Package ‘RGMQL’

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Type Package

Title GenoMetric Query Language for R/Bioconductor

Version 1.22.0

Description This package brings the GenoMetric Query Language (GMQL) functionalities into the R environment. GMQL is a high-level, declarative language to manage heterogeneous genomic datasets for biomedical purposes, using simple queries to process genomic regions and their metadata and properties. GMQL adopts algorithms efficiently designed for big data using cloud-computing technologies (like Apache Hadoop and Spark) allowing GMQL to run on modern infrastructures, in order to achieve scalability and high performance. It allows to create, manipulate and extract genomic data from different data sources both locally and remotely. Our RGMQL functions allow complex queries and processing leveraging on the R idiomatic paradigm. The RGMQL package also provides a rich set of ancillary classes that allow sophisticated input/output management and sorting, such as: ASC, DESC, BAG, MIN, MAX, SUM, AVG, MEDIAN, STD, Q1, Q2, Q3 (and many others). Note that many RGMQL functions are not directly executed in R environment, but are deferred until real execution is issued.

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'gmql_cover.R' 'gmql_difference.R' 'gmql_extend.R'
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### R topics documented:

- **aggregate** ................................................. 3
- **AGGREGATES-Object** ........................................ 4
- **arrange** .................................................... 7
- **collect** ...................................................... 9
- **compile_query** .............................................. 10
- **cover** ....................................................... 11
- **Cover-Param** ............................................... 13
- **delete_dataset** ............................................. 14
- **DISTAL-Object** ............................................. 15
- **download_dataset** .......................................... 17
- **Evaluation-Function** ....................................... 18
- **execute** ...................................................... 19
- **export_gmql** ................................................ 19
- **extend** ....................................................... 21
- **filter** ....................................................... 22
- **filter-extract** ............................................. 24
- **filter_and_extract** ....................................... 24
- **group_by** .................................................... 26
- **import_gmql** ................................................ 29
- **init_gmql** ................................................... 29
- **login_gmql** .................................................. 31
- **logout_gmql** ................................................ 32
- **log_job** ..................................................... 32
**aggregate**

**Description**

Wrapper to GMQL MERGE operator

It builds a dataset consisting of a single sample having as many regions as the number of regions of all the input dataset samples and as many metadata as the union of the "attribute-value" tuples of the input samples. If `groupBy` is specified, the samples are then partitioned in groups, each with a distinct value of the grouping metadata attributes. The operation is separately applied to each group, yielding one sample in the result for each group. Samples whose metadata are not present in the grouping metadata parameter are disregarded.

**Usage**

```r
## S4 method for signature 'GMQLDataset'
aggregate(x, groupBy = conds())
```
Arguments

- **x**: GMQLDataset class object
- **groupBy**: `condition_evaluation` function to support methods with `groupBy` or `JoinBy` input parameter

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such file as a GMQL dataset named "exp"
## using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
exp = read_gmql(test_path)

## This statement creates a dataset called merged which contains one
## sample for each antibody_target and cell value found within the metadata
## of the exp dataset sample; each created sample contains all regions
## from all 'exp' samples with a specific value for their
## antibody_target and cell metadata attributes.

merged = aggregate(exp, conds(c("antibody_target", "cell")))
```

**Description**

This class constructor is used to create instances of AGGREGATES object, to be used in GMQL functions that require aggregate on value.

**Usage**

- `SUM(value)`
- `COUNT()`
- `COUNTSAMP()`
- `MIN(value)`
AGGREGATES-Object

Max(value)
Avg(value)
Median(value)
Std(value)
Bag(value)
Bagd(value)
Q1(value)
Q2(value)
Q3(value)

Arguments

value string identifying name of metadata or region attribute

Details

• SUM: It prepares input parameter to be passed to the library function sum, performing all the type conversions needed
• COUNT: It prepares input parameter to be passed to the library function count, performing all the type conversions needed
• COUNTSAMP: It prepares input parameter to be passed to the library function countsamp, performing all the type conversions needed. It is used only with group_by functions
• MIN: It prepares input parameter to be passed to the library function minimum, performing all the type conversions needed
• MAX: It prepares input parameter to be passed to the library function maximum, performing all the type conversions needed
• AVG: It prepares input parameter to be passed to the library function mean, performing all the type conversions needed
• MEDIAN: It prepares input parameter to be passed to the library function median, performing all the type conversions needed
• STD: It prepares input parameter to be passed to the library function standard deviation, performing all the type conversions needed
• BAG: It prepares input parameter to be passed to the library function bag; this function creates comma-separated strings of attribute values, performing all the type conversions needed
• BAGD: It prepares input parameter to be passed to the library function bagd; this function creates comma-separated strings of distinct attribute values, performing all the type conversions needed
• Q1: It prepares input parameter to be passed to the library function first quartile, performing all the type conversions needed
• Q2: It prepares input parameter to be passed to the library function second quartile, performing all the type conversions needed
• Q3: It prepares input parameter to be passed to the library function third quartile, performing all the type conversions needed

Value
Aggregate object

Examples

```
init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
exp = read_gmql(test_path)

# This statement copies all samples of exp dataset into res dataset, and then calculates new metadata attribute sum_score for each of them:
# sum_score is the sum of score values of the sample regions.
res = extend(exp, sum_score = SUM("score"))

# This statement copies all samples of exp dataset into res dataset, and then calculates new metadata attribute min_pvalue for each of them:
# min_pvalue is the minimum pvalue of the sample regions.
res = extend(exp, min_pvalue = MIN("pvalue"))

# This statement copies all samples of exp dataset into res dataset, and then calculates new metadata attribute max_score for each of them:
# max_score is the maximum score of the sample regions.
res = extend(exp, max_score = MAX("score"))

# The following cover operation produces output regions where at least 2 and at most 3 regions of exp dataset overlap, having as resulting region attribute the average signal of the overlapping regions; the result has one sample for each input cell value.
res = cover(exp, 2, 3, groupBy = conds("cell"), avg_signal = AVG("signal"))

# This statement copies all samples of 'exp' dataset into 'out' dataset, and then for each of them it adds another metadata attribute, allScore, which is the aggregation comma-separated list of all the values that the region attribute score takes in the sample.
```
out = extend(exp, allScore = BAG("score"))

## This statement counts the regions in each sample and stores their number
## as value of the new metadata RegionCount attribute of the sample.

out = extend(exp, RegionCount = COUNT())

## This statement copies all samples of exp dataset into res dataset,
## and then calculates new metadata attribute std_score for each of them:
## std_score is the standard deviation of the score values of the sample
## regions.

res = extend(exp, std_score = STD("score"))

## This statement copies all samples of exp dataset into res dataset,
## and then calculates new metadata attribute m_score for each of them:
## m_score is the median score of the sample regions.

res = extend(exp, m_score = MEDIAN("score"))

---

**arrange**

**Method arrange**

**Description**

Wrapper to GMQL ORDER operator

It is used to order either samples or sample regions or both, according to a set of metadata and/or region attributes. Order can be specified as ascending / descending for every attribute. The number of samples and their regions remain the same (unless fetching options are specified), as well as their attributes, but a new ordering metadata and/or region attribute is added. Sorted samples or regions have a new attribute ".order", added to their metadata, or "order" added to their regions, or to both of them as specified in input.

**Usage**

```r
## S4 method for signature 'GMQLDataset'
arrange(
  .data,
  metadata_ordering = NULL,
  regions_ordering = NULL,
  fetch_opt = "",
  num_fetch = 0L,
  reg_fetch_opt = "",
  reg_num_fetch = 0L
)
```
Arguments

.data          GMQLDataset class object
metadata_ordering  list of ordering functions containing name of metadata attribute. The functions available are: ASC, DESC. If NULL, fetch_opt and num_fetch are not considered
regions_ordering list of ordering functions containing name of region attribute. The functions available are: ASC, DESC. If NULL, reg_fetch_opt and reg_num_fetch are not considered
fetch_opt       string indicating the option used to fetch the first k samples; it can assume the values:
                 • mtop: it fetches the first k samples
                 • mtopp: it fetches the first k percentage of samples.
                 • mtopg: it fetches the first k samples in each group.
                 if NULL, num_fetch is not considered
num_fetch       integer value identifying the number of samples to fetch; by default it is 0, that means all samples are fetched
reg_fetch_opt   string indicating the option used to fetch the first k regions; it can assume the values:
                 • rtop: it fetches the first k regions.
                 • rtopp: it fetches the first k percentage of regions.
                 • rtopg: it fetches the first k regions in each group.
                 if NULL, reg_num_fetch is not considered
reg_num_fetch   integer value identifying the number of regions to fetch; by default it is 0, that means all regions are fetched

Value
GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such file as a GMQL dataset named
## "data" using CustomParser
init_gmql()

test_path <- system.file("example", "DATASET", package = "RGMQL")
data = read_gmql(test_path)

## The following statement orders the samples according to the Region_Count
## metadata attribute and takes the two samples that have the highest count.
o = arrange(data, list(ASC("Region_Count")), fetch_opt = "mtop",
```
Description

Wrapper to GMQL MATERIALIZE operator

It saves the content of a dataset that contains samples metadata and regions. It is normally used to persist the content of any dataset generated during a GMQL query. Any dataset can be materialized, but the operation can be time-consuming. For best performance, materialize the relevant data only.

