Package 'punKEGGer'

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Title Parse, Expand, Annotate and Visualize KEGG Pathway Networks as Tidy Graphs

Version 0.99.65

Description Provides tools to parse KEGG pathway KGML files into tidy graphs, expand metanodes (e.g., multi-gene entries), annotate them with custom dictionaries, and produce consistent visualizations using ggraph. Enables integration of KEGG pathways with tidygraph-based workflows.

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`add_kegg_layout` *Add KEGG layout coordinates to a tidygraph*

Description

Joins a KEGG layout table (as returned by `layout_kegg()`) to a tidygraph object, using the `meta_id` field of each node as the key.

Usage

```
add_kegg_layout(graph, layout_tbl)
```

Arguments

`graph`	A `tidygraph` object, where each node has a `meta_id`.
`layout_tbl`	A tibble with layout coordinates: `id`, `x`, `y`.

Value

The same `tidygraph`, with `x` and `y` coordinates added to nodes.

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
doc <- xml2::read_xml(kgml_file)

g <- combine_kegg_network(doc)
layout_tbl <- layout_kegg(doc)
g_layout <- add_kegg_layout(g, layout_tbl)

# View the layout coordinates
head(tidygraph::as_tibble(g_layout))
```

annotate_kegg_graph *Annotate a KEGG tidygraph with custom identifiers*

Description

Adds external identifiers (e.g., HGNC symbols, Ensembl IDs) to the nodes of a tidygraph-style KEGG network, using a custom dictionary.

Usage

```
annotate_kegg_graph(graph, kegg_dict, identifiers = c("hgnc_symbol"))
```

Arguments

graph	A tidygraph object (nodes should be named with KEGG IDs).
kegg_dict	A tibble with one column kegg_id, plus any other IDs (e.g. hgnc_symbol, ensembl_id, etc.).
identifiers	Character vector of column names in kegg_dict to attach (default: "hgnc_symbol").

Details

Note: You must provide your own annotation dictionary (kegg_dict) as a tibble with at least one column named kegg_id, containing KEGG gene IDs in the form "hsa:1234". This dictionary can be generated from BioMart or other curated sources.

Value

The same tidygraph, with new columns added to the node attributes.

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
dict_file <- system.file("extdata", "example_dict.hsa04210.csv", package = "punKEGGer")

doc <- xml2::read_xml(kgml_file)
dict <- read.csv(dict_file)
nodes <- extract_kegg_nodes(doc)
meta_dict <- create_meta_dict(nodes, dict)
g <- combine_kegg_network(doc)
g_annot <- annotate_kegg_graph(g, meta_dict)
head(tidygraph::as_tibble(g_annot))
```

combine_kegg_network *Combine KEGG group and relation edges into a tidygraph*

Description

Parses both standard KEGG relations and intra-group edges, and builds a directed tidygraph. Also assigns meta_id to each node: either its group_id (if in a group) or its own ID.

Usage

```
combine_kegg_network(kgml)
```

Arguments

kgml	A parsed XML document from `xml2::read_xml()`.

Value

A `tidygraph` object with all edges from the KGML and nodes carrying `meta_id`.

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
doc <- xml2::read_xml(kgml_file)
g <- combine_kegg_network(doc)
print(g)
igraph::gorder(g)
```

create_meta_dict *Create a meta_id-to-annotation dictionary*

Description

Takes the output of `extract_kegg_nodes()` and a KEGG annotation dictionary (e.g., from BioMart or custom source), and merges them based on `kegg_id`. This enables annotating each metanode (`meta_id`) with HGNC, Ensembl, Entrez, etc.

Usage

```
create_meta_dict(node_info, kegg_dict)
```

Arguments

node_info	A tibble from `extract_kegg_nodes()` with `meta_id` and `kegg_id` columns.
kegg_dict	A tibble mapping KEGG gene IDs to external identifiers. Must contain a column `kegg_id` with KEGG-formatted IDs (e.g., `"hsa:1234"`).

Value

A tibble linking each `meta_id` to any identifiers in `kegg_dict`.

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
dict_file <- system.file("extdata", "example_dict.hsa04210.csv", package = "punKEGGer")

doc <- xml2::read_xml(kgml_file)
nodes <- extract_kegg_nodes(doc)
dict <- read.csv(dict_file)
meta_dict <- create_meta_dict(nodes, dict)
head(meta_dict)
```

---

expand_metagraph *Expand a KEGG tidygraph by unrolling multi-gene metanodes*

Description

Takes a tidygraph where node names are KGML entry IDs and expands the network by replacing group/multi-gene nodes with individual gene-level edges.

Usage

```
expand_metagraph(g, node_info, node_types = c("gene"))
```

Arguments

g	A tidygraph object, typically created by combine_kegg_network().
node_info	A tibble as returned by extract_kegg_nodes().
node_types	Character vector indicating which node types to expand (default is "gene").

Value

A new tidygraph object with expanded node IDs (e.g., hsa:00001, hsa:00002).

