

Package ‘akin’

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Type Package

Title Functional Utilities for Data Processing

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Description Covers several areas of data processing: batch-splitting, reading and writing of large data files, data tiling, one-hot encoding and decoding of data tiles, stratified proportional (random or probabilistic) data sampling, data normalization and thresholding, substring location and commonalities inside strings, and location and tabulation of amino acids, modifications or associated monoisotopic masses inside modified peptides. The extractor implements code from 'Matrix.utils', Varrichio C (2020), <<https://cran.r-project.org/package=Matrix.utils>>.

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cover	<i>Calculate The Number Of Combinations Of String Covering</i>
-------	--

Description

Calculates the cardinality of substring family (*the covering*) and returns valid elements.

Usage

```
cover(x, valid. = FALSE, wplot = FALSE)
```

Arguments

x	integer, length = 1 or character vector, length > 1, or character string. White space is removed
valid.	logical, default, FALSE. When TRUE, valid substrings are returned. Requires x as character or string
wplot	logical, FALSE. When TRUE, displays a plot of combinations versus number of characters in string covering

Details

This function finds the total, the minimum and the maximum number of combinations of individual string covering or returns a subset of valid substrings (i.e. elements of the string) by retaining even transpositions with *sequential* values inside the combinations matrix. Very long strings may result in memory allocation error when `valid. = TRUE`. Use [fcommon](#) instead.

NOTE: Herein, the *covering* represents the substring family - of min. 2 characters each - that preserves the order of characters inside the string. Hence, the use of combinations instead of partial permutations. Valid substrings form a (lower cardinality) subset having elements in sequence (see Example 3).

Value

When `valid. = FALSE` a prettified named vector showing the total, minimum and maximum number of combinations for respective string covering. When `valid. = TRUE`, a character vector of valid substrings having min. 2 characters each. In both cases, a plot is returned when `wplot = TRUE`.

See Also

[fcommon](#), [comboCount](#), [comboGeneral](#)

Examples

```
if (interactive()) {  
  
  # 1.1 A string  
  x = 'tyrvsvltvltvhqdwlngkeykck'  
  
  # 1.2 A vector  
  y = strsplit(x, '')[[1]]  
  
  # 1.3 An integer  
  n = length(y)  
  
  ll = list(str = x, char = y, int = n)  
  print(t(  
    sapply(ll, cover)  
  ))  
  
  # 2. Valid substrings with plot  
  
  d = cover(x, TRUE, TRUE) # first 30 substrings  
  print(head(d, 30))  
  
  # 3. Valid set versus covering  
  
  # The plot shows 3 combinations of 2-character groups while e  
  # contains 2 sequences of 2 characters each, substring "ac"  
  # not being a sequence.  
  
  x = letters[1:3]  
  e = cover(x, TRUE, TRUE) # valid combinations  
  print(e)  
  
}
```

fcommon

Identify Common Substrings In A Pair Of Strings

Description

Checks and identifies substrings that are common to a pair of strings.

Usage

```
fcommon(x, y)
```

Arguments

`x, y` character, length 1 each: a string, such as a protein chain. `y` can be missing. White space is removed

Details

This utility identifies common substrings in the `x, y` pair of strings by isolating *sequences* of identical characters in both strings which then, are packed into substrings and validated. All one-character substrings are removed. When `y` is missing, `x` is cleaved at each letter producing all substrings longer than 1 character. Example 1.3 shows that *all* existing common substrings - of min. 2 characters each - are identified.

Value

A sorted character vector of common substrings of min. 2 characters each. When `y` is missing from call, a sorted character vector of valid substrings in `x` of min. 2 characters each.

See Also

[cover](#)

Examples

```
if (interactive()) {

  # 1. Check for common substrings in the pair below

  x = 'dvmtqsplslpvtgpepasicrsslaktyrvvsvltvlhqdwlngkeykckvv'
  y = 'mtqspltyrvvsvltvlhqdwlngkeykcksnkalpapiektisk'

  # 1.1 Common substrings
  system.time(a <- fcommon(x, y))
  print(head(a, 30))

  # 1.2 Cleaving (slow on very long strings!)
  system.time(aa <- fcommon(x))
  system.time(bb <- fcommon(y))

  # 1.3 Complete identification of common substrings
  A = sort(intersect(aa, bb))                # common substrings
  identical(a, A)                          # TRUE

  # 2. Different methods for valid substrings

  x = 'tyrvvsvltvlhqdwlngkeykck'

  # 2.1. Combinations matrix (limited by character length)
  system.time(am <- cover(x, valid. = TRUE)) # valid substrings

  # 2.2 String cleaving
  system.time(ac <- fcommon(x))            # valid substrings
}
```

```

    identical(am, ac)                                # TRUE
}

```

findLoc *Find Substring Locations Inside A String*

Description

Finds all locations of a *known* character substring inside a character string.