Usage

```r
## S4 method for signature 'GMQLDataset'
collect(x, name = "ds1", dir_out = getwd())
```

Arguments

- `x`: GMQLDataset class object
- `name`: name of the result dataset. By default it is the string "ds1"
- `dir_out`: destination folder path. By default it is the current working directory of the R process

Details

An error occurs if the directory already exist at the destination folder path

Value

None

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such file as a GMQL dataset named
## "data" using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
data = read_gmql(test_path)

## The following statement materializes the dataset 'data', previously read,
## at the specific destination test_path into local folder "ds1" opportunely
## created
```
**compile_query**

**Description**

It compiles a GMQL query taken from file or inserted as text string, using the proper GMQL web service available on a remote server.

**Usage**

```r
compile_query(url, query)

compile_query_fromfile(url, filePath)
```

**Arguments**

- `url` string url of server: It must contain the server address and base url; service name is added automatically
- `query` string text of a GMQL query
- `filePath` string path of txt file containing a GMQL query

**Value**

None

**Examples**

```r
## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)

## This statement gets the query as text string and runs the compile web service
compile_query(remote_url, "DATASET = SELECT() Example_Dataset_1;
                MATERIALIZE DATASET INTO RESULT_DS;")

## This statement defines the path to the file "query1.txt" in the subdirectory "example" of the package "RGMQL" and run the compile web service

test_path <- system.file("example", package = "RGMQL")
test_query <- file.path(test_path, "query1.txt")
```
compile_query_fromfile(remote_url, test_query)

## Logout from GMQL REST services suite

logout_gmql(remote_url)

---

### cover

**Method cover**

**Description**

Wrapper to GMQL COVER operator

It takes as input a dataset containing one or more samples and returns another dataset (with a single sample, if no `groupBy` option is specified) by “collapsing” the input dataset samples and their regions according to certain rules specified by the input parameters. The attributes of the output genomic regions are only the region coordinates, and Jaccard indexes (`JaccardIntersect` and `JaccardResult`). Jaccard Indexes are standard measures of similarity of the contributing regions, added as default region attributes. The JaccardIntersect index is calculated as the ratio between the lengths of the intersection and of the union of the contributing regions; the JaccardResult index is calculated as the ratio between the lengths of the result and the union of the contributing regions. If aggregate functions are specified, a new region attribute is added for each aggregate function specified. Output metadata are the union of the input ones. If `groupBy` clause is specified, the input samples are partitioned in groups, each with distinct values of the grouping metadata attributes, and the `cover` operation is separately applied to each group, yielding to one sample in the result for each group. Input samples that do not satisfy the `groupBy` condition are disregarded.

**Usage**

```r
cover(.data, ...)
```

```r
## S4 method for signature 'GMQLDataset'
cover(.data, min_acc, max_acc, groupBy = conds(), variation = "cover", ...)
```

**Arguments**

- **.data**: GMQLDataset class object
- **...**: a series of expressions separated by comma in the form `key = aggregate`. The `aggregate` is an object of class AGGREGATES. The aggregate functions available are: `SUM`, `COUNT`, `MIN`, `MAX`, `AVG`, `MEDIAN`, `STD`, `BAG`, `BAGD`, `Q1`, `Q2`, `Q3`. Every aggregate accepts a string value, except for `COUNT`, which does not have any value. Argument of `aggregate function` must exist in schema, i.e. among region attributes. Two styles are allowed:
  - list of key-value pairs: e.g. `sum = SUM("pvalue")`
  - list of values: e.g. `SUM("pvalue")`
  "mixed style" is not allowed
min_acc  minimum number of overlapping regions to be considered during execution. It is an integer number, declared also as string. minAcc accepts also:
- PARAMETER class object: ALL, that represents the number of samples in the input dataset
- an expression built using PARAMETER object: \((\text{ALL}() + N) / K\) or \(\text{ALL}() / K\), with \(N\) and \(K\) integer values

max_acc  maximum number of overlapping regions to be considered during execution. It is an integer number, declared also as string. maxAcc accept also:
- PARAMETER class object: ALL, that represents the number of samples in the input dataset
- PARAMETER class object: ANY, that acts as a wildcard, considering any amount of overlapping regions.
- an expression built using PARAMETER object: \((\text{ALL}() + N) / K\) or \(\text{ALL}() / K\), with \(N\) and \(K\) integer values

groupBy conds function to support methods with groupBy or JoinBy input parameter

variation string identifying the cover GMQL operator variation. The admissible strings are:
- FLAT: It returns the regions that start from the first end and stop at the last end of the regions which would contribute to each region of the cover.
- SUMMIT: It returns regions that start from a position where the number of intersecting regions is not increasing afterwards and stop at a position where either the number of intersecting regions decreases, or it violates the max accumulation index.
- HISTOGRAM: It returns the non-overlapping regions contributing to the cover, each with its accumulation index value, which is assigned to the AccIndex region attribute.
- COVER: default value.

It can be all caps or lowercase

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such file as a GMQL dataset named "exp"
## using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
exp = read_gmql(test_path)

## The following statement produces an output dataset with a single output
## sample. The COVER operation considers all areas defined by a minimum
```
## of two overlapping regions in the input samples, up to any amount of
## overlapping regions.

res = cover(exp, 2, ANY())

## The following GMQL statement computes the result grouping the input
## exp samples by the values of their cell metadata attribute,
## thus one output res sample is generated for each cell value;
## output regions are produced where at least 2 and at most 3 regions
## of grouped exp samples overlap, setting as attributes of the resulting
## regions the minimum pvalue of the overlapping regions (min_pvalue)
## and their Jaccard indexes (JaccardIntersect and JaccardResult).

res = cover(exp, 2, 3, groupBy = conds("cell"), min_pValue = MIN("pvalue"))

---

**Description**

This class constructor is used to create instances of PARAM object to be used in GMQL cover method.

**Usage**

ALL()

ANY()

**Details**

- ALL: It represents the number of samples in the input dataset.
- ANY: It represents any amount of overlapping regions to be considered.

**Value**

Param object

**Examples**

## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the file "DATASET" in the subdirectory "example"
## of the package "RGQL" and opens such file as a GMQL dataset named "exp"
## using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGQL")
```
exp = read_gmql(test_path)

## The following statement produces an output dataset with a single
## output sample. The COVER operation considers all areas defined by
## a minimum of two overlapping regions in the input samples,
## up to maximum amount of overlapping regions equal to the number
## of input samples.
res = cover(exp, 2, ALL())

## The following statement produces an output dataset with a single
## output sample. The COVER operation considers all areas defined by
## a minimum of two overlapping regions in the input samples,
## up to any amount of overlapping regions.
res = cover(exp, 2, ANY())

## The following statement produces an output dataset with a single
## output sample. The COVER operation considers all areas defined by
## minimum of overlapping regions in the input samples equal to half of
## the number of input samples, up to any amount of overlapping regions.
res = cover(exp, ALL()/2, ANY())
```

description

**Delete dataset**

**Description**

It deletes single private dataset specified by name from remote repository using the proper GMQL web service available on a remote server.

**Usage**

`delete_dataset(url, datasetName)`

**Arguments**

- `url` string url of server: It must contain the server address and base url; service name is added automatically
- `datasetName` string name of dataset to delete

**Details**

If no error occurs, it prints "Deleted Dataset", otherwise a specific error is printed

**Value**

None
Examples

```r
## Not run:

## This dataset does not exist

remote_url <- "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)
delete_dataset(remote_url, "test1_20170604_180908_RESULT_DS")
```

## End(Not run)

### DISTAL-Object

**DISTAL object class constructor**

#### Description

This class constructor is used to create instances of DISTAL object to be used in GMQL JOIN operations (RGMQL merge functions) that use genometric predicate parameter requiring distal condition on value.

#### Usage

- `DL(value)`
- `DG(value)`
- `DLE(value)`
- `DGE(value)`
- `MD(value)`
- `UP()`
- `DOWN()`

#### Arguments

- `value` string identifying distance between genomic regions in base pair

#### Details

- **DL**: It denotes the less distance clause, which selects all the regions of a joined experiment dataset sample such that their distance from the anchor region of the joined reference dataset sample is less than `value` bases.
DISTAL-Object

- **DLE**: It denotes the less equal distance clause, which selects all the regions of a joined experiment dataset sample such that their distance from the anchor region of the joined reference dataset sample is less than, or equal to, 'value' bases.
- **DG**: It denotes the great distance clause, which selects all the regions of a joined experiment dataset sample such that their distance from the anchor region of the joined reference dataset sample is greater than 'value' bases.
- **DGE**: It denotes the great equal distance clause, which selects all the regions of a joined experiment dataset sample such that their distance from the anchor region of the joined reference dataset sample is greater than, or equal to, 'value' bases.
- **MD**: It denotes the minimum distance clause, which selects the first 'value' regions of the joined experiment at minimial distance from the anchor region of the joined reference dataset sample.
- **UP**: It denotes the upstream direction of the genome. It makes predicates to be hold on the upstream of the regions of the joined reference dataset sample. UP is true when region of the joined experiment dataset sample is in the upstream genome of the anchor region of the joined reference dataset sample. When this clause is not present, distal conditions apply to both directions of the genome.
- **DOWN**: It denotes the downstream direction of the genome. It makes predicates to be hold on the downstream of the regions of the joined reference dataset sample. DOWN is true when region of the joined experiment dataset sample is in the downstream genome of the anchor region of the joined reference dataset sample. When this clause is not present, distal conditions apply to both directions of the genome.

