

Package ‘genoPlotR’

January 25, 2019

Type Package

Title Plot Publication-Grade Gene and Genome Maps

Version 0.8.9

Date 2019-01-16

Author Lionel Guy <lionel.guy@imbim.uu.se>

URL <http://genoplotr.r-forge.r-project.org/>

Depends R (>= 2.10.0), ade4, grid

Imports methods

Maintainer Lionel Guy <lionel.guy@imbim.uu.se>

Description Draws gene or genome maps and comparisons between these, in a publication-grade manner. Starting from simple, common files, it will draw postscript or PDF files that can be sent as such to journals.

License GPL (>= 2)

LazyLoad yes

NeedsCompilation no

R topics documented:

genoPlotR-package	2
annotation	4
apply_color_scheme	6
artemisColors	8
auto_annotate	9
barto	10
c.dna_seg	11
chrY_subseg	11
comparison	12
dna_seg	13
gene_types	15
human_nt	18
mauve_bbone	19
middle	19
plot_gene_map	20
range.dna_seg	27
read_functions	29

reverse	33
seg_plot	35
three_genes	38
trim	38

Index	41
--------------	-----------

genoPlotR-package *Plot Publication-Grade Gene and Genome Maps*

Description

Draws gene or genome maps and comparisons between these, in a publication-grade manner. Starting from simple, common files, it will draw postscript or PDF files that can be sent as such to journals.

Details

Package: genoPlotR
 Type: Package
 Title: Plot Publication-Grade Gene and Genome Maps
 Version: 0.8.9
 Date: 2019-01-16
 Author: Lionel Guy <lionel.guy@imbim.uu.se>
 URL: <http://genopltr.r-forge.r-project.org/>
 Depends: R (>= 2.10.0), ade4, grid
 Imports: methods
 Maintainer: Lionel Guy <lionel.guy@imbim.uu.se>
 Description: Draws gene or genome maps and comparisons between these, in a publication-grade manner. Starting from
 License: GPL (>= 2)
 LazyLoad: yes

Index of help topics:

annotation	Annotation class and class functions
apply_color_scheme	Apply a color scheme
artemisColors	Artemis Colors
auto_annotate	Auto-annotate dna_segs
barto	Comparison of 4 Bartonella genomes
c.dna_seg	Concatenate dna_seg objects
chrY_subseg	Comparisons of subsegments of the Y chromosome in human and chimp
comparison	Comparison class and class functions
dna_seg	DNA segment (dna_seg) class and class functions
gene_types	Gene types
genoPlotR-package	Plot Publication-Grade Gene and Genome Maps
human_nt	Human-readable nucleotide scale
mauve_bbone	Mauve backbone of 4 Bartonella genomes
middle	Middles of a dna_seg
plot_gene_map	Plot gene and genome maps

range.dna_seg	Range calculation
read_functions	Reading functions
reverse	Reverse objects
seg_plot	seg_plot class and class functions
three_genes	Three genes data set
trim	Trimming data frames or more complex objects with ≥ 2 numeric columns

The only plotting function is `plot_gene_map`, which produces `link[grid]{grid}` graphics. Data is composed mainly of DNA segments (`dna_seg`) objects, which represent collections of genes or segments of genomes, and of `comparison` objects, which are the pairwise comparisons between the `dna_segs`. Data can be read from files (see `read_functions`) or from R objects like `data.frames` or `lists`, with `dna_seg` and `comparison` conversion functions.

Author(s)

Lionel Guy <lionel.guy@imbim.uu.se>

Maintainer: Lionel Guy <lionel.guy@imbim.uu.se>

References

Guy, L., Roat Kultima, J, and Andersson, S.G.E. (2010). genoPlotR: comparative gene and genome visualization in R. *Bioinformatics* 26(18):2334-2335.

See Also

`plot_gene_map` for plotting. `dna_seg` and `comparison` for the base objects and conversion functions. `read_dna_seg_from_tab`, `read_dna_seg_from_ptt`, `read_comparison_from_tab` and `read_comparison_from_blast` to read from files.

Examples

```
## simple example
## dna segments
## data.frame with several genes
names1 <- c("feat1", "feat2", "feat3")
starts1 <- c(2, 1000, 1050)
ends1 <- c(600, 800, 1345)
strands1 <- c("-", -1, 1)
cols1 <- c("blue", "grey", "red")
df1 <- data.frame(name=names1, start=starts1, end=ends1,
                  strand=strands1, col=cols1)
dna_seg1 <- dna_seg(df1)
is.dna_seg(dna_seg1)

## with only one gene, or two, and merging
gene2a <- dna_seg(list(name="feat1", start=50, end=900, strand="-", col="blue"))
genes2b <- dna_seg(data.frame(name=c("feat2", "feat3"), start=c(800, 1200),
                              end=c(1100, 1322), strand=c("+", 1),
                              col=c("grey", "red")))
dna_seg2 <- c.dna_seg(gene2a, genes2b)
is.dna_seg(dna_seg2)

## reading from file
dna_seg3_file <- system.file('extdata/dna_seg3.tab', package = 'genoPlotR')
```

```

dna_seg3 <- read_dna_seg_from_tab(dna_seg3_file)
is.dna_seg(dna_seg3)

## comparison
## from a data.frame
comparison1 <- as.comparison(data.frame(start1=starts1, end1=ends1,
                                       start2=dna_seg2$start,
                                       end2=dna_seg2$end))

is.comparison(comparison1)

## from a file
comparison2_file <- system.file('extdata/comparison2.tab',
                               package = 'genoPlotR')
comparison2 <- read_comparison_from_tab(comparison2_file,
                                       color_scheme="red_blue")

is.comparison(comparison1)

## plot
plot_gene_map(dna_segs=list(dna_seg1, dna_seg2, dna_seg3),
              comparisons=list(comparison1, comparison2))

```

annotation

Annotation class and class functions

Description

An annotation describes a DNA segment. It has labels attached to positions. Each label can be attached to a single position or to a range.

Usage

```

annotation(x1, x2 = NA, text, rot = 0, col = "black")
as.annotation(df, x2 = NA, rot = 0, col = "black")
is.annotation(annotation)

```

Arguments

x1	Numeric. A vector giving the first or only position of the label. Mandatory.
x2	Numeric. A vector of the same length as x1. If a row (or the whole column is NA, then the annotation(s) will be attached to x0. Else, the annotation will be attached to the range between both positions. NA by default.
text	Character of the same length as x0. Gives the text of the labels. Mandatory.
rot	Numeric of the same length as x0. Gives the rotation, in degrees, of the labels. 0 by default.
col	Vector of the same length as x0. The color of the labels. black by default.
df	A data frame to convert to an annotation object. Should have at least columns x1 and text.
annotation	An object to test.

Details

An annotation object is a data frame with columns `x0`, `x1`, `text`, `col` and `rot`. They give, respectively, the first (or only) position, eventually the second position, the text, the color and the rotation of the annotation. When plotted with `plot_gene_map`, it will add an annotation row on top of the first `dna_seg`. Labels for which only one position is given will be centered on that position. Labels for which two positions are given are linked by an horizontal square bracket and the label is plotted in the middle of the positions.

Value

`annotation` and `as.annotation` return an annotation object. `is.annotation` returns a logical.

Author(s)

Lionel Guy

See Also

[plot_gene_map](#), [middle](#).

Examples

```
## loading data
data(three_genes)

## Calculating middle positions
mid_pos <- middle(dna_segs[[1]])

# Create first annotation
annot1 <- annotation(x1=mid_pos, text=dna_segs[[1]]$name)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons, annotations=annot1)

## Exploring options
annot2 <- annotation(x1=c(mid_pos[1], dna_segs[[1]]$end[2]),
                    x2=c(NA, dna_segs[[1]]$end[3]),
                    text=c(dna_segs[[1]]$name[1], "region1"),
                    rot=c(30, 0), col=c("grey", "black"))
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              annotations=annot2, annotation_height=1.3)

## Annotations on all the segments
annots <- lapply(dna_segs, function(x){
  mid <- middle(x)
  annot <- annotation(x1=mid, text=x$name, rot=30)
})
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              annotations=annots, annotation_height=1.8, annotation_cex=1)

##
## Using a bigger dataset from a 4-genome comparison
##
data(barto)
## Adding a tree
tree <- newick2phylog("(BB:2.5, (BG:1.8, (BH:1, BQ:0.8):1.9):3);")
## Showing several subsegments
```

```

xlims2 <- list(c(1445000, 1415000, 1380000, 1412000),
              c( 10000,  45000,  50000,  83000, 90000, 120000),
              c( 15000,  36000,  90000, 120000, 74000,  98000),
              c(  5000,   82000))
## Adding annotations for all genomes, allow segments to be placed out
## of the longest segment
annots <- lapply(barto$dna_segs, function(x){
  mid <- middle(x)
  annot <- annotation(x1=mid, text=x$name, rot=30)
  # removing gene names starting with "B" and keeping 1 in 4
  idx <- grep("^[^B]", annot$text, perl=TRUE)
  annot[idx[idx %% 4 == 0],]
})
plot_gene_map(barto$dna_segs, barto$comparisons, tree=tree,
             annotations=annots,
             xlims=xlims2,
             limit_to_longest_dna_seg=FALSE,
             dna_seg_scale=TRUE)

```

apply_color_scheme *Apply a color scheme*

Description

Apply a color scheme to a numeric vector, eventually taking the direction into account.