Examples

```
# Parse KGML and extract nodes and relations
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
doc <- xml2::read_xml(kgml_file)
node_info <- extract_kegg_nodes(doc)
rels <- parse_kegg_relations_clean(doc)
g <- combine_kegg_network(doc)

# Expand the graph from metanodes to gene-level nodes
g_exp <- expand_metagraph(g, node_info)

# Compare number of nodes before and after expansion
igraph::gorder(g)      # number of metanodes
igraph::gorder(g_exp)  # number of gene-level nodes
```

extract_kegg_nodes *Extract KEGG node information from a KGML file*

Description

Parses all `entry` elements from a KEGG KGML XML document and extracts ID, name, type, and individual KEGG IDs. Supports multi-gene entries (e.g., `hsa:1234+hsa:5678`) by expanding them into separate rows with a shared `meta_id`.

Usage

```
extract_kegg_nodes(kgml)
```

Arguments

`kgml`	A parsed XML document from `xml2::read_xml()`.

Value

A tibble with columns: `id`, `meta_id`, `type`, `kegg_id`

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
doc <- xml2::read_xml(kgml_file)
nodes <- extract_kegg_nodes(doc)
head(nodes)
```

fetch_kegg_kgml *Fetch a KEGG pathway KGML via KEGGREST*

Description

Downloads a KEGG pathway in KGML format using `KEGGREST::keggGet()` and returns it as an `xml2` document ready for downstream parsing with `punKEGGer`.

Usage

```
fetch_kegg_kgml(pathway_id)
```

Arguments

`pathway_id`	A KEGG pathway identifier, e.g. `"hsa04210"`.

Value

An `xml2` document.

Examples

```
kgml <- fetch_kegg_kgml("hsa04210")
g <- combine_kegg_network(kgml)
```

layout_kegg *Extract node layout coordinates from a KEGG KGML file*

Description

Parses the graphics element of each node in the KGML to extract manual layout positions (x, y), which are typically defined for KEGG maps.

Usage

```
layout_kegg(kgml)
```

Arguments

kgml	A parsed XML document from xml2::read_xml().

Value

A tibble with columns: id, x, y (corresponding to KEGG entry IDs).

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
doc <- xml2::read_xml(kgml_file)
layout_tbl <- layout_kegg(doc)
head(layout_tbl)
```

parse_kegg_groups *Parse KEGG group nodes from a KGML file*

Description

Extracts group-type entries from a KEGG KGML file and generates both: (1) a mapping of group ID to component node IDs (with meta_id), (2) a set of intra-group edges linking the components as undirected pairs.

Usage

```
parse_kegg_groups(kgml)
```

Arguments

kgml	A parsed XML document from xml2::read_xml(), representing a KEGG KGML file.

Value

A list with two elements:

mapping A tibble mapping each member ID to its meta_id (group_id or itself).

edges A tibble with pairwise intra-group edges (from, to, type = "group").

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
doc <- xml2::read_xml(kgml_file)
group_data <- parse_kegg_groups(doc)
head(group_data$mapping)
head(group_data$edges)
```

`parse_kegg_relations_clean` *Parse clean KEGG relations from a KGML file*

Description

Extracts pairwise relations between KEGG entries and their subtypes if available.

Usage

```
parse_kegg_relations_clean(kgml)
```

Arguments

`kgml`	A parsed XML document from `xml2::read_xml()`.

Value

A tibble with columns: `from`, `to`, `type`, `subtype`.

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
doc <- xml2::read_xml(kgml_file)
rels <- parse_kegg_relations_clean(doc)
head(rels)
```

`plot_kegg_graph` *Visualize a KEGG pathway tidygraph using manual layout*

Description

Generates a `ggraph` plot of a KEGG network with manual layout (x, y), colored by node type and edge subtype. The user can specify which identifier to display on each node label (e.g., `hgnc_symbol`).

Usage

```
plot_kegg_graph(g, id = hgnc_symbol)
```

Arguments

g	A tidygraph object, where nodes contain x, y, type, and a label column (e.g. hgnc_symbol).
id	Unquoted column name to use for node labels (e.g., hgnc_symbol, kegg_id). Default: hgnc_symbol.

Value

A ggplot object with the KEGG network visualization.

Examples

```
kgml_file <- system.file("extdata", "hsa04210.xml", package = "punKEGGer")
dict_file <- system.file("extdata", "example_dict.hsa04210.csv", package = "punKEGGer")

kgml <- xml2::read_xml(kgml_file)
g <- combine_kegg_network(kgml)

node_info <- extract_kegg_nodes(kgml)
dict <- read.csv(dict_file)
meta_dict <- create_meta_dict(node_info, dict)

g_exp <- expand_metagraph(g, node_info, node_types = "gene")
g_annot <- annotate_kegg_graph(g_exp, meta_dict, identifiers = "hgnc_symbol")

layout_tbl <- layout_kegg(kgml)
g_layout <- add_kegg_layout(g_annot, layout_tbl)

plot_kegg_graph(g_layout, id = hgnc_symbol)
```

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