Package 'FastqCleaner'

April 15, 2019

Type Package

Title A Shiny Application for Quality Control, Filtering and Trimming
of FASTQ Files

Version 1.0.0

Date 2018-05-19

Maintainer Leandro Roser <learoser@gmail.com>

Description An interactive web application for quality control, filtering and trim-
ming of FASTQ files. This user-friendly tool combines a pipeline for data process-
ing based on Biostrings and ShortRead infrastructure, with a cutting-edge visual environment.
Single-Read and Paired-
End files can be locally processed. Diagnostic interactive plots (CG content, per-
base sequence quality, etc.) are provided for both the input and output files.

License GPL (>= 2)

LazyData TRUE

Imports methods, shiny, stats, IRanges, Biostrings, ShortRead, DT,
methods, S4Vectors, graphics, htmltools, shinyBS, Rcpp (>=
0.12.12)

Suggests BiocStyle, testthat, knitr, rmarkdown

LinkingTo Rcpp

Collate 'roxygen.auxiliar.R' 'auxiliar.R' 'matching.R'
'server_functions.R' 'n_filter.R' 'seq_filter.R'
'complex_filter.R' 'adapter_filter.R' 'launch_fqc.R'
'length_filter.R' 'fixed_filter.R' 'trim3q_filter.R'
'unique_filter.R' 'plotObjects.R' 'qmean_filter.R' 'simulate.R'
'RcppExports.R'

biocViews QualityControl,Sequencing,Software,SangerSeq,SequenceMatching

VignetteBuilder knitr

Author Leandro Roser [aut, cre],
Fernán Agüero [aut],
Daniel Sánchez [aut]

Encoding UTF-8

RoxygenNote 6.0.1

git_url https://git.bioconductor.org/packages/FastqCleaner

git_branch RELEASE_3_8

R topics documented:

---

    adapter_filter   *Remove full and partial adapters from a ShortReadQ object*

Description

This program can remove adapters and partial adapters from 3' and 5', using the functions isMatchingEndingAt and isMatchingStartingAt of **Biostrings**. The program extends the methodology of the trimLRPatterns function of **Biostrings**, being also capable of removing adapters present within reads. For a given position in the read, the two Biostrings functions return TRUE when a match is present between a substring of the read and the adapter. As trimLRPatterns, adapter_filter also selects region and goes up to the end of the sequence in the corresponding flank as the best match. If several valid matches are found, the function removes the largest subsequence. Adapters can be anchored or not. Two methods are available: one based on the exact matching of the adapter and the reads, and other in an error rate. When indels are allowed, the second method uses the 'edit distance' between the subsequences and the adapter

Usage

```
adapter_filter(input, Lpattern = "", Rpattern = "", method = c("exact",
"er"), rc.L = FALSE, rc.R = FALSE, first = c("R", "L"),
with_indels = FALSE, error_rate = 0.2, anchored = TRUE,
fixed = "subject", remove_zero = TRUE, checks = TRUE,
min_match_flank = 1L, ...)
```

Arguments

input	[ShortReadQ] object
Lpattern	5' pattern (character or [DNAString] object)
Rpattern	3' pattern (character or [DNAString] object)
method	Method used for trimming. If 'exact' the method is based on the exact match between the possible subsequences of the subject and adapter(s). If 'er' the metod is based on the error-rate between the subsequences, allowing mismatches in any place
rc.L	Reverse complement Lpattern? default FALSE
rc.R	Reverse complement Rpatter? default FALSE
first	trim first right('R') or left ('L') side of sequences when both Lpattern and Rpattern are passed
with_indels	Allow indels? This feature is available only when the error_rate is not null
error_rate	Error rate (value in the range [0, 1] used for the 'er' method. The error rate is the proportion of mismatches allowed between the adapter and the aligned portion of the subject. For a given adapter A, the number of allowed mismatches between each subsequence s of A and the subject is computed as: error_rate * L_s, where L_s is the length of the subsequence s
anchored	Adapter or partial adapter within sequence (anchored = FALSE, default) or only in 3' and 5' terminals? (anchored = TRUE)
fixed	Parameter passed to [isMatchingStartingAt] or [isMatchingEndingAt]. Default 'subject', where only ambiguities in the pattern are interpreted as wildcard
remove_zero	Remove zero-length sequences? Default TRUE
checks	Perform checks? Default TRUE
min_match_flank	
	When a match is found between a subsequence of the subject and the adapter in the corresponding flank, which would be the minimum length of the overlapping region (threshold) used for trimming? Default is 1L (trim when >= 2 base(s) match).
...	additional parameters passed to [isMatchingStartingAt] or [isMatchingEndingAt].