Usage

```

apply_color_scheme(x, direction = NULL, color_scheme = "grey",
decreasing = FALSE, rng = NULL, transparency = 0.5)

```

Arguments

<code>x</code>	A numeric, that will be used to apply a gradient of colors to a comparison.
<code>direction</code>	If a red-blue scheme is chosen, the vector (composed of -1 and 1 values and of same length as <code>x</code>) giving the direction of the comparison.
<code>color_scheme</code>	Character. One of <code>red_blue</code> , <code>blue_red</code> , <code>grey</code> , <code>gray</code> .
<code>decreasing</code>	Logical. Are the values of the comparisons oriented such as the lower the value, the closer the relationship (e.g. e-values, gaps, mismatches, etc)? <code>FALSE</code> by default.
<code>rng</code>	Numeric of length 2. Gives the higher and lower limit to apply a color scheme.
<code>transparency</code>	Numeric of length 1, between 0 and 1, or <code>FALSE</code> . Should the color scheme use transparency, and if yes how much (ratio). 0.5 by default. Not supported on all devices.

Details

A color scale is calculated, with the darker color corresponding to the highest values of x , or the contrary is decreasing is TRUE. For the moment, two schemes (red-blue and grey scale) are used.

For the red-blue scale (as in ACT), the direct comparisons are colored in red hues, and the reversed ones in blue hues.

This is especially useful to replace comparison values (such as BLAST percent identity values) by color hues.

Value

A character vector of same length as x , representing colors.

Author(s)

Lionel Guy

References

Artemis Comparison Tool, <http://www.sanger.ac.uk/Software/ACT/>

See Also

[comparison](#)

Examples

```
## Load data
data(three_genes)

## Color schemes
## Greys
comparisons[[1]]$values <- c(70, 80, 90)
comparisons[[1]]$col <- apply_color_scheme(comparisons[[1]]$values,
                                           color_scheme="grey")
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons)
## Red-blue
comparisons[[1]]$col <- apply_color_scheme(comparisons[[1]]$values,
                                           direction=comparisons[[1]]$direction,
                                           color_scheme="red_blue")
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons)
## Decreasing
comparisons[[1]]$col <- apply_color_scheme(comparisons[[1]]$values,
                                           direction=comparisons[[1]]$direction,
                                           color_scheme="red_blue",
                                           decreasing=TRUE)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons)
## Range
comparisons[[1]]$col <- apply_color_scheme(comparisons[[1]]$values,
                                           direction=comparisons[[1]]$direction,
                                           color_scheme="red_blue",
                                           rng=c(30,100))
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons)
## Transparency
x1 <- seq(100, 600, by=50)
```

```

x2 <- seq(1100, 700, by=-50)
comparisons[[2]] <- as.comparison(data.frame(start1=c(x1, x2),
                                             end1=c(x1+250, x2+300),
                                             start2=c(x1+150, x2-300)+2000,
                                             end2=c(x1+250, x2-500)+2000
                                             ))
comparisons[[2]]$col <- apply_color_scheme(1:nrow(comparisons[[2]]),
                                           comparisons[[2]]$direction,
                                           color_scheme="blue_red")
comparisons[[1]]$col <- apply_color_scheme(comparisons[[1]]$values,
                                           color_scheme="grey",
                                           transparency=0.8)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons)
comparisons[[1]]$col <- apply_color_scheme(comparisons[[1]]$values,
                                           color_scheme="grey",
                                           transparency=1)
comparisons[[2]]$col <- apply_color_scheme(1:nrow(comparisons[[2]]),
                                           comparisons[[2]]$direction,
                                           color_scheme="blue_red",
                                           transparency=0.2)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons)

```

artemisColors

Artemis Colors

Description

Returns a data frame with the standard artemis colors.

Usage

```
artemisColors()
```

Value

A `data.frame` with the following columns: `n`, `names`, `colors`, `r`, `g` and `b`. The 3 first columns give the Artemis color number, its name, and its equivalent in R. The 3 last give the r, g and b values.

Author(s)

Lionel Guy

References

Artemis website: <http://www.sanger.ac.uk/resources/software/artemis/>

Examples

```

artCol <- artemisColors()
plot(rep(1, nrow(artCol)), artCol$n, xlim=c(1, 2), type="n")
text(rep(1, nrow(artCol)), artCol$n, labels=artCol$n, col=artCol$colors)
text(rep(1, nrow(artCol)), artCol$n, labels=artCol$names, col=artCol$colors,
     pos=4, offset=1)

```

auto_annotate *Auto-annotate dna_segs*

Description

Annotate `dna_segs` in a smart way. This is especially designed for `dna_segs` read from `genbank` or `embl` files, but can be extended for other uses. In short, it produces annotations from `dna_segs`, grouping the tags for operons (`atpA`, `atpB`, `atC`) into one tag (`atpA-C`), and similarly for numbered genes (`bep1-9`).

Usage

```
auto_annotate(dna_seg, locus_tag_pattern=NULL, names=dna_seg$gene,
              keep_genes_only=TRUE, ...)
```

Arguments

`dna_seg` A `dna_seg` object.

`locus_tag_pattern` NULL by default. A character giving a pattern, that is used to simplify names. Specially useful to transform long locus tags into numbers (e.g. `Eco003456` becomes `3456`).

`names` A character vector with as many elements as there are rows in the `dna_seg`. By default, the `gene` column of the `dna_seg` is taken. Gives the names to be summarized.

`keep_genes_only` A logical, TRUE by default. If set, the genes that have a name that is "-" or empty are not annotated.

`...` Further arguments to be passed to annotation function, like `rot` or `color`.

Value

An `annotation` object.

Author(s)

Lionel Guy

See Also

[annotation](#), [dna_seg](#).

Examples

```
## Prepare dna_seg
names <- paste("Eco", sprintf("%04d", 1:20), sep="")
gene <- c("-", "atpC", "atpB", "atpA", "atp2",
          "-", "-", "cda1", "cda2", "cda3",
          "vcx23", "vcx22", "vcx21", "cde20",
          "-", "gfrU", "gfrT", "gfrY", "gfrX", "gfrW")
ds <- dna_seg(data.frame(name=names, start=(1:20)*3, end=(1:20)*3+2,
                        strand=rep(1, 20), gene=gene,
```

```

                                stringsAsFactors=FALSE))
## Original annotation
annot1 <- annotation(x1=middle(ds), text=ds$gene, rot=30)
## auto_annotate with various options
annot2 <- auto_annotate(ds)
annot3 <- auto_annotate(ds, keep_genes_only=FALSE, rot=45)
annot4 <- auto_annotate(ds, keep_genes_only=FALSE,
                        locus_tag_pattern="Eco", col="red")
## Plot
plot_gene_map(list(ds, ds, ds, ds),
              annotations=list(annot1, annot2, annot3, annot4))

```

barto

Comparison of 4 Bartonella genomes

Description

Comparison of 4 Bartonella genomes by BLAST.

Usage

```
data(barto)
```

Format

barto, a list of three dataframes, representing the four genomes and their pairwise comparisons:

- `dna_segs` which is a list of 4 `dna_seg` objects, containing all the protein genes for each genome. Obtained by reading ptt files downloaded from NCBI with `read_dna_seg_from_ptt`.
- `comparisons` which is a list of 3 `comparison` objects, obtained by doing genome-to-genome (fasta files) BLASTS, and then reading the resulting tab files with `read_comparison_from_blast`.
- `rnt_segs` which is a list of 4 `dna_seg` objects, containing all the RNA genes of the four genomes. Obtained by reading rnt files downloaded from NCBI with `read_dna_seg_from_ptt`.

A bash script to obtain the same file as in the dataset is available in the `extdata` folder of the package. Find its location by running `system.file('extdata/barto.sh', package = 'genoPlotR')`.

References

BLAST: <http://www.ncbi.nlm.nih.gov/blast/>

Examples

```

data(barto)
plot_gene_map(barto$rnt_segs, barto$comparisons, gene_type="blocks")

```

c.dna_seg	<i>Concatenate dna_seg objects</i>
-----------	------------------------------------

Description

Concatenate dna_seg objects.

Usage

```
## S3 method for class 'dna_seg'  
c(...)
```

Arguments

... dna_segs to be concatenated.

Value

A dna_seg object

Author(s)

Lionel Guy

See Also

[dna_seg](#)

Examples

```
## load data  
data(three_genes)  
  
dna_segs[1:2]  
c(dna_segs[[1]], dna_segs[[2]])
```

chrY_subseg	<i>Comparisons of subsegments of the Y chromosome in human and chimp</i>
-------------	--

Description

A subsegment of the Y chromosome in Homo sapiens and Pan troglodytes, to illustrate support for exons and introns.

Usage

```
data(chrY_subseg)
```

Format

A list of two data frames, representing the Y segment in the two species, and containing:

- `dna_segs` which is a list of two `dna_seg` objects, containing each three rows (or genes).
- `comparison` which is a list of one `comparison` objects.

Details

Header for the Homo sapiens genbank file: LOCUS NC_000023 220001 bp DNA linear CON 10-JUN-2009 DEFINITION Homo sapiens chromosome X, GRCh37 primary reference assembly. ACCESSION NC_000023 REGION: 2600000..2820000 GPC_000000047

Header for the Pan troglodytes file: LOCUS NC_006491 220001 bp DNA linear CON 18-SEP-2006 DEFINITION Pan troglodytes chromosome X, reference assembly (based on Pan_troglodytes-2.1). ACCESSION NC_006491 REGION: 2620000..2840000

Examples

```
data(chrY_subseg)
plot_gene_map(chrY_subseg$dna_segs, chrY_subseg$comparison, dna_seg_scale=TRUE,
              scale=FALSE)
```

comparison

Comparison class and class functions

Description

A comparison is a collection of similarities, representing the comparison between two DNA segments. These functions are class functions to create, convert and test comparison objects.

