

# Package ‘ComplexHeatmap’

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**Type** Package

**Title** Make Complex Heatmaps

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

**biocViews** Software, Visualization, Sequencing

**URL** <https://github.com/jokergoo/ComplexHeatmap>,  
<https://jokergoo.github.io/ComplexHeatmap-reference/book/>

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---

ComplexHeatmap-package

*Make complex heatmaps*

---

## Description

Make complex heatmaps

## Details

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

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

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

There are also several internal classes:

- [SingleAnnotation-class](#): a single row annotation or column annotation.
- [ColorMapping-class](#): mapping from values to colors.
- [AnnotationFunction-class](#): construct an annotation function which allows subsetting.

Following two high-level functions take use of functionality of complex heatmaps:

- [oncoPrint](#): oncoPrint plot which visualize genomic alterations in a set of genes.
- [densityHeatmap](#): use heatmaps to visualize density distributions.

The complete reference of ComplexHeatmap package is available at <http://jokergoo.github.io/ComplexHeatmap-reference/book>.

## Examples

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

---

+.AdditiveUnit                    *Horizontally Add Heatmaps or Annotations to a Heatmap List*

---

## Description

Horizontally Add Heatmaps or 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. Column annotations should be added to the heatmap list by `%v%`.

x and y can also be NULL.

## Value

A [HeatmapList-class](#) object.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## See Also

`%v%` operator is used for vertical heatmap list.

## Examples

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



---

`AdditiveUnit`*Constructor Method for AdditiveUnit Class*

---

**Description**

Constructor Method for AdditiveUnit Class

**Usage**

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

**Arguments**

...            Black hole arguments.

**Details**

This method is not used in the package.

**Value**

No value is returned.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

`AdditiveUnit-class`*Class for Concatenating Heatmaps and Annotations*

---

**Description**

Class for Concatenating Heatmaps and Annotations

**Details**

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

**Examples**

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

---

add\_heatmap-dispatch    *Method dispatch page for add\_heatmap*

---

**Description**

Method dispatch page for add\_heatmap.

**Dispatch**

add\_heatmap can be dispatched on following classes:

- [add\\_heatmap, Heatmap-method, Heatmap-class](#) class method
- [add\\_heatmap, HeatmapList-method, HeatmapList-class](#) class method
- [add\\_heatmap, HeatmapAnnotation-method, HeatmapAnnotation-class](#) class method

**Examples**

```
# no example
NULL
```

---

add\_heatmap-Heatmap-method  
*Add Heatmap to the Heatmap List*

---

**Description**

Add Heatmap to the Heatmap List

**Usage**

```
## S4 method for signature 'Heatmap'
add_heatmap(object, x, direction = c("horizontal", "vertical"))
```

**Arguments**

object	A <a href="#">Heatmap-class</a> object.
x	a <a href="#">Heatmap-class</a> object, a <a href="#">HeatmapAnnotation-class</a> object or a <a href="#">HeatmapList-class</a> object.
direction	Whether the heatmap is added horizontal or vertically?

**Details**

Normally we directly use + for horizontal concatenation and %v% for vertical concatenation.

**Value**

A [HeatmapList-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

add\_heatmap-HeatmapAnnotation-method

*Add Annotations or Heatmaps as a Heatmap List*

---

**Description**

Add Annotations or Heatmaps as a Heatmap List

**Usage**

```
## S4 method for signature 'HeatmapAnnotation'
add_heatmap(object, x, direction = c("horizontal", "vertical"))
```

**Arguments**

object	A <a href="#">HeatmapAnnotation-class</a> object.
x	A <a href="#">Heatmap-class</a> object, a <a href="#">HeatmapAnnotation-class</a> object or a <a href="#">HeatmapList-class</a> object.
direction	Whether it is horizontal list or a vertical list?

**Details**

Normally we directly use + for horizontal concatenation and %v% for vertical concatenation.

**Value**

A [HeatmapList-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

---

add\_heatmap-HeatmapList-method

*Add heatmaps and row annotations to the heatmap list*

---

## Description

Add heatmaps and row annotations to the heatmap list

## Usage

```
## S4 method for signature 'HeatmapList'
add_heatmap(object, x, direction = c("horizontal", "vertical"))
```

## Arguments

object	a <a href="#">HeatmapList-class</a> object.
x	a <a href="#">Heatmap-class</a> object or a <a href="#">HeatmapAnnotation-class</a> object or a <a href="#">HeatmapList-class</a> object.
direction	direction of the concatenation.

## Details

There is a shortcut function `+.AdditiveUnit`.

## Value

A [HeatmapList-class](#) object.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

---

adjust\_dend\_by\_x      *Adjust the Positions of nodes/leaves in the Dendrogram*

---

**Description**

Adjust the Positions of nodes/leaves in the Dendrogram

**Usage**

```
adjust_dend_by_x(dend, leaf_pos = 1:nobs(dend)-0.5)
```

**Arguments**

dend                    A [dendrogram](#) object.  
leaf\_pos                A vector of positions of leaves. The value can also be a [unit](#) object.

**Details**

The positions of nodes stored as x attribute are recalculated based on the new positions of leaves.  
By default, the position of leaves are at 0.5, 1.5, ..., n-0.5.

**Examples**

```
m = matrix(rnorm(100), 10)
dend = as.dendrogram(hclust(dist(m)))
dend = adjust_dend_by_x(dend, sort(runif(10)))
str(dend)
dend = adjust_dend_by_x(dend, unit(1:10, "cm"))
str(dend)
```

---

adjust\_heatmap\_list-HeatmapList-method  
*Adjust Heatmap List*

---

**Description**

Adjust Heatmap List

**Usage**

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

**Arguments**

object                A [HeatmapList-class](#) object.

**Details**

This function adjusts settings in all other heatmaps according to the main heatmap. It also adjust the size of heatmap annotations to make them aligned nicely.

This function is only for internal use.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

alter_graphic	<i>Automatically generate alter_fun</i>
---------------	---

---

**Description**

Automatically generate alter\_fun

**Usage**

```
alter_graphic(graphic = c("rect", "point"),
  width = 1, height = 1,
  horiz_margin = unit(1, "pt"), vertical_margin = unit(1, "pt"),
  fill = "red", col = NA, pch = 16, ...)
```

**Arguments**

graphic	Graphic to draw.
width	Relative width of the rectangle.
height	Relative height of the rectangle.
horiz_margin	Horizontal margin. E.g. if you want 1mm margin on top and 1mm margin at bottom of the rectangle, set this value to <code>unit(1, 'mm')</code> .
vertical_margin	Vertical margin.
fill	Filled color.
col	Border color.
pch	Pch for points
...	Pass to <a href="#">gpar</a>

## Details

This function aims to simplify the definition of functions in `alter_fun`. Now it only supports rectangles and points.

