## Package ‘rGADEM’

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**Type**  Package  
**Title**  de novo motif discovery  
**Version**  2.15.0  
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**Depends**  R (>= 2.11.0), Biostrings, IRanges, BSgenome, methods, seqLogo  
**Imports**  Biostrings, IRanges, methods, graphics, seqLogo  
**Suggests**  BSgenome.Hsapiens.UCSC.hg19  
**Description**  rGADEM is an efficient de novo motif discovery tool for large-scale genomic sequence data. It is an open-source R package, which is based on the GADEM software.  
**License**  Artistic-2.0  
**biocViews**  Microarray, ChIPchip, Sequencing, ChIPSeq, MotifDiscovery  
**NeedsCompilation**  yes  

### R topics documented:

- align-class ........................................................................ 2  
- GADEM .............................................................................. 3  
- gadem-class ........................................................................ 5  
- motif-class .......................................................................... 6  
- parameters-class ................................................................... 7  
- readPWMfile ......................................................................... 8  

**Index**  

1
align-class

Class "align"

Description

This object contains the individual motifs identified but also the location (seqID and position) of the sites in the original sequence data. It also included the spaced dyad from which the motifs is derived, PWM score p-value cutoff for the run.

Objects from the Class

Objects can be created by calls of the form `new("align", ...).

Slots

- `seq` : Motif identified.
- `chr` : Chromosome identified.
- `start` : Sequence start.
- `end` : Sequence end.
- `strand` : Strand position.
- `seqID` : Sequence identification.
- `pos` : Position identification.
- `pval` : p-Value for each identification.
- `fastaHeader` : Fasta accession.

Author(s)

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See Also

`gadem`, `motif`, `parameters`

Examples

`showClass("align")`
Description

It is an R implementation of GADEM, a powerful computational tool for de novo motif discovery.

Usage

GADEM(Sequences, seed=1, genome=NULL, verbose=FALSE, numWordGroup=3, numTop3mer=20, numTop4mer=40, numTop5mer=60, numGeneration=5, populationSize=100, pValue=0.0002, eValue=0.0, extTrim=1, minSpaceWidth=0, maxSpaceWidth=10, useChIPscore=0, numEM=40, fEM=0.5, widthWt=80, fullScan=0, slideWinPWM=6, stopCriterion=1, numBackgSets=10, weightType=0, bFileName="NULL", Spwm="NULL", minSites =-1, maskR=0, nmotifs=25)

