Package 'drawProteins'

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Title Package to Draw Protein Schematics from Uniprot API output

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Description This package draws protein schematics from Uniprot API output. From the JSON returned by the GET command, it creates a dataframe from the Uniprot Features API. This dataframe can then be used by geoms based on ggplot2 and base R to draw protein schematics.

Depends R (>= 4.0)

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`drawProteins` *drawProteins.*

Description

This package has been created to allow the visualisation of protein schematics based on the data obtained from the [Uniprot Protein Database](http://www.uniprot.org/).

`draw_canvas` *Create ggplot2 object with protein chains from feature database*

Description

`draw_canvas` uses the dataframe containing the protein features to creates the basic plot element by determining the length of the longest protein and the number of proteins to plot.

Usage

```
draw_canvas(data)
```

Arguments

data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.

Value

A ggplot2 object either in the plot window or as an object.

Examples

```
# draws a blank canvas of the correct size
data("five_rel_data")
draw_canvas(five_rel_data)
```

---

draw_chains *Create ggplot2 object with protein chains from feature database*

Description

draw_chains uses the dataframe containing the protein features to plot the chains, the full length proteins. It creates the basic plot element by determining the length of the longest protein. The ggplot2 function geom_rect is then used to draw each of the protein chains proportional to their number of amino acids (length).

Usage

```
draw_chains(p, data = data,
    outline = "black", fill = "grey",
    label_chains = TRUE, labels = data[data$type == "CHAIN",]$entryName,
    linewidth = 0.5, alpha = 1.0, label_size = 4)
```

Arguments

p	ggplot2 object ideally created with draw_canvas.
data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.
outline	Colour of the outline of each chain.
fill	Colour of the fill of each chain.
label_chains	Option to label chains or not.
labels	Vector with source of names for the chains. EntryName used as default but can be changed.
linewidth	Thickness of the outline of the chains.
alpha	Transparency of the rectangles representing the chains.
label_size	Size of the text used for labels.

Value

A ggplot2 object either in the plot window or as an object.

Examples

```
# combines with draw_canvas to plot and label chains.
data("five_rel_data")
p <- draw_canvas(five_rel_data)
draw_chains(p, five_rel_data)

# draws five chains with different colours to default
data("five_rel_data")
p <- draw_canvas(five_rel_data)
draw_chains(p, five_rel_data,
    label_chains = FALSE,
    fill = "red",
    outline = "grey")
```

---

draw_domains *Add protein domains to ggplot2 object.*

Description

draw_domains adds domains to the ggplot2 object created by draw_chains. It uses the data object. The ggplot2 function geom_rect is used to draw each of the domain chains proportional to their number of amino acids (length).

Usage

```
draw_domains(p,
         data = data,
         label_domains = TRUE,
         label_size = 4,
         alpha = 1.0,
         show.legend = TRUE,
         type = "DOMAIN")
```

Arguments

p	ggplot2 object ideally created with draw_canvas.
data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.
label_domains	Option to label domains or not.
label_size	Size of the text used for labels.
alpha	Transparency of the rectangles representing the domains.

show.legend	Option to include legend in this layer
type	Can change to show other protein features

Value

A ggplot2 object either in the plot window or as an object with an additional geom_rect layer.

Examples

```
# combines with draw_chains to plot chains and domains.
data("five_rel_data")
p <- draw_canvas(five_rel_data)
p <- draw_chains(p, five_rel_data, label_size = 1.25)
draw_domains(p, five_rel_data)
```

---

draw_folding *Add regions to ggplot object: alpha-helixes, beta-strands and turns.*

Description

draw_folding adds alpha-helixes, beta-strands and turns to the ggplot2 object created by draw_chains. It uses the data object. The ggplot2 function geom_rect is used to draw parts of the protein chain which has alpha-helixes, beta-strands and turns proportional to the number of amino acids (length).

Usage

```
draw_folding(p, data = data,
show.legend = TRUE,show_strand = TRUE,show_helix = TRUE, show_turn = TRUE,
alpha = 1.0)
```

Arguments

p	ggplot2 object ideally created with draw_canvas.
data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Uses STRAND, HELIX and TURN type to indicate these parts of the proteins.
show.legend	Option to include legend in this layer
show_strand	Option to show STRAND in this layer
show_helix	Option to show HELIX in this layer
show_turn	Option to show TURN in this layer
alpha	alpha Transparency of the rectangles representing the folds.

Value

A ggplot2 object either in the plot window or as an object with an additional geom_rect layer.