Usage

```

findLoc(
  subchain,
  chain,
  outlist = FALSE,
  named = FALSE,
  all. = FALSE,
  which = min,
  ignore.case = TRUE,
  perl = FALSE,
  fixed = FALSE,
  useBytes = FALSE
)

```

Arguments

subchain	character, length 1, e.g. a peptide sequence. White space is removed
chain	(named) character, length 1 or a (named) list of such characters such as a list of protein chains obtained from a <i>fasta</i> file. White space is removed
outlist	logical. Default, FALSE, the output is a (named) integer vector of locations. Otherwise, it is a (named) list of location vectors, each corresponding to a chain in a list of chains
named	logical. Default, FALSE. Output is not named. Otherwise, the output is named
all.	logical, default FALSE, returns the leftmost or the rightmost location inside the chain. When TRUE, returns all locations inside the chain for each chain in a list
which	symbol. Location to report. Default, min . Requires all. = FALSE. which = min returns the leftmost location inside the chain, e.g. closest to the N-terminus of a protein chain. which = max returns the rightmost location, e.g. closest to the C-terminus of a protein chain. Overwritten when all. = TRUE
ignore.case, perl, fixed, useBytes	arguments to base::gregexpr

Details

Wrapper to [base::gregexpr](#), the function scans all chains in a list of chains to find subchain locations. The location is defined as the position inside the chain relative to the left end of the chain of the first subchain character.

Value

A (named) integer or a (named) list of integer vectors of subchain locations inside the chain.

See Also

[gregexpr](#)

Examples

```
if (interactive()) {

# 1. List of chains

chain = list(chain1 = 'alpdxoipoyloiekladxoipoylyl',
             chain2 = 'kdxoipoylyydxoipoylopldxoipoylac')
subchain = 'DXOIPOYL'                                     # ignoring the case

findLoc(subchain, chain, outlist = TRUE, named = TRUE, all. = TRUE)  # named list
findLoc(subchain, chain, named = TRUE, all. = TRUE)                 # named integer
findLoc(subchain, chain, outlist = TRUE, named = TRUE)               # the leftmost positions
findLoc(subchain, chain, which = max, named = TRUE)                  # the rightmost positions

# 2. Single chain

chain = chain[[1]]

findLoc(subchain, chain, all. = TRUE)
findLoc(subchain, chain, which = max)
findLoc(subchain, chain)                                           # default location
findLoc(subchain, chain, which = max, ignore.case = FALSE)        # not ignoring the case

}
```

getEV

Extract Encoded Variables From Encoded Split Or Tiled Data

Description

Extracts a single encoded variable from a [list](#) or [listenv](#) of encoded matrices containing multiple encoded variables


```

c = oneHot(b, decode) # revert
identical(mtcars$cyl, c) # FALSE. 'mtcars$cyl' is type "double"
isTRUE(all.equal(mtcars$cyl, c)) # TRUE

# 2. Warnings associated with low cardinality categorical variable

# See tileHot() Examples for full decoding of a dataset

# 2.1 Make 'csv' file
data(iris) # low cardinality "Species"
tempf = tempfile(fileext = '.csv')
write.table(iris, tempf, sep = ',', row.names = FALSE, quote = FALSE)

A = tileHot(readpath = tempf, rows = 14, splits = 3) # encoded tiles list
print(A[[11]][[5]]) # e.g. one-column matrix
a = getEV(A, 'Species') # warning
colSums(a) # incorrect!

# solution b
B = tileHot(readpath = tempf, rows = 60, splits = 3) # increase number of rows
b = getEV(B, 'Species') # still warning
colSums(b) # incorrect!

# Solution b) could work in combination with solution a)

# solution c
C = tileHot(tempf, rows = 14, splits = 3, orn = TRUE) # encoded matrix
c = getEV(C, 'Species') # no warning
colSums(c) # correct!

unlink(tempf)

# 2.2 Shuffled 'csv' file
tempf = tempfile(fileext = '.csv')
iris22 = iris[set.seed(327); sample.int(150),] # shuffled iris data
write.table(iris22, tempf, sep = ',', row.names = FALSE, quote = FALSE)

A = tileHot(readpath = tempf, rows = 14, splits = 3) # same as above

#solution a
a = getEV(A, 'Species') # no warning
colSums(a) # correct!

unlink(tempf)

}

```

locateMod *Locate And Extract Modifications Or Monoisotopic Masses From A Modified Peptide*

Description

Finds and tabulates amino acid modification sites and extracts modifications or monoisotopic masses from modified peptide data representation.

Usage

```
locateMod(string, wrap = "]", inbracket = ")", except = NULL, rmve = NULL)
```

Arguments

string	character, length 1. Modified or unmodified peptide, or NULL
wrap	character, length 1. The closing (right-hand) side of any of the bracket types ']', ')', '}' that wrap the modifications, such as in protein mass spectrometry data representation of modified peptides. Default, ']'
inbracket	character, length 1. Same as above for brackets used inside modification wrappings. Default, ')'
except	character, length ≥ 1 . Default, NULL. Punctuation marks or characters that appear along modifications and are needed to remain present in the output: '-', '+', ',', ';', ':', '=', '.', '[:digit:]', '[:alpha:]', '\w+', ''
rmve	character, length 1. Default, NULL. Regular expression. Digits or extra characters that need to be removed from the output (see Examples)

Details

Although capable of handling most situations, it is recommended that the wrapping bracket type remains consistent throughout and the inbracket type *be different* from wrapping type. No extra characters are removed from result when `except = rmve = NULL`.

