Package ‘RaggedExperiment’

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Title Representation of Sparse Experiments and Assays Across Samples

Version 1.26.0

Description This package provides a flexible representation of copy number, mutation, and other data that fit into the ragged array schema for genomic location data. The basic representation of such data provides a rectangular flat table interface to the user with range information in the rows and samples/specimen in the columns. The RaggedExperiment class derives from a GRangesList representation and provides a semblance of a rectangular dataset.

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biocViews Infrastructure, DataRepresentation

BugReports https://github.com/Bioconductor/RaggedExperiment/issues

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Description

RaggedExperiment allows the user to represent, copy number, mutation, and other types of range-based data formats where optional information about samples can be provided. At the backbone of this package is the GRangesList class. The RaggedExperiment class uses this representation and presents the data in a couple of different ways:

- rowRanges
- colData

The rowRanges method will return the internal GRangesList representation of the dataset. A distinction between the SummarizedExperiment and the RaggedExperiment classes is that the RaggedExperiment class allows for ragged ranges, meaning that there may be a different number of ranges or rows per sample.

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See Also

Useful links:

- Report bugs at https://github.com/Bioconductor/RaggedExperiment/issues
assay-functions

Create simplified representation of ragged assay data.

Description

These methods transform assay() from the default (i.e., sparseAssay()) representation to various forms of more dense representation. compactAssay() collapses identical ranges across samples into a single row. disjoinAssay() creates disjoint (non-overlapping) regions, simplifies values within each sample in a user-specified manner, and returns a matrix of disjoint regions x samples.

This method transforms assay() from the default (i.e., sparseAssay()) representation to a reduced representation summarizing each original range overlapping ranges in query. Reduction in each cell can be tailored to individual needs using the simplifyReduce functional argument.

Usage

sparseAssay(
  x,
  i = 1,
  withDimnames = TRUE,
  background = NA_integer_,
  sparse = FALSE
)

compactAssay(
  x,
  i = 1,
  withDimnames = TRUE,
  background = NA_integer_,
  sparse = FALSE
)

disjoinAssay(
  x,
  simplifyDisjoin,
  i = 1,
  withDimnames = TRUE,
  background = NA_integer_
)

qreduceAssay(
  x,
  query,
  simplifyReduce,
  i = 1,
  withDimnames = TRUE,
  background = NA_integer_
)
Arguments

- **x**: A `RaggedExperiment` object
- **i**: integer(1) or character(1) name of assay to be transformed.
- **withDimnames**: logical(1) include dimnames on the returned matrix. When there are no explicit rownames, these are manufactured with `as.character(rowRanges(x)); rownames are always manufactured for `compactAssay()` and `disjoinAssay()`.
- **background**: A value (default NA) for the returned matrix after `*Assay` operations
- **sparse**: logical(1) whether to return a `sparseMatrix` representation
- **simplifyDisjoin**: A function / functional operating on a `*List`, where the elements of the list are all within-sample assay values from ranges overlapping each disjoint range. For instance, to use the `simplifyDisjoin=mean` of overlapping ranges, where ranges are characterized by integer-valued scores, the entries are calculated as
  
  original: |-----------|
  
  |----------|
  
  a a, b b  
  
  disjoint: |----|------|---|
  
  values <- `IntegerList(a, c(a, b), b)`
  
  `simplifyDisjoin(values)`

- **query**: `GRanges` providing regions over which reduction is to occur.
- **simplifyReduce**: A function / functional accepting arguments `score`, `range`, and `qrange`:
  
  - `score`: A `*List`, where each list element corresponds to a cell in the matrix to be returned by `qreduceAssay`. Vector elements correspond to ranges overlapping query. The `*List` objects support many vectorized mathematical operations, so `simplifyReduce` can be implemented efficiently.
  
  - `range`: A `GRangesList` instance, ‘parallel’ to `score`. Each element of the list corresponds to a cell in the matrix to be returned by `qreduceAssay`. Each range in the element corresponds to the range for which the `score` element applies.
  
