Title  Representing Different Biological Sets

Version  1.16.1

Description  BiocSet displays different biological sets in a triple tibble format. These three tibbles are `element`, `set`, and `elementset`. The user has the ability to activate one of these three tibbles to perform common functions from the dplyr package. Mapping functionality and accessing web references for elements/sets are also available in BiocSet.

Depends  R (>= 3.6), dplyr

Imports  methods, tibble, utils, rlang, plyr, S4Vectors, BiocIO, AnnotationDbi, KEGGREST, ontologyIndex, tidyr

Suggests  GSEABase, airway, org.Hs.eg.db, DESeq2, limma, BiocFileCache, GO.db, testthat, knitr, rmarkdown, BiocStyle

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BiocSet

Description

character()

The BiocSet constructor, the show method, the slot accessors, and creating a BiocSet object from an element set tibble rather than character vector(s).

Usage

BiocSet(..., metadata = list(), active = c("elementset", "element", "set"))

## S4 method for signature 'BiocSet'
show(object)

es_element(x)

## S4 method for signature 'BiocSet'
es_element(x)

es_set(x)

## S4 method for signature 'BiocSet'
es_set(x)
BiocSet

es_elementset(x)

## S4 method for signature 'BiocSet'
es_elementset(x)

BiocSet_from_elementset(elementset, element, set, metadata)

### Arguments

... Named character() vectors of element sets, or a named list of character() vectors. Each character vector is an element set. The names of the character vectors are the names of the sets.

metadata A list() with arbitrary content, describing the set.

active A character(1) to indicate which tibble is active. The default is "elementset".

object A BiocSet object.

x A BiocSet object.

elementset A tibble with element set information.

element A tibble with element information.

set A tibble with set information.

### Value

An S4 BiocSet object shown as a tripple tibble, where each slot is a tibble.

### Slots

- **element** The element tibble from 'tbl_elementset'
- **set** The set tibble from 'tbl_elementset'
- **elementset** The elementset tibble created from user input
- **active** A character(1), indicates which tibble is active
- **metadata** A list() with arbitrary elements describing the set

### Examples

```r
BiocSet(set1 = letters, set2 = LETTERS)
lst <- list(set1 = letters, set2 = LETTERS)
BiocSet(lst)

set.seed(123)

element <-
tibble(
  element = letters[1:10],
  v1 = sample(10),
  v2 = sample(10)
)

set <-
```
```r
tibble(
    set = LETTERS[1:2],
    v1 = sample(2),
    v2 = sample(2)
)  
elementset <-
  tibble(
    element = letters[1:10],
    set = sample(LETTERS[1:2], 10, TRUE)
  )
BiocSet_from_elementset(elementset, element, set)
```

---

**BiocSet-methods**  
**BiocSet methods**

### Description

- **es_activate**: which of the three tibbles in the BiocSet object should be activated and have the chosen functionality applied to it.
- **filter**: choose rows where conditions are true.
- **select**: keep only the variables listed.
- **mutate**: add new variable and preserve the existing variables.
- **summarise**: usually used with `group_by()`, output will have one row for each group.
- **arrange**: order rows by an expression involving its variables.
- **.tbl_nongroup_vars**: returns only non-grouping variables.
- **group_by**: converts an existing tbl into a grouped tbl.
- **left_join**: returns all rows from `x`, and all columns from `x` and `y`. If no rows in `x` match with `y` there will be NAs in the new column. If there are multiple matches then all combinations are returned.
- **as.list**: coerces argument into a list.
- **union**: combines all rows from two BiocSet objects and removes duplicate records from the combined BiocSet object.
- **intersect**: combines all rows from two BiocSet objects and returns rows that appear in both BiocSet objects.

### Usage

```r
es_activate(.data, what)

## S3 method for class 'BiocSet'
filter(.data, ...)

## S3 method for class 'BiocSet'
select(.data, ...)
```
## S3 method for class 'BiocSet'
mutate(.data, ...)

