

Package ‘SPLINTER’

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Type Package

Title Splice Interpreter of Transcripts

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URL <https://github.com/dianalow/SPLINTER/>

BugReports <https://github.com/dianalow/SPLINTER/issues>

Description Provides tools to analyze alternative splicing sites, interpret outcomes based on sequence information, select and design primers for site validation and give visual representation of the event to guide downstream experiments.

License GPL-2

LazyData TRUE

Depends R (>= 3.6.0), grDevices, stats

Imports graphics, ggplot2, seqLogo, Biostrings, biomaRt, GenomicAlignments, GenomicRanges, GenomicFeatures, Gviz, IRanges, S4Vectors, GenomeInfoDb, utils, plyr, stringr, methods, BSgenome.Mmusculus.UCSC.mm9, googleVis

biocViews ImmunoOncology, GeneExpression, RNASeq, Visualization, AlternativeSplicing

Collate primerpcr.R main_splinter.R

Encoding UTF-8

RoxygenNote 7.1.0

VignetteBuilder knitr

Suggests BiocStyle, knitr, rmarkdown

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| | |
|-------------------------|-------------------|
| <code>acceptor.m</code> | <i>acceptor.m</i> |
|-------------------------|-------------------|

Description

Acceptor site mammalian frequency matrices for GT-AG pairs from SpliceDB

Usage

```
data("acceptor.m")
```

Format

The format is: num [1:4, 1:15] 9 31.03 12.5 42.36 8.44 ... - attr(*, "dimnames")=List of 2 ..\$: chr [1:4] "A" "C" "G" "T" ..\$: chr [1:15] "V1" "V2" "V3" "V4" ...

Source

[urlhttp://www.softberry.com/spldb/SpliceDB.html](http://www.softberry.com/spldb/SpliceDB.html)

References

Burset M., Seledtsov I., Solovyev V. (Nucl.Acids Res.,2000,28,4364-4375; Nucl. Acids Res.,2001,29,255-259)

Examples

```
data(acceptor.m)
```

| | |
|-----------------------------------|-----------------------------|
| <code>addEnsemblAnnotation</code> | <i>addEnsemblAnnotation</i> |
|-----------------------------------|-----------------------------|

Description

Adds annotation to `extractSpliceEvents` object (if not present)

Usage

```
addEnsemblAnnotation(data, species = "hsapiens")
```

Arguments

data `extractSpliceEvents` object
species character. biomaRt species passed to retrieve annotation. Common species include: 'hsapiens', 'mmusculus'

Value

`extractSpliceEvents` object with annotated genes under \$geneSymbol

Author(s)

Diana Low

See Also

http://asia.ensembl.org/info/data/biomart/biomart_r_package.html#biomartexamples

Examples

```
data_path<-system.file("extdata",package="SPLINTER")
splice_data<-extractSpliceEvents(data=paste(data_path,"/skipped_exons.txt",sep=""))
#splice_data<-addEnsemblAnnotation(data=splice_data,species="mmusculus")
```

annotateEvents

annotateEvents

Description

Gives detailed description of splicing event in terms of splicing outcome post translation. Currently supports exon skipping and intron retention events.

Usage

```
annotateEvents(  
  thedata,  
  db,  
  bsgenome,  
  outputdir,  
  full_output = FALSE,  
  output_prefix = "results"  
)
```

Arguments

| | |
|---------------|--|
| thedata | list. output of extractSpliceEvents. |
| db | TxDb object |
| bsgenome | BSGenome object |
| outputdir | character. relative output directory to current location. |
| full_output | logical. writes out detailed text report and generate figures. |
| output_prefix | character. text prefix for full_output files. |

Value

list containing information on (1) data.frame with splicing regions (2) splice event type

Author(s)

Diana LOW

| | |
|-------------|--------------------|
| callPrimer3 | <i>callPrimer3</i> |
|-------------|--------------------|

Description

call primer3 for a given set of DNAstringSet object

Usage

```
callPrimer3(
  seq,
  size_range = "150-500",
  Tm = c(57, 59, 62),
  name = "Primer1",
  primer3 = "primer3-2.3.7/bin/primer3_core",
  thermo.param = "primer3-2.3.7/src/primer3_config/",
  sequence_target = NULL,
  settings = "primer3-2.3.7/primer3web_v4_0_0_default_settings.txt"
)
```