**Value**

Distal object

**Examples**

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folders "DATASET" and "DATASET_GDM" in the subdirectory
## "example" of the package "RGMQL", and opens such folders as a GMQL
## datasets named "TSS" and "HM", respectively, using CustomParser
init_gmql()

TSS <- read_gmql(test_path)
HM <- read_gmql(test_path2)

## Given a dataset HM and one called TSS with a sample including
## Transcription Start Site annotations, this statement searches for those
## regions of HM that are at a minimal distance from a transcription
## start site (TSS) and takes the first/closest one for each TSS, provided
## that such distance is lesser than 1200 bases and joined TSS and HM
## samples are obtained from the same provider (joinby clause).
join_data = merge(TSS, HM,
```
Given a dataset HM and one called TSS with a sample including Transcription Start Site annotations, this statement searches for those regions of HM that are downstream and at a minimal distance from a transcription start site (TSS) and takes the first/closest one for each TSS, provided that such distance is greater than 12K bases and joined TSS and HM samples are obtained from the same provider (joinby clause).

\[
\text{join\_data} = \text{merge(TSS, HM, genometric\_predicate = list(MD(1), DGE(12000), DOWN()), conds("provider"), region\_output = "RIGHT")}
\]

---

### Description

It downloads private dataset as zip file from remote repository to local path, or downloads and saves it into R environment as GRangesList, using the proper GMQL web service available on a remote server.

### Usage

```r
download_dataset(url, datasetName, path = getwd())
download_as_GRangesList(url, datasetName)
```

### Arguments

- **url**: string url of server: It must contain the server address and base url; service name is added automatically
- **datasetName**: string name of dataset to download
- **path**: string local path folder where to store dataset, by default it is R working directory

### Details

If error occurs, a specific error is printed.

### Value

None

GRangesList containing all GMQL samples in dataset
Evaluation-Function

Examples

## Download dataset in R working directory
## In this case we try to download a dataset of the user
## (public datasets from remote repository cannot be downloaded)

## Not run:

remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)
download_dataset(remote_url, "Example_Dataset_1", path = getwd())

## Create GRangesList from user dataset Example_Dataset1 got
## from repository

download_as_GRangesList(remote_url, "Example_Dataset_1")

## End(Not run)

evaluation-function | Condition evaluation functions

Description

This function is used to support joinBy and/or groupBy function parameter.

Usage

conds(default = c(""), full = c(""), exact = c""))

Arguments

default concatenation of string identifying a name of metadata attribute to be evaluated.
It defines a DEFAULT evaluation of the input values. DEFAULT evaluation: the
two attributes match if both end with value.

full concatenation of string identifying a name of metadata attribute to be evaluated.
It defines a FULL (FULLNAME) evaluation of the input values. FULL evaluation:
two attributes match if they both end with value and, if they have further
prefixes, the two prefix sequences are identical.

exact concatenation of string identifying a name of metadata attribute to be evaluated.
It defines an EXACT evaluation of the input values. EXACT evaluation: only
attributes exactly as value match; no further prefixes are allowed.

Value

list of 2-D array containing method of evaluation and metadata attribute name
**GMQL Function: EXECUTE**

**Description**

It executes GMQL query. The function works only after invoking at least one `collect`.

**Usage**

```r
execute()
```

**Value**

None

**Examples**

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with `system.file()` it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such folder as a GMQL dataset
## named "data"

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
data = read_gmql(test_path)

## The following statement materializes the dataset "data", previously read,
## at the specific destination `test_path` into local folder "ds1" opportuneley
## created

collect(data, dir_out = test_path)

## This statement executes GMQL query.
## Not run:

execute()

## End(Not run)
```

**Create GMQL dataset from GRangesList**

**Description**

It creates GMQL dataset from GRangesList. All samples are in GDM (tab-separated values) or GTF file format.
Usage

```r
export_gmql(samples, dir_out, is_gtf)
```

Arguments

- **samples**: GRangesList
- **dir_out**: folder path where to create a folder and write the sample files
- **is_gtf**: logical value indicating if samples have to be exported with GTF or GDM format

Details

The GMQL dataset is made up by two different file types:

- metadata files: they contain metadata associated with corresponding sample.
- region files: they contain genomic regions data.
- region schema file: XML file that contains region attribute names (e.g. chr, start, end, pvalue)

Sample region files and metadata files are associated through file name: for example `S_0001.gdm` for region file and `S_0001.gdm.meta` for its metadata file.

Value

None

See Also

- `import_gmql`

Examples

```r
## Load and attach add-on GenomicRanges package
library(GenomicRanges)

## These statements create two GRanges with the region attributes: seqnames, ranges (region coordinates) and strand, plus two column elements: score and GC
## gr1 <- GRanges(seqnames = "chr2", ranges = IRanges(3, 6), strand = "+", score = 5L, GC = 0.45)
gr2 <- GRanges(seqnames = c("chr1", "chr1"),
              ranges = IRanges(c(7,13), width = 3), strand = c("+", "-"),
              score = 3:4, GC = c(0.3, 0.5))

## This statement creates a GRangesList using the previous GRanges
grl = GRangesList(gr1, gr2)

## This statement defines the path to the subdirectory "example" of the package "RGQLQ" and exports the GRangesList as GMQL datasets with sample files in GTF file format, using the last name of 'dir_out' path as
```
## dataset name

test_out_path <- system.file("example", package = "RGMQL")
export_gmql(gml, test_out_path, TRUE)

---

**Method extend**

### Description

Wrapper to GMQL EXTEND operator

For each sample in an input dataset, it generates new metadata attributes as result of aggregate functions applied to sample region attributes and adds them to the existing metadata attributes of the sample. Aggregate functions are applied sample by sample.

### Usage

```
extend(.data, ...)
```

### Arguments

- `.data` GMQLDataset class object
- `...` a series of expressions separated by comma in the form `key = aggregate`. The `aggregate` is an object of class AGGREGATES. The aggregate functions available are: `SUM`, `COUNT`, `MIN`, `MAX`, `AVG`, `MEDIAN`, `STD`, `BAG`, `BAGD`, `Q1`, `Q2`, `Q3`. Every aggregate accepts a string value, except for COUNT, which does not have any value. Argument of `aggregate function` must exist in schema, i.e. among region attributes. Two styles are allowed:
  - list of key-value pairs: e.g. `sum = SUM("pvalue")`
  - list of values: e.g. `SUM("pvalue")`

"mixed style" is not allowed

### Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method
Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such folder as a GMQL dataset
## named "data"

init_gmql()

## This statement defines the path to the folder "DATASET" in the subdirectory "example"
system.file("example", "DATASET", package = "RGMQL")

data <- read_gmql(test_path)

## This statement counts the regions in each sample and stores their number
## as value of the new metadata attribute RegionCount of the sample.

e <- extend(data, RegionCount = COUNT())

## This statement copies all samples of data dataset into 'res' dataset,
## and then calculates for each of them two new metadata attributes:
## 1. RegionCount is the number of sample regions;
## 2. MinP is the minimum pvalue of the sample regions.
## res sample regions are the same as the ones in data.

res <- extend(data, RegionCount = COUNT(), MinP = MIN("pvalue"))
```

---

### filter

#### Method filter

**Description**

Wrapper to GMQL SELECT operator

It creates a new dataset from an existing one by extracting a subset of samples and/or regions from the input dataset according to the predicate. Each sample in the output dataset has the same region attributes, values, and metadata as in the input dataset. When semijoin function is defined, it extracts those samples containing all metadata attributes defined in semijoin clause with at least one metadata value in common with semijoin dataset. If no metadata in common between input dataset and semijoin dataset, no sample is extracted.

**Usage**

```r
## S4 method for signature 'GMQLDataset'
filter(.data, m_predicate = NULL, r_predicate = NULL, semijoin = NULL)
```

**Arguments**

- `.data` GMQLDataset class object
- `m_predicate` logical predicate made up by R logical operations on metadata attributes. Only `!`, `|`, `||`, `&`, `&&` are admitted.
### Filter

Filtering is based on logical predicates made up by R logical operations on region attributes. Only !, |, ||, &, && are admitted.

**semijoin**

Function to define filter method with semijoin condition (see examples).

### Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method.

### Examples

```r
# This statement initializes and runs the GMQ server for local execution
# and creation of results on disk. Then, with system.file() it defines
# the path to the folder "DATASET" in the subdirectory "example"
# of the package "RGMQL" and opens such folder as a GMQL dataset
# named "data"

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
data <- read_gmql(test_path)

# This statement selects from input the data samples of patients younger
# than 70 years old, based on filtering on sample metadata attribute
# 'patient_age'

filter_data <- filter(data, patient_age < 70)

# This statement defines the path to the folder "DATASET_GDM" in the
# subdirectory "example" of the package "RGMQL" and opens such folder
# as a GMQL dataset named "join_data"

test_path2 <- system.file("example", "DATASET_GDM", package = "RGMQL")
join_data <- read_gmql(test_path2)

# This statement creates a new dataset called 'jun_tf' by selecting those
# samples and their regions from the existing 'data' dataset such that:
# Each output sample has a metadata attribute called antibody_target
# with value JUN.
# Each output sample also has not a metadata attribute called "cell"
# that has the same value of at least one of the values that a metadata
# attribute equally called cell has in at least one sample
# of the 'join_data' dataset.
# For each sample satisfying previous conditions, only its regions that
# have a region attribute called 'pvalue' with the associated value
# less than 0.01 are conserved in output