## S3 method for class 'BiocSet'
summarise(.data, ...)

## S3 method for class 'BiocSet'
arrange(.data, ...)

.tbl_nongroup_vars.BiocSet(x)

## S3 method for class 'BiocSet'
group_by(.data, ..., add = FALSE)

## S3 method for class 'BiocSet'
left_join(x, y, by, copy, suffix, ...)

## S3 method for class 'BiocSet'
as.list(x, ...)

## S3 method for class 'BiocSet'
union(x, y, ...)

## S3 method for class 'BiocSet'
intersect(x, y, ...)

### Arguments

- `.data` The BiocSet object.
- `what` Which of the three tibbles from BiocSet to activate.
- `...` Additional arguments passed to function.
- `x` For `.tbl_nongroup_vars` (internal), a BiocSet object. For union and intersect the first BiocSet object to perform the operations on.
- `add` logical, whether to add to the existing groups.
- `y` For `left_join`, a tibble to join. For union and intersect the second BiocSet object used.
- `by` A character vector of variables to join by.
- `copy` logical, allows you to join tables across srcs.
- `suffix` Character vector of length 2, if there are non-joined duplicate variables in `x` and `y` these suffixes will be added to the output.

### Value

A BiocSet object.
Examples

```r
es <- BiocSet(set1 = letters, set2 = LETTERS)
es_activate(es, element)

es %>% es_activate(element) %>% filter(element == "a")
es %>% select(element)
es %>% es_activate(set) %>% mutate(pval = rnorm(1:2))
es %>% es_activate(set) %>% summarise(n = n())
es %>% es_activate(element) %>% arrange(desc(element))
es %>% mutate(pval = rnorm(1:52)) %>% es_elementset() %>%
  BiocSet:::.tbl_nongroup_vars()
es %>% group_by(element, set)

es <- BiocSet(set1 = letters[1:5], set2 = LETTERS[1:5])
tbl <- tibble(x = 1:10, y = c(letters[1:5], LETTERS[1:5]))
es %>% left_join(tbl, by = c(element = "y"))

library(org.Hs.eg.db)
es <- go_sets(org.Hs.eg.db, "ENSEMBL")
head(as.list(es))

es1 <- BiocSet(set1 = letters[c(1:4)], set2 = LETTERS[c(1:4)])
es2 <- BiocSet(set1 = letters[c(3:8)], set2 = LETTERS[c(3:8)])
dplyr::union(es1, es2)
dplyr::intersect(es1, es2)
```

---

coerce

```r
as("BiocSet", "list")
```

---

Description

as("BiocSet", "list")

---

elementset_funs

Functions applied to elementsets in a BiocSet object

Description

All of the major methods applied to a BiocSet object can be explicitly applied to the elementset tibble. These functions bypass the need to use the `es_activate` function by indicating what function should be used on the elementset tibble.
Usage

filter_elementset(.data, ...)
select_elementset(.data, ...)
mutate_elementset(.data, ...)
summarise_elementset(.data, ...)
arrange_elementset(.data, ...)
left_join_elementset(.data, ...)
tibble_from_elementset(.data)
data.frame_from_elementset(.data)

Arguments

.data A BiocSet object.
... Additional arguments passed to the function.

Value

A BiocSet object.
For tibble_from_elementset, a tibble.
For data.frame_from_elementset, a data.frame.

Examples

es <- BiocSet(set1 = letters, set2 = LETTERS)
filter_elementset(es, element == "a" | element == "A")
es %>% select_elementset(element)
es %>% mutate_elementset(pval = rnorm(1:52))
es %>% summarise_elementset(n = n())
es %>% arrange_elementset(desc(element))
tbl <- tibble(x = 5:6, y = c("set1", "set2"))
es %>% left_join_elementset(tbl, by = c(set = "y"))
tibble_from_elementset(es)
data.frame_from_elementset(es)
element_funs

Functions applied to elements in a BiocSet object

Description

All of the major methods applied to a BiocSet object can be explicitly applied to the element tibble. These functions bypass the need to use the es_activate function by indicating what function should be used on the element tibble.

Usage

filter_element(.data, ...)
select_element(.data, ...)
mutate_element(.data, ...)
summarise_element(.data, ...)
arrange_element(.data, ...)
left_join_element(.data, ...)
tibble_from_element(.data, how = unlist)
data.frame_from_element(.data, how = unlist)

Arguments

.data A BiocSet object.
... Additional arguments passed to the function.
how Multiple entries will become a list.

