genomeIntervals

October 5, 2010

`Genome_intervals-class`
Class "Genome_intervals"

Description

A set of genomic intervals without specified strand. Genomic intervals are intervals over the integers with two further annotations: `seq_name` (a chromosome or more generally a sequence of origin) and `inter_base` (`logical`) that states whether the interval is to be understood as an interval over bases (such as coding-sequence) or inter-bases (such as restriction sites or insertion positions).

Slots

`.Data`: See `Intervals_full`

`annotation`: A `"data.frame"` with the same number of rows as `.Data`. It has a column named `seq_name` that is a factor and does not contain missing values. `seq_name` is used to represent the chromosome or more generally the sequence of origin of the intervals. `annotation` has a column named `inter_base` that is logical and does not contain missing values. `inter_base` is `FALSE` if the interval is to be understood as an interval over bases (such as coding-sequence) and `TRUE` if it is over inter-bases (such as restriction site or an insertion position). Like base intervals, inter-base interval are encoded over the integers. An inter-base at position `n` indicates the space between base `n` and `n+1`.

`closed`: See `Intervals_full`

`type`: See `Intervals_full`

Extends

Class `"Intervals_full"`, directly. Class `"Intervals_virtual"`, by class "Intervals_full", distance 2. Class `"matrix"`, by class "Intervals_full", distance 3. Class `"array"`, by class "Intervals_full", distance 4. Class `"structure"`, by class "Intervals_full", distance 5. Class `"vector"`, by class "Intervals_full", distance 6, with explicit coerce.

Methods

`[ signature(x = "Genome_intervals")`: ...

`[[ signature(x = "Genome_intervals")`: ...

`[[<- signature(x = "Genome_intervals")`: ...

\$ `signature(x = "Genome_intervals")`: ...

\$<- `signature(x = "Genome_intervals")`: ...

annotation `signature(object = "Genome_intervals")`: ...

annotation<- `signature(object = "Genome_intervals")`: ...

coerce `signature(from = "Genome_intervals", to = "Intervals_full")`: ...

coerce `signature(from = "Genome_intervals", to = "character")`: ...

distance_to_nearest `signature(from = "Genome_intervals", to = "Genome_intervals")`: ...

inter_base `signature(x = "Genome_intervals")`: ...

inter_base<- `signature(x = "Genome_intervals")`: ...

interval_complement `signature(x = "Genome_intervals")`: ...

interval_intersection `signature(x = "Genome_intervals")`: ...

interval_overlap `signature(from = "Genome_intervals", to = "Genome_intervals")`: ...

interval_union `signature(x = "Genome_intervals")`: ...

seq_name `signature(x = "Genome_intervals")`: ...

seq_name<- `signature(x = "Genome_intervals")`: ...

size `signature(x = "Genome_intervals")`: ...

type<- `signature(x = "Genome_intervals")`: ...

Note

A `Genome_intervals` is a `"Intervals_full"` of type Z (i.e. a set of intervals over the integers). The `annotation` slot can carry further columns that can serve as annotations.

See Also

`Genome_intervals_stranded` for a derived class that allows stranded genomic intervals.

Examples

```
# The "Genome_intervals" class

i <- new(
 "Genome_intervals",
 matrix(
  c(1,2,
    3,5,
    4,6,
    8,9
    ),
  byrow = TRUE,
                ncol = 2
 ),
 closed = matrix(
  c(
  TRUE, FALSE,
  TRUE, FALSE,
  TRUE, TRUE,
  TRUE, FALSE
```

```
  ),
 byrow = TRUE,
     ncol = 2
     ),
annotation = data.frame(
 seq_name = factor(c("chr01","chr01", "chr02","chr02")),
 inter_base = c(FALSE, FALSE, TRUE, TRUE)
 )
)

colnames(i) <- c( "start", "end" )

# print
print(i)

# size (number of bases per interval)
size(i)
```

Genome_intervals_stranded-class
Class "Genome_intervals_stranded"

Description

A set of genomic intervals with a specified strand.

Slots

`.Data`: See `Genome_intervals`

`annotation`: A `data.frame` (see `Genome_intervals` for basic requirements). The `annotation` moreover has a `strand` column that is a factor with exactly two levels(typically `"+"` and `"-"`).

