Package 'megadepth'

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Title megadepth: BigWig and BAM related utilities

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Description This package provides an R interface to Megadepth by Christopher Wilks available at https://github.com/ChristopherWilks/megadepth. It is particularly useful for computing the coverage of a set of genomic regions across bigWig or BAM files. With this package, you can build base-pair coverage matrices for regions or annotations of your choice from BigWig files. Megadepth was used to create the raw files provided by https://bioconductor.org/packages/recount3.

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URL https://github.com/LieberInstitute/megadepth

BugReports https://support.bioconductor.org/t/megadepth

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`bam_to_bigwig` *Convert a BAM file to a BigWig*

Description

Given an input BAM file, convert this to the BigWig format which can then be used in `get_coverage()`.

Usage

```
bam_to_bigwig(
  bam_file,
  prefix = file.path(tempdir(), basename(bam_file)),
  min_unique_qual = FALSE,
  double_count = FALSE,
  overwrite = FALSE
)
```

Arguments

`bam_file`	A `character(1)` with the path to the input BAM file.
`prefix`	A `character(1)` specifying the output file prefix. This function creates a BigWig file called `{prefix}.all.bw`. By default, the prefix is the BAM file name and the file is created in the `tempdir()` and will be deleted after you close your R session.

`min_unique_qual`
: A `integer(1)` specifying a mapping quality threshold and only bases above this will be used to generate the BigWig. If set to `FALSE` this argument is not used by Megadepth. Otherwise it will generate files `{prefix}.unique.bw` and `{prefix}.unique.tsv`.

`double_count`
: A `logical(1)` determining whether to count the overlapping ends of paired ends reads twice.

`overwrite`
: A `logical(1)` specifying whether to overwrite the output file(s), if they exist already.

Details

Note that this functionality is currently not supported on Windows by Megadepth.

Value

A `character()` with the path to the output files(s).

Examples

```
## Install the latest version if necessary
install_megadepth(force = TRUE)

## Find the example BAM file
example_bam <- system.file("tests", "test.bam",
    package = "megadepth", mustWork = TRUE
)

## Create the BigWig file
## Currently Megadepth does not support this on Windows
if (!xfun::is_windows()) {
    example_bw <- bam_to_bigwig(example_bam, overwrite = TRUE)

    ## Path to the output file(s) generated by bam_to_bigwig()
    example_bw

    ## Use the all.bw file in get_coverage(), first find an annotation file
    annotation_file <- system.file("tests", "testbw2.bed",
        package = "megadepth", mustWork = TRUE
    )

    ## Compute the coverage
    bw_cov <- get_coverage(
        example_bw["all.bw"],
        op = "mean",
        annotation = annotation_file
    )
    bw_cov
}
```

bam_to_junctions *Extract junctions from a BAM file*

Description

Given a BAM file, extract junction information including co-ordinates, strand, anchor length for each junction read. For details on the format of the output TSV file, check https://github.com/ChristopherWilks/megadepth#junctions.

Usage

```
bam_to_junctions(
  bam_file,
  prefix = file.path(tempdir(), basename(bam_file)),
  all_junctions = TRUE,
  junctions = FALSE,
  long_reads = FALSE,
  filter_in = 65535,
  filter_out = 260,
  overwrite = FALSE
)
```

Arguments

bam_file	A character(1) with the path to the input BAM file.
prefix	A character(1) specifying the output file prefix. This function creates a file called prefix.jxs.tsv. By default, the prefix is the BAM file name and the file is created in the tempdir() and will be deleted after you close your R session.
all_junctions	A logical(1) indicating whether to obtain all junctions.
junctions	A logical(1) indicating whether to obtain co-occurring jx coordinates.
long_reads	A logical(1) indicating whether to increase the buffer size to accommodate for long-read RNA-sequencing.
filter_in	A integer(1) used to filter in read alignments. See https://github.com/ChristopherWilks/megadepth#bam processing and https://samtools.github.io/hts-specs/SAMv1.pdf for further documentation on how to apply this parameter.
filter_out	A integer(1) used to filter out read alignments. See https://github.com/ChristopherWilks/megadepth#ba processing and https://samtools.github.io/hts-specs/SAMv1.pdf for further documentation on how to apply this parameter.
overwrite	A logical(1) specifying whether to overwrite the output file(s), if they exist already.

Value

A character(1) with the path to the output junction tsv file.

Examples

```
## Install if necessary
install_megadepth()

## Find the example BAM file
example_bam <- system.file("tests", "test.bam",
    package = "megadepth", mustWork = TRUE
)

## Run bam_to_junctions()
example_jxs <- bam_to_junctions(example_bam, overwrite = TRUE)

## Path to the output file generated by bam_to_junctions()
example_jxs
```

`get_coverage` *Compute coverage summarizations across a set of regions*

Description

Given an input set of annotation regions, compute coverage summarizations using Megadepth for a given BigWig file.