Value

A BiocSet object.
For tibble_from_element, a tibble.
For data.frame_from_element, a data.frame.

Examples

es <- BiocSet(set1 = letters, set2 = LETTERS)
filter_element(es, element == "a")
es %>% select_element(element)
```
es %>% mutate_element(pval = rnorm(1:52))
es %>% summarise_element(n = n())
es %>% arrange_element(desc(element))

tbl <- tibble(x = 1:5, y = letters[1:5])
es <- BiocSet(set1 = letters[c(1,3,5)], set2 = letters[c(2,4)])
left_join_element(es, tbl, by = c(element = "y"))
tibble_from_element(es)
data.frame_from_element(es)
```

---

genesetcollection  GeneSetCollection

**Description**

The following functions deal with converting a BiocSet object into a GeneSetCollection object, or vice versa.

**Usage**

GeneSetCollection_from_BiocSet(biocset)

BiocSet_from_GeneSetCollection(gsc)

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>biocset</td>
<td>The BiocSet object that will become a GeneSetCollection object.</td>
</tr>
<tr>
<td>gsc</td>
<td>The GeneSetCollection that will become a BiocSet object.</td>
</tr>
</tbody>
</table>

**Value**

For `GeneSetCollection_from_BiocSet()`, a GeneSetCollection.

For `BiocSet_from_GeneSetCollection()`, a BiocSet object.

**Examples**

```
biocset <- BiocSet(set1 = letters, set2 = LETTERS)
gsc <- GeneSetCollection_from_BiocSet(biocset)
gsc

BiocSet_from_GeneSetCollection(gsc)
```
**Description**

Importing/exporting and formatting of element sets as a BiocSet object.

**Usage**

```r
## S4 method for signature 'GMTFile,ANY,ANY'
import(con, format, text, ...)

## S4 method for signature 'BiocSet,GMTFile,ANY'
export(object, con, format, ...)

## S4 method for signature 'OBOFile,ANY,ANY'
import(con, format, text, ...)

## S4 method for signature 'BiocSet,OBOFile,ANY'
export(object, con, format, ...)
```

**Arguments**

- `con` For `import`, the file name or URL the element set is loaded from. For `export`, the file name or URL the element set is written to.
- `format` For `import`, the format of the input. For `export`, the format of the output.
- `text` If `con` is missing this is a character vector directly providing the element set that should be imported.
- `...` Parameters to pass to the format-specific method
- `object` For `export()`, the object to be exported.

**Value**

- For `import()`, a BiocSet object
- For `export()`, a GMTFile object representing the location where the BiocSet object was written to

**Examples**

```r
gmtFile <- system.file(package = "BiocSet", "extdata",  
  "hallmark.gene.symbol.gmt")
tbl <- import(gmtFile)

tbl2 <- BiocSet(set1 = letters, set2 = LETTERS)
fl <- tempfile(fileext = ".gmt")
gmt <- export(tbl2, fl)
```
Intersect on a single BiocSet object

Description

This function performs an intersection within a single BiocSet object.

Usage

```r
intersect_single(x, ...)
```

Arguments

- `x`: A BiocSet object.
- `...`: Additional arguments passed to function.

Value

A BiocSet object with a single set 'intersect' and intersected elements from `x`.

Examples

```r
es1 <- BiocSet(set1 = letters[c(1:10)], set2 = letters[c(4:20)])
intersect_single(es1)
```

Functions for mapping elements in the element tibble to different id types

Description

Functions for dealing with unique mapping and multiple mapping. `map_add_element` will add the mapping as a new column instead of overwriting the current one used for the mapping.
Usage

map_unique(es, org, from, to)

map_multiple(
es,
org,
from,
to,
multi = c("list", "filter", "asNA", "CharacterList")
)

map_add_element(es, org, from, add)

Arguments

es The BiocSet object to map the elements on.
org The AnnotationDbi object to identify keys/mappings from.
from A character to indicate which identifier to map from.
to A character to indicate which identifier to map to.
multi How should multiple values be returned? Options include:
  • list: This will just return a list object to the end user.
  • filter: This will remove all elements that contain multiple matches and will therefore return a shorter vector than what came in whenever some of the keys match more than one value.
  • asNA: This will return an NA value whenever there are multiple matches.
  • CharacterList: This just returns a SimpleCharacterList object.
  • FUN: A function can be supplied to the 'multiVals' argument for custom behaviors.

add The id to add to the BiocSet object.