Arguments

Sequences Sequences from BED or FASTA file are converted into XString object view
seed When a seed is specified, the run results are deterministic
genome Specify the genome
verbose Print immediate results on screen [TRUE-yes (default), FALSE-no]. These results include the motif consensus sequence, number of sites (in sequences subjected to EM optimization, see -fEM, above), and ln(E-value).
numWordGroup number of non-zero k-mer groups
numTop3mer Number of top-ranked trimers for spaced dyads (default: 20).
numTop4mer Number of top-ranked tetramers for spaced dyads (default: 40).
numTop5mer Number of top-ranked pentamers for spaced dyads (default: 60).
numGeneration Number of genetic algorithm (GA) generations (default: 5).
populationSize GA population size (default: 100). Both default settings should work well for most datasets (ChIP-chip and ChIP-seq). The above two arguments are ignored in a seeded analysis, because spaced dyads and GA are no longer needed (numGeneration is set to 1 and populationSize is set to 10 internally, corresponding to the 10 maxp choices).
pValue P-value cutoff for declaring BINDING SITES (default: 0.0002). Depending on data size and the motif, you might want to assess more than one value. For ChIP-seq data (e.g., 10 thousand +/-200-bp max-center peak cores), p=0.0002 often seems appropriate. However, short motifs may require a less stringent setting.
eValue ln(E-value) cutoff for selecting MOTIFS (default: 0.0). If a seeded analysis fails to identify the expected motif, run GADEM with -verbose 1 to show motif ln(E-value)s on screen, then rerun with a larger ln(E-value) cutoff. This can help in identifying short and/or low abundance motifs, for which the default E-value threshold may be too low.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>extTrim</td>
<td>Base extension and trimming (1 -yes, 0 -no) (default: 1).</td>
</tr>
<tr>
<td>minSpaceWidth</td>
<td>Minimal number of unspecified nucleotides in spaced dyads (default: 0).</td>
</tr>
<tr>
<td>maxSpaceWidth</td>
<td>Maximal number of unspecified nucleotides in spaced dyads (default: 10). minSpaceWidth and maxSpaceWidth control the lengths of spaced dyads, and, with exTrim, control motif lengths. Longer motifs can be discovered by setting maxSpaceWidth to larger values (e.g. 50).</td>
</tr>
<tr>
<td>useChIPscore</td>
<td>Use top-scoring sequences for deriving PWMs. Sequence (quality) scores are stored in sequence header (see documentation). 0 - no (default, randomly select sequences). 1 - yes.</td>
</tr>
<tr>
<td>numEM</td>
<td>Number of EM steps (default: 40). One might want to set it to a larger value (e.g. 80) in a seeded run, because such runs are fast.</td>
</tr>
<tr>
<td>fEM</td>
<td>Fraction of sequences used in EM to obtain PWMs in an unseeded analysis (default: 0.5). For unseeded motif discovery in a large dataset (e.g. &gt;10 million nt), one might want to set fEM to a smaller value (e.g., 0.3 or 0.4) to reduce run time.</td>
</tr>
<tr>
<td>widthWt</td>
<td>For posWt 1 or 3, width of central sequence region with large EM weights for PWM optimization (default: 50). This argument is ignored when weightType is 0 (uniform prior) or 2 (Gaussian prior).</td>
</tr>
<tr>
<td>fullScan</td>
<td>GADEM keeps two copies of the input sequences internally: one (D) for discovering PWMs and one (S) for scanning for binding sites using the PWMs. Once a motif is identified, its instances in set D are always masked by Ns. However, masking motif instances in set S is optional, and scanning unmasked sequences allows sites of discovered motifs to overlap.</td>
</tr>
<tr>
<td>slideWinPWM</td>
<td>Sliding window for comparing PWM similarity (default: 6).</td>
</tr>
<tr>
<td>stopCriterion</td>
<td>Number of generations without new motifs before stopping analysis.</td>
</tr>
<tr>
<td>numBackgSets</td>
<td>Number of sets of background sequences (default: 10). The background sequences are simulated using the [a,c,g,t] frequencies in the input sequences, with length matched between the two sets. The background sequences are used as the random sequences for assessing motif enrichment in the input data.</td>
</tr>
<tr>
<td>weightType</td>
<td>Weight profile for positions on the sequence. 0 - no weight (uniform spatial prior, default), 1 (gaussian prior) and 2 (triangle prior) - small or zero weights for the ends and large weights for the center (e.g. the center 50 bp). Consider using 1 or 2 if you expect strong central enrichment (as in ChIP-seq) and your sequences are long (e.g. &gt;200 bp).</td>
</tr>
<tr>
<td>bFileName</td>
<td>Reading user-specified background models.</td>
</tr>
<tr>
<td>Spwm</td>
<td>File name for the seed PWM, when a seeded approach is used. can be used as the starting PWM for the EM algorithm. This will help find an expected motif and is much faster than unseeded de novo discovery. Also, when a seed PWM is specified, the run results are deterministic, so only a single run is needed (repeat runs with the same settings will give identical results). In contrast, unseeded runs are stochastic, and we recommend comparing results from several repeat runs.</td>
</tr>
<tr>
<td>minSites</td>
<td>Minimal number of sites required for a motif to be reported (default: numSeq/20).</td>
</tr>
</tbody>
</table>
maskR  Mask low-complexity sequences or repeats; 'aaaaaaaa', 'ttttttt', 'cacacaca', 'ttgtgtg', 'atatatat', 'ggagagagaga', 'gaggaggaggag', 'agaagaagaaga', 'ctctctctctc', 'tcctctctctc', 'tcttcttcttct', or 'cagcagcagcag' (default: 0-no masking, 1-masking)

nmotifs  Number of motifs sought (default: 25)

Author(s)
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Examples

library(EnsGenome.Hsapiens.UCSC.hg19)
pwd<""  # INPUT FILES- BedFiles, FASTA, etc.
path< system.file("extdata","Test_100.bed",package="rGADEM")
Bedfile<paste(pwd,path,sep="")
BED<read.table(BedFile,header=FALSE,sep="\t")
BED<data.frame(chr=as.factor(BED[,1]),start=as.numeric(BED[,2]),end=as.numeric(BED[,3]))
# CREATE RD files
rgBED<IRanges(start=BED[2],end=BED[3])
Sequences<IRangedData(rgBED,space=BED[1])

gadem<GADEM(Sequences,verbose=1,genome=Hsapiens)

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gadem-class  

Class "gadem"

Description
This object contains all gadem output information.

Objects from the Class
Objects can be created by calls of the form new("gadem", ...).

Slots

motifList  List of input PWM.
parameters  List of rGADEM parameters.

Methods

[ signature(x = "gadem"): subset gadem object.

[[] signature(x = "gadem"): subset gadem object.

nMotifs signature(x = "gadem"): Number of motifs identified

names signature(x = "gadem"): Assign motifs names.
motif-class

\textbf{dim} \ signature(x = "gadem"): Number of sequences identified for each motifs.
\textbf{consensus} \ signature(x = "gadem"): Sequence of consensus motifs.
\textbf{nOccurrences} \ signature(x = "gadem"): View of PWMs.
\textbf{plot, gadem-method} \ signature(x = "gadem"): Plot.
\textbf{startPos} \ signature(x = "gadem"): Start position for each sequences.
\textbf{endPos} \ signature(x = "gadem"): End position for each sequences.
\textbf{getPWM} \ signature(x = "gadem"): End position for each sequences.

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\textbf{See Also}
\url{motif, align, parameters}

\textbf{Examples}
\begin{verbatim}
showClass("gadem")
\end{verbatim}

\textbf{Description}
This object contains PWM, motif consensus, motif length and all aligned sequences for a specific motif.

