

Package ‘ComplexHeatmap’

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Type Package

Title Making Complex Heatmaps

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Description Complex heatmaps are efficient to visualize associations
between different sources of data sets and reveal potential structures.
Here the ComplexHeatmap package provides a highly flexible way to arrange
multiple heatmaps and supports self-defined annotation graphics.

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ComplexHeatmap-package

Making complex heatmap

Description

Making complex heatmap

Details

This package aims to provide a simple and flexible way to arrange multiple heatmaps as well as self-defining annotation graphics.

The package is implemented in an object-oriented way. Components of heatmap lists are abstracted into several classes.

- [Heatmap-class](#): a single heatmap containing heatmap body, row/column names, titles, dendrograms and column annotations.
- [HeatmapList-class](#): a list of heatmaps and row annotations.
- [HeatmapAnnotation-class](#): a list of row annotations or column annotations.

There are also several internal classes:

- [SingleAnnotation-class](#): a single row annotation or column annotation.
- [ColorMapping-class](#): mapping from values to colors.

For plotting one single heatmap, please go to the documentation page of [Heatmap](#). For plotting multiple heatmaps, please go to [HeatmapList-class](#) and `+.AdditiveUnit`.

The vignette provides detailed explanation of how to use this package.

Examples

```
# There is no example
NULL
```

```
+.AdditiveUnit      Add heatmaps or row annotations to a heatmap list
```

Description

Add heatmaps or row annotations to a heatmap list

Usage

```
## S3 method for class 'AdditiveUnit'
x + y
```

Arguments

x a [Heatmap-class](#) object, a [HeatmapAnnotation-class](#) object or a [HeatmapList-class](#) object.

y a [Heatmap-class](#) object, a [HeatmapAnnotation-class](#) object or a [HeatmapList-class](#) object.

Details

It is only a helper function. It actually calls [add_heatmap, Heatmap-method](#), [add_heatmap, HeatmapList-method](#) or [add_heatmap, HeatmapAnnotation-method](#) depending on the class of the input objects.

The [HeatmapAnnotation-class](#) object to be added should only be row annotations.

Value

A [HeatmapList-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))
rownames(mat) = letters[1:12]
colnames(mat) = letters[1:10]
```

```
ht = Heatmap(mat)
ht + ht
ht + ht + ht
```

```
ht_list = ht + ht
ht + ht_list

ha = rowAnnotation(points = row_anno_points(1:12))
ht + ha
ht_list + ha

ha + ha + ht
```

AdditiveUnit

Constructor method for AdditiveUnit class

Description

Constructor method for AdditiveUnit class

Usage

```
AdditiveUnit(...)
```

Arguments

... black hole arguments.

Details

This method is not used in the package.

Value

No value is returned.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this function
NULL
```

AdditiveUnit-class *An internal class*

Description

An internal class

Details

This class is a super class for [Heatmap-class](#), [HeatmapList-class](#) and [HeatmapAnnotation-class](#) classes. It is only designed for + generic method so that above three classes can be appended to each other.

Examples

```
# no example  
NULL
```

add_heatmap-dispatch *Method dispatch page for add_heatmap*

Description

Method dispatch page for add_heatmap.

Dispatch

add_heatmap can be dispatched on following classes:

- [add_heatmap, HeatmapAnnotation-method, HeatmapAnnotation-class](#) class method
- [add_heatmap, HeatmapList-method, HeatmapList-class](#) class method
- [add_heatmap, Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example  
NULL
```

add_heatmap-Heatmap-method

Add heatmaps or row annotations as a heatmap list

Description

Add heatmaps or row annotations as a heatmap list

Usage

```
## S4 method for signature 'Heatmap'  
add_heatmap(object, x)
```

Arguments

object	a Heatmap-class object.
x	a Heatmap-class object, a HeatmapAnnotation-class object or a HeatmapList-class object.

Details

There is a shortcut function `+.AdditiveUnit`.

Value

A [HeatmapList-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)  
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))  
rownames(mat) = letters[1:12]  
colnames(mat) = letters[1:10]  
  
ht = Heatmap(mat)  
add_heatmap(ht, ht)  
  
ha = HeatmapAnnotation(points = anno_points(1:12, which = "row"),  
  which = "row")  
add_heatmap(ht, ha)
```

`add_heatmap-HeatmapAnnotation-method`*Add row annotations or heatmaps as a heatmap list*

Description

Add row annotations or heatmaps as a heatmap list

Usage

```
## S4 method for signature 'HeatmapAnnotation'  
add_heatmap(object, x)
```

Arguments

<code>object</code>	a HeatmapAnnotation-class object.
<code>x</code>	a Heatmap-class object, a HeatmapAnnotation-class object or a HeatmapList-class object.

Details

There is a shortcut function `+.AdditiveUnit`.

Value

A [HeatmapList-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)  
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))  
rownames(mat) = letters[1:12]  
colnames(mat) = letters[1:10]  
  
ht = Heatmap(mat)  
  
ha = HeatmapAnnotation(points = anno_points(1:12, which = "row"),  
  which = "row")  
add_heatmap(ha, ht)
```

add_heatmap-HeatmapList-method

Add heatmaps and row annotations to the heatmap list

Description

Add heatmaps and row annotations to the heatmap list

Usage

```
## S4 method for signature 'HeatmapList'  
add_heatmap(object, x)
```

Arguments

`object` a [HeatmapList-class](#) object.
`x` a [Heatmap-class](#) object or a [HeatmapAnnotation-class](#) object or a [HeatmapList-class](#) object.

Details

There is a shortcut function `+.AdditiveUnit`.

Value

A [HeatmapList-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)  
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))  
rownames(mat) = letters[1:12]  
colnames(mat) = letters[1:10]  
  
ht = Heatmap(mat)  
ht_list = ht + ht  
add_heatmap(ht_list, ht)  
  
ha = HeatmapAnnotation(points = anno_points(1:12, which = "row"),  
  which = "row")  
add_heatmap(ht_list, ha)
```

annotation_legend_size-HeatmapList-method

Size of the annotation legend viewport

Description

Size of the annotation legend viewport

Usage

```
## S4 method for signature 'HeatmapList'  
annotation_legend_size(object, legend_list = list(), ...)
```

Arguments

`object` a [HeatmapList-class](#) object.
`legend_list` a list of self-defined legend, should be wrapped into [grob](#) objects.
... graphic parameters passed to [color_mapping_legend, ColorMapping-method](#).

Details

Legends for all heatmaps or legends for all annotations will be put in one viewport. This function calculates the size of such viewport. Note graphic parameters for legends will affect the size.

This function is only for internal use.

Value

A [unit](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

anno_barplot

Using barplot as annotation

Description

Using barplot as annotation

Usage

```
anno_barplot(x, baseline = "min", which = c("column", "row"), border = TRUE, bar_width = 0.6,
            gp = gpar(fill = "#CCCCCC"), ylim = NULL, axis = FALSE, axis_side = NULL,
            axis_gp = gpar(fontsize = 8), axis_direction = c("normal", "reverse"), ...)
```

Arguments

x	a vector of numeric values.
baseline	baseline for bars. The value should be "min" or "max", or a numeric value.
which	is the annotation a column annotation or a row annotation?
border	whether show border of the annotation component
bar_width	relative width of the bars, should less than one
gp	graphic parameters.
ylim	data ranges.
axis	whether add axis
axis_side	if it is placed as column annotation, value can only be "left" or "right". If it is placed as row annotation, value can only be "bottom" or "top".
axis_gp	graphic parameters for axis
axis_direction	if the annotation is row annotation, should the axis be from left to right (default) or follow the reversed direction?
...	for future use.

Value

A graphic function which can be set in [HeatmapAnnotation](#) constructor method.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
f = anno_barplot(rnorm(10))
grid.newpage(); f(1:10)
```

```
f = anno_barplot(rnorm(10), which = "row")
grid.newpage(); f(1:10)
```

anno_boxplot

*Using boxplot as annotation***Description**

Using boxplot as annotation

Usage

```
anno_boxplot(x, which = c("column", "row"), border = TRUE,
             gp = gpar(fill = "#CCCCCC"), ylim = NULL, outline = TRUE,
             pch = 16, size = unit(2, "mm"), axis = FALSE, axis_side = NULL,
             axis_gp = gpar(fontsize = 8), axis_direction = c("normal", "reverse"))
```

Arguments

x	a matrix or a list. If x is a matrix and if which is column, statistics for boxplot is calculated by columns, if which is row, the calculation is by rows.
which	is the annotation a column annotation or a row annotation?
border	whether show border of the annotation component
gp	graphic parameters
ylim	data ranges.
outline	whether draw outliers
pch	point type
size	point size
axis	whether add axis
axis_side	if it is placed as column annotation, value can only be "left" or "right". If it is placed as row annotation, value can only be "bottom" or "top".
axis_gp	graphic parameters for axis
axis_direction	if the annotation is row annotation, should the axis be from left to right (default) or follow the reversed direction?

Value

A graphic function which can be set in [HeatmapAnnotation](#) constructor method.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(32), nrow = 4)
f = anno_boxplot(mat)
grid.newpage(); f(1:8)

f = anno_boxplot(mat, which = "row")
grid.newpage(); f(1:4)

lt = lapply(1:4, function(i) rnorm(8))
f = anno_boxplot(lt)
grid.newpage(); f(1:4)
```

anno_density

Using kernel density as annotation

Description

Using kernel density as annotation

Usage

```
anno_density(x, which = c("column", "row"), gp = gpar(fill = "#CCCCCC"),
  type = c("lines", "violin", "heatmap"), ...)
```

Arguments

x	a matrix or a list. If x is a matrix and if which is column, statistics for density is calculated by columns, if which is row, the calculation is by rows.
which	is the annotation a column annotation or a row annotation?
gp	graphic parameters. Note it is ignored if type equals to heatmap.
type	which type of graphics is used to represent density distribution.
...	pass to density

Value

A graphic function which can be set in [HeatmapAnnotation](#) constructor method.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```

mat = matrix(rnorm(32), nrow = 4)
f = anno_density(mat)
grid.newpage(); f(1:8)

f = anno_density(mat, which = "row", type = "violin")
grid.newpage(); f(1:4)

lt = lapply(1:4, function(i) rnorm(8))
f = anno_density(lt, type = "heatmap")
grid.newpage(); f(1:4)

```

anno_histogram	<i>Using histogram as annotation</i>
----------------	--------------------------------------

Description

Using histogram as annotation

Usage

```
anno_histogram(x, which = c("column", "row"), gp = gpar(fill = "#CCCCCC"), ...)
```

Arguments

x	a matrix or a list. If x is a matrix and if which is column, statistics for histogram is calculated by columns, if which is row, the calculation is by rows.
which	is the annotation a column annotation or a row annotation?
gp	graphic parameters
...	pass to hist

Value

A graphic function which can be set in [HeatmapAnnotation](#) constructor method.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```

mat = matrix(rnorm(32), nrow = 4)
f = anno_histogram(mat)
grid.newpage(); f(1:8)

f = anno_histogram(mat, which = "row")
grid.newpage(); f(1:4)

```

```
lt = lapply(1:4, function(i) rnorm(8))
f = anno_histogram(lt)
grid.newpage(); f(1:4)
```

anno_link

Link annotation with labels

Description

Link annotation with labels

Usage

```
anno_link(at, labels, which = c("column", "row"), side = ifelse(which == "column", "top", "right"),
          lines_gp = gpar(), labels_gp = gpar(), padding = 0.25, link_width = NULL)
```

Arguments

at	numeric index in the original matrix
labels	corresponding labels
which	column annotation or row annotation
side	side of the labels. If it is a column annotation, permitted values are "top" and "bottom"; If it is a row annotation, permitted values are "left" and "right".
lines_gp	graphic settings for the segments
labels_gp	graphic settings for the labels
padding	padding between labels if they are attached to each other
link_width,	width of the segments.

Details

Sometimes there are many rows or columns in the heatmap and we want to mark some of the rows. This annotation function is used to mark these rows and connect labels and corresponding rows with links.

Value

A graphic function which can be set in [HeatmapAnnotation](#) constructor method.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(10000), nr = 1000)
labels = sample(letters, 20, replace = TRUE)
Heatmap(mat, show_row_dend = FALSE, show_column_dend = FALSE) +
rowAnnotation(link = row_anno_link(at = sample(1000, 20), labels = labels),
              width = unit(1, "cm") + max_text_width(labels))
```

anno_points

*Using points as annotation***Description**

Using points as annotation

Usage

```
anno_points(x, which = c("column", "row"), border = TRUE, gp = gpar(), pch = 16,
            size = unit(2, "mm"), ylim = NULL, axis = FALSE, axis_side = NULL,
            axis_gp = gpar(fontsize = 8), axis_direction = c("normal", "reverse"), ...)
```

Arguments

x	a vector of numeric values.
which	is the annotation a column annotation or a row annotation?
border	whether show border of the annotation component
gp	graphic parameters.
pch	point type.
size	point size.
ylim	data ranges.
axis	whether add axis.
axis_side	if it is placed as column annotation, value can only be "left" or "right". If it is placed as row annotation, value can only be "bottom" or "top".
axis_gp	graphic parameters for axis
axis_direction	if the annotation is row annotation, should the axis be from left to right (default) or follow the reversed direction?
...	for future use.

Value

A graphic function which can be set in [HeatmapAnnotation](#) constructor method.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
f = anno_points(rnorm(10))
grid.newpage(); f(1:10)
```

anno_text

Using text as annotation

Description

Using text as annotation

Usage

```
anno_text(x, which = c("column", "row"), gp = gpar(), rot = 0,
just = NULL, offset = unit(0.5, "npc"))
```

Arguments

x	a vector of text
which	is the annotation a column annotation or a row annotation?
gp	graphic parameters.
rot	rotation of text
just	justification of text, pass to grid.text
offset	if it is a row annotation, offset corresponds to the x-coordinates of text. and if it is a column annotation, offset corresponds to the y-coordinates of text. The value should be a unit object.