## Examples

```
mat = read.table(textConnection(
"s1,s2,s3
g1,snv;indel,snv,indel
g2,,snv;indel,snv
g3,snv,,indel;snv"), row.names = 1, header = TRUE, sep = ",", stringsAsFactors = FALSE)
mat = as.matrix(mat)
col = c(snv = "red", indel = "blue")

oncoPrint(mat,
alter_fun = list(
snv = alter_graphic("rect", width = 0.9, height = 0.9, fill = col["snv"]),
indel = alter_graphic("rect", width = 0.9, height = 0.9, fill = col["indel"])
), col = col)
```

---

AnnotationFunction      *Constructor of AnnotationFunction Class*

---

## Description

Constructor of AnnotationFunction Class

## Usage

```
AnnotationFunction(fun, fun_name = "", which = c("column", "row"),
var_import = list(), n = NA, data_scale = c(0, 1), subset_rule = list(),
subsetable = length(subset_rule) > 0, show_name = TRUE, width = NULL, height = NULL)
```

## Arguments

<code>fun</code>	A function which defines how to draw the annotation. See <b>Details</b> section.
<code>fun_name</code>	The name of the function. It is only used for printing the object.
<code>which</code>	Whether it is drawn as a column annotation or a row annotation?
<code>var_import</code>	The names of the variables or the variable themselves that the annotation function depends on. See <b>Details</b> section.
<code>n</code>	Number of observations in the annotation. It is not mandatory, but it is better to provide this information so that the higher order <a href="#">HeatmapAnnotation</a> knows it and it can perform check on the consistency of annotations and heatmaps.
<code>data_scale</code>	The data scale on the data axis (y-axis for column annotation and x-axis for row annotation). It is only used when <a href="#">decorate_annotation</a> is used with "native" unit coordinates.

subset_rule	The rule of subsetting variables in <code>var_import</code> . It should be set when users want the final object to be subsettable. See <b>Details</b> section.
subsettable	Whether the object is subsettable?
show_name	It is used to turn off the drawing of annotation names in <code>HeatmapAnnotation</code> . Annotations always have names associated and normally they will be drawn beside the annotation graphics to tell what the annotation is about. e.g. the annotation names put beside the points annotation graphics. However, for some of the annotations, the names are not necessarily to be drawn, such as text annotations drawn by <code>anno_text</code> or an empty annotation drawn by <code>anno_empty</code> . In this case, when <code>show_names</code> is set to <code>FALSE</code> , there will be no annotation names drawn for the annotation.
width	The width of the plotting region (the viewport) that the annotation is drawn. If it is a row annotation, the width must be an absolute unit. Since the <code>AnnotationFunction</code> object is always contained by the <code>SingleAnnotation-class</code> object, you can only set the width of row annotations or height of column annotations, while e.g. the height of the row annotation is always <code>unit(1, "npc")</code> which means it always fully filled in the parent <code>SingleAnnotation</code> and only in <code>SingleAnnotation</code> or even <code>HeatmapAnnotation</code> can adjust the height of the row annotations.
height	The height of the plotting region (the viewport) that the annotation is drawn. If it is a column annotation, the width must be an absolute unit.

### Details

In the package, we have implemented quite a lot annotation functions by `AnnotationFunction` constructor: `anno_empty`, `anno_image`, `anno_points`, `anno_lines`, `anno_barplot`, `anno_boxplot`, `anno_histogram`, `anno_density`, `anno_joyplot`, `anno_horizon`, `anno_text` and `anno_mark`. These built-in annotation functions support as both row annotations and column annotations and they are all subsettable.

The built-in annotation functions are already enough for most of the analysis, nevertheless, if users want to know more about how to construct the `AnnotationFunction` class manually, they can refer to <https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#implement-new-annotation-functions>.

### Value

A `AnnotationFunction-class` object which can be used in `HeatmapAnnotation`.

### Examples

```
x = 1:10
anno1 = AnnotationFunction(
  fun = function(index, k, n) {
    n = length(index)
    pushViewport(viewport(xscale = c(0.5, n + 0.5), yscale = c(0, 10)))
    grid.rect()
    grid.points(1:n, x[index], default.units = "native")
    if(k == 1) grid.yaxis()
    popViewport()
```



```

    },
    var_import = list(x = x),
    n = 10,
    subsetable = TRUE,
    height = unit(2, "cm")
  )
  m = rbind(1:10, 11:20)
  Heatmap(m, top_annotation = HeatmapAnnotation(foo = anno1))
  Heatmap(m, top_annotation = HeatmapAnnotation(foo = anno1), column_km = 2)

```

---

 AnnotationFunction-class

*The AnnotationFunction Class*


---

## Description

The AnnotationFunction Class

## Details

The heatmap annotation is basically graphics aligned to the heatmap columns or rows. There is no restriction for the graphic types, e.g. it can be heatmap-like annotation or points. Here the AnnotationFunction class is designed for creating complex and flexible annotation graphics. As the main part of the class, it uses a user-defined function to define the graphics. It also keeps information of the size of the plotting regions of the annotation. And most importantly, it allows subsetting to the annotation to draw a subset of the graphics, which is the base for the splitting of the annotations.

See [AnnotationFunction](#) constructor for details.

## Examples

```

# There is no example
NULL

```

---

 annotation\_axis\_grob *Grob for Annotation Axis*


---

## Description

Grob for Annotation Axis

## Usage

```

annotation_axis_grob(at = NULL, labels = at, labels_rot = 0, gp = gpar(),
  side = "left", facing = "outside", direction = "normal", scale = NULL)

```

**Arguments**

at	Break values. If it is not specified, it is inferred from data scale in current viewport.
labels	Corresponding labels.
labels_rot	Rotations of labels.
gp	Graphic parameters.
side	side of the axis of the annotation viewport.
facing	Facing of the axis.
direction	Direction of the axis. Value should be "normal" or "reverse".
scale	The data scale. If it is NULL, it is inferred from current viewport.

**Value**

A `grob` object.

**Examples**

```
gb = annotation_axis_grob(at = 1:5, labels = month.name[1:5], labels_rot = 0,
  side = "left", facing = "outside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "left", facing = "outside"')
grid.draw(gb)
popViewport()
```

```
gb = annotation_axis_grob(at = 1:5, labels = month.name[1:5], labels_rot = 0,
  side = "left", facing = "inside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "left", facing = "inside"')
grid.draw(gb)
popViewport()
```

```
gb = annotation_axis_grob(at = 1:5, labels = month.name[1:5], labels_rot = 0,
  side = "right", facing = "outside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "right", facing = "outside"')
grid.draw(gb)
popViewport()
```

```
gb = annotation_axis_grob(at = 1:5, labels = month.name[1:5], labels_rot = 0,
  side = "right", facing = "inside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
```

```
grid.text('side = "right", facing = "inside"')
grid.draw(gb)
popViewport()

gb = annotation_axis_grob(at = 1:3, labels = month.name[1:3], labels_rot = 0,
  side = "top", facing = "outside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "top", facing = "outside"')
grid.draw(gb)
popViewport()

gb = annotation_axis_grob(at = 1:3, labels = month.name[1:3], labels_rot = 90,
  side = "top", facing = "outside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "top", facing = "outside"')
grid.draw(gb)
popViewport()

gb = annotation_axis_grob(at = 1:3, labels = month.name[1:3], labels_rot = 45,
  side = "top", facing = "outside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "top", facing = "outside"')
grid.draw(gb)
popViewport()

gb = annotation_axis_grob(at = 1:3, labels = month.name[1:3], labels_rot = 0,
  side = "top", facing = "inside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "top", facing = "inside"')
grid.draw(gb)
popViewport()

gb = annotation_axis_grob(at = 1:3, labels = month.name[1:3], labels_rot = 0,
  side = "bottom", facing = "outside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
grid.rect()
grid.text('side = "bottom", facing = "outside"')
grid.draw(gb)
popViewport()

gb = annotation_axis_grob(at = 1:3, labels = month.name[1:3], labels_rot = 0,
  side = "bottom", facing = "inside")
grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
```

```

grid.rect()
grid.text('side = "bottom", facing = "inside"')
grid.draw(gb)
popViewport()

grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
gb = annotation_axis_grob(labels_rot = 0, side = "left", facing = "outside")
grid.rect()
grid.text('side = "left", facing = "outside"')
grid.draw(gb)
popViewport()

grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
gb = annotation_axis_grob(side = "left", direction = "reverse")
grid.rect()
grid.text('side = "left", direction = "reverse"')
grid.draw(gb)
popViewport()

grid.newpage()
pushViewport(viewport(xscale = c(0, 4), yscale = c(0, 6), width = 0.6, height = 0.6))
gb = annotation_axis_grob(side = "bottom", direction = "reverse")
grid.rect()
grid.text('side = "bottom", directio = "reverse"')
grid.draw(gb)
popViewport()

```

---

annotation\_legend\_size-HeatmapList-method  
*Size of the Annotation Legends*

---

## Description

Size of the Annotation Legends

## Usage

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

## Arguments

object	a <a href="#">HeatmapList-class</a> object.
legend_list	A list of self-defined legend, should be wrapped into <a href="#">grob</a> objects. It is normally constructed by <a href="#">Legend</a> .
...	Other arguments.