Usage

```
comparison(x)
as.comparison(df)
is.comparison(comparison)
```

Arguments

<code>x</code>	Can be a list or <code>data.frame</code> object. See the details for the columns in the <code>data.frame</code> .
<code>df</code>	A <code>data.frame</code> object. See details for the required columns.
<code>comparison</code>	Any object to test.

Details

Objects (either data frames or lists) should have at least named elements `start1`, `end1`, `start2` and `end2`. In addition, it can take a `color` column. Additional numeric columns can be used for color-coding (via `apply_color_scheme`).

`comparison` tries to build a comparison object from either a data frame or a list, `as.comparison` accepts only `data.frames`.

`is.comparison` returns `TRUE` if the object tested is a comparison object.

Read functions such as [read_comparison_from_tab](#) and [read_comparison_from_blast](#) also return comparison objects.

Value

A comparison object for `comparison` and `as.comparison`. Comparison objects are also of class `data.frame`. They contain the columns `start1`, `end1`, `start2`, `end2`, `direction` and `col` (color).

A logical for `is.comparison`.

Author(s)

Lionel Guy

See Also

[dna_seg](#), [read_comparison_from_tab](#), [read_comparison_from_blast](#), [trim.comparison](#), [reverse.comparison](#).

Examples

```
## Get some values
starts1 <- c(2, 1000, 1050)
ends1 <- c(600, 800, 1345)
starts2 <- c(50, 800, 1200)
ends2 <- c(900, 1100, 1322)

## From a data.frame
comparison1 <- as.comparison(data.frame(start1=starts1, end1=ends1,
                                       start2=starts2, end2=ends2))

comparison1
is.comparison(comparison1)
is.data.frame(comparison1)
comparison(data.frame(start1=starts1, end1=ends1,
                      start2=starts2, end2=ends2))

## From a list
comparison(list(start1=starts1, end1=ends1,
               start2=starts2, end2=ends2))

## From a file
comparison2_file <- system.file('extdata/comparison2.tab',
                               package = 'genoPlotR')
comparison2 <- read_comparison_from_tab(comparison2_file)
```

dna_seg

DNA segment (dna_seg) class and class functions

Description

A DNA segment is a collection of genes or elements along a genome, to be represented on a map. These functions are class functions to create, convert and test `dna_seg` objects.

Usage

```

dna_seg(x, ...)
as.dna_seg(df, col = "blue", fill = "blue", lty = 1, lwd = 1,
           pch = 8, cex = 1, gene_type = "arrows")
is.dna_seg(dna_seg)

```

Arguments

<code>x</code>	A <code>data.frame</code> or <code>list</code> that can be coerced to a data frame.
<code>...</code>	Arguments further passed to <code>as.dna_seg</code> (see below).
<code>df</code>	A data frame representing the <code>dna_seg</code> object. See details for necessary columns.
<code>col</code>	Either a color vector of the same length as <code>df</code> or of length one, to be applied to the whole object. Will be passed to corresponding <code>grob</code> object. Default to <code>blue</code> .
<code>fill</code>	Either a fill vector of the same length as <code>df</code> or of length one, to be applied to the whole object. Will be passed to corresponding <code>grob</code> object. Default to <code>blue</code> .
<code>lty</code>	A vector of the same length as <code>df</code> or of length one, giving the line type around the objects.
<code>lwd</code>	Same as <code>lty</code> , giving the line width.
<code>pch</code>	Same as <code>lty</code> , giving the character representing each object. Goes with <code>gene_type</code> points.
<code>cex</code>	Same as <code>lty</code> , giving the character size representing each object. Goes with <code>gene_type</code> points.
<code>gene_type</code>	Vector of the same length as <code>df</code> or of length one, giving the type of representation of each object.
<code>dna_seg</code>	Object to test.

Details

Objects to be converted needs to have their first 4 columns named `name`, `start`, `end` and `strand`. Extra columns with names `col`, `lty`, `lwd`, `pch`, `cex`, `gene_type` will be used in the plotting process. Other extra columns will be kept in the object, but not used.

`dna_seg` tries to build a `dna_seg` object from a data frame or a list.

`as.dna_seg` tries to build a `dna_seg` object from a data frame.

Read functions such as [read_dna_seg_from_tab](#) and [read_dna_seg_from_ptt](#) also return `dna_seg` objects.

Value

A comparison object for `comparison` and `as.comparison`. DNA seg objects are also of class `data.frame`. They contain the following columns: `name`, `start`, `end`, `strand`, `col`, `lty`, `lwd`, `pch`, `cex`, `gene_type`.

A logical for `is.comparison`.

Author(s)

Lionel Guy

See Also

[read_dna_seg_from_tab](#), [read_dna_seg_from_ptt](#), [gene_types](#).

Examples

```
## generate data
names1 <- c("feat1", "feat2", "feat3")
starts1 <- c(2, 1000, 1050)
ends1 <- c(600, 800, 1345)
strands1 <- c("-", -1, 1)
cols1 <- c("blue", "grey", "red")

## create data.frame
df1 <- data.frame(name=names1, start=starts1, end=ends1,
                  strand=strands1, col=cols1)

## with dna_seg
dna_seg1 <- dna_seg(df1)
dna_seg1
as.dna_seg(df1)

## test
is.dna_seg(dna_seg1)

## directly readable with read_dna_seg_from_tab
## Not run:
write.table(x=dna_seg1, file="dna_seg1.tab", quote=FALSE,
           row.names=FALSE, sep="\t")

## End(Not run)

## with only one gene and with list, or two, and merging with c.dna_seg
gene2a <- dna_seg(list(name="feat1", start=50, end=900, strand="-", col="blue"))
genes2b <- dna_seg(data.frame(name=c("feat2", "feat3"), start=c(800, 1200),
                             end=c(1100, 1322), strand=c("+", 1),
                             col=c("grey", "red"),
                             fill=c("transparent", "grey"),
                             gene_type=c("arrows", "blocks")))
dna_seg2 <- c(gene2a, genes2b)

## test
is.dna_seg(dna_seg2)

## reading from file
dna_seg3_file <- system.file('extdata/dna_seg3.tab', package = 'genoPlotR')
dna_seg3 <- read_dna_seg_from_tab(dna_seg3_file)
is.dna_seg(dna_seg3)
```

Description

Returns a vector containing the available gene types. In addition to these gene types, the user can provide graphical functions that return a list or a single `grob` object.

Usage

```
gene_types(auto = TRUE)
```

Arguments

`auto` Logical. Should type "auto" be added?

Details

`dna_segs` may contain one character column `gene_type`. Elements in this column should either be one of the predefined gene types, or refer to a graphical function that has exactly the same name and that returns a `grob` or a `gList` object.

A gene object (i.e. a single row of a `dna_seg`) is passed to the graphical function, as well as the contents of the `...`. The start and line width of an element can thus be accessed via `gene$start` and `gene$lwd`. Extra columns that would be added in the `dna_seg` can be used similarly. Extra arguments can also be globally passed via `...` when calling `plot_gene_map`.

Value

A character vector.

Author(s)

Lionel Guy

See Also

[plot_gene_map](#), [dna_seg](#)

Examples

```
## To view pre-coded gene types:
gene_types()

## Load data
data(barto)
n <- length(gene_types(auto=FALSE))

## Get a small subset from the barto dataset
dna_seg <- barto$dna_segs[[3]][1:n,]
plot_gene_map(list(dna_seg))

## Change gene_types and plot again
dna_seg$gene_type <- gene_types(auto=FALSE)
dna_seg$fill <- rainbow(n)
dna_seg_r <- dna_seg
dna_seg_r$strand <- -dna_seg$strand

## Add an annotation
annot <- annotation(middle(dna_seg), text=dna_seg$gene_type, rot=45,
```



```

col=dna_seg$col)

## Plot
plot_gene_map(list(dna_seg, dna_seg_r), annotations=list(annot, annot),
              annotation_height=5, dna_seg_line=grey(0.7))

## Using home-made graphical functions
## Data
data(three_genes)

## Functions returning grobs.
## Creates a triangle
triangleGrob <- function(gene, ...) {
  x <- c(gene$start, (gene$start+gene$end)/2, gene$end)
  y1 <- 0.5 + 0.4*gene$strand
  y <- c(y1, 0.5, y1)
  polygonGrob(x, y, gp=gpar(fill=gene$fill, col=gene$col, lty=gene$lty,
                           lwd=gene$lwd), default.units="native")
}

## Draws a star. Note that the limits of the dna_seg region are
## voluntarily not respected
starGrob <- function(gene, ...){
  ## Coordinates for the star
  x <- sin(((0:5)/2.5)*pi)*(gene$end-gene$start)/2 + (gene$end+gene$start)/2
  y <- cos(((0:5)/2.5)*pi)*gene$strand*2 + 0.5
  idx <- c(1, 3, 5, 2, 4, 1)
  ## Attribute line_col only if present in the gene
  line_col <- if (!is.null(gene$line_col)) gene$line_col else gene$col
  ## Having a conditional transparency, depending on a length cut-off
  ## passed via dots
  length_cutoff <- list(...)$length_cutoff
  if (!is.null(length_cutoff)){
    alpha <- if ((gene$end-gene$start) < length_cutoff) 0.3 else 0.8
  } else alpha <- 1

  ## Grobs
  g <- polygonGrob(x[idx], y[idx], gp=gpar(fill=gene$col, col=line_col,
                                           lty=gene$lty, lwd=gene$lwd, alpha=alpha),
                 default.units="native")
  t <- textGrob(label="***", x=(gene$end+gene$start)/2, y=0.5,
               default.units="native")
  gList(g, t)
}

## Replacing the standard types
dna_segs[[1]]$gene_type <- "triangleGrob"
dna_segs[[2]]$gene_type <- "starGrob"
## Adding more variables
dna_segs[[2]]$line_col <- c("black", grey(0.3), "blue")
## Mix of several types on the same line
dna_segs[[3]]$gene_type <- c("starGrob", "triangleGrob", "arrows")

## Plot
plot_gene_map(dna_segs, comparisons, length_cutoff=600)

```

human_nt	<i>Human-readable nucleotide scale</i>
----------	--

Description

Return a human readable list from a nucleotide position or length.