Arguments

| | |
|--------------|---|
| seq | DNAstring object, one DNA string for the given amplicon |
| size_range | default: '151-500' |
| Tm | melting temperature parameters default:c(55,57,58) |
| name | name of the amplicon in chr_start_end format |
| primer3 | primer3 path |
| thermo.param | thermodynamic parameters folder |

sequence_target If one or more targets is specified then a legal primer pair must flank at least one of them.

settings text file for parameters

Details

modified to include SEQUENCE_TARGET as an option

Value

data.frame of designed primers and parameters

Author(s)

Altuna Akalin's modified Arnaud Krebs' original function further modified here by Diana Low

Examples

```
### NOT RUN ###
# primer_results<-callPrimer3(seq='')
```

| | |
|-------------|--------------------|
| checkPrimer | <i>checkPrimer</i> |
|-------------|--------------------|

Description

checkPrimer

Usage

```
checkPrimer(pp, genome, roi = NULL)
```

Arguments

pp data.frame defining primers, or output of [callPrimer3](#). minimal columns = PRIMER_LEFT_SEQUENCE,PRIMER_RIGHT_SEQUENCE

genome BSgenome object

roi [makeROI](#) object

Value

list of GRanges with primer locations

Author(s)

Diana Low

Examples

```
# create a primer pair
roi
primer_pair <- data.frame(PRIMER_LEFT_SEQUENCE="agctcttgaattggagctgac",
                          PRIMER_RIGHT_SEQUENCE="cttagaaagaacaggaaatcc",
                          stringsAsFactors=FALSE)
```

| | |
|----------------|-----------------------|
| compatible_cds | <i>compatible_cds</i> |
|----------------|-----------------------|

Description

compatible_cds

Examples

```
data(compatible_cds)
## maybe str(compatible_cds) ; plot(compatible_cds) ...
```

| | |
|---------------|----------------------|
| compatible_tx | <i>compatible_tx</i> |
|---------------|----------------------|

Description

compatible_tx

Examples

```
data(compatible_tx)
## maybe str(compatible_tx) ; plot(compatible_tx) ...
```

| | |
|---------|----------------|
| donor.m | <i>donor.m</i> |
|---------|----------------|

Description

Donor site mammalian frequency matrices for GT-AG pairs from SpliceDB

Usage

```
data("donor.m")
```

Format

The format is: num [1:4, 1:9] 34.1 36.2 18.3 11.4 60.4 ... - attr(*, "dimnames")=List of 2 ..\$: chr [1:4] "A" "C" "G" "T" ..\$: chr [1:9] "V1" "V2" "V3" "V4" ...

Source

<http://www.softberry.com/spldb/SpliceDB.html>

References

Burset M., Seledtsov I., Solovyev V. (Nucl.Acids Res.,2000,28,4364-4375; Nucl. Acids Res.,2001,29,255-259)

Examples

```
data(donor.m)
```

```
eventOutcomeCompare  eventOutcomeCompare
```

Description

Compares two sequences and gives differences if there's a switch from 1->2 if seq2 is NULL, assume seq1 is a list of length 2 to compare

Usage

```
eventOutcomeCompare(
  seq1,
  seq2 = NULL,
  genome,
  direction = TRUE,
  fullseq = TRUE,
  verbose = FALSE
)
```

Arguments

| | |
|-----------|---|
| seq1 | GRangesList |
| seq2 | GRangesList |
| genome | BSGenome object |
| direction | logical. Report direction of sequence change. |
| fullseq | logical. Report full sequences. |
| verbose | logical. turn messages on/off. |

Value

list containing
(1) tt : PairwiseAlignmentsSingleSubject pairwise alignment
(2) eventtypes : string detailing primary event classification

Author(s)

