building the model
tfList	A character list, often the gene symbols for known transcription factors
mtx	An assay matrix of expression data

## Value

A data frame containing the gene model

## Examples

```

if(interactive()){ # takes too long for the bioconductor build
# Create a Trena object for human and make a gene model for "MEF2C" using a footprint filter
trena <- Trena("hg38")
chromosome <- "chr5"
mef2c.tss <- 88904257
loc.start <- mef2c.tss - 1000
loc.end <- mef2c.tss + 1000

database.filename <- system.file(package="trena", "extdata", "mef2c.neighborhood.hg38.footprints.db")
database.uri <- sprintf("sqlite://%s", database.filename)

```

```

sources <- c(database.uri)
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))

model.mef2c <- createGeneModelFromTfList(trena, "MEF2C", c("lasso","ridge","randomforest"),
                                         tfList=c())
} # if interactive

```

---

elasticNetSolver      *Run the Elastic Net Solvers*

---

### Description

Given a TReNA object with either LASSO or Ridge Regression as the solver, use the [glmnet](#) function to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

### Usage

```

elasticNetSolver(
  obj,
  target.gene,
  tfs,
  tf.weights,
  alpha,
  lambda,
  keep.metrics
)

```

### Arguments

obj	An object of class Solver
target.gene	A designated target gene that should be part of the mtx.assay data
tfs	The designated set of transcription factors that could be associated with the target gene.
tf.weights	A set of weights on the transcription factors (default = rep(1, length(tfs)))
alpha	The LASSO/Ridge tuning parameter
lambda	The penalty tuning parameter for elastic net
keep.metrics	A binary variable indicating whether or not to keep metrics

### Value

A data frame containing the coefficients relating the target gene to each transcription factor, plus other fit parameters

### See Also

[glmnet](#)

EnsembleSolver

*Create a Solver class object using an ensemble of solvers***Description**

Create a Solver class object using an ensemble of solvers

**Usage**

```

EnsembleSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  solverNames = c("lasso", "lassopv", "pearson", "randomForest", "ridge", "spearman",
    "xgboost"),
  geneCutoff = 0.1,
  alpha.lasso = 0.9,
  alpha.ridge = 0,
  lambda.lasso = numeric(0),
  lambda.ridge = numeric(0),
  lambda.sqrt = numeric(0),
  nCores.sqrt = 4,
  nOrderings.bayes = 10,
  quiet = TRUE
)

```

**Arguments**

<code>mtx.assay</code>	An assay matrix of gene expression data
<code>targetGene</code>	A designated target gene that should be part of the <code>mtx.assay</code> data
<code>candidateRegulators</code>	The designated set of transcription factors that could be associated with the target gene
<code>solverNames</code>	A character vector of strings denoting
<code>geneCutoff</code>	A fraction (0-1) of the supplied candidate regulators to be included in the features output by the solver (default = 0.1)
<code>alpha.lasso</code>	A fraction (0-1) denoting the LASSO-Ridge balance of the 'glmnet' solver used by the LASSO method (default = 0.9)
<code>alpha.ridge</code>	A fraction (0-1) denoting the LASSO-Ridge balance of the 'glmnet' solver used by the Ridge method (default = 0)
<code>lambda.lasso</code>	The penalty parameter for LASSO, used to determine how strictly to penalize the regression coefficients. If none is supplied, this will be determined via permutation testing (default = NULL).
<code>lambda.ridge</code>	The penalty parameter for Ridge, used to determine how strictly to penalize the regression coefficients. If none is supplied, this will be determined via permutation testing (default = NULL).
<code>lambda.sqrt</code>	The penalty parameter for square root LASSO, used to determine how strictly to penalize the regression coefficients. If none is supplied, this will be determined via permutation testing (default = NULL).

nCores.sqrt      An integer denoting the number of computational cores to devote to the square root LASSO solver, which is the slowest of the solvers (default = 4)

nOrderings.bayes      An integer denoting the number of random starts to use for the Bayes Spike method (default = 10)

quiet      A logical denoting whether or not the solver should print output

**Value**

A Solver class object with Ensemble as the solver

**See Also**

[solve.Ensemble](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
ensemble.solver <- EnsembleSolver(mtx.sub, target.gene, tfs)
```

---

EnsembleSolver-class    *Class EnsembleSolver*

---

**Description**

Class EnsembleSolver

---

[findMatchesByChromosomalRegion](#), [MotifMatcher-method](#)  
*Find Motif Matches by Chromosomal Region*

---

**Description**

Given a [MotifMatcher](#) object, a table of chromosomal regions, and a minimum match percentage, pull out a list containing a data frame of the motifs in those regions and a character vector of their associated transcription factors.

**Usage**

```
## S4 method for signature 'MotifMatcher'
findMatchesByChromosomalRegion(
  obj,
  tbl.regions,
  pwmMatchMinimumAsPercentage,
  variants = NA_character_
)
```

**Arguments**

obj	An object of class MotifMatcher
tbl.regions	A data frame where each row contains a chromosomal region with the fields "chrom", "start", and "end".
pwmMatchMinimumAsPercentage	A percentage (0-100) used as a cutoff for what constitutes a motif match
variants	A character containing variants to use for the matching (default = NA_character_). The variants should either have the same number of entries as rows in the tbl.regions, or they should not be supplied.

**Value**

A list containing a data frame of the motifs in the given regions and a character vector of their associated transcription factors

**Examples**

```
## Not run:
# Perform a simple match in the rs13384219 neighborhood
library(MotifDb)
motifMatcher <- MotifMatcher(genomeName="hg38",
  pfms = as.list(query(query(MotifDb, "sapiens"), "jaspar2016")), quiet=TRUE)
tbl.regions <- data.frame(chrom="chr2", start=57907313, end=57907333, stringsAsFactors=FALSE)
x <- findMatchesByChromosomalRegion(motifMatcher, tbl.regions, pwmMatchMinimumAsPercentage=92)

# Perform the same match, but now include a variant
x.mut <- findMatchesByChromosomalRegion(motifMatcher, tbl.regions,
  pwmMatchMinimumAsPercentage=92, variants = "rs13384219")

## End(Not run)
```

---

FootprintFilter-class *Create a FootprintFilter object*

---

**Description**

A FootprintFilter object allows for filtering based on gene footprinting databases. Using its associated getCandidates method and URIs for both a genome database and project database, a FootprintFilter object can be used to filter a list of possible transcription factors to those that match footprint motifs for a supplied target gene.

**Usage**

```
FootprintFilter(genomeDB, footprintDB, regions = data.frame(), quiet = TRUE)
```

**Arguments**

genomeDB	A connection to a database that contains genome information
footprintDB	A connection to a database that contains footprint information
regions	A data frame that specifies the regions of interest (default = data.frame())
quiet	A logical denoting whether or not the filter should print output

**Value**

An object of the FootprintFilter class

**See Also**

[getCandidates-FootprintFilter](#)

Other Filtering Objects: [VarianceFilter-class](#)

**Examples**

```
## Not run:
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:",db.address,"mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:",db.address,"mef2c.neighborhood.hg38.footprints.db", sep = "/")
target.gene <- "MEF2C"
size.upstream <- 1000
size.downstream <- 1000

# Construct a Trena object and use it to retrieve the regions
trena <- Trena("hg38")
regions <- getProximalPromoter(trena,target.gene, size.upstream, size.downstream)

footprint.filter <- FootprintFilter(genomeDB = genome.db.uri, footprintDB = project.db.uri,
                                   regions = regions)

## End(Not run)
```

---

FootprintFinder-class *Class FootprintFinder*

---

**Description**

The FootprintFinder class is designed to query 2 supplied footprint databases (a genome database and a project database) for supplied genes or regions. Within the TReNA package, the FootprintFinder class is mainly used by the FootprintFilter class, but the FootprintFinder class offers more flexibility in constructing queries.

**Usage**

```
FootprintFinder(genome.database.uri, project.database.uri, quiet = TRUE)
```

**Arguments**

genome.database.uri

The address of a genome database for use in filtering. This database must contain the tables "gtf" and "motifsgenes" at a minimum. The URI format is as follows: "dbtype://host/database" (e.g. "postgres://localhost/genomedb")

project.database.uri

The address of a project database for use in filtering. This database must contain the tables "regions" and "hits" at a minimum. The URI format is as follows: "dbtype://host/database" (e.g. "postgres://localhost/projectdb")

quiet

A logical denoting whether or not the FootprintFinder object should print output

**Value**

An object of the FootprintFinder class

**Slots**

genome.db The address of a genome database for use in filtering  
 project.db The address of a project database for use in filtering  
 quiet A logical argument denoting whether the FootprintFinder object should behave quietly

**See Also**

[FootprintFilter](#)

Other FootprintFinder methods: [closeDatabaseConnections](#), [FootprintFinder-method](#), [getChromLoc](#), [FootprintF](#)  
[getFootprintsForGene](#), [FootprintFinder-method](#), [getFootprintsInRegion](#), [FootprintFinder-method](#),  
[getGenePromoterRegion](#), [FootprintFinder-method](#), [getGtfGeneBioTypes](#), [FootprintFinder-method](#),  
[getGtfMoleculeTypes](#), [FootprintFinder-method](#), [getPromoterRegionsAllGenes](#), [FootprintFinder-method](#)

---

GeneOntologyFilter-class

*Create a GeneOntologyFilter object*

---

**Description**

A GeneOntologyFilter object allows for filtering based on gene ontology (GO) terms. Its associated `getCandidates` method uses an organism database and a GO term (e.g. `GO:#####`) to filter a list of possible regulators factors to those that match the GO term.

**Usage**

