Package ‘ComplexHeatmap’

January 30, 2017

Type Package
Title Making Complex Heatmaps
Version 1.12.0
Date 2016-10-14
Author Zuguang Gu
Maintainer Zuguang Gu <z.gu@dkfz.de>
Depends R (>= 3.1.2), grid, graphics, stats, grDevices
Imports methods, circlize (>= 0.3.4), GetoptLong, colorspace, RColorBrewer, dendextend (>= 1.0.1), GlobalOptions (>= 0.0.10)
Suggests testthat (>= 0.3), knitr, markdown, cluster, MASS, pvclust, dendsort, HilbertCurve, Cairo, png, jpeg, tiff, fastcluster
VignetteBuilder knitr
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.

biocViews Software, Visualization, Sequencing
URL https://github.com/jokergoo/ComplexHeatmap
License GPL (>= 2)
Repository Bioconductor
Date/Publication 2016-10-14 00:00:00
NeedsCompilation no

R topics documented:

ComplexHeatmap-package ...................................................... 4
+.AdditiveUnit .......................................................... 5
AdditiveUnit .......................................................... 6
AdditiveUnit-class ......................................................... 6
add_heatmap-dispatch ...................................................... 7
add_heatmap-Heatmap-method ............................................ 7
add_heatmap-HeatmapAnnotation-method ................................. 8
add_heatmap-HeatmapList-method ......................................... 9
annotation_legend_size-HeatmapList-method ............................. 10
R topics documented:

draw_dimnames-Heatmap-method .......................... 54
draw_heatmap_body-Heatmap-method ..................... 55
draw_heatmap_legend-HeatmapList-method ............... 56
draw_heatmap_list-HeatmapList-method .................. 56
draw_title-dispatch ...................................... 57
draw_title-Heatmap-method ................................ 58
draw_title-HeatmapList-method ........................... 59
enhanced_basicplot ....................................... 59
get_color_mapping_list-HeatmapAnnotation-method .... 61
get_color_mapping_param_list-HeatmapAnnotation-method 61
grid.dendrogram ........................................... 62
Heatmap ....................................................... 63
Heatmap-class ................................................. 69
HeatmapAnnotation .......................................... 71
HeatmapAnnotation-class .................................. 73
HeatmapList .................................................. 73
HeatmapList-class .......................................... 74
heatmap_legend_size-HeatmapList-method .............. 76
ht_global_opt ............................................... 76
is_abs_unit .................................................... 78
Legend .......................................................... 79
make_column_cluster-Heatmap-method .................... 80
make_layout-dispatch ...................................... 81
make_layout-Heatmap-method .............................. 81
make_layout-HeatmapList-method .......................... 82
make_row_cluster-Heatmap-method ........................ 84
map_to_colors-ColorMapping-method .................... 85
max_text_height ............................................. 86
max_text_width .............................................. 87
oncoPrint ..................................................... 88
plotDataFrame ............................................... 89
prepare-Heatmap-method .................................. 91
rowAnnotation ............................................... 92
row_anno_barplot .......................................... 92
row_anno_boxplot .......................................... 93
row_anno_density .......................................... 94
row_anno_histogram ....................................... 94
row_anno_link ............................................... 95
row_anno_points ............................................ 96
row_anno_text .............................................. 96
row_dend-dispatch ........................................ 97
row_dend-Heatmap-method ................................ 97
row_dend-HeatmapList-method ............................. 98
row_order-dispatch ........................................ 99
row_order-Heatmap-method ................................. 99
row_order-HeatmapList-method ............................ 100
selectArea ...................................................... 100
set_component_height-Heatmap-method .................. 101
show-ColorMapping-method ................................ 102
show-dispatch ............................................... 102
show-Heatmap-method ...................................... 103
show-HeatmapAnnotation-method .......................... 104
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

```r
# There is no example
NULL
```
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-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
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

```r
# no example
NULL
```

Description

Add heatmaps or row annotations as a heatmap list

Usage

```r
## 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

```r
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

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

Arguments

- `object` a `HeatmapAnnotation-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**

```r
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)
```

---

**Description**

Add heatmaps and row annotations to the heatmap list

**Usage**

```r
## 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**

```r
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

```r
## 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

```r
# 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. If the value is a matrix, columns of the matrix will be represented as stacked barplots. Note for stacked barplots, each row in the matrix should only contain values with same sign (either all positive or all negative).

baseline baseline for bars. The value should be "min" or "max", or a numeric value. It is enforced to be zero for stacked barplots.