Diana LOW

Examples

```
suppressMessages(library(BSgenome.Mmusculus.UCSC.mm9))
bsgenome<-BSgenome.Mmusculus.UCSC.mm9
eventOutcomeCompare(seq1=compatible_cds$hits[[1]],seq2=region_minus_exon,
  genome=bsgenome,direction=TRUE)
```

eventOutcomeTranslate *eventOutcomeTranslate*

Description

translates sequences, reports if NMD or NTC

Usage

```
eventOutcomeTranslate(  
  seq1,  
  genome,  
  direction = FALSE,  
  fullseq = TRUE,  
  verbose = FALSE  
)
```

Arguments

| | |
|-----------|---|
| seq1 | GRangesList |
| genome | BSGenome object |
| direction | logical. Report direction of sequence change. |
| fullseq | logical. Output full AA sequence. |
| verbose | logical. turn messages on/off. |

Value

list of translated sequences

Author(s)

Diana LOW

Examples

```
suppressMessages(library(BSgenome.Mmusculus.UCSC.mm9))
bsgenome<-BSgenome.Mmusculus.UCSC.mm9
translation_results<-eventOutcomeTranslate(compatible_cds,genome=bsgenome,
direction=TRUE)
```

eventPlot

eventPlot

Description

eventPlot

Usage

```
eventPlot(
  transcripts,
  roi_plot = NULL,
  bams = c(),
  names = c(),
  annoLabel = c("Gene A"),
  rspan = 1000,
  pfam_dom = NULL,
  showAll = TRUE
)
```

Arguments

| | |
|-------------|---|
| transcripts | GRanges object |
| roi_plot | GRanges object region to plot |
| bams | character vector of bam file locations |
| names | character vector of name labels |
| annoLabel | character. annotation label |
| rspan | integer or NULL. number of basepairs to span from roi. if NULL, will consider whole gene of roi |
| pfam_dom | optional GRanges object of PFAM domains from UCSC Tables. |
| showAll | logical. TRUE = display splice junctions of entire view or FALSE = just roi. |

Value

a Gviz plot of genomic region

Author(s)

Diana Low

Examples

```
# define BAM files
data_path<-system.file("extdata", package="SPLINTER")
mt<-paste(data_path, "/mt_chr14.bam", sep="")
wt<-paste(data_path, "/wt_chr14.bam", sep="")

# plot results
eventPlot(transcripts=valid_tx, roi_plot=roi, bams=c(wt, mt),
          names=c('wt', 'mt'), rspan=1000)
```

 extendROI

extendROI

Description

extend the span of the current ROI by n number of up/downstream exon(s) by modifying roi_range within the makeROI object while retaining legacy sites by keeping \$roi and \$flank

Usage

```
extendROI(roi, tx, up = 0, down = 0, type = 1)
```

Arguments

| | |
|------|--|
| roi | makeROI object |
| tx | GRangesList transcript list to pull regions from |
| up | integer. number of exons to extend upstream |
| down | integer. number of exons to extend downstream |
| type | integer. 1=full cassette, 2=flank only |

Value

[makeROI](#) object with modified ranges

Examples

```
extendROI(roi, valid_tx, up=1)
```

`extractSpliceEvents` *extractSpliceEvents*

Description

Extracts the location of target, upstream and downstream splice sites Used for calculations and genome visualizations

Usage

```
extractSpliceEvents(
  data = NULL,
  filetype = "mats",
  splicetype = "SE",
  fdr = 1,
  inclusion = 1,
  start0 = TRUE
)
```

Arguments

| | |
|-------------------------|--|
| <code>data</code> | character. path to file |
| <code>filetype</code> | character. type of splicing output. c('mats','custom'). see Details. |
| <code>splicetype</code> | character. c('SE', 'RI', 'MXE', 'A5SS', 'A3SS') |
| <code>fdr</code> | numeric. false discovery rate filter range [0,1] |
| <code>inclusion</code> | numeric. splicing inclusion range, takes absolute value |
| <code>start0</code> | boolean 0-base start |

Details

filetype 'custom' should provide a 9-column tab-delimited text file with the following columns: ID (Ensembl gene id), Symbol (gene name), chr, strand, exonStart, exonEnd, exon2Start, exon2End, upstreamStart, upstreamEnd, downstreamStart, downstreamEnd eg. ENSG0000012345 chr1 + 3 4 5 6 1 2 7 8