This utility covers most data representation styles for modified peptide. However, clean data results are not guaranteed. The template for letter casing accepted for modified peptide and for modifications should match those presented in Examples: upper case for peptide and mixed case for modifications.

Value

A 'data.table' class data frame containing the unmodified peptide, the modified peptide, the modification site (i.e. the amino acid code letter and location inside the peptide) and the associated modification(s). In case of monoisotopic mass extraction, monoisotopic mass values populate column "Modification" as "character" types. Multiple modifications (identical or not) found at the same site are listed as many times as they appear at that site. Unmodified, endogenous peptides are listed with no other information. Empty strings are listed as such with a warning.

See Also[regex](#)**Examples**

```

if (interactive()) {

# Completely made-up modified peptides:

# 1. Modifications

# 1.1 Default brackets
string = 'K[Prop_A][Met][Prop (C)]PSSABCELR[Prop][Prop][Prop]FQC[Carba (C)]GQQ[Met +44]TARP'

a = locateMod(string)
print(a)                                     # with extra-characters
b = locateMod(string, except = '\\w+', rmve = '\\(\\.\\.\\.\\)|_[A-Z]|[0-9]')
print(b)                                     # without extra-characters

# In this example argument "rmve" contains the default in-brackets

# 1.2 Alternative bracketing

string = 'K{Prop_A}{Met}{Prop [A]}PSSABCELR{Prop +15}{Prop}{Prop}FQC{Carba [C]}GQQ{Met +44}TARP'

c = locateMod(string, '}', ']')
print(c)
d = locateMod(string, '}', ']', except = '\\w+', rmve = '\\[\\.\\.\\.\\]|_[A-Z]|[0-9]')
print(d)

# In this example argument "rmve" contains the alternative in-brackets

# 2. Empty string

empty = locateMod(""); print(empty)

# 3. Monoisotopic masses

string = 'TAAC[+57.021464]PPC[+57.021464]PAPPAPS[+162.052824]VFLTLMISR'
e = locateMod(string)
print(e)                                     # with extra-characters
f = locateMod(string, rmve = '[:punct:]')$Modification
print(f)                                     # incorrect values
g = locateMod(string, rmve = '\\+')$Modification
print(g)                                     # correct!
class(g)                                     # character
}

```

 oneHot

One-hot Encoder And Decoder Of Variables

Description

Encodes logical, categorical, integer and double type variables.

Usage

```
oneHot(x, type, omc = "dgCMatrix", verbose = TRUE)
```

Arguments

x	a (named) vector or list for encoding. Missing data are removed. For decoding, a dense or sparse matrix (preferably, the result of encoding) representing a single source data column
type	symbol. Choices: encode - one-hot encoding, decode - revert to original
omc	character length 1. Output matrix class . Default, 'dgCMatrix', other option, 'matrix'
verbose	logical, default TRUE, display messages

Details

This utility one-hot encodes when type = encode and verifies the encoded result (or any matrix of encodings obtained with [getEV](#) extractor) when type = decode. It detects illicit states.

Value

Encoding returns a matrix of length(x) rows and length(unique(x)) columns or a warning. Decoding returns a (named) vector or a warning. List vectors are returned unlisted. Integer(ish) vectors, converted to integer, character vectors - to factor, double or logical vector types remain unchanged.

Examples

```
if (interactive()) {
  # 1. Encode type "double"

  x = runif(9)                # numeric, length 9
  names(x) = letters[1:9]    # named
  typeof(x)
  a = oneHot(x, encode)      # a sparse matrix of "dgCMatrix" class
  b = oneHot(a, decode)      # a type "double" named numeric, length 9
  isTRUE(all.equal(x, b))   # TRUE
  typeof(b)
  print(x); print(b)
}
```

```

# 2. Type "logical" with missing values

y = c(TRUE, TRUE, NA, FALSE, TRUE, NA) # logical, length 6 with missing values
typeof(y)
a = oneHot(y, encode, 'matrix')
print(a) # a dense matrix
b = oneHot(a, decode) # revert
all.equal(y, b) # missing values in y removed
typeof(b)
print(x); print(b)

# 3. iris data

data(iris)
a = lapply(iris, oneHot, encode) # encode entire data
b = as.data.frame(
  lapply(a, oneHot, decode) # revert
)
identical(iris, b) # TRUE. Now, replace iris data with
# mtcars data!

# 4. Illicit states in one-hot encoding

`3.41` = c(1,0,0,1,1,0,0,1) # encoded type "double"
`0.12` = c(0,1,0,0,0,1,1,0)
a = cbind(`3.41`, `0.12`) # form encoded matrix
print(a) # matrix resembling one-hot encoding
x = oneHot(a, decode) # illicit state detected
print(x) # list with 2 different data types

}

```

score

Scaling And Thresholding Of Numeric Variables

Description

Implements classical methods for data scaling: range, z-score normalization, location and location-scale normalization, as well as data thresholding through the simplest form of ReLU rectifier. Missing values are removed in all cases.