**Details**

Internally, all annotation legends are packed by `packLegend` as a single `grob` object.  
This function is only for internal use.

**Value**

A `unit` object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

anno_barplot	<i>Barplot Annotation</i>
--------------	---------------------------

---

**Description**

Barplot Annotation

**Usage**

```
anno_barplot(x, baseline = 0, which = c("column", "row"), border = TRUE, bar_width = 0.6,
  gp = gpar(fill = "#CCCCCC"), ylim = NULL, extend = 0.05, axis = TRUE,
  axis_param = default_axis_param(which),
  width = NULL, height = NULL, ...)
```

**Arguments**

<code>x</code>	The value vector. The value can be a vector or a matrix. The length of the vector or the number of rows of the matrix is taken as the number of the observations of the annotation. If <code>x</code> is a vector, the barplots will be represented as stacked barplots.
<code>baseline</code>	baseline of bars. The value should be "min" or "max", or a numeric value. It is enforced to be zero for stacked barplots.
<code>which</code>	Whether it is a column annotation or a row annotation?
<code>border</code>	Whether draw borders of the annotation region?
<code>bar_width</code>	Relative width of the bars. The value should be smaller than one.
<code>gp</code>	Graphic parameters for points. The length of each graphic parameter can be 1, length of <code>x</code> if <code>x</code> is a vector, or number of columns of <code>x</code> if <code>x</code> is a matrix.

ylim	Data ranges. By default it is <code>range(x)</code> if <code>x</code> is a vector, or <code>range(rowSums(x))</code> if <code>x</code> is a matrix.
extend	The extension to both side of <code>ylim</code> . The value is a percent value corresponding to <code>ylim[2] - ylim[1]</code> .
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <a href="#">default_axis_param</a> for all possible settings and default parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.
...	Other arguments.

**Value**

An annotation function which can be used in [HeatmapAnnotation](#).

**See Also**

[https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#barplot\\_annotation](https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#barplot_annotation)

**Examples**

```
anno = anno_barplot(1:10)
draw(anno, test = "a vector")

m = matrix(runif(4*10), nc = 4)
m = t(apply(m, 1, function(x) x/sum(x)))
anno = anno_barplot(m, gp = gpar(fill = 2:5), bar_width = 1, height = unit(6, "cm"))
draw(anno, test = "proportion matrix")
```

---

anno\_block

*Block annotation*


---

**Description**

Block annotation

**Usage**

```
anno_block(gp = gpar(), labels = NULL, labels_gp = gpar(),
  labels_rot = ifelse(which == "row", 90, 0),
  labels_offset = unit(0.5, "npc"), labels_just = "center",
  which = c("column", "row"), width = NULL, height = NULL, show_name = FALSE,
  graphics = NULL)
```

**Arguments**

gp	Graphic parameters.
labels	Labels put on blocks.
labels_gp	Graphic parameters for labels.
labels_rot	Rotation for labels.
labels_offset	Positions of the labels. It controls offset on y-directions for column annotation and on x-direction for row annotation.
labels_just	Justification of the labels.
which	Is it a row annotation or a column annotation?
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.
show_name	Whether show annotation name.
graphics	A self-defined function that draws graphics in each slice. It must have two arguments: 1. row/column indices for the current slice and a vector of levels from the split variable that correspond to current slice. When graphics is set, all other graphics parameters in <code>anno_block</code> are ignored.

**Details**

The block annotation is used for representing slices. The length of all arguments should be 1 or the number of slices.

**Value**

An annotation function which can be used in `HeatmapAnnotation`.

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#block-annotation>

**Examples**

```
Heatmap(matrix(rnorm(100), 10),
  top_annotation = HeatmapAnnotation(foo = anno_block(gp = gpar(fill = 2:4),
    labels = c("group1", "group2", "group3"), labels_gp = gpar(col = "white"))),
  column_km = 3,
  left_annotation = rowAnnotation(foo = anno_block(gp = gpar(fill = 2:4),
    labels = c("group1", "group2", "group3"), labels_gp = gpar(col = "white"))),
  row_km = 3)

# ===== set the graphics argument =====
col = c("1" = "red", "2" = "blue", "A" = "green", "B" = "orange")
Heatmap(matrix(rnorm(100), 10), row_km = 2, row_split = sample(c("A", "B"), 10, replace = TRUE)) +
  rowAnnotation(foo = anno_block(
```

```

graphics = function(index, levels) {
  grid.rect(gp = gpar(fill = col[levels[2]], col = "black"))
  grid.text(paste(levels, collapse = ","), 0.5, 0.5, rot = 90,
  gp = gpar(col = col[levels[1]]))
}
))

labels = c("1" = "one", "2" = "two", "A" = "Group_A", "B" = "Group_B")
Heatmap(matrix(rnorm(100), 10), row_km = 2, row_split = sample(c("A", "B"), 10, replace = TRUE)) +
rowAnnotation(foo = anno_block(graphics = function(index, levels) {
  grid.rect(gp = gpar(fill = col[levels[2]], col = "black"))
  grid.text(paste(labels[levels], collapse = ","), 0.5, 0.5, rot = 90,
  gp = gpar(col = col[levels[1]]))
})))

Heatmap(matrix(rnorm(100), 10), row_km = 2, row_split = sample(c("A", "B"), 10, replace = TRUE)) +
rowAnnotation(foo = anno_block(
  graphics = function(index, levels) {
    grid.rect(gp = gpar(fill = col[levels[2]], col = "black"))
    txt = paste(levels, collapse = ",")
    txt = paste0(txt, "\n", length(index), " rows")
    grid.text(txt, 0.5, 0.5, rot = 0,
    gp = gpar(col = col[levels[1]]))
  },
  width = unit(3, "cm")
))

```

anno\_boxplot

*Boxplot Annotation***Description**

Boxplot Annotation

**Usage**

```

anno_boxplot(x, which = c("column", "row"), border = TRUE,
  gp = gpar(fill = "#CCCCCC"), ylim = NULL, extend = 0.05, outline = TRUE, box_width = 0.6,
  pch = 1, size = unit(2, "mm"), axis = TRUE, axis_param = default_axis_param(which),
  width = NULL, height = NULL, ...)