jun_tf <- filter(data, antibody_target == "JUN", pvalue < 0.01,
                semijoin(join_data, FALSE, conds("cell")))
```

filter_and_extract  

**PARAM object class constructor**

**Description**

This class constructor is used to create instances of PARAM object to be used in filter and extract function.

**Usage**

\[
\text{FULL}(\text{except} = \text{NULL})
\]

**Arguments**

- **except**  
  The list of attribute to not consider

**Details**

It is used to encompasses all the region parameters already present into the dataset or GRangesList

- **FULL**: It consider all the region parameter

**Value**

Param object

---

filter_and_extract  

**Filter and extract function**

**Description**

This function lets user to create a new GRangesList with fixed information: seqnames, ranges and strand, and a variable part made up by the regions defined as input. The metadata and metadata_prefix are used to filter the data and choose only the samples that match at least one metadata with its prefix. The input regions are shown for each sample obtained from filtering.

**Usage**

\[
\text{filter_and_extract}(
\quad \text{data},
\quad \text{metadata} = \text{NULL},
\quad \text{metadata_prefix} = \text{NULL},
\quad \text{region_attributes} = \text{NULL},
\quad \text{suffix} = \text{"antibody_target"}
\)
\]
Arguments

data [string] GMQL dataset folder path or GRangesList object
metadata [vector of strings] containing names of metadata attributes to be searched for in metadata files. Data will be extracted if at least one condition is satisfied: this condition is logically "ANDed" with prefix filtering (see below) if NULL no filtering action occurs (i.e. every sample is taken for region filtering).

metadata_prefix [vector of strings] that will support the metadata filtering. If defined, each ‘metadata’ is concatenated with the corresponding prefix.

region_attributes [vector of strings] that extracts only region attributes specified; if NULL no regions attribute is taken and the output is only GRanges made up by the region coordinate attributes (seqnames, start, end, strand); It is also possible to assign the FULL with or without its input parameter; in case was without the ‘except’ parameter, all the region attributes are taken, otherwise all the region attributes are taken except the input attribute defined by except.

suffix [name] for each metadata column of GRanges. By default it is the value of the metadata attribute named "antibody_target". This string is taken from sample metadata file or from metadata() associated. If not present, the column name is the name of selected regions specified by ‘region_attributes’ input parameter.

Details

This function works only with dataset or GRangesList all whose samples or Granges have the same region coordinates (chr, ranges, strand) ordered in the same way for each sample.

In case of GRangesList data input, the function searches for metadata into metadata() function associated to GRangesList.

Value

GRanges with selected regions

Examples

## This statement defines the path to the folder "DATASET" in the
## subdirectory "example" of the package "RGMQL" and filters such folder
## dataset including at output only "pvalue" and "peak" region attributes

test_path <- system.file("example", "DATASET", package = "RGMQL")
filter_and_extract(test_path, region_attributes = c("pvalue", "peak"))

## This statement imports a GMQL dataset as GRangesList and filters it
## including at output only "pvalue" and "peak" region attributes, the sort
## function makes sure that the region coordinates (chr, ranges, strand)
## of all samples are ordered correctly

grl <- import_gmql(test_path, TRUE)
sorted_grl <- sort(grl)
group_by

### Method group_by

**Description**

Wrapper to GMQL GROUP operator

It performs the grouping of samples and/or sample regions of the input dataset based on one specified metadata and/or region attribute. If the metadata attribute is multi-value, i.e., it assumes multiple values for sample (e.g., both disease, cancer> and <disease, diabetes>), the grouping identifies different groups of samples for each attribute value combination (e.g., group1 for samples that feature the combination <disease, cancer>, group2 for samples that feature the combination <disease, diabetes>, and group3 for samples that feature both combinations <disease, cancer> and <disease, diabetes>). For each obtained group, it is possible to request the evaluation of aggregate functions on metadata attributes; these functions consider the metadata contained in all samples of the group. The regions, their attributes and their values in output are the same as the ones in input for each sample, and the total number of samples does not change. All metadata in the input samples are conserved with their values in the output samples, with the addition of the "_group" attribute, whose value is the identifier of the group to which the specific sample is assigned; other metadata attributes can be added as aggregate functions computed on specified metadata. When used on region attributes, group_by can group regions of each sample individually, based on their coordinates (chr, start, stop, strand) and possibly also on other specified grouping region attributes (when these are present in the schema of the input dataset). In each sample, regions found in the same group (i.e., regions with same coordinates and grouping attribute values), are combined into a single region; this allows to merge regions that are duplicated inside the same sample (based on the values of their coordinates and of other possible specified region attributes). For each grouped region, it is possible to request the evaluation of aggregate functions on other region attributes (i.e., which are not coordinates, or grouping region attributes). This use is independent on the possible grouping realised based on metadata. The generated output schema only contains the original region attributes on which the grouping has been based, and additionally the attributes in case calculated as aggregated functions. If the group_by is applied only on regions, the output metadata and their values are
equal to the ones in input. Both when applied on metadata and on regions, the `group_by` operation returns a number of output samples equal to the number of input ones. Note that the two possible uses of `group_by`, on metadata and on regions, are perfectly orthogonal, therefore they can be used in combination or independently.

### Usage

```r
## S4 method for signature 'GMQLDataset'

group_by(
  .data,
  groupBy_meta = conds(),
  groupBy_regions = c(""),
  region_aggregates = NULL,
  meta_aggregates = NULL
)
```

### Arguments

- `.data` GMQLDataset object
- `groupBy_meta` `conds` function to support methods with `groupBy` or `JoinBy` input parameter
- `groupBy_regions` vector of strings made up by region attribute names
- `region_aggregates` It accepts a list of aggregate functions on region attribute. All the elements in the form `key = aggregate`. The `aggregate` is an object of class `AGGREGATES`. The aggregate functions available are: `SUM, COUNT, MIN, MAX, AVG, MEDIAN, STD, BAG, BAGD, Q1, Q2, Q3`. Every aggregate accepts a string value, except for `COUNT`, which does not have any value. Argument of `aggregate function` must exist in schema, i.e. among region attributes. Two styles are allowed:
  - list of key-value pairs: e.g. `sum = SUM("pvalue")`
  - list of values: e.g. `SUM("pvalue")`
  "mixed style" is not allowed

- `meta_aggregates` It accepts a list of aggregate functions on metadata attribute. All the elements in the form `key = aggregate`. The `aggregate` is an object of class `AGGREGATES`. The aggregate functions available are: `SUM, COUNTSAMP, MIN, MAX, AVG, MEDIAN, STD, BAG, BAGD, Q1, Q2, Q3`. Every aggregate accepts a string value, except for `COUNTSAMP`, which does not have any value. Argument of `aggregate function` must exist in schema, i.e. among region attributes. Two styles are allowed:
  - list of key-value pairs: e.g. `sum = SUM("cell")`
  - list of values: e.g. `SUM("cell")`
  "mixed style" is not allowed

### Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method
Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such file as a GMQL dataset named "exp"
## using CustomParser

init_gmql()

exp = read_gmql(test_path)

## This GMQL statement groups samples of the input 'exp' dataset according
## to their value of the metadata attribute 'tumor_type' and computes the
## maximum value that the metadata attribute 'size' takes inside the samples
## belonging to each group. The samples in the output GROUPS_T dataset
## have a new _group metadata attribute which indicates which group they
## belong to, based on the grouping on the metadata attribute tumor_type.
## In addition, they present the new metadata aggregate attribute 'MaxSize'.
## Note that the samples without metadata attribute 'tumor_type' are
## assigned to a single group with _group value equal 0

GROUPS_T = group_by(exp, conds("tumor_type"),
                    meta_aggregates = list(max_size = MAX("size")))

## This GMQL statement takes as input dataset the same input dataset as
## the previous example. Yet, it calculates new _group values based on the
## grouping attribute 'cell', and adds the metadata aggregate attribute
## 'n_samp', which counts the number of samples belonging to the respective
## group. It has the following output GROUPS_C dataset samples
## (note that now no sample has metadata attribute _group with value
## equal 0 since all input samples include the metadata attribute cell,
## with different values, on which the new grouping is based)

GROUPS_C = group_by(exp, conds("cell"),
                    meta_aggregates = list(n_samp = COUNTSAMP()))

## This GMQL statement groups the regions of each 'exp' dataset sample by
## region coordinates chr, left, right, strand (these are implicitly
## considered) and the additional region attribute score (which is
## explicitly specified), and keeps only one region for each group.
## In the output GROUPS dataset schema, the new region attributes
## avg_pvalue and max_qvalue are added, respectively computed as the
## average of the values taken by the pvalue and the maximum of the values
## taken by the qvalue region attributes in the regions grouped together,
## and the computed value is assigned to each region of each output sample.
## Note that the region attributes which are not coordinates or score are
## discarded.

GROUPS = group_by(exp, groupBy_regions = "score",
                  region_aggregates = list(avg_pvalue = AVG("pvalue"),
                                           max_qvalue = MAX("qvalue")))
```
import_gmql

Create GRangesList from GMQL dataset

Description

It creates a GRangesList from GMQL samples in dataset. It reads sample files in GTF or GDM/tab-delimited format.

Usage

import_gmql(dataset_path, is_gtf)

Arguments

dataset_path  string with GMQL dataset folder path
is_gtf        logical value indicating if dataset samples are in GTF format; if TRUE and
dataset does not contain GTF samples, an error occurs

Value

GRangesList containing all GMQL samples in dataset

See Also

extport_gmql

Examples

```r
## This statement defines the path to the subdirectory "example" of the
## package "RGMQL" and imports as GRangesList the contained GMQL dataset

test_path <- system.file("example", "DATASET", package = "RGMQL")
grl = import_gmql(test_path, TRUE)
```

init_gmql

Init GMQL server

Description

It initializes and runs GMQL server for executing GMQL query. It also performs a login to GMQL REST services suite, if needed
Usage

init_gmql(
  output_format = "GTF",
  remote_processing = FALSE,
  url = NULL,
  username = NULL,
  password = NULL
)

Arguments

output_format  string that identifies the output format of all sample files. It can be TAB, GTF or COLLECT:
  • TAB: tab-delimited file format
  • GTF: tab-delimited text standard format based on the General Feature Format
  • COLLECT: used for storing output in memory (only in the case of local processing, i.e., remote_processing = FALSE)

remote_processing  logical value specifying the processing mode. True for processing on cluster (remote), false for local processing.

url  string url of server: It must contain the server address and base url; service name is added automatically. If NULL, no login is performed. You can always perform it by calling the function login_gmql explicitly

username  string name used during remote server signup

password  string password used during remote server signup

Value

None

Examples

## This statement initializes GMQL with local processing with sample files
## output format as tab-delimited

init_gmql("tab", FALSE)

## This statement initializes GMQL with remote processing

remote_url = "http://www.gmql.eu/gmql-rest/
init_gmql(remote_processing = TRUE, url = remote_url)
Description

Login to GMQL REST services suite as a registered user, specifying username and password, or as guest, using the proper GMQL web service available on a remote server.