  - `qrange`: A `GRanges` instance with the same length as `unlist(score)`, providing the query range window to which the corresponding scores apply.

Value

- **sparseAssay()**: A `matrix()` with dimensions `dim(x)`. Elements contain the assay value for the \( i \)th range and \( j \)th sample. Use ‘sparse=TRUE’ to obtain a `sparseMatrix` assay representation.

- **compactAssay()**: Samples with identical range are placed in the same row. Non-disjoint ranges are NOT collapsed. Use ‘sparse=TRUE’ to obtain a `sparseMatrix` assay representation.
disjoinAssay(): A matrix with number of rows equal to number of disjoint ranges across all samples. Elements of the matrix are summarized by applying simplifyDisjoin() to assay values of overlapping ranges.

qreduceAssay(): A matrix() with dimensions length(query) x ncol(x). Elements contain assay values for the ith query range and jth sample, summarized according to the function simplifyReduce.

Examples

```
re4 <- RaggedExperiment(GRangesList(
  GRanges(c(A = "chr1:1-10:-", B = "chr1:8-14:-", C = "chr2:15-18:+"), score = 3:5),
  GRanges(c(D = "chr1:1-10:-", E = "chr2:11-18:+"), score = 1:2)
), colData = DataFrame(id = 1:2))

query <- GRanges(c("chr1:1-14:-", "chr2:11-18:+"))

weightedmean <- function(scores, ranges, qranges)
{
  ## weighted average score per query range
  ## the weight corresponds to the size of the overlap of each
  ## overlapping subject range with the corresponding query range
  isects <- pintersect(ranges, qranges)
  sum(scores * width(isects)) / sum(width(isects))
}

qreduceAssay(re4, query, weightedmean)
```

```
# Not run:
## Extended example: non-silent mutations, summarized by genic region
suppressPackageStartupMessages(
  library(TxDb.Hsapiens.UCSC.hg19.knownGene)
  library(org.Hs.eg.db)
  library(GenomeInfoDb)
  library(MultiAssayExperiment)
  library(curatedTCGAData)
  library(TCGAutils)
)

## TCGA MultiAssayExperiment with RaggedExperiment data
mae <- curatedTCGAData("ACC", c("RNASeq2GeneNorm", "CNASNP", "Mutation"),
  version = "1.1.38", dry.run = FALSE)

## genomic coordinates
gn <- genes(TxDb.Hsapiens.UCSC.hg19.knownGene)
gn <- keepStandardChromosomes(granges(gn), pruning.mode="coarse")
seqlevelsStyle(gn) <- "NCBI"
genome(gn)

## reduce mutations, marking any genomic range with non-silent mutation as FALSE
```
nonsilent <- function(scores, ranges, qranges) any(scores != "Silent")
mre <- mae["ACC_Mutation-20160128"]
seqlevelsStyle(rowRanges(mre)) <- "NCBI"
## hack to make genomes match
genome(mre) <- paste0(correctBuild(unique(genome(mre)), "NCBI"), ".p13")
mutations <- qreduceAssay(mre, gn, nonsilent, "Variant_Classification")
genome(mre) <- correctBuild(unique(genome(mre)), "NCBI")

## reduce copy number
re <- mae["ACC_CNASNP-20160128"]
class(re) ## [1] "RaggedExperiment"
seqlevelsStyle(re) <- "NCBI"
genome(re) <- "GRCh37.p13"
cn <- qreduceAssay(re, gn, weightedmean, "Segment_Mean")
genome(re) <- "GRCh37"

## ALTERNATIVE
##
## TCGAutils helper function to convert RaggedExperiment objects to
## RangedSummarizedExperiment based on annotated gene ranges
mae2 <- mae
mae2[[1L]] <- re
mae2[[2L]] <- mre
qreduceTCGA(mae2)

## End(Not run)

RaggedExperiment-class

RaggedExperiment objects

Description

The RaggedExperiment class is a container for storing range-based data, including but not limited to copy number data, and mutation data. It can store a collection of GRanges objects, as it is derived from the GenomicRangesList.