Usage

```
human_nt(nt, signif = FALSE)
```

Arguments

nt	A nucleotide position
signif	Either a logical or an integer. If FALSE (default), nt is not rounded. Else, it returns signif significant digits.

Details

Return a nucleotide value in nt, kb, Mb or Gb, according to the value given. This is particularly useful to display nice scales without too many trailing zeros.

Value

Returns a list with 4 elements

n	A numeric value corresponding to nt divided by mult (see below).
tag	A character, giving the multiplier used in text.
mult	The multiplier used, in numeric value.
text	A character, giving the value in a human readable format.

Author(s)

Lionel Guy

Examples

```
human_nt(123456)
human_nt(123456, signif=2)
human_nt(123456890, signif=2)
```

mauve_bbone	<i>Mauve backbone of 4 Bartonella genomes</i>
-------------	---

Description

The result of a multiple genome alignment with Mauve.

Usage

```
data(mauve_bbone)
```

Format

bbone, a list of two dataframes, representing the regions which are conserved in at least two genomes:

- `dna_segs` which is a list of 4 `dna_seg` objects, containing the mauve blocks for each genome.
- `comparisons` which is a list of 3 `comparison` objects.

A bash script to obtain the same file as in the data is available in the `extdata` folder of the package.

Find its location by running `system.file('extdata/mauve.sh', package = 'genoPlotR')`.

The resulting backbone file can then be read with [read_mauve_backbone](#).

References

Mauve: <http://asap.ahabs.wisc.edu/mauve/>

Examples

```
data(mauve_bbone)
plot_gene_map(bbone$dna_segs, bbone$comparisons)
```

middle	<i>Middles of a dna_seg</i>
--------	-----------------------------

Description

Returns a vector containing the middle of the genes of a `dna_seg`. Useful to prepare annotations, for example.

Usage

```
middle(dna_seg)
```

Arguments

`dna_seg` A `dna_seg` object.

Value

A numeric vector.

Author(s)

Lionel Guy

See Also

[annotation](#), [dna_seg](#)

Examples

```
## Load data
data(barto)

## Get middles of the first dna_seg
mid <- middle(barto$dna_segs[[1]])
```

plot_gene_map

Plot gene and genome maps

Description

This plotting function represents linearly DNA segments and their comparisons. It will plot one line per DNA segment, eventually separated by the comparisons. In addition, a tree can be plotted on the left of the plot, and annotations on the top row. Since this is a grid plot, it can be placed into other graphics, or modified subsequently.

Usage

```
plot_gene_map(dna_segs,
              comparisons = NULL,
              tree = NULL,
              tree_width = NULL,
              tree_branch_labels_cex = NULL,
              tree_scale = FALSE,
              legend = NULL,
              annotations = NULL,
              annotation_height = 1,
              annotation_cex = 0.8,
              seg_plots=NULL,      # user-defined plots
              seg_plot_height=3,  # height of plots (in lines)
              seg_plot_height_unit="lines", # unit of preceding
              seg_plot_yaxis=3,  # if non-null or non false, ticks
              seg_plot_yaxis_cex=scale_cex,
              xlims = NULL,
              offsets = NULL,
              minimum_gap_size = 0.05,
              fixed_gap_length = FALSE,
```

```

limit_to_longest_dna_seg = TRUE,
main = NULL,
main_pos = "centre",
dna_seg_labels = NULL,
dna_seg_label_cex=1,
dna_seg_label_col="black",
gene_type = NULL,
arrow_head_len = 200,
dna_seg_line = TRUE,
scale = TRUE,
dna_seg_scale = !scale,
n_scale_ticks=7,
scale_cex=0.6,
global_color_scheme = c("auto", "auto", "blue_red", 0.5),
override_color_schemes = FALSE,
plot_new=TRUE,
debug = 0,
...)
```

Arguments

- `dna_segs` A list of `dna_seg` objects. Mandatory.
- `comparisons` A list of `comparison` objects. Optional.
- `tree` A tree, under the form of a [phylog](#) object. If specified, takes place at the left of the tags. See details below for more information.
- `tree_width` Numeric. The width of the tree area in the plot, in inches. By default, takes 20 percent of the total plot.
- `tree_branch_labels_cex` Numeric or `NULL` (default). If the tree provided contains node annotations, they will be displayed with this `cex`. If equal to 0, node annotations are not displayed.
- `tree_scale` Logical. Plot a scale for the tree? Default is `FALSE`.
- `legend` Yet unimplemented.
- `annotations` An annotation object or a list of annotation objects. See details. Optional.
- `annotation_height` Numeric. The height, in lines, of the annotation line. One by default, if annotation is defined.
- `annotation_cex` Numeric. The `cex` (i.e. the character expansion) of the annotation line.
- `seg_plots` A list of `seg_plot` objects of the length as `dna_segs`, a single `seg_plot` or `NULL` (default). To draw plots associated to a `dna_seg`. See [seg_plot](#) for more information and some examples.
- `seg_plot_height` The height of the `seg_plot` regions. By default, equals to 3 (lines, see next argument).
- `seg_plot_height_unit` The unit of the height of the `seg_plot` regions. Should be a valid unit. See the `grid` documentation for more information. If equals to "null", then the height will be calculated as a proportion of the comparison region (i.e. 0.5 means the `seg_plot` region will be half the size of the comparison).

seg_plot_yaxis	Can be NULL, FALSE or a numeric. In the first two cases, no y-axis is drawn for the seg_plots. If numeric, a axis is drawn with approximately that number of ticks.
seg_plot_yaxis_cex	The character expansion of the seg_plot_yaxis labels. Equals to scale_cex by default.
xlims	A list with as many elements as there are dna_segs, or NULL. If NULL, the whole segment will be represented. If a list, each element of the list is a numeric vector, representing pairs of left and right limits for each subsegment. See details.
offsets	A list or a vector with as many elements as there are dna_segs, or NULL. If is a numeric vector, gives the offset of the first subsegment. If is a list, each element should have the same length as there are subsegments (see xlims). Gives then the length of each gap. If NULL, the size of the gaps is optimized to minimize the lengths of the comparisons. See details.
minimum_gap_size	A numeric. How much of the plotting region should a gap be, at least. Default is 0.05 (20% of the plotting region).
fixed_gap_length	Should the gaps have a fixed length? Otherwise, the gap length will be optimized to minimize the size of comparisons. FALSE by default.
limit_to_longest_dna_seg	A logical. Should the plot be restricted to the longest dna_seg? If no, the other segments can be extended to better fit comparisons.
main	A character. Main title of the plot.
main_pos	Position of the main title. One of centre, left or right.
dna_seg_labels	A character, same length as dna_segs. The names of the segments. If NULL, the names of dna_segs will be used, if available. Else, no name are plotted. If a tree is given, names must exist either in dna_seg_labels or in the names of dna_segs.
dna_seg_label_cex	A numeric. The character size for the DNA segments labels, or tree labels. Default is 1.
dna_seg_label_col	A color, of length 1 or of the same length as dna_segs. Gives the color of the labels. Default is black.
gene_type	A character. Describes the type of representation of genes or dna_seg elements. See details.
arrow_head_len	A numeric. Gives the length of arrow heads for gene type "arrows". The arrow head extends at maximum at half of the gene. Set to Inf to have all arrow heads covering the half of the gene. 200 by default.
dna_seg_line	A vector, either logical or giving colors, of length 1 or of same length as dna_segs. Should the line in the middle of the segments be drawn, and if yes, in what color. TRUE by default, which gives black lines. FALSE (logical, or as a string) results in no plotting.
scale	A logical. Should the scale be displayed on the plot. TRUE by default.

<code>dna_seg_scale</code>	A logical, of length one or of the same length as <code>dna_segs</code> . Should a scale be displayed below each or all dna segments, respectively. <code>!scale</code> by default.
<code>n_scale_ticks</code>	A integer. The (approximate) number of ticks on the longest segment. Default: 7.
<code>scale_cex</code>	A numeric. The character size for the scale labels. Default is 1.
<code>global_color_scheme</code>	A character of length 4. If no <code>col</code> column is present on any comparison or <code>override_color_schemes</code> is set, apply a global color scheme over all comparisons. See below for more details. <code>c("auto", "auto", "blue_red")</code> by default.
<code>override_color_schemes</code>	A logical. If <code>TRUE</code> , apply a global color scheme even if there are comparisons that have <code>col</code> columns. <code>FALSE</code> by default.
<code>plot_new</code>	Logical. Produce a new plot? If <code>TRUE</code> , uses <code>grid.newpage</code> before plotting.
<code>debug</code>	A numeric. If <code>> 0</code> , only that number of element will be plotted for each <code>dna_seg</code> and <code>comparison</code> .
<code>...</code>	Further arguments to be passed to user-defined graphical functions.