Value

list containing information on

- (1) original file type
- (2) splice event type
- (3) data.frame with splicing regions

Author(s)

Diana Low

See Also

http://rnaseq-mats.sourceforge.net/user_guide.htm for MATS file definition

Examples

```
data_path<-system.file("extdata",package="SPLINTER")
splice_data<-extractSpliceEvents(data=paste(data_path,"/skipped_exons.txt",sep=""))
```

extractSpliceSites *extractSpliceSites*

Description

Extracts and formats to bed the location of target, upstream and downstream splice sites

Usage

```
extractSpliceSites(  
  df,  
  target = "SE",  
  site = "donor",  
  motif_range = c(-3, 6),  
  start0 = TRUE  
)
```

Arguments

| | |
|-------------|--|
| df | extractSpliceEvents object |
| target | the target site to extract. See Details. |
| site | character donor or acceptor |
| motif_range | numeric vector of splice position to extract |
| start0 | boolean 0-base start |

Details

target : the site to extract the sequence from. It can be either the event in question (SE, RI, MXE - first exon, MXE2 - second exon, A5SSlong, A5SSshort, A3SSlong, A3SSshort, upstream or downstream). If this function is used in conjunction with [shapiroDonor](#) or [shapiroAcceptor](#) to compute scores, then most likely it will be run twice - once for the event, and the other either up- or downstream as a comparison.

Value

GRanges object

Author(s)

Diana Low

See Alsohttp://rnaseq-mats.sourceforge.net/user_guide.htm for MATS file definition**Examples**

```
data_path<-system.file("extdata",package="SPLINTER")
splice_data<-extractSpliceEvents(data=paste(data_path,"/skipped_exons.txt",sep=""))
splice_sites<-extractSpliceSites(splice_data,target="SE")
```

findCompatibleEvents *findCompatibleEvents*

Description

Which transcript contains the event? Each event has 2 possibilities, as long as the transcript fulfills one, it passes the test Has to be exact (inner junctions)

Usage

```
findCompatibleEvents(tx, tx2 = NULL, roi, sequential = TRUE, verbose = FALSE)
```

Arguments

| | |
|------------|--|
| tx | GRangesList object of transcripts |
| tx2 | optional GRangesList object of transcripts if tx is list of cds |
| roi | makeROI object containing event information |
| sequential | logical. Exons have to appear sequentially to be considered compatible |
| verbose | logical. printouts and messages. |

Details

Separates into event/region1 and 2 for the alternative case

Value

list of length 4
 (1) GRangesList
 (2) Hits status [c]=coding; [nc]=non-coding
 (3) ct - compatible transcripts
 (4) tt - total transcripts

Author(s)

Diana Low

Examples

```
compatible_cds <- findCompatibleEvents(valid_cds,roi=roi,verbose=TRUE)
```

`findCompatibleExon` *findCompatibleExon*

Description

Finds compatible exon in annotation with the one present in roi object

Usage

```
findCompatibleExon(tx, roi, verbose = FALSE)
```

Arguments

| | |
|----------------------|---|
| <code>tx</code> | GRangesList object of transcripts |
| <code>roi</code> | makeROI object containing event information |
| <code>verbose</code> | logical. printouts and messages. |

Value

list of length 3
(1) GRangesList hits
(2) Number of transcripts
(3) Original number of input transcripts

Author(s)

Diana Low

Examples

```
compatible_exons <- findCompatibleExon(valid_cds,roi)
```

`findExactOverlaps` *findExactOverlaps*

Description

Internal function similar to `findSpliceOverlaps` but only preserves internal flanks

Usage

```
findExactOverlaps(query, subject, sequential = FALSE, verbose = FALSE)
```

Arguments

| | |
|-------------------------|--|
| <code>query</code> | GRanges object |
| <code>subject</code> | GRanges object |
| <code>sequential</code> | logical. TRUE if exons are sequential. |
| <code>verbose</code> | logical. report intermediate output |

Value

Hits object

Author(s)