Usage

RaggedExperiment(..., colData = DataFrame())

## S4 method for signature 'RaggedExperiment'
seqinfo(x)

## S4 replacement method for signature 'RaggedExperiment'
seqinfo(x, new2old = NULL, pruning.mode = c("error", "coarse", "fine", "tidy")) <- value
## S4 method for signature 'RaggedExperiment'
rowRanges(x, ...)

## S4 replacement method for signature 'RaggedExperiment,GRanges'
rowRanges(x, ...) <- value

## S4 method for signature 'RaggedExperiment'
mcols(x, use.names = FALSE, ...)

## S4 replacement method for signature 'RaggedExperiment'
mcols(x, ...) <- value

## S4 method for signature 'RaggedExperiment'
rowData(x, use.names = TRUE, ...)

## S4 replacement method for signature 'RaggedExperiment'
rowData(x, ...) <- value

## S4 method for signature 'RaggedExperiment'
dim(x)

## S4 method for signature 'RaggedExperiment'
dimnames(x)

## S4 replacement method for signature 'RaggedExperiment,list'
dimnames(x) <- value

## S4 replacement method for signature 'RaggedExperiment,ANY'
dimnames(x) <- value

## S4 method for signature 'RaggedExperiment'
length(x)

## S4 method for signature 'RaggedExperiment'
colData(x, ...)

## S4 replacement method for signature 'RaggedExperiment,DataFrame'
colData(x) <- value

## S4 method for signature 'RaggedExperiment,missing'
assay(x, i, withDimnames = TRUE, ...)

## S4 method for signature 'RaggedExperiment,ANY'
assay(x, i, withDimnames = TRUE, ...)

## S4 method for signature 'RaggedExperiment'
assays(x, withDimnames = TRUE, ...)

RaggedExperiment-class
## S4 method for signature 'RaggedExperiment'
assayNames(x, ...)

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

## S4 method for signature 'RaggedExperiment'
as.list(x, ...)

## S4 method for signature 'RaggedExperiment'
as.data.frame(x, row.names = NULL, optional = FALSE, ...)

## S4 method for signature 'RaggedExperiment'
x$name

## S4 method for signature 'RaggedExperiment',ANY,ANY,ANY'
x[i, j, ..., drop = TRUE]

## S4 method for signature 'RaggedExperiment',Vector'
overlapsAny(
    query,
    subject,
    maxgap = 0L,
    minoverlap = 1L,
    type = c("any", "start", "end", "within", "equal"),
    ...
)

## S4 method for signature 'RaggedExperiment',Vector'
subsetByOverlaps(
    x,
    ranges,
    maxgap = -1L,
    minoverlap = 0L,
    type = c("any", "start", "end", "within", "equal"),
    invert = FALSE,
    ...
)

## S4 method for signature 'RaggedExperiment'
subset(x, subset, select, ...)

### Arguments

... Constructor: GRanges, list of GRanges, or GRangesList OR assay: Additional arguments for assay. See details for more information.

colData A DataFrame describing samples. Length of rowRanges must equal the number of rows in colData
A RaggedExperiment object.

The `new2old` argument allows the user to rename, drop, add and/or reorder the "sequence levels" in `x`.

`new2old` can be *NULL* or an integer vector with one element per entry in `Seqinfo` object value (i.e. `new2old` and `value` must have the same length) describing how the "new" sequence levels should be mapped to the "old" sequence levels, that is, how the entries in `value` should be mapped to the entries in `seqinfo(x)`. The values in `new2old` must be $\geq 1$ and $\leq \text{length(seqinfo(x))}$. NAs are allowed and indicate sequence levels that are being added. Old sequence levels that are not represented in `new2old` will be dropped, but this will fail if those levels are in use (e.g. if `x` is a GRanges object with ranges defined on those sequence levels) unless a pruning mode is specified via the `pruning.mode` argument (see below).