Value

A graphic function which can be set in [HeatmapAnnotation](#) constructor method.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)
colnames(mat) = letters[1:10]
rownames(mat) = LETTERS[1:10]
long_cn = do.call("paste0", rep(list(colnames(mat)), 4)) # just to construct long text
ha_rot_cn = HeatmapAnnotation(text = anno_text(long_cn, rot = 45, offset = unit(5, "mm")))
Heatmap(mat, name = "foo", top_annotation = ha_rot_cn, top_annotation_height = unit(1.2, "cm"))
```

ColorMapping

Constructor methods for ColorMapping class

Description

Constructor methods for ColorMapping class

Usage

```
ColorMapping(name, colors = NULL, levels = NULL,  
             col_fun = NULL, breaks = NULL, na_col = "#FFFFFF")
```

Arguments

name	name for this color mapping. The name is automatically generated if it is not specified.
colors	discrete colors.
levels	levels that correspond to colors. If colors is name indexed, levels can be ignored.
col_fun	color mapping function that maps continuous values to colors.
breaks	breaks for the continuous color mapping. If col_fun is generated by colorRamp2 , breaks can be ignored.
na_col	colors for NA values.

Details

colors and levels are used for discrete color mapping, col_fun and breaks are used for continuous color mapping.

Value

A [ColorMapping-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# discrete color mapping for characters  
cm = ColorMapping(name = "test",  
                  colors = c("blue", "white", "red"),  
                  levels = c("a", "b", "c"))  
cm  
  
# discrete color mapping for numeric values  
cm = ColorMapping(name = "test",
```

```
    colors = c("blue", "white", "red"),
    levels = c(1, 2, 3))
cm

# continuous color mapping
require(circlize)
cm = ColorMapping(name = "test",
  col_fun = colorRamp2(c(0, 0.5, 1), c("blue", "white", "red")))
cm
```

ColorMapping-class *Class to map values to colors*

Description

Class to map values to colors

Details

The [ColorMapping-class](#) handles color mapping with both discrete values and continuous values. Discrete values are mapped by setting a vector of colors and continuous values are mapped by setting a color mapping function.

Methods

The [ColorMapping-class](#) provides following methods:

- [ColorMapping](#): constructor methods.
- [map_to_colors,ColorMapping-method](#): mapping values to colors.
- [color_mapping_legend,ColorMapping-method](#): draw legend or get legend as a [grob](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# for examples, please go to `ColorMapping` method page
NULL
```

color_mapping_legend-ColorMapping-method
Draw legend based on color mapping

Description

Draw legend based on color mapping

Usage

```
## S4 method for signature 'ColorMapping'
color_mapping_legend(object, ...,
  plot = TRUE,
  title = object@name,
  title_gp = gpar(fontsize = 10, fontface = "bold"),
  title_position = c("topleft", "topcenter", "leftcenter", "lefttop"),
  color_bar = c("discrete", "continuous"),
  grid_height = unit(4, "mm"),
  grid_width = unit(4, "mm"),
  grid_border = NULL,
  at = object@levels,
  labels = at,
  labels_gp = gpar(fontsize = 10),
  nrow = NULL,
  ncol = 1,
  legend_height = NULL, legend_width = NULL,
  legend_direction = c("vertical", "horizontal"),
  param = NULL)
```

Arguments

object	a ColorMapping-class object.
plot	whether to plot or just return the size of the legend viewport.
title	title of the legend, by default it is the name of the legend
title_gp	graphical parameters for legend title
title_position	position of the title
color_bar	if the mapping is continuous, whether show the legend as discrete color bar or continuous color bar
grid_height	height of each legend grid.
grid_width	width of each legend grid.
grid_border	color for legend grid borders.
at	break values of the legend
labels	labels corresponding to break values
labels_gp	graphical parameters for legend labels

nrow	if there are too many legend grids, they can be put as an array, this controls number of rows
ncol	if there are too many legend grids, they can be put as an array, this controls number of columns
legend_height	height of the legend, only works when color_bar is continuous and direction is vertical
legend_width	width of the legend, only works when color_bar is continuous and direction is horizontal
legend_direction	when color_bar is continuous, should the legend be vertical or horizontal?
param	will be parsed if the parameters are specified as a list
...	pass to viewport .

Details

A viewport is created which contains a legend title, legend grids and corresponding labels.

This function will be improved in the future to support more types of legends.

Value

A [grob](#) object which contains the legend

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# discrete color mapping for characters
cm = ColorMapping(name = "test",
  colors = c("blue", "white", "red"),
  levels = c("a", "b", "c"))
grid.newpage()
color_mapping_legend(cm)

# discrete color mapping for numeric values
cm = ColorMapping(name = "test",
  colors = c("blue", "white", "red"),
  levels = c(1, 2, 3))
grid.newpage()
color_mapping_legend(cm)

# continuous color mapping
require(circlize)
cm = ColorMapping(name = "test",
  col_fun = colorRamp2(c(0, 0.5, 1), c("blue", "white", "red")))
grid.newpage()
color_mapping_legend(cm, title_gp = gpar(fontsize = 16))
```

columnAnnotation	<i>Construct column annotations</i>
------------------	-------------------------------------

Description

Construct column annotations

Usage

```
columnAnnotation(...)
```

Arguments

... pass to [HeatmapAnnotation](#)

Details

The function is identical to

```
HeatmapAnnotation(..., which = "column")
```

Value

A [HeatmapAnnotation-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
df = data.frame(type = c("a", "a", "a", "b", "b", "b"))
ha = rowAnnotation(df = df)
```

column_anno_barplot	<i>Column annotation which is represented as barplots</i>
---------------------	---

Description

Column annotation which is represented as barplots

Usage

```
column_anno_barplot(...)
```

Arguments

... pass to [anno_barplot](#)

Details

A wrapper of [anno_barplot](#) with pre-defined which to column.

Value

See help page of [anno_barplot](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

column_anno_boxplot *Column annotation which is represented as boxplots*

Description

Column annotation which is represented as boxplots

Usage

```
column_anno_boxplot(...)
```

Arguments

... pass to [anno_boxplot](#)

Details

A wrapper of [anno_boxplot](#) with pre-defined which to column.

Value

See help page of [anno_boxplot](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

column_anno_density *Column annotation which is represented as density plot*

Description

Column annotation which is represented as density plot

Usage

```
column_anno_density(...)
```

Arguments

... pass to [anno_density](#)

Details

A wrapper of [anno_density](#) with pre-defined which to column.

Value

See help page of [anno_density](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

column_anno_histogram *Column annotation which is represented as histogram*

Description

Column annotation which is represented as histogram

Usage

```
column_anno_histogram(...)
```

Arguments

... pass to [anno_histogram](#)

Details

A wrapper of [anno_histogram](#) with pre-defined which to column.

Value

See help page of [anno_histogram](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

column_anno_link *Column annotation which is represented as links*

Description

Column annotation which is represented as links

Usage

```
column_anno_link(...)
```

Arguments

... pass to [anno_link](#)

Details

A wrapper of [anno_link](#) with pre-defined which to column.

Value

See help page of [anno_link](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

column_anno_points	<i>Column annotation which is represented as points</i>
--------------------	---

Description

Column annotation which is represented as points

Usage

```
column_anno_points(...)
```

Arguments

... pass to [anno_points](#)

Details

A wrapper of [anno_points](#) with pre-defined which to column.

Value

See help page of [anno_points](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

column_anno_text *Column annotation which is represented as text*

Description

Column annotation which is represented as text

Usage

```
column_anno_text(...)
```

Arguments

... pass to [anno_text](#)

Details

A wrapper of [anno_text](#) with pre-defined which to column.

Value

See help page of [anno_text](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

column_dend-dispatch *Method dispatch page for column_dend*

Description

Method dispatch page for column_dend.

Dispatch

column_dend can be dispatched on following classes:

- [column_dend,HeatmapList-method, HeatmapList-class](#) class method
- [column_dend,Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example  
NULL
```

column_dend-Heatmap-method

Get column dendrograms from a heatmap

Description

Get column dendrograms from a heatmap

Usage

```
## S4 method for signature 'Heatmap'  
column_dend(object)
```

Arguments

object a [Heatmap-class](#) object

Value

A dendrogram object

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)  
ht = Heatmap(mat)  
column_dend(ht)  
ht = Heatmap(mat, km = 2)  
column_dend(ht)
```

column_dend-HeatmapList-method

Get column dendrograms from a heatmap list

Description

Get column dendrograms from a heatmap list

Usage

```
## S4 method for signature 'HeatmapList'  
column_dend(object)
```

Arguments

object a [HeatmapList-class](#) object

Value

A list of dendrograms for which dendrogram corresponds to each matrix

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)  
ht_list = Heatmap(mat) + Heatmap(mat)  
column_dend(ht_list)  
ht_list = Heatmap(mat, km = 2) + Heatmap(mat)  
column_dend(ht_list)
```

column_order-dispatch *Method dispatch page for column_order*

Description

Method dispatch page for column_order.

Dispatch

column_order can be dispatched on following classes:

- [column_order,HeatmapList-method, HeatmapList-class](#) class method
- [column_order,Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example
NULL
```

column_order-Heatmap-method

Get column order from a heatmap list

Description

Get column order from a heatmap list

Usage

```
## S4 method for signature 'Heatmap'
column_order(object)
```

Arguments

object a [Heatmap-class](#) object

Value

A vector containing column orders

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)
ht = Heatmap(mat)
column_order(ht)
ht = Heatmap(mat, km = 2)
column_order(ht)
```

column_order-HeatmapList-method

Get column order from a heatmap list

Description

Get column order from a heatmap list

Usage

```
## S4 method for signature 'HeatmapList'  
column_order(object)
```

Arguments

object a [HeatmapList-class](#) object

Value

A list contains column orders which correspond every matrix

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)  
ht_list = Heatmap(mat) + Heatmap(mat)  
column_order(ht_list)  
ht = Heatmap(mat, km = 2) + Heatmap(mat)  
column_order(ht_list)
```

component_height-dispatch

Method dispatch page for component_height

Description

Method dispatch page for component_height.

Dispatch

component_height can be dispatched on following classes:

- [component_height,HeatmapList-method](#), [HeatmapList-class](#) class method
- [component_height,Heatmap-method](#), [Heatmap-class](#) class method

Examples

```
# no example  
NULL
```

component_height-Heatmap-method

Height of each heatmap component

Description

Height of each heatmap component

Usage

```
## S4 method for signature 'Heatmap'  
component_height(object, k = 1:9)
```

Arguments

object a [Heatmap-class](#) object.
k which component in the heatmap, see [Heatmap-class](#).

Details

This function is only for internal use.

Value

A [unit](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
```

component_height-HeatmapList-method
Height of each heatmap list component

Description

Height of each heatmap list component

Usage

```
## S4 method for signature 'HeatmapList'  
component_height(object, k = 1:7)
```

Arguments

object a [HeatmapList-class](#) object.
k which component in the heatmap list, see [HeatmapList-class](#).

Value

A [unit](#) object

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
```

component_width-dispatch
Method dispatch page for component_width

Description

Method dispatch page for component_width.

Dispatch

component_width can be dispatched on following classes:

- [component_width, HeatmapList-method, HeatmapList-class](#) class method
- [component_width, Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example
NULL
```

component_width-Heatmap-method
Width of each heatmap component

Description

Width of each heatmap component

Usage

```
## S4 method for signature 'Heatmap'
component_width(object, k = 1:7)
```

Arguments

object a [Heatmap-class](#) object.
k which component in the heatmap, see [Heatmap-class](#).

Details

This function is only for internal use.

Value

A [unit](#) object.

Details

This function is only for internal use.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
```

component_width-HeatmapList-method

Width of each heatmap list component

Description

Width of each heatmap list component

Usage

```
## S4 method for signature 'HeatmapList'  
component_width(object, k = 1:7)
```

Arguments

object a [HeatmapList-class](#) object.
k which component in the heatmap list, see [HeatmapList-class](#).

Details

This function is only for internal use.

Value

A [unit](#) object

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
```

decorate_annotation *Decorate the heatmap annotation*

Description

Decorate the heatmap annotation

Usage

```
decorate_annotation(annotation, code, slice)
```

Arguments

annotation	name of the annotation
code	code that adds graphics in the selected heatmap body
slice	index of row slices in the heatmap

Details

There is a viewport for every column annotation and row annotation. This function constructs the name of the viewport, goes to the viewport by [seekViewport](#) and applies code to that viewport.