`closed`: See `Genome_intervals`

`type`: See `Genome_intervals`

Extends

Class `"Genome_intervals"`, directly. Class `"Intervals_full"`, by class "Genome_intervals", distance 2. Class `"Intervals_virtual"`, by class "Genome_intervals", distance 3. Class `"matrix"`, by class "Genome_intervals", distance 4. Class `"array"`, by class "Genome_intervals", distance 5. Class `"structure"`, by class "Genome_intervals", distance 6. Class `"vector"`, by class "Genome_intervals", distance 7, with explicit coerce.

Methods

coerce `signature(from = "Genome_intervals_stranded", to = "character")`: ...

distance_to_nearest `signature(from = "Genome_intervals_stranded", to = "Genome_inter` ...

interval_complement `signature(x = "Genome_intervals_stranded")`: ...

interval_intersection `signature(x = "Genome_intervals_stranded")`: ...

interval_overlap `signature(to = "Genome_intervals_stranded", from = "Genome_interval`
...

interval_union `signature(x = "Genome_intervals_stranded")`: ...

strand `signature(x = "Genome_intervals_stranded")`: ...

strand<- `signature(x = "Genome_intervals_stranded")`: ...

See Also

`Genome_intervals` the parent class without strand.

Examples

```
# The "Genome_intervals_stranded" class
j <- new(
 "Genome_intervals_stranded",
 matrix(
  c(1,2,
    3,5,
    4,6,
    8,9
    ),
  byrow = TRUE,
                ncol = 2
 ),
 closed = matrix(
  c(
  FALSE, FALSE,
  TRUE, FALSE,
  TRUE, TRUE,
  TRUE, FALSE
   ),
  byrow = TRUE,
      ncol = 2
      ),
     annotation = data.frame(
      seq_name = factor( c("chr01","chr01", "chr02","chr02") ),
  strand = factor( c("+", "+", "+", "-") ),
  inter_base = c(FALSE,FALSE,FALSE,TRUE)
  )
 )

## print
print(j)

## size of each interval as count of included bases
size(j)

## close intervals left and right (canonical representation)
close_intervals(j)
```

c *Combine genome intervals objects*

Description

S3 methods for combining several genome intervals into a single one.

Usage

```
## S3 method for class 'Genome\_intervals':
c(...)
## S3 method for class 'Genome\_intervals\_stranded':
c(...)
```

Arguments

`...`	`Genome_intervals` or `Genome_intervals_stranded` objects.

Details

If the arguments have mixed classes (both `Genome_intervals` or `Genome_intervals_stranded`), then they are coerced to `Genome_intervals` before combination. Otherwise, the common class is used.

Value

A single `Genome_intervals` or `Genome_intervals_stranded` object. Input objects are combined in their order of appearance in the the argument list.

If any input argument is not a `Genome_intervals`, `list(...)` is returned instead.

Note

These methods will be converted to S4 once the necessary dispatch on `...` is supported.

Examples

```
# load toy examples
data("gen_ints")

# combine i and j returns a Genome_intervals_stranded object
c( i, j )

# combine a not-stranded and a stranded returns a not-stranded object
c( as(i, "Genome_intervals"), j )
```

core_annotated *Genome intervals with minimal annotation*

Description

returns a copy of the input (stranded) genome intervals object with annotations restricted to the minimally required ones.

Usage

```
core_annotated(x)
```

Arguments

x	A Genome_intervals or Genome_intervals_stranded object.

Value

A copy of x with the annotation slot restricted to seq_name, inter_base and strand (the latter only if x is a Genome_intervals_stranded object).

Examples

```
# load toy examples
data("gen_ints")

# add some non-core annotations to i
annotation(i)$comment = "some non-core annotation"

# i with all annotations
i

# core annotations only
core_annotated(i)

## Not run:
# with different annotation columns, i and j cannot be combined
c( i, j )

## End(Not run)

# core annotated versions can
c( core_annotated(i), core_annotated(j) )
```

distance_to_nearest

Distance in bases to the closest interval(s)

Description

Given two objects, `from` and `to`, compute the distance in bases of each `from` interval to the nearest `to` interval(s). The distance between a base and the next inter-bases on either side values 0.5. Thus, base - base and inter-base - inter-base intervals distances are integer, whereas base - inter-base intervals distances are half-integers.

Usage

```
## S4 method for signature 'Genome\_intervals,Genome\_intervals':
distance\_to\_nearest(from, to)
## S4 method for signature 'Genome\_intervals\_stranded,Genome\_intervals\_stran
distance\_to\_nearest(from, to)
```

Arguments

`from`	A `Genome_intervals` or `Genome_intervals_stranded` object.
`to`	A `Genome_intervals` or `Genome_intervals` object.