Usage

```
score(x, how, filter = NULL, ...)
```

Arguments

x numeric vector, length > 1. Variable to be scaled or filtered
 how symbol. Choices are **range**, **stdev** or **relu**

`filter` character, length 1. Default NULL. Choices "positive", "negative". Requires `how = relu`

`...` list reserved for User input of paired values, statistic or otherwise. The list uses individual ellipsis arguments therefore, order of values needs be respected at all times e.g. when `how = range` min value *first*, max value *second*. When `how = stdev`, mean value *first*, standard deviation *second*.

Details

Normalization (scaling) can be applied locally on subsets of `x` when User inputs the values in the `...` list. Otherwise, the scaling is global i.e. it is applied to `x` as a whole. No assumptions regarding the underlying distribution of `x` are made.

`how != relu`. When `...` is empty, the function uses the sample statistics of `x` e.g. the mean, range or standard deviation. Otherwise, it uses values inputted by User case in which, *location-scale* normalization requires `how = stdev` and the `...` list filled as follows: the $\min(x)$ or $\max(x)$, or any other value *first* and $\text{sd}(x) > 0$ or any other positive value *second*. In particular, *location* normalization works similarly but with the *second* value = 1. Other location types, e.g. $x/\max(x)$, are obtainable.

NOTE: when `...` is populated with custom values, all other arguments should be present and named (see Examples).

`how = relu`. This option acts as numeric thresholding locally as well as globally. It stands for **rectified linear unit** and involves no statistics. It applies to numeric types that have ordering property (double, integer). On return, all `x` attributes are dropped. When `filter = 'positive'`, all negative values are set to zero while positive values remain unchanged. Alternatively, when `filter = 'negative'`, all negative values remain unchanged while all other values are set to zero. The "negative" option was added for symmetry.

Value

Numeric. When missing `...` and `how != relu`, scaled values using `x` own sample statistics. Otherwise, scaling is based on values inputted by User. When `how = relu`, $x \geq 0$ or $x \leq 0$, depending on `filter` setting.

References

[Ancillary Statistic](#) for location and location-scale distributions

Examples

```
if (interactive()) {

# 1. ReLU thresholding

x = { set.seed(223); sort(runif(10, -3, 3)) }
y = score(x, relu, 'positive'); y
z = score(x, relu, 'negative'); z

# 1.1 ReLU Plot
olp = par(no.readonly = TRUE)
par(list(mar = c(1,1,1,1), mgp = c(0,0,0), tcl = -0.01, pty = 's'))
```

```

plot(x, y, type = 'l', col = 'steelblue', lwd = 2 ,
      xlim = c(min(x), max(x)), ylim = c(min(x), max(x))
      , ylab = expression(ReLU(x)), xaxs = 'i', yaxs = 'i', axes = FALSE, cex.lab = 0.7)
axis(1, pos = 0, cex.axis = 0.6) ; axis(2, pos = 0, cex.axis = 0.6)
points(x, z, type = 'l', col = 'orangered', lwd = 2)
legend('topleft', legend = c('positive', 'negative'),
       col = c('steelblue', 'orangered'), pch = 'l', lwd = 2, cex = 0.6, bty = 'n')
par(olp)

# 2. Location and location-scale

# 2.1 Location (e.g. "x - max(x)")
x = 1:10
M = max(x)
std = 1
a = score(x, stdev, NULL, M, std); a

# 2.2 Location (e.g. "x/max(x)")
m = 0 # the mean
M = max(x) # or any value
b = score(x, range, NULL, m, M); b

# 2.3 Location-scale (e.g. "(x - max(x))/sd(x)")
M = max(x) # or any value
std = sd(x) # or any value > 0
c = score(x, stdev, NULL, M, std); c

# m, M and std above can be replaced with any values decided by User

# 3. Classical normalization

# 3.1 Range
d = score(x, range); d

# 3.2 z-score
e = score(x, stdev); e

# 4. Local vs. global z-score normalization

data(mtcars)
x = mtcars$wt
m = mean(x)
std = sd(x)

ll = split(x, f = as.factor(mtcars$cyl)) # partitioned x

# 4.1 Local scaling
aa = lapply(ll, score, stdev, NULL, m, std) # filled ... list
na = unlist(aa, FALSE, FALSE)

# 4.2 Global scaling
nb = score(x, stdev)

```

```
# 4.3 Local as well as global hold
identical(sort(na), sort(nb))          # TRUE
}
```

splitH

Read Or Write Subsets Of Data Files From Or To Disk

Description

Reads or writes data files from/to disk in disjoint subsets. This is a two-stage function (see Examples).