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
set.seed(123)
ha1 = HeatmapAnnotation(df = data.frame(type = rep(letters[1:2], 5)))
ha2 = rowAnnotation(point = anno_points(runif(10), which = "row"))
Heatmap(matrix(rnorm(100), 10), name = "mat", km = 2,
  top_annotation = ha1) + ha2
decorate_annotation("type", {
  grid.circle(x = unit(c(0.2, 0.4, 0.6, 0.8), "npc"),
    gp = gpar(fill = "#FF00080"))
})
decorate_annotation("point", {
  grid.rect(gp = gpar(fill = "#FF00080"))
}, slice = 2)
```

decorate_column_dend *Decorate heatmap dendrogram on columns*

Description

Decorate heatmap dendrogram on columns

Usage

```
decorate_column_dend(...)
```

Arguments

... pass to [decorate_dend](#)

Details

This is a wrapper function which pre-defined which argument in [decorate_dend](#).

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# No example for this function
NULL
```

decorate_column_names *Decorate heatmap column names*

Description

Decorate heatmap column names

Usage

```
decorate_column_names(...)
```

Arguments

... pass to [decorate_dimnames](#)

Details

This is a helper function which pre-defined which argument in [decorate_dimnames](#).

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# No example for this function
NULL
```

decorate_column_title *Decorate heatmap column title*

Description

Decorate heatmap column title

Usage

```
decorate_column_title(...)
```

Arguments

... pass to [decorate_title](#)

Details

This is a helper function which pre-defined which argument in [decorate_title](#).

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# No example for this function  
NULL
```

decorate_dend *Decorate the heatmap dendrogram*

Description

Decorate the heatmap dendrogram

Usage

```
decorate_dend(heatmap, code, slice = 1, which = c("column", "row"))
```

Arguments

heatmap	name of the heatmap
code	code that adds graphics in the selected heatmap body
slice	index of row slices in the heatmap
which	on rows or on columns?

Details

There is a viewport for each dendrogram in the heatmap. This function constructs the name of the viewport, goes to the viewport by [seekViewport](#) and applies code to that viewport.

If you know the number of leaves in the dendrogram, it is simple to calculate the position of every leave in the dendrogram. E.g., for the column dendrogram, the i^{th} leave is located at:

```
# assume nc is the number of columns
unit((i-0.5)/nc, "npc")
```

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
set.seed(123)
Heatmap(matrix(rnorm(100), 10), name = "mat", km = 2)
decorate_dend("mat", {
  grid.rect(gp = gpar(fill = "#FF000080"))
}, which = "row", slice = 2)
```

decorate_dimnames *Decorate the heatmap dimension names*

Description

Decorate the heatmap dimension names

Usage

```
decorate_dimnames(heatmap, code, slice = 1, which = c("column", "row"))
```


Arguments

heatmap	name of the heatmap
code	code that adds graphics in the selected heatmap body
slice	index of row slices in the heatmap
which	on rows or on columns?

Details

There is a viewport for row names and column names in the heatmap. This function constructs the name of the viewport, goes to the viewport by [seekViewport](#) and applies code to that viewport.

If you know the dimensions of the matrix, it is simple to calculate the position of every row name or column name in the heatmap. E.g., for the column column, the i^{th} name is located at:

```
# assume nc is the number of columns
unit((i-0.5)/nc, "npc")
```

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
set.seed(123)
mat = matrix(rnorm(100), 10)
rownames(mat) = letters[1:10]
colnames(mat) = LETTERS[1:10]
Heatmap(mat, name = "mat", km = 2)

decorate_dimnames("mat", {
  grid.rect(gp = gpar(fill = "#FF000080"))
}, which = "row", slice = 2)
```

decorate_heatmap_body *Decorate the heatmap body*

Description

Decorate the heatmap body

Usage

```
decorate_heatmap_body(heatmap, code, slice = 1)
```

Arguments

heatmap	name of the heatmap which is set as name option in Heatmap function
code	code that adds graphics in the selected heatmap body
slice	index of row slices in the heatmap if it is split by rows

Details

There is a viewport for each row slice in each heatmap. This function constructs the name of the viewport, goes to the viewport by [seekViewport](#) and applies code to that viewport.

If you know the number of rows and columns for that row slice, it is simple to calculate the position of every small grid in the row slice. E.g., the position for the grid in i^{th} row and j^{th} column is:

```
# assume nc is the number of columns
# and nr is the number of rows in that row slice
unit((i-0.5)/nc, "npc")
unit((j-0.5)/nr, "npc")

# the width is
unit(1/nc, "npc")

# the height is
unit(1/nr, "npc")
```

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
set.seed(123)
Heatmap(matrix(rnorm(100), 10), name = "mat")
decorate_heatmap_body("mat", {
  grid.circle(gp = gpar(fill = "#FF00080"))
})
```

decorate_row_dend

Decorate heatmap dendrogram on rows

Description

Decorate heatmap dendrogram on rows

Usage

```
decorate_row_dend(...)
```

Arguments

```
... pass to decorate\_dend
```

Details

This is a helper function which pre-defined which argument in [decorate_dend](#).

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# No example for this function  
NULL
```

decorate_row_names	<i>Decorate heatmap row names</i>
--------------------	-----------------------------------

Description

Decorate heatmap row names

Usage

```
decorate_row_names(...)
```

Arguments

```
... pass to decorate\_dimnames
```

Details

This is a helper function which pre-defined which argument in [decorate_dimnames](#).

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# No example for this function
NULL
```

decorate_row_title *Decorate heatmap row title*

Description

Decorate heatmap row title

Usage

```
decorate_row_title(...)
```

Arguments

... pass to [decorate_title](#)

Details

This is a helper function which pre-defined which argument in [decorate_title](#).

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# No example for this function
NULL
```

decorate_title	<i>Decorate the heatmap title</i>
----------------	-----------------------------------

Description

Decorate the heatmap title

Usage

```
decorate_title(heatmap, code, slice = 1, which = c("column", "row"))
```

Arguments

heatmap	name of the heatmap
code	code that adds graphics in the selected heatmap body
slice	index of row slices in the heatmap
which	on rows or on columns?

Details

There is a viewport for row titles and column title in the heatmap. This function constructs the name of the viewport, goes to the viewport by [seekViewport](#) and applies code to that viewport.

Value

The function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
set.seed(123)
Heatmap(matrix(rnorm(100), 10), name = "mat", km = 2)
decorate_title("mat", {
  grid.rect(gp = gpar(fill = "#FF000080"))
}, which = "row", slice = 2)
```

densityHeatmap *Use colors to represent density distribution*

Description

Use colors to represent density distribution

Usage

```
densityHeatmap(data,
  col = rev(brewer.pal(11, "Spectral")),
  color_space = "LAB",
  anno = NULL,
  ylab = deparse(substitute(data)),
  title = paste0("Density heatmap of ", deparse(substitute(data))),
  range = c(-Inf, Inf),
  column_order = NULL,
  ...)
```

Arguments

data	a matrix or a list. If it is a matrix, density will be calculated by columns.
col	a list of colors that density values are mapped to.
color_space	the color space in which colors are interpolated. Pass to colorRamp2 .
anno	annotation for the matrix columns or the list. The value should be a vector or a data frame and colors for annotations are randomly assigned. If you want to customize the annotation colors, use a HeatmapAnnotation-class object directly.
ylab	label on y-axis in the plot
title	title of the plot
range	ranges on the y-axis. By default the range is between 1th quantile and 99th quantile of the data.
column_order	order of columns
...	pass to draw,HeatmapList-method

Details

To visualize data distribution in a matrix or in a list, sometimes we use boxplot or beanplot. Here we use colors to map the density values and visualize distribution of values in each column (or each vector in the list) through a heatmap. It is useful if you have huge number of columns in data to visualize.

Value

No value is returned.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
matrix = matrix(rnorm(100), 10); colnames(matrix) = letters[1:10]
densityHeatmap(matrix)
densityHeatmap(matrix, anno = rep(c("A", "B"), each = 5))
densityHeatmap(matrix, col = c("white", "red"), anno = rep(c("A", "B"), each = 5))

ha = HeatmapAnnotation(points = anno_points(runif(10)),
  anno = rep(c("A", "B"), each = 5), col = list(anno = c("A" = "red", "B" = "blue")))
densityHeatmap(matrix, anno = ha)

lt = list(rnorm(10), rnorm(10))
densityHeatmap(lt)
```

dist2

Calculate pairwise distance from a matrix

Description

Calculate pairwise distance from a matrix

Usage

```
dist2(mat, pairwise_fun = function(x, y) sqrt(sum((x - y)^2)), ...)
```

Arguments

mat a matrix. The distance is calculated by rows.
pairwise_fun a function which calculates distance between two vectors.
... pass to [as.dist](#).

Details

You can construct any type of distance measurements by defining a pair-wise distance function. The function is implemented by two nested for loops, so the efficiency may not be so good.

Value

A [dist](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(40), nr = 4, ncol = 10)
rownames(mat) = letters[1:4]
colnames(mat) = letters[1:10]

d2 = dist2(mat)
d2 = dist2(mat, pairwise_fun = function(x, y) 1 - cor(x, y))
# distance only calculated within 10 and 90 quantile of each vector
d2 = dist2(mat, pairwise_fun = function(x, y) {
  q1 = quantile(x, c(0.1, 0.9))
  q2 = quantile(y, c(0.1, 0.9))
  l = x > q1[1] & x < q1[2] & y > q2[1] & y < q2[2]
  sqrt(sum((x[l] - y[l])^2))
})
```

draw-dispatch

Method dispatch page for draw

Description

Method dispatch page for draw.

Dispatch

draw can be dispatched on following classes:

- [draw, HeatmapAnnotation-method, HeatmapAnnotation-class](#) class method
- [draw, SingleAnnotation-method, SingleAnnotation-class](#) class method
- [draw, HeatmapList-method, HeatmapList-class](#) class method
- [draw, Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example
NULL
```

draw-Heatmap-method *Draw a single heatmap*

Description

Draw a single heatmap

Usage

```
## S4 method for signature 'Heatmap'  
draw(object, internal = FALSE, test = FALSE, ...)
```

Arguments

object	a Heatmap-class object.
internal	only used inside the calling of draw,HeatmapList-method . Only heatmap without legends will be drawn.
test	only for testing
...	pass to draw,HeatmapList-method .

Details

The function creates a [HeatmapList-class](#) object which only contains a single heatmap and call [draw,HeatmapList-method](#) to make the final heatmap.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)  
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))  
rownames(mat) = letters[1:12]  
colnames(mat) = letters[1:10]  
  
ht = Heatmap(mat)  
draw(ht, heatmap_legend_side = "left")
```

draw-HeatmapAnnotation-method

Draw the heatmap annotations

Description

Draw the heatmap annotations

Usage

```
## S4 method for signature 'HeatmapAnnotation'  
draw(object, index, k = NULL, n = NULL, align_to = "bottom", ...)
```

Arguments

object	a HeatmapAnnotation-class object.
index	a vector of order.
k	if row annotation is splitted, the value identifies which row slice.
n	total number of row slices.
align_to	if the allocated space is more than than the column annotation itself, should the viewport be aligned to the top or bottom?
...	pass to viewport which contains all annotations.

Details

A viewport is created. Mostly, this method is used inside [draw,HeatmapList-method](#).

Value

No value is returned.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
df = data.frame(type = c("a", "a", "a", "b", "b", "b"))  
ha = HeatmapAnnotation(df = df)  
grid.newpage(); draw(ha, 1:6)  
grid.newpage(); draw(ha, 6:1)  
  
ha = HeatmapAnnotation(df = df, col = list(type = c("a" = "red", "b" = "blue")))  
grid.newpage(); draw(ha, 1:6)  
  
ha = HeatmapAnnotation(df = df, col = list(type = c("a" = "red", "b" = "blue")),  
  which = "row")
```

```

grid.newpage(); draw(ha, 1:6)

ha = HeatmapAnnotation(points = anno_points(1:6))
grid.newpage(); draw(ha, 1:6)

ha = HeatmapAnnotation(histogram = anno_barplot(1:6))
grid.newpage(); draw(ha, 1:6)

mat = matrix(rnorm(36), 6)
ha = HeatmapAnnotation(boxplot = anno_boxplot(mat))
grid.newpage(); draw(ha, 1:6)

```

draw-HeatmapList-method

Draw a list of heatmaps

Description

Draw a list of heatmaps

Usage

```

## S4 method for signature 'HeatmapList'
draw(object,
      padding = unit(c(2, 2, 2, 2), "mm"),
      newpage = TRUE,
      row_title = character(0),
      row_title_side = c("left", "right"),
      row_title_gp = gpar(fontsize = 14),
      column_title = character(0),
      column_title_side = c("top", "bottom"),
      column_title_gp = gpar(fontsize = 14),
      heatmap_legend_side = c("right", "left", "bottom", "top"),
      show_heatmap_legend = TRUE,
      heatmap_legend_list = list(),
      annotation_legend_side = c("right", "left", "bottom", "top"),
      show_annotation_legend = TRUE,
      annotation_legend_list = list(),
      gap = unit(3, "mm"),
      main_heatmap = which(sapply(object@ht_list, inherits, "Heatmap"))[1],
      row_dend_side = c("original", "left", "right"),
      row_sub_title_side = c("original", "left", "right"), ...)