Details

One line is plotted per `dna_seg`. Eventually, the space between the lines will be filled with the `comparisons`. `dna_segs` can be annotated with `annotations`, and accompanying data can be plotted using `seg_plot`.

A phylogenetic tree (a `phylog` object from package `ade4`) can be drawn at the left of the plot. The tree does not need to be ordered as the `dna_seg_labels`, but a permutation of the tree with that order should exist. If the tree is large, the number of permutations become too large, and the function will stop (>100000 permutations). The solution is then to provide segments that are ordered in the same manner as the tree labels (or vice-versa).

There is an (experimental) support for branch annotations. These are given in the Newick tree, directly after the parenthesis closing a node. They can be characters or integers, but so far `newick2phylog` doesn't support decimal values. Tags will be ignored if they start with "I", and trimmed if they start with "X".

The format of the elements of `dna_segs` is previously determined in the object or can be globally set by `gene_type`. See the function `gene_types` to return the available types. Gene type can also be user-defined, using a function returning a `grob`. See `gene_types` for more details.

`xlims` allow the user to plot subsegments of a `dna_seg`. `xlims` consists of a list composed of as many numeric vectors as there are segments. Each of these numeric vectors give pairs of left and right borders, and gives the direction. For example, `c(1,2,6,4)` will plot two subsegments, segment 1 to 2 which is plotted left to right and segment 4 to 6, plotted right to left. `-Inf` and `Inf` values are accepted. `NULL` values will result in plotting the whole segment.

`offsets` allows to user to define the placement of the subsegments. If a list is provided, each element of the list should have as many elements as there are subsegments. It will give the size of the gaps, including the first one from the border of the plot to the first subsegment.

A main title (`main`) can also be added at the top of the plot, at the position defined by `main_pos`. A general scale can be added at the bottom right of the plot (`scale`).

`dna_seg_scale` gives the ability to plot scales on one, some or every segment. `c(TRUE, FALSE, TRUE)` will add scales to the first and third segments.

The four elements of `global_color_scheme` are (i) which column serves as scale to apply the color scheme, or "auto" (default); (ii) if the scale is "increasing" or "decreasing" (see `apply_color_scheme` for more details), or "auto" (default); (iii) the color scheme to apply; (iv) the transparency to apply (0.5 by default).

Value

Nothing. A lattice graphic is plotted on the current device.

Note

This plotting function has been tested as far as possible, but given its complexity and that the package is young, bugs or strange behaviors are possible. Please report them to the author.

As of 10/3/2010, support for viewing exons/introns is only available using genbank and embl formats, not when importing ptt files.

Author(s)

Lionel Guy <lionel.guy@ebc.uu.se>, Jens Roat Kultima

See Also

[dna_seg](#) and [comparison](#) for the base objects; [read_dna_seg_from_tab](#), [read_dna_seg_from_ptt](#), [read_comparison_from_tab](#) and [read_comparison_from_blast](#) to read from files; [annotation](#) to annotate dna_segs; [seg_plot](#) to draw plots next to dna_segs; [gene_types](#) for gene_type argument; [apply_color_scheme](#) for color schemes;

Examples

```
old.par <- par(no.readonly=TRUE)
data("three_genes")

## Segments only
plot_gene_map(dna_segs=dna_segs)

## With comparisons
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons)

## Tree
names <- c("A_aaa", "B_bbb", "C_ccc")
names(dna_segs) <- names
tree <- newick2phylog("((A_aaa:4.2,B_bbb:3.9):3.1,C_ccc:7.3):1);")
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              tree=tree)

## Increasing tree width
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              tree=tree, tree_width=3)

## Annotations on the tree
tree2 <- newick2phylog("((A_aaa:4.2,B_bbb:3.9)97:3.1,C_ccc:7.3)78:1);")
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              tree=tree2, tree_width=3)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              tree=tree2, tree_width=3, tree_branch_labels_cex=0.5)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              tree=tree2, tree_width=3, tree_branch_labels_cex=0)
```



```

## Annotation
## Calculating middle positions
mid_pos <- middle(dna_segs[[1]])

# Create first annotation
annot1 <- annotation(x1=mid_pos, text=dna_segs[[1]]$name)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons, annotations=annot1)

## Exploring options
annot2 <- annotation(x1=c(mid_pos[1], dna_segs[[1]]$end[2]),
                    x2=c(NA, dna_segs[[1]]$end[3]),
                    text=c(dna_segs[[1]]$name[1], "region1"),
                    rot=c(30, 0), col=c("grey", "black"))
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              annotations=annot2, annotation_height=1.3)

## xlims
## Just returning a segment
plot_gene_map(dna_segs, comparisons,
              xlims=list(NULL, NULL, c(Inf,-Inf)),
              dna_seg_scale=TRUE)
## Removing one gene
plot_gene_map(dna_segs, comparisons,
              xlims=list(NULL, NULL, c(-Inf,2800)),
              dna_seg_scale=TRUE)

## offsets
offsets <- c(0, 0, 0)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons, offsets=offsets)
offsets <- c(200, 400, 0)
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons, offsets=offsets)

## main
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              main="Comparison of A, B and C")
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              main="Comparison of A, B and C", main_pos="left")

## dna_seg_labels
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              dna_seg_labels=c("Huey", "Dewey", "Louie"))

## dna_seg_labels size
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              dna_seg_labels=c("Huey", "Dewey", "Louie"),
              dna_seg_label_cex=2)

## dna_seg_line
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              dna_seg_line=c("FALSE", "red", grey(0.6)))

## gene_type
plot_gene_map(dna_segs=dna_segs, comparisons=comparisons,
              gene_type="side_blocks")

##

```

```

## From here on, using a bigger dataset from a 4-genome comparison
##
data("barto")
## Adding a tree
tree <- newick2phylog("(BB:2.5, (BG:1.8, (BH:1, BQ:0.8):1.9):3);")
## Showing only subsegments
xlims1 <- list(c(1380000, 1445000),
              c(10000, 83000),
              c(15000, 98000),
              c(5000, 82000))
## Reducing dataset size for speed purpose
for (i in 1:length(barto$dna_segs)){
  barto$dna_segs[[i]] <- trim(barto$dna_segs[[i]], xlim=xlims1[[i]])
  if (i < length(barto$dna_segs))
    barto$comparisons[[i]] <- trim(barto$comparisons[[i]],
                                  xlim1=xlims1[[i]], xlims1[[i+1]])
}
plot_gene_map(barto$dna_segs, barto$comparisons, tree=tree,
             xlims=xlims1,
             dna_seg_scale=TRUE)
## Showing several subsegments per genome
xlims2 <- list(c(1445000, 1415000, 1380000, 1412000),
              c( 10000,  45000,  50000,  83000, 90000, 120000),
              c( 15000,  36000,  90000, 120000, 74000, 98000),
              c(  5000,   82000))

## dna_seg_scale, global_color_scheme, size, number, color of dna_seg_scale,
## size of dna_seg_scale labels
plot_gene_map(barto$dna_segs, barto$comparisons, tree=tree, xlims=xlims2,
             dna_seg_scale=c(TRUE, FALSE, FALSE, TRUE), scale=FALSE,
             dna_seg_label_cex=1.7,
             dna_seg_label_col=c("black", "grey", "blue", "red"),
             global_color_scheme=c("e_value", "auto", "grey", "0.7"),
             n_scale_ticks=3, scale_cex=1)

## Hand-made offsets: size of all gaps
offsets2 <- list(c(10000, 10000),
               c(2000, 2000, 2000),
               c(10000, 5000, 2000),
               c(10000))
plot_gene_map(barto$dna_segs, barto$comparisons, tree=tree,
             #annotations=annots,
             xlims=xlims2,
             offsets=offsets2,
             dna_seg_scale=TRUE)

##
## Exploring and modifying a previously plotted gene map plot
##
## View viewports
current.vpTree()
## Go down to one of the viewports, add an xaxis, go back up to root viewport
downViewport("dna_seg_scale.3.2")
grid.rect()
upViewport(0)
## Get all the names of the objects
grobNames <- getNames()
grobNames

```

```

## Change the color of the scale line
grid.edit("scale.lines", gp=gpar(col="grey"))
## Remove first dna_seg_lines
grid.remove("dna_seg_line.1.1")

##
## Plot genoPlotR logo
##
col <- c("#B2182B", "#D6604D", "#F4A582", "#FDDBC7",
         "#D1E5F0", "#92C5DE", "#4393C3", "#2166AC")
cex <- 2.3
## First segment
start1 <- c(150, 390, 570)
end1 <- c( 1, 490, 690)
genoR <- c(270, 530)
## Second segment
start2 <- c(100, 520, 550)
end2 <- c(240, 420, 650)
Plot <- c(330)
## dna_segs
ds1 <- as.dna_seg(data.frame(name=c("", "", ""),
                             start=start1, end=end1, strand=rep(1, 3),
                             col=col[c(2, 6, 1)], stringsAsFactor=FALSE))
ds_genoR <- as.dna_seg(data.frame(name=c("geno", "R"),
                                   start=genoR, end=genoR, strand=rep(1, 2),
                                   col=c(col[8], "black"),
                                   stringsAsFactor=FALSE), cex=cex, gene_type="text")
ds2 <- as.dna_seg(data.frame(name=c("", "", ""),
                             start=start2, end=end2, strand=rep(1, 3),
                             col=col[c(5, 3, 7)],
                             stringsAsFactor=FALSE))
ds_Plot <- as.dna_seg(data.frame(name="Plot",
                                  start=Plot, end=Plot, strand=1,
                                  col=col[c(1)],
                                  stringsAsFactor=FALSE), cex=cex, gene_type="text")

## comparison
c1 <- as.comparison(data.frame(start1=start1, end1=end1,
                               start2=start2, end2=end2,
                               col=grey(c(0.6, 0.8, 0.5))))

## Generate genoPlotR logo
## Not run:
cairo_pdf("logo.pdf", h=0.7, w=3)

## End(Not run)
par(fin=c(0.7, 3))
plot_gene_map(dna_segs=list(c(ds1, ds_genoR), c(ds2, ds_Plot)),
              comparisons=list(c1), scale=FALSE, dna_seg_scale=FALSE,
              dna_seg_line=grey(0.7), offsets=c(-20,160))

## Not run:
dev.off()

## End(Not run)
par(old.par)

```

Description

Calculate the range of `dna_seg` and comparisons.