Diana Low

`findTermination` *findTermination*

Description

Internal function to find the first stop codon that occurs in the AA sequence, returns their position and the resulting truncated protein

Usage

```
findTermination(s1)
```

Arguments

| | |
|-----------------|-----------------------------|
| <code>s1</code> | character. protein sequence |
|-----------------|-----------------------------|

Value

list containing
(1) stop1 : stop position
(2) s1 : sequence truncated to first stop

Author(s)

Diana LOW

| | |
|--------|---------------|
| findTX | <i>findTX</i> |
|--------|---------------|

Description

Given an ENSEMBL id, find all transcripts that matches id

Usage

```
findTX(id, db, tx, valid = FALSE, verbose = FALSE)
```

Arguments

| | |
|---------|---|
| id | character. transcript identification (currently ENSEMBL gene names) |
| db | TxDB object |
| tx | GRangesList |
| valid | logical. check if in multiples of 3 [TRUE] for CDS translation. |
| verbose | logical. turn messages on/off. |

Value

GRangesList

Author(s)

Diana Low

Examples

```
valid_cds <-findTX(id=splice_data$data[2,]$ID,tx=thecds,db=txdb,valid=FALSE)
```

`getPCRsizes`*getPCRsizes*

Description

returns length of product given a GRanges span and GRangesList of transcripts

Usage

```
getPCRsizes(pcr_span, txlist, verbose = FALSE)
```

Arguments

| | |
|-----------------------|--------------------------------------|
| <code>pcr_span</code> | GRanges object |
| <code>txlist</code> | GRangesList object |
| <code>verbose</code> | logical. report intermediate output. |

Value

data.frame of transcript names with detected sizes in basepairs

Author(s)

Diana Low

Examples

```
suppressMessages(library(BSgenome.Mmusculus.UCSC.mm9))
bsgenome<-BSgenome.Mmusculus.UCSC.mm9
## create a primer pair
## for actual use, obtain primer pair from primer design (callPrimer3)
primer_pair <- data.frame(PRIMER_LEFT_SEQUENCE="agctcttgaatggagctgac",
                          PRIMER_RIGHT_SEQUENCE="cttagaaagaacaggaatcc",
                          stringsAsFactors=FALSE)

## confirm location
cp<-checkPrimer(primer_pair,bsgenome,roi)
cp

## get the PCR sizes
pcr_result1 <- getPCRsizes(cp,theexons)
```

| | |
|--------------|---------------------|
| getRegionDNA | <i>getRegionDNA</i> |
|--------------|---------------------|

Description

get DNA sequence give a region of interest

Usage

```
getRegionDNA(roi, genome, introns = FALSE)
```

Arguments

| | |
|---------|--|
| roi | makeROI object |
| genome | BSgenome object |
| introns | TRUE/FALSE. whether to include intronic (lowercase) DNA. By default returns only exonic (uppercase) DNA. |

Value

list of
(1) DNA sequence (2) Junction start (for primer design)

Author(s)

Diana Low

Examples

```
suppressMessages(library(BSgenome.Mmusculus.UCSC.mm9))  
bsgenome<-BSgenome.Mmusculus.UCSC.mm9  
getRegionDNA(roi,bsgenome)
```

| | |
|--------------|---------------------|
| insertRegion | <i>insertRegion</i> |
|--------------|---------------------|

Description

inserts a region (exon or intron) into roi object

Usage

```
insertRegion(subject, roi)
```

Arguments

subject GRangesList
 roi [makeROI](#) object containing region of interest (to insert). refer to [makeROI\(\)](#).