```

Arguments

object	a HeatmapList-class object
padding	padding of the plot. Elements correspond to bottom, left, top, right paddings.

<code>newpage</code>	whether create a new page for the graphics.
<code>row_title</code>	title on the row.
<code>row_title_side</code>	will the title be put on the left or right of the heatmap.
<code>row_title_gp</code>	graphic parameters for drawing text.
<code>column_title</code>	title on the column.
<code>column_title_side</code>	will the title be put on the top or bottom of the heatmap.
<code>column_title_gp</code>	graphic parameters for drawing text.
<code>heatmap_legend_side</code>	side of the heatmap legend.
<code>show_heatmap_legend</code>	whether show heatmap legend.
<code>heatmap_legend_list</code>	a list of self-defined legend, should be wrapped into <code>grob</code> objects.
<code>annotation_legend_side</code>	side of annotation legend.
<code>show_annotation_legend</code>	whether show annotation legend.
<code>annotation_legend_list</code>	a list of self-defined legend, should be wrapped into <code>grob</code> objects.
<code>gap</code>	gap between heatmaps, should be a <code>unit</code> object.
<code>main_heatmap</code>	name or index for the main heatmap
<code>row_dend_side</code>	if auto adjust, where to put the row dendrograms for the main heatmap
<code>row_sub_title_side</code>	if auto adjust, where to put sub row titles for the main heatmap
<code>...</code>	pass to <code>make_layout,HeatmapList-method</code>

Details

The function first calls `make_layout,HeatmapList-method` to calculate the layout of the heatmap list and the layout of every single heatmap, then makes the plot by re-calling the graphic functions which are already recorded in the layout.

Value

This function returns a list of row dendrograms and column dendrogram.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))
rownames(mat) = letters[1:12]
colnames(mat) = letters[1:10]

ht = Heatmap(mat)
ht_list = ht + ht
draw(ht_list)
draw(ht_list, row_title = "row title", column_title = "column title",
heatmap_legend_side = "top")
```

draw-SingleAnnotation-method

Draw the single annotation

Description

Draw the single annotation

Usage

```
## S4 method for signature 'SingleAnnotation'
draw(object, index, k = NULL, n = NULL)
```

Arguments

object	a SingleAnnotation-class object.
index	a vector of orders
k	if row annotation is splitted, the value identifies which row slice. It is only used for the naems of the viewport which contains the annotation graphics.
n	total number of row slices

Details

A viewport is created.

The graphics would be different depending the annotation is a row annotation or a column annotation.

Value

No value is returned.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```

anno = SingleAnnotation(name = "test", value = c("a", "a", "a", "b", "b", "b"))
grid.newpage(); draw(anno, 1:5)
grid.newpage(); draw(anno, c(1, 4, 3, 5, 2))

anno = SingleAnnotation(value = c("a", "a", "a", "b", "b", "b"),
  col = c("a" = "red", "b" = "blue"))
grid.newpage(); draw(anno, 1:5)
grid.newpage(); draw(anno, c(1, 4, 3, 5, 2))

anno = SingleAnnotation(value = c("a", "a", "a", "b", "b", "b"),
  col = c("a" = "red", "b" = "blue"), which = "row")
grid.newpage(); draw(anno, 1:5)

anno = SingleAnnotation(value = 1:10)
grid.newpage(); draw(anno, 1:10)

require(circlize)
anno = SingleAnnotation(value = 1:10, col = colorRamp2(c(1, 10), c("blue", "red")))
grid.newpage(); draw(anno, 1:10)

anno = SingleAnnotation(fun = anno_points(1:10))
grid.newpage(); draw(anno, 1:10)

```

draw_annotation-Heatmap-method

Draw column annotations

Description

Draw column annotations

Usage

```

## S4 method for signature 'Heatmap'
draw_annotation(object, which = c("top", "bottom"))

```

Arguments

object a [Heatmap-class](#) object.
which are the annotations put on the top or bottom of the heatmap?

Details

A viewport is created which contains column annotations.

Since the column annotations is a [HeatmapAnnotation-class](#) object, the function calls [draw, HeatmapAnnotation-method](#) to draw the annotations.

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

draw_annotation_legend-HeatmapList-method

Draw legends for all column annotations

Description

Draw legends for all column annotations

Usage

```
## S4 method for signature 'HeatmapList'
draw_annotation_legend(object, legend_list = list(), ...)
```

Arguments

object	a HeatmapList-class object
legend_list	a list of self-defined legend, should be wrapped into grob objects.
...	graphic parameters passed to color_mapping_legend,ColorMapping-method .

Details

A viewport is created which contains annotation legends.

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

draw_dend-Heatmap-method

Draw dendrogram on row or column

Description

Draw dendrogram on row or column

Usage

```
## S4 method for signature 'Heatmap'
draw_dend(object,
  which = c("row", "column"), k = 1, max_height = NULL, ...)
```

Arguments

object	a Heatmap-class object.
which	is dendrogram put on the row or on the column of the heatmap?
k	a matrix may be splitted by rows, the value identifies which row-slice.
max_height	maximum height of the dendrograms.
...	pass to viewport , basically for defining the position of the viewport.

Details

If the matrix is split into several row slices, a list of dendrograms will be drawn by the heatmap that each dendrogram corresponds to its row slices.

A viewport is created which contains dendrograms.

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

See Also

[grid.dendrogram](#)

Examples

```
# There is no example
NULL
```

draw_dimnames-Heatmap-method

Draw row names or column names

Description

Draw row names or column names

Usage

```
## S4 method for signature 'Heatmap'
draw_dimnames(object,
  which = c("row", "column"), k = 1, dimname_padding = unit(0, "mm"), ...)
```

Arguments

object	a Heatmap-class object.
which	are names put on the row or on the column of the heatmap?
k	a matrix may be split by rows, the value identifies which row-slice.
dimname_padding	padding for the row/column names
...	pass to viewport , basically for defining the position of the viewport.

Details

A viewport is created which contains row names or column names.
This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

draw_heatmap_body-Heatmap-method

Draw the heatmap body

Description

Draw the heatmap body

Usage

```
## S4 method for signature 'Heatmap'  
draw_heatmap_body(object, k = 1, ...)
```

Arguments

object	a Heatmap-class object.
k	a matrix may be split by rows, the value identifies which row-slice.
...	pass to viewport , basically for defining the position of the viewport.

Details

The matrix can be split into several parts by rows if `km` or `split` is specified when initializing the [Heatmap](#) object. If the matrix is split, there will be gaps between rows to identify different row-slice.

A viewport is created which contains subset rows of the heatmap.

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

draw_heatmap_legend-HeatmapList-method
Draw legends for all heatmaps

Description

Draw legends for all heatmaps

Usage

```
## S4 method for signature 'HeatmapList'  
draw_heatmap_legend(object, legend_list = list(), ...)
```

Arguments

`object` a [HeatmapList-class](#) object
`legend_list` a list of self-defined legend, should be wrapped into [grob](#) objects.
`...` graphic parameters passed to [color_mapping_legend, ColorMapping-method](#).

Details

A viewport is created which contains heatmap legends.

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

draw_heatmap_list-HeatmapList-method
Draw the list of heatmaps

Description

Draw the list of heatmaps

Usage

```
## S4 method for signature 'HeatmapList'  
draw_heatmap_list(object)
```

Arguments

object a [HeatmapList-class](#) object

Details

A viewport is created which contains heatmaps.

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

draw_title-dispatch *Method dispatch page for draw_title*

Description

Method dispatch page for draw_title.

Dispatch

draw_title can be dispatched on following classes:

- [draw_title, HeatmapList-method, HeatmapList-class](#) class method
- [draw_title, Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example
NULL
```

draw_title-Heatmap-method
Draw heatmap title

Description

Draw heatmap title

Usage

```
## S4 method for signature 'Heatmap'
draw_title(object,
  which = c("row", "column"), k = 1, ...)
```

Arguments

object	a Heatmap-class object.
which	is title put on the row or on the column of the heatmap?
k	a matrix may be split by rows, the value identifies which row-slice.
...	pass to viewport , basically for defining the position of the viewport.

Details

A viewport is created which contains heatmap title.
This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

draw_title-HeatmapList-method
Draw heatmap list title

Description

Draw heatmap list title

Usage

```
## S4 method for signature 'HeatmapList'
draw_title(object,
  which = c("column", "row"))
```

Arguments

object	a HeatmapList-class object
which	dendrogram on the row or on the column of the heatmap

Details

A viewport is created which contains heatmap list title.

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

enhanced_basicplot *Enhanced version of basic barplot and boxplot*

Description

Enhanced version of basic barplot and boxplot

Usage

```
enhanced_basicplot(data, ..., ylim = NULL,
  ylab = deparse(substitute(data)), title = NULL, title_gp = gpar(fontsize = 14),
  type = c("boxplot", "barplot"), width = 0.8, gp = gpar(),
  pch = 1, size = unit(2, "mm"), axis_gp = gpar(fontsize = 8),
  padding = unit(c(2, 18, 2, 2), "mm"),
  heatmap_legend_list = list())
```

Arguments

data	a matrix, a list or a simple numeric vector. If your data is a data frame please convert it to a matrix in the first place.
...	pass to Heatmap
ylim	ranges on y axis
ylab	label on y axis
title	title of the plot
title_gp	graphic parameters for the title
type	type of the plot
width	relative width of the bar or box
gp	graphic parameters for hte bar or box
pch	shape of outlier points in the boxplot
size	size of hte outlier points in the boxplot
axis_gp	graphic parameters for the axis
padding	padding of the plot
heatmap_legend_list	a list of grob which contains legend. It can be generated by color_mapping_legend , ColorMapping-met

Details

This function adds annotations to the barplot or boxplot.

This function is still quite experimental.

Value

No value is returned

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(runif(100), 10)
enhanced_basicplot(mat)
ha = HeatmapAnnotation(char = sample(letters[1:2], 10, replace = TRUE),
                       num = runif(10))
enhanced_basicplot(mat, top_annotation = ha)
enhanced_basicplot(mat, type = "barplot", top_annotation = ha)
```

get_color_mapping_list-HeatmapAnnotation-method
Get a list of color mapping objects

Description

Get a list of color mapping objects

Usage

```
## S4 method for signature 'HeatmapAnnotation'
get_color_mapping_list(object)
```

Arguments

object a [HeatmapAnnotation-class](#) object.

Details

Color mapping for visible simple annotations are only returned.

This function is only for internal use.

Value

A list of [ColorMapping-class](#) objects or an empty list.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

get_color_mapping_param_list-HeatmapAnnotation-method
Get a list of color mapping parameters

Description

Get a list of color mapping parameters

Usage

```
## S4 method for signature 'HeatmapAnnotation'  
get_color_mapping_param_list(object)
```

Arguments

object a [HeatmapAnnotation-class](#) object.

Details

Color mapping parameters for visible simple annotations are only returned.
This function is only for internal use.

Value

A list.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

grid.dendrogram	<i>Draw dendrogram under grid system</i>
-----------------	--

Description

Draw dendrogram under grid system

Usage

```
grid.dendrogram(dend, facing = c("bottom", "top", "left", "right"),
  max_height = NULL, order = c("normal", "reverse"), ...)
```

Arguments

dend	a dendrogram object.
facing	facing of the dendrogram.
max_height	maximum height of the dendrogram. It is useful to make dendrograms comparable if you want to plot more than one dendrograms. Height for each dendrogram can be obtained by <code>attr(dend, "height")</code> .
order	should leaves of dendrogram be put in the normal order (1, ..., n) or reverse order (n, ..., 1)? It may matters for the dendrograms putting on left and right.
...	pass to viewport which contains the dendrogram.

Details

The dendrogram can be rendered (e.g. by `dendextend` package).

A viewport is created which contains the dendrogram.

This function only plots the dendrogram without adding labels. The leaves of the dendrogram locates at `unit(c(0.5, 1.5, ..., (n-0.5))/n, "npc")`.