Usage

```
## S3 method for class 'dna_seg'  
range(x, ...)  
## S3 method for class 'comparison'  
range(x, overall=TRUE, ...)  
## S3 method for class 'annotation'  
range(x, ...)
```

Arguments

<code>x</code>	Object to calculate the range from.
<code>overall</code>	Logical, TRUE by default. Should the range be calculated over the whole object? If FALSE, a range is calculated on each side of the comparison.
<code>...</code>	Unused.

Details

Calculate the overall range of a `dna_seg`, `comparison` or an `annotation` object.

Value

A numeric of length 2. For `comparison`, if `overall` is FALSE, a data frame with two rows and two columns, `xlim1` and `xlim2`.

Author(s)

Lionel Guy

See Also

[dna_seg](#), [comparison](#), [trim](#) for further examples.

Examples

```
## Load data  
data(three_genes)  
  
## On dna_seg  
dna_segs[[1]]  
range(dna_segs[[1]])  
  
## On comparison  
comparisons[[2]]  
range(comparisons[[2]])  
range(comparisons[[2]], overall=FALSE)
```

read_functions *Reading functions*

Description

Functions to parse dna_seg objects from tab, embl, genbank, fasta, ptt files or from mauve backbone files, and comparison objects from tab or blast files.

Usage

```
read_dna_seg_from_tab(file, header = TRUE, ...)
read_dna_seg_from_file(file, tagsToParse=c("CDS"), fileType = "detect",
                       meta_lines = 2, gene_type = "auto", header = TRUE,
                       extra_fields = NULL, ...)
read_dna_seg_from_embl(file, tagsToParse=c("CDS"), ...)
read_dna_seg_from_genbank(file, tagsToParse=c("CDS"), ...)
read_dna_seg_from_fasta(file, ...)
read_dna_seg_from_ptt(file, meta_lines = 2, header = TRUE, ...)
read_comparison_from_tab(file, header = TRUE, ...)
read_comparison_from_blast(file, sort_by = "per_id",
                           filt_high_evalue = NULL,
                           filt_low_per_id = NULL,
                           filt_length = NULL,
                           color_scheme = NULL, ...)
read_mauve_backbone(file, ref = 1, gene_type = "side_blocks",
                    header = TRUE, filter_low = 0,
                    common_blocks_only = TRUE, ...)
```

Arguments

file	Path to file to load. URL are accepted.
header	Logical. Does the tab file has headers (column names)?
tagsToParse	Character vector. Tags to parse in embl or genbank files. Common tags are 'CDS', 'gene', 'misc_feature'.
fileType	Character string. Select file type, could be 'detect' for automatic detection, 'embl' for embl files, 'genbank' for genbank files or 'ptt' for ptt files.
meta_lines	The number of lines in the ptt file that represent "meta" data, not counting the header lines. Standard for NCBI files is 2 (name and length, number of proteins. Default is also 2.
gene_type	Determines how genes are visualized. If 'auto' genes will appear as arrows in there are no introns and as blocks if there are introns. Can also be set to for example 'blocks' or 'arrows'. Do note, currently introns are not supported in the ptt file format. Default for mauve backbone is side_blocks. See gene_types page for more details, or use function <code>gene_types</code> .
extra_fields	NULL by default. If a character vector, parses extra fields in the genbank or embl file that have corresponding keys and put them in the resulting dna_seg.
sort_by	In BLAST-like tabs, gives the name of the column that will be used to sort the comparisons. Accepted values are per_id (percent identity, default), mism (mismatches), gaps (gaps), e_value (E-value), bit_score (bit score).

<code>filt_high_evalue</code>	A numerical, or NULL (default). Filters out all comparisons that have a e-value higher than this one.
<code>filt_low_per_id</code>	A numerical, or NULL (default). Filters out all comparisons that have a percent identity lower than this one.
<code>filt_length</code>	A numerical, or NULL (default). Filters out all comparisons that have alignments shorter than this value.
<code>color_scheme</code>	A color scheme to apply. See <code>apply_color_scheme</code> for more details. Possible values include <code>grey</code> and <code>red_blue</code> . NULL by default. Color schemes can be applied while running <code>plot_gene_map</code> .
<code>ref</code>	In mauve backbone, which of the dna segments will be the reference, i.e. which one will have its blocks in order.
<code>...</code>	Further arguments passed to generic reading functions and class conversion functions. See <code>as.dna_seg</code> and <code>as.comparison</code> . For <code>read_comparison*</code> functions, see details.
<code>filter_low</code>	A numeric. If larger than 0, all blocks smaller than this number will be filtered out. Defaults to 0.
<code>common_blocks_only</code>	A logical. If TRUE (by default), reads only common blocks (core blocks).

Details

Tab files representing DNA segments should have at least the following columns: name, start, end, strand (in that order). Additionally, if the tab file has headers, more columns will be used to define, for example, the color, line width and type, pch and/or cex. See `dna_seg` for more information. An example:

name	start	end	strand	col
feat1A	2	1345	1	blue
feat1B	1399	2034	1	red
feat1C	2101	2932	-1	grey
feat1D	2800	3120	1	green

Embl and Genbank files are two commonly used file types. These file types often contain a great variety of information. To properly extract data from these files, the user has to choose which features to extract. Commonly 'CDS' features are of interest, but other feature tags such as 'gene' or 'misc_feature' may be of interest. Should a feature contain an inner "pseudo" tag indicating this CDS or gene is a pseudo gene, this will be presented as a 'CDS_pseudo' or a 'gene_pseudo' feature type respectively in the resulting table. Certain constraints apply to these file types, of which some are: embl files must contain one and only one ID tag; genbank files may only contain one and only one locus tag. In these two files, the following tags are parsed (in addition to the regular name, start, end and strand): `protein_id`, `product`, `color` (or `colour`). In addition, extra tags can be parsed with the argument `extra_fields`. If there are more than one field with such a tag, only the first one is parsed.

Fasta files are read as one gene, as long as there are nucleotides in the fasta file.

Ptt (or protein table) files are a tabular format giving a bunch of information on each protein of a genome (or plasmid, or virus, etc). They are available for each published genome on the NCBI ftp site (`ftp://ftp.ncbi.nlm.nih.gov/genomes/`). As an example, look at `ftp://ftp.ncbi.nlm.nih.gov/genomes/Bacteria/Bartonella`

1/NC_005956.ptt.

Tabular comparison files should have at least the following columns: start1, end1, start2, end2. If no header is specified, the fifth column is parsed as the color.

start1	end1	start2	end2	col
2	1345	10	1210	red
1399	2034	2700	1100	blue
500	800	3000	2500	blue

BLAST tabular result files are produced either with blastall using -m8 or -m9 parameter, or with any of the newer blastn/blastp/blastx/tblastx using -outfmt 6 or -outfmt 7.

In the subsequent `plot_gene_map`, the comparisons are drawn in the order of the `comparison` object, i.e. the last rows of the comparison object are on the top in the plot. For comparisons read from BLAST output, the order can be modified by using the argument `sort_by`. In any case, the order of plotting can be modified by modifying the order of rows in the `comparison` object prior to plotting.

Mauve backbone is another tabular data file that summarizes the blocks that are similar between all compared genomes. Each genome gets two columns, one start and one end of the block. There is one row per block and eventually a header row. If named, columns have sequence numbers, not actual names, so be careful to input the same order in both Mauve and `genoPlotR`. See <http://asap.ahabs.wisc.edu/mauve-aligner/mauve-user-guide/mauve-output-file-formats.html> for more info on the file format. Normally, the function should be able to read both `progressiveMauve` and `mauveAligner` outputs. The function returns both the blocks as `dna_segs` and the links between the blocks as `comparisons`.

Value

`read_dna_seg_from_tab`, `read_dna_seg_from_file`, `read_dna_seg_from_embl`, `read_dna_seg_from_genbank` and `read_dna_seg_from_ptt` return `dna_seg` objects. `read_comparison_from_tab` and `read_comparison_from_blast` return `comparison` objects. `read_mauve_backbone` returns a list containing a list of `dna_segs` and `comparisons` objects.

Note

Formats are changing and it maybe that some functions are temporarily malfunctioning. Please report any bug to the author. Mauve examples were prepared with Mauve 2.3.1.

Author(s)

Lionel Guy, Jens Roat Kultima

References

For BLAST: <http://www.ncbi.nlm.nih.gov/blast/> For Mauve: <http://asap.ahabs.wisc.edu/mauve/>

See Also

[comparison](#), [dna_seg](#), [apply_color_scheme](#).

