Package ‘pqsfinder’

Type Package

Title Identification of potential quadruplex forming sequences

Version 2.20.0

Date 2021-11-21

URL https://pqsfinder.fi.muni.cz

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Description Pqsfinder detects DNA and RNA sequence patterns that are likely to fold into an intramolecular G-quadruplex (G4). Unlike many other approaches, pqsfinder is able to detect G4s folded from imperfect G-runs containing bulges or mismatches or G4s having long loops. Pqsfinder also assigns an integer score to each hit that was fitted on G4 sequencing data and corresponds to expected stability of the folded G4.

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biocViews MotifDiscovery, SequenceMatching, GeneRegulation

LazyData TRUE

Depends Biostrings

Imports Rcpp (>= 0.12.3), GenomicRanges, IRanges, S4Vectors, methods

Suggests BiocStyle, knitr, rmarkdown, Gviz, rtracklayer, ggplot2, BSgenome.Hsapiens.UCSC.hg38, testthat, stringr, stringi

LinkingTo Rcpp, BH (>= 1.78.0)

SystemRequirements GNU make, C++11

VignetteBuilder knitr

RoxygenNote 7.1.2

Encoding UTF-8

NeedsCompilation yes

git_url https://git.bioconductor.org/packages/pqsfinder
as.character,PQSViews-method

Coerce to character vector

Description

Coerce to character vector

Usage

```r
## S4 method for signature 'PQSViews'
as.character(x)
```

Arguments

- `x` PQSViews object.

Value

Character vector representing PQS.
density, PQSViews-method

Get density vector

Description
Density vector represents numbers of PQS (potential quadruplex forming sequences) overlapping at each position in input sequence.

Usage
```r
## S4 method for signature 'PQSViews'
density(x)
```

Arguments
- `x`: PQSViews object.

Value
Density vector.

Examples
```r
pqs <- pqsfinder(DNAString("CCCCCCGGGGTGGGTGGGAAAA"))
density(pqs)
```

maxScores

Get vector of maximal scores

Description
Get vector of maximal scores for a given object.

Usage
```
maxScores(x, ...)
```

Arguments
- `x`: An object.
- `...`: Additional arguments, for use in specific methods.

Value
Vector of maximal scores.
Examples

showMethods("maxScores")

---

maxScores,PQSViews-method

*Get vector of maximal scores*

Description

For each sequence position it gives the maximal score of all PQS conformations which overlap that position.

Usage

```r
## S4 method for signature 'PQSViews'
maxScores(x)
```

Arguments

- `x`: PQSViews object.

Value

Vector of maximal scores.

Examples

```r
pqs <- pqsfnder(DNAString("CCCCCGGGTGGGTTGGGGAAAA"))
maxScores(pqs)
```

---

*pqsfnder*

*Identify potential quadruplex forming sequences.*

Description

Function for identification of all potential intramolecular quadruplex patterns (PQS) in DNA or RNA sequence.
Usage

pqsfinder(
  subject,
  strand = "*",
  overlapping = FALSE,
  max_len = 50L,
  min_score = 47L,
  run_min_len = 2L,
  run_max_len = 11L,
  loop_min_len = 0L,
  loop_max_len = 30L,
  max_bulges = 3L,
  max_mismatches = 3L,
  max_defects = 3L,
  tetrad_bonus = 40L,
  mismatch_penalty = 28L,
  bulge_penalty = 20L,
  bulge_len_factor = 0.2,
  bulge_len_exponent = 1,
  loop_mean_factor = 6.6,
  loop_mean_exponent = 0.8,
  run_re = "G\{1,10\}(.\{0,9\})G\{1,10\}",
  custom_scoring_fn = NULL,
  use_default_scoring = TRUE,
  deep = FALSE,
  verbose = FALSE
)

Arguments

subject DNAString or RNAString object.
strand Strand specification. Allowed values are "+", "," or "*", where the last one represents both strands. Implicitly, the input DNAString object is assumed to encode the "+" strand.
overlapping If true, than all overlapping PQS will be reported.
max_len Maximal length of PQS.
min_score Minimal PQS score. The default value 52 shows the best balanced accuracy on G4 sequencing data provided by Chambers et al. 2015.
run_min_len Minimal length of quadruplex run.
run_max_len Maximal length of quadruplex run.
loop_min_len Minimal length of quadruplex loop. Unless the default scoring system is disabled, at most one loop can have zero length.
loop_max_len Maximal length of quadruplex loop.
max_bulges Maximal number of runs with bulge.
max_mismatches Maximal number of runs with mismatch.
max_defects Maximum number of defects in total (max_bulges + max_mismatches).
tetrad_bonus Score bonus for one complete G tetrad.
mismatch_penalty Penalization for a mismatch in tetrads.
bulge_penalty Penalization for a bulge in quadruplex run.
bulge_len_factor Penalization factor for a bulge length.
bulge_len_exponent Exponent of bulge length.
loop_mean_factor Penalization factor of loop length mean.
loop_mean_exponent Exponent of loop length mean.
run_re Regular expression specifying one run of quadruplex.
custom_scoring_fn