Details

in the case of intron retention, replaces exon with intron retention range `reduce()` the GRanges in question

Value

GRanges object

Author(s)

Diana Low

Examples

```
#Inserts the exon defined in roi GRanges object from a GRanges/GRangesList
region_minus_exon
region_with_exon<-insertRegion(region_minus_exon,roi)
```

makeROI

makeROI

Description

Creates an object to store information about the splice site (region of interest) including flanking regions and alternative splice outcome

Usage

```
makeROI(df, type = "SE")
```

Arguments

df data.frame object from [extractSpliceEvents](#)
 type type of splicing event c("SE","RI","MXE","A5SS","A3SS")

Value

a list containing

- (1) type : splice type
- (2) name : ID of transcript
- (3) roi : GRanges object of splice site
- (4) flank : GRanges object of flanking exons of splice site
- (5) roi_range : GRangesList of splice site and its alternative outcome based on type

Author(s)

Diana Low

Examples

```
single_record<-splice_data$data[which(grepl("Prmt5",splice_data$data$Symbol)),]  
roi <- makeROI(single_record,type="SE")
```

| | |
|---------------|----------------------|
| makeUniqueIDs | <i>makeUniqueIDs</i> |
|---------------|----------------------|

Description

Makes unique ID names from event location

Usage

```
makeUniqueIDs(ddata)
```

Arguments

ddata extractSpliceEvents object

Value

original extractSpliceEvents list object with unique ID appended to data accessor

Author(s)

Diana Low

Examples

```
data_with_id<-makeUniqueIDs(splice_data)
```

matchExons

matchExons

Description

Internal function to help match the inner coordinates of a 2/3 cassette checks if reference and subject matches

Usage

```
matchExons(ref, subject)
```

Arguments

ref GRanges object

subject GRanges object

Value

logical. check if exons match (TRUE) or not (FALSE)

Author(s)

Diana Low

metaremove

metaremove

Description

helper function to remove metadata from GRanges object

Usage

```
metaremove(x)
```

Arguments

x GRanges or GRangesList

Value

GRanges or GRangesList

`pcr_result1`*pcr_result1*

Description`pcr_result1`**Examples**`data(pcr_result1)`

`plot_seqlogo`*plotting sequence logo*

Description

Plots the sequence logo of a given set of FASTA sequences

Usage`plot_seqlogo(fasta_seq)`**Arguments**`fasta_seq` DNASTringSet or path to fasta-formatted file**Value**

sequence logo image

Author(s)

Diana Low

Examples

```
head(splice_fasta)
plot_seqlogo(Biostrings::DNASTringSet(splice_fasta$V2))
```

 primers

primers

Description

primers designed using Primer3 for sample data

Usage

```
data("primers")
```

Format

A data frame with 5 observations on the following 28 variables.

i a numeric vector
 PRIMER_LEFT_SEQUENCE a character vector
 PRIMER_RIGHT_SEQUENCE a character vector
 PRIMER_LEFT_TM a numeric vector
 PRIMER_RIGHT_TM a numeric vector
 PRIMER_LEFT_pos a numeric vector
 PRIMER_LEFT_len a numeric vector
 PRIMER_RIGHT_pos a numeric vector
 PRIMER_RIGHT_len a numeric vector
 PRIMER_PAIR_PENALTY a numeric vector
 PRIMER_LEFT_PENALTY a numeric vector
 PRIMER_RIGHT_PENALTY a numeric vector
 PRIMER_LEFT_GC_PERCENT a numeric vector
 PRIMER_RIGHT_GC_PERCENT a numeric vector
 PRIMER_LEFT_SELF_ANY_TH a numeric vector
 PRIMER_RIGHT_SELF_ANY_TH a numeric vector
 PRIMER_LEFT_SELF_END_TH a numeric vector
 PRIMER_RIGHT_SELF_END_TH a numeric vector
 PRIMER_LEFT_HAIRPIN_TH a numeric vector
 PRIMER_RIGHT_HAIRPIN_TH a numeric vector
 PRIMER_LEFT_END_STABILITY a numeric vector
 PRIMER_RIGHT_END_STABILITY a numeric vector
 PRIMER_LEFT_TEMPLATE_MISPRIMING a numeric vector
 PRIMER_RIGHT_TEMPLATE_MISPRIMING a numeric vector
 PRIMER_PAIR_COMPL_ANY_TH a numeric vector
 PRIMER_PAIR_COMPL_END_TH a numeric vector
 PRIMER_PAIR_PRODUCT_SIZE a numeric vector
 PRIMER_PAIR_TEMPLATE_MISPRIMING a numeric vector