Examples

```

##
## From tabs
##
## Read DNA segment from tab
dna_seg3_file <- system.file('extdata/dna_seg3.tab', package = 'genoPlotR')
dna_seg3 <- read_dna_seg_from_tab(dna_seg3_file)

## Read comparison from tab
comparison2_file <- system.file('extdata/comparison2.tab',
                               package = 'genoPlotR')
comparison2 <- read_comparison_from_tab(comparison2_file)

##
## Mauve backbone
##
## File: this is only to retrieve the file from the genoPlotR
## installation folder.
bbone_file <- system.file('extdata/barto.backbone', package = 'genoPlotR')
## Read backbone
## To read your own backbone, run something like
## bbone_file <- "/path/to/my/file.bbone"
bbone <- read_mauve_backbone(bbone_file)
names <- c("B_bacilliformis", "B_grahamii", "B_henselae", "B_quintana")
names(bbone$dna_segs) <- names
## Plot
plot_gene_map(dna_segs=bbone$dna_segs, comparisons=bbone$comparisons)

## Using filter_low & changing reference sequence
bbone <- read_mauve_backbone(bbone_file, ref=2, filter_low=2000)
names(bbone$dna_segs) <- names
plot_gene_map(dna_segs=bbone$dna_segs, comparisons=bbone$comparisons)

## Read guide tree
tree_file <- system.file('extdata/barto.guide_tree', package = 'genoPlotR')
tree_str <- readLines(tree_file)
for (i in 1:length(names)){
  tree_str <- gsub(paste("seq", i, sep=""), names[i], tree_str)
}
tree <- newick2phylog(tree_str)
## Plot
plot_gene_map(dna_segs=bbone$dna_segs, comparisons=bbone$comparisons,
              tree=tree)

##
## From embl file
##
bq_embl_file <- system.file('extdata/BG_plasmid.embl', package = 'genoPlotR')
bq <- read_dna_seg_from_embl(bq_embl_file)

##
## From genbank file
##
bq_genbank_file <- system.file('extdata/BG_plasmid.gbk', package = 'genoPlotR')
bq <- read_dna_seg_from_file(bq_genbank_file, fileType="detect")

```



```

## Parsing extra fields in the genbank file
bq <- read_dna_seg_from_file(bq_genbank_file,
                             extra_fields=c("db_xref", "transl_table"))
names(bq)

##
## From ptt files
##
## From a file
bq_ptt_file <- system.file('extdata/BQ.ptt', package = 'genoPlotR')
bq <- read_dna_seg_from_ptt(bq_ptt_file)
## Read directly from NCBI ftp site:
url <- "ftp://ftp.ncbi.nih.gov/genomes/Bacteria/Bartonella_henselae_Houston-1/NC_005956.p
attempt <- 0
## Not run:
while (attempt < 5){
  attempt <- attempt + 1
  bh <- try(read_dna_seg_from_ptt(url))
  if (!inherits(bh, "try-error")) {
    attempt <- 99
  } else {
    print(paste("Tried", attempt, "times, retrying in 5s"))
    Sys.sleep(5)
  }
}

## End(Not run)
## If attempt to connect to internet fails
if (!exists("bh")){
  data(barto)
  bh <- barto$dna_segs[[3]]
}

##
## Read from blast
##
bh_vs_bq_file <- system.file('extdata/BH_vs_BQ.blastn.tab',
                             package = 'genoPlotR')
bh_vs_bq <- read_comparison_from_blast(bh_vs_bq_file, color_scheme="grey")

## Plot
plot_gene_map(dna_segs=list(BH=bh, BQ=bq), comparisons=list(bh_vs_bq),
              xlims=list(c(1,50000), c(1, 50000)))

```

reverse

Reverse objects

Description

Reverse objects, mainly dna_seg and comparison

Usage

```
reverse(x, ...)
## Default S3 method:
reverse(x, ...)
## S3 method for class 'dna_seg'
reverse(x, ...)
## S3 method for class 'comparison'
reverse(x, side = 0, ...)
```

Arguments

<code>x</code>	The object to reverse.
<code>...</code>	Unused.
<code>side</code>	In the case of comparisons, the side of the comparison that should be reversed. If <code>side=1</code> , the first side will be reversed. If <code>side=2</code> , the second side will be reversed. If <code>side<1</code> , no side is reversed. If <code>side>2</code> , both sides are reversed.

Value

The same object as input.

Author(s)

Lionel Guy

See Also

[dna_seg](#), [comparison](#)

Examples

```
## load data
data(three_genes)

## on dna_seg
dna_segs[[1]]
reverse(dna_segs[[1]])
## on comparison
reverse(comparisons[[2]], side=1)
reverse(comparisons[[2]], side=3)

## With mauve backbone
data(mauve_bbone)
## Plot
plot_gene_map(dna_segs=bbone$dna_segs, comparisons=bbone$comparisons)

## Reverse B_bacilliformis, and the corresponding comparison (first "side")
bbone$dna_segs[[1]] <- reverse(bbone$dna_segs[[1]])
bbone$comparisons[[1]] <- reverse(bbone$comparisons[[1]], 1)
plot_gene_map(dna_segs=bbone$dna_segs, comparisons=bbone$comparisons)
```

seg_plot

*seg_plot class and class functions***Description**

An `seg_plot` is an object to plot data associated to a `dna_seg` object. It is a `list` with mandatory and optional arguments. The main arguments are `func`, which is a function returning a `grob` or a `gList`, and `args`, which are arguments to be passed to this function.

Usage

```
seg_plot(func,
         args = NULL,
         xargs = c("x", "x0", "x1", "x2", "v"),
         yargs = c("y", "y0", "y1", "y2", "h"),
         ylim = NULL)
as.seg_plot(seg_plot)
is.seg_plot(seg_plot)
```

Arguments

<code>func</code>	Mandatory, with no defaults. A function that returns a <code>grob</code> object. See grid documentation to find ready-made functions. User-defined functions work too.
<code>args</code>	A list, <code>NULL</code> by default. The arguments that will be passed to the function. It is recommended that all arguments are named.
<code>xargs</code>	A vector giving the names of which of the arguments in <code>args</code> are defining the x-axis. Used, among others, by the function trim.seg_plot . By default, gives the most common x-defining arguments of the <code>grid</code> functions (<code>x</code> , <code>x0</code> , <code>x1</code> , <code>x2</code> , <code>v</code>).
<code>yargs</code>	A vector giving the names of which of the arguments in <code>args</code> are defining the y-axis. Used when plotting the graphs to define a sensible <code>ylim</code> if not defined. By default, gives the most common y-defining arguments of the <code>grid</code> functions (<code>y</code> , <code>y0</code> , <code>y1</code> , <code>y2</code> , <code>h</code>).
<code>ylim</code>	A numeric vector of length 2, defining the range of the plot when drawn with plot_gene_map . Derived from <code>yargs</code> if not set.
<code>seg_plot</code>	In <code>as.seg_plot</code> , a <code>list</code> object to convert to <code>seg_plot</code> . See details below. In <code>is.seg_plot</code> , an object to test.

Details

A `seg_plot` object is an object describing how to plot data associated to a `dna_seg`. It is a list composed of a function, arguments to pass to this function, two arguments to define which of those define x and y, and an eventual `ylim` to limit the plotting to a certain range when plotting.

The function `func` should return a `grob` object, or a `gList` list of `grobs`. The predefined functions of `grid`, such as `linesGrob`, `pointsGrob`, `segmentsGrob`, `textGrob` or `polygonGrob` can be used, or user-defined functions can be defined.

The arguments in `args` should correspond to arguments passed to `func`. For example, if `func = pointsGrob`, `args` could contain the elements `x = 10:1`, `y = 1:10`. It will often also contain a `gpar` element, the result of a call to the [gpar](#) function, to control graphical aspects of the plot such as color, fill, line width and style, fonts, etc.

Value

`seg_plot` and `as.seg_plot` return a `seg_plot` object. `is.seg_plot` returns a logical.

Author(s)

Lionel Guy

See Also

[plot_gene_map](#), [trim.seg_plot](#).