Usage

```
splitH(readpath, writepath = NULL)
```

Arguments

readpath	character length 1. Full path to the source file
writepath	character length 1. Full path to the destination file

Details

Above arguments apply to Stage 1 only. The arguments for Stage 2 function, which is the output of Stage 1, are the following:

rows integer, length 1. Number of rows per subset. When rows = Inf, the data can be either copied *as is* or moved to a new location

seq logical, default TRUE: read discrete subsets. Otherwise, progressively appended subsets from first to current

dropcols character of length < ncol(data). Columns to drop. Works only when rows is finite. Replaces argument select from [data.table::fread](#)

how symbol. Works only when rows = Inf and writepath location is given. Options: how = scp, data file is copied *as is* to writepath location; how = mv, data file is moved to writepath location

print logical, default TRUE, each subset written to disk is shown in console. Setting print to FALSE could increase writing speed

orn logical, default FALSE. When TRUE, the original data row numbers are shown in each subset

The main purpose of this utility is to bring manageable subsets from very large data into the working environment for further processing when writepath = NULL. When orn = TRUE, each subset receives a new column named "srn" showing source data row numbers. This column is absent from subsets written to disk regardless of orn value. The source data file can be any type of file readable by [data.table::fread](#).

At the first stage:

- the utility retrieves information about source data without loading them into memory and also provides the new function which, in the second stage:
- reads source data in successive disjoint subsets ($rows < Inf$) and brings them into the work environment (`writpath = NULL`), **or**
- writes subsets to `writpath` location appending them automatically to the destination file. During writing, if (`print = TRUE`) the displayed subsets are just printouts (class "NULL"). When `writpath = NULL`, displayed subsets are objects.

There is a functional difference between `rows = Inf` and `rows = nrow(data)`:

- when `rows = Inf`, the size of source data is irrelevant. They can be either copied (`how = scp`) or moved (`how = mv`) to `writpath` destination without being loaded into memory.
- when `rows` has finite value, the size of source data is relevant and data columns can be dropped.

Value

At stage 1, displayed information and a function (a closure). At stage 2, a "data.table" class subset of data or a printout of said subset when written on disk.

References

Part of internal code for Stage 1 was inspired by [data.table Issue# 7169](#)

See Also

Linux commands `scp` and `mv`

Examples

```
if (interactive()) {

# Make a 'csv' file

data(mtcars)
tmpf = tempfile(fileext = '.csv')
write.table(mtcars,tmpf , sep = ',', row.names = FALSE, quote = FALSE)

# 1. Read data file step by step

# 1.1 Get information on data
r = splitH(readpath = tmpf)           # stage 1
class(r)                             # function

# 1.2 Read data iteratively           # stage 2
a = r(rows = 11, dropcols = c('am', 'vs')) # iter1 no original row numbers
b = r(rows = 11, dropcols = c('am', 'vs'), orn = TRUE) # iter2 w. original row numbers
c = r(rows = 11, dropcols = c('am', 'vs')) # iter3 the last subset
## Not run:
d = r(rows = 11, dropcols = c('am', 'vs')) # iter4 stop! Return to stage 1

## End(Not run)
```

```

print(list(a, b, c))

# 2. Read data file completely

r = splitH(readpath = tmpf)           # stage 1
n = ceiling(32/13)                   # read 13 rows at a time
a = replicate(n, r(rows = 13), simplify = FALSE) # read file
class(a)                              # list
print(a)                              # a list of tables

tmpf1 = tempfile(fileext = '.csv')    # new location

# 3. Iteratively write to new location

r = splitH(readpath = tmpf, writepath = tmpf1) # stage 1
n = ceiling(32/11)                   # 11 rows each time
invisible(
  replicate(n, r(rows = 11) , simplify = FALSE) # write to new location
)
a = data.table::fread(tmpf1)         # check result
dim(a)
print(head(a))

unlink(tmpf1)

tmpf2 = tempfile(fileext = '.csv')    # new location

# 4. Move file from tmpf to another location

r = splitH(readpath = tmpf, writepath = tmpf2) # stage 1
r(rows = Inf, how = mv, print = FALSE) # move to new location
a = data.table::fread(tmpf2)         # check result
print(head(a))

unlink(tmpf)
unlink(tmpf2)

}

```

splitV

Split Data Vertically Into Subsets

Description

Splits data into unequal and disjoint groups of columns (i.e. vertical splits)

Usage

```
splitV(data, splits)
```

Arguments

`data` a "data.table" class data frame or convertible to "data.table" class
`splits` integer, length 1, of value $\leq \text{ncol}(\text{data})$. The number of disjoint selections (i.e. vertical splits). When `splits = 0`, there are no splits

Details

The smaller the `splits` value, the wider the column groups. Column order from source data is not preserved

Value

An exhaustive [listenv](#) of disjoint column groups from original data

Examples

```
if (interactive()) {
  # 1. Split iris data vertically

  data(iris)
  a = splitV(iris, splits = 3)    # split data in 3 column groups
  class(a)                       # listenv, environment
  print(as.list(a))              # list
}
```

stratify

Extract A Proportional Stratified Sample From A Data Set

Description

Obtains a proportional stratified sample from any data convertible to "data.table" class containing categorical variables.