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. If it is the stacked barplots, the length of the graphic parameter should be same as the number of stacks.

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)
anno_density

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)
Using histogram as annotation

**Usage**

```r
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**

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

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

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

---

**aneo_link**  
*Link annotation with labels*

**Description**

Link annotation with labels

**Usage**

```r
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**

```r
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_oncoprint_barplot

Description
Column barplot annotation for oncoPrint

Usage
anno_oncoprint_barplot()

Details
This function is only used for column annotation

Author(s)
Zuguang Gu <z.gu@dkfz.de>

Examples
# There is no example
NULL

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.
anno_text

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))
ggrid.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

```r
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

```r
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
```r
cm = ColorMapping(name = "test",
                  colors = c("blue", "white", "red"),
                  levels = c("a", "b", "c"))
cm
```

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

# continuous color mapping
```r
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
## 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, 
lables = at, 
lables_gp = gpar(fontsize = 10), 
nrow = NULL, 
col = 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  
- **lables**: labels corresponding to break values  
- **lables_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

Construct column annotations

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

Column annotation which is represented as barplots

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

```r
# 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.
column_anno_link

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**  
*Column annotation which is represented as points*

**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**

```r
# 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

```r
# 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

```r
# no example
NULL
```

---

column_dend-Heatmap-method

Get column dendrograms from a heatmap

### Description

Get column dendrograms from a heatmap

### Usage

```r
## 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

```r
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

```r
## 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

```r
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)
```
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

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
Description

Height of each heatmap component

Usage

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

Arguments

- `object`: a `Heatmap` 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

```r
# 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

```r
## 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

```r
# 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
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.

The function returns no value.

Zuguang Gu <z.gu@dkfz.de>

```r
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 = "#FF000080"))
})
decorate_annotation("point", {
    grid.rect(gp = gpar(fill = "#FF000080"))
}, slice = 2)
```

Decorate heatmap dendrogram on columns

Decorate heatmap dendrogram on columns

```
decorate_column_dend(...)  
... pass to decorate_dend
```

This is a wrapper function which pre-defined which argument in `decorate_dend`.

The function returns no value.

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 &lt;z.gu@dkfz.de&gt;

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:

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

Value

This function returns no value.

Author(s)

Zuguang Gu &lt;z.gu@dkfz.de&gt;
Examples

```r
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

```r
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:

```r
# 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**

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

---

**decorate_heatmap_body**  *Decorate the heatmap body*

**Description**

Decorate the heatmap body

**Usage**

```r
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:

```r
# 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

```r
set.seed(123)
Heatmap(matrix(rnorm(100), 10), name = "mat")
decorate_heatmap_body("mat", {
  grid.circle(gp = gpar(fill = "#FF000080"))
})
```

---

decorate_row_dend    Decorate heatmap dendrogram on rows

Description

Decorate heatmap dendrogram on rows

Usage

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

Arguments

```r
...
```

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

```r
# No example for this function
NULL
```
**Description**

Decorate heatmap row names

**Usage**

\[\text{decorate_row_names}(\ldots)\]

**Arguments**

\[\ldots\text{ pass to} \text{\textit{decorate_dimnames}}\]

**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
\[\text{NULL}\]

---

**Description**

Decorate heatmap row title

**Usage**

\[\text{decorate_row_title}(\ldots)\]

**Arguments**

\[\ldots\text{ pass to} \text{\textit{decorate_title}}\]