```
GeneOntologyFilter(  
  organismDatabase = org.Hs.eg.db : org.Hs.eg.db,  
  GOTerm = "GO:0006351",  
  quiet = TRUE  
)
```

**Arguments**

organismDatabase	An organism-specific database of type 'OrgDb'
GOTerm	A character matching an accepted gene ontology term. The default term corresponds to "transcription, DNA-templated". (default="GO:0006351")
quiet	A logical denoting whether or not the filter should print output

**Value**

A GeneOntologyFilter object

**See Also**

[CandidateFilter](#)



**Examples**

```
# Make a filter for "transcription, DNA-templated"
library(org.Hs.eg.db)
goFilter <- GeneOntologyFilter(org.Hs.eg.db, GOTerm="GO:0006351")
```

---

```
getAssayData,Solver-method
```

*Retrieve the assay matrix of gene expression data from a Solver object*

---

**Description**

Retrieve the assay matrix of gene expression data from a Solver object

**Usage**

```
## S4 method for signature 'Solver'
getAssayData(obj)
```

**Arguments**

obj                    An object of class Solver

**Value**

The assay matrix of gene expression data associated with a Solver object

**Examples**

```
# Create a Solver object using the included Alzheimer's data and retrieve the matrix
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "MEF2C"
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)
solver <- Solver(mtx.sub, targetGene, candidateRegulators)
mtx <- getAssayData(solver)
```

---

```
getAvailableSolvers    Get the available solvers for use in trena
```

---

**Description**

Retrieve the vector of different methods that can be used as solvers in trena. Solver names in the returned vector correspond to the exact capitalization used in their Solver subclasses (i.e. a Solver object using LASSO is LassoSolver)

**Usage**

```
getAvailableSolvers()
```

**Value**

A character vector of all solvers currently available in trena.

**Examples**

```
all.solvers <- getAvailableSolvers()
```

---

getCandidates	<i>Get candidate genes using a CandidateFilter object</i>
---------------	-----------------------------------------------------------

---

**Description**

Get candidate genes using a CandidateFilter object

**Usage**

```
getCandidates(obj)
```

**Arguments**

obj                    An object of a CandidateFilter class

**Value**

A vector containing genes from the assay matrix that are selected by the filter

**See Also**

Other getCandidate Methods: [getCandidates, FootprintFilter-method](#), [getCandidates, GeneOntologyFilter-method](#), [getCandidates, HumanDHSFilter-method](#), [getCandidates, VarianceFilter-method](#)

---

getCandidates, FootprintFilter-method	<i>Get candidate genes using the footprint filter</i>
---------------------------------------	-------------------------------------------------------

---

**Description**

Get candidate genes using the footprint filter

**Usage**

```
## S4 method for signature 'FootprintFilter'
getCandidates(obj)
```

**Arguments**

obj                    An object of class FootprintFilter

**Value**

A list, where one element is the transcription factors found in the footprints and the other is a data frame containing all the meta data for the footprints

**See Also**[FootprintFilter](#)Other getCandidate Methods: [getCandidates, GeneOntologyFilter-method](#), [getCandidates, HumanDHSFilter-method](#), [getCandidates, VarianceFilter-method](#), [getCandidates\(\)](#)**Examples**

```
# Use footprint filter with the included SQLite database for MEF2C to filter candidates
# in the included Alzheimer's dataset, using the Trena object to get regions
## Not run:
target.gene <- "MEF2C"
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")
size.upstream <- 1000
size.downstream <- 1000
# Construct a Trena object and use it to retrieve the regions
trena <- Trena("hg38")
regions <- getProximalPromoter(trena, target.gene, size.upstream, size.downstream)
footprint.filter <- FootprintFilter(genomeDB = genome.db.uri, footprintDB = project.db.uri,
                                   regions = regions)
footprints <- getCandidates(footprint.filter)

## End(Not run)
```

---

getCandidates, GeneOntologyFilter-method

*Get candidate genes using a gene ontology filter*


---

**Description**

Get candidate genes using a gene ontology filter

**Usage**

```
## S4 method for signature 'GeneOntologyFilter'
getCandidates(obj)
```

**Arguments**

obj                    An object of class GeneOntologyFilter

**Value**

A list, where one element a character vector of transcription factors that match the GO term and the other is an empty data frame.

**See Also**[GeneOntologyFilter](#)Other getCandidate Methods: [getCandidates, FootprintFilter-method](#), [getCandidates, HumanDHSFilter-method](#), [getCandidates, VarianceFilter-method](#), [getCandidates\(\)](#)

**Examples**

```
# Make a filter for "transcription, DNA-templated" and use it to filter candidates
library(org.Hs.eg.db)
goFilter <- GeneOntologyFilter(org.Hs.eg.db, GOTerm="GO:0006351")
candidates <- getCandidates(goFilter)
```

---

```
getCandidates,HumanDHSFilter-method
```

*Get candidate genes using a human DHS filter*

---

**Description**

Get candidate genes using a human DHS filter

**Usage**

```
## S4 method for signature 'HumanDHSFilter'
getCandidates(obj)
```

**Arguments**

obj                    An object of class FootprintFilter

**Value**

A list, where one element a character vector of transcription factors that match the GO term and the other is an empty data frame.

**See Also**

[FootprintFilter](#)

Other getCandidate Methods: [getCandidates, FootprintFilter-method](#), [getCandidates, GeneOntologyFilter-method](#), [getCandidates, VarianceFilter-method](#), [getCandidates\(\)](#)

**Examples**

```
# Make a filter for "transcription, DNA-templated" and use it to filter candidates
## Not run:
#' load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "VRK2"
promoter.length <- 1000
genomeName <- "hg38"
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "vrk2.neighborhood.hg38.gtfAnnotation.db", sep = "/")
jaspar.human <- as.list(query(query(MotifDb, "sapiens"), "jaspar2016"))

# Grab regions for VRK2 using shoulder size of 1000
trena <- Trena(genomeName)
tbl.regions <- getProximalPromoter(trena, "VRK2", 1000, 1000)

hd.filter <- HumanDHSFilter(genomeName, pwmMatchPercentageThreshold = 85,
```

```
geneInfoDatabase.uri = genome.db.uri, regions = tbl.regions, pfms = jaspar.human)
getCandidates(hd.filter)
## End(Not run)
```

---

*getCandidates, VarianceFilter-method*

*Get candidate genes using the variance filter*

---

## Description

Get candidate genes using the variance filter

## Usage

```
## S4 method for signature 'VarianceFilter'
getCandidates(obj)
```

## Arguments

obj                    An object of class VarianceFilter

## Value

A vector containing all genes with variances less than the target gene

## See Also

[VarianceFilter](#)

Other `getCandidate` Methods: [getCandidates, FootprintFilter-method](#), [getCandidates, GeneOntologyFilter-method](#), [getCandidates, HumanDHSFilter-method](#), [getCandidates\(\)](#)

## Examples

```
# Using the included Alzheimer's dataset, filter out only those transcription factors with variance
# within 50% of the variance of MEF2C
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
variance.filter <- VarianceFilter(mtx.assay = mtx.sub, targetGene = "MEF2C")
tfs <- getCandidates(variance.filter)
```

---

getChromLoc, FootprintFinder-method  
*Get Chromosome Location*

---

## Description

Using the gtf table in the genome database contained in a FootprintFinder object, get the locations of chromosomes with the specified gene name, biological unit type, and molecule type

## Usage

```
## S4 method for signature 'FootprintFinder'  
getChromLoc(obj, name, biotype = "protein_coding", moleculetype = "gene")
```

## Arguments

obj	An object of class FootprintFinder
name	A gene name or ID
biotype	A type of biological unit (default="protein_coding")
moleculetype	A type of molecule (default="gene")

## Value

A dataframe containing the results of a database query pertaining to the specified name, biotype, and molecule type. This dataframe contains the following columns: gene\_id, gene\_name, chr, start, endpos, strand

## See Also

Other FootprintFinder methods: [FootprintFinder-class](#), [closeDatabaseConnections](#), [FootprintFinder-method](#), [getFootprintsForGene](#), [FootprintFinder-method](#), [getFootprintsInRegion](#), [FootprintFinder-method](#), [getGenePromoterRegion](#), [FootprintFinder-method](#), [getGtfGeneBioTypes](#), [FootprintFinder-method](#), [getGtfMoleculeTypes](#), [FootprintFinder-method](#), [getPromoterRegionsAllGenes](#), [FootprintFinder-method](#)

## Examples

```
db.address <- system.file(package="trena", "extdata")  
genome.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")  
project.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")  
fp <- FootprintFinder(genome.db.uri, project.db.uri)  
  
chrom.locs <- getChromLoc(fp, name = "MEF2C")
```

---

getCoverage,PCAMax-method

*what percentage of the variance is captured in the first two principal components?*

---

### Description

what percentage of the variance is captured in the first two principal components?

### Usage

```
## S4 method for signature 'PCAMax'  
getCoverage(obj)
```

### Arguments

obj                    An object of the class PCAMax

### Value

a number between zero and one

---

getEncodeRegulatoryTableNames,HumanDHSFilter-method

*Get Encode regulatory tables using a human DHS filter*

---

### Description

Get Encode regulatory tables using a human DHS filter

### Usage