Value

Filtered [ShortReadQ] object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require('Biostrings')
require('ShortRead')

# create 6 sequences of width 43
set.seed(10)
input <- random_seq(6, 43)
```

```
# add adapter in 3' reverse complemented. In read 1,
# it will appear the 5' adapter of read 2 reverse complemented.
adapter <- 'ATCGACT'

input <- paste0(input, as.character(reverseComplement(DNAString(adapter))))
input <- DNAStringSet(input)

# create qualities of width 50
set.seed(10)
input_q <- random_qual(c(30,40), slength = 6, swidth = 50,
encod = 'Sanger')

# create names
input_names <- seq_names(length(input))

# create ShortReadQ object
my_read <- ShortReadQ(sread = input, quality = input_q, id = input_names)

# trim adapter
filtered <- adapter_filter(my_read, Rpattern = adapter, rc.R = TRUE)

# look at the filtered sequences
sread(filtered)

# adapter in the second strand of paired-end reads is reverse-complemented,
# with adapter in the end of sequence
adapterR <- as.character(reverseComplement(DNAString('ATCGACT')))
adapterR <- DNAString(adapterR)
inputR <- reverseComplement(input)


# create qualities of width 50
set.seed(10)
inputqR <- random_qual(c(30,40), slength = 6, swidth = 50,
encod = 'Sanger')

my_readR <- ShortReadQ(sread = inputR, quality = inputqR, id = input_names)

# trim adapter
filteredR <- adapter_filter(my_readR, Rpattern = adapterR)

# look at the filtered sequences
sread(filteredR)
```

---

check_encoding   *Check quality encoding*

Description

Check quality encoding

Usage

```
check_encoding(x = NULL, custom = NULL)
```

Arguments

x	Quality values
custom	custom encoding from the following: 'Sanger' ——————> expected range: [0, 40] 'Illumina1.8' ——————> expected range: [0, 41] 'Illumina1.5' ——————> expected range: [0, 40] 'Illumina1.3' ——————> expected range: [3, 40] 'Solexa' ——————> expected range: [-5, 40]

Value

List with encoding information

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require(Biostrings)

x <- list(PhredQuality(0:40), SolexaQuality(-5:40), IlluminaQuality(3:40))
x <- lapply(x, function(i)utf8ToInt(as.character(i)[1]))
lapply(x, check_encoding)

SolexaQuality(0:40)
IlluminaQuality(0:40)
```

---

complex_filter	*Remove sequences with low complexity*

Description

The program removes low complexity sequences, computing the entropy with the observed frequency of dinucleotides.

Usage

```
complex_filter(input, threshold = 0.5, referenceEntropy = 3.908135)
```

Arguments

input	[ShortReadQ](#) object
threshold	A threshold value computed as the relation of the H of the sequences and the reference H. Default is 0.5
referenceEntropy	
	Reference entropy. By default, the program uses a value of 3.908, that corresponds to the entropy of the human genome in bits

Value

Filtered ShortReadQ object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require('Biostrings')
require('ShortRead')

# create  sequences of different width
set.seed(10)
input <- lapply(c(0, 6, 10, 16, 20, 26, 30, 36, 40),
function(x) random_seq(1, x))


# create repetitive 'CG' sequences with length adequante
# for a total length:
# input +  CG = 40

set.seed(10)
CG <- lapply(c(20, 17, 15, 12, 10, 7, 5, 2, 0),
function(x) paste(rep('CG', x), collapse = ''))