**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  

Decorate the heatmap title

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),
    cluster_columns = FALSE,
    clustering_distance_columns = "euclidean",
    clustering_method_columns = "complete",
    column_dend_side = "top",
    column_dend_height = unit(10, "mm"),
    show_column_dend = FALSE,
    column_dend_gp = gpar(),
    column_dend_reorder = TRUE,
    column_names_side = c("bottom", "top"),
    show_column_names = TRUE,
    column_names_max_height = unit(4, "cm"),
    column_names_gp = gpar(fontsize = 12),
    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.
cluster_columns whether cluster columns (here cluster by density distributions)
clustering_distance_columns pass to Heatmap
densityHeatmap

clustering_method_columns
  pass to Heatmap
column_dend_side
  pass to Heatmap
column_dend_height
  pass to Heatmap
show_column_dend
  pass to Heatmap
column_dend_gp
  pass to Heatmap
column_dend_reorder
  pass to Heatmap
column_names_side
  pass to Heatmap
show_column_names
  pass to Heatmap
column_names_max_height
  pass to Heatmap
column_names_gp
  pass to Heatmap
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

```r
mat = matrix(rnorm(40), nr = 4, ncol = 10)ownames(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))
  sqrt(sum((x[1] - y[1])^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**

```r
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")
```

**Description**

Draw the heatmap annotations

**Usage**

```r
## 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.
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"),
  annotation_legend_list = list(),
  ...)
draw-HeatmapList-method

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.
newpage  whether create a new page for the graphics.
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_legand  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_sub_title_side  if auto adjust, where to put sub row titles for the main heatmap
...

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

```r
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

```r
## 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 names 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

```r
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

```r
## 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 \texttt{HeatmapList-class} object

  legend_list  
  a list of self-defined legend, should be wrapped into \texttt{grob} objects.

  ...  
  graphic parameters passed to \texttt{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**

```r
## 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**

```r
# There is no example
NULL
```
draw_dimnames-Heatmap-method

Draw row names or column names

Description

Draw row names or column names

Usage

```r
## 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

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

Draw the heatmap body

Usage

```r
## 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

```r
# no example for this internal method
NULL
```
draw_heatmap_legend-HeatmapList-method

**Description**

Draw legends for all heatmaps

**Usage**

```r
## 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**

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

draw_heatmap_list-HeatmapList-method

**Description**

Draw the list of heatmaps

**Usage**

```r
## 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

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
## 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**

```r
## 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**

```r
# 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

```r
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 the 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`.

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

```r
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 

Draw dendrogram under grid system

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 attr(dend, "height").
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()
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

matrix a matrix. Either numeric or character. If it is a simple vector, it will be converted to a one-column matrix.

col 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
Heatmap

be interpolated. Pass to ColorMapping.

name
name of the heatmap. The name is used as the title of the heatmap legend.

na_col
color for NA values.

rect_gp
graphic parameters for drawing rectangles (for heatmap body).

color_space
the color space in which colors are interpolated. Only used if matrix is numeric and col is a vector of colors. Pass to colorRamp2.

cell_fun
self-defined function to add graphics on each cell. Seven parameters will be passed into this function: i, j, x, y, width, height, fill which are row index, column index in matrix, coordinate of the middle points in the heatmap body viewport, the width and height of the cell and the filled color. x, y, width and height are all unit objects.

row_title
title on 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.

row_title_rot
rotation of row titles. Only 0, 90, 270 are allowed to set.

column_title
title on 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.

column_title_rot
rotation of column titles. Only 0, 90, 270 are allowed to set.

cluster_rows
If the value is a logical, it means whether make cluster on rows. The value can also be a hclust or a dendrogram that already contains clustering information. This means you can use any type of clustering methods and render the dendrogram object with self-defined graphic settings.

clustering_distance_rows
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 matrix and the returned value should be a dist object. If the function has two arguments, the input arguments are two vectors and the function calculates distance between these two vectors.

clustering_method_rows
method to make cluster, pass to hclust.

row_dend_side
should the row cluster be put on the left or right of the heatmap?

row_dend_width
width of the row cluster, should be a unit object.

show_row_dend
whether show row clusters.

row_dend_gp
graphics parameters for drawing lines. If users already provide a dendrogram object with edges rendered, this argument will be ignored.

row_dend_reorder
apply reordering on rows. The value can be a logical value or a vector which contains weight which is used to reorder rows

row_hclust_side
deprecated, use row_dend_side instead

row_hclust_width
deprecated, use row_dend_width instead
Heatmap

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

column_names_gp

  graphic parameters for drawing text.

top_annotation

  a HeatmapAnnotation object which contains a list of annotations.

top_annotation_height

  total height of the column annotations on the top.

bottom_annotation

  a HeatmapAnnotation object.

bottom_annotation_height

  total height of the column annotations on the bottom.

km

  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.

split

  a vector or a data frame by which the rows are split. But if cluster_rows is a
  clustering object, split can be a single number indicating rows are to be split
  according to the split on the tree.

gap

  gap between row-slices if the heatmap is split by rows, should be unit object.
  If it is a vector, the order corresponds to top to bottom in the heatmap

combined_name_fun

  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 split.

width

  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.

show_heatmap_legend

  whether show heatmap legend?

heatmap_legend_param

  a list contains parameters for the heatmap legend. See color_mapping_legend,ColorMapping-method
  for all available parameters.

use_raster

  whether render the heatmap body as a raster image. It helps to reduce file size
  when the matrix is huge.

raster_device

  graphic device which is used to generate the raster image

raster_quality

  a value set to larger than 1 will improve the quality of the raster image.

raster_device_param

  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