Usage

```
stratify(
  X,
  target,
  stratum = NULL,
  size,
  thresh,
  seed = NULL,
  indx = TRUE,
  dis = NULL,
  args = list(),
  ext = FALSE,
```

```

    replace = FALSE,
    verbose = TRUE
  )

```

Arguments

<code>x</code>	any data array convertible to "data.table" class
<code>target</code>	character length 1. The name of column considered to be the root stratum. For example, the name of the 'target' categorical column in a classification training set. This argument should always have a value
<code>stratum</code>	character of length $\leq \text{ncol}(\text{data}) - 1$. Default, NULL. Names of additional categorical data columns which deepen the stratification
<code>size</code>	integer length 1. Default, none. Value set by User. In this case, it is upper-bounded by the size of the thinnest stratum having more than one row. Setting size value above this bound requires sampling with replacement
<code>thresh</code>	integer, length 1. Default, none. An automatic switch between sample size calculation formulae. Can be set when <code>size</code> is missing from call. It can take as value any of the stratum thicknesses shown in the output message NOTE: it is recommended that <i>both</i> <code>size</code> and <code>thresh</code> values are missing from call until information on stratification becomes available after first run
<code>seed</code>	integer length 1. Seed value for output reproducibility
<code>indx</code>	logical. Default TRUE, returns the sample row index only. FALSE, returns the sampled data
<code>dis</code>	symbol. Default NULL. One of the density or function distributions used for generating probability vectors for probabilistic sampling
<code>args</code>	list of arguments required by distributions as described in stats::distributions documentation. Default, none. NB The list should <i>never</i> include the first argument (<code>x</code> or <code>n</code>) required in documentation, as it is collected internally from each stratum NOTE: Even if <code>seed</code> is set, the sample row index changes if either the distribution in <code>dis</code> or the values in <code>args</code> is changed
<code>ext</code>	logical, default FALSE. When TRUE, expands the output sampled data with the following extra columns: row - sample rows, strat - stratum, n - stratum total rows (i.e. thickness) and size - the sample size extracted from each stratum. Requires <code>indx = FALSE</code>
<code>replace</code>	logical, default FALSE. When TRUE, sampling with replacement if <code>size</code> is present in call and exceeds the thinnest stratum with more than one row
<code>verbose</code>	logical, default TRUE, display messages

Details

This utility is designed to find a true sample representation of the data under current stratification by matching closely the proportionality of strata as long as argument `size` is missing from call. Each distinct combination of `target` and `stratum` levels defines a stratum. For minimal stratification, argument `target` must always have a value present in call. All one-row strata, when formed, are simply appended to the compounded output.

size. As column in the extended output, it represents the size of the sample extracted from each stratum, internally derived to be proportional to stratum thickness, unbounded by the thinnest stratum with more than one row. Deep stratification along with high cardinality and imbalance may severely restrict the size of the compounded output which is the sum of all stratum sizes plus the number of one-row strata. The sampling occurs at stratum level except for one-row strata for which $size = 0$ is interpreted as "no sampling".

As function argument, size is interpreted as the largest sample size without replacement that can be requested, being bounded by the thinnest stratum with more than one row. The presence of size in call alters the proportionality since each stratum - except one-row strata - contributes equally to the output size which is the number of strata times the size value plus the number of one-row strata.

thresh. Automatic switch that modifies stratum sample size calculation method based on the extreme stratum thickness values, stratification depth and total data rows. Internally, it searches for the formula that finds at least one sample size accommodating the thinnest stratum with more than one row. Messages are displayed at runtime although, in most cases the condition is satisfied at first iteration. When $thresh \geq nrow(data)$, each stratum is sampled proportional with the ratio between thinnest and thickest strata, which may lead to a relatively small size output. All other thresh values compromise slightly between output size and proportionality (see Example 3).

Probabilistic Sampling:

dis. The prob argument in `base::sample` cannot be used as required since the length of probability vector varies with stratum thickness. Herein, stratum probability vectors are determined by the distribution specified in argument `dis` which associates each stratum with a probability vector of thickness (**n**) length. When `args` is missing from call, `dis` uses the default argument values for respective distribution. An error is thrown when the probability vector has insufficient number of non-zero values. See package **stats**, "Distributions" documentation.

NOTE: The *random variate generators* i.e. the **r*** version of `distributions`, generate vectors of absolute *random deviate* values which play the role of pseudo-probabilities (i.e. not necessarily elements of (**n-1**)-simplex) conformant with requirements listed in `base::sample` documentation.