# concatenate input and CG
input  <- mapply('paste', input, CG, sep = '')
input <- DNAStringSet(input)

# plot relative entropy (E, Shannon 1948)

freq <- dinucleotideFrequency(input)
freq  <- freq /rowSums(freq)
H <- -rowSums(freq  * log2(freq), na.rm = TRUE)
H_max <- 3.908135  # max entropy
plot(H/H_max, type='b', xlab = 'Sequence', ylab= 'E')


# create qualities of width 40

set.seed(10)
input_q <- random_qual(c(30,40), slength = 9, swidth = 40,
encod = 'Sanger')

# create names
input_names <- seq_names(9)

# create ShortReadQ object
my_read <- ShortReadQ(sread = input, quality = input_q, id = input_names)

# apply the filter
filtered <- complex_filter(my_read)
```

```
# look at the filtered sequences
sread(filtered)
```

---

fixed_filter *Remove a fixed number of bases of a ShortReadQ object from 3' or 5'*

Description

The program removes a given number of bases from the 3' or 5' regions of the sequences contained in a ShortReadQ object

Usage

```
fixed_filter(input, trim3 = NA, trim5 = NA)
```

Arguments

input	ShortReadQ object
trim3	Number of bases to remove from 3'
trim5	Number of bases to remove from 5'

Value

Filtered ShortReadQ object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require('Biostrings')
require('ShortRead')

# create 6 sequences of width 20

set.seed(10)
input <- random_seq(6, 20)

# create qualities of width 20

set.seed(10)
input_q <- random_qual(c(30,40), slength = 6, swidth = 20,
encod = 'Sanger')


# create names
input_names <- seq_names(6)

# create ShortReadQ object
my_read <- ShortReadQ(sread = input, quality = input_q, id = input_names)
```

```
# apply the filter
filtered3 <- fixed_filter(my_read, trim5 = 5)

filtered5 <- fixed_filter(my_read, trim3 = 5)

filtered3and5 <- fixed_filter(my_read, trim3 = 10, trim5 = 5)

# look at the trimmed sequences
sread(filtered3)
sread(filtered5)
sread(filtered3and5)
```

---

inject_letter_random   *Inject a letter in a set of sequences at random positions*

Description

Inject a letter in a set of sequences at random positions

Usage

```
inject_letter_random(my_seq, how_many_seqs = NULL, how_many_letters = NULL,
letter = "N")
```

Arguments

my_seq	character vector with sequences to inject
how_many_seqs	How many sequences pick to inject Ns. An interval [min_s, max_s] with min_s minimum and max_s maximum sequences can be passed. In this case, a value is picked from the interval. If NULL, a random value within the interval [1, length(my_seq)] is picked.
how_many_letters	
	How many times inject the letter in the i sequences that are going to be injected. An interval [min_i max_i] can be passed. In this case, a value is randomly picked for each sequence i. This value represents the number of times that the letter will be injected in the sequence i. If NULL, a random value within the interval [1, width(my_seq[i])] is picked for each sequence i.
letter	Letter to inject. Default: 'N'

Value

character vector

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
# For reproducible examples, make a call to set.seed before
# running each random function

set.seed(10)
s <- random_seq(slength = 10, swidth = 20)

set.seed(10)
s <- inject_letter_random(s, how_many_seqs = 1:30, how_many= 2:10)
```

---

launch_fqc   *Launch FastqCleaner application*

Description

Launch FastqCleaner application

Usage

```
launch_fqc(launch.browser = TRUE, ...)
```

Arguments

launch.browser   Launch in browser? Default TRUE

...   Additional parameters passed to [runApp](#)

Value

Launch the application, without return value

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
# Uncomment and paste in te console to launch the application:
# launch_fqc()

NULL
```

---

length_filter   *Filter sequences of a FASTQ file by length*

Description

The program removes from a ShortReadQ object those sequences with a length lower than rm.min or/and higher than rm.max

Usage

```
length_filter(input, rm.min = NA, rm.max = NA)
```

Arguments

input	[ShortReadQ](#) object
rm.min	Threshold value for the minimun number of bases
rm.max	Threshold value for the maximum number of bases