Value

No value is returned.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
hc = hclust(dist(USArrests[1:5, ]))
dend = as.dendrogram(hc)

grid.newpage()
layout = grid.layout(nrow = 2, ncol = 2)
pushViewport(viewport(layout = layout))
```

```

grid.dendrogram(dend, layout.pos.row = 1, layout.pos.col = 1)
grid.dendrogram(dend, facing = "top", layout.pos.row = 1, layout.pos.col = 2)
grid.dendrogram(dend, facing = "top", order = "reverse", layout.pos.row = 2,
  layout.pos.col = 1)
grid.dendrogram(dend, facing = "left", layout.pos.row = 2, layout.pos.col = 2)
upViewport()

```

Heatmap

*Constructor method for Heatmap class***Description**

Constructor method for Heatmap class

Usage

```

Heatmap(matrix, col, name,
  na_col = "grey",
  color_space = "LAB",
  rect_gp = gpar(col = NA),
  cell_fun = function(j, i, x, y, width, height, fill) NULL,
  row_title = character(0),
  row_title_side = c("left", "right"),
  row_title_gp = gpar(fontsize = 14),
  row_title_rot = switch(row_title_side[1], "left" = 90, "right" = 270),
  column_title = character(0),
  column_title_side = c("top", "bottom"),
  column_title_gp = gpar(fontsize = 14),
  column_title_rot = 0,
  cluster_rows = TRUE,
  clustering_distance_rows = "euclidean",
  clustering_method_rows = "complete",
  row_dend_side = c("left", "right"),
  row_dend_width = unit(10, "mm"),
  show_row_dend = TRUE,
  row_dend_reorder = TRUE,
  row_dend_gp = gpar(),
  row_hclust_side = row_dend_side,
  row_hclust_width = row_dend_width,
  show_row_hclust = show_row_dend,
  row_hclust_reorder = row_dend_reorder,
  row_hclust_gp = row_dend_gp,
  cluster_columns = TRUE,
  clustering_distance_columns = "euclidean",
  clustering_method_columns = "complete",
  column_dend_side = c("top", "bottom"),

```

```

column_dend_height = unit(10, "mm"),
show_column_dend = TRUE,
column_dend_gp = gpar(),
column_dend_reorder = TRUE,
column_hclust_side = column_dend_side,
column_hclust_height = column_dend_height,
show_column_hclust = show_column_dend,
column_hclust_gp = column_dend_gp,
column_hclust_reorder = column_dend_reorder,
row_order = NULL,
column_order = NULL,
row_names_side = c("right", "left"),
show_row_names = TRUE,
row_names_max_width = unit(4, "cm"),
row_names_gp = gpar(fontsize = 12),
column_names_side = c("bottom", "top"),
show_column_names = TRUE,
column_names_max_height = unit(4, "cm"),
column_names_gp = gpar(fontsize = 12),
top_annotation = new("HeatmapAnnotation"),
top_annotation_height = top_annotation@size,
bottom_annotation = new("HeatmapAnnotation"),
bottom_annotation_height = bottom_annotation@size,
km = 1,
split = NULL,
gap = unit(1, "mm"),
combined_name_fun = function(x) paste(x, collapse = "/"),
width = NULL,
show_heatmap_legend = TRUE,
heatmap_legend_param = list(title = name, color_bar = "discrete"),
use_raster = FALSE,
raster_device = c("png", "jpeg", "tiff", "CairoPNG", "CairoJPEG", "CairoTIFF"),
raster_quality = 1,
raster_device_param = list()

```

Arguments

<code>matrix</code>	a matrix. Either numeric or character. If it is a simple vector, it will be converted to a one-column matrix.
<code>col</code>	a vector of colors if the color mapping is discrete or a color mapping function if the matrix is continuous numbers (should be generated by colorRamp2 . If the matrix is continuous, the value can also be a vector of colors so that colors will be interpolated. Pass to ColorMapping .
<code>name</code>	name of the heatmap. The name is used as the title of the heatmap legend.
<code>na_col</code>	color for NA values.
<code>rect_gp</code>	graphic parameters for drawing rectangles (for heatmap body).
<code>color_space</code>	the color space in which colors are interpolated. Only used if <code>matrix</code> is numeric and <code>col</code> is a vector of colors. Pass to colorRamp2 .

<code>cell_fun</code>	self-defined function to add graphics on each cell. Seven parameters will be passed into this function: <code>i</code> , <code>j</code> , <code>x</code> , <code>y</code> , <code>width</code> , <code>height</code> , <code>fill</code> which are row index, column index in <code>matrix</code> , coordinate of the middle points in the heatmap body viewport, the width and height of the cell and the filled color. <code>x</code> , <code>y</code> , <code>width</code> and <code>height</code> are all <code>unit</code> objects.
<code>row_title</code>	title on row.
<code>row_title_side</code>	will the title be put on the left or right of the heatmap?
<code>row_title_gp</code>	graphic parameters for drawing text.
<code>row_title_rot</code>	rotation of row titles. Only 0, 90, 270 are allowed to set.
<code>column_title</code>	title on column.
<code>column_title_side</code>	will the title be put on the top or bottom of the heatmap?
<code>column_title_gp</code>	graphic parameters for drawing text.
<code>column_title_rot</code>	rotation of column titles. Only 0, 90, 270 are allowed to set.
<code>cluster_rows</code>	If the value is a logical, it means whether make cluster on rows. The value can also be a <code>hclust</code> or a <code>dendrogram</code> that already contains clustering information. This means you can use any type of clustering methods and render the <code>dendrogram</code> object with self-defined graphic settings.
<code>clustering_distance_rows</code>	it can be a pre-defined character which is in ("euclidean", "maximum", "manhattan", "canberra", "binary", "minkowski", "pearson", "spearman", "kendall"). It can also be a function. If the function has one argument, the input argument should be a <code>matrix</code> and the returned value should be a <code>dist</code> object. If the function has two arguments, the input arguments are two vectors and the function calculates distance between these two vectors.
<code>clustering_method_rows</code>	method to make cluster, pass to <code>hclust</code> .
<code>row_dend_side</code>	should the row cluster be put on the left or right of the heatmap?
<code>row_dend_width</code>	width of the row cluster, should be a <code>unit</code> object.
<code>show_row_dend</code>	whether show row clusters.
<code>row_dend_gp</code>	graphics parameters for drawing lines. If users already provide a <code>dendrogram</code> object with edges rendered, this argument will be ignored.
<code>row_dend_reorder</code>	apply reordering on rows. The value can be a logical value or a vector which contains weight which is used to reorder rows
<code>row_hclust_side</code>	deprecated, use <code>row_dend_side</code> instead
<code>row_hclust_width</code>	deprecated, use <code>row_dend_width</code> instead
<code>show_row_hclust</code>	deprecated, use <code>show_row_dend</code> instead
<code>row_hclust_gp</code>	deprecated, use <code>row_dend_gp</code> instead

<code>row_hclust_reorder</code>	deprecated, use <code>row_dend_reorder</code> instead
<code>cluster_columns</code>	whether make cluster on columns. Same settings as <code>cluster_rows</code> .
<code>clustering_distance_columns</code>	same setting as <code>clustering_distance_rows</code> .
<code>clustering_method_columns</code>	method to make cluster, pass to <code>hclust</code> .
<code>column_dend_side</code>	should the column cluster be put on the top or bottom of the heatmap?
<code>column_dend_height</code>	height of the column cluster, should be a <code>unit</code> object.
<code>show_column_dend</code>	whether show column clusters.
<code>column_dend_gp</code>	graphic parameters for drawing lines. Same settings as <code>row_dend_gp</code> .
<code>column_dend_reorder</code>	apply reordering on columns. The value can be a logical value or a vector which contains weight which is used to reorder columns
<code>column_hclust_side</code>	deprecated, use <code>column_dend_side</code> instead
<code>column_hclust_height</code>	deprecated, use <code>column_dend_height</code> instead
<code>show_column_hclust</code>	deprecated, use <code>show_column_dend</code> instead
<code>column_hclust_gp</code>	deprecated, use <code>column_dend_gp</code> instead
<code>column_hclust_reorder</code>	deprecated, use <code>column_dend_reorder</code> instead
<code>row_order</code>	order of rows. It makes it easy to adjust row order for a list of heatmaps if this heatmap is selected as the main heatmap. Manually setting row order should turn off clustering
<code>column_order</code>	order of column. It makes it easy to adjust column order for both matrix and column annotations.
<code>row_names_side</code>	should the row names be put on the left or right of the heatmap?
<code>show_row_names</code>	whether show row names.
<code>row_names_max_width</code>	maximum width of row names viewport. Because some times row names can be very long, it is not reasonable to show them all.
<code>row_names_gp</code>	graphic parameters for drawing text.
<code>column_names_side</code>	should the column names be put on the top or bottom of the heatmap?
<code>column_names_max_height</code>	maximum height of column names viewport.

<code>show_column_names</code>	whether show column names.
<code>column_names_gp</code>	graphic parameters for drawing text.
<code>top_annotation</code>	a HeatmapAnnotation object which contains a list of annotations.
<code>top_annotation_height</code>	total height of the column annotations on the top.
<code>bottom_annotation</code>	a HeatmapAnnotation object.
<code>bottom_annotation_height</code>	total height of the column annotations on the bottom.
<code>km</code>	do k-means clustering on rows. If the value is larger than 1, the heatmap will be split by rows according to the k-means clustering. For each row-clusters, hierarchical clustering is still applied with parameters above.
<code>split</code>	a vector or a data frame by which the rows are split. But if <code>cluster_rows</code> is a clustering object, <code>split</code> can be a single number indicating rows are to be split according to the split on the tree.
<code>gap</code>	gap between row-slices if the heatmap is split by rows, should be unit object.
<code>combined_name_fun</code>	if the heatmap is split by rows, how to make a combined row title for each slice? The input parameter for this function is a vector which contains level names under each column in <code>split</code> .
<code>width</code>	the width of the single heatmap, should be a fixed unit object. It is used for the layout when the heatmap is appended to a list of heatmaps.
<code>show_heatmap_legend</code>	whether show heatmap legend?
<code>heatmap_legend_param</code>	a list contains parameters for the heatmap legend. See color_mapping_legend , ColorMapping-method for all available parameters.
<code>use_raster</code>	whether render the heatmap body as a raster image. It helps to reduce file size when the matrix is huge.
<code>raster_device</code>	graphic device which is used to generate the raster image
<code>raster_quality</code>	a value set to larger than 1 will improve the quality of the raster image.
<code>raster_device_param</code>	a list of further parameters for the selected graphic device

Details

The initialization function only applies parameter checking and fill values to each slot with proper ones. Then it will be ready for clustering and layout.

Following methods can be applied on the [Heatmap-class](#) object:

- [show](#), [Heatmap-method](#): draw a single heatmap with default parameters
- [draw](#), [Heatmap-method](#): draw a single heatmap.

- [add_heatmap, Heatmap-method](#) append heatmaps and row annotations to a list of heatmaps.

The constructor function pretends to be a high-level graphic function because the show method of the [Heatmap-class](#) object actually plots the graphics.

Value

A [Heatmap-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))
rownames(mat) = letters[1:12]
colnames(mat) = letters[1:10]

require(circlize)

Heatmap(mat)
Heatmap(mat, col = colorRamp2(c(-3, 0, 3), c("green", "white", "red")))
Heatmap(mat, name = "test")
Heatmap(mat, column_title = "blablabla")
Heatmap(mat, row_title = "blablabla")
Heatmap(mat, column_title = "blablabla", column_title_side = "bottom")
Heatmap(mat, column_title = "blablabla", column_title_gp = gpar(fontsize = 20,
  fontface = "bold"))
Heatmap(mat, cluster_rows = FALSE)
Heatmap(mat, clustering_distance_rows = "pearson")
Heatmap(mat, clustering_distance_rows = function(x) dist(x))
Heatmap(mat, clustering_distance_rows = function(x, y) 1 - cor(x, y))
Heatmap(mat, clustering_method_rows = "single")
Heatmap(mat, row_dend_side = "right")
Heatmap(mat, row_dend_width = unit(1, "cm"))
Heatmap(mat, row_names_side = "left", row_dend_side = "right",
  column_names_side = "top", column_dend_side = "bottom")
Heatmap(mat, show_row_names = FALSE)

mat2 = mat
rownames(mat2) = NULL
colnames(mat2) = NULL
Heatmap(mat2)

Heatmap(mat, row_names_gp = gpar(fontsize = 20))
Heatmap(mat, km = 2)
Heatmap(mat, split = rep(c("A", "B"), 6))
Heatmap(mat, split = data.frame(rep(c("A", "B"), 6), rep(c("C", "D"), each = 6)))
Heatmap(mat, split = data.frame(rep(c("A", "B"), 6), rep(c("C", "D"), each = 6)),
  combined_name_fun = function(x) paste(x, collapse = "\n"))
```



```

annotation = HeatmapAnnotation(df = data.frame(type = c(rep("A", 6), rep("B", 6))))
Heatmap(mat, top_annotation = annotation)

annotation = HeatmapAnnotation(df = data.frame(type1 = rep(c("A", "B"), 6),
  type2 = rep(c("C", "D"), each = 6)))
Heatmap(mat, bottom_annotation = annotation)

annotation = data.frame(value = rnorm(10))
annotation = HeatmapAnnotation(df = annotation)
Heatmap(mat, top_annotation = annotation)

annotation = data.frame(value = rnorm(10))
value = 1:10
ha = HeatmapAnnotation(df = annotation, points = anno_points(value),
  annotation_height = c(1, 2))
Heatmap(mat, top_annotation = ha, top_annotation_height = unit(2, "cm"),
  bottom_annotation = ha)

# character matrix
mat3 = matrix(sample(letters[1:6], 100, replace = TRUE), 10, 10)
rownames(mat3) = {x = letters[1:10]; x[1] = "aaaaaaaaaaaaaaaaaaaaaa";x}
Heatmap(mat3, rect_gp = gpar(col = "white"))

mat = matrix(1:9, 3, 3)
rownames(mat) = letters[1:3]
colnames(mat) = letters[1:3]

Heatmap(mat, rect_gp = gpar(col = "white"),
  cell_fun = function(i, j, x, y, width, height, fill) {
    grid.text(mat[i, j], x = x, y = y)
  },
  cluster_rows = FALSE, cluster_columns = FALSE, row_names_side = "left",
  column_names_side = "top")

```

Heatmap-class

Class for a single heatmap

Description

Class for a single heatmap

Details

The components for a single heatmap are placed into a 9 x 7 layout:

```

+-----+ (1)
+-----+ (2)
+-----+ (3)
+-----+ (4)

```

```

+--+--+-----+--+--+
|1|2|3| 4(5) |5|6|7|
+--+--+-----+--+--+
      +-----+ (6)
      +-----+ (7)
      +-----+ (8)
      +-----+ (9)

```

From top to bottom in column 4, the regions are:

- title which is put on the top of the heatmap, graphics are drawn by `draw_title,Heatmap-method`.
- column cluster on the top, graphics are drawn by `draw_dend,Heatmap-method`.
- column annotation on the top, graphics are drawn by `draw_annotation,Heatmap-method`.
- column names on the top, graphics are drawn by `draw_dimnames,Heatmap-method`.
- heatmap body, graphics are drawn by `draw_heatmap_body,Heatmap-method`.
- column names on the bottom, graphics are drawn by `draw_dimnames,Heatmap-method`.
- column annotation on the bottom, graphics are drawn by `draw_annotation,Heatmap-method`.
- column cluster on the bottom, graphics are drawn by `draw_dend,Heatmap-method`.
- title on the bottom, graphics are drawn by `draw_title,Heatmap-method`.