Usage

```
login_gmql(url, username = NULL, password = NULL)
```

Arguments

- `url` string url of server: It must contain the server address and base url; service name is added automatically.
- `username` string name used during signup
- `password` string password used during signup

Details

If both username and password are missing, you will be logged as guest. After login you will receive an authentication token. As token remains valid on server (until the next login / registration or logout), a user can safely use a token for a previous session as a convenience; this token is saved in R Global environment to perform subsequent REST call even on complete R restart (if the environment has been saved). If error occurs, a specific error is printed.

Value

None

Examples

```r
## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)
```
**logout_gmql**

*Logout from GMQL*

**Description**

Logout from GMQL REST services suite using the proper GMQL web service available on a remote server.

**Usage**

```
logout_gmql(url)
```

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>url</code></td>
<td>string url of server: It must contain the server address and base url; service name is added automatically</td>
</tr>
</tbody>
</table>

**Details**

After logout the authentication token will be invalidated. The authentication token is removed from R Global environment. If error occurs, a specific error is printed.

**Value**

None

**Examples**

```r
# Login to GMQL REST services suite as guest, then logout

remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)
logout_gmql(remote_url)
```

**log_job**

*Show a job log or trace*

**Description**

It shows a job log or traces a specific job.

**Usage**

```
show_job_log(url, job_id)
trace_job(url, job_id)
```
Arguments

url  string url of server: It must contain the server address and base url; service name is added automatically
job_id  string id of the job

Details

If error occurs, a specific error is printed

Value

Log or trace text

Examples

## Login to GMQL REST services suite as guest

remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)

## List all jobs

list_jobs <- show_jobs_list(remote_url)

## Not run:

jobs_1 <- list_jobs$jobs[[1]]

## Show jobs_1 log

show_job_log(remote_url, jobs_1)

## Trace jobs_1

trace_job(remote_url, jobs_1)

## End(Not run)

map

Method map

Description

Wrapper to GMQL MAP operator

It computes, for each sample in the right dataset, aggregates over the values of the right dataset regions that intersect with a region in a left dataset sample, for each region of each sample in the left dataset. The number of generated output samples is the Cartesian product of the samples in the two input datasets; each output sample has the same regions as the related input left dataset sample, with their attributes and values, plus the attributes computed as aggregates over right region values. Output sample metadata are the union of the related input sample metadata, whose attribute names are prefixed with 'left' or 'right' respectively.
Usage

map(x, y, ...)

## S4 method for signature 'GMQLDataset'
map(x, y, ..., joinBy = conds(), count_name = "")

Arguments

x GMQLDataset class object

y GMQLDataset class object

... a series of expressions separated by comma in the form key = aggregate. The aggregate is an object of class AGGREGATES. The aggregate functions available are: SUM, COUNT, MIN, MAX, AVG, MEDIAN, STD, BAG, BAGD, Q1, Q2, Q3. Every aggregate accepts a string value, except for COUNT, which does not have any value. Argument of 'aggregate function' must exist in schema, i.e. among region attributes. Two styles are allowed:

- list of key-value pairs: e.g. sum = SUM("pvalue")
- list of values: e.g. SUM("pvalue")

"mixed style" is not allowed

joinBy conds function to support methods with groupBy or JoinBy input parameter

count_name string defining the metadata count name; if it is not specified the name is "count_left_right"

Details

When the joinby clause is present, only pairs of samples of x dataset and of y dataset with metadata M1 and M2, respectively, that satisfy the joinby condition are considered.

The clause consists of a list of metadata attribute names that must be present with equal values in both M1 and M2

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folders "DATASET" and "DATASET_GDM" in the subdirectory
## "example" of the package "RGMQL", and opens such folders as a GMQL
## dataset named "exp" and "ref", respectively, using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
test_path2 <- system.file("example", "DATASET_GDM", package = "RGMQL")
exp = read_gmql(test_path)
ref = read_gmql(test_path2)
This statement counts the number of regions in each sample from `exp` dataset that overlap with a `ref` dataset region, and for each `ref` region it computes the minimum score of all the regions in each `exp` sample that overlap with it. The MAP `joinBy` option ensures that only the `exp` samples referring to the same 'cell_tissue' of a `ref` sample are mapped on such `ref` sample; `exp` samples with no `cell_tissue` metadata attribute, or with such metadata attribute, but with a different value from the one(s) of `ref` sample(s), are disregarded.

```r
definition = map(ref, exp, minScore = MIN("score"), joinBy = conds("cell_tissue"))```

---

### Description

**Wrapper to GMQL JOIN operator**

It takes in input two datasets, respectively known as anchor (left) and experiment (right) and returns a dataset of samples consisting of regions extracted from the operands according to the specified conditions (a.k.a `genometric_predicate` and `region_attribute` predicate). The number of generated output samples is the Cartesian product of the number of samples in the anchor and in the experiment dataset (if `joinBy` is not specified). The output metadata are the union of the input metadata, with their attribute names prefixed with left or right dataset name, respectively.

### Usage

```r
# S4 method for signature 'GMQLDataset,GMQLDataset'
merge(
  x,
  y,
  genometric_predicate = NULL,
  region_output = "CAT",
  joinBy = conds(),
  reg_attr = c("")
)
```

### Arguments

- **x** GMQLDataset class object
- **y** GMQLDataset class object
- **genometric_predicate** it is a list of DISTAL objects. For details of DISTAL objects see: DLE, DGE, DL, DG, MD, UP, DOWN
- **region_output** single string that declares which region is given in output for each input pair of left dataset and right dataset regions satisfying the genometric predicate and/or the region attribute predicate:
• LEFT: It outputs the anchor regions from 'x' that satisfy the genometric and/or region attribute predicate
• RIGHT: It outputs the experiment regions from 'y' that satisfy the genometric and/or region attribute predicate
• INT (intersection): It outputs the overlapping part (intersection) of the 'x' and 'y' regions that satisfy the genometric and/or region attribute predicate; if the intersection is empty, no output is produced
• CAT: It outputs the concatenation between the 'x' and 'y' regions that satisfy the genometric and/or region attribute predicate, (i.e. the output regions defined as having left (right) coordinates equal to the minimum (maximum) of the corresponding coordinate values in the 'x' and 'y' regions satisfying the genometric and/or region attribute predicate)
• LEFT_DIST: It outputs the duplicate elimination of 'x' output regions with the same coordinates and values, regardless the 'y' paired region and its values. In this case, the output region attributes and their values are all and only those of 'x', and the output metadata are equal to the 'x' metadata, without additional prefixes
• RIGHT_DIST: It outputs the duplicate elimination of 'y' output regions with the same coordinates and values, regardless the 'x' paired region and its values. In this case, the output regions attributes and their values are all and only those of 'y', and the output metadata are equal to the 'y' metadata, without additional prefixes
• BOTH: It outputs the same regions as LEFT, but it adds in the output region attributes the coordinates of the 'y' paired region that, together with the 'x' output region, satisfies the genometric and/or region attribute predicate

joinBy

condition_evaluation function to support methods with groupBy or JoinBy input parameter

reg_attr

vector of strings made up by region field attribute names, whose values in the paired left and right dataset regions must be equal in order to consider the two paired regions. If specified, region_output cannot be INT or CAT.

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folders "DATASET" and "DATASET_GDM" in the subdirectory
## "example" of the package "RGMQL" and opens such folders as a GMQL
## datasets named TSS and HM, respectively, using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
test_path2 <- system.file("example", "DATASET_GDM", package = "RGMQL")
TSS = read_gmql(test_path)
HM = read_gmql(test_path2)
```
Given a dataset HM and one called TSS with a sample including Transcription Start Site annotations, this statement searches for those regions of HM that are at a minimal distance from a transcription start site (TSS) and takes the first/closest one for each TSS, provided that such distance is lesser than 120K bases and joined TSS and HM samples are obtained from the same provider (joinby clause).

```
join_data = merge(TSS, HM, genometric_predicate = list(MD(1), DLE(120000)),
conds("provider"), region_output = "RIGHT")
```

---

**Description**

This class constructor is used to create instances of OPERATOR object, to be used in GMQL functions that require operator on value.

**Usage**

- `META(value, type = NULL)`
- `NIL(type)`
- `SQRT(value)`

**Arguments**

- `value` : string identifying name of metadata attribute
- `type` : string identifying the type of the attribute value; it must be: INTEGER, DOUBLE or STRING. For NIL() function, only INTEGER and DOUBLE are allowed

**Details**

- **META**: It prepares input parameter to be passed to library function meta, performing all the type conversions needed
- **SQRT**: It prepares input parameter to be passed to library function sqrt, performing all the type conversions needed
- **NIL**: It prepares input parameter to be passed to library function null, performing all the type conversions needed

**Value**

- Operator object
Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such folder as a GMQL dataset
## named "exp"

init_gmql()

# Let's define the path to the folder

test_path <- system.file("example", "DATASET", package = "RGMQL")

# Now, let's read the file

exp = read_gmql(test_path)

## This statement allows to select, in all input samples, all those regions
## for which the region attribute score has a value which is greater
## than the metadata attribute value "avg_score" in their sample.

data = filter(exp, r_predicate = score > META("avg_score"))

## This statement defines new numeric region attributes with "null" value.
## The syntax for creating a new attribute with null value is
## attribute_name = NULL(TYPE), where type may be INTEGER or DOUBLE.

out = select(exp, regions_update = list(signal = NIL("INTEGER"),
                                       pvalue = NIL("DOUBLE")))

## This statement allows to build an output dataset named 'out' such that
## all the samples from the input dataset 'exp' are conserved,
## as well as their region attributes (and their values)
## and their metadata attributes (and their values).
## The new metadata attribute 'concSq' is added to all output samples
## with value correspondent to the mathematical squared root
## of the pre-existing metadata attribute 'concentration'.