Value

A proportional or non-proportional stratified sample (depending on whether size is absent or present in call), either as row index or as sampled data, compounded from random or probability samples taken from each stratum. Informative messages are displayed. Existing data row names are preserved in the output case in which, the sampled data output gains the column named "rn".

See Also

[sample](#), [distributions](#)

Examples

```
if (interactive()) {
  # 1. Row index for sampling

  data(mtcars)
  rowID = stratify(mtcars
    , target = 'cyl'
```

```

        , stratum = c('vs', 'am')
        , seed = 314)                                # display information
print(rowID)                                        # integer

# 2. Sampled data with extra-columns

smp = stratify(mtcars
               , 'cyl'
               , c('vs', 'am')
               , seed = 314
               , indx = FALSE                        # sampled data
               , ext = TRUE)                         # extra columns
print(smp)
identical(rowID, smp$row)                            # TRUE

# 3. Impact of "thresh" value on output size

sl = list()
thresholds = c(2, 4, 12, 32)                         # stratum thicknesses

for (t in seq(along=thresholds)) {
  sl[[t]] = stratify(mtcars
                    , 'cyl'
                    , c('am', 'vs')
                    , thresh = thresholds[t]
                    , seed = 314
                    , indx = FALSE, ext = TRUE)
}
names(sl) = quote(thresholds)
print(sl)                                            # stratified samples
                                                    # of various sizes

# 4. Probabilistic sampling

rowIDn = stratify(mtcars
                  , 'cyl'
                  , c('vs', 'am')
                  , seed = 314
                  , dis = pnorm                       # Normal distribution
                  , args = c(mean = 1, sd = 3))       # no first argument!

rowIDb = stratify(mtcars
                  , 'cyl'
                  , c('vs', 'am')
                  , seed = 314                        # same seed
                  , dis = pbeta                       # Beta distribution
                  , args = c(shape1 = 1, shape2 = 3)) # no first argument!

# Same seed but changing the distribution changes the sample row index
identical(rowIDn, rowIDb)                            # FALSE
}

```

tileData	<i>Tile And Write Tiled Data To Disk</i>
----------	--

Description

Splits long and wide data files in lists of disjoint tiles for further processing.

Usage

```
tileData(readpath, writepath = NULL, rows, splits, ...)
```

Arguments

readpath	character length 1. Full path to the source file
writepath	character length 1. Full path to the destination file
rows	integer length 1. Number of rows in each subset. Internally, it determines the total number of subsets before the vertical split
splits	integer, length 1. Number of vertical data splits in each above subset. See splitV
...	extra arguments to splitH e.g. dropcols for columns dropped from source data

Details

Facilitates local operations on small size tiles by partitioning the data horizontally and vertically. The list of tiles can be written to disk as "rds" file when a writepath destination is given. The written data can then be read entirely or in subsets (see Example 2).

NOTE: This utility uses background processing. Check "Security Considerations" in **callr** package documentation.

Value

A [listenv](#) of "data.table" class tiles. When writepath is given, it produces a "rds" file containing data tiles.

See Also

[splitH](#), [splitV](#), [tileHot](#), [readRDS](#)

Examples

```
if (interactive()) {
  # Make a 'csv' file

  data(iris)
  tmpf = tempfile(fileext = '.csv')
  write.table(iris, tmpf, sep = ',', row.names = FALSE, quote = FALSE)
```

```

# 1. Tile data

a = tileData(tmpf, rows = 10, splits = 3)    # 10x2 and 10x1 tiles
class(a)                                     # listenv, environment
str(a)                                       # nested list

tmpf1 = tempfile(fileext = '.rds')          # new location

# 2. Write tiled data

tileData(tmpf, tmpf1, rows = 10, splits = 3)
a = readRDS(tmpf1)[[1]]                     # partial read from new location
print(a)                                    # list component

unlink(tmpf)
unlink(tmpf1)
}

```

tileHot

One-hot Encoder Of Tiled Data

Description

One-hot encodes tiled data.

Usage

```
tileHot(readpath, rows, splits, omc = "dgCMatrix", ...)
```

Arguments

readpath	character, length 1. Path to source data that is readable with data.table::fread
rows	integer length 1. Number of rows in each data subset. Internally, it determines the total number of subsets before the vertical split
splits	integer, length 1. Number of vertical data splits in each subset, see splitV . Recommended for very wide data frames. When <code>splits = 0</code> , no vertical splitting occurs
omc	character length 1. Output matrix class . Default, "dgCMatrix". Other option: "matrix"
...	reserved for splitH function arguments, such as <code>dropcols</code> or <code>orn = TRUE</code> which is needed for single matrix output

Details

This utility reads the data in disjoint subsets, tiles them and then one-hot encodes each tile. Encoded tiles are returned as nested list of matrices, as a single matrix, as data frame or as a two-component data frame and sparse matrix list, decided through combinations of `dropcols`, `omc` and `orn` values.