```
## S4 method for signature 'HumanDHSFilter'  
getEncodeRegulatoryTableNames(obj)
```

### Arguments

obj                    An object of class HumanDHSFilter

### Value

A character vector containing the names of the Encode regulatory tables for the regions contained in the HumanDHSFilter object

### See Also

[HumanDHSFilter](#)

**Examples**

```
## Not run:
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "VRK2"
promoter.length <- 1000
genomeName <- "hg38"
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "vrk2.neighborhood.hg38.gtfAnnotation.db", sep = "/")
jaspar.human <- as.list(query(query(MotifDb, "sapiens"), "jaspar2016"))
# Grab regions for VRK2 using shoulder size of 1000
trena <- Trena(genomeName)
tbl.regions <- getProximalPromoter(trena, "VRK2", 1000, 1000)
hd.filter <- HumanDHSFilter(genomeName, pwmMatchPercentageThreshold = 85,
geneInfoDatabase.uri = genome.db.uri, regions = tbl.regions, pfms = jaspar.human)
getEncodeRegulatoryTableNames(hd.filter)

## End(Not run)
```

---

```
getFootprintsForGene, FootprintFinder-method
Get Footprints for Gene
```

---

**Description**

Using the [getGenePromoterRegion](#) and [getFootprintsInRegion](#) functions in conjunction with the gtf table inside the genome database specified by the FootprintFinder object, retrieve a dataframe containing the footprints for a specified gene

**Usage**

```
## S4 method for signature 'FootprintFinder'
getFootprintsForGene(
  obj,
  gene,
  size.upstream = 1000,
  size.downstream = 0,
  biotype = "protein_coding",
  moleculetype = "gene"
)
```

**Arguments**

obj	An object of class FootprintFinder
gene	A gene name of ID
size.upstream	An integer denoting the distance upstream of the target gene to look for footprints (default = 1000)
size.downstream	An integer denoting the distance downstream of the target gene to look for footprints (default = 0)
biotype	A type of biological unit (default="protein_coding")
moleculetype	A type of molecule (default="gene")



**Value**

A dataframe containing all footprints for the specified gene and accompanying parameters

**See Also**

Other FootprintFinder methods: [FootprintFinder-class](#), [closeDatabaseConnections](#), [FootprintFinder-method](#), [getChromLoc](#), [FootprintFinder-method](#), [getFootprintsInRegion](#), [FootprintFinder-method](#), [getGenePromoterRegion](#), [FootprintFinder-method](#), [getGtfGeneBioTypes](#), [FootprintFinder-method](#), [getGtfMoleculeTypes](#), [FootprintFinder-method](#), [getPromoterRegionsAllGenes](#), [FootprintFinder-method](#)

**Examples**

```
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")
fp <- FootprintFinder(genome.db.uri, project.db.uri)

footprints <- getFootprintsForGene(fp, gene = "MEF2C")
```

---

getFootprintsInRegion, FootprintFinder-method

*Get Footprints in a Region*

---

**Description**

Using the regions and hits tables inside the project database specified by the FootprintFinder object, return the location, chromosome, starting position, and ending positions of all footprints for the specified region.

**Usage**

```
## S4 method for signature 'FootprintFinder'
getFootprintsInRegion(obj, chromosome, start, end)
```

**Arguments**

obj	An object of class FootprintFinder
chromosome	The name of the chromosome of interest
start	An integer denoting the start of the desired region
end	An integer denoting the end of the desired region

**Value**

A dataframe containing all footprints for the specified region

**See Also**

Other FootprintFinder methods: [FootprintFinder-class](#), [closeDatabaseConnections](#), [FootprintFinder-method](#), [getChromLoc](#), [FootprintFinder-method](#), [getFootprintsForGene](#), [FootprintFinder-method](#), [getGenePromoterRegion](#), [FootprintFinder-method](#), [getGtfGeneBioTypes](#), [FootprintFinder-method](#), [getGtfMoleculeTypes](#), [FootprintFinder-method](#), [getPromoterRegionsAllGenes](#), [FootprintFinder-method](#)

**Examples**

```
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")
fp <- FootprintFinder(genome.db.uri, project.db.uri)

footprints <- getFootprintsInRegion(fp, chromosome = "chr5",
start = 88903305, end = 88903319 )
```

---

```
getGeneModelTableColumnNames, Trena-method
```

*Retrieve the column names in the gene model table for a Trena object*

---

**Description**

Retrieve the column names in the gene model table for a Trena object

**Usage**

```
## S4 method for signature 'Trena'
getGeneModelTableColumnNames(obj)
```

**Arguments**

obj                    An object of class Trena

**Value**

A character vector listing the column names in the Trena object gene model table

**Examples**

```
# Create a Trena object and retrieve the column names of the gene model table
trena <- Trena("mm10")
tbl.cols <- getRegulatoryTableColumnNames(trena)
```

---

```
getGenePromoterRegion, FootprintFinder-method
```

*Get Gene Promoter Region*

---

**Description**

Using the [getChromLoc](#) function in conjunction with the gtf table inside the genome database specified by the FootprintFinder object, get the chromosome, starting location, and ending location for gene promoter region.

**Usage**

```
## S4 method for signature 'FootprintFinder'
getGenePromoterRegion(
  obj,
  gene,
  size.upstream = 1000,
  size.downstream = 0,
  biotype = "protein_coding",
  moleculetype = "gene"
)
```

**Arguments**

obj	An object of class FootprintFinder
gene	A gene name of ID
size.upstream	An integer denoting the distance upstream of the target gene to look for footprints (default = 1000)
size.downstream	An integer denoting the distance downstream of the target gene to look for footprints (default = 0)
biotype	A type of biological unit (default="protein_coding")
moleculetype	A type of molecule (default="gene")

**Value**

A list containing 3 elements: 1) chr : The name of the chromosome containing the promoter region for the specified gene 2) start : The starting location of the promoter region for the specified gene 3) end : The ending location of the promoter region for the specified gene

**See Also**

Other FootprintFinder methods: [FootprintFinder-class](#), [closeDatabaseConnections](#), [FootprintFinder-method](#), [getChromLoc](#), [FootprintFinder-method](#), [getFootprintsForGene](#), [FootprintFinder-method](#), [getFootprintsInRegion](#), [getGtfGeneBioTypes](#), [FootprintFinder-method](#), [getGtfMoleculeTypes](#), [FootprintFinder-method](#), [getPromoterRegionsAllGenes](#), [FootprintFinder-method](#)

**Examples**

```
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")
fp <- FootprintFinder(genome.db.uri, project.db.uri)

prom.region <- getGenePromoterRegion(fp, gene = "MEF2C")
```

---

getGtfGeneBioTypes, FootprintFinder-method  
*Get the List of Biotypes*

---

**Description**

Using the gtf table in the genome database contained in a FootprintFinder object, get the list of different types of biological units (biotypes) contained in the table.

**Usage**

```
## S4 method for signature 'FootprintFinder'
getGtfGeneBioTypes(obj)
```

**Arguments**

obj                    An object of class FootprintFinder

**Value**

A sorted list of the types of biological units contained in the gtf table of the genome database.

**See Also**

Other FootprintFinder methods: [FootprintFinder-class](#), [closeDatabaseConnections, FootprintFinder-method](#), [getChromLoc, FootprintFinder-method](#), [getFootprintsForGene, FootprintFinder-method](#), [getFootprintsInRegion, FootprintFinder-method](#), [getGenePromoterRegion, FootprintFinder-method](#), [getGtfMoleculeTypes, FootprintFinder-method](#), [getPromoterRegionsAllGenes, FootprintFinder-method](#)

**Examples**

```
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:/", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")
fp <- FootprintFinder(genome.db.uri, project.db.uri)

biotypes <- getGtfGeneBioTypes(fp)
```

---

getGtfMoleculeTypes, FootprintFinder-method  
*Get the List of Molecule Types*

---

**Description**

Using the gtf table in the genome database contained in a FootprintFinder object, get the list of different types of molecules contained in the table.

**Usage**

```
## S4 method for signature 'FootprintFinder'
getGtfMoleculeTypes(obj)
```

**Arguments**

obj                    An object of class FootprintFinder

**Value**

A sorted list of the types of molecules contained in the gtf table of the genome database.

**See Also**

Other FootprintFinder methods: [FootprintFinder-class](#), [closeDatabaseConnections](#), [FootprintFinder-method](#), [getChromLoc](#), [FootprintFinder-method](#), [getFootprintsForGene](#), [FootprintFinder-method](#), [getFootprintsInRegion](#), [getGenePromoterRegion](#), [FootprintFinder-method](#), [getGtfGeneBioTypes](#), [FootprintFinder-method](#), [getPromoterRegionsAllGenes](#), [FootprintFinder-method](#)

**Examples**

```
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")
fp <- FootprintFinder(genome.db.uri, project.db.uri)

mol.types <- getGtfMoleculeTypes(fp)
```

---

getPfms, MotifMatcher-method

*Retrieve the motifs from the pfms slot*

---

**Description**

Given a MotifMatcher object, return the motifs, which are stored in the pfms slot.

**Usage**