out = select(exp, metadata_update = list(concSq = SQRT("concentration")))
```

Ordering-Functions

**Ordering functions**

**Description**

These functions are used to create a series of metadata as string that require ordering on value; it is used only in arrange method (see example).

**Usage**

- `DESC(...)`
- `ASC(...)`
Arguments

... series of metadata as string

Details

- ASC: It defines an ascending order for input value
- DESC: It defines a descending order for input value

Value

Ordering object

Examples

```r
# This statement initializes and runs the GMQL server for local execution
# and creation of results on disk. Then, with system.file() it defines
# the path to the folder "DATASET" in the subdirectory "example"
# of the package "RGMQL" and opens such file as a GMQL dataset named
# "data" using CustomParser

init_gmql()

test_path <- system.file("example", "DATASET", package = "RGMQL")
data = read_gmql(test_path)

# This statement orders the samples according to the Region_Count metadata
# attribute and takes the two samples that have the lowest count.

asc = arrange(data, list(ASC("Region_Count")), fetch_opt = "mtop",
               num_fetch = 2)

# This statement orders the regions of each samples according to their
# pvalue attribute value and in each sample it takes the first seven
# regions with the highest pvalue

desc = arrange(data, regions_ordering = list(DESC("pvalue")),
               reg_fetch_opt = "rtop", reg_num_fetch = 7)
```

Function read

Description

It reads a GMQL dataset, as a folder containing some homogenus samples on disk or as a GRangesList, saving it in Scala memory in a way that can be referenced in R. It is also used to read a repository dataset in case of remote processing.
Usage

```r
read_gmql(dataset, parser = "CustomParser", is_local = TRUE)
read_GRangesList(samples)
```

Arguments

dataset: folder path for GMQL dataset or dataset name on repository

parser: string used to parsing dataset files. The Parsers available are:

- BedParser
- BroadPeakParser
- NarrowPeakParser
- CustomParser

Default is CustomParser.

is_local: logical value indicating local or remote dataset

samples: GRangesList

Details

Normally, a GMQL dataset contains an XML schema file that contains name of region attributes. (e.g chr, start, stop, strand) The CustomParser reads this XML schema; if you already know what kind of schema your files have, use one of the parsers defined, without reading any XML schema.

If GRangesList has no metadata: i.e. metadata() is empty, two metadata are generated:

- "provider" = "PoliMi"
- "application" = "RGMQL"

NOTE: The folder layout must obey the following rules and adopt the following layout: The dataset folder can have any name, but must contains the sub-folders named: "files". The sub-folder "files" contains the dataset files and the schema xml file. The schema files adopt the following the naming conventions:

- "schema.xml" - "test.schema"

The names must be in LOWERCASE. Any other schema file will not be considered, if both are present, "test.schema" will be used.

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such folder as a GMQL dataset
## named "data" using CustomParser
```
init_gmql()

## This statement opens such folder as a GMQL dataset named "data" using
## "NarrowPeakParser"
dataPeak = read_gmql(test_path, "NarrowPeakParser")

## This statement reads a remote public dataset stored into GMQL system
## repository. For a public dataset in a (remote) GMQL repository the
## prefix "public." is needed before dataset name
remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)
data1 = read_gmql("public.Example_Dataset_1", is_local = FALSE)

---

**register_gmql**  
Register into remote GMQL

**Description**

Register to GMQL REST services suite using the proper GMQL web service available on a remote server.

**Usage**

```r
register_gmql(url, username, psr, email, first_name, last_name)
```

**Arguments**

- **url**: string url of server: It must contains the server address and base url; service name is added automatically
- **username**: string user name used to login in
- **psr**: string password used to login in
- **email**: string user email
- **first_name**: string user first name
- **last_name**: string user last name

**Details**

After registration you will receive an authentication token. As token remains valid on server (until the next login / registration or logout), a user can safely use a token for a previous session as a convenience; this token is saved in R Global environment to perform subsequent REST calls or batch processing even on complete R restart (if the environment has been saved). If error occurs, a specific error is printed.
remote_processing

Value
None

Examples

```
## Register to GMQL REST services suite

remote_url = "http://www.gmql.eu/gmql-rest/
## Not run:
register_gmql(remote_url,"foo","foo","foo@foo.com","foo","foo")
## End(Not run)
```

```
## This statement initializes GMQL with local processing with sample
## files output format as tab-delimited, and then it changes processing
## mode to remote
init_gmql("tab", remote_processing = FALSE)
remote_processing(TRUE)
```
run_query

Run a GMQL query

**Description**

It runs a GMQL query into repository taken from file or inserted as text string, using the proper GMQL web service available on a remote server.

**Usage**

```r
r flipping query(url, queryName, query, output_gtf = TRUE)
r flipping query_fromfile(url, filePath, output_gtf = TRUE)
```

**Arguments**

- `url` string url of server: It must contain the server address and base url; service name is added automatically.
- `queryName` string name of the GMQL query file.
- `query` string text of the GMQL query.
- `output_gtf` logical value indicating file format used for storing samples generated by the query. The possibilities are:
  - GTF
  - TAB
- `filePath` string path of a txt file containing a GMQL query.

**Details**

If error occurs, a specific error is printed.

**Value**

None

**Examples**

```r
## Not run:

## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)

## Run query as string input parameter
## NOTE: not very suitable for long queries
run_query(remote_url, "query_1", "DATASET = SELECT() Example_Dataset1;"
```
MATERIALIZE DATASET INTO RESULT_DS;", output_gtf = FALSE)

## With system.file() this statement defines the path to the folder
## "example" of the package "RGMQL", and then it executes the query
## written in the text file "query1.txt"

test_path <- system.file("example", package = "RGMQL")
test_query <- file.path(test_path, "query1.txt")
run_query_fromfile(remote_url, test_query, output_gtf = FALSE)

## End(Not run)

---

sample_metadata  

Show metadata list from dataset sample

Description

It retrieves metadata of a specific sample in dataset using the proper GMQL web service available on a remote server

Usage

sample_metadata(url, datasetName, sampleName)

Arguments

url  
string url of server: It must contain the server address and base url; service name is added automatically

datasetName  
string name of dataset of interest

sampleName  
string name of sample of interest

Details

If error occurs, a specific error is printed

Value

List of metadata in the form 'key = value'

Examples

## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)

## This statement retrieves metadata of sample 'S_00000' from public
## dataset 'Example_Dataset_1'
sample_region

It retrieves regions data of a specific sample (whose name is specified in the parameter "sample-Name") in a specific dataset (whose name is specified in the parameter "datasetName") using the proper GMQL web service available on a remote server.

Usage

sample_region(url, datasetName, sampleName)

Arguments

url: string url of server. It must contain the server address and base url; service name is added automatically.
datasetName: string name of dataset of interest.
sampleName: string name of sample of interest.

Details

If error occurs, a specific error is printed.

Value

GRanges data containing regions of sample.

Examples

## Not run:

## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/
login.gmql(remote_url)

## This statement retrieves regions data of sample "S_00000" from public dataset "Example_Dataset_1"

sample_region(remote_url, "public.Example_Dataset_1", "S_00000")

## End(Not run)
Save GMQL query

Description

It saves a GMQL query into repository, taken from file or inserted as text string, using the proper GMQL web service available on a remote server.

Usage

```
save_query(url, queryName, queryTxt)
```

```
save_query_fromfile(url, queryName, filePath)
```

Arguments

- `url` string url of server: It must contain the server address and base url; service name is added automatically
- `queryName` string name of query
- `queryTxt` string text of GMQL query
- `filePath` string local file path of a txt file containing a GMQL query

Details

If you save a query with the same name of another query already stored in repository, you will overwrite it; if no error occurs, it prints: "Saved", otherwise it prints the error.

Value

None

Examples

```r
## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)

## This statement saves query written directly as input string parameter
## with name "dna_query"

save_query(remote_url, "example_query",
"DATASET = SELECT() Example_Dataset_1; MATERIALIZE DATASET INTO RESULT_DS;")
```

```r
## With system.file() this statement defines the path to the folder
## "example" of the package "RGMQL", and then it saves the query written
## in the text file "query1.txt" into remote repository
```
```r
test_path <- system.file("example", package = "RGMQL")
test_query <- file.path(test_path, "query1.txt")
save_query_fromfile(remote_url, "query1", test_query)
```

<table>
<thead>
<tr>
<th>select</th>
<th>Method select</th>
</tr>
</thead>
</table>

**Description**

Wrapper to GMQL PROJECT operator

It creates, from an existing dataset, a new dataset with all the samples from input dataset, but keeping for each sample in the input dataset only those metadata and/or region attributes specified. Region coordinates and values of the remaining metadata and/or region attributes remain equal to those in the input dataset. It allows to:

- Remove existing metadata and/or region attributes from a dataset
- Update or set new metadata and/or region attributes in the result

**Usage**

```r
## S4 method for signature 'GMQLDataset'
select(
  .data,
  metadata = NULL,
  metadata_update = NULL,
  all_but_meta = FALSE,
  regions = NULL,
  regions_update = NULL,
  all_but_reg = FALSE
)
```

**Arguments**

- `.data` GMQLDataset class object
- `metadata` vector of strings made up by metadata attributes
- `metadata_update` list of updating rules in the form of key = value generating new metadata attributes and/or attribute values. The following options are available:
  - All aggregation functions already defined by AGGREGATES object
  - All basic mathematical operations (+, -, *, /), including parenthesis
  - SQRT constructor object defined by OPERATOR object
- `all_but_meta` logical value indicating which metadata you want to exclude; If FALSE, only the metadata attributes specified in `metadata` argument are kept in the output of the operation; if TRUE, the metadata are all kept except those in `metadata` argument. If `metadata` input parameter is not defined `all_but_meta` is not considered.
semijoin

regions vector of strings made up by region attributes
regions_update list of updating rules in the form of key = value generating new genomic region attributes and/or values. The following options are available:
  • All aggregation functions already defined by AGGREGATES object
  • All basic mathematical operations (+, -, *, /), including parenthesis
  • SQRT, META, NIL constructor objects defined by OPERATOR object
all_but_reg logical value indicating which region attributes you want to exclude; if FALSE, only the regions attributes specified in regions argument are kept in the output of the operation; if TRUE, the regions attributes are all kept except those in regions argument. If regions is not defined, all_but_reg is not considered.