Value

Dataframe of primer design results

Examples

```
data(primers)
```

psiPlot

psiPlot

Description

Plots percentage spliced in (PSI) values in terms of inclusion levels

Usage

```
psiPlot(df = NULL, type = "MATS", sample_labels = c("Sample 1", "Sample 2"))
```

Arguments

| | |
|---------------|---|
| df | data.frame containing PSI values |
| type | character. either 'MATS' output (will read in MATS headers) or 'generic' (provide 4 or 6 column data.frame) |
| sample_labels | x-axis labels for the plot |

Value

bar plot of PSI values

Author(s)

Diana Low

Examples

```
#we give inclusion and skipped numbers as reads
#this will be converted into percentages
df<-data.frame(inclusion1=c("6,4,6"),skipped1=c("10,12,12"),inclusion2=c("15,15,15"),
               skipped2=c("3,3,4"),stringsAsFactors = FALSE)
psiPlot(df,type='generic')
```

| | |
|-------------------|--------------------------|
| region_minus_exon | <i>region_minus_exon</i> |
|-------------------|--------------------------|

Description

region_minus_exon

Examples

```
data(region_minus_exon)
## maybe str(region_minus_exon) ; plot(region_minus_exon) ...
```

| | |
|--------------|---------------------|
| removeRegion | <i>removeRegion</i> |
|--------------|---------------------|

Description

removes a region (exon) from a GRanges or GRangesList

Usage

```
removeRegion(subject, roi)
```

Arguments

| | |
|---------|---|
| subject | GRanges or GrangesList object |
| roi | makeROI object containing GRanges range (to remove) |

Value

GRanges object

Author(s)

Diana Low

```
# Removes the exon defined in roi GRanges object from a GRanges/GRangesList compatible_cds$hits[[1]]
region_minus_exon<-removeRegion(compatible_cds$hits[[1]],roi)
```

| | |
|----------|-----------------|
| remvalue | <i>remvalue</i> |
|----------|-----------------|

Description

helper function to remove metadata from GRanges object used within metaremove

Usage

```
remvalue(x)
```

Arguments

x GRanges or GRangesList

Value

GRanges or GRangesList

| | |
|-----|------------|
| roi | <i>roi</i> |
|-----|------------|

Description

roi

Usage

```
data("roi")
```

Value

List containing region of interest information

Examples

```
data(roi)
```

| | |
|-----------------|------------------------|
| shapiroAcceptor | <i>shapiroAcceptor</i> |
|-----------------|------------------------|

Description

Shapiro's score of acceptor site (range is from -13 [intron] to +1 [exon]) is: $100 * ((t1 - l1)/(h1 - l1) + (t2 - l2)/(h2 - l2))/2$, where t1 is the sum of the best 8 of 10 percentages at positions -13 to -4, l1 is the sum of the lowest 8 of 10 percentages at position -13 to -4, h1 is the sum of the highest 8 of 10 percentages at positions -13 to -4, t2 is the sum of percentages at positions -3 to +1, l2 is the sum of the lowest percentages at positions -3 to +1, and h2 is the sum of the highest percentages at positions -3 to +1

Usage

```
shapiroAcceptor(reference_fasta, target_fasta)
```

Arguments

reference_fasta vector of strings or DNAStringSet of reference splice list

target_fasta vector of strings or DNAStringSet of fasta to score

Value

data.frame with Shapiro scores

Author(s)

Diana Low

See Also

<http://www.softberry.com/spldb/SpliceDB.html>

Examples

```
library(BSgenome.Mmusculus.UCSC.mm9)
bsgenome <- BSgenome.Mmusculus.UCSC.mm9
data_path<-system.file("extdata",package="SPLINTER")
splice_data<-extractSpliceEvents(data=paste(data_path,"/skipped_exons.txt",sep=""))
splice_sites<-extractSpliceSites(splice_data,site="acceptor")
acceptor.ss<-getSeq(bsgenome,splice_sites)
##sacceptor<-shapiroAcceptor(acceptor.m,acceptor.ss)
```

| | |
|----------------|-----------------------|
| shapiroDensity | <i>shapiroDensity</i> |
|----------------|-----------------------|