Details

A wrapper calling `intervals::distance_to_nearest` by `seq_name` and by `strand` (if both `from` and `to` are `Genome_intervals_stranded` objects). Thus, if both are stranded, distances are computed over each strand separately. One object must be coerced to `Genome_intervals` if this is not wished.

Value

A numeric vector of distances with one element for each row of `from`.

See Also

`intervals::distance_to_nearest`

Examples

```
## load toy examples
data(gen_ints)

## i in close_intervals notation
close_intervals(i)

## j in close_intervals notation
close_intervals(j)

## distances from i to j
dn = distance_to_nearest(i,j)
dn
```

```
## distance == 0 if and only if the interval overlaps another one:
io = interval_overlap(i,j)
if( any( ( sapply(io, length) >0 )  != (!is.na(dn) & dn ==0) ) )
  stop("The property 'distance == 0 if and only if the interval overlaps another one' is

## distances without strand-specificity
distance_to_nearest(
  as(i,"Genome_intervals"),
  as(j,"Genome_intervals")
)
```

`gen_ints` *Genome Intervals examples*

Description

Toy examples for testing functions and running examples of the package `genomeIntervals`.

Usage

```
data(gen_ints)
```

Format

Two `Genome_intervals_stranded` objects, `i` and `j`, without inter-base intervals and a third one, `k`, with.

`genomeIntervals-package`
Operations on genomic intervals

Description

Tools for operation on genomic intervals.

Details

Package:	genomeIntervals
Version:	0.9.6
Date:	2009-01-15
Type:	Package
Depends:	R (>= 2.8.0), intervals (>= 0.10.3), Biobase, methods
Suggests:	
License:	Artistic 2.0
BiocViews:	DataImport, Infrastructure, Genetics
LazyLoad:	yes

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See Also

intervals

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getGffAttribute *Pull one or more key/value pairs from gffAttributes strings*

Description

GFF files contain a string, with key/value pairs separated by ";", and the key and value separated by "=". This function quickly extracts one or more key/value pairs.

Usage

```
getGffAttribute(gi, attribute)
```

Arguments

gi	A Genome_intervals object.
attribute	A vector of key names.

Value

A matrix with the same number of rows as gi, and one column per element of attribute.

See Also

See parseGffAttributes for more complete parsing. See the function readGff3 for loading a GFF file.

Examples

```
# Get file path
libPath <- installed.packages()["genomeIntervals", "LibPath"]
filePath <- file.path(
                  libPath,
                  "genomeIntervals",
                  "example_files"
                  )

# Load gff
gff <- readGff3( file.path( filePath, "sgd_simple.gff"), isRightOpen=FALSE)

## head of full gff annotations
head(annotation(gff))

# extract ID and Parent attributes
idpa = getGffAttribute( gff, c( "ID", "Parent" ) )

head(idpa)
```

`interval_overlap` *Assess overlap from one set of genomic intervals to another*

Description

Given two objects, a 'from' and a 'to', assess which intervals in 'to' overlap which of 'from'.

Usage

```
## S4 method for signature 'Genome\_intervals,Genome\_intervals':
interval\_overlap(
                  from, to,
                  check_valid = TRUE
                  )
## S4 method for signature 'Genome\_intervals\_stranded,Genome\_intervals\_stran
interval\_overlap(
                  from, to,
                  check_valid = TRUE
                  )
```

Arguments

`from`	A `Genome_intervals` or `Genome_intervals_stranded` object.
`to`	A `Genome_intervals` or `Genome_intervals_stranded` object.
`check\_valid`	Should `validObject` be called before passing to compiled code?

Details

A wrapper calling intervals:interval_overlap by seq_name and by strand (if both to and from are "Genome_intervals_stranded" objects).

Value

A list, with one element for each row of from. The elements are vectors of indices, indicating which to rows overlap each from. A list element of length 0 indicates a from with no overlapping to intervals.

Examples

```
data(gen_ints)
# i as entered
i

# i in close_intervals notation
close_intervals(i)

# j in close_intervals notation
close_intervals(j)

# list of intervals of j overlapping intervals of i
interval_overlap(i,j)
```

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interval_union *Genome interval set operations*

Description

Compute interval set operations on "Genome_intervals" or "Genome_intervals_stranded" objects.