```

**Arguments**

x	A matrix or a list. If x is a matrix and if which is column, statistics for boxplots are calculated by columns, if which is row, the calculation is done by rows.
which	Whether it is a column annotation or a row annotation?
border	Whether draw borders of the annotation region?
gp	Graphic parameters for the boxes. The length of the graphic parameters should be one or the number of observations.



ylim	Data ranges.
extend	The extension to both side of ylim. The value is a percent value corresponding to ylim[2] -ylim[1].
outline	Whether draw outline of boxplots?
box_width	Relative width of boxes. The value should be smaller than one.
pch	Point style.
size	Point size.
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <a href="#">default_axis_param</a> for all possible settings and default parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.
...	Other arguments.

**Value**

An annotation function which can be used in [HeatmapAnnotation](#).

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#box-annotation>

**Examples**

```
set.seed(123)
m = matrix(rnorm(100), 10)
anno = anno_boxplot(m, height = unit(4, "cm"))
draw(anno, test = "anno_boxplot")
anno = anno_boxplot(m, height = unit(4, "cm"), gp = gpar(fill = 1:10))
draw(anno, test = "anno_boxplot with gp")
```

---

anno\_density

*Density Annotation*


---

**Description**

Density Annotation

**Usage**

```
anno_density(x, which = c("column", "row"),
             type = c("lines", "violin", "heatmap"), xlim = NULL,
             heatmap_colors = rev(brewer.pal(name = "RdYlBu", n = 11)),
             joyplot_scale = 1, border = TRUE, gp = gpar(fill = "#CCCCCC"),
             axis = TRUE, axis_param = default_axis_param(which),
             width = NULL, height = NULL)
```

**Arguments**

x	A matrix or a list. If x is a matrix and if which is column, statistics for boxplots are calculated by columns, if which is row, the calculation is done by rows.
which	Whether it is a column annotation or a row annotation?
type	Type of graphics to represent density distribution. "lines" for normal density plot; "violine" for violin plot and "heatmap" for heatmap visualization of density distribution.
xlim	Range on x-axis.
heatmap_colors	A vector of colors for interpolating density values.
joyplot_scale	Relative height of density distribution. A value higher than 1 increases the height of the density distribution and the plot will be represented as so-called "joyplot".
border	Whether draw borders of the annotation region?
gp	Graphic parameters for the boxes. The length of the graphic parameters should be one or the number of observations.
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <a href="#">default_axis_param</a> for all possible settings and default parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

**Value**

An annotation function which can be used in [HeatmapAnnotation](#).

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#density-annotation>

**Examples**

```
m = matrix(rnorm(100), 10)
anno = anno_density(m, which = "row")
draw(anno, test = "normal density")
anno = anno_density(m, which = "row", type = "violin")
```

```

draw(anno, test = "violin")
anno = anno_density(m, which = "row", type = "heatmap")
draw(anno, test = "heatmap")
anno = anno_density(m, which = "row", type = "heatmap",
  heatmap_colors = c("white", "orange"))
draw(anno, test = "heatmap, colors")

```

---

anno\_empty

*Empty Annotation*


---

## Description

Empty Annotation

## Usage

```

anno_empty(which = c("column", "row"), border = TRUE, zoom = FALSE,
  width = NULL, height = NULL)

```

## Arguments

which	Whether it is a column annotation or a row annotation?
border	Whether draw borders of the annotation region?
zoom	If it is true and when the heatmap is split, the empty annotation slices will have equal height or width, and you can see the correspondance between the annotation slices and the original heatmap slices.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

## Details

It creates an empty annotation and holds space, later users can add graphics by [decorate\\_annotation](#). This function is useful when users have difficulty to implement [AnnotationFunction](#) object.

In following example, an empty annotation is first created and later points are added:

```

m = matrix(rnorm(100), 10)
ht = Heatmap(m, top_annotation = HeatmapAnnotation(pt = anno_empty()))
ht = draw(ht)
co = column_order(ht)[[1]]
pt_value = 1:10
decorate_annotation("pt", {
  pushViewport(viewport(xscale = c(0.5, ncol(mat))+0.5), yscale = range(pt_value)))
  grid.points(seq_len(ncol(mat)), pt_value[co], pch = 16, default.units = "native")
  grid.yaxis()
  popViewport()
})

```

And it is similar as using `anno_points`:

```
Heatmap(m, top_annotation = HeatmapAnnotation(pt = anno_points(pt_value)))
```

### Value

An annotation function which can be used in `HeatmapAnnotation`.

### See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#empty-annotation>

### Examples

```
anno = anno_empty()
draw(anno, test = "anno_empty")
anno = anno_empty(border = FALSE)
draw(anno, test = "anno_empty without border")
```

---

anno_histogram	<i>Histogram Annotation</i>
----------------	-----------------------------

---

### Description

Histogram Annotation

### Usage

```
anno_histogram(x, which = c("column", "row"), n_breaks = 11,
  border = FALSE, gp = gpar(fill = "#CCCCCC"),
  axis = TRUE, axis_param = default_axis_param(which),
  width = NULL, height = NULL)
```

### Arguments

<code>x</code>	A matrix or a list. If <code>x</code> is a matrix and if <code>which</code> is <code>column</code> , statistics for boxplots are calculated by columns, if <code>which</code> is <code>row</code> , the calculation is done by rows.
<code>which</code>	Whether it is a column annotation or a row annotation?
<code>n_breaks</code>	Number of breaks for calculating histogram.
<code>border</code>	Whether draw borders of the annotation region?
<code>gp</code>	Graphic parameters for the boxes. The length of the graphic parameters should be one or the number of observations.
<code>axis</code>	Whether to add axis?
<code>axis_param</code>	parameters for controlling axis. See <code>default_axis_param</code> for all possible settings and default parameters.

width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

**Value**

An annotation function which can be used in [HeatmapAnnotation](#).

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#histogram-annotation>

**Examples**

```
m = matrix(rnorm(1000), nc = 10)
anno = anno_histogram(t(m), which = "row")
draw(anno, test = "row histogram")
anno = anno_histogram(t(m), which = "row", gp = gpar(fill = 1:10))
draw(anno, test = "row histogram with color")
anno = anno_histogram(t(m), which = "row", n_breaks = 20)
draw(anno, test = "row histogram with color")
```

---

anno_horizon	<i>Horizon chart Annotation</i>
--------------	---------------------------------

---

**Description**

Horizon chart Annotation

**Usage**

```
anno_horizon(x, which = c("column", "row"),
             gp = gpar(pos_fill = "#D73027", neg_fill = "#313695"),
             n_slice = 4, slice_size = NULL, negative_from_top = FALSE,
             normalize = TRUE, gap = unit(0, "mm"),
             axis = TRUE, axis_param = default_axis_param(which),
             width = NULL, height = NULL)
```

**Arguments**

x	A matrix or a list. If x is a matrix or a data frame, columns correspond to observations.
which	Whether it is a column annotation or a row annotation?

gp	Graphic parameters for the boxes. The length of the graphic parameters should be one or the number of observations. There are two unstandard parameters specifically for horizon chart: <code>pos_fill</code> and <code>neg_fill</code> controls the filled color for positive values and negative values.
n_slice	Number of slices on y-axis.
slice_size	Height of the slice. If the value is not NULL, <code>n_slice</code> will be recalculated.
negative_from_top	Whether the areas for negative values start from the top or the bottom of the plotting region?
normalize	Whether normalize <code>x</code> by <code>max(abs(x))</code> .
gap	Gap size of neighbouring horizon chart.
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <code>default_axis_param</code> for all possible settings and default parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

### Details

Horizon chart as row annotation is only supported.

### Value

An annotation function which can be used in `HeatmapAnnotation`.