```r
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 = gpars(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 = gpars(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-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)
|1|2|3| 4(5)|5|6|7|
+--------+ (2)
+--------+ (3)
+--------+ (4)
```

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`.
Heatmap-class

- 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

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"),
show_annotation_name = FALSE,
annotation_name_gp = gpar(),
annotation_name_offset = unit(2, "mm"),
annotation_name_side = ifelse(which == "column", "right", "bottom"),
annotation_name_rot = ifelse(which == "column", 0, 90))

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.
HeatmapAnnotation

- **gap**: gap between each annotation
- **show_annotation_name**: whether show annotation names. For column annotation, annotation names are drawn either on the left or the right, and for row annotations, names are draw either on top to at bottom. The value can be a vector.
- **annotation_name_gp**: graphic parameters for annotation names. Graphic parameters can be vectors.
- **annotation_name_offset**: offset to the annotations, unit object. The value can be a vector.
- **annotation_name_side**: side of the annotation names.
- **annotation_name_rot**: rotation of the annotation names, can only take values in \( \{00, 90, 180, 270\}\). The value can be a vector.

**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**

```r
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**

```r
# 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

```r
mat = matrix(rnorm(80, 2), 8, 10)
m = 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  

Global graphic options for heatmaps

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. Please 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.
fast_hclust whether use hclust to speed up clustering?

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.
is_abs_unit

*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

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 unit 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 col_fun is specified and direction is
    set to vertical
legend_width width of the whole legend, used when col_fun is specified and direction 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

Description

Make cluster on columns

Usage

```r
## 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
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**

```r
# no example
NULL
```

---

Method dispatch page for `make_layout-Heatmap-method`

**Description**

Make the layout of a single heatmap

**Usage**

```r
## 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 for the complete plot

Usage

```r
## S4 method for signature
quotesingle.Var
HeatmapList
quotesingle.Var
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"),
ccluster_rows = NULL,
clustering_distance_rows = NULL,
clustering_method_rows = NULL,
row_dend_width = NULL,
show_row_dend = NULL,
row_dend_reorder = NULL,
row_dend_gp = NULL,
row_order = NULL,
km = NULL,
split = NULL)
```
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
cluster_rows: same setting as in Heatmap, if it is specified, cluster_rows in main heatmap is ignored.
clustering_distance_rows: same setting as in Heatmap, if it is specified, clustering_distance_rows in main heatmap is ignored.
clustering_method_rows: same setting as in Heatmap, if it is specified, clustering_method_rows in main heatmap is ignored.
row_dend_width: same setting as in Heatmap, if it is specified, row_dend_width in main heatmap is ignored.
show_row_dend: same setting as in Heatmap, if it is specified, show_row_dend in main heatmap is ignored.
row_dend_reorder: same setting as in Heatmap, if it is specified, row_dend_reorder in main heatmap is ignored.
row_dend_gp: same setting as in Heatmap, if it is specified, row_dend_gp in main heatmap is ignored.
make_row_cluster-Heatmap-method

row_order
same setting as in Heatmap, if it is specified, row_order in main heatmap is ignored.

km
same setting as in Heatmap, if it is specified, km in main heatmap is ignored.

split
same setting as in Heatmap, if it is specified, split in main heatmap is ignored.