If `new2old=NULL`, then sequence levels can only be added to the existing ones, that is, `value` must have at least as many entries as `seqinfo(x)` (i.e. `length(values) >= length(seqinfo(x))`) and also `seqlevels(values)[seq_len(length(seqlevels(x)))]` must be identical to `seqlevels(x)`.

Note that most of the times it's easier to proceed in 2 steps:

1. First align the `seqlevels` on the left (`seqlevels(x)`) with the `seqlevels` on the right.
2. Then call `seqinfo(x) <- value`. Because `seqlevels(x)` and `seqlevels(value)` now are identical, there's no need to specify `new2old`.

This 2-step approach will typically look like this:

```r
seqlevels(x) <- seqlevels(value)  # align seqlevels
seqinfo(x) <- seqinfo(value)      # guaranteed to work
```

Or, if `x` has `seqlevels` not in `value`, it will look like this:

```r
seqlevels(x, pruning.mode="coarse") <- seqlevels(value)
seqinfo(x) <- seqinfo(value)      # guaranteed to work
```

The `pruning.mode` argument will control what happens to `x` when some of its `seqlevels` get dropped. See below for more information.

When some of the `seqlevels` to drop from `x` are in use (i.e. have ranges on them), the ranges on these sequences need to be removed before the `seqlevels` can be dropped. We call this *pruning*. The `pruning.mode` argument controls how to *prune* `x`. Four pruning modes are currently defined: "error", "coarse", "fine", and "tidy". "error" is the default. In this mode, no pruning is done and an error is raised. The other pruning modes do the following:

- "coarse": Remove the elements in `x` where the `seqlevels` to drop are in use. Typically reduces the length of `x`. Note that if `x` is a list-like object (e.g. GRangesList, GAlignmentPairs, or GAlignmentsList), then any list element in `x` where at least one of the sequence levels to drop is in use is fully removed. In other words, when `pruning.mode="coarse"`, the `seqlevels` setter will keep or remove *full list elements* and not try to change
their content. This guarantees that the exact ranges (and their order) inside
the individual list elements are preserved. This can be a desirable property
when the list elements represent compound features like exons grouped
by transcript (stored in a GRangesList object as returned by exonsBy(, by="tx")), or paired-end or fusion reads, etc...

• "fine": Supported on list-like objects only. Removes the ranges that are
  on the sequences to drop. This removal is done within each list element
  of the original object x and doesn’t affect its length or the order of its list
  elements. In other words, the pruned object is guaranteed to be parallel
to the original object.

• "tidy": Like the "fine" pruning above but also removes the list elements
  that become empty as the result of the pruning. Note that this pruning mode
  is particularly well suited on a GRangesList object that contains transcripts
  grouped by gene, as returned by transcriptsBy(, by="gene"). Finally
  note that, as a convenience, this pruning mode is supported on non list-
  like objects (e.g. GRanges or GAlignments objects) and, in this case, is
  equivalent to the "coarse" mode.

See the "B. DROP SEQLEVELS FROM A LIST-LIKE OBJECT" section in the
examples below for an extensive illustration of these pruning modes.
is an `IntegerRanges` object, query or `x` can be an integer vector to be converted to length-one ranges.

If query (or `x`) is an `IntegerRangesList` object, then subject (or ranges) must also be an `IntegerRangesList` object.

If both arguments are list-like objects with names, each list element from the 2nd argument is paired with the list element from the 1st argument with the matching name, if any. Otherwise, list elements are paired by position. The overlap is then computed between the pairs as described below.

If subject is omitted, query is queried against itself. In this case, and only this case, the drop.self and drop.redundant arguments are allowed. By default, the result will contain hits for each range against itself, and if there is a hit from A to B, there is also a hit for B to A. If drop.self is TRUE, all self matches are dropped. If drop.redundant is TRUE, only one of A->B and B->A is returned.