Examples

```
# combines with draw_chains to colour chain with helicies, strands and turns.
data("five_rel_data")
p <- draw_canvas(five_rel_data)
p <- draw_chains(p, five_rel_data, label_size = 1.25)
draw_folding(p, five_rel_data)
```

`draw_motif` *Add protein motifs sites to ggplot2 object.*

Description

`draw_motif` adds protein motifs from Uniprot to ggplot2 object created by `draw_canvas` and `draw_chains`. It uses the data object. The ggplot2 function `geom_rect` is used to draw each of the motifs proportional to their number of amino acids (length).

Usage

```
draw_motif(p, data = data, alpha = 1.0, show.legend = TRUE)
```

Arguments

`p`	ggplot2 object ideally created with `draw_canvas`.
`data`	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.
`alpha`	Transparency of the rectangles representing the motifs.
`show.legend`	Option to include legend in this layer

Value

A ggplot2 object either in the plot window or as an object with an additional geom_rect layer.

Examples

```
# combines with draw_chains to plot chains and motifs
data("five_rel_data")
p <- draw_canvas(five_rel_data)
p <- draw_chains(p, five_rel_data, label_size = 1.25)
draw_motif(p, five_rel_data)
```

draw_phospho *Add protein phosphorylation sites to ggplot2 object.*

Description

draw_phospho adds phosphorylation sites to ggplot2 object created by draw_canvas and draw_chains. It uses the data object. The ggplot2 function geom_point is used to draw each of the phosphorylation sites at their location as determined by data object.

Usage

```
draw_phospho(p, data = data, size = 2,
         fill = "yellow", alpha = 1.0, show.legend = FALSE)
```

Arguments

p	ggplot2 object ideally created with draw_canvas.
data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.
size	Size of the circle
fill	Colour of the circle.
alpha	Transparency of the circles representing the protein phosphorylation sites.
show.legend	Option to include legend in this layer

Value

A ggplot2 object either in the plot window or as an object with an additional geom_point layer.

Examples

```
# combines will with draw_domains to plot chains and phosphorylation sites.
data("five_rel_data")
p <- draw_canvas(five_rel_data)
p <- draw_chains(p, five_rel_data, label_size = 1.25)
draw_phospho(p, five_rel_data)
```

draw_recept_dom *Add receptor domains to ggplot2 object.*

Description

draw_recept_dom adds receptor domains to the ggplot2 object created by draw_chains. It uses the data object. The ggplot2 function geom_rect is used to draw each of the domain chains proportional to their number of amino acids (length).

Usage

```
draw_recept_dom(p, data = data, alpha = 1.0, label_domains = FALSE, label_size = 4,
         show.legend = TRUE)
```

Arguments

p	ggplot2 object ideally created with draw_canvas.
data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Uses TOPO_DOM and TRANSMEM type to plot these parts of receptors
alpha	Transparency of the rectangles representing the receptor domains.
label_domains	Option to label receptor domains or not.
label_size	Size of the text used for labels.
show.legend	Option to include legend in this layer

Value

A ggplot2 object either in the plot window or as an object with an additional geom_rect layer.

Examples

```
# combines with draw_chains to plot chains and domains.
# we like to draw receptors vertically so flip using ggplot2 functions
# scale_x_reverse and coord_flip
data("tnfs_data")
p <- draw_canvas(tnfs_data)
p <- draw_chains(p, tnfs_data, label_size = 1.25)
draw_recept_dom(p, tnfs_data) + ggplot2::scale_x_reverse() +
ggplot2::coord_flip()
```

draw_regions *Add protein region sites to ggplot2 object.*

Description

draw_regions adds protein regions from Uniprot to ggplot2 object created by draw_canvas draw_chains. It uses the data object. The ggplot2 function geom_rect is used to draw each of the regions proportional to their number of amino acids (length).

Usage

```
draw_regions(p, data = data, alpha = 1.0, show.legend=TRUE)
```

Arguments

p	ggplot2 object ideally created with draw_canvas.
data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.
alpha	Transparency of the rectangles representing the regions.
show.legend	Option to include legend in this layer

Value

A ggplot2 object either in the plot window or as an object with an additional geom_rect layer.

Examples

```
# combines with draw_chains to plot chains and regions.
data("five_rel_data")
p <- draw_canvas(five_rel_data)
p <- draw_chains(p, five_rel_data, label_size = 1.25)
draw_regions(p, five_rel_data)
```

draw_repeat *Add protein repeats sites to ggplot2 object.*

Description

draw_repeat adds protein repeats from Uniprot to ggplot2 object created by draw_canvas and draw_chains. It uses the data object. The ggplot2 function geom_rect is used to draw each of the motifs proportional to their number of amino acids (length).