```
## S4 method for signature 'MotifMatcher'
getPfms(obj)
```

**Arguments**

obj                    An object of class MotifMatcher

**Value**

The list of motif matrices stored in the pfms slot.

**Examples**

```
# Return the default matrix of JASPAR motifs
library(MotifDb)
motifMatcher <- MotifMatcher(genomeName="hg38", pfms = as.list(query(MotifDb, "sapiens")))
motifs <- getPfms(motifMatcher)
```

---

```
getPromoterRegionsAllGenes, FootprintFinder-method
```

*Get Promoter Regions for All Genes*

---

### Description

Using the `gtf` table inside the genome database specified by the `FootprintFinder` object, return the promoter regions for every protein-coding gene in the database.

### Usage

```
## S4 method for signature 'FootprintFinder'
getPromoterRegionsAllGenes(
  obj,
  size.upstream = 10000,
  size.downstream = 10000,
  use_gene_ids = TRUE
)
```

### Arguments

<code>obj</code>	An object of class <code>FootprintFinder</code>
<code>size.upstream</code>	An integer denoting the distance upstream of each gene's transcription start site to include in the promoter region (default = 1000)
<code>size.downstream</code>	An integer denoting the distance downstream of each gene's transcription start site to include in the promoter region (default = 1000)
<code>use_gene_ids</code>	A binary indicating whether to return gene IDs or gene names (default = T)

### Value

A `GRanges` object containing the promoter regions for all genes

### See Also

Other `FootprintFinder` methods: [FootprintFinder-class](#), [closeDatabaseConnections](#), [FootprintFinder-method](#), [getChromLoc](#), [FootprintFinder-method](#), [getFootprintsForGene](#), [FootprintFinder-method](#), [getFootprintsInRegion](#), [getGenePromoterRegion](#), [FootprintFinder-method](#), [getGtfGeneBioTypes](#), [FootprintFinder-method](#), [getGtfMoleculeTypes](#), [FootprintFinder-method](#)

### Examples

```
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:", db.address, "mef2c.neighborhood.hg38.gtfAnnotation.db", sep = "/")
project.db.uri <- paste("sqlite:", db.address, "mef2c.neighborhood.hg38.footprints.db", sep = "/")
fp <- FootprintFinder(genome.db.uri, project.db.uri)

footprints <- getPromoterRegionsAllGenes(fp)
```

---

 getProximalPromoter,Trena-method

*Grab the region of the proximal promoter for a given gene symbol*


---

### Description

For the genome of a given Trena object, retrieve a data frame containing the region surrounding a target gene.

### Usage

```
## S4 method for signature 'Trena'
getProximalPromoter(obj, geneSymbols, tssUpstream = 1000, tssDownstream = 1000)
```

### Arguments

obj	An object of class Trena
geneSymbols	A vector containing genes of interest
tssUpstream	A designated distance upstream of the promoter to use as a shoulder (default = 1000)
tssDownstream	A designated distance downstream of the promoter to use as a shoulder (default = 1000)

### Value

A dataframe containing the regions surrounding the proximal promoter

### Examples

```
if(interactive()) { # too slow for the bioc windows build
  # Retrieve the proximal promoter for MEF2C using a shoulder size of 2000 on each side
  trena <- Trena("hg38")
  regions <- getProximalPromoter(trena, "MEF2C", 2000, 2000)
}
```

---

 getRegulators,Solver-method

*Retrieve the candidate regulators from a Solver object*


---

### Description

Retrieve the candidate regulators from a Solver object

### Usage

```
## S4 method for signature 'Solver'
getRegulators(obj)
```

**Arguments**

obj                    An object of class Solver

**Value**

The candidate regulators associated with a Solver object

**Examples**

```
# Create a Solver object using the included Alzheimer's data and retrieve the regulators
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "MEF2C"
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)
solver <- Solver(mtx.sub, targetGene, candidateRegulators)
regs <- getRegulators(solver)
```

---

getRegulatoryChromosomalRegions,Trena-method

*Get the regulatory chromosomal regions for a Trena object*

---

**Description**

Get the regulatory chromosomal regions for a Trena object

**Usage**

```
## S4 method for signature 'Trena'
getRegulatoryChromosomalRegions(
  obj,
  chromosome,
  chromStart,
  chromEnd,
  regulatoryRegionSources,
  targetGene,
  targetGeneTSS,
  combine = FALSE
)
```

**Arguments**

obj                    An object of class Trena

chromosome            A chromosome of interest

chromStart            The beginning of the desired region

chromEnd             The end of the desired region

regulatoryRegionSources

                      A vector containing the names of sources for chromosome information. These can be addresses of footprint databases or the names of DHS databases

targetGene            A target gene of interest

targetGeneTSS        An integer giving the location of the target gene's transcription start site

combine               A logical indicating whether or not to combine the output into one data frame (default = FALSE)



**Value**

A list of regulatory regions for the supplied target gene. If combine is set to TRUE, the list is converted into a data frame.

**Examples**

```
# Get regulatory regions for MEF2C from a footprint database
database.filename <- system.file(package="trena", "extdata", "mef2c.neighborhood.hg38.footprints.db")
database.uri <- sprintf("sqlite://%", database.filename)
sources <- c(database.uri)

trena <- Trena("hg38")
chromosome <- "chr5"
mef2c.tss <- 88904257
loc.start <- mef2c.tss - 1000
loc.end <- mef2c.tss + 1000

#regions <- getRegulatoryChromosomalRegions(trena, chromosome, mef2c.tss-1000, mef2c.tss+1000,
#                                           sources, "MEF2C", mef2c.tss)

# Get regulatory regions for AQP4 from a Human DHS source
trena <- Trena("hg38")
aqp4.tss <- 26865884
chromosome <- "chr18"
sources <- c("encodeHumanDHS")

#regions <- getRegulatoryChromosomalRegions(trena, chromosome, aqp4.tss-1, aqp4.tss+3, sources, "AQP4", aqp4.tss)
```

---

getRegulatoryRegions,HumanDHSFilter-method

*Get a table of regulatory regions for a Human DHS filter*

---

**Description**

Get a table of regulatory regions for a Human DHS filter

**Usage**

```
## S4 method for signature 'HumanDHSFilter'
getRegulatoryRegions(
  obj,
  encode.table.name,
  chromosome,
  start,
  end,
  score.threshold = 0
)
```

**Arguments**

obj                   An object of class HumanDHSFilter  
 encode.table.name    A vector of names for Encode tables

chromosome	The chromosome of interest
start	The starting position
end	The ending position
score.threshold	A threshold for the score (default = 200)

**Value**

A data frame containing the regulatory regions for the filter, including the chromosome, start, and end positions, plus the count and score of each region.

**See Also**

[HumanDHSFilter](#)

**Examples**

```
## Not run:
# Make a filter for "transcription, DNA-templated" and use it to filter candidates
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "VRK2"
promoter.length <- 1000
genomeName <- "hg38"
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "vrk2.neighborhood.hg38.gtfAnnotation.db", sep = "/")
jaspar.human <- as.list(query(query(MotifDb, "sapiens"), "jaspar2016"))

# Grab regions for VRK2 using shoulder size of 1000
trena <- Trena(genomeName)
tbl.regions <- getProximalPromoter(trena, "VRK2", 1000, 1000)

hd.filter <- HumanDHSFilter(genomeName, pwmMatchPercentageThreshold = 85,
geneInfoDatabase.uri = genome.db.uri, regions = tbl.regions, pfms = jaspar.human)

chrom <- "chr2"
rs13384219.loc <- 57907323
start <- rs13384219.loc - 10
end <- rs13384219.loc + 10

tableNames <- getEncodeRegulatoryTableNames(hd.filter)

getRegulatoryRegions(hd.filter, tableNames[1], chrom, start, end)

## End(Not run)
```

---

`getRegulatoryTableColumnNames, Trena-method`

*Retrieve the column names in the regulatory table for a Trena object*

---

**Description**

Retrieve the column names in the regulatory table for a Trena object

**Usage**

```
## S4 method for signature 'Trena'
getRegulatoryTableColumnNames(obj)
```

**Arguments**

obj                    An object of class Trena

**Value**

A character vector listing the column names in the Trena object regulatory table

**Examples**

```
# Create a Trena object and retrieve the column names of the regulatory table
trena <- Trena("mm10")
tbl.cols <- getRegulatoryTableColumnNames(trena)
```

---

getSequence,MotifMatcher-method

*Retrieve the Sequence for a Set of Regions*

---

**Description**

Given a MotifMatcher object, a table of chromosomal regions, and an optional set of variants, return the sequences as a new column of the table.

**Usage**

```
## S4 method for signature 'MotifMatcher'
getSequence(obj, tbl.regions, variants = NA_character_)
```

**Arguments**

obj                    An object of class MotifMatcher

tbl.regions            A data frame where each row contains a chromosomal region with the fields "chrom", "start", and "end".

variants                A character containing variants to use for the matching (default = NA\_character\_)  
The variants should either have the same number of entries as rows in the tbl.regions, or they should not be supplied.

**Value**

The tbl.regions data frame with an added column containing the sequence for each entry

**Examples**

```
## Not run:
# Retrieve the sequences for the rs13384219 neighborhood
library(MotifDb)
motifMatcher <- MotifMatcher(genomeName="hg38",
  pfms = as.list(query(query(MotifDb, "sapiens"), "jaspar2016")))
tbl.regions <- data.frame(chrom="chr2", start=57907313, end=57907333, stringsAsFactors=FALSE)
x <- findMatchesByChromosomalRegion(motifMatcher, tbl.regions, pwmMatchMinimumAsPercentage=92)