Value

Filtered [ShortReadQ](#) object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require('Biostrings')
require('ShortRead')

# create  ShortReadQ object width widths between 1 and 100

set.seed(10)
input <- random_length(100, widths = 1:100)

# apply the filter, removing sequences with  10> length > 80
filtered <- length_filter(input, rm.min = 10, rm.max = 80)

# look at the filtered sequences
sread(filtered)
```

---

n_filter   *Remove sequences with non-identified bases (Ns) from a ShortReadQ*
                                  object

Description

This program is a wrapper to nFilter. It removes the sequences with a number of N's above a
threshold value 'rm.N'. All the sequences with a number of N > rm.N (N >= rm.N) will be removed

Usage

```
n_filter(input, rm.N)
```

Arguments

input   ShortReadQ object

rm.N   Threshold value of N's to remove a sequence from the output (sequences with
                 number of Ns > threshold are removed) For example, if rm.N is 3, all the se-
                 quences with a number of Ns > 3 (Ns >= 4) will be removed

Value

Filtered ShortReadQ object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require('Biostrings')
require('ShortRead')

# create 6 sequences of width 20
set.seed(10)
input <- random_seq(50, 20)

# inject N's
set.seed(10)
input <- inject_letter_random(input, how_many_seqs = 1:30,
how_many = 1:10)

input <- DNAStringSet(input)


# watch the N's frequency
hist(letterFrequency(input, 'N'), breaks = 0:10,
main  = 'Ns Frequency', xlab = '# Ns')

# create qualities of width 20
set.seed(10)
input_q <- random_qual(50, 20)
```

```
# create names
input_names <- seq_names(50)

# create ShortReadQ object
my_read <- ShortReadQ(sread = input, quality = input_q, id = input_names)

# apply the filter
filtered <- n_filter(my_read, rm.N = 3)

# watch the filtered sequences
sread(filtered)

# watch the N's frequency
hist(letterFrequency(sread(filtered), 'N'),
main = 'Ns distribution', xlab = '')
```

---

qmean_filter   *Filter sequences by their average quality*

Description

The program removes the sequences with a quality lower the 'minq' threshold

Usage

```
qmean_filter(input, minq, q_format = NULL, check.encod = TRUE)
```

Arguments

input	[ShortReadQ](#) object
minq	Quality threshold
q_format	Quality format used for the file, as returned by check.encoding
check.encod	Check the encoding of the sequence? This argument is incompatible with q_format

Value

Filtered [ShortReadQ](#) object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require(ShortRead)

set.seed(10)
# create 30 sequences of width 20
input <- random_seq(30, 20)
```

```
# create qualities of width 20
## high quality (15 sequences)
set.seed(10)
my_qual <- random_qual(c(30,40), slength = 15, swidth = 20,
encod = 'Sanger')
## low quality (15 sequences)
set.seed(10)
my_qual_2 <-  random_qual(c(5,30), slength = 15, swidth = 20,
encod = 'Sanger')

# concatenate vectors
input_q<- c(my_qual, my_qual_2)

# create names
input_names <- seq_names(30)

# create ShortReadQ object
my_read <- ShortReadQ(sread = input, quality = input_q, id = input_names)

# watch the average qualities
alphabetScore(my_read) / width(my_read)

# apply the filter
filtered <- qmean_filter(my_read, minq = 30)

# watch the average qualities
alphabetScore(my_read) / width(my_read)


# watch the filtered sequences
sread(filtered)
```

---

random_length | *Create a named object with random sequences and qualities*

Description

Create a [ShortReadQ](#) object with random sequences and qualities

Usage