From left to right in row 5, the regions are:

- title which is put in the left of the heatmap, graphics are drawn by `draw_title,Heatmap-method`.
- row cluster on the left, graphics are drawn by `draw_dend,Heatmap-method`.
- row names on the left, graphics are drawn by `draw_dimnames,Heatmap-method`.
- heatmap body
- row names on the right, graphics are drawn by `draw_dimnames,Heatmap-method`.
- row cluster on the right, graphics are drawn by `draw_dend,Heatmap-method`.
- title on the right, graphics are drawn by `draw_title,Heatmap-method`.

The `Heatmap-class` is not responsible for heatmap legend and annotation legends. The `draw,Heatmap-method` method will construct a `HeatmapList-class` object which only contains one single heatmap and call `draw,HeatmapList-method` to make a complete heatmap.

Methods

The `Heatmap-class` provides following methods:

- `Heatmap`: constructor method.
- `draw,Heatmap-method`: draw a single heatmap.
- `add_heatmap,Heatmap-method` append heatmaps and row annotations to a list of heatmaps.
- `row_order,HeatmapList-method`: get order of rows
- `column_order,HeatmapList-method`: get order of columns
- `row_dend,HeatmapList-method`: get row dendrograms
- `column_dend,HeatmapList-method`: get column dendrograms

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# for examples, please go to `Heatmap` method page
NULL
```

HeatmapAnnotation *Constructor method for HeatmapAnnotation class*

Description

Constructor method for HeatmapAnnotation class

Usage

```
HeatmapAnnotation(df, name, col, na_col = "grey",
  annotation_legend_param = list(),
  show_legend = TRUE,
  ...,
  which = c("column", "row"),
  annotation_height = 1,
  annotation_width = 1,
  height = calc_anno_size(),
  width = calc_anno_size(),
  gp = gpar(col = NA),
  gap = unit(0, "mm"))
```

Arguments

df	a data frame. Each column will be treated as a simple annotation. The data frame must have column names.
name	name of the heatmap annotation, optional.
col	a list of colors which contains color mapping to columns in df. See SingleAnnotation for how to set colors.
na_col	color for NA values in simple annotations.
annotation_legend_param	a list which contains parameters for annotation legends
show_legend	whether show legend for each column in df.
...	functions which define complex annotations or vectors of simple annotation. Values should be named arguments.
which	are the annotations row annotations or column annotations?

annotation_height	height of each annotation if annotations are column annotations.
annotation_width	width of each annotation if annotations are row annotations.
height	not using currently.
width	width of the whole heatmap annotations, only used for row annotation when appending to the list of heatmaps.
gp	graphic parameters for simple annotations.
gap	gap between each annotation

Details

The simple annotations are defined by `df` and `col` arguments. Complex annotations are defined by the function list. So you need to at least to define `df` or a annotation function.

Value

A [HeatmapAnnotation-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

See Also

There are two shortcut functions: [rowAnnotation](#) and [columnAnnotation](#).

Examples

```
df = data.frame(type = c("a", "a", "a", "b", "b", "b"))
ha = HeatmapAnnotation(df = df)

ha = HeatmapAnnotation(df = df, col = list(type = c("a" = "red", "b" = "blue")))
ha = HeatmapAnnotation(type = c("a", "a", "a", "b", "b", "b"),
  col = list(type = c("a" = "red", "b" = "blue")))

ha = HeatmapAnnotation(df = df, col = list(type = c("a" = "red", "b" = "blue")),
  which = "row")

ha = HeatmapAnnotation(points = anno_points(1:6))

ha = HeatmapAnnotation(histogram = anno_points(1:6))

mat = matrix(rnorm(36), 6)
ha = HeatmapAnnotation(boxplot = anno_boxplot(mat))
```

HeatmapAnnotation-class

Class for heatmap annotations

Description

Class for heatmap annotations

Details

A complex heatmap contains a list of annotations which are represented as different graphics placed on rows and columns. The [HeatmapAnnotation-class](#) contains a list of single annotations which are represented as a list of [SingleAnnotation-class](#) objects with same number of rows or columns.

Methods

The [HeatmapAnnotation-class](#) provides following methods:

- [HeatmapAnnotation](#): constructor method
- [draw,HeatmapAnnotation-method](#): draw the annotations

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# for examples, please go to `HeatmapAnnotation` method page  
NULL
```

HeatmapList

Constructor method for HeatmapList class

Description

Constructor method for HeatmapList class

Usage

```
HeatmapList(...)
```

Arguments

... arguments

Details

There is no public constructor method for the [HeatmapList-class](#).

Value

No value is returned.

Details

There is no public constructor method for the [HeatmapList-class](#).

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example
NULL
```

HeatmapList-class *Class for a list of heatmaps*

Description

Class for a list of heatmaps

Details

A heatmap list is defined as a list of heatmaps and row annotations.

The components for the heatmap list are placed into a 7 x 7 layout:

```

+-----+(1)
+-----+(2)
+-----+(3)
+--+--+-----+--+--+
|1|2|3| 4(4) |5|6|7|
+--+--+-----+--+--+
+-----+(5)
+-----+(6)
+-----+(7)

```

From top to bottom in column 4, the regions are:

- annotation legend on the top, graphics are drawn by [draw_annotation_legend, HeatmapList-method](#).
- heatmap legend on the top, graphics are drawn by [draw_heatmap_legend, HeatmapList-method](#).

- title for the heatmap list which is put on the top, graphics are drawn by `draw_title,HeatmapList-method`.
- the list of heatmaps and row annotations
- title for the heatmap list which is put on the bottom, graphics are drawn by `draw_title,HeatmapList-method`.
- heatmap legend on the bottom, graphics are drawn by `draw_heatmap_legend,HeatmapList-method`.
- annotation legend on the bottom, graphics are drawn by `draw_annotation_legend,HeatmapList-method`.

From left to right in row 4, the regions are:

- annotation legend on the left, graphics are drawn by `draw_annotation_legend,HeatmapList-method`.
- heatmap legend on the left, graphics are drawn by `draw_heatmap_legend,HeatmapList-method`.
- title for the heatmap list which is put on the left, graphics are drawn by `draw_title,HeatmapList-method`.
- the list of heatmaps and row annotations
- title for the heatmap list which is put on the right, graphics are drawn by `draw_title,HeatmapList-method`.
- heatmap legend on the right, graphics are drawn by `draw_heatmap_legend,HeatmapList-method`.
- annotation legend on the right, graphics are drawn by `draw_annotation_legend,HeatmapList-method`.

For the list of heatmaps which are placed at (5, 5) in the layout, the heatmaps and row annotations are placed one after the other.

Methods

The `HeatmapList-class` provides following methods:

- `draw,HeatmapList-method`: draw the list of heatmaps and row annotations.
- `add_heatmap,HeatmapList-method`: add heatmaps to the list of heatmaps.
- `row_order,HeatmapList-method`: get order of rows
- `column_order,HeatmapList-method`: get order of columns
- `row_dend,HeatmapList-method`: get row dendrograms
- `column_dend,HeatmapList-method`: get column dendrograms

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))
rownames(mat) = letters[1:12]
colnames(mat) = letters[1:10]

ht = Heatmap(mat)
ht + ht
ht + ht + ht

ht_list = ht + ht
```

```
ht + ht_list

ha = HeatmapAnnotation(points = anno_points(1:12, which = "row"),
  which = "row")
ht + ha
ht_list + ha
```

heatmap_legend_size-HeatmapList-method
Size of the heatmap legend viewport

Description

Size of the heatmap legend viewport

Usage

```
## S4 method for signature 'HeatmapList'
heatmap_legend_size(object, legend_list = list(), ...)
```

Arguments

object	a HeatmapList-class object
legend_list	a list of self-defined legend, should be wrapped into grob objects.
...	graphic parameters passed to color_mapping_legend , ColorMapping-method .

Details

This function is only for internal use.

Value

A [unit](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

ht_global_opt	<i>Global graphic options for heatmaps</i>
---------------	--

Description

Global graphic options for heatmaps

Usage

```
ht_global_opt(..., RESET = FALSE, READ.ONLY = NULL, LOCAL = FALSE)
```

Arguments

...	options, see 'details' section
RESET	reset all the option values
READ.ONLY	TRUE means only to return read-only values, FALSE means only to return non-read-only values, NULL means to return both.
LOCAL	switch local mode

Details

You can set some parameters for all heatmaps/annotations simultaneously by this global function. Pleast note you should put it before your heatmap code and reset all option values after drawing the heatmaps to get rid of affecting next heatmap plotting.

There are following parameters:

heatmap_row_names_gp set row_names_gp in [Heatmap](#).

heatmap_column_names_gp set column_names_gp in [Heatmap](#).

heatmap_row_title_gp set row_title_gp in [Heatmap](#).

heatmap_column_title_gp set column_title_gp in [Heatmap](#).

heatmap_legend_title_gp set title_gp element in heatmap_legend_param in [Heatmap](#).

heatmap_legend_title_position set title_position element in heatmap_legend_param in [Heatmap](#).

heatmap_legend_labels_gp set labels_gp element in heatmap_legend_param in [Heatmap](#).

heatmap_legend_grid_width set grid_width element in heatmap_legend_param in [Heatmap](#).

heatmap_legend_grid_height set grid_height element in heatmap_legend_param in [Heatmap](#).

heatmap_legend_grid_border set grid_border element in heatmap_legend_param in [Heatmap](#).

heatmap_legend_title_gp set title_gp element in legend_param in [SingleAnnotation](#).

heatmap_legend_title_position set title_position element in legend_param in [SingleAnnotation](#).

heatmap_legend_labels_gp set labels_gp element in legend_param in [SingleAnnotation](#).

heatmap_legend_grid_width set grid_width element in legend_param in [SingleAnnotation](#).

heatmap_legend_grid_height set grid_height element in legend_param in [SingleAnnotation](#).

heatmap_legend_grid_border set grid_border element in legend_param in [SingleAnnotation](#).