### See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#horizon-chart-annotation>

### Examples

```
lt = lapply(1:20, function(x) cumprod(1 + runif(1000, -x/100, x/100)) - 1)
anno = anno_horizon(lt, which = "row")
draw(anno, test = "horizon chart")
anno = anno_horizon(lt, which = "row",
  gp = gpar(pos_fill = "orange", neg_fill = "darkgreen"))
draw(anno, test = "horizon chart, col")
anno = anno_horizon(lt, which = "row", negative_from_top = TRUE)
draw(anno, test = "horizon chart + negative_from_top")
anno = anno_horizon(lt, which = "row", gap = unit(1, "mm"))
draw(anno, test = "horizon chart + gap")
anno = anno_horizon(lt, which = "row",
  gp = gpar(pos_fill = rep(c("orange", "red"), each = 10),
  neg_fill = rep(c("darkgreen", "blue"), each = 10))
draw(anno, test = "horizon chart, col")
```

---

anno\_image

*Image Annotation*

---

## Description

Image Annotation

## Usage

```
anno_image(image, which = c("column", "row"), border = TRUE,  
           gp = gpar(fill = NA, col = NA), space = unit(1, "mm"),  
           width = NULL, height = NULL)
```

## Arguments

image	A vector of file paths of images. The format of the image is inferred from the suffix name of the image file. NA values or empty strings in the vector means no image to drawn.
which	Whether it is a column annotation or a row annotation?
border	Whether draw borders of the annotation region?
gp	Graphic parameters for annotation grids. If the image has transparent background, the <code>fill</code> parameter can be used to control the background color in the annotation grids.
space	The space around the image to the annotation grid borders. The value should be a <code>unit</code> object.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

## Details

This function supports image formats in png, svg, pdf, eps, jpeg/jpg, tiff. png, jpeg/jpg and tiff images are imported by `readPNG`, `readJPEG` and `readTIFF`, and drawn by `grid.raster`. svg images are firstly reformatted by `rsvg::rsvg_svg` and then imported by `readPicture` and drawn by `grid.picture`. pdf and eps images are imported by `PostScriptTrace` and `readPicture`, later drawn by `grid.picture`.

Different image formats can be mixed in the `image` vector.

## Value

An annotation function which can be used in `HeatmapAnnotation`.

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#image-annotation>

**Examples**

```
# download the free icons from https://github.com/Keyamoon/IcoMoon-Free
## Not run:
image = sample(dir("~/Downloads/IcoMoon-Free-master/PNG/64px", full.names = TRUE), 10)
anno = anno_image(image)
draw(anno, test = "png")
image[1:5] = ""
anno = anno_image(image)
draw(anno, test = "some of png")

## End(Not run)
```

---

anno\_joyplot

*Joyplot Annotation*

---

**Description**

Joyplot Annotation

**Usage**

```
anno_joyplot(x, which = c("column", "row"), gp = gpar(fill = "#000000"),
  scale = 2, transparency = 0.6,
  axis = TRUE, axis_param = default_axis_param(which),
  width = NULL, height = NULL)
```

**Arguments**

x	A matrix or a list. If x is a matrix or a data frame, columns correspond to observations.
which	Whether it is a column annotation or a row annotation?
gp	Graphic parameters for the boxes. The length of the graphic parameters should be one or the number of observations.
scale	Relative height of the curve. A value higher than 1 increases the height of the curve.
transparency	Transparency of the filled colors. Value should be between 0 and 1.
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <a href="#">default_axis_param</a> for all possible settings and default parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.



**Value**

An annotation function which can be used in [HeatmapAnnotation](#).

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#joyplot-annotation>

**Examples**

```
m = matrix(rnorm(1000), nc = 10)
lt = apply(m, 2, function(x) data.frame(density(x)[c("x", "y")]))
anno = anno_joyplot(lt, width = unit(4, "cm"), which = "row")
draw(anno, test = "joyplot")
anno = anno_joyplot(lt, width = unit(4, "cm"), which = "row", gp = gpar(fill = 1:10))
draw(anno, test = "joyplot + col")
anno = anno_joyplot(lt, width = unit(4, "cm"), which = "row", scale = 1)
draw(anno, test = "joyplot + scale")

m = matrix(rnorm(5000), nc = 50)
lt = apply(m, 2, function(x) data.frame(density(x)[c("x", "y")]))
anno = anno_joyplot(lt, width = unit(4, "cm"), which = "row", gp = gpar(fill = NA), scale = 4)
draw(anno, test = "joyplot")
```

---

anno\_lines

*Lines Annotation*


---

**Description**

Lines Annotation

**Usage**

```
anno_lines(x, which = c("column", "row"), border = TRUE, gp = gpar(),
  add_points = smooth, smooth = FALSE, pch = 16, size = unit(2, "mm"), pt_gp = gpar(), ylim = NULL,
  extend = 0.05, axis = TRUE, axis_param = default_axis_param(which),
  width = NULL, height = NULL)
```

**Arguments**

x	The value vector. The value can be a vector or a matrix. The length of the vector or the number of rows of the matrix is taken as the number of the observations of the annotation.
which	Whether it is a column annotation or a row annotation?
border	Whether draw borders of the annotation region?
gp	Graphic parameters for lines. The length of each graphic parameter can be 1, or number of columns of x is x is a matrix.

add_points	Whether to add points on the lines?
smooth	If it is TRUE, smoothing by <code>loess</code> is performed. If it is TRUE, <code>add_points</code> is set to TRUE by default.
pch	Point type. The length setting is the same as <code>gp</code> .
size	Point size, the value should be a <code>unit</code> object. The length setting is the same as <code>gp</code> .
pt_gp	Graphic parameters for points. The length setting is the same as <code>gp</code> .
ylim	Data ranges. By default it is <code>range(x)</code> .
extend	The extension to both side of <code>ylim</code> . The value is a percent value corresponding to <code>ylim[2] - ylim[1]</code> .
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <code>default_axis_param</code> for all possible settings and default parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

### Value

An annotation function which can be used in `HeatmapAnnotation`.

### See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#lines-annotation>

### Examples

```
anno = anno_lines(runif(10))
draw(anno, test = "anno_lines")
anno = anno_lines(cbind(c(1:5, 1:5), c(5:1, 5:1)), gp = gpar(col = 2:3))
draw(anno, test = "matrix")
anno = anno_lines(cbind(c(1:5, 1:5), c(5:1, 5:1)), gp = gpar(col = 2:3),
  add_points = TRUE, pt_gp = gpar(col = 5:6), pch = c(1, 16))
draw(anno, test = "matrix")
```

---

anno\_link

*Link Annotation*

---

### Description

Link Annotation

**Usage**

```
anno_link(...)
```

**Arguments**

```
...          Pass to anno\_zoom.
```

**Details**

This function is the same as [anno\\_zoom](#). It links subsets of rows or columns to a list of graphic regions.

**Examples**

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

---

anno_mark	<i>Link annotation with labels</i>
-----------	------------------------------------

---

**Description**

Link annotation with labels

**Usage**

```
anno_mark(at, labels, which = c("column", "row"),
  side = ifelse(which == "column", "top", "right"),
  lines_gp = gpar(), labels_gp = gpar(),
  labels_rot = ifelse(which == "column", 90, 0), padding = unit(1, "mm"),
  link_width = unit(5, "mm"), link_height = link_width,
  link_gp = lines_gp,
  extend = unit(0, "mm"))
```

**Arguments**

at	Numeric index from the original matrix.
labels	Corresponding labels.
which	Whether it is a column annotation or a row annotation?
side	Side of the labels. If it is a column annotation, valid values are "top" and "bottom"; If it is a row annotation, valid values are "left" and "right".
lines_gp	Please use link_gp instead.
link_gp	Graphic settings for the segments.
labels_gp	Graphic settings for the labels.

labels_rot	Rotations of labels, scalar.
padding	Padding between neighbouring labels in the plot.
link_width	Width of the segments.
link_height	Similar as link_width, used for column annotation.
extend	By default, the region for the labels has the same width (if it is a column annotation) or same height (if it is a row annotation) as the heatmap. The size can be extended by this options. The value can be a proportion number or a <a href="#">unit</a> object. The length can be either one or two.