### maxgap
A single integer >= -1.

If type is set to "any", maxgap is interpreted as the maximum gap that is allowed between 2 ranges for the ranges to be considered as overlapping. The gap between 2 ranges is the number of positions that separate them. The gap between 2 adjacent ranges is 0. By convention when one range has its start or end strictly inside the other (i.e. non-disjoint ranges), the gap is considered to be -1.

If type is set to anything else, maxgap has a special meaning that depends on the particular type. See type below for more information.

### minoverlap
A single non-negative integer.

Only ranges with a minimum of minoverlap overlapping positions are considered to be overlapping.

When type is "any", at least one of maxgap and minoverlap must be set to its default value.

### type
By default, any overlap is accepted. By specifying the type parameter, one can select for specific types of overlap. The types correspond to operations in Allen’s Interval Algebra (see references). If type is start or end, the intervals are required to have matching starts or ends, respectively. Specifying equal as the type returns the intersection of the start and end matches. If type is within, the query interval must be wholly contained within the subject interval. Note that all matches must additionally satisfy the minoverlap constraint described above.

The maxgap parameter has special meaning with the special overlap types. For start, end, and equal, it specifies the maximum difference in the starts, ends or both, respectively. For within, it is the maximum amount by which the subject may be wider than the query. If maxgap is set to -1 (the default), it’s replaced internally by 0.

### invert
If TRUE, keep only the ranges in `x` that do not overlap ranges.

### subset
logical expression indicating elements or rows to keep: missing values are taken as false.

### select
If query is an `IntegerRanges` derivative: When select is "all" (the default), the results are returned as a `Hits` object. Otherwise the returned value is an integer vector parallel to query (i.e. same length) containing the first, last, or
arbitrary overlapping interval in subject, with NA indicating intervals that did not overlap any intervals in subject. If query is an IntegerRangesList derivative: When select is "all" (the default), the results are returned as a HitsList object. Otherwise the returned value depends on the drop argument. When select != "all" && !drop, an IntegerList is returned, where each element of the result corresponds to a space in query. When select != "all" && drop, an integer vector is returned containing indices that are offset to align with the unlisted query.

Value

constructor returns a RaggedExperiment object
'rowRanges' returns a GRanges object summarizing ranges corresponding to assay() rows.
'rowRanges<- ' returns a RaggedExperiment object with replaced ranges
'mcols' returns a DataFrame object of the metadata columns
'assays' returns a SimpleList
'overlapsAny' returns a logical vector of length equal to the number of rows in the query; TRUE when the copy number region overlaps the subject.
'subsetByOverlaps' returns a RaggedExperiment containing only copy number regions overlapping subject.

Methods (by generic)

- seqinfo(RaggedExperiment): seqinfo accessor
- seqinfo(RaggedExperiment) <- value: Replace seqinfo metadata of the ranges
- rowRanges(RaggedExperiment): rowRanges accessor
- rowRanges(x = RaggedExperiment) <- value: rowRanges replacement
- mcols(RaggedExperiment): get the metadata columns of the ranges, rectangular representation of the 'assays'
- mcols(RaggedExperiment) <- value: set the metadata columns of the ranges corresponding to the assays
- rowData(RaggedExperiment): get the rowData or metadata for the ranges
- rowData(RaggedExperiment) <- value: set the rowData or metadata for the ranges
- dim(RaggedExperiment): get dimensions (number of sample-specific row ranges by number of samples)
- dimnames(RaggedExperiment): get row (sample-specific) range names and sample names
- dimnames(x = RaggedExperiment) <- value: set row (sample-specific) range names and sample names
- dimnames(x = RaggedExperiment) <- value: set row range names and sample names to NULL
- length(RaggedExperiment): get the length of row vectors in the object, similar to SummarizedExperiment
- colData(RaggedExperiment): get column data
• `colData(x = RaggedExperiment) <- value`: change the colData
• `assay(x = RaggedExperiment, i = missing)`: assay missing method uses first metadata column
• `assay(x = RaggedExperiment, i = ANY)`: assay numeric method.
• `assays(RaggedExperiment)`: assays
• `assayNames(RaggedExperiment)`: names in each assay
• `show(RaggedExperiment)`: show method
• `as.list(RaggedExperiment)`: Allow extraction of metadata columns as a plain list
• `as.data.frame(RaggedExperiment)`: Allow conversion to plain data.frame
• `$`: Easily access the colData columns with the dollar sign operator
• `x[i]`: Subset a RaggedExperiment object
• `overlapsAny(query = RaggedExperiment, subject = Vector)`: Determine whether copy number ranges defined by query overlap ranges of subject.
• `subsetByOverlaps(x = RaggedExperiment, ranges = Vector)`: Subset the RaggedExperiment to contain only copy number ranges overlapping ranges of subject.
• `subset(RaggedExperiment)`: subset helper function for dividing by rowData and / or colData values