Usage

```
draw_repeat(p, data = data, label_size = 2, outline = "dimgrey",
            fill = "dimgrey", alpha = 1.0,
            label_repeats = TRUE, show.legend = TRUE)
```

Arguments

p	ggplot2 object ideally created with draw_canvas.
data	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.
label_size	Size of text used for labels of protein repeats.
outline	Colour of the outline of each repeat.
fill	Colour of the fill of each repeat.
alpha	Transparency of the rectangles representing the repeats.
label_repeats	Option to label repeats or not.
show.legend	Option to include legend in this layer

Value

A ggplot2 object either in the plot window or as an object with an additional geom_rect layer.

Examples

```
# combines with draw_chains to plot chains and repeats.
data("five_rel_data")
p <- draw_canvas(five_rel_data)
p <- draw_chains(p, five_rel_data, label_size = 1.25)
draw_repeat(p, five_rel_data)
```

---

extract_feat_acc *Create a dataframe of protein features from JSON object (List of 6)*

Description

Converts the list of 6 JSON object created by getting the features from UniProt. Used in the feature_to_dataframe(). Does not give order. Does not operate on List of lists - just the list of 6.

Usage

```
extract_feat_acc(features_list)
```

Arguments

features_list	A JSON object - list of 6 with features inside. Created as one of the lists in the list of lists by the get_features() function.

Value

A dataframe with features: "type", "description", "begin", "end" and adds accession, entryName and taxid for each row.

Examples

```
data("five_rel_list")
one_protein_features <- extract_feat_acc(five_rel_list[[1]])
head(one_protein_features)
```

---

extract_names *Extract protein names into a list*

Description

Extracts protein names from JSON object produced by a search of Uniprot with a single protein asking for all the information. The search produces a Large list that contains all the Uniprot information about a protein.

Usage

```
extract_names(protein_json)
```

Arguments

protein_json	A JSON object from a search with 14 primary parts

Value

A List of 6 with "accession", "name", "protein.recommendedName.fullName", gene.name.primary, gene.name.synonym and organism.name.scientific

Examples

```
# using internal data
data("protein_json")
prot_names <- extract_names(protein_json)
# generates a list of 6

## Not run:
# access the Uniprot Protein API
uniprot_acc <- c("Q04206")  # change this for your fav protein
# Get UniProt entry by accession
```

```
acc_uniprot_url <-
    c("https://www.ebi.ac.uk/proteins/api/proteins?accession=")
comb_acc_api <- paste0(acc_uniprot_url, uniprot_acc)
# basic function is GET() which accesses the API
# requires internet access
protein <- httr::GET(comb_acc_api, accept_json())
status_code(protein)  # returns a 200 means it worked
# use content() function from httr to give us a list
protein_json <- httr::content(protein) # gives a Large list
# with 14 primary parts and lots of bits inside
# function from my package to extract names of protein
names <- extract_names(protein_json)

## End(Not run)
```

`extract_transcripts` *Create a new dataframe of protein features from dataframe with multiple transcripts separated so that each transcript is drawn separtely with only the appropriate features.*

Description

This function works on the object returned by the get_features() function. It creates a data.frame of features and includes the accession number AND an order number. It uses the extract_feat_acc function

Usage

```
extract_transcripts(data)
```

Arguments

`data`	Dataframe of one or more rows with the following column names: 'type', 'description', 'begin', 'end', 'length', 'accession', 'entryName', 'taxid', 'order'. Must contain a minimum of one "CHAIN" as data$type.

Value

A dataframe with extra rows if there were multiple transcripts present. Extra transcripts will have an order at the end of the object Each new row should have 9 variables including type, description, begin, end, length, accession, entryName, taxid and order for plotting.

Examples

```
data(five_rel_data)
new_data <- extract_transcripts(five_rel_data)
# because there are two entries with two transcripts
max(new_data$order) # should now be 7...
```

feature_to_dataframe *Create a dataframe of protein features from JSON object*

Description

This function works on the object returned by the get_features() function. It creates a data.frame of features and includes the accession number AND an order number. It uses the extract_feat_acc function below.

Usage

```
feature_to_dataframe(features_in_lists_of_six)
```

Arguments

features_in_lists_of_six	A list of lists returned by get_features() The number of lists corresponds to the number of accession numbers queried using get_features. The list of 6 contains protein names and features.

Value

A dataframe with 9 variables including type, description, begin, end, length, accession, entryName, taxid and order for plotting.