Usage

```
## S4 method for signature 'Genome\_intervals':
interval\_union(x, ...)
## S4 method for signature 'Genome\_intervals\_stranded':
interval\_union(x, ...)

## S4 method for signature 'Genome\_intervals':
interval\_complement(x)
## S4 method for signature 'Genome\_intervals\_stranded':
interval\_complement(x)

## S4 method for signature 'Genome\_intervals':
interval\_intersection(x,...)
## S4 method for signature 'Genome\_intervals\_stranded':
interval\_intersection(x,...)
```

Arguments

x	A "Genome_intervals" or "Genome_intervals_stranded" object.
...	Optionally, additional objects of the same class as x.

Details

Wrappers calling the corresponding functions of the package intervals by same seq_name, inter_base and if needed strand. Note that the union of single input object x returns the reduced form of x, i.e. the interval representation of the covered set.

Value

A single object of appropriate class, representing the union, complement or intersection of intervals computed over entries with same seq_name, inter_base and also strand if all passed objects are of the class "Genome_intervals_stranded".

See Also

interval_union, interval_complement, interval_intersection and reduce from the package intervals.

Examples

```
## load toy examples
data(gen_ints)
## content of i object
i

## complement
interval_complement(i)

## reduced form (non-overlapping interval representation of the covered set)
interval_union(i)

## union
interval_union(i[1:2,], i[1:4,])

# map to genome intervals and union again
i.nostrand = as(i,"Genome_intervals")
interval_union(i.nostrand)

## intersection with a second object
# print i and j in closed interval notation
close_intervals(i)
close_intervals(j)

# interval_intersection
interval_intersection(i,j)

#interval intersection non-stranded
interval_intersection(i.nostrand, as(j, "Genome_intervals"))
```

`parseGffAttributes` *Parse out the gffAttributes column of a Genome_intervals object*

Description

GFF files contain a string, with key/value pairs separated by ";", and the key and value separated by "=". This function parses such strings into a list of vectors with named elements.

Usage

```
parseGffAttributes(gi)
```

Arguments

`gi`	A `Genome_intervals` object.

Value

A list, with one element per row of `gi`. Each element is a character vector with named components. Names correspond to keys, and components correspond to values.

Note

Key/value pairs which are missing the "=" symbol, or which have nothing between it and the ";" delimiter or end of line, will generate a `NA` value, with a warning. Any key/value "pairs" with more than one "=" cause an error.

See Also

In many cases, `getGffAttribute`, in this package, is easier and faster. See the function `readGff3` for loading a GFF file.

Examples

```
# Get file path
libPath <- installed.packages()["genomeIntervals", "LibPath"]
filePath <- file.path(
                  libPath,
                  "genomeIntervals",
                  "example_files"
                  )

# Load gff and parse attributes
gff <- readGff3( file.path( filePath, "sgd_simple.gff"), isRightOpen = FALSE )
gfatt <- parseGffAttributes(gff)

head( gfatt )
```

readGff3 *Make a Genome_intervals_stranded object from a GFF file*

Description

Make a Genome_intervals_stranded object from a gff file in gff3 format.

Usage

```
readGff3(file, isRightOpen=TRUE)
```

Arguments

file	The name of the gff file to read.
isRightOpen	Although a proper GFF3 file follows the convention of right-open intervals, improper GFF files following the right-closed convention are frequently found. Set isRightOpen = FALSE in this case.

Details

The file must follow gff3 format specifications as in http://www.sequenceontology.org/gff3.shtml. The file is read as a table. Meta-information (lines starting with \#\#\#) are not parsed. A "." in, for example, the gff file's *score* or *frame* field will be converted to NA. When the GFF file follows the right-open interval convention (isRightOpen is TRUE), then GFF entries for which end base equals first base are recognized as zero-length features and loaded as inter_base intervals. It can be that readGff3 is able to construct a Genome_intervals_stranded object from the input file, although not valid. A warning message is then generated and the constructed object is returned to allow inspection of it.

Value

A Genome_intervals_stranded object image of the gff file. The GFF3 fields seqid, source, type, score, strand, phase and attributes are stored in the annotation slot and renamed as seq_name, source, type, score, strand, phase and gffAttributes respectively.

Note

Potential FASTA entries at the end of the file are ignored.

See Also

The functions getGffAttribute and parseGffAttributes for parsing GFF attributes.

Examples

```
# Get file path
libPath <- installed.packages()["genomeIntervals", "LibPath"]
filePath <- file.path(
                      libPath,
                      "genomeIntervals",
```

```
                        "example_files"
                        )

    # Load SGD gff
    # SGD does not comply to the GFF3 right-open interval convention
    gff <- readGff3( file.path( filePath, "sgd_simple.gff"), isRightOpen = FALSE)

    head(gff,10)

    head(annotation(gff),10)
```

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