Value

For map_unique, a BiocSet object with unique elements.
For map_multiple, a BiocSet object with multiple mappings for certain elements.
For map_add_element, a BiocSet object with a new column in the element tibble with the mapping of the new id type.

Examples

library(org.Hs.eg.db)
es <- BiocSet(set1 = c("C5", "GANC"), set2 = c("AFM", "CGB1", "ADAM32"))
map_unique(es, org.Hs.eg.db, "SYMBOL", "ENTREZID")

map_multiple(es, org.Hs.eg.db, "SYMBOL", "ENSEMBLTRANS", "asNA")

map <- map_add_element(es, org.Hs.eg.db, "SYMBOL", "ENTREZID")
es %>% mutate_element(entrez = map)
Description

Functions for creating BiocSet objects from GO sets and KEGG sets, and creating a new set mapping from a current BiocSet object. map_add_set will add the mapping as a new column instead of overwriting the current one used for the mapping.

Usage

```r
go_sets(org, from, go = c("GO", "GOID"), evidence = NULL, ontology = NULL)
kegg_sets(species)
map_set(.data, from, to)
map_add_set(.data, org, from, add)
```

Arguments

- `org`: The AnnotationDbi object to identify keys/mappings from.
- `from`: A character to indicate which identifier to map from.
- `go`: A character to indicate the column name for the GO ids. Default is "GO".
- `evidence`: A character to indicate the evidence codes for GO associations with a gene of interest. Default is all possible evidence codes.
- `ontology`: A character to indicate which Gene Ontology to use. Default is BP, CC, and MF.
- `species`: Which species the pathways are from.
- `.data`: The BiocSet object that contains the set tibble being mapped.
- `to`: A character to indicate which identifier to map to.
- `add`: The id to add to the BiocSet object.

Value

For `go_sets`, a BiocSet object with GO ids as the set ids.
For `kegg_sets`, a BiocSet object with Entrez IDs reported as elements (default from KEGGREST) and KEGG pathways as sets.
For `map_set`, a BiocSet object with the mapped set present in the set tibble.
For `map_add_set`, a BiocSet object with a new column in the set tibble with the mapping of the new id type.
Examples

library(org.Hs.eg.db)
go <- go_sets(org.Hs.eg.db, "ENSEMBL")
kegg_sets("hsa")
es <- BiocSet(set1 = letters, set2 = LETTERS)
es %>% map_set("set1", "foo")

library(GO.db)
map <- map_add_set(go, GO.db, "GOID", "DEFINITION")
go %>% mutate_set(definition = map)

OBOSets

OBOSet class

Description

A class representing the 'OBO' file format as a BiocSet.

Usage

OBOSet(elementset, element, set, metadata)

Arguments

elementset A tibble with element set information.
element A tibble with element information.
set A tibble with set information.
metadata A tibble with key-value pairs describing OBO file format header data

Value

An S4 OBOSet object. OBO sets conform to the 'obo' file format, with OBO 'Term' entries corresponding to elements. Parent / child relationships (e.g., 'is_a') are summarized as 'parents', 'ancestors', and 'children' character list columns of 'set'.

Examples

OBOSet()
oboFile <- system.file(package = "BiocSet", "extdata", "sample_go.obo")
import(oboFile)
Functions to display relationships of an `OBOSet` object

**Description**

These functions will display the relationships (children, parents, or ancestors) for either the elements or the sets of an `OBOSet` object.