# Retrieve the sequences, but now include a variant
x.mut <- findMatchesByChromosomalRegion(motifMatcher, tbl.regions,
  pwmMatchMinimumAsPercentage=92, "rs13384219")

## End(Not run)
```

---

```
getSolverNames, EnsembleSolver-method
```

*Retrieve the solver names from an EnsembleSolver object*

---

**Description**

Retrieve the solver names from an EnsembleSolver object

**Usage**

```
## S4 method for signature 'EnsembleSolver'
getSolverNames(obj)
```

**Arguments**

obj                    An object of class Solver

**Value**

The vector of solver names associated with an EnsembleSolver object

**Examples**

```
# Create a Solver object using the included Alzheimer's data and retrieve the regulators
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "MEF2C"
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)
solver <- EnsembleSolver(mtx.sub, targetGene, candidateRegulators,
  solverNames = c("lasso", "randomForest"))
solver.names <- getSolverNames(solver)
```

---

`getTarget, Solver-method`*Retrieve the target gene from a Solver object*

---

**Description**

Retrieve the target gene from a Solver object

**Usage**

```
## S4 method for signature 'Solver'  
getTarget(obj)
```

**Arguments**

`obj` An object of class Solver

**Value**

The target gene associated with a Solver object

**Examples**

```
# Create a Solver object using the included Alzheimer's data and retrieve the target gene  
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))  
targetGene <- "MEF2C"  
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)  
solver <- Solver(mtx.sub, targetGene, candidateRegulators)  
target <- getTarget(solver)
```

---

`HumanDHSFilter-class` *Create a HumanDHSFilter object*

---

**Description**

A HumanDHSFilter object allows for filtering based on DNase hypersensitivity (DHS) data. Its associated `getCandidates` method uses a genome from a BSgenome database (either hg19 or hg38), DNA region specifications, and `(variants/pfms,encodetablename, match)` to filter a list of possible regulator factors to those that match the supplied criteria.

**Usage**

```
HumanDHSFilter(  
  genomeName,  
  encodeTableName = "wgEncodeRegDnaseClustered",  
  pwmMatchPercentageThreshold,  
  geneInfoDatabase.uri,  
  regions,  
  variants = NA_character_,  
  pfms,  
  quiet = TRUE  
)
```

**Arguments**

genomeName	A character string indicating the reference genome; currently, the only accepted strings are "hg38" and "hg19", both of which are human genomes.
encodeTableName	(default = "wgEncodeRegDnaseClustered")
pwmMatchPercentageThreshold	A numeric from 0-100 to serve as a threshold for a match
geneInfoDatabase.uri	An address for a gene database
regions	A data frame containing the regions of interest
variants	A character vector containing a list of variants
pfms	A list of position frequency matrices, often converted from a MotifList object created by a MotifDb query
quiet	A logical denoting whether or not the solver should print output

**Value**

A CandidateFilter class object that filters using Human DHS data

**See Also**

[getCandidates-HumanDHSFilter](#),

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
if(interactive()) { # takes too long in the bioc windows build
  load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
  targetGene <- "VRK2"
  promoter.length <- 1000
  genomeName <- "hg38"
  db.address <- system.file(package="trena", "extdata")
  genome.db.uri <- paste("sqlite:/", db.address, "vrk2.neighborhood.hg38.gtfAnnotation.db", sep = "/")

  # Grab regions for VRK2 using shoulder size of 1000
  trena <- Trena(genomeName)
  tbl.regions <- getProximalPromoter(trena, "VRK2", 1000, 1000)

  hd.filter <- HumanDHSFilter(genomeName, pwmMatchPercentageThreshold = 85,
    geneInfoDatabase.uri = genome.db.uri, regions = tbl.regions,
    pfms = as.list(query(query(MotifDb, "sapiens"), "jaspar2016")))
} # if interactive
```

---

LassoPVSolver	<i>Create a Solver class object using the LASSO P-Value solver</i>
---------------	--------------------------------------------------------------------

---

**Description**

Create a Solver class object using the LASSO P-Value solver

**Usage**

```
LassoPVSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  quiet = TRUE
)
```

**Arguments**

<code>mtx.assay</code>	An assay matrix of gene expression data
<code>targetGene</code>	A designated target gene that should be part of the <code>mtx.assay</code> data
<code>candidateRegulators</code>	The designated set of transcription factors that could be associated with the target gene
<code>quiet</code>	A logical denoting whether or not the solver should print output

**Value**

A Solver class object with LASSO P-Value as the solver

**See Also**

[solve.LassoPV](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
lassopv.solver <- LassoPVSolver(mtx.sub, target.gene, tfs)
```

---

LassoPVSolver-class	<i>An S4 class to represent a LASSO P-Value solver</i>
---------------------	--------------------------------------------------------

---

**Description**

An S4 class to represent a LASSO P-Value solver

---

LassoSolver

---

*Create a Solver class object using the LASSO solver*


---

## Description

Create a Solver class object using the LASSO solver

## Usage

```
LassoSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  regulatorWeights = rep(1, length(candidateRegulators)),
  alpha = 0.9,
  lambda = numeric(0),
  keep.metrics = FALSE,
  quiet = TRUE
)
```

## Arguments

<code>mtx.assay</code>	An assay matrix of gene expression data
<code>targetGene</code>	A designated target gene that should be part of the <code>mtx.assay</code> data
<code>candidateRegulators</code>	The designated set of transcription factors that could be associated with the target gene
<code>regulatorWeights</code>	A set of weights on the transcription factors (default = <code>rep(1, length(tfs))</code> )
<code>alpha</code>	A parameter from 0-1 that determines the proportion of LASSO to ridge used in the elastic net solver, with 0 being fully ridge and 1 being fully LASSO (default = 0.9)
<code>lambda</code>	A tuning parameter that determines the severity of the penalty function imposed on the elastic net regression. If unspecified, <code>lambda</code> will be determined via permutation testing (default = <code>numeric(0)</code> ).
<code>keep.metrics</code>	A logical denoting whether or not to keep the initial supplied metrics versus determining new ones
<code>quiet</code>	A logical denoting whether or not the solver should print output

## Value

A Solver class object with LASSO as the solver

## See Also

[solve.Lasso](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)



**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
lasso.solver <- LassoSolver(mtx.sub, target.gene, tfs)
```

---

LassoSolver-class      *Class LassoSolver*

---

**Description**

Class LassoSolver

---

MotifMatcher-class      *Create a MotifMatcher object*

---

**Description**

A MotifMatcher object is used directly by the [HumanDHSFilter](#) class to match motif matrices to where they occur in the supplied genome.

The MotifMatcher class is used to match motif position weight matrices to places where they occur in a given genome. It requires specification of a genome to search in and a list of motifs to search for. Ordinarily this class is primarily used by the [HumanDHSFilter](#), but can alternatively be used to search for motifs in a given genome without any filtering functionality.

**Usage**

```
MotifMatcher(genomeName, pfms, quiet = TRUE)
```

**Arguments**

genomeName	A character string identifying an object of type BSgenome. The genome object contains the information for a specific human genome and should be either "hg38" or "hg19". The supplied genome serves as the search space for matching motifs (default = "hg38").
pfms	A list of motif matrices to serve as queries for the target genome. If supplied, these should be created using a MotifList object from the <a href="#">MotifDb</a> package (see example below). If unspecified, the motifs will default to all vertebrates in the JASPAR database (default = list())
quiet	A logical denoting whether or not the MotifMatcher object should print output

**Value**

An object of the MotifMatcher class

**See Also**

[HumanDHSFilter](#)

**Examples**

```
# Specify the genome, and motif list to create a MotifMatcher for only human motifs
library(MotifDb)
mm <- MotifMatcher( genomeName="hg38",
  pfms = as.list(query(MotifDb, "sapiens")))
```

---

```
normalizeModel,PCAMax-method
```

*transform a specific column to fit normal distribution*

---

**Description**

transform a specific column to fit normal distribution

**Usage**

```
## S4 method for signature 'PCAMax'
normalizeModel(obj, normalizing.max = 10)
```

**Arguments**

```
obj          An object of the class PCAMax
normalizing.max  numeric, a maximum value for the normalized distributions
```

**Value**

a normalized matrix, each column treated separately

---

```
parseChromLocString  Parse a string containing a chromosome and location on the genome
```

---

**Description**

Given a string of the format "chromosome:start-end", pull out the three values contained in the string and return them as a named list

**Usage**

```
parseChromLocString(chromLocString)
```

**Arguments**

```
chromLocString  A string of the format "chromosome:start-end"
```

**Value**

A named list containing the chromosome, start, and end from the supplied string

**Examples**

```
# Note: Both examples return :
# list(chrom="chr10", start=118441047, end=118445892)

# Parse a string containing the "chr" prefix for chromosome
chrom.list <- parseChromLocString("chr10:118441047-118445892")

# Parse a string without the "chr" prefix in the chromosome
chrom.list <- parseChromLocString("10:118441047-118445892")
```

---

parseDatabaseUri	<i>Parse a string containing the information for connecting to a database</i>
------------------	-------------------------------------------------------------------------------

---

**Description**

Given a string of the format "database\_driver://host/database\_name", pull out the 3 pieces of information and return them as a named list.