You can get or set option values by the traditional way (like [options](#)) or by \$ operator:

```
# to get option values
ht_global_opt("heatmap_row_names_gp")
ht_global_opt$heatmap_row_names_gp

# to set option values
ht_global_opt("heatmap_row_names_gp" = gpar(fontsize = 8))
ht_global_opt$heatmap_row_names_gp = gpar(fontsize = 8)
```

Value

Depends on the options users selected.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this function
NULL
```

is_abs_unit

Whether the unit object contains absolute unit

Description

Whether the unit object contains absolute unit

Usage

```
is_abs_unit(u)
```

Arguments

u a [unit](#) object

Details

Besides the normal absolute units (e.g. "mm", "inches"), this function simply treat [grob](#) objects as absolute units.

For a complex unit which is combination of different units, it is absolute only if all units included are absolute units.

Value

A logical value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
is_abs_unit(unit(1, "mm"))
is_abs_unit(unit(1, "npc"))
is_abs_unit(textGrob("foo"))
is_abs_unit(unit(1, "mm") + unit(1, "npc"))
```

Legend

Making legend grobs

Description

Making legend grobs

Usage

```
Legend(at, labels = at, nrow = NULL, ncol = 1, col_fun,
       grid_height = unit(4, "mm"), grid_width = unit(4, "mm"), gap = unit(2, "mm"),
       labels_gp = gpar(fontsize = 10),
       border = NULL, background = "#EEEEEE",
       type = "grid", legend_gp = gpar(),
       pch = 16, size = unit(2, "mm"),
       legend_height = NULL, legend_width = NULL,
       direction = c("vertical", "horizontal"),
       title = "", title_gp = gpar(fontsize = 10, fontface = "bold"),
       title_position = c("topleft", "topcenter", "leftcenter", "lefttop"))
```

Arguments

at	breaks, can be wither numeric or character
labels	labels corresponding to at
nrow	if there are too many legends, they can be positioned in an array, this controls number of rows
ncol	if there are too many legends, they can be positioned in an array, this controls number of columns. At a same time only one of nrow and ncol can be specified.
col_fun	a color mapping function which is used to make a continuous color bar
grid_height	height of legend grid
grid_width	width of legend grid

gap	when legends are put in multiple columns, this is the gap between neighbouring columns, measured as a <code>unit</code> object
labels_gp	graphic parameters for labels
border	color of legend borders, also for the ticks in the continuous legend
background	background colors
type	type of legends, can be grid, points and lines
legend_gp	graphic parameters for the legend
pch	type of points
size	size of points
legend_height	height of the whole legend, used when <code>col_fun</code> is specified and <code>direction</code> is set to vertical
legend_width	width of the whole legend, used when <code>col_fun</code> is specified and <code>direction</code> is set to horizontal
direction	direction of the continuous legend
title	title of the legend
title_gp	graphic parameters of title
title_position	position of title according to the legend

Value

A `grob` object

Examples

```
# There is no example
NULL
```

```
make_column_cluster-Heatmap-method
  Make cluster on columns
```

Description

Make cluster on columns

Usage

```
## S4 method for signature 'Heatmap'
make_column_cluster(object)
```

Arguments

object a `Heatmap-class` object.

Details

The function will fill or adjust column_dend and column_order slots.

This function is only for internal use.

Value

A [Heatmap-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

make_layout-dispatch *Method dispatch page for make_layout*

Description

Method dispatch page for make_layout.

Dispatch

make_layout can be dispatched on following classes:

- [make_layout, HeatmapList-method, HeatmapList-class](#) class method
- [make_layout, Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example
NULL
```

make_layout-Heatmap-method

Make the layout of a single heatmap

Description

Make the layout of a single heatmap

Usage

```
## S4 method for signature 'Heatmap'  
make_layout(object)
```

Arguments

object a [Heatmap-class](#) object.

Details

The layout of the single heatmap will be established by setting the size of each heatmap components. Also functions that make graphics for heatmap components will be recorded.

Whether apply row clustering or column clustering affects the layout, so clustering should be applied first before making the layout.

This function is only for internal use.

Value

A [Heatmap-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

 make_layout-HeatmapList-method

Make layout for the complete plot

Description

Make layout for the complete plot

Usage

```
## S4 method for signature 'HeatmapList'
make_layout(object, row_title = character(0),
  row_title_side = c("left", "right"),
  row_title_gp = gpar(fontsize = 14),
  column_title = character(0),
  column_title_side = c("top", "bottom"),
  column_title_gp = gpar(fontsize = 14),
  heatmap_legend_side = c("right", "left", "bottom", "top"),
  show_heatmap_legend = TRUE,
  heatmap_legend_list = list(),
  annotation_legend_side = c("right", "left", "bottom", "top"),
  show_annotation_legend = TRUE,
  annotation_legend_list = list(),
  gap = unit(3, "mm"),
  main_heatmap = which(sapply(object@ht_list, inherits, "Heatmap"))[1],
  row_dend_side = c("original", "left", "right"),
  row_hclust_side = row_dend_side,
  row_sub_title_side = c("original", "left", "right"))
```

Arguments

object	a HeatmapList-class object.
row_title	title on the row.
row_title_side	will the title be put on the left or right of the heatmap.
row_title_gp	graphic parameters for drawing text.
column_title	title on the column.
column_title_side	will the title be put on the top or bottom of the heatmap.
column_title_gp	graphic parameters for drawing text.
heatmap_legend_side	side of the heatmap legend.
show_heatmap_legend	whether show heatmap legend.

heatmap_legend_list
a list of self-defined legend, should be wrapped into [grob](#) objects.

annotation_legend_side
side of annotation legend.

show_annotation_legend
whether show annotation legend.

annotation_legend_list
a list of self-defined legend, should be wrapped into [grob](#) objects.

gap
gap between heatmaps, should be a [unit](#) object.

main_heatmap
name or index for the main heatmap

row_dend_side
if auto adjust, where to put the row dendrograms for the main heatmap

row_hclust_side
deprecated, use row_dend_side instead

row_sub_title_side
if auto adjust, where to put sub row titles for the main heatmap

Details

It sets the size of each component of the heatmap list and adjusts graphic parameters for each heatmap if necessary.

The layout for the heatmap list and layout for each heatmap are calculated when drawing the heatmap list.

This function is only for internal use.

Value

A [HeatmapList-class](#) object in which settings for each heatmap are adjusted.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

make_row_cluster-Heatmap-method
Make cluster on rows

Description

Make cluster on rows

Usage

```
## S4 method for signature 'Heatmap'  
make_row_cluster(object)
```

Arguments

object a [Heatmap-class](#) object.

Details

The function will fill or adjust row_dend_list, row_order_list, row_title and matrix_param slots.

If order is defined, no clustering will be applied.

This function is only for internal use.

Value

A [Heatmap-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method  
NULL
```

map_to_colors-ColorMapping-method
Map values to colors

Description

Map values to colors

Usage

```
## S4 method for signature 'ColorMapping'  
map_to_colors(object, x)
```

Arguments

object	a ColorMapping-class object.
x	input values.

Details

It maps a vector of values to a vector of colors.

Value

A vector of colors.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# discrete color mapping for characters  
cm = ColorMapping(name = "test",  
  colors = c("blue", "white", "red"),  
  levels = c("a", "b", "c"))  
map_to_colors(cm, "a")  
map_to_colors(cm, c("a", "a", "b"))  
  
# discrete color mapping for numeric values  
cm = ColorMapping(name = "test",  
  colors = c("blue", "white", "red"),  
  levels = c(1, 2, 3))  
map_to_colors(cm, 1)  
map_to_colors(cm, "1")  
map_to_colors(cm, c(1, 1, 2, 2))  
  
# continuous color mapping  
require(circlize)
```

```
cm = ColorMapping(name = "test",
  col_fun = colorRamp2(c(0, 0.5, 1), c("blue", "white", "red")))
map_to_colors(cm, 0.2)
map_to_colors(cm, seq(0.2, 0.8, by = 0.1))
```

max_text_height	<i>Maximum height of text</i>
-----------------	-------------------------------

Description

Maximum height of text

Usage

```
max_text_height(text, ...)
```

Arguments

text	a vector of text
...	pass to textGrob

Details

Simply calculate maximum height of a list of [textGrob](#) objects.

Value

A [unit](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

See Also

[max_text_height](#) is always used to calculate the size of viewport when there is text annotation ([anno_text](#))

Examples

```
x = c("a", "b\nb", "c\nc\nc")
max_text_height(x, gp = gpar(fontsize = 10))
```

max_text_width	<i>Maximum width of text</i>
----------------	------------------------------

Description

Maximum width of text

Usage

```
max_text_width(text, ...)
```

Arguments

text	a vector of text
...	pass to textGrob

Details

Simply calculate maximum width of a list of [textGrob](#) objects.

Value

A [unit](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

See Also

[max_text_width](#) is always used to calculate the size of viewport when there is text annotation ([anno_text](#))

Examples

```
x = c("a", "bb", "ccc")
max_text_width(x, gp = gpar(fontsize = 10))
```

oncoPrint

Make oncoPrint

Description

Make oncoPrint

Usage

```
oncoPrint(mat, get_type = function(x) x,
  alter_fun = alter_fun_list, alter_fun_list = NULL, col,
  row_order = oncoprint_row_order(),
  column_order = oncoprint_column_order(),
  show_column_names = FALSE,
  show_pct = TRUE, pct_gp = gpar(), pct_digits = 0,
  axis_gp = gpar(fontsize = 8),
  show_row_barplot = TRUE,
  row_barplot_width = unit(2, "cm"),
  remove_empty_columns = FALSE,
  heatmap_legend_param = list(title = "Alterations"),
  top_annotation = HeatmapAnnotation(column_bar = anno_column_bar,
  annotation_height = unit(2, "cm")),
  barplot_ignore = NULL,
  ...)
```

Arguments

mat	a character matrix which encodes multiple alterations or a list of matrix for which every matrix contains binary value representing the alteration is present or absent. When it is a list, the names represent alteration types. You can use unify_mat_list to make all matrix having same row names and column names.
get_type	If different alterations are encoded in the matrix, this self-defined function determines how to extract them. Only work when mat is a matrix.
alter_fun	a single function or a list of functions which define how to add graphics for different alterations. If it is a list, the names of the list should cover all alteration types.
alter_fun_list	deprecated, use alter_run instead.
col	a vector of color for which names correspond to alteration types.
row_order	order of genes. By default it is sorted by frequency of alterations decreasingly. Set it to NULL if you don't want to set the order
column_order	order of samples. By default the order is calculated by the 'memo sort' method which can visualize the mutual exclusivity across genes. Set it to NULL if you don't want to set the order
show_column_names	whether show column names

show_pct	whether show percent values on the left of the oncoprint
pct_gp	graphic paramters for percent row annotation
pct_digits	digits for percent values
axis_gp	graphic paramters for axes
show_row_barplot	whether show barplot annotation on rows
row_barplot_width	width of barplot annotation on rows. It should be a <code>unit</code> object
remove_empty_columns	if there is no alteration in that sample, whether remove it on the heatmap
heatmap_legend_param	pass to <code>Heatmap</code>
top_annotation	by default the top annotation contains barplots representing frequency of mutations in every sample.
barplot_ignore	alterations that you don't want to put on the barplots.
...	pass to <code>Heatmap</code> , so can set <code>bottom_annotation</code> here.

Details

The function returns a normal heatmap list and you can add more heatmaps/row annotations to it.

The 'memo sort' method is from <https://gist.github.com/armish/564a65ab874a770e2c26>. Thanks to B. Arman Aksoy for contributing the code.

The function would be a little bit slow if you plot it in an interactive device because all alterations are added through a `for` loop.

For more explanation, please go to the vignette.

Value

A `HeatmapList-class` object which means you can add other heatmaps or row annotations to it.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example
NULL
```

plotDataFrame *Quickly visualize a data frame*

Description

Quickly visualize a data frame

Usage

```
plotDataFrame(df, overlap = 0.25, nlevel = 30, show_row_names = TRUE,
  show_column_names = TRUE, group = NULL, group_names = names(group),
  main_heatmap = NULL, km = 1, split = NULL, cluster_rows = TRUE,
  cluster_columns = TRUE, row_order = NULL, ...)
```

Arguments

df	a data frame.
overlap	how to group numeric columns. If the overlapping rate between the ranges in the current column and previous numeric column is larger than this value, the two columns are treated as under same measurement and should be grouped.
nlevel	If the number of levels of a character column is larger than this value, the column will be excluded, because it doesn't make any sense to visualize a character vector or matrix that contains huge number of unique elements through a heatmap.
show_row_names	whether show row names after the last heatmap if there are row names.
show_column_names	whether show column names for all heatmaps.
group	a list of index that defines the grouping.
group_names	names for each group.
main_heatmap	which group is the main heatmap?
km	a value larger than 1 means applying k-means clustering on rows for the main heatmap.
split	one or multiple variables that split the rows.
cluster_rows	whether perform clustering on rows of the main heatmap.
cluster_columns	whether perform clustering on columns for all heatmaps.
row_order	order of rows, remember to turn off cluster_rows
...	pass to draw,HeatmapList-method or make_layout,HeatmapList-method

Details

The data frame contains heterogeneous information. The `plotDataFrame` function provides a simple and quick way to visualize information that are stored in a data frame.

There are only a few settings in this function, so the heatmap generated by this function may look ugly (in most of the time). However, users can customize the style of the heatmaps by manually constructing a `HeatmapList` object.

Value

A [HeatmapList](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
df = data.frame(matrix(rnorm(40), nrow = 10, dimnames = list(letters[1:10], letters[1:4])),
  large = runif(10)*100,
  t1 = sample(letters[1:3], 10, replace = TRUE),
  matrix(runif(60), nrow = 10, dimnames = list(LETTERS[1:10], LETTERS[1:6])),
  t2 = sample(LETTERS[1:3], 10, replace = TRUE))
plotDataFrame(df)
plotDataFrame(df, group = list(1:4, 5, 6, 7:12, 13), group_names = c("mat1", "large", "t1", "mat2", "t2"),
  main_heatmap = 4, km = 2, column_title = "column title", row_title = "row title")
```

prepare-Heatmap-method

Prepare the heatmap

Description

Prepare the heatmap

Usage

```
## S4 method for signature 'Heatmap'
prepare(object, process_rows = TRUE)
```

Arguments

`object` a [Heatmap-class](#) object.
`process_rows` whether process rows of the heatmap

Details

The preparation of the heatmap includes following steps:

- making clustering on rows if specified (by calling [make_row_cluster, Heatmap-method](#))
- making clustering on columns if specified (by calling [make_column_cluster, Heatmap-method](#))
- making the layout of the heatmap (by calling [make_layout, Heatmap-method](#))

This function is only for internal use.

Value

A [Heatmap-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

rowAnnotation	<i>Construct row annotations</i>
---------------	----------------------------------

Description

Construct row annotations

Usage

```
rowAnnotation(...)
```

Arguments

... pass to [HeatmapAnnotation](#)

Details

The function is identical to

```
HeatmapAnnotation(..., which = "row")
```

Value

A [HeatmapAnnotation-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
df = data.frame(type = c("a", "a", "a", "b", "b", "b"))
ha = columnAnnotation(df = df)
```

row_anno_barplot *Row annotation which is represented as barplots*

Description

Row annotation which is represented as barplots

Usage

```
row_anno_barplot(...)
```

Arguments

... pass to [anno_barplot](#)

Details

A wrapper of [anno_barplot](#) with pre-defined which to row.