Description

convenience function for plotting Shapiro score density

Usage

```
shapiroDensity(ctrl_scores, treat_scores, sample = c(1, 2))
```

Arguments

| | |
|--------------|---|
| ctrl_scores | output of shapiroDonor or shapiroAcceptor |
| treat_scores | output of shapiroDonor or shapiroAcceptor |
| sample | samplenames |

Value

density plot of Shapiro scores

Author(s)

Diana Low

| | |
|--------------|---------------------|
| shapiroDonor | <i>shapiroDonor</i> |
|--------------|---------------------|

Description

Shapiro and Senapathy (1987) have developed a method to score the strength of a splice site based on percentages of each nucleotide at each position. Shapiro's score of donor site (range is from -3 [exon] to +7 [intron]) is : $100 * (t - \min) / (\max - \min)$, where t is the sum of percentages at positions -3 to +7, min is the sum of the lowest percentages at positions -3 to +7, and max is the sum of the highest percentages at positions -3 to +7.

Usage

```
shapiroDonor(reference_fasta, target_fasta)
```

Arguments

| | |
|-----------------|--|
| reference_fasta | vector of strings or DNASTringSet of reference splice list |
| target_fasta | vector of strings or DNASTringSet of fasta to score |

Value

data.frame with Shapiro scores

Author(s)

Diana Low

Diana Low

See Also

<http://www.softberry.com/spldb/SpliceDB.html>

Examples

```
library(BSgenome.Mmusculus.UCSC.mm9)
bsgenome <- BSgenome.Mmusculus.UCSC.mm9
data_path<-system.file("extdata",package="SPLINTER")
splice_data<-extractSpliceEvents(data=paste(data_path,"/skipped_exons.txt",sep=""))
splice_sites<-extractSpliceSites(splice_data)
donor.ss<-getSeq(bsgenome,splice_sites)
##sdonor<-shapiroDonor(donor.m,donor.ss)
```

splice_data

splice_data

Description

splice_data

Usage

```
data("splice_data")
```

Value

List containing splice event file information

Examples

```
data(splice_data)
```

| | |
|--------------|---------------------|
| splice_fasta | <i>splice_fasta</i> |
|--------------|---------------------|

Description

splice_fasta

Usage

```
data("splice_fasta")
```

Format

A data frame with 0 observations on the following 2 variables.

V1 a numeric vector

V2 a numeric vector

Value

Dataframe of region and fasta sequence

Examples

```
data(splice_fasta)
```

| | |
|-------------|--------------------|
| splitPCRhit | <i>splitPCRhit</i> |
|-------------|--------------------|

Description

splits the PCR alignment into the two AS conditions

Usage

```
splitPCRhit(res, hitlist)
```

Arguments

res result from [getPCRsizes](#)

hitlist [findCompatibleEvents](#) object

Value

list of 2 data.frame objects with isoform name (ID) and length of PCR product (bp) matching Type 1 or Type 2 transcripts

Author(s)

Diana Low

Examples

```
## as getPCRsizes gives you all PCR bands when the primers are used,  
## splitPCRhit will determine which bands are relevant to the target  
relevant_pcr_bands<-splitPCRhit(pcr_result1,compatible_tx)
```

| | |
|---------|----------------|
| the cds | <i>the cds</i> |
|---------|----------------|

Description

the cds

Usage

```
data("the cds")
```

Value

List containing GRanges info

Examples

```
data(the cds)
```

| | |
|-----------|------------------|
| the exons | <i>the exons</i> |
|-----------|------------------|

Description

the exons

Usage

```
data("the cds")
```

Value

List containing GRanges info

Examples

```
data(the exons)
```

| | |
|-----------|------------------|
| valid_cds | <i>valid_cds</i> |
|-----------|------------------|

Description

valid_cds

Usage

```
data("valid_cds")
```

Value

GRangesList

Examples

```
data(valid_cds)
```

| | |
|----------|-----------------|
| valid_tx | <i>valid_tx</i> |
|----------|-----------------|

Description

valid_tx

Value

GRangesList

Examples

```
data(valid_tx)
## maybe str(valid_tx) ; plot(valid_tx) ...
```

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