Examples

```
## Using the existing pointsGrob
x <- 1:20
y <- rnorm(20)
sp <- seg_plot(func=pointsGrob, args=list(x=x, y=y,
                                          gp=gpar(col=1:20, cex=1:3)))

is.seg_plot(sp)
## Function seg_plot(...) is identical to as.seg_plot(list(...))
sp2 <- as.seg_plot(list(func=pointsGrob, args=list(x=x, y=y,
                                                  gp=gpar(col=1:20, cex=1:3))))

identical(sp, sp2)
## For the show, plot the obtained result
grb <- do.call(sp$func, sp$args)
## Trim the seg_plot
sp_trim <- trim(sp, c(3, 10))
## Changing color and function "on the fly"
sp_trim$args$gp$col <- "blue"
sp_trim$func <- linesGrob
grb_trim <- do.call(sp_trim$func, sp_trim$args)
## Now plot
plot.new()
pushViewport(viewport(xscale=c(0,21), yscale=c(-4,4)))
grid.draw(grb)
grid.draw(grb_trim)

## Using home-made function
triangleGrob <- function(start, end, strand, col, ...) {
  x <- c(start, (start+end)/2, end)
  y1 <- 0.5 + 0.4*strand
  y <- c(y1, rep(0.5, length(y1)), y1)
  polygonGrob(x, y, gp=gpar(col=col), default.units="native",
             id=rep(1:7, 3))
}
start <- seq(1, 19, by=3)+rnorm(7)/3
end <- start + 1 + rnorm(7)
strand <- sign(rnorm(7))
sp_tr <- seg_plot(func=triangleGrob,
                 args=list(start=start, end=end, strand=strand,
                           col=1:length(start)), xargs=c("start", "end"))
grb_tr <- do.call(sp_tr$func, sp_tr$args)
plot.new()
pushViewport(viewport(xscale=c(1,22), yscale=c(-2,2)))
grid.draw(grb_tr)
## Trim
```

```

sp_tr_trim <- trim(sp_tr, xlim=c(5, 15))
str(sp_tr_trim)
## If the correct xargs are not indicated, trimming won't work
sp_tr$xargs <- c("x")
sp_tr_trim2 <- trim(sp_tr, xlim=c(5, 15))
identical(sp_tr_trim, sp_tr_trim2)

y1 <- convertY(grobY(grb_tr, "south"), "native")
y2 <- convertY(grobY(grb_tr, "north"), "native")
heightDetails(grb)
grb

## Applying it to plot_gene_maps
data(three_genes)

## Build data to plot
xs <- lapply(dna_segs, range)
colors <- c("red", "blue", "green")

seg_plots <- list()
for (i in 1:length(xs)){
  x <- seq(xs[[i]][1], xs[[i]][2], length=20)
  seg_plots[[i]] <- seg_plot(func=pointsGrob,
                            args=list(x=x, y=rnorm(20)+2*i,
                                       default.units="native", pch=3,
                                       gp=gpar(col=colors[i], cex=0.5)))
}
plot_gene_map(dna_segs, comparisons,
              seg_plots=seg_plots,
              seg_plot_height=0.5,
              seg_plot_height_unit="inches",
              dna_seg_scale=TRUE)

## A more complicated example
data(barto)
tree <- newick2phylog("(BB:2.5, (BG:1.8, (BH:1, BQ:0.8):1.9):3);")
## Showing several subsegments per genome
xlims2 <- list(c(1445000, 1415000, 1380000, 1412000),
               c( 10000,  45000,  50000,  83000,  90000, 120000),
               c( 15000,  36000,  90000, 120000, 74000,  98000),
               c(  5000,   82000))

## Adding fake data in 1kb windows
seg_plots <- lapply(barto$dna_segs, function(ds){
  x <- seq(1, range(ds)[2], by=1000)
  y <- jitter(seq(100, 300, length=length(x)), amount=50)
  seg_plot(func=linesGrob, args=list(x=x, y=y, gp=gpar(col=grey(0.3), lty=2)))
})
plot_gene_map(barto$dna_segs, barto$comparisons, tree=tree,
              seg_plots=seg_plots,
              seg_plot_height=0.5,
              seg_plot_height_unit="inches",
              xlims=xlims2,
              limit_to_longest_dna_seg=FALSE,
              dna_seg_scale=TRUE,
              main="Random plots for the same segment in 4 Bartonella genomes")

```

three_genes	<i>Three genes data set</i>
-------------	-----------------------------

Description

A set of three made-up genes, compared in three chromosomes.

Usage

```
data(three_genes)
```

Format

Two dataframes, representing the three genes in three DNA segments:

- `dna_segs` which is a list of three `dna_seg` objects, containing each three rows (or genes).
- `comparisons` which is a list of two `comparison` objects.

Examples

```
data(three_genes)
plot_gene_map(dna_segs, comparisons)
```

trim	<i>Trimming data frames or more complex objects with ≥ 2 numeric columns</i>
------	--

Description

Trims data frames with 2 or more numeric columns using a `xlim`. `xlim(s)` are as used to filter rows whose numeric values are included in this interval.

Usage

```
trim(x, ...)
## Default S3 method:
trim(x, xlim = NULL, ...)
## S3 method for class 'dna_seg'
trim(x, xlim = NULL, ...)
## S3 method for class 'comparison'
trim(x, xlim1 = c(-Inf, Inf), xlim2 = c(-Inf, Inf), ...)
## S3 method for class 'annotation'
trim(x, xlim = NULL, ...)
## S3 method for class 'seg_plot'
trim(x, xlim = NULL, ...)
```

Arguments

<code>x</code>	An object to trim, generally a data frame or a matrix, or a <code>seg_plot</code> object.
<code>xlim</code>	A numeric of length 2. In a general case, the rows whose values are included in this interval are returned.
<code>...</code>	Unused.
<code>xlim1</code>	A numeric of length 2. In the case of comparison, where the comparison can be filtered on two sides, the interval to filter the first side.
<code>xlim2</code>	A numeric of length 2. The interval to filter the second side.

Details

In the case where `x` is a `seg_plot` object, the function uses the `xargs` argument to define what are the vectors defining the `x` position (they should be the same length). Then, all the arguments (including those inside an eventual `gp` argument) that are the same length as the `x` vectors are trimmed, so that only the rows for which the `x` values are inside the `xlim` argument are kept.

Value

Returns the same object as input, with the rows (or subset) corresponding to the given interval.

Author(s)

Lionel Guy

See Also

[dna_seg](#), [comparison](#), [seg_plot](#).

Examples

```
## Load
data(barto)
xlim_ref <- c(10000, 45000)
## Seg 2 (ref)
barto$dna_segs[[2]] <- trim(barto$dna_segs[[2]], xlim=xlim_ref)
## Seg 1
barto$comparisons[[1]] <- trim(barto$comparisons[[1]], xlim2=xlim_ref)
xlim1 <- range(barto$comparisons[[1]], overall=FALSE)$xlim1
barto$dna_segs[[1]] <- trim(barto$dna_segs[[1]], xlim=xlim1)
## Seg 3
barto$comparisons[[2]] <- trim(barto$comparisons[[2]], xlim1=xlim_ref)
xlim3 <- range(barto$comparisons[[2]], overall=FALSE)$xlim2
barto$dna_segs[[3]] <- trim(barto$dna_segs[[3]], xlim=xlim3)
## Seg 4
barto$comparisons[[3]] <- trim(barto$comparisons[[3]], xlim1=xlim3)
xlim4 <- range(barto$comparisons[[3]], overall=FALSE)$xlim2
barto$dna_segs[[4]] <- trim(barto$dna_segs[[4]], xlim=xlim4)
## Plot
plot_gene_map(barto$dna_segs, barto$comparisons)

## With seg_plot
x <- 1:20
y <- rnorm(20)
sp <- seg_plot(func=pointsGrob, args=list(x=x, y=y,
```

```
gp=gpar(col=1:20, cex=1:3))  
## Trim  
sp_trim <- trim(sp, c(3, 10))  
str(sp_trim)  
range(sp_trim$arg$x)
```


Index

*Topic **IO**

read_functions, 29

*Topic **aplot**

genoPlotR-package, 2

*Topic **datasets**

barto, 10

chrY_subseg, 11

mauve_bbone, 19

three_genes, 38

*Topic **data**

annotation, 4

apply_color_scheme, 6

artemisColors, 8

auto_annotate, 9

c.dna_seg, 11

comparison, 12

dna_seg, 13

gene_types, 15

human_nt, 18

middle, 19

range.dna_seg, 27

reverse, 33

seg_plot, 35

trim, 38

*Topic **file**

read_functions, 29

*Topic **hplot**

plot_gene_map, 20

annotation, 4, 9, 20, 23, 24

apply_color_scheme, 6, 24, 31

artemisColors, 8

as.annotation(*annotation*), 4

as.comparison, 30

as.comparison(*comparison*), 12

as.dna_seg, 30

as.dna_seg(*dna_seg*), 13

as.seg_plot(*seg_plot*), 35

auto_annotate, 9

barto, 10

bbone (*mauve_bbone*), 19

c.dna_seg, 11

chrY_subseg, 11

comparison, 3, 7, 12, 23, 24, 28, 31, 34, 39

comparisons (*three_genes*), 38

dna_seg, 3, 9, 11, 13, 13, 16, 20, 23, 24, 28,
30, 31, 34, 39

dna_segs (*three_genes*), 38

gene_types, 15, 15, 23, 24, 29

genoPlotR (*genoPlotR-package*), 2

genoPlotR-package, 2

gList, 35

gpar, 35

grid, 35

grob, 35

human_nt, 18

is.annotation(*annotation*), 4

is.comparison(*comparison*), 12

is.dna_seg(*dna_seg*), 13

is.seg_plot(*seg_plot*), 35

mauve_bbone, 19

middle, 5, 19

phylog, 21

plot_gene_map, 3, 5, 16, 20, 35, 36

range.annotation(*range.dna_seg*),
27

range.comparison(*range.dna_seg*),
27

range.dna_seg, 27

read_comparison_from_blast, 3, 12,
13, 24

read_comparison_from_blast
(*read_functions*), 29

read_comparison_from_tab, 3, 12, 13,
24

read_comparison_from_tab
(*read_functions*), 29

read_dna_seg_from_embl
(*read_functions*), 29

`read_dna_seg_from_fasta`
 (*read_functions*), 29

`read_dna_seg_from_file`
 (*read_functions*), 29

`read_dna_seg_from_genbank`
 (*read_functions*), 29

`read_dna_seg_from_ptt`, 3, 14, 15, 24

`read_dna_seg_from_ptt`
 (*read_functions*), 29

`read_dna_seg_from_tab`, 3, 14, 15, 24

`read_dna_seg_from_tab`
 (*read_functions*), 29

`read_functions`, 3, 29

`read_mauve_backbone`, 19

`read_mauve_backbone`
 (*read_functions*), 29

`reverse`, 33

`reverse.comparison`, 13

`seg_plot`, 21, 23, 24, 35, 39

`three_genes`, 38

`trim`, 28, 38

`trim.comparison`, 13

`trim.seg_plot`, 35, 36