```
random_length(n, widths, random_widths = TRUE, replace = TRUE,
len_prob = NULL, seq_prob = c(0.25, 0.25, 0.25, 0.25), q_prob = NULL,
nuc = c("DNA", "RNA"), qual = NULL, encod = c("Sanger", "Illumina1.8",
"Illumina1.5", "Illumina1.3", "Solexa"), base_name = "s", sep = "_")
```

Arguments

n	number of sequences
widths	width of the sequences
random_widths	width must be picked at random from the passed parameter 'widths', considering the value as an interval where any integer can be picked. Default TRUE. Otherwise, widths are picked only from the vector passed.

replace	sample widths with replacement? Default TRUE.
len_prob	vector with probabilities for each width value. Default NULL (equiprobability)
seq_prob	a vector of four probabilities values to set the frequency of the nucleotides 'A', 'C', 'G', 'T', for DNA, or 'A', 'C', 'G', 'U', for RNA. For example = c(0.25, 0.25, 0.5, 0). Default is = c(0.25, 0.25, 0.25, 0.25) (equiprobability for the 4 bases). If the sum of the probabilities is > 1, the values will be nomalized to the range [0, 1].
q_prob	a vector of range = range(qual), with probabilities to set the frequency of each quality value. Default is equiprobability. If the sum of the probabilities is > 1, the values will be nomalized to the range [0, 1].
nuc	create sequences of DNA (nucleotides = c('A', 'C', 'G', 'T')) or RNA (nucleotides = c('A', 'C', 'G', 'U'))?. Default: 'DNA'
qual	quality range for the sequences. It must be a range included in the selected encoding: 'Sanger' = [0, 40] 'Illumina1.8' = [0, 41] 'Illumina1.5' = [0, 40] 'Illumina1.3' = [3, 40] 'Solexa' = [-5, 40] example: for a range from 20 to 30 in Sanger encoding, pass the argument = c(20, 30)
encod	sequence encoding
base_name	Base name for strings
sep	Character separing base names and the read number. Default: '_'

Value

[ShortReadQ](#) object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
# For reproducible examples, make a call to set.seed before
# running each random function

set.seed(10)
s1 <- random_seq(slength = 10, swidth = 20)
s1

set.seed(10)
s2 <- random_seq(slength = 10, swidth = 20,
prob = c(0.6, 0.1, 0.3, 0))
s2
```

---

random_qual   *Create random qualities for a given encoding*

Description

Create a [BStringSet](#) object with random qualities

Usage

```
random_qual(slength, swidth, qual = NULL, encod = c("Sanger", "Illumina1.8",
"Illumina1.5", "Illumina1.3", "Solexa"), prob = NULL)
```

Arguments

slength	number of sequences
swidth	width of the sequences
qual	quality range for the sequences. It must be a range included in the selected encoding: 'Sanger' = [0, 40] 'Illumina1.8' = [0, 41] 'Illumina1.5' = [0, 40] 'Illumina1.3' = [3, 40] 'Solexa' = [-5, 40] example: for a range from 20 to 30 in Sanger encoding, pass the argument = c(20, 30)
encod	sequence encoding
prob	a vector of range = range(qual), with probabilities to set the frequency of each quality value. Default is equiprobability. If the sum of the probabilities is > 1, the values will be nomalized to the range [0, 1].

Value

[BStringSet](#) object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
q <- random_qual(30, 20)
q
```

random_seq   *Create random sequences*

Description

Create a [DNAStringSet](#) object with random sequences

Usage

```
random_seq(slength, swidth, nuc = c("DNA", "RNA"), prob = c(0.25, 0.25,
0.25, 0.25))
```

Arguments

slength   Number of sequences

swidth   Width of the sequences

nuc   Create sequences of DNA (nucleotides = c('A', 'C', 'G', 'T')) or RNA (nu-
               cleotides = c('A, 'C', 'G', 'U'))?. Default: 'DNA'

prob   A vector of four probability values used to set the frequency of the nucleotides
               'A', 'C', 'G', 'T', for DNA, or 'A', 'C', 'G', 'U', for RNA. For example =
               c(0.25, 0.25, 0.5, 0). Default is = c(0.25, 0.25, 0.25, 0.25) (equiprobability for
               the 4 bases). If the sum of the probabilities is > 1, the values will be nomalized
               to the range [0, 1].

Value

[DNAStringSet](#) object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
# For reproducible examples, make a call to set.seed before
# running each random function

set.seed(10)
s1 <- random_seq(slength = 10, swidth = 20)
s1

set.seed(10)
s2 <- random_seq(slength = 10, swidth = 20,
prob = c(0.6, 0.1, 0.3, 0))
s2
```