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
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
```r
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
```r
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
```r
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**

*Maximum height of text*

**Description**

Maximum height of text

**Usage**

```r
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>
max_text_width

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))

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_oncoprint_barplot(),
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 parameters for percent row annotation

pct_digits digits for percent values
plotDataFrame

axis_gp  graphic parameters for axes
show_row_barplot  whether show barplot annotation on rows
row_barplot_width  width of barplot annotation on rows. It should be a unit object
remove_empty_columns  if there is no alteration in that sample, whether remove it on the heatmap
heatmap_legend_param  pass to `Heatmap`
top_annotation  by default the top annotation contains barplots representing frequency of mutations in every sample.
barplot_ignore  specific alterations that you don’t want to put on the barplots. If you want to really suppress the top barplot set top_annotation to NULL.
...  pass to `Heatmap`, so can set bottom_annotation 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 foo 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...

**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**

```r
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 the heatmap**

**Description**

Prepare the heatmap

**Usage**

```r
## 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**

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

*Construct row annotations*

**Description**

Construct row annotations

**Usage**

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

**Arguments**

... pass to `HeatmapAnnotation`

**Details**

The function is identical to

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

**Value**

A `HeatmapAnnotation-class` object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

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

Row annotation which is represented as density plot

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 \texttt{anno_histogram}

Author(s)
Zuguang Gu \textless z.gu@dkfz.de\textgreater

Examples
# There is no example
NULL

\begin{verbatim}
row_anno_link
\end{verbatim}

\textit{Column annotation which is represented as links}

Description
Column annotation which is represented as links

Usage
\begin{verbatim}
row_anno_link(...)
\end{verbatim}

Arguments
\begin{verbatim}
... pass to \texttt{anno_link}
\end{verbatim}

Details
A wrapper of \texttt{anno_link} with pre-defined which to row.

Value
See help page of \texttt{anno_link}

Author(s)
Zuguang Gu \textless z.gu@dkfz.de\textgreater

Examples
# There is no example
NULL
row_anno_points  Row annotation which is represented as points

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  Row annotation which is represented as text

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**  
Method dispatch page for row_dend

**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**
```r
## 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
show-dispatch

Examples

# no example for this internal method
NULL

---

show-ColorMapping-method

*Print ColorMapping object*

Description

Print ColorMapping object

Usage

## S4 method for signature 'ColorMapping'

```r
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

*Method dispatch page for show*

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
show-Heatmap-method

Examples

# no example
NULL

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**

```r
drawHeatmapAnnotation <- function(HeatmapAnnotation)
show(Heatmap Annotation)
```

**Arguments**

- `object`: a `HeatmapAnnotation-class` object.

**Value**

No value is returned.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```r
# 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**

```r
drawHeatmapList <- function(HeatmapList)
show(Heatmap List)
```

**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

Description
Print the SingleAnnotation object

Usage
```r
## 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(),
show_name = FALSE,
name_gp = gpar(fontsize = 12),
name_offset = unit(2, "mm"),
name_side = ifelse(which == "column", "right", "bottom"),
name_rot = ifelse(which == "column", 0, 90))

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.
show_name whether show annotation name
name_gp graphic parameters for annotation name
name_offset offset to the annotation, a `unit` object
name_side 'right' and 'left' for column annotations and 'top' and 'bottom' for row annotations
name_rot rotation of the annotation name, can only take values in c(0, 90, 180, 270).
**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 uses `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
```r
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
```r
SingleAnnotation(value = c("a", "a", "a", "b", "b", "b"),
col = c("a" = "red", "b" = "blue"))
```