Constructors

`RaggedExperiment(..., colData=DataFrame())`: Creates a RaggedExperiment object using multiple GRanges objects or a list of GRanges objects. Additional column data may be provided as a DataFrame object.

Accessors

In the following, 'x' represents a RaggedExperiment object:

`rowRanges(x)`: Get the ranged data. Value is a GenomicRanges object.

`assays(x)`: Get the assays. Value is a `SimpleList`.

`assay(x, i)`: An alternative to `assays(x)[[i]]` to get the ith (default first) assay element.

`mcols(x), mcols(x) <- value`: Get or set the metadata columns. For RaggedExperiment, the columns correspond to the assay ith elements.

`rowData(x), rowData(x) <- value`: Get or set the row data. Value is a `DataFrame` object. Also corresponds to the `mcols` data.

Note for advanced users and developers. Both `mcols` and `rowData` setters may reduce the size of the internal RaggedExperiment data representation. Particularly after subsetting, the internal row index is modified and such setter operations will use the index to subset the data and reduce the "rows" of the internal data representation.
Subsetting

\(x[i, j]\): Get ranges or elements \((i\ and\ j, \ respectively)\) with optional metadata columns where \(i\ or\ j\) can be missing, an NA-free logical, numeric, or character vector.

Coercion

In the following, 'object' represents a RaggedExperiment object:

as(object, "GRangesList"):
Creates a GRangesList object from a RaggedExperiment.

as(from, "RaggedExperiment"):
Creates a RaggedExperiment object from a GRangesList, or GRanges object.

Examples

```r
## Create an empty RaggedExperiment instance
re0 <- RaggedExperiment()
re0

## Create a couple of GRanges objects with row ranges names
sample1 <- GRanges(
  c(a = "chr1:1-10:-", b = "chr1:11-18:+"),
  score = 1:2)
sample2 <- GRanges(
  c(c = "chr2:1-10:-", d = "chr2:11-18:+"),
  score = 3:4)

## Include column data
colDat <- DataFrame(id = 1:2)

## Create a RaggedExperiment object from a couple of GRanges
re1 <- RaggedExperiment(sample1=sample1, sample2=sample2, colData = colDat)
re1

## With list of GRanges
lgr <- list(sample1 = sample1, sample2 = sample2)

## Create a RaggedExperiment from a list of GRanges
re2 <- RaggedExperiment(lgr, colData = colDat)

grl <- GRangesList(sample1 = sample1, sample2 = sample2)

## Create a RaggedExperiment from a GRangesList
re3 <- RaggedExperiment(grl, colData = colDat)

## Subset a RaggedExperiment
assay(re3[c(1, 3),])
subsetByOverlaps(re3, GRanges("chr1:1-5")) # by ranges
```
sparseSummarizedExperiment

Create SummarizedExperiment representations by transforming ragged assays to rectangular form.

Description

These methods transform RaggedExperiment objects to similar SummarizedExperiment objects. They do so by transforming assay data to more rectangular representations, following the rules outlined for similarly names transformations sparseAssay(), compactAssay(), disjoinAssay(), and qreduceAssay(). Because of the complexity of the transformation, it usually only makes sense transform RaggedExperiment objects with a single assay; this is currently enforced at time of coercion.