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such folder as a GMQL dataset
## named "data"
init_gmql()

test_path <- system.file("example", "DATASET", package = "RGMQL")
data = read_gmql(test_path)

## This statement creates a new dataset called CTCF_NORM_SCORE by preserving
## all region attributes apart from score, and creating a new region
## attribute called new_score by dividing the existing score value of each
## region by 1000.0 and incrementing it by 100.
## It also generates, for each sample of the new dataset,
## a new metadata attribute called normalized with value 1,
## which can be used in future selections.
CTCF_NORM_SCORE = select(data, metadata_update = list(normalized = 1),
                         regions_update = list(new_score = (score / 1000.0) + 100),
                         regions = c("score"), all_but_reg = TRUE)
```

semijoin | Semijoin condition

Description

This function is used as support to the filter method to define semijoin conditions on metadata
semijoin

Usage

semijoin(.data, is_in = TRUE, groupBy)

Arguments

- `.data` GMQLDataset class object
- `is_in` logical value: TRUE => for a given sample of input dataset `.data` in filter method, if and only if there exists at least one sample in dataset `.data` with metadata attributes defined in groupBy and these attributes of `.data` have at least one value in common with the same attributes defined in at least one sample of `.data` in filter method, FALSE => semijoin condition is evaluated accordingly.
- `groupBy` condition_evaluation function to support methods with groupBy or JoinBy input parameter

Value

semijoin condition as list

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folders "DATASET" and "DATASET_GDM" in the subdirectory
## "example" of the package "RGMQL" and opens such folders as GMQL datasets
## named "data" and "join_data", respectively

init_gmql()

test_path <- system.file("example", "DATASET", package = "RGMQL")
test_path2 <- system.file("example", "DATASET_GDM", package = "RGMQL")
data <- read_gmql(test_path)
join_data <- read_gmql(test_path2)

## This statement creates a new dataset called 'jun_tf' by selecting those
## samples and their regions from the existing 'data' dataset such that:
## Each output sample has a metadata attribute called antibody_target
## with value JUN.
## Each output sample also has not a metadata attribute called cell
## that has the same value of at least one of the values that a metadata
## attribute equally called cell has in at least one sample
## of the 'join_data' dataset.
## For each sample satisfying previous conditions, only its regions that
## have a region attribute called pValue with the associated value
## less than 0.01 are conserved in output

jun_tf <- filter(data, antibody_target == "JUN", pvalue < 0.01,
                 semijoin(join_data, FALSE, conds("cell")))
```
Method setdiff

Description

Wrapper to GMQL DIFFERENCE operator

It produces one sample in the result for each sample of the left operand, by keeping the same metadata of the left input sample and only those regions (with their attributes and values) of the left input sample which do not intersect with any region in any right operand sample. The optional joinBy clause is used to extract a subset of pairs from the Cartesian product of the two input datasets x and y on which to apply the DIFFERENCE operator: only those samples that have the same value for each specified metadata attribute are considered when performing the difference.

Usage

```r
setdiff(x, y, joinBy = conds(), is_exact = FALSE)
```

Arguments

- **x**: GMQLDataset class object
- **y**: GMQLDataset class object
- **joinBy**: conds function to support methods with groupBy or JoinBy input parameter
- **is_exact**: single logical value: TRUE means that the region difference is executed only on regions in 'x' dataset with exactly the same coordinates of at least one region present in 'y' dataset; if is_exact = FALSE, the difference is executed on all regions in 'x' dataset that overlap (even just one base) with at least one region in 'y' dataset

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
# This statement initializes and runs the GMQL server for local execution
# and creation of results on disk. Then, with system.file() it defines
# the path to the folders "DATASET" and "DATASET_GDM" in the subdirectory
# "example" of the package "RGMQL" and opens such folders as a GMQL
# datasets named "data1" and "data2", respectively, using CustomParser

init_gmql()

test_path <- system.file("example", "DATASET", package = "RGMQL")
test_path2 <- system.file("example", "DATASET_GDM", package = "RGMQL")
data1 = read_gml(test_path)
data2 = read_gml(test_path2)
```
## This statement returns all the regions in the first dataset
## that do not overlap any region in the second dataset.
out = setdiff(data1, data2)

## This statement extracts for every pair of samples s1 in data1
## and s2 in data2 having the same value of the metadata
## attribute 'cell' the regions that appear in s1 but
## do not overlap any region in s2.
## Metadata of the result are the same as the metadata of s1.
out_t = setdiff(data1, data2, conds("cell"))

### show_all_metadata

**show_all_metadata**

*Show a metadata cartesian product of all metadata present into the
dataset and the region sets*

#### Description

It show the presence of the metadata keys in that specific regions set, showing its value or just the logical value TRUE.

#### Usage

```
show_all_metadata(dataset, show_value = FALSE)
```

#### Arguments

- **dataset**: string with GMQL dataset folder path or remote dataset. In case of remote dataset to distinguish among private or public repository each name must be prefixed with "private." or "public." respectively.
- **show_value**: whether or not show the value associated to metadata, otherwise only logical value (TRUE or FALSE) are shown.

#### Value

A Dataframe containing the mapping between metadata and the regions set

#### See Also

- `show_all_metadata`
Examples

```r
test_path <- system.file("example", "DATASET", package = "RGMQL")
show_all_metadata(test_path)
```

```r
test_path <- system.file("example", "DATASET", package = "RGMQL")
show_all_metadata(test_path, show_value = TRUE)
```

```r
test_url = "http://www.gmql.eu/gmql-rest"
login_gmql(test_url)
show_all_metadata("public.Example_Dataset_1", show_value = TRUE)
```

---

**show_datasets_list**  
*Show datasets*

## Description

It shows all GMQL datasets stored by the user or public in remote repository, using the proper GMQL web service available on a remote server.

## Usage

```r
show_datasets_list(url)
```

## Arguments

- `url` single string url of server: It must contain the server address and base url; service name is added automatically

## Details

If error occurs, a specific error is printed
show_jobs_list

Value

List of datasets. Every dataset in the list is described by:

- name: name of dataset
- owner: public or name of the user

Examples

```r
## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)

## List all datasets
list <- show_datasets_list(remote_url)
```

Description

It shows all jobs (run, succeeded or failed) invoked by the user on remote server using, the proper GMQL web service available on a remote server

Usage

```r
show_jobs_list(url)
```

Arguments

- `url`: string url of server: It must contain the server address and base url; service name is added automatically

Details

If error occurs, a specific error is printed

Value

List of jobs. Every job in the list is described by:

- id: unique job identifier
Examples

```r
## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)

## List all jobs
list_jobs <- show_jobs_list(remote_url)
```

---

**show_queries_list**  
*Show all queries*

### Description

It shows all the GMQL queries saved by the user on remote repository, using the proper GMQL web service available on a remote server.

### Usage

```r
show_queries_list(url)
```

### Arguments

- `url` 
  - string url of server: It must contain the server address and base url; service name is added automatically

### Details

If error occurs, a specific error is printed

### Value

List of queries. Every query in the list is described by:

- name: name of query
- text: text of GMQL query

### Examples

```r
## Login to GMQL REST services suite
remote_url = "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)

## List all queries executed on remote GMQL system
list <- show_queries_list(remote_url)
```
show_samples_list

Description

It shows all samples from a specific GMQL dataset on remote repository, using the proper GMQL web service available on a remote server.

Usage

show_samples_list(url, datasetName)

Arguments

url string url of server: It must contain the server address and base url; service name is added automatically

datasetName name of dataset containing the samples whose list we like to get; if the dataset is a public dataset, we have to add "public." as prefix, as shown in the example below, otherwise no prefix is needed

Details

If error occurs, a specific error is printed

Value

List of samples in dataset. Every sample in the list is described by:

- id: id of sample
- name: name of sample
- path: sample repository path

Examples

```r
## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/"
login_gmql(remote_url)

## This statement shows all samples present into public dataset
## 'Example_Dataset_1'
list <- show_samples_list(remote_url, "public.Example_Dataset_1")
```
show_schema

**Description**

It shows the region attribute schema of a specific GMQL dataset on remote repository, using the proper GMQL web service available on a remote server.

**Usage**

```
show_schema(url, datasetName)
```

**Arguments**

- **url**: string url of server: It must contain the server address and base url; service name is added automatically.
- **datasetName**: name of dataset to get the schema; if the dataset is a public dataset, we have to add "public." as prefix, as shown in the example below, otherwise no prefix is needed.

**Details**

If error occurs, a specific error is printed.

**Value**

List of region schema fields. Every field in the list is described by:

- **name**: name of field (e.g. chr, start, end, strand, ...)
- **fieldType**: (e.g. STRING, DOUBLE, ...)

**Examples**

```
## Login to GMQL REST services suite as guest
remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)

## Show schema of public dataset 'Example_Dataset_1'
list <- show_schema(remote_url, "public.Example_Dataset_1")
```
**stop_gmql**

*Stop GMQL server*

**Description**
It stops GMQL server processing

**Usage**

```r
stop_gmql()
```

**Value**
None

**Examples**

```r
# This statement first initializes GMQL with local processing and with
# sample file output format as tab-delimited, and then stops it
init_gmql("tab", FALSE)
stop_gmql()
```

**stop_job**

*Stop a job*

**Description**
It stops a specific current query job

**Usage**