### 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

An annotation function which can be used in [HeatmapAnnotation](#).

### See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#mark-annotation>

### Examples

```
anno = anno_mark(at = c(1:4, 20, 60, 97:100), labels = month.name[1:10], which = "row")
draw(anno, index = 1:100, test = "anno_mark")
```

```
m = matrix(1:1000, byrow = TRUE, nr = 100)
anno = anno_mark(at = c(1:4, 20, 60, 97:100), labels = month.name[1:10], which = "row")
Heatmap(m, cluster_rows = FALSE, cluster_columns = FALSE) + rowAnnotation(mark = anno)
Heatmap(m) + rowAnnotation(mark = anno)
```

---

anno\_ancoprint\_barplot

*Barplot Annotation for oncoPrint*

---

### Description

Barplot Annotation for oncoPrint

### Usage

```
anno_ancoprint_barplot(type = NULL, which = c("column", "row"),
  bar_width = 0.6, ylim = NULL, show_fraction = FALSE, axis = TRUE,
  axis_param = if(which == "column") default_axis_param("column") else list(side = "top", labels_rot =
  width = NULL, height = NULL, border = FALSE)
```

**Arguments**

type	A vector of the alteration types in the data. It can be a subset of all alteration types if you don't want to show them all.
which	Is it a row annotation or a column annotation?
bar_width	Width of the bars.
ylim	Data range.
show_fraction	Whether to show the numbers or the fractions?
axis	Whether draw axis?
axis_param	Parameters for controlling axis.
width	Width of the annotation.
height	Height of the annotation.
border	Whether draw the border?

**Details**

This annotation function should always be used with [oncoPrint](#).

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

anno\_points

*Points Annotation*

---

**Description**

Points Annotation

**Usage**

```
anno_points(x, which = c("column", "row"), border = TRUE, gp = gpar(), pch = 16,  
size = unit(2, "mm"), ylim = NULL, extend = 0.05, axis = TRUE,  
axis_param = default_axis_param(which), width = NULL, height = NULL, ...)
```

## Arguments

x	The value vector. The value can be a vector or a matrix. The length of the vector or the number of rows of the matrix is taken as the number of the observations of the annotation.
which	Whether it is a column annotation or a row annotation?
border	Whether draw borders of the annotation region?
gp	Graphic parameters for points. The length of each graphic parameter can be 1, length of x if x is a vector, or number of columns of x if x is a matrix.
pch	Point type. The length setting is the same as gp.
size	Point size, the value should be a <code>unit</code> object. The length setting is the same as gp.
ylim	Data ranges. By default it is <code>range(x)</code> .
extend	The extension to both side of ylim. The value is a percent value corresponding to <code>ylim[2] - ylim[1]</code> .
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <code>default_axis_param</code> for all possible settings and default parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.
...	Other arguments.

## Value

An annotation function which can be used in `HeatmapAnnotation`.

## See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#points-annotation>

## Examples

```
anno = anno_points(runif(10))
draw(anno, test = "anno_points")
anno = anno_points(matrix(runif(20), nc = 2), pch = 1:2)
draw(anno, test = "matrix")
```

anno\_simple

*Simple Annotation***Description**

Simple Annotation

**Usage**

```
anno_simple(x, col, na_col = "grey",
            which = c("column", "row"), border = FALSE, gp = gpar(col = NA),
            pch = NULL, pt_size = unit(1, "snpc")*0.8, pt_gp = gpar(),
            simple_anno_size = ht_opt$simple_anno_size,
            width = NULL, height = NULL)
```

**Arguments**

x	The value vector. The value can be a vector or a matrix. The length of the vector or the nrow of the matrix is taken as the number of the observations of the annotation. The value can be numeric or character and NA value is allowed.
col	Color that maps to x. If x is numeric and needs a continuous mapping, col should be a color mapping function which accepts a vector of values and returns a vector of colors. Normally it is generated by <a href="#">colorRamp2</a> . If x is discrete (numeric or character) and needs a discrete color mapping, col should be a vector of colors with levels in x as vector names. If col is not specified, the color mapping is randomly generated by <code>ComplexHeatmap:::default_col</code> .
na_col	Color for NA value.
which	Whether it is a column annotation or a row annotation?
border	Whether draw borders of the annotation region?
gp	Graphic parameters for grid borders. The fill parameter is disabled.
pch	Points/symbols that are added on top of the annotation grids. The value can be numeric or single letters. It can be a vector if x is a vector and a matrix if x is a matrix. No points are drawn if the corresponding values are NA.
pt_size	Size of the points/symbols. It should be a <a href="#">unit</a> object. If x is a vector, the value of pt_size can be a vector, while if x is a matrix, pt_size can only be a single value.
pt_gp	Graphic parameters for points/symbols. The length setting is same as pt_size. If pch is set as letters, the fontsize should be set as <code>pt_gp = gpar(fontsize = ...)</code> .
simple_anno_size	size of the simple annotation.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

**Details**

The "simple annotation" is the most widely used annotation type which is heatmap-like, where the grid colors correspond to the values. `anno_simple` also supports to add points/symbols on top of the grids where the it can be normal point (when `pch` is set as numbers) or letters (when `pch` is set as single letters).

**Value**

An annotation function which can be used in [HeatmapAnnotation](#).

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#simple-annotation-as-an-annotation-function>

**Examples**

```
anno = anno_simple(1:10)
draw(anno, test = "a numeric vector")

anno = anno_simple(cbind(1:10, 10:1))
draw(anno, test = "a matrix")

anno = anno_simple(1:10, pch = c(1:4, NA, 6:8, NA, 10))
draw(anno, test = "pch has NA values")

anno = anno_simple(1:10, pch = c(rep("A", 5), rep(NA, 5)))
draw(anno, test = "pch has NA values")

pch = matrix(1:20, nc = 2)
pch[sample(length(pch), 10)] = NA
anno = anno_simple(cbind(1:10, 10:1), pch = pch)
draw(anno, test = "matrix, pch is a matrix with NA values")
```

---

anno\_summary

*Summary Annotation*


---

**Description**

Summary Annotation

**Usage**

```
anno_summary(which = c("column", "row"), border = TRUE, bar_width = 0.8,
  axis = TRUE, axis_param = default_axis_param(which),
  ylim = NULL, extend = 0.05, outline = TRUE, box_width = 0.6,
  pch = 1, size = unit(2, "mm"), gp = gpar(),
  width = NULL, height = NULL)
```



**Arguments**

which	Whether it is a column annotation or a row annotation?
border	Whether draw borders of the annotation region?
bar_width	Relative width of the bars. The value should be smaller than one.
axis	Whether to add axis?
axis_param	parameters for controlling axis. See <a href="#">default_axis_param</a> for all possible settings and default parameters.
ylim	Data ranges. ylim for barplot is enforced to be $c(0, 1)$ .
extend	The extension to both side of ylim. The value is a percent value corresponding to $ylim[2] - ylim[1]$ . This argument is only for boxplot.
outline	Whether draw outline of boxplots?
box_width	Relative width of boxes. The value should be smaller than one.
pch	Point style.
size	Point size.
gp	Graphic parameters.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.