NOTE 1: traceability is assured by assembling the data as character names and values from columns marked for encoding. As side effect, at run time the encoding is reported as being applied to "integer(ish)" values only with no loss in accuracy. Empty source data columns gain the "NA" suffix and become single-column, single-valued matrices.

NOTE 2: this utility implements background, processing. Check "Security Considerations" in `callr` package documentation.

Value

- When `orn = FALSE`, an unnamed `listenv` of sparse matrices. Recommended for very large source data files. Before proceeding with list output, read NOTE 2 in `getEV` documentation. See Examples 1 and 2.
- When `orn = TRUE`, a matrix.

NOTE 3: In this case, row and column binding operations were avoided to prevent situations described in NOTE 2, `getEV` documentation. As result, the output matrix is gradually populated instead of being gradually expanded.

While `orn = TRUE` and `dropcols != NULL`:

- When `omc = 'matrix'`, a `data.table` containing encoded, as well as unencoded, dropped columns placed in the leftmost positions.
- When `omc = 'dgCMatrix'`, a two-component `listenv`: a data table containing dropped, unencoded columns and a sparse matrix containing the encoded columns. The row order in both components is identical. See Examples below, and Example 2 in `getEV` documentation.

NOTE 4: In all above cases, specific encoded variables can be obtained with `getEV` extractor. When `orn = TRUE`, `oneHot` *decoded* variables extracted from matrix outputs return named vectors having row numbers as names.

See Also

[splitH](#), [splitV](#), [oneHot](#), [listenv](#), [Matrix](#)

Examples

```
if (interactive()) {

# 1. Shuffled data

tempf = tempfile(fileext = '.csv')
data(iris)
iris22 = iris[ { set.seed(327); sample.int(150) }, ]           # shuffled iris data
rownames(iris22) <- NULL                                     # remove shuffled row names
write.table(iris22, tempf, sep = ',', row.names = FALSE, quote = FALSE)
```

```

# 1.1 Output as List
# In most cases, list output requires shuffled data!

A = tileHot(readpath = tempf
            , rows = 14, splits = 3, print = FALSE)      # encoded data tiles
print(A)                                               # a listenv
print(A[[1]])                                          # a snapshot

# 1.2 Retrieve iris22 data from encoded list output
X = sapply(names(iris22), \(n) getEV(A, n))             # extract all encoded columns
Y = lapply(
    lapply(X, oneHot, decode)
    , unname)                                          # decoded columns are named vectors!
d = as.data.frame(Y)
identical(iris22, d)                                  # TRUE

unlink(tempf)

# 2. Unshuffled data

# Make unshuffled data 'csv' file
tempf = tempfile(fileext = '.csv')
write.table(iris, tempf, sep = ',', row.names = FALSE, quote = FALSE)

# 2.1 Output as list
# List output fails low cardinality variables on unshuffled data.

E = tileHot(readpath = tempf
            , rows = 14, splits = 3, print = FALSE)    # same as above

# 2.2 Retrieve iris data from encoded list output
V = sapply(names(iris), \(n) getEV(E, n))             # warning
W = lapply(
    lapply(V, oneHot, decode)
    , unname)                                          # decoded columns are named vectors!
dd = as.data.frame(W)
identical(iris, dd)                                  # FALSE
all.equal(iris, dd)                                  # low cardinality "Species"

# 2.3 Output as matrix
# Matrix output handles low cardinality variables. No data shuffling required.

m = tileHot(readpath = tempf
            , rows = 14
            , splits = 3
            , orn = TRUE,
            , print = FALSE)                          # low cardinality "Species"
print(m)                                              # needed for matrix output
                                                    # 150x126 sparse matrix

# 2.4 Retrieve iris data from encoded matrix output
P = sapply(names(iris), \(n) getEV(m, n))             # extract encoded columns
Q = lapply(
    lapply(P, oneHot, decode)

```

```

                                , unname)                                # decoded columns are named vectors!
R = as.data.frame(Q)
identical(iris, R)                                                    # TRUE

# 2.5 Output as "data.table" class
D = tileHot(readpath = tempf
            , rows = 14
            , splits = 3
            , omc = 'matrix'                                          # encoded dense matrix
            , dropcols = c('Petal.Width', 'Petal.Length')          # unencoded columns
            , orn = TRUE                                              # needed for matrix output
            , print = FALSE)
print(head(D, 10))                                                  # a "data.table" class
dim(D)                                                                # 150x63

# 2.6 Output as a 2-component list
Dl = tileHot(readpath = tempf
            , rows = 14
            , splits = 3
            , omc = 'dgCMatrix'                                       # the default class
            , dropcols = c('Petal.Width', 'Petal.Length')          # unencoded columns
            , orn = TRUE                                              # needed for matrix output
            , print = FALSE)
print(Dl)                                                            # 2-component listenv
print(Dl[[1]])                                                       # unencoded columns
print(Dl[[2]])                                                       # encoded sparse matrix

# iris data can be retrieved from the Dl list in similar fashion described above

unlink(tempf)

}

```

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