\textbf{Objects from the Class}
Objects can be created by calls of the form \texttt{new("motif\_gadem", \ldots}).

\textbf{Slots}
- \texttt{pwm}: PWM results.
- \texttt{consensus}: Sequences consensus.
- \texttt{alignList}: List of sequences alignment.
- \texttt{name}: Name of sequences.

\textbf{Author(s)}
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\textbf{See Also}
\url{gadem, align, parameters}
Examples

```r
showClass("gadem")
```

---

**Description**

This object contains parameters of GADEM analysis.

**Objects from the Class**

Objects can be created by calls of the form `new("motif_gadem", ...)`.

**Slots**

- `numWordGroup`: Number of non-zero k-mer groups.
- `numTop3mer`: Number of top-ranked trimers for spaced dyads (default: 20).
- `verbose`: Print immediate results on screen [1-yes (default), 0-no].
- `numTop4mer`: Number of top-ranked tetramers for spaced dyads (default: 40).
- `numTop5mer`: Number of top-ranked pentamers for spaced dyads (default: 60).
- `numGeneration`: Number of genetic algorithm (GA) generations (default: 5).
- `populationSize`: GA population size (default: 100).
- `pValue`: P-value cutoff for declaring BINDING SITES (default: 0.0002).
- `eValue`: ln(E-value) cutoff for selecting MOTIFS (default: 0.0).
- `extTrim`: Base extension and trimming (1-yes, 0-no) (default: 1).
- `minSpaceWidth`: Minimal number of unspecified nucleotides in spaced dyads (default: 0).
- `maxSpaceWidth`: Maximal number of unspecified nucleotides in spaced dyads (default: 10).
- `useChIPscore`: Use top-scoring sequences for deriving PWMs.
- `numEM`: Number of EM steps (default: 40).
- `fEM`: Fraction of sequences used in EM to obtain PWMs in an unseeded analysis (default: 0.5).
- `widthWt`: For -posWt 1 or 3, width of central sequence region with large EM weights for PWM optimization (default: 50).
- `fullScan`: GADEM keeps two copies of the input sequences internally.
- `slideWinPWM`: Sliding window for comparing pwm similarity (default: 6).
- `stopCriterion`
- `numBackgSets`: Number of sets of background sequences (default: 10).
- `weightType`: Weight profile for positions on the sequence.
- `bFileName`: Reading user-specified background models.
- `Spwm`: File name for the seed PWM, when a seeded approach is used.
- `nSequences`: Number of input sequences.
- `maskR`: Mask low-complexity sequences or repeats.
- `nmotifs`: Maximal number of motifs sought.
readPWMfile

Author(s)
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See Also
gadem, align, motif

Examples
showClass("parameters")

readPWMfile  Read Transfac File

Description
This function is use to read standard Transfac type file.

Usage
readPWMfile(file)

Arguments
file  Transfac file's name.

Details
This function is designed to read standard Transfac type file. For more information about the format, please refer to http://mcast.sdsc.edu/doc/transfac-format.html

Value
A list of matrix.

Author(s)
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Examples
Database and Scores
path <- system.file("extdata","jaspar2009.txt",package="rGADEM")
jasper <- readPWMfile(path)
Index

+Topic GADEM
GADEM, 3

+Topic MOTIFS
GADEM, 3

+Topic classes
align-class, 2
gadem-class, 5
motif-class, 6
parameters-class, 7

+Topic misc
readPWMfile, 8
[,gadem,ANY,ANY-method (gadem-class), 5
[,gadem-method (gadem-class), 5
[[,gadem,ANY,ANY-method (gadem-class), 5
[[,gadem-method (gadem-class), 5
align, 6, 8
align (align-class), 2
align-class, 2

consensus (gadem-class), 5
consensus,gadem-method (gadem-class), 5
dim,gadem-method (gadem-class), 5

endPos (gadem-class), 5
eндPos,gadem-method (gadem-class), 5

GADEM, 3
gadem, 2, 6, 8
gadem (gadem-class), 5
gadem-class, 5
getPWM (gadem-class), 5
getPWM,gadem-method (gadem-class), 5
getPWM,motif-method (gadem-class), 5

length,gadem-method (gadem-class), 5

motif, 2, 6, 8
motif (motif-class), 6
motif-class, 6

names,gadem-method (gadem-class), 5
names<-,gadem-method (gadem-class), 5
nMotifs (motif-class), 6
nMotifs,gadem-method (gadem-class), 5
nOccurrences (gadem-class), 5
nOccurrences,gadem-method (gadem-class), 5

parameters, 2, 6
parameters (parameters-class), 7
parameters,gadem-method (gadem-class), 5
parameters-class, 7
plot,gadem,ANY-method (gadem-class), 5
plot,gadem-method (gadem-class), 5
plot,motif,ANY-method (gadem-class), 5

readPWMfile, 8

startPos (gadem-class), 5
startPos,gadem-method (gadem-class), 5
summary,list-method (gadem-class), 5