**Usage**

```r
obo relations <- Functions to display relationships of an OBOSet object

Description

These functions will display the relationships (children, parents, or ancestors) for either the elements or the sets of an OBOSet object.

Usage

obo_relations_element_children(obo)
obo_relations_element_parents(obo)
obo_relations_element_ancestors(obo)
obo_relations_set_children(obo)
obo_relations_set_parents(obo)
obo_relations_set_ancestors(obo)

Arguments

obo
The OBOSet of interest.

Value

A 2 column tibble.

Examples

```r
oboFile <- source_bio.info("extdata", "sample_go.obo", package = "Bioconductor")
obo <- import(oboFile)
obo_relations_element_children(obo)
obo_relations_element_parents(obo)
obo_relations_element_ancestors(obo)
obo_relations_set_children(obo)
obo_relations_set_parents(obo)
obo_relations_set_ancestors(obo)
```
set_funs

Functions applied to sets in a BiocSet object

Description

All of the major methods applied to a BiocSet object can be explicitly applied to the set tibble. These functions bypass the need to use the es_activate function by indicating what function should be used on the element tibble.

Usage

filter_set(.data, ...)
select_set(.data, ...)
mutate_set(.data, ...)
summarise_set(.data, ...)
arrange_set(.data, ...)
left_join_set(.data, ...)
tibble_from_set(.data, how = unlist)
data.frame_from_set(.data, how = unlist)

Arguments

.data A BiocSet object.
... Additional argument passed to the function.
how Multiple entries will become a list.

Value

A BiocSet object.
For tibble_from_set, a tibble.
For data.frame_from_set, a data.frame.

Examples

es <- BiocSet(set1 = letters, set2 = LETTERS)
filter_set(es, set == "set1")
es %>% select_set(set)
es %>% mutate_set(pval = rnorm(1:2))
es %>% summarise_set(n = n())
es %>% arrange_set(desc(set))

tbl <- tibble(x = 10:11, y = c("set1", "set2"))
es <- BiocSet(set1 = letters[c(1,3,5)], set2 = letters[c(2,4)])
left_join_set(es, tbl, by = c(set = "y"))
tibble_from_set(es)
data.frame_from_set(es)

description of "Element representation as an S3 class tibble"

Description
Element representation as an S3 class tibble

Usage
.tbl_element(tbl_elementset)

Arguments
tbl_elementset  An S3 elementset tibble.

Value
An S3 element object in a tibble representation.

Examples
tbl <- BiocSet:::.tbl_elementset(set1 = letters, set2 = LETTERS)
BiocSet:::.tbl_element(tbl)
### tblset

**Set representation as an S3 class tibble**

**Description**

Set representation as an S3 class tibble

**Usage**

`.tbl_set(tbl_elementset)`

**Arguments**

`tbl_elementset` An S3 elementset tibble.

---

### tbl_elementset

**Element set representation as an S3 class tibble**

**Description**

Element set representation as an S3 class tibble

**Usage**

`.tbl_elementset(...)`

`.is_tbl_elementset(x)`

**Arguments**

`...` For `tbl_elementset`, named character vectors of gene sets. Each character vector is a element set. The name of the character vector is the name of the element set.

`x` A tibble that may or may not be an elementset

**Value**

For `tbl_elementset`, an S3 `elementset` tibble representation.

For `.is_tbl_elementset` (internal), a logical indicating if the tibble is an elementset.

**Examples**

```r
es <- BiocSet:::.tbl_elementset(set1 = letters, set2 = LETTERS)

BiocSet:::.is_tbl_elementset(es)
```
union_single

Value

An S3 set object in a tibble representation.

Examples

tbl <- BiocSet:::tbl_elementset(set1 = letters, set2 = LETTERS)
BiocSet:::tbl_set(tbl)

union_single

Union on a single BiocSet object

Description

This function performs a union within a single BiocSet object.

Usage

union_single(x, ...)

Arguments

x
A BiocSet object.

... Additional arguments passed to function.

Value

For union_single, a BiocSet object with a single set union and unioned elements from x.

Examples

es3 <- BiocSet(set1 = letters[1:10], set2 = letters[4:20])
union_single(es3)

url_ref

Functions to access reference urls for different identifiers

Description

Functions to access reference urls for different identifiers

Usage

url_ref_element(es)

url_ref_set(es)

url_ref(es)
Arguments

es A BiocSet object that the reference urls should be added to.

Value

For url_ref_element, a BiocSet object with the url column added to the element tibble.
For url_ref_set, a BiocSet object with the url column added to the set tibble.
For url_ref, a BiocSet object with the url column added to both the element and set tibbles.

Examples

es <- BiocSet("GO:000002" = c("TP53", "TNF"), "GO:000003" = c("IL6"))

url_ref_element(es)

url_ref_set(es)

url_ref(es)
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