Usage

```
get_coverage(
  bigwig_file,
  op = c("sum", "mean", "max", "min"),
  annotation,
  prefix = file.path(tempdir(), "bw.mean")
)
```

Arguments

`bigwig_file`	A `character(1)` with the path to the input BigWig file.
`op`	A `character(1)` specifying the summarization operation to perform.
`annotation`	A `character(1)` path to a BED file with the genomic coordinates you are interested in.
`prefix`	A `character(1)` specifying the output file prefix. This function creates a file called `prefix.annotation.tsv` that can be read again later with `read_coverage()`. By default the file is created in the `tempdir()` and will be deleted after you close your R session.

Details

Note that the chromosome names (seqnames) in the BigWig file and the annotation file should use the same format. Otherwise, Megadepth will return 0 counts.

Value

A GRanges-class object with the coverage summarization across the annotation ranges.

See Also

Other Coverage functions: `read_coverage()`

Examples

```
## Install if necessary
install_megadepth()

## Next, we locate the example BigWig and annotation files
example_bw <- system.file("tests", "test.bam.all.bw",
    package = "megadepth", mustWork = TRUE
)
annotation_file <- system.file("tests", "testbw2.bed",
    package = "megadepth", mustWork = TRUE
)

## Compute the coverage
bw_cov <- get_coverage(example_bw, op = "mean", annotation = annotation_file)
bw_cov

## If you want to cast this into a RleList object use the following code:
## (it's equivalent to rtracklayer::import.bw(as = "RleList"))
## although in the megadepth case the data has been summarized
GenomicRanges::coverage(bw_cov)

## Checking with derfinder and rtracklayer
bed <- rtracklayer::import(annotation_file)

## The file needs a name
names(example_bw) <- "example"

## Read in the base-pair coverage data
if (!xfun::is_windows()) {
    regionCov <- derfinder::getRegionCoverage(
        regions = bed,
        files = example_bw,
        verbose = FALSE
    )

    ## Summarize the base-pair coverage data.
    ## Note that we have to round the mean to make them comparable.
    testthat::expect_equivalent(
        round(sapply(regionCov[c(1, 3:4, 2)], function(x) mean(x$value)), 2),
        bw_cov$score,
    )

    ## If we compute the sum, there's no need to round
    testthat::expect_equivalent(
```

```
        sapply(regionCov[c(1, 3:4, 2)], function(x) sum(x$value)),
        get_coverage(example_bw, op = "sum", annotation = annotation_file)$score,
    )
}
```

`install_megadepth` *Install Megadepth*

Description

Download the appropriate Megadepth executable for your platform from Github and try to copy it to a system directory so **megadepth** can run the `megadepth` command.

Usage

```
install_megadepth(version = "latest", force = FALSE)
```

Arguments

`version`	A `character()`‘ specifying the Megadepth version number, e.g., `1.0.4`; the special value `latest` means the latest version (fetched from Github releases).
`force`	A `logical(1)` specifying whether to install megadepth even if it has already been installed.

Details

If this function is run in an non-interactive session such as `R CMD Check`, it will install Megadepth to `tempdir()`. If this function is run interactively, the user will be prompted to agree to allow Megadepth to be installed at `Sys.getenv('APPDATA')` on Windows, ‘`~/Library/Application Support`’ on macOS, and ‘`~/bin/`’ on other platforms (such as Linux). If these directories are not writable, the package directory ‘`Megadepth`’ of **megadepth** will be used. If it still fails, you have to install Megadepth by yourself and make sure it can be found via the environment variable `PATH`.

If you want to install Megadepth to a custom path, you can set the global option `megadepth.dir` to a directory to store the Megadepth executable before you call `install_megadepth()`, e.g., `options(megadepth.hugo.dir = '~/Downloads/Megadepth_1.0.4/')`. This may be useful for you to use a specific version of Megadepth for a specific project. You can set this option per project, similar to how `blogdown.hugo.dir` is used for specifying the directory for Hugo in the **blogdown** package.. See Section 1.4 Global options for details, or store a copy of Megadepth on a USB Flash drive along with your project code.

Value

Returns `NULL`. The main use is to install Megadepth.

References

This function is based on blogdown::install_hugo() which is available from https://github.com/rstudio/blogdown/blob/master/R/install.R.

Examples

```
## Install megadepth
install_megadepth()
```

`megadepth_cmd` *Run Megadepth commands*

Description

Wrapper functions to run Megadepth commands via `system2('megadepth', ...)`.

Usage

```
megadepth_cmd(...)

megadepth_shell(input = ".", ...)
```

Arguments

`...`	Arguments to be passed to `system2('megadepth', ...)`, e.g. `annotation(path)` is basically `megadepth_cmd(c('--annotation', path))` (i.e. run the command `megadepth --annotation path`).
`input`	A `character(1)` with the path to the input BAM, BigWig or text file for Megadepth.

Value

See `base::system2()` for the types of output you can generate.

A `character()` with the capture of the standard output stream generated by Megadepth.

Functions

- `megadepth_cmd()`: Run an arbitrary Megadepth command.
- `megadepth_shell()`: Run an arbitrary Megadepth command.

References

`megadepth_cmd()` is based on blogdown::hugo_cmd() which is available at https://github.com/rstudio/blogdown/blob/master/R/hugo.R.