**Usage**

```
parseDatabaseUri(database.uri)
```

**Arguments**

database.uri    A string of the format "database\_driver://host/database\_name"

**Value**

A named list containing the driver, host, and database name from the supplied string

**Examples**

```
# Parse a URI for a local PostgreSQL database called "gtf"
parsed.URI <- parseDatabaseUri("postgres://localhost/gtf")

# Parse a URI for the included SQLite database "vrk2.neighborhood.hg38.gtfAnnotation.db" in the local documents
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "vrk2.neighborhood.hg38.gtfAnnotation.db", sep = "/")
parsed.URI <- parseDatabaseUri(genome.db.uri)
```

---

PCAMax	<i>Class PCAMax</i>
--------	---------------------

---

**Description**

Class PCAMax

Create a PCAMax object from a data.frame produced by the EnsembleSolver

**Usage**

```
PCAMax(tbl, tfIdentifierColumnName = "tf.hgnc")
```

**Arguments**

tbl	a data.frame
tfIdentifierColumnName	a character string identifying the transcription factor column

**Value**

a PCAMax object

**See Also**

[EnsembleSolver](#)

---

PearsonSolver	<i>Create a Solver class object using Pearson correlation coefficients as the solver</i>
---------------	------------------------------------------------------------------------------------------

---

**Description**

Create a Solver class object using Pearson correlation coefficients as the solver

**Usage**

```
PearsonSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  quiet = TRUE
)
```

**Arguments**

mtx.assay	An assay matrix of gene expression data
targetGene	A designated target gene that should be part of the mtx.assay data
candidateRegulators	The designated set of transcription factors that could be associated with the target gene
quiet	A logical denoting whether or not the solver should print output

**Value**

A Solver class object with Pearson correlation coefficients as the solver

**See Also**

[solve.Pearson](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
pearson.solver <- PearsonSolver(mtx.sub, target.gene, tfs)
```

---

PearsonSolver-class     *An S4 class to represent a Pearson solver*

---

**Description**

An S4 class to represent a Pearson solver

---

RandomForestSolver     *Create a Solver class object using the Random Forest solver*

---

**Description**

Create a Solver class object using the Random Forest solver

**Usage**

```
RandomForestSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  regulatorWeights = rep(1, length(candidateRegulators)),
  quiet = TRUE
)
```

**Arguments**

<code>mtx.assay</code>	An assay matrix of gene expression data
<code>targetGene</code>	A designated target gene that should be part of the <code>mtx.assay</code> data
<code>candidateRegulators</code>	The designated set of transcription factors that could be associated with the target gene
<code>regulatorWeights</code>	A set of weights on the transcription factors (default = <code>rep(1, length(candidateRegulators))</code> )
<code>quiet</code>	A logical denoting whether or not the solver should print output

**Value**

A Solver class object with Random Forest as the solver

**See Also**

[solve.RandomForest](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "MEF2C"
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)
rf.solver <- RandomForestSolver(mtx.sub, targetGene, candidateRegulators)
```

---

RandomForestSolver-class

*Class RandomForestSolver*

---

**Description**

Class RandomForestSolver

---

rescalePredictorWeights,Solver-method

*Rescale the Predictor Weights*

---

**Description**

Solvers such as LASSO penalize predictors on a scale of 1 (full weight) to infinity (zero weight). With the `rescalePredictorWeights` method, incoming raw values can be scaled between a possibly theoretical minimum and maximum value.

**Usage**

```
## S4 method for signature 'Solver'
rescalePredictorWeights(obj, rawValue.min, rawValue.max, rawValues)
```

**Arguments**

<code>obj</code>	An object of the Solver class
<code>rawValue.min</code>	The minimum value of the raw expression values
<code>rawValue.max</code>	The maximum value of the raw expression values
<code>rawValues</code>	A matrix of raw expression values

**Value**

A matrix of the raw values re-scaled using the minimum and maximum values

**Examples**

```
# Create a LassoSolver object using the included Alzheimer's data and rescale the predictors
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "MEF2C"
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)
ls <- LassoSolver(mtx.sub, targetGene, candidateRegulators)
raw.values <- c(241, 4739, 9854, 22215, 658334)
cooked.values <- rescalePredictorWeights(ls, rawValue.min = 1, rawValue.max = 1000000, raw.values)
```

RidgeSolver

*Create a Solver class object using the Ridge solver***Description**

Create a Solver class object using the Ridge solver

**Usage**

```
RidgeSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  regulatorWeights = rep(1, length(candidateRegulators)),
  alpha = 0,
  lambda = numeric(0),
  keep.metrics = FALSE,
  quiet = TRUE
)
```

**Arguments**

<code>mtx.assay</code>	An assay matrix of gene expression data
<code>targetGene</code>	A designated target gene that should be part of the <code>mtx.assay</code> data
<code>candidateRegulators</code>	The designated set of transcription factors that could be associated with the target gene
<code>regulatorWeights</code>	A set of weights on the transcription factors (default = <code>rep(1, length(tfs))</code> )
<code>alpha</code>	A parameter from 0-1 that determines the proportion of LASSO to ridge used in the elastic net solver, with 0 being fully ridge and 1 being fully LASSO (default = 0.9)
<code>lambda</code>	A tuning parameter that determines the severity of the penalty function imposed on the elastic net regression. If unspecified, <code>lambda</code> will be determined via permutation testing (default = <code>numeric(0)</code> ).
<code>keep.metrics</code>	A logical denoting whether or not to keep the initial supplied metrics versus determining new ones
<code>quiet</code>	A logical denoting whether or not the solver should print output

**Value**

A Solver class object with Ridge as the solver

**See Also**

[solve.Ridge](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [Solver-class](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
## Not run:
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
ridge.solver <- RidgeSolver(mtx.sub, target.gene, tfs)

## End(Not run)
```

---

RidgeSolver-class	<i>Class RidgeSolver</i>
-------------------	--------------------------

---

**Description**

Class RidgeSolver

---

run	<i>Run a Solver object to select features</i>
-----	-----------------------------------------------

---

**Description**

Run a Solver object to select features

**Usage**

```
run(obj)
```

**Arguments**

obj                    An object of a Solver class

**Value**

A data frame of candidate regulators and the relation to the target gene



---

 run, BayesSpikeSolver-method

*Run the Bayes Spike Solver*


---

## Description

Given a TReNA object with Bayes Spike as the solver, use the [vbsr](#) function to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

## Usage

```
## S4 method for signature 'BayesSpikeSolver'
run(obj)
```

## Arguments

obj                    An object of the class BayesSpikeSolver

## Value

A data frame containing the coefficients relating the target gene to each transcription factor, plus other fit parameters

## See Also

[vbsr](#), [BayesSpikeSolver](#)

Other solver methods: [run, EnsembleSolver-method](#), [run, LassoPVSolver-method](#), [run, LassoSolver-method](#), [run, PearsonSolver-method](#), [run, RandomForestSolver-method](#), [run, RidgeSolver-method](#), [run, SpearmanSolver-method](#), [run, XGBoostSolver-method](#)

## Examples

```
## Not run:
# Load included Alzheimer's data, create a TReNA object with Bayes Spike as solver, and solve
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
bayes.solver <- BayesSpikeSolver(mtx.sub, target.gene, tfs)
tbl <- run(bayes.solver)

# Solve the same Alzheimer's problem, but this time set the number of random starts to 100
bayes.solver <- BayesSpikeSolver(mtx.sub, target.gene, tfs, nOrderings = 100)
tbl <- run(bayes.solver)

## End(Not run)
```

---

 run,EnsembleSolver-method

*Run the Ensemble Solver*


---

## Description

Given a TReNA object with Ensemble as the solver and a list of solvers (default = "default.solvers"), estimate coefficients for each transcription factor as a predictor of the target gene's expression level. The final scores for the ensemble method combine all specified solvers to create a composite score for each transcription factor. This method should be called using the [solve](#) method on an appropriate TReNA object.

## Usage

```
## S4 method for signature 'EnsembleSolver'
run(obj)
```

## Arguments

obj                    An object of class Solver with "ensemble" as the solver string

## Details

- concordance composite score
- pcaMaxa composite of the principal components of the individual solver scores

## Value

A data frame containing the scores for all solvers and two composite scores relating the target gene to each transcription factor. The two new scores are:

## See Also

[EnsembleSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, LassoPVSolver-method](#), [run, LassoSolver-method](#), [run, PearsonSolver-method](#), [run, RandomForestSolver-method](#), [run, RidgeSolver-method](#), [run, SpearmanSolver-method](#), [run, XGBoostSolver-method](#)

## Examples

```
## Not run:
# Load included Alzheimer's data, create an Ensemble object with default solvers, and solve
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)[1:30]
ensemble.solver <- EnsembleSolver(mtx.sub, target.gene, tfs)
tbl <- run(ensemble.solver)

# Solve the same problem, but supply extra arguments that change alpha for LASSO to 0.8 and also
# Change the gene cutoff from 10% to 20%
ensemble.solver <- EnsembleSolver(mtx.sub, target.gene, tfs, geneCutoff = 0.2, alpha.lasso = 0.8)
tbl <- run(ensemble.solver)
```

```
# Solve the original problem with default cutoff and solver parameters, but use only 4 solvers
ensemble.solver <- EnsembleSolver(mtx.sub, target.gene, tfs,
solverNames = c("lasso", "pearson", "ridge"))
tbl <- run(ensemble.solver)