**Details**

anno\_summary is a special annotation function that it only works for one-column or one-row heatmap. It shows the summary of the values in the heatmap. If the values in the heatmap is discrete, the proportion of each level (the sum is normalized to 1) is visualized as stacked barplot. If the heatmap is split into multiple slices, multiple bars are put in the annotation. If the value is continuous, boxplot is used.

In the barplot, the color schema is used as the same as the heatmap, while for the boxplot, the color needs to be controlled by gp.

**Value**

An annotation function which can be used in [HeatmapAnnotation](#).

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#summary-annotation>

**Examples**

```
ha = HeatmapAnnotation(summary = anno_summary(height = unit(4, "cm")))
v = sample(letters[1:2], 50, replace = TRUE)
split = sample(letters[1:2], 50, replace = TRUE)
Heatmap(v, top_annotation = ha, width = unit(1, "cm"), split = split)
```

```
ha = HeatmapAnnotation(summary = anno_summary(gp = gpar(fill = 2:3), height = unit(4, "cm")))
v = rnorm(50)
Heatmap(v, top_annotation = ha, width = unit(1, "cm"), split = split)
```

---

anno\_text

*Text Annotation*


---

## Description

Text Annotation

## Usage

```
anno_text(x, which = c("column", "row"), gp = gpar(),
  rot = guess_rot(), just = guess_just(),
  offset = guess_location(), location = guess_location(),
  width = NULL, height = NULL, show_name = FALSE)
```

## Arguments

x	A vector of text.
which	Whether it is a column annotation or a row annotation?
gp	Graphic parameters.
rot	Rotation of the text, pass to <a href="#">grid.text</a> .
just	Justification of text, pass to <a href="#">grid.text</a> .
offset	Deprecated, use <code>location</code> instead.
location	Position of the text. By default <code>rot</code> , <code>just</code> and <code>location</code> are automatically inferred according to whether it is a row annotation or column annotation. The value of <code>location</code> should be a <a href="#">unit</a> object, normally in <code>npc</code> unit. E.g. <code>unit(0, 'npc')</code> means the most left of the annotation region and <code>unit(1, 'npc')</code> means the most right of the annotation region.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.
show_name	Whether to show the annotation name.

## Value

An annotation function which can be used in [HeatmapAnnotation](#).

## See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#text-annotation>

**Examples**

```

anno = anno_text(month.name)
draw(anno, test = "month names")
anno = anno_text(month.name, gp = gpar(fontsize = 16))
draw(anno, test = "month names with fontsize")
anno = anno_text(month.name, gp = gpar(fontsize = 1:12+4))
draw(anno, test = "month names with changing fontsize")
anno = anno_text(month.name, which = "row")
draw(anno, test = "month names on rows")
anno = anno_text(month.name, location = 0, rot = 45,
  just = "left", gp = gpar(col = 1:12))
draw(anno, test = "with rotations")
anno = anno_text(month.name, location = 1,
  rot = 45, just = "right", gp = gpar(fontsize = 1:12+4))
draw(anno, test = "with rotations")

```

anno\_zoom

*Zoom annotation***Description**

Zoom annotation

**Usage**

```

anno_zoom(align_to, panel_fun = function(index, nm = NULL) { grid.rect() },
  which = c("column", "row"), side = ifelse(which == "column", "top", "right"),
  size = NULL, gap = unit(1, "mm"),
  link_width = unit(5, "mm"), link_height = link_width, link_gp = gpar(),
  extend = unit(0, "mm"), width = NULL, height = NULL, internal_line = TRUE)

```

**Arguments**

align_to	It defines how the boxes correspond to the rows or the columns in the heatmap. If the value is a list of indices, each box corresponds to the rows or columns with indices in one vector in the list. If the value is a categorical variable (e.g. a factor or a character vector) that has the same length as the rows or columns in the heatmap, each box corresponds to the rows/columns in each level in the categorical variable.
panel_fun	A self-defined function that defines how to draw graphics in the box. The function must have a <code>index</code> argument which is the indices for the rows/columns that the box corresponds to. It can have second argument <code>nm</code> which is the "name" of the selected part in the heatmap. The corresponding value for <code>nm</code> comes from <code>align_to</code> if it is specified as a categorical variable or a list with names.
which	Whether it is a column annotation or a row annotation?
side	Side of the boxes. If it is a column annotation, valid values are "top" and "bottom"; If it is a row annotation, valid values are "left" and "right".

size	The size of boxes. It can be pure numeric that they are treated as relative fractions of the total height/width of the heatmap. The value of size can also be absolute units.
gap	Gaps between boxes.
link_gp	Graphic settings for the segments.
link_width	Width of the segments.
link_height	Similar as link_width, used for column annotation.
extend	By default, the region for the labels has the same width (if it is a column annotation) or same height (if it is a row annotation) as the heatmap. The size can be extended by this options. The value can be a proportion number or a <code>unit</code> object. The length can be either one or two.
width	Width of the annotation. The value should be an absolute unit. Width is not allowed to be set for column annotation.
height	Height of the annotation. The value should be an absolute unit. Height is not allowed to be set for row annotation.
internal_line	Internally used.

### Details

`anno_zoom` creates several plotting regions (boxes) which can be corresponded to subsets of rows/columns in the heatmap.

### Value

An annotation function which can be used in `HeatmapAnnotation`.

### See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html#zoom-annotation>

### Examples

```
set.seed(123)
m = matrix(rnorm(100*10), nrow = 100)
subgroup = sample(letters[1:3], 100, replace = TRUE, prob = c(1, 5, 10))
rg = range(m)
panel_fun = function(index, nm) {
  pushViewport(viewport(xscale = rg, yscale = c(0, 2)))
  grid.rect()
  grid.xaxis(gp = gpar(fontsize = 8))
  grid.boxplot(m[index, ], pos = 1, direction = "horizontal")
  grid.text(paste("distribution of group", nm), mean(rg), y = 1.9,
    just = "top", default.units = "native", gp = gpar(fontsize = 10))
  popViewport()
}
anno = anno_zoom(align_to = subgroup, which = "row", panel_fun = panel_fun,
  size = unit(2, "cm"), gap = unit(1, "cm"), width = unit(4, "cm"))
Heatmap(m, right_annotation = rowAnnotation(foo = anno), row_split = subgroup)
```

---

 attach\_annotation-Heatmap-method

*Attach heatmap annotations to the heatmap*


---

### Description

Attach heatmap annotations to the heatmap

### Usage

```
## S4 method for signature 'Heatmap'
attach_annotation(object, ha, side = c("top", "bottom", "left", "right"),
  gap = unit(1, "points"))
```

### Arguments

object	A <a href="#">Heatmap-class</a> object.
ha	A <a href="#">HeatmapAnnotation-class</a> object.
side	Which side of the heatmap. Value should be in "top", "bottom", "left", "right".
gap	Space between the two heatmap annotations.