Custom quadruplex scoring function. It takes the following 10 arguments: subject - Input DNAString or RNAString object, score - implicit PQS score, start - PQS start position, width - PQS width, loop_1 - start pos. of loop #1, run_2 - start pos. of run #2, loop_2 - start pos. of loop #2, run_3 - start pos. of run #3, loop_3 - start pos. of loop #3, run_4 - start pos. of run #4. Return value of the function has to be new score represented as a single integer value. Please note that if use_default_scoring is enabled, the custom scoring function is evaluated AFTER the default scoring system but ONLY IF the default scoring system resulted in non-zero score (for performance reasons). On the other hand, when use_default_scoring is disabled, custom scoring function is evaluated on every PQS.

use_default_scoring Enables default internal scoring system. This option is particularly useful in case you intend to radically change the default behavior and specify your own scoring function. By disabling the default scoring you will get a full control above the underlying detection algorithm.
deep Perform deep search. With this option enabled, maxScores and density vectors are computed. Deep search is much more computationally demanding.
verbose Enables detailed output. Turn it on if you want to see all possible PQS found at each positions and not just the best one. It is highly recommended to use this option for debugging custom quadruplex scoring function. Each PQS is reported on separate row in the following format: start cnt pqs_sequence score, where start is the PQS starting position, pqs_sequence shows the PQS sequence structure with each run surrounded by square brackets and score is the score assigned to the particular PQS by all applied scoring functions.

Details

Use elementMetadata function to get extra PQS features like number of tetrads (nt), bulges (nb), mismatches (nm) or loop lengths (ll1, ll2, ll3).
**Value**

PQSViews object

**Examples**

```r
pv <- pqsfinder(DNAString("CCCCCCGGGTGGGTGGGTAAAA"))
pv
elementMetadata(pv)
```

---

**PQSViews**

*PQSViews class constructor*

**Description**

User friendly constructor for PQSViews class representing potential quadruplex forming sequences (PQS). PQSViews is a subclass of XStringViews class and adds two more slots to store PQS density and PQS score distribution.

**Usage**

```r
PQSViews(
  subject,
  start,
  width,
  strand,
  score,
  density,
  max_scores,
  nt,
  nb,
  nm,
  r11,
  r12,
  r13,
  l11,
  l12,
  l13
)
```

**Arguments**

- **subject**: DNAString or RNAString object.
- **start**: Start positions.
- **width**: Lengths.
- **strand**: Strand specifications.
PQSViews-class

Description

Represents potential quadruplex forming sequences found by pqsfinder function. This is a sub-class of XStringViews-class class and adds one more slot.

Details

Use elementMetadata function to get extra PQS features like number of tetrads, bulges, mismatches or loop lengths.

Value

PQSViews object.

Examples

pv <- PQSViews(DNAString("GGTGGTGGTGG"), 1, 11, "+", 33, as.integer(rep(1, 11)),
               as.integer(rep(33, 11)), 2, 0, 0, 2, 2, 1, 1, 1)

start(pv)
width(pv)
strand(pv)
score(pv)
density(pv)
maxScores(pv)
elementMetadata(pv)
Slots

density  Numbers of PQS (potential quadruplex forming sequences) overlapping at each position in input sequence.
max_scores  Score of the best PQS found at each position.

score,PQSViews-method  Get PQS score vector

Description

Get PQS score vector

Usage

## S4 method for signature 'PQSViews'
score(x)

Arguments

x  PQSViews object.

Value

Score vector.

Examples

pqs <- pqsfinder(DNAString("CCCCCCCCGTTGTTGTTGTTGAAAA"))
score(pqs)

show,PQSViews-method  Show method

Description

Show method

Usage

## S4 method for signature 'PQSViews'
show(object)

Arguments

object  PQSViews object.
Value

PQSViews object printed.

Description

Get PQS strand vector

Usage

```r
## S4 method for signature 'PQSViews'
strand(x)
```

Arguments

- `x` PQSViews object.

Value

Strand vector.

Examples

```r
pqs <- pqsfinder(DNAString("CCCCCCGGGTTGGGTGGGGAAAA"))
strand(pqs)
```
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