## End(Not run)
```

---

run,LassoPVSolver-method

*Run the LASSO P-Value Solver*

---

## Description

Given a TReNA object with LASSO P-Value as the solver, use the [lassopv](#) function to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

## Usage

```
## S4 method for signature 'LassoPVSolver'
run(obj)
```

## Arguments

obj                    An object of class LassoPVSolver

## Value

A data frame containing the p-values for each transcription factor pertaining to the target gene plus the Pearson correlations between each transcription factor and the target gene.

## See Also

[lassopv](#), [LassoPVSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, EnsembleSolver-method](#), [run, LassoSolver-method](#), [run, PearsonSolver-method](#), [run, RandomForestSolver-method](#), [run, RidgeSolver-method](#), [run, SpearmanSolver-method](#), [run, XGBoostSolver-method](#)

## Examples

```
# Load included Alzheimer's data, create a TReNA object with Bayes Spike as solver, and solve
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
lassopv.solver <- LassoPVSolver(mtx.sub, target.gene, tfs)
tbl <- run(lassopv.solver)
```

---

 run,LassoSolver-method

*Run the LASSO Solver*


---

### Description

Given a LassoSolver object, use the [glmnet](#) function to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

### Usage

```
## S4 method for signature 'LassoSolver'
run(obj)
```

### Arguments

obj                    An object of class LassoSolver

### Value

A data frame containing the coefficients relating the target gene to each transcription factor, plus other fit parameters.

### See Also

[glmnet](#), [LassoSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, EnsembleSolver-method](#), [run, LassoPVSolver-method](#), [run, PearsonSolver-method](#), [run, RandomForestSolver-method](#), [run, RidgeSolver-method](#), [run, SpearmanSolver-method](#), [run, XGBoostSolver-method](#)

### Examples

```
# Load included Alzheimer's data, create a TReNA object with LASSO as solver, and solve
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
lasso.solver <- LassoSolver(mtx.sub, target.gene, tfs)
tbl <- run(lasso.solver)
```

---

 run,PearsonSolver-method

*Run the Pearson Solver*


---

### Description

Given a PearsonSolver object, use the [cor](#) function to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

**Usage**

```
## S4 method for signature 'PearsonSolver'
run(obj)
```

**Arguments**

obj                    An object of class PearsonSolver

**Value**

The set of Pearson Correlation Coefficients between each transcription factor and the target gene.

**See Also**

[cor](#), [PearsonSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, EnsembleSolver-method](#), [run, LassoPVSolver-method](#), [run, LassoSolver-method](#), [run, RandomForestSolver-method](#), [run, RidgeSolver-method](#), [run, SpearmanSolver-method](#), [run, XGBoostSolver-method](#)

**Examples**

```
# Load included Alzheimer's data, create a TReNA object with Bayes Spike as solver, and solve
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
pearson.solver <- PearsonSolver(mtx.sub, target.gene, tfs)
tbl <- run(pearson.solver)
```

---

run,RandomForestSolver-method

*Run the Random Forest Solver*

---

**Description**

Given a TReNA object with RandomForest as the solver, use the [randomForest](#) function to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

**Usage**

```
## S4 method for signature 'RandomForestSolver'
run(obj)
```

**Arguments**

obj                    An object of class TReNA with "randomForest" as the solver string

**Value**

A data frame containing the IncNodePurity for each candidate regulator. This coefficient estimates the relationship between the candidates and the target gene.

**See Also**

[randomForest](#), [RandomForestSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, EnsembleSolver-method](#), [run, LassoPVSolver-method](#), [run, LassoSolver-method](#), [run, PearsonSolver-method](#), [run, RidgeSolver-method](#), [run, SpearmanSolver-method](#), [run, XGBoostSolver-method](#)

**Examples**

```
# Load included Alzheimer's data, create a TReNA object with Random Forest as solver, and solve
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "MEF2C"
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)
rf.solver <- RandomForestSolver(mtx.sub, targetGene, candidateRegulators)
tbl <- run(rf.solver)
```

---

run,RidgeSolver-method

*Run the Ridge Regression Solver*

---

**Description**

Given a TReNA object with Ridge Regression as the solver, use the [glmnet](#) function to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

**Usage**

```
## S4 method for signature 'RidgeSolver'
run(obj)
```

**Arguments**

obj                    An object of class RidgeSolver

**Value**

A data frame containing the coefficients relating the target gene to each transcription factor, plus other fit parameters.

**See Also**

[glmnet](#), [RidgeSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, EnsembleSolver-method](#), [run, LassoPVSolver-method](#), [run, LassoSolver-method](#), [run, PearsonSolver-method](#), [run, RandomForestSolver-method](#), [run, SpearmanSolver-method](#), [run, XGBoostSolver-method](#)

**Examples**

```
# Load included Alzheimer's data, create a TReNA object with Bayes Spike as solver, and solve
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
ridge.solver <- RidgeSolver(mtx.sub, target.gene, tfs)
tbl <- run(ridge.solver)
```

---

run,SpearmanSolver-method

*Run the Spearman Solver*

---

### Description

Given a TReNA object with Spearman as the solver, use the `cor` function with `method = "spearman"` to estimate coefficients for each transcription factor as a predictor of the target gene's expression level.

### Usage

```
## S4 method for signature 'SpearmanSolver'  
run(obj)
```

### Arguments

`obj` An object of class `SpearmanSolver`

### Value

The set of Spearman Correlation Coefficients between each transcription factor and the target gene.

### See Also

[cor](#), [SpearmanSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, EnsembleSolver-method](#), [run, LassoPVSolver-method](#), [run, LassoSolver-method](#), [run, PearsonSolver-method](#), [run, RandomForestSolver-method](#), [run, RidgeSolver-method](#), [run, XGBoostSolver-method](#)

### Examples

```
# Load included Alzheimer's data, create a TReNA object with Bayes Spike as solver, and solve  
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))  
target.gene <- "MEF2C"  
tfs <- setdiff(rownames(mtx.sub), target.gene)  
spearman.solver <- SpearmanSolver(mtx.sub, target.gene, tfs)  
tbl <- run(spearman.solver)
```

---

run,XGBoostSolver-method

*Run the XGBoost Solver*

---

### Description

Given a TReNA object with XGBoost as the solver, use the `cor` function with `method = "XGBoost"` to estimate importances for each transcription factor as a predictor of the target gene's expression level.

**Usage**

```
## S4 method for signature 'XGBoostSolver'  
run(obj)
```

**Arguments**

obj                    An object of class XGBoostSolver

**Value**

The set of XGBoost relative importances between each transcription factor and the target gene.

**See Also**

[cor](#), [XGBoostSolver](#)

Other solver methods: [run, BayesSpikeSolver-method](#), [run, EnsembleSolver-method](#), [run, LassoPVSolver-method](#), [run, LassoSolver-method](#), [run, PearsonSolver-method](#), [run, RandomForestSolver-method](#), [run, RidgeSolver-method](#), [run, SpearmanSolver-method](#)

**Examples**

```
# Load included Alzheimer's data, create a TRENA object with Bayes Spike as solver, and solve  
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))  
target.gene <- "MEF2C"  
tfs <- setdiff(rownames(mtx.sub), target.gene)  
XGBoost.solver <- XGBoostSolver(mtx.sub, target.gene, tfs)  
tbl <- run(XGBoost.solver)
```

---

show, BayesSpikeSolver-method

*Show the Bayes Spike Solver*

---

**Description**

Show the Bayes Spike Solver

**Usage**

```
## S4 method for signature 'BayesSpikeSolver'  
show(object)
```

**Arguments**

object                An object of the class BayesSpikeSolver

**Value**

A truncated view of the supplied object



**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
bayes.solver <- BayesSpikeSolver(mtx.sub, target.gene, tfs)
show(bayes.solver)
```

---

show,EnsembleSolver-method

*Show the Ensemble Solver*

---

**Description**

Show the Ensemble Solver

**Usage**

```
## S4 method for signature 'EnsembleSolver'
show(object)
```

**Arguments**

object            An object of the class EnsembleSolver

**Value**

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
ensemble.solver <- EnsembleSolver(mtx.sub, target.gene, tfs)
show(ensemble.solver)
```

---

show,HumanDHSFilter-method

*Show the details of a human DHS filter*

---

**Description**

Show the details of a human DHS filter

**Usage**

```
## S4 method for signature 'HumanDHSFilter'
show(object)
```

**Arguments**

object            An object of class HumanDHSFilter

**Value**

A list, where one element a character vector of transcription factors that match the GO term and the other is an empty data frame.

**See Also**

[HumanDHSFilter](#)

**Examples**

```
## Not run:
# Make a filter and show it
# load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "VRK2"
promoter.length <- 1000
genomeName <- "hg38"
db.address <- system.file(package="trena", "extdata")
genome.db.uri <- paste("sqlite:/", db.address, "vrk2.neighborhood.hg38.gtfAnnotation.db", sep = "/")
jaspar.human <- as.list(query(query(MotifDb, "sapiens"), "jaspar2016"))
# Grab regions for VRK2 using shoulder size of 1000
trena <- Trena(genomeName)
tbl.regions <- getProximalPromoter(trena, "VRK2", 1000, 1000)
hd.filter <- HumanDHSFilter(genomeName, pwmMatchPercentageThreshold = 85,
geneInfoDatabase.uri = genome.db.uri, regions = tbl.regions, pfms = jaspar.human)
show(hd.filter)