```r
stop_job(url, job_id)
```

**Arguments**

- `url` (string): URL of server. It must contain the server address and base URL; service name is added automatically.
- `job_id` (string): ID of the job

**Details**
If error occurs, a specific error is printed
take

Value

None

Examples

## Not run:

## Login to GMQL REST services suite at remote url

remote_url = "http://www.gmql.eu/gmql-rest/
login_gmql(remote_url)

## This statement shows all jobs at GMQL remote system and selects one
## running job, saving it into 'jobs_1' (in this case is the first of the
## list), and then stop it

list_jobs <- show_jobs_list(remote_url)
jobs_1 <- list_jobs$jobs[[1]]
stop_job(remote_url, jobs_1)

## End(Not run)

take

Method take

take(.data, ...)

## S4 method for signature 'GMQLDataset'
take(.data, rows = 0L)

Arguments

.data returned object from any GMQL function
... Additional arguments for use in other specific methods of the generic take function
rows number of regions rows for each sample that you want to retrieve and store in memory. By default it is 0, that means take all rows for each sample

Description

Wrapper to TAKE operation

It saves the content of a dataset that contains samples metadata and regions as GRangesList. It is normally used to store in memory the content of any dataset generated during a GMQL query. The operation can be very time-consuming. If you invoked any materialization before take function, all those datasets are materialized as folders.
## Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folder "DATASET" in the subdirectory "example"
## of the package "RGMQL" and opens such folder as a GMQL dataset
## named "rd" using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
rd = read_gmql(test_path)

## This statement creates a dataset called 'aggr' which contains one
## sample for each antibody_target and cell value found within the metadata
## of the 'rd' dataset sample; each created sample contains all regions
## from all 'rd' samples with a specific value for their
## antibody_target and cell metadata attributes.

aggr = aggregate(rd, conds(c("antibody_target", "cell")))

## This statement performs the query and returns the resulted dataset as
## GRangesList named 'taken'. It returns only the first 45 regions of
## each sample present into GRangesList and all the metadata associated
## with each sample

taken <- take(aggr, rows = 45)
```

### union

#### Method union

Wrapper to GMQL UNION operator

It is used to integrate samples of two homogeneous or heterogeneous datasets within a single dataset; for each sample of either input dataset, a result sample is created as follows:

- Metadata are the same as in the original sample.
- Resulting schema is the schema of the left input dataset.
- Regions are the same (in coordinates and attribute values) as in the original sample, if it is from the left input dataset; if it is from the right input dataset, its regions are the same in coordinates, but only region attributes identical (in name and type) to those of the left input dataset are retained, with the same values. Region attributes which are missing in an input dataset sample w.r.t. the merged schema are set to null.
Usage

```r
## S4 method for signature 'GMQLDataset,GMQLDataset'
union(x, y)
```

Arguments

- `x`: GMQLDataset object
- `y`: GMQLDataset object

Value

GMQLDataset object. It contains the value to use as input for the subsequent GMQLDataset method

Examples

```r
## This statement initializes and runs the GMQL server for local execution
## and creation of results on disk. Then, with system.file() it defines
## the path to the folders "DATASET" and "DATASET_GDM" in the subdirectory
## "example" of the package "RGMQL" and opens such folders as a GMQL
## datasets named "data1" and "data2", respectively, using CustomParser

init_gmql()
test_path <- system.file("example", "DATASET", package = "RGMQL")
test_path2 <- system.file("example", "DATASET_GDM", package = "RGMQL")
data1 <- read_gmql(test_path)
data2 <- read_gmql(test_path2)

## This statement creates a dataset called 'full' which contains all samples
## from the datasets 'data1' and 'data2'

res <- union(data1, data2)
```

---

### Description

It uploads a folder (GMQL or not) containing sample files using the proper GMQL web service available on a remote server: a new dataset is created on remote repository

Usage

```r
upload_dataset(url, datasetName, folderPath, schemaName = NULL)
```
Arguments

- **url**: string url of server: It must contain the server address and base url; service name is added automatically
- **datasetName**: name of dataset to create in repository
- **folderPath**: string local path to the folder containing the samples files
- **schemaName**: string name of schema used to parse the samples; schemaName available are:
  - NARROWPEAK
  - BROADPEAK
  - VCF
  - BED
  - BEDGRAPH

  If schemaName is NULL, it looks for a XML schema file to read in the folder-Path

Details

If no error occurs, it prints "Upload Complete", otherwise a specific error is printed

NOTE: The folder layout must obey the following rules and adopt the following layout: The dataset folder can have any name, but must contains the sub-folders named: "files". The sub-folder "files" contains the dataset files and the schema xml file. The schema files adopt the following the naming conventions:
- "schema.xml" - "test.schema"

  The names must be in LOWERCASE. Any other schema file will not be considered, if both are present, "test.schema" will be used.

Value

None

Examples

```r
## Not run:

## This statement defines the path to the folder "DATASET_GDM" in the
## subdirectory "example" of the package "RGMQL"

test_path <- system.file("example", "DATASET_GDM", package = "RGMQL")

## Login to GMQL REST services suite at remote url

remote_url <- "http://www.gmql.eu/gmql-rest/

login_gmql(remote_url)

## Upload of GMQL dataset with "dataset1" as name, without specifying any
## schema

upload_dataset(remote_url, "dataset1", folderPath = test_path)
```
## End (Not run)
Index

aggregate, 3
aggregate,GMQLDataset-method (aggregate), 3
aggregate-method (aggregate), 3
AGGREGATES-Object, 4
ALL, 12
ALL (Cover-Param), 13
ANY, 12
ANY (Cover-Param), 13
arrange, 7
arrange,GMQLDataset-method (arrange), 7
arrange-method (arrange), 7
ASC, 8
ASC (Ordering-Functions), 38
AVG, 11, 21, 27, 34
AVG (AGGREGATES-Object), 4
BAG, 11, 21, 27, 34
BAG (AGGREGATES-Object), 4
BAGD, 11, 21, 27, 34
BAGD (AGGREGATES-Object), 4
collect, 9
collect,GMQLDataset-method (collect), 9
collect-method (collect), 9
compile_query, 10
compile_query_fromfile (compile_query), 10
condition_evaluation, 4, 36, 49
collection_evaluation (Evaluation-Function), 18
conds, 12, 27, 34, 50
conds (Evaluation-Function), 18
COUNT, 11, 21, 27, 34
COUNT (AGGREGATES-Object), 4
COUNTSAMP, 27
COUNTSAMP (AGGREGATES-Object), 4
cover, 11
cover,GMQLDataset-method (cover), 11
cover-method (cover), 11
Cover-Param, 13
delete_dataset, 14
DESC, 8
DESC (Ordering-Functions), 38
DG, 35
dg (DISTAL-Object), 15
dge, 35
dge (DISTAL-Object), 15
DISTAL-Object, 15
DL, 35
dl (DISTAL-Object), 15
DLE, 35
dle (DISTAL-Object), 15
DOWN, 35
down (DISTAL-Object), 15
download_as_GRangesList
download_dataset, 17
export_gmql, 19, 29
execute, 19
extend, 21
extend,GMQLDataset-method (extend), 21
extend-method (extend), 21
filter, 22, 49
filter,GMQLDataset-method (filter), 22
filter-extract, 24
filter-method (filter), 22
filter_and_extract, 24
FULL, 25
FULL (filter-extract), 24
group_by, 26
group_by,GMQLDataset-method (group_by), 26
group_by-method (group_by), 26
import_gmql, 20, 29
init_gmql, 29
log_job, 32
login_gmql, 30, 31
logout_gmql, 32
map, 33
map, GMQLDataset-method (map), 33
map-method (map), 33
MAX, 11, 21, 27, 34
MAX (AGGREGATES-Object), 4
MD, 35
MD (DISTAL-Object), 15
MEDIAN, 11, 21, 27, 34
MEDIAN (AGGREGATES-Object), 4
merge, 35
merge, GMQLDataset, GMQLDataset-method (merge), 35
merge-method (merge), 35
META (OPERATOR-Object), 37
MIN, 11, 21, 27, 34
MIN (AGGREGATES-Object), 4
NIL (OPERATOR-Object), 37
OPERATOR-Object, 37
Ordering-Functions, 38
Q1, 11, 21, 27, 34
Q1 (AGGREGATES-Object), 4
Q2, 11, 21, 27, 34
Q2 (AGGREGATES-Object), 4
Q3, 11, 21, 27, 34
Q3 (AGGREGATES-Object), 4
read_gmql, 39
read_GRangesList (read_gmql), 39
register_gmql, 41
remote_processing, 42
run_query, 43
run_query_fromfile (run_query), 43
sample_metadata, 44
sample_region, 45
save_query, 46
save_query_fromfile (save_query), 46
select, 47
select, GMQLDataset-method (select), 47
select-method (select), 47
semijoin, 23, 48
setdiff, 50
setdiff, GMQLDataset, GMQLDataset-method (setdiff), 50
setdiff-method (setdiff), 50
show_all_metadata, 51, 51
show_datasets_list, 52
show_job_log (log_job), 32
show_jobs_list, 53
show_queries_list, 54
show_samples_list, 55
show_schema, 56
SQRT (OPERATOR-Object), 37
STD, 11, 21, 27, 34
STD (AGGREGATES-Object), 4
stop_gmql, 57
stop_job, 57
SUM, 11, 21, 27, 34
SUM (AGGREGATES-Object), 4
take, 58
take, GMQLDataset-method (take), 58
take-method (take), 58
trace_job (log_job), 32
union, 59
union, GMQLDataset, GMQLDataset-method (union), 59
union-method (union), 59
UP, 35
UP (DISTAL-Object), 15
upload_dataset, 60