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

# self-defined graphic function
```r
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**

Unify a list of matrix

**Usage**

unify_mat_list(mat_list, default = 0)

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mat_list</td>
<td>a list of matrix, all of them should have dimension names</td>
</tr>
<tr>
<td>default</td>
<td>default values for the newly added rows and columns</td>
</tr>
</tbody>
</table>

**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
INDEX

32
component_width
(component_width-dispatch), 32
(component_width-Heatmap-method), 33
(component_width-HeatmapList-method), 34
(component_width-dispatch), 32
(component_width-Heatmap-method), 33
(component_width-HeatmapList-method), 34
(component_width-dispatch), 32
(component_width-Heatmap-method), 33
(component_width-HeatmapList-method), 34

decorate_annotation, 34
decorate_column_dend, 35
decorate_column_names, 36
decorate_column_title, 36
decorate_dend, 35, 37, 40
decorate_dimnames, 36, 38, 41
decorate_heatmap_body, 39
decorate_row_dend, 40
decorate_row_names, 41
decorate_row_title, 41
decorate_title, 36, 37, 41, 42
dendrogram, 62, 65
density, 13
densityHeatmap, 43
dist, 45, 65
dist2, 45
draw (draw-dispatch), 46
draw, Heatmap-method
(draw-Heatmap-method), 46
draw, HeatmapAnnotation-method
(draw-HeatmapAnnotation-method), 47
draw, HeatmapList-method
(draw-HeatmapList-method), 48
draw, SingleAnnotation-method
(draw-SingleAnnotation-method), 50
draw-dispatch, 46
draw-Heatmap-method, 46
draw-HeatmapAnnotation-method, 47
draw-HeatmapList-method, 48
draw-SingleAnnotation-method, 50
draw_annotation
(draw_annotation-Heatmap-method), 51
draw_annotation,Heatmap-method
(draw_annotation-Heatmap-method), 51
draw_annotation-Heatmap-method, 51
draw_annotation_legend
(draw_annotation_legend-HeatmapList-method), 52
draw_annotation_legend,HeatmapList-method
(draw_annotation_legend-HeatmapList-method), 52
draw_annotation_legend-HeatmapList-method, 52
draw_dend (draw_dend-Heatmap-method), 53
draw_dend, Heatmap-method
(draw_dend-Heatmap-method), 53
draw_dend-Heatmap-method, 53
draw_dimnames
(draw_dimnames-Heatmap-method), 54
draw_dimnames, Heatmap-method
(draw_dimnames-Heatmap-method), 54
draw_dimnames-Heatmap-method, 54
draw_heatmap_body
(draw_heatmap_body-Heatmap-method), 55
draw_heatmap_body, Heatmap-method
(draw_heatmap_body-Heatmap-method), 55
draw_heatmap_body-Heatmap-method, 55
draw_heatmap_legend
(draw_heatmap_legend-HeatmapList-method), 56
draw_heatmap_legend, HeatmapList-method
(draw_heatmap_legend-HeatmapList-method), 56
draw_heatmap_legend-HeatmapList-method, 56
draw_heatmap_list
(draw_heatmap_list-HeatmapList-method), 56
draw_heatmap_list, HeatmapList-method
(draw_heatmap_list-HeatmapList-method), 56
draw_heatmap_list-HeatmapList-method, 56
draw_title (draw_title-dispatch), 57
draw_title, Heatmap-method
(draw_title-Heatmap-method), 58
draw_title, HeatmapList-method
(draw_title-HeatmapList-method), 59
draw_title-dispatch, 57
draw_title-Heatmap-method, 58
draw_title-HeatmapList-method, 59
enhanced_basicplot, 59
INDEX

row_order, Heatmap-method
   (row_order-Heatmap-method), 99
row_order, HeatmapList-method
   (row_order-HeatmapList-method), 100
row_order-dispatch, 99
row_order-Heatmap-method, 99
row_order-HeatmapList-method, 100
rowAnnotation, 72, 92
seekViewport, 35, 37–39, 42
selectArea, 100
set_component_height
   (set_component_height-Heatmap-method), 101
set_component_height, Heatmap-method
   (set_component_height-Heatmap-method), 101
set_component_height-Heatmap-method, 101
show(show-dispatch), 102
show, ColorMapping-method
   (show-ColorMapping-method), 102
show, Heatmap-method
   (show-Heatmap-method), 103
show, HeatmapAnnotation-method
   (show-HeatmapAnnotation-method), 104
show, HeatmapList-method
   (show-HeatmapList-method), 104
show, SingleAnnotation-method
   (show-SingleAnnotation-method), 105
show-ColorMapping-method, 102
show-dispatch, 102
show-Heatmap-method, 103
show-HeatmapAnnotation-method, 104
show-HeatmapList-method, 104
show-SingleAnnotation-method, 105
SingleAnnotation, 71, 77, 106, 108
SingleAnnotation-class, 108
textGrob, 86, 87

unify_mat_list, 88, 109
viewport, 21, 47, 53–55, 58, 62