`megadepth_shell()` is based on the shell_ls() example from cmdfun which is available at https://snystrom.github.io/cmdfun/index.html.

Examples

```
## Install if necessary
install_megadepth()

## Find version
## megadepth_shell() provides an interface more familiar to R users
megadepth_shell(version = TRUE)
## megadepth_cmd() requires using directly the command line syntax for
## Megadepth
megadepth_cmd("--version", stdout = TRUE)

## Compare the help files:
# megadepth_shell() captures the standard output and returns a character()
# megadepth_cmd() shows the standard output on the console
megadepth_shell("--help")
megadepth_cmd("--help")
```

`process_junction_table`

Process junctions into a STAR compatible format

Description

Parses the junctions outputted from `process_junction_table()` into an STAR compatible format (SJ.out) for more convenient use in downstream analyses. The columns strand, intron_motif and annotated will always be 0 (undefined) but can be derived through extracting the dinucleotide motifs for the given reference coordinates for canonical motifs. This function is an R-implementation of the Megadepth helper script, on which further details of column definitions can be found: https://github.com/ChristopherWilks/megadepth#junctions.

Usage

```
process_junction_table(all_jxs)
```

Arguments

`all_jxs`	A `tibble::tibble()` containing junction data ("all.jxs.tsv") generated by `bam_to_junctions(all_junc = TRUE)` and imported through `megadepth::read_junction_table()`.

Value

Processed junctions in a STAR-compatible format.

Examples

```
## Install if necessary
install_megadepth()

## Find the example BAM file
example_bam <- system.file("tests", "test.bam",
    package = "megadepth", mustWork = TRUE
)

## Run bam_to_junctions()
example_jxs <- bam_to_junctions(example_bam, overwrite = TRUE)

## Read the junctions in as a tibble
all_jxs <- read_junction_table(example_jxs[["all_jxs.tsv"]])

## Process junctions into a STAR-compatible format
processed_jxs <- process_junction_table(all_jxs)

processed_jxs
```

`read_coverage` *Read a coverage TSV file created by Megadepth*

Description

Read an `*annotation.tsv` file created by `get_coverage()` or manually by the user using Megadepth.

Usage

```
read_coverage(tsv_file, verbose = TRUE)

read_coverage_table(tsv_file)
```

Arguments

`tsv_file`	A `character(1)` specifying the path to the tab-separated (TSV) file created manually using `megadepth_shell()` or on a previous `get_coverage()` run.
`verbose`	A `logical(1)` controlling whether to suppress messages when reading the data.

Value

A GRanges-class object with the coverage summarization across the annotation ranges.

A `tibble::tibble()` with columns `chr`, `start`, `end` and `score`.

Functions

- `read_coverage_table()`: Read a coverage TSV file created by Megadepth as a table

See Also

Other Coverage functions: `get_coverage()`

Examples

```
## Install if necessary
install_megadepth()

## Locate example BigWig and annotation files
example_bw <- system.file("tests", "test.bam.all.bw",
    package = "megadepth", mustWork = TRUE
)
annotation_file <- system.file("tests", "testbw2.bed",
    package = "megadepth", mustWork = TRUE
)

## Compute the coverage
bw_cov <- get_coverage(example_bw, op = "mean", annotation = annotation_file)
bw_cov

## Read in the coverage file again, using read_coverage()
## First, lets locate the tsv file that was generated by get_coverage()
tsv_file <- file.path(tempdir(), "bw.mean.annotation.tsv")
bw_cov_manual <- read_coverage(tsv_file)
stopifnot(identical(bw_cov, bw_cov_manual))

## To get an RleList object, just like the one you would get
## from using rtracklayer::import.bw(as = "RleList") directly on the
## BigWig file, use:
GenomicRanges::coverage(bw_cov_manual)

## The coverage data can also be read as a `tibble::tibble()`
read_coverage_table(tsv_file)
```

---

read_junction_table *Read a junction TSV file created by Megadepth as a table*

Description

Read an `*all_jxs.tsv` or `*jxs.tsv` file created by `bam_to_junctions()` or manually by the user using Megadepth. The rows of a `*jxs.tsv` can have either 7 or 14 columns, which can lead to warnings when reading in - these are safe to ignore. For details on the format of the input TSV file, check https://github.com/ChristopherWilks/megadepth#junctions.

Usage

```
read_junction_table(tsv_file)
```

Arguments

tsv_file	A character(1) specifying the path to the tab-separated (TSV) file created manually using megadepth_shell() or on a previous bam_to_junctions() run.

Value

A tibble::tibble() with the junction data that follows the format specified at https://github.com/ChristopherWilks/megadepth#junctions.

Examples

```
## Install if necessary
install_megadepth()

## Find the example BAM file
example_bam <- system.file("tests", "test.bam",
    package = "megadepth", mustWork = TRUE
)

## Run bam_to_junctions()
example_jxs <- bam_to_junctions(example_bam, overwrite = TRUE)

## Read the junctions in as a tibble
all_jxs <- read_junction_table(example_jxs[["all_jxs.tsv"]])

all_jxs
```

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