Examples

```
data("rel_json")
rel_data <- feature_to_dataframe(rel_json)
head(rel_data)

data("five_rel_list")
prot_data <- feature_to_dataframe(five_rel_list)
head(prot_data)
```

five_rel_data *Dataframe features of 5 human NFkappaB proteins Uniprot on 1 Nov 2017*

Description

Dataframe features of 5 human NFkappaB proteins Uniprot on 1 Nov 2017

Usage

```
five_rel_data
```

Format

A data frame with 320 rows and 9 variables:

type type of features - e.g. chain

description long name for the protein

begin starting position (amino acid number) of feature

end ending position (amino acid number) of feature

length length of feature - number of amino acids

accession protein Uniprot accession number

entryName protein Uniprot entry Name

taxid taxonomic identification - species

order plotting order from the bottom of the graph

Value

A data frame with 320 rows and 9 variables

Source

Uniprot http://www.uniprot.org Accession numbers Q04206 Q01201 Q04864 P19838 Q00653

---

five_rel_list *Features of five human Rel A proteins*

Description

List of features from five human NFkappaB proteins downloaded from Uniprot on 15 August 2017

Usage

```
five_rel_list
```

Format

Large List of 5 elements - one element for each protein

Value

Large List of 5 elements - one element for each protein

Source

Uniprot http://www.uniprot.org Accession numbers Q04206 Q01201 Q04864 P19838 Q00653

get_features *GET features of protein(s) from UniProt API*

Description

This function creates the URL required to query the UniProt API and returns the features of the protein or proteins in JSON format. It uses the GET() function from the httr package.

Usage

```
get_features(proteins_acc)
```

Arguments

proteins_acc	A vector of length 1 with one or more UniProt accession numbers separated by spaces.

Value

If there is internet access and the UniProt accession numbers are good, the function will return a list of lists. The list will be of length equivalent to the number of Uniprot accession numbers supplied. The lists inside will be of length 6 and will contain information about the proteins and the features.

Examples

```
# Requires internet access
prot_data <- get_features("Q04206 Q01201 Q04864 P19838 Q00653")
```

parse_gff *Reformat file or url in gff format to allow to draw*

Description

parse_gff loads a file or downloads from an url if provided protein information that is then changed to allow it to work with draw_canvas and other draw functions in drawProteins.

Usage

```
parse_gff(file_or_link)
```

Arguments

file_or_link	link in gff format or a file in gff format that can be read by read_tsv function from the readr package.

Value

Dataframe of one or more rows with the following column names: 'accession', 'source', 'type', 'begin', 'end', 'order', 'entryName', 'description'. Must contain a minimum of one "CHAIN" as data$type to allow plotting.

Examples

```
data <- parse_gff("https://www.uniprot.org/uniprot/Q04206.gff")
```

---

phospho_site_info *Create a dataframe of protein features from JSON object*

Description

Reduces data.frame of features to just phosphorylation sites. Uses a subsetting step and a grep with the pattern "Phospho".

Usage

```
phospho_site_info(features)
```

Arguments

features	A dataframe of protein features, for example created by the feature_to_dataframe() function.

Value

A dataframe that only contains protein phosphorylation sites from Uniprot

Examples

```
data("five_rel_data")
sites <- phospho_site_info(five_rel_data)
head(sites)
```

protein_json *Uniprot infor human Rel A protein in JSON format*

Description

Large list (968.8 Kb) of information about human Rel A downloaded from Uniprot on 1 November 2017

Usage

```
protein_json
```

Format

List of 1 with List of 14 inside

Value

List of 6 - information necessary to draw Rel A/p65

Source

http://www.uniprot.org/uniprot/Q04206

rel_A_features *Features of human Rel A protein*

Description

List of features from human Rel A downloaded from Uniprot on 15 August 2017

Usage

```
rel_A_features
```

Format

List of 6 - information necessary to draw Rel A/p65

Value

List of 6 - information necessary to draw Rel A/p65

Source

http://www.uniprot.org/uniprot/Q04206

rel_json — *Human Rel A protein features in JSON format*

Description

List of 1 with List of 6 inside downloaded from Uniprot on 1 November 2017

Usage

```
rel_json
```

Format

List of 1 with List of 6 - information necessary to draw Rel A/p65

Value

List of 1 with List of 6 - information necessary to draw Rel A/p65

Source

http://www.uniprot.org/uniprot/Q04206

tnfs_data — *Dataframe features of 2 human TNF receptors from Uniprot on 3 Jan 2018*

Description

Dataframe features of 2 human TNF receptors from Uniprot on 3 Jan 2018

Usage

```
tnfs_data
```

Format

A data frame with 127 rows of 9 variables:

type type of features - e.g. chain
description long name for the protein
begin starting position (amino acid number) of feature
end ending position (amino acid number) of feature
length length of feature - number of amino acids
accession protein Uniprot accession number
entryName protein Uniprot entry Name
taxid taxonomic identification - species
order plotting order from the bottom of the graph

Value

A data frame with 127 rows and 9 variables

Source

Uniprot http://www.uniprot.org Accession numbers P19438 P25942

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