Usage

sparseSummarizedExperiment(x, i = 1, withDimnames = TRUE, sparse = FALSE)
compactSummarizedExperiment(x, i = 1L, withDimnames = TRUE, sparse = FALSE)
disjoinSummarizedExperiment(x, simplifyDisjoin, i = 1L, withDimnames = TRUE)
qreduceSummarizedExperiment(
  x,
  query,
  simplifyReduce,
  i = 1L,
  withDimnames = TRUE
)

Arguments

x RaggedExperiment
i integer(1), character(1), or logical() selecting the assay to be transformed.
withDimnames logical(1) default TRUE. propagate dimnames to SummarizedExperiment.
sparse logical(1) whether to return a sparseMatrix representation
simplifyDisjoin function of 1 argument, used to transform assays. See assay-functions.
query GRanges providing regions over which reduction is to occur.
simplifyReduce function of 3 arguments used to transform assays. See assay-functions.
Value

All functions return RangedSummarizedExperiment.

sparseSummarizedExperiment has rowRanges() identical to the row ranges of x, and assay() data as sparseAssay(). This is very space-inefficient representation of ragged data. Use 'sparse=TRUE' to obtain a sparseMatrix assay representation.

compactSummarizedExperiment has rowRanges() identical to the row ranges of x, and assay() data as compactAssay(). This is space-inefficient representation of ragged data when samples are primarily composed of different ranges. Use 'sparse=TRUE' to obtain a sparseMatrix assay representation.

disjoinSummarizedExperiment has rowRanges() identical to the disjoint row ranges of x, disjoint(rowRanges(x)), and assay() data as disjoinAssay().

qreduceSummarizedExperiment has rowRanges() identical to query, and assay() data as qreduceAssay().

sparseMatrix

Convert a dgCMatrix to a RaggedExperiment given that the rownames are coercible to GRanges.

In the following example, x is a dgCMatrix from the Matrix package.

`as(x, "RaggedExperiment")`

Examples

```r
x <- RaggedExperiment(GRangesList(
  GRanges(c("A:1-5", "A:4-6", "A:10-15"), score=1:3),
  GRanges(c("A:1-5", "B:1-3"), score=4:5)
))

## sparseSummarizedExperiment
sse <- sparseSummarizedExperiment(x)
assay(sse)
rowRanges(sse)

## compactSummarizedExperiment
cse <- compactSummarizedExperiment(x)
assay(cse)
rowRanges(cse)

## disjoinSummarizedExperiment
disjoinAssay(x, lengths)
dse <- disjoinSummarizedExperiment(x, lengths)
assay(dse)
rowRanges(dse)

## qreduceSummarizedExperiment
x <- RaggedExperiment(GRangesList(
```
```r
GRanges(c("A:1-3", "A:4-5", "A:10-15"), score=1:3),
  GRanges(c("A:4-5", "B:1-3"), score=4:5)
))
query <- GRanges(c("A:1-2", "A:4-5", "B:1-5"))

weightedmean <- function(scores, ranges, qranges)
{
  ## weighted average score per query range
  ## the weight corresponds to the size of the overlap of each
  ## overlapping subject range with the corresponding query range
  isects <- pintersect(ranges, qranges)
  sum(scores * width(isects)) / sum(width(isects))
}

qreduceAssay(x, query, weightedmean)
qse <- qreduceSummarizedExperiment(x, query, weightedmean)
assay(qse)
rowRanges(qse)

sm <- Matrix::sparseMatrix(
  i = c(2, 3, 4, 3, 4, 3, 4),
  j = c(1, 1, 1, 3, 3, 4, 4),
  x = c(2L, 4L, 2L, 2L, 2L, 4L, 2L),
  dims = c(4, 4),
  dimnames = list(
    c("chr2:1-10", "chr2:2-10", "chr2:3-10", "chr2:4-10"),
    LETTERS[1:4]
  )
)

as(sm, "RaggedExperiment")
```
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