seq_filter   *Remove a set of sequences*

Description

Removes a set of sequences

Usage

```
seq_filter(input, rm.seq)
```

Arguments

input	[ShortReadQ](#) object
rm.seq	Ccharacter vector with sequences to remove

Value

Filtered [ShortReadQ](#) object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require(ShortRead)

set.seed(10)
input <- random_length(30, 3:7)
rm.seq  = c('TGGTC', 'CGGT', 'GTTCT', 'ATA')

# verify that some sequences match
match_before <- unlist(lapply(rm.seq,
function(x) grep(x, as.character(sread(input)))))

filtered <- seq_filter(input,rm.seq =  rm.seq)

# verify that matching sequences were removed
match_after <- unlist(lapply(rm.seq,
function(x) grep(x, as.character(sread(filtered)))))
```

seq_names	*Create sequences names*

Description

Create [BStringSet](#) object with names

Usage

```
seq_names(n, base_name = "s", sep = "_")
```

Arguments

n	Number of reads
base_name	Base name for strings
sep	Character separing base names and the read number. Default: '_

Value

[BStringSet](#) object

Examples

```
snames <- seq_names(10)
snames
snames2 <- seq_names(10, base_name = 's', sep = '.')
snames2
```

trim3q_filter	*Filter sequences with low quality in 3' tails*

Description

The program removes from the 3' tails of the sequences a set of nucleotides showing a quality < a threshold value in a ShortReadQ object

Usage

```
trim3q_filter(input, rm.3qual, q_format = NULL, check.encod = TRUE,
remove_zero = TRUE)
```

Arguments

input	[ShortReadQ](#) object
rm.3qual	Quality threshold for 3' tails
q_format	Quality format used for the file, as returned by check_encoding
check.encod	Check the encoding of the sequence? This argument is incompatible with q_format. Default TRUE
remove_zero	Remove zero-length sequences?

Value

Filtered [ShortReadQ] object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require('Biostrings')
require('ShortRead')

# create 6 sequences of width 20
set.seed(10)
input <- random_seq(6, 20)

# create qualities of width 15 and paste to qualities
# of length 5 used for the tails.
# for two of the sequences, put low qualities in tails

set.seed(10)
my_qual <- random_qual(c(30,40), slength = 6, swidth = 15,
encod = 'Sanger')

set.seed(10)
tails <-   random_qual(c(30,40), slength = 6, swidth = 5,
encod = 'Sanger')

set.seed(10)
tails[2:3] <- random_qual(c(3, 20), slength = 2,
swidth = 5,  encod = 'Sanger')
my_qual <- paste0(my_qual, tails)
input_q <- BStringSet(my_qual)
# create names
input_names <- seq_names(6)

# create ShortReadQ object
my_read <- ShortReadQ(sread = input,
quality = input_q, id = input_names)

# apply the filter
filtered <- trim3q_filter(my_read, rm.3qual = 28)

# look at the trimmed sequences
sread(filtered)
```

---

unique_filter   *Remove duplicated sequences in a FASTQ file*

Description

This program is a wrapper to [occurrenceFilter]. It removes the duplicated sequences of a FASTQ file.

Usage

```
unique_filter(input)
```

Arguments

input   ShortReadQ object

Value

Filtered ShortReadQ object

Author(s)

Leandro Roser <learoser@gmail.com>

Examples

```
require('Biostrings')
require('ShortRead')

set.seed(10)
s <- random_seq(10, 10)
s <- sample(s, 30, replace = TRUE)
q <- random_qual(30, 10)
n <- seq_names(30)

my_read <- ShortReadQ(sread = s, quality = q, id = n)

# check presence of duplicates
isUnique(as.character(sread(my_read)))

# apply the filter
filtered <- unique_filter(my_read)

isUnique(as.character(sread(filtered)))
```

Index