Value

See help page of [anno_barplot](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

row_anno_boxplot *Row annotation which is represented as boxplots*

Description

Row annotation which is represented as boxplots

Usage

```
row_anno_boxplot(...)
```

Arguments

... pass to [anno_boxplot](#)

Details

A wrapper of [anno_boxplot](#) with pre-defined which to row.

Value

See help page of [anno_boxplot](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

row_anno_density	<i>Row annotation which is represented as density plot</i>
------------------	--

Description

Row annotation which is represented as density plot

Usage

```
row_anno_density(...)
```

Arguments

```
...          pass to anno\_density
```

Details

A wrapper of [anno_density](#) with pre-defined which to row.

Value

See help page of [anno_density](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

row_anno_histogram *Row annotation which is represented as histogram*

Description

Row annotation which is represented as histogram

Usage

```
row_anno_histogram(...)
```

Arguments

... pass to [anno_histogram](#)

Details

A wrapper of [anno_histogram](#) with pre-defined which to row.

Value

See help page of [anno_histogram](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example
NULL
```

row_anno_link *Column annotation which is represented as links*

Description

Column annotation which is represented as links

Usage

```
row_anno_link(...)
```

Arguments

... pass to [anno_link](#)

Details

A wrapper of [anno_link](#) with pre-defined which to row.

Value

See help page of [anno_link](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

row_anno_points	<i>Row annotation which is represented as points</i>
-----------------	--

Description

Row annotation which is represented as points

Usage

```
row_anno_points(...)
```

Arguments

```
...          pass to anno\_points
```

Details

A wrapper of [anno_points](#) with pre-defined which to row.

Value

See help page of [anno_points](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

row_anno_text	<i>Row annotation which is represented as text</i>
---------------	--

Description

Row annotation which is represented as text

Usage

```
row_anno_text(...)
```

Arguments

... pass to [anno_text](#)

Details

A wrapper of [anno_text](#) with pre-defined which to row.

Value

See help page of [anno_text](#)

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

row_dend-dispatch	<i>Method dispatch page for row_dend</i>
-------------------	--

Description

Method dispatch page for row_dend.

Dispatch

row_dend can be dispatched on following classes:

- [row_dend](#), [HeatmapList-method](#), [HeatmapList-class](#) class method
- [row_dend](#), [Heatmap-method](#), [Heatmap-class](#) class method

Examples

```
# no example  
NULL
```

row_dend-Heatmap-method

Get row dendrograms from a heatmap

Description

Get row dendrograms from a heatmap

Usage

```
## S4 method for signature 'Heatmap'  
row_dend(object)
```

Arguments

object a [Heatmap-class](#) object

Value

A list of dendrograms for which each dendrogram corresponds to a row slice

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)  
ht = Heatmap(mat)  
row_dend(ht)  
ht = Heatmap(mat, km = 2)  
row_dend(ht)
```

row_dend-HeatmapList-method

Get row dendrograms from a heatmap list

Description

Get row dendrograms from a heatmap list

Usage

```
## S4 method for signature 'HeatmapList'  
row_dend(object)
```

Arguments

object a [HeatmapList-class](#) object

Value

A list of dendrograms for which each dendrogram corresponds to a row slice

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)  
ht_list = Heatmap(mat) + Heatmap(mat)  
row_dend(ht_list)  
ht_list = Heatmap(mat, km = 2) + Heatmap(mat)  
row_dend(ht_list)
```

row_order-dispatch

Method dispatch page for row_order

Description

Method dispatch page for row_order.

Dispatch

row_order can be dispatched on following classes:

- [row_order,HeatmapList-method,HeatmapList-class](#) class method
- [row_order,Heatmap-method,Heatmap-class](#) class method

Examples

```
# no example
NULL
```

row_order-Heatmap-method

Get row order from a heatmap

Description

Get row order from a heatmap

Usage

```
## S4 method for signature 'Heatmap'
row_order(object)
```

Arguments

object a [Heatmap-class](#) object

Value

A list contains row orders which correspond to the original matrix

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)
ht = Heatmap(mat)
row_order(ht)
ht = Heatmap(mat, km = 2)
row_order(ht)
```

row_order-HeatmapList-method

Get row order from a heatmap list

Description

Get row order from a heatmap list

Usage

```
## S4 method for signature 'HeatmapList'  
row_order(object)
```

Arguments

object a [HeatmapList-class](#) object

Value

A list contains row orders which correspond to the original matrix

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(100), 10)  
ht_list = Heatmap(mat) + Heatmap(mat)  
row_order(ht_list)  
ht = Heatmap(mat, km = 2) + Heatmap(mat)  
row_order(ht_list)
```

selectArea

Select an area in the heatmap

Description

Select an area in the heatmap

Usage

```
selectArea(mark = TRUE)
```

Arguments

mark whether mark the selected area as a rectangle

Details

Users can use mouse to click two positions on the heatmap, the function will return the row index and column index for the selected region in the selected matrix.

This function only works under interactive graphical environment.

Value

A list containing row index and column index corresponding to the selected region.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# No example for this function
NULL
```

set_component_height-Heatmap-method

Set height of each heatmap component

Description

Set height of each heatmap component

Usage

```
## S4 method for signature 'Heatmap'
set_component_height(object, k, v)
```

Arguments

object	a Heatmap-class object.
k	which components, see Heatmap-class .
v	height of the component, a unit object.

Details

This function is only for internal use.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# no example for this internal method
NULL
```

show-ColorMapping-method

Print ColorMapping object

Description

Print ColorMapping object

Usage

```
## S4 method for signature 'ColorMapping'
show(object)
```

Arguments

object a [ColorMapping-class](#) object.

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example
NULL
```

show-dispatch	<i>Method dispatch page for show</i>
---------------	--------------------------------------

Description

Method dispatch page for show.

Dispatch

show can be dispatched on following classes:

- [show, ColorMapping-method, ColorMapping-class](#) class method
- [show, HeatmapAnnotation-method, HeatmapAnnotation-class](#) class method
- [show, SingleAnnotation-method, SingleAnnotation-class](#) class method
- [show, HeatmapList-method, HeatmapList-class](#) class method
- [show, Heatmap-method, Heatmap-class](#) class method

Examples

```
# no example  
NULL
```

show-Heatmap-method	<i>Draw the single heatmap with default parameters</i>
---------------------	--

Description

Draw the single heatmap with default parameters

Usage

```
## S4 method for signature 'Heatmap'  
show(object)
```

Arguments

object a [Heatmap-class](#) object.

Details

Actually it calls [draw, Heatmap-method](#), but only with default parameters. If users want to customize the heatmap, they can pass parameters directly to [draw, Heatmap-method](#).

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
mat = matrix(rnorm(80, 2), 8, 10)
mat = rbind(mat, matrix(rnorm(40, -2), 4, 10))
rownames(mat) = letters[1:12]
colnames(mat) = letters[1:10]

ht = Heatmap(mat)
ht
draw(ht, heatmap_legend_side = "left")
```

show-HeatmapAnnotation-method

Print the Heatmap Annotation object

Description

Print the Heatmap Annotation object

Usage

```
## S4 method for signature 'HeatmapAnnotation'
show(object)
```

Arguments

object a [HeatmapAnnotation-class](#) object.

Value

No value is returned.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example
NULL
```

`show-HeatmapList-method`*Draw a list of heatmaps with default parameters*

Description

Draw a list of heatmaps with default parameters

Usage

```
## S4 method for signature 'HeatmapList'  
show(object)
```

Arguments

`object` a [HeatmapList-class](#) object.

Details

Actually it calls [draw,HeatmapList-method](#), but only with default parameters. If users want to customize the heatmap, they can pass parameters directly to [draw,HeatmapList-method](#).

Value

This function returns no value.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

`show-SingleAnnotation-method`*Print the SingleAnnotation object*

Description

Print the SingleAnnotation object

Usage

```
## S4 method for signature 'SingleAnnotation'
show(object)
```

Arguments

object a [SingleAnnotation-class](#) object.

Value

No value is returned.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example
NULL
```

SingleAnnotation *Constructor method for SingleAnnotation class*

Description

Constructor method for SingleAnnotation class

Usage

```
SingleAnnotation(name, value, col, fun,
  na_col = "grey",
  which = c("column", "row"),
  show_legend = TRUE,
  gp = gpar(col = NA),
  legend_param = list())
```

Arguments

name	name for this annotation. If it is not specified, an internal name is assigned.
value	A vector of discrete or continuous annotation.
col	colors corresponding to value. If the mapping is discrete mapping, the value of col should be a vector; If the mapping is continuous mapping, the value of col should be a color mapping function.
fun	a self-defined function to add annotation graphics. The argument of this function should only be a vector of index that corresponds to rows or columns.

na_col	color for NA values in simple annotations.
which	is the annotation a row annotation or a column annotation?
show_legend	if it is a simple annotation, whether show legend when making the complete heatmap.
gp	Since simple annotation is represented as a row of grids. This argument controls graphic parameters for the simple annotation.
legend_param	parameters for the legend. See color_mapping_legend , ColorMapping-method for options.

Details

The most simple annotation is one row or one column grids in which different colors represent different classes of the data. Here the function use [ColorMapping-class](#) to process such simple annotation. `value` and `col` arguments controls values and colors of the simple annotation and a [ColorMapping-class](#) object will be constructed based on `value` and `col`.

`fun` is used to construct a more complex annotation. Users can add any type of annotation graphics by implementing a function. The only input argument of `fun` is a index of rows or columns which is already adjusted by the clustering. In the package, there are already several annotation graphic function generators: [anno_points](#), [anno_histogram](#) and [anno_boxplot](#).

In the case that row annotations are splitted by rows, index corresponding to row orders in each row-slice and `fun` will be applied on each of the row slices.

One thing that users should be careful is the difference of coordinates when the annotation is a row annotation or a column annotation.

Value

A [SingleAnnotation-class](#) object.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

See Also

There are following built-in annotation functions that can be used to generate complex annotations: [anno_points](#), [anno_barplot](#), [anno_histogram](#), [anno_boxplot](#), [anno_density](#), [anno_text](#) and [anno_link](#).

Examples

```
# discrete character
SingleAnnotation(name = "test", value = c("a", "a", "a", "b", "b", "b"))
SingleAnnotation(name = "test", value = c("a", "a", "a", "b", "b", "b"),
  which = "row")

# with defined colors
SingleAnnotation(value = c("a", "a", "a", "b", "b", "b"),
  col = c("a" = "red", "b" = "blue"))
```

```
# continuous numbers
require(circlize)
SingleAnnotation(value = 1:10)
SingleAnnotation(value = 1:10, col = colorRamp2(c(1, 10), c("blue", "red")))

# self-defined graphic function
SingleAnnotation(fun = anno_points(1:10))
```

SingleAnnotation-class

Class for a single annotation

Description

Class for a single annotation

Details

A complex heatmap always has more than one annotations on rows and columns. Here the [SingleAnnotation-class](#) defines the basic unit of annotations. The most simple annotation is one row or one column grids in which different colors represent different classes of the data. The annotation can also be more complex graphics, such as a boxplot that shows data distribution in corresponding row or column.

The [SingleAnnotation-class](#) is used for storing data for a single annotation and provides methods for drawing annotation graphics.

Methods

The [SingleAnnotation-class](#) provides following methods:

- [SingleAnnotation](#): constructor method
- [draw, SingleAnnotation-method](#): draw the single annotation.

Author(s)

Zuguang Gu <z.gu@dkfz.de>

See Also

The [SingleAnnotation-class](#) is always used internally. The public [HeatmapAnnotation-class](#) contains a list of [SingleAnnotation-class](#) objects and is used to add annotation graphics on heatmaps.

Examples

```
# for examples, please go to `SingleAnnotation` method page
NULL
```

unify_mat_list	<i>Unify a list of matrix</i>
----------------	-------------------------------

Description

Unify a list of matrix

Usage

```
unify_mat_list(mat_list, default = 0)
```

Arguments

mat_list	a list of matrix, all of them should have dimension names
default	default values for the newly added rows and columns

Details

All matrix will be unified to have same row names and column names

Value

A list of matrix

Author(s)

Zuguang Gu <z.gu@dkfz.de>

Examples

```
# There is no example  
NULL
```

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