## End(Not run)
```

---

show,LassoPVSolver-method

*Show the Lasso PV Solver*

---

**Description**

Show the Lasso PV Solver

**Usage**

```
## S4 method for signature 'LassoPVSolver'
show(object)
```

**Arguments**

object            An object of the class LassoPVSolver

**Value**

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
lassopv.solver <- LassoPVSolver(mtx.sub, target.gene, tfs)
show(lassopv.solver)
```

---

show,LassoSolver-method

*Show the Lasso Solver*

---

**Description**

Show the Lasso Solver

**Usage**

```
## S4 method for signature 'LassoSolver'
show(object)
```

**Arguments**

object            An object of the class LassoSolver

**Value**

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
lasso.solver <- LassoSolver(mtx.sub, target.gene, tfs)
show(lasso.solver)
```

---

show,MotifMatcher-method

*Show a MotifMatcher object*

---

**Description**

Show a MotifMatcher object

**Usage**

```
## S4 method for signature 'MotifMatcher'
show(object)
```

**Arguments**

object            An object of the class MotifMatcher

**Value**

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
lassopv.solver <- LassoPVSolver(mtx.sub, target.gene, tfs)
show(lassopv.solver)
```

---

show,PearsonSolver-method

*Show the Pearson Solver*

---

**Description**

Show the Pearson Solver

**Usage**

```
## S4 method for signature 'PearsonSolver'
show(object)
```

**Arguments**

object            An object of the class PearsonSolver

**Value**

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
pearson.solver <- PearsonSolver(mtx.sub, target.gene, tfs)
show(pearson.solver)
```

---

show,RandomForestSolver-method

*Show the Random Forest Solver*

---

### Description

Show the Random Forest Solver

### Usage

```
## S4 method for signature 'RandomForestSolver'  
show(object)
```

### Arguments

object            An object of the class RandomForestSolver

### Value

A truncated view of the supplied object

### Examples

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))  
target.gene <- "MEF2C"  
tfs <- setdiff(rownames(mtx.sub), target.gene)  
rf.solver <- RandomForestSolver(mtx.sub, target.gene, tfs)  
show(rf.solver)
```

---

show,RidgeSolver-method

*Show the Ridge Solver*

---

### Description

Show the Ridge Solver

### Usage

```
## S4 method for signature 'RidgeSolver'  
show(object)
```

### Arguments

object            An object of the class RidgeSolver

### Value

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
ridge.solver <- RidgeSolver(mtx.sub, target.gene, tfs)
show(ridge.solver)
```

---

show,SpearmanSolver-method

*Show the Spearman Solver*

---

**Description**

Show the Spearman Solver

**Usage**

```
## S4 method for signature 'SpearmanSolver'
show(object)
```

**Arguments**

object            An object of the class SpearmanSolver

**Value**

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
spearman.solver <- SpearmanSolver(mtx.sub, target.gene, tfs)
show(spearman.solver)
```

---

show,XGBoostSolver-method

*Show the XGBoost Solver*

---

**Description**

Show the XGBoost Solver

**Usage**

```
## S4 method for signature 'XGBoostSolver'
show(object)
```

**Arguments**

object            An object of the class XGBoostSolver

**Value**

A truncated view of the supplied object

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
XGBoost.solver <- XGBoostSolver(mtx.sub, target.gene, tfs)
show(XGBoost.solver)
```

---

Solver-class	<i>Define an object of class Solver</i>
--------------	-----------------------------------------

---

**Description**

The Solver class is a base class that governs the different solvers available in trena. It is rarely called by itself; rather, interaction with a particular solver object is achieved using a specific solver type.

**Usage**

```
Solver(mtx.assay = matrix(), targetGene, candidateRegulators, quiet = TRUE)
```

**Arguments**

mtx.assay            An assay matrix of gene expression data

targetGene            A designated target gene that should be part of the mtx.assay data

candidateRegulators            The designated set of transcription factors that could be associated

quiet                A logical indicating whether or not the Solver object should print output

**Value**

An object of the Solver class

**See Also**

[getAssayData](#), [getTarget](#), [getRegulators](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [SpearmanSolver](#), [XGBoostSolver](#)

**Examples**

```
#' # Create a Solver object using the included Alzheimer's data
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
targetGene <- "MEF2C"
candidateRegulators <- setdiff(rownames(mtx.sub), targetGene)
solver <- Solver(mtx.sub, targetGene, candidateRegulators) # Create a simple Solver object with default options
```

---

SpearmanSolver	<i>Create a Solver class object using Spearman correlation coefficients as the solver</i>
----------------	-------------------------------------------------------------------------------------------

---

**Description**

Create a Solver class object using Spearman correlation coefficients as the solver

**Usage**

```
SpearmanSolver(
  mtx.assay = matrix(),
  targetGene,
  candidateRegulators,
  quiet = TRUE
)
```

**Arguments**

mtx.assay	An assay matrix of gene expression data
targetGene	A designated target gene that should be part of the mtx.assay data
candidateRegulators	The designated set of transcription factors that could be associated with the target gene
quiet	A logical denoting whether or not the solver should print output

**Value**

A Solver class object with Spearman correlation coefficients as the solver

**See Also**

[solve.Spearman](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [XGBoostSolver](#)

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
target.gene <- "MEF2C"
tfs <- setdiff(rownames(mtx.sub), target.gene)
spearman.solver <- SpearmanSolver(mtx.sub, target.gene, tfs)
```



---

SpearmanSolver-class    *An S4 class to represent a Spearman solver*

---

### Description

An S4 class to represent a Spearman solver

---

Trena-class                      *Define an object of class Trena*

---

### Description

The Trena class provides a convenient wrapper for the most commonly used filters and solvers in the trena package. Given a particular genome (one of c("hg38", "mm10")), the Trena class provides methods to retrieve information about possible regulators for a target gene, assess the effects of SNPs, and create gene models using the flexible [EnsembleSolver](#) class.

### Usage

```
Trena(genomeName, quiet = TRUE)
```

### Arguments

genomeName	A string indicating the genome used by the Trena object. Currently, only human and mouse ("hg38", "mm10") are supported
quiet	A logical indicating whether or not the Trena object should print output

### Value

An object of the Trena class

### See Also

[getRegulatoryChromosomalRegions](#), [getRegulatoryTableColumnNames](#), [getGeneModelTableColumnNames](#), [createGeneModelFromRegulatoryRegions](#), [createGeneModelFromTfList](#)

### Examples

```
# Create a Trena object using the human hg38 genome
trena <- Trena("hg38")
```

---

VarianceFilter-class    *Create a VarianceFilter object*

---

### Description

A VarianceFilter object allows for filtering based on the variance of a target gene in relation to other genes in the assay matrix. Using its associated getCandidates method, a VarianceFilter object can be used to filter a list of possible transcription factors to those within a given range of the variance of a supplied target gene.

### Usage

```
VarianceFilter(mtx.assay = matrix(), targetGene, varSize = 0.5, quiet = TRUE)
```

### Arguments

mtx.assay	An assay matrix of gene expression data
targetGene	A designated target gene that must be part of the mtx.assay data
varSize	A user-specified fraction (0-1) of the target gene variance to use as a filter
quiet	A logical denoting whether or not the solver should print output

### Value

A CandidateFilter class object with variance as the filtering method  
 An object of the VarianceFilter class

### See Also

[getCandidates-VarianceFilter](#)

Other Filtering Objects: [FootprintFilter-class](#)

### Examples

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))
variance.filter <- VarianceFilter(mtx.assay = mtx.sub, targetGene = "MEF2C")
```

---

XGBoostSolver                      *Create a Solver class using gradient boosting (a regression technique) and the XGBoost library*

---

### Description

Create a Solver class using gradient boosting (a regression technique) and the XGBoost library

**Usage**

```
XGBoostSolver(  
  mtx.assay = matrix(),  
  targetGene,  
  candidateRegulators,  
  quiet = TRUE  
)
```

**Arguments**

<code>mtx.assay</code>	An assay matrix of gene expression data
<code>targetGene</code>	A designated target gene that should be part of the <code>mtx.assay</code> data
<code>candidateRegulators</code>	The designated set of transcription factors that could be associated with the target gene
<code>quiet</code>	A logical denoting whether or not the solver should print output

**Value**

A Solver class object with XGBoost Importances (Gain) as the solver

**See Also**

[solve.XGBoost](#), [getAssayData](#)

Other Solver class objects: [BayesSpikeSolver](#), [EnsembleSolver](#), [HumanDHSFilter-class](#), [LassoPVSolver](#), [LassoSolver](#), [PearsonSolver](#), [RandomForestSolver](#), [RidgeSolver](#), [Solver-class](#), [SpearmanSolver](#)

**Examples**

```
load(system.file(package="trena", "extdata/ampAD.154genes.mef2cTFs.278samples.RData"))  
target.gene <- "MEF2C"  
tfs <- setdiff(rownames(mtx.sub), target.gene)  
XGBoost.solver <- XGBoostSolver(mtx.sub, target.gene, tfs)
```

---

XGBoostSolver-class    *An S4 class to represent a XGBoost solver*

---

**Description**

An S4 class to represent a XGBoost solver

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