### Examples

```
m = matrix(rnorm(100), 10)
ht = Heatmap(m)
ha = HeatmapAnnotation(foo = 1:10)
ht = attach_annotation(ht, ha)
ht
ha2 = HeatmapAnnotation(bar = letters[1:10])
ht = attach_annotation(ht, ha2)
ht
```

---

 bar3D

*Draw 3D bars*


---

### Description

Draw 3D bars

### Usage

```
bar3D(x, y, w, h, l, theta = 60, default.units = "npc", fill = "white", col = "black")
```

**Arguments**

x	x coordinate of the center point in the bottom face.
y	y coordinate of the center point in the bottom face.
w	Width of the bottom face.
h	Height of the bottom face.
l	Length of the bars (in the z-direction).
theta	The angle for the projection.
default.units	Units.
fill	Filled colors for the bars.
col	Border colors.

**Examples**

```
grid.newpage()
bar3D(c(0.3, 0.7), 0.5, 0.2, 0.2, 0.2, fill = 2:3)
```

---

bin\_genome

*Bin the genome*


---

**Description**

Bin the genome

**Usage**

```
bin_genome(species = "hg19", bins = 2000, bin_size = NULL, ...)
```

**Arguments**

species	Abbreviation of the genome, pass to <a href="#">read.chromInfo</a> .
bins	Number of bins. The final number of bins is approximately equal to it.
bin_size	Size of the bins. If bin_size is set, bins is ignored.
...	All pass to <a href="#">read.chromInfo</a> . E.g. you can set a subset of chromosomes there.

**Value**

A [GRanges](#) object of the genomic bins.

**Examples**

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



### Details

The heatmap annotations should have same number of observations.

### Examples

```
ha1 = HeatmapAnnotation(foo = 1:10)
ha2 = HeatmapAnnotation(bar = anno_points(10:1))
ha = c(ha1, ha2)
ha
ha3 = HeatmapAnnotation(sth = cbind(1:10, 10:1))
ha = c(ha1, ha2, ha3, gap = unit(c(1, 4), "mm"))
ha
```

---

cluster\_between\_groups

*Cluster only between Groups*

---

### Description

Cluster only between Groups

### Usage

```
cluster_between_groups(mat, factor)
```

### Arguments

mat	A matrix where clustering is applied on columns.
factor	A categorical vector.

### Details

The clustering is only applied between groups and inside a group, the order is unchanged.

### Value

A [dendrogram](#) object.

### Examples

```
m = matrix(rnorm(120), nc = 12)
colnames(m) = letters[1:12]
fa = rep(c("a", "b", "c"), times = c(2, 4, 6))
dend = cluster_between_groups(m, fa)
grid.dendrogram(dend, test = TRUE)
```



---

cluster\_within\_group *Cluster within and between Groups*

---

**Description**

Cluster within and between Groups

**Usage**

```
cluster_within_group(mat, factor)
```

**Arguments**

mat                    A matrix where clustering is applied on columns.  
 factor                A categorical vector.

**Details**

The clustering is firstly applied in each group, then clustering is applied to group means. The within-group dendrograms and between-group dendrogram are finally connected by [merge\\_dendrogram](#).

In the final dendrogram, the within group dendrograms are enforced to be flat lines to emphasize that the within group dendrograms have no sense to compare to between-group dendrogram.

**Value**

A [dendrogram](#) object. The order of columns can be retrieved by [order.dendrogram](#).

**Examples**

```
m = matrix(rnorm(120), nc = 12)
colnames(m) = letters[1:12]
fa = rep(c("a", "b", "c"), times = c(2, 4, 6))
dend = cluster_within_group(m, fa)
grid.dendrogram(dend, test = TRUE)
```

---

ColorMapping                    *Constructor Method for ColorMapping Class*

---

**Description**

Constructor Method for ColorMapping Class

**Usage**

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

**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 <code>colorRamp2</code> , breaks is automatically inferred from the color mapping function.
na_col	Colors for NA values.
full_col	A super set of colors, used internally.

**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**

```
cm = ColorMapping(colors = c("A" = "red", "B" = "black"))
cm
require(circlize)
col_fun = colorRamp2(c(0, 1), c("white", "red"))
cm = ColorMapping(col_fun = col_fun)
```

---

ColorMapping-class      *Class for Color Mapping*

---

**Description**

Class for Color Mapping

**Details**

The `ColorMapping-class` handles color mapping for 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 an object.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

---

color\_mapping\_legend-ColorMapping-method  
*Draw Legend Based on Color Mapping*

---

## Description

Draw Legend Based on Color Mapping

## Usage

```
## S4 method for signature 'ColorMapping'  
color_mapping_legend(object,  
  plot = TRUE, ...,  
  
  color_bar = object@type,  
  
  title = object@name,  
  title_gp = gpar(fontsize = 10, fontface = "bold"),  
  title_position = "topleft",  
  grid_height = unit(4, "mm"),  
  grid_width = unit(4, "mm"),  
  border = NULL,  
  at = object@levels,  
  labels = at,  
  labels_gp = gpar(fontsize = 10),  
  labels_rot = 0,  
  nrow = NULL,  
  ncol = 1,  
  by_row = FALSE,  
  legend_height = NULL,
```

```

legend_width = NULL,
legend_direction = c("vertical", "horizontal"),
break_dist = NULL,

graphics = NULL,
param = NULL)

```

### Arguments

object	A <a href="#">ColorMapping-class</a> object.
plot	Whether to plot or just return the legend object?
...	Pass to <a href="#">draw,Legends-method</a> .
color_bar	"continuous" or "discrete". It controls whether to show the discrete legend for the continuous color mapping.
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. See <a href="#">Legend</a> for all possible values.
grid_height	Height of each legend grid. Pass to <a href="#">Legend</a> .
grid_width	Width of each legend grid. Pass to <a href="#">Legend</a> .
border	Color for legend grid borders. Pass to <a href="#">Legend</a> .
at	Break values of the legend. By default it is the levels in the <a href="#">ColorMapping-class</a> object.
labels	Labels corresponding to break values.
labels_gp	Graphical parameters for legend labels.
labels_rot	Rotation of labels.
nrow	Pass to <a href="#">Legend</a> . It controls the layout of legend grids if they are arranged in multiple rows or columns.
ncol	Pass to <a href="#">Legend</a> . It controls the layout of legend grids if they are arranged in multiple rows or columns.
by_row	Pass to <a href="#">Legend</a> . It controls the order of legend grids if they are arranged in multiple rows or columns.
legend_height	Height of the legend body. It only works when color_bar is continuous and direction is vertical. Pass to <a href="#">Legend</a> .
legend_width	Width of the legend body. It only works when color_bar is continuous and direction is horizontal. Pass to <a href="#">Legend</a> .
legend_direction	When color_bar is continuous, whether the legend is vertical or horizontal? Pass to <a href="#">Legend</a> .
break_dist	A zooming factor to control relative distance of two neighbouring break values. The length of it should be length(at) - 1 or a scalar.
graphics	Internally used.
param	All the legend-related parameters can be specified as a single list.

**Details**

The legend is constructed by [Legend](#).

**Value**

A [Legends-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

columnAnnotation	<i>Construct Column Annotations</i>
------------------	-------------------------------------

---

**Description**

Construct Column Annotations

**Usage**

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

**Arguments**

```
...          Pass to HeatmapAnnotation.
```

**Details**

The function is identical to

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

**Value**

A [HeatmapAnnotation-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```
# 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,Heatmap-method](#), [Heatmap-class](#) class method
- [column\\_dend,HeatmapList-method](#), [HeatmapList-class](#) class method

### Examples

```
# no example  
NULL
```

---

column\_dend-Heatmap-method  
*Get Column Dendrograms from a Heatmap*

---

### Description

Get Column Dendrograms from a Heatmap

### Usage

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

### Arguments

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

### Value

The format of the returned object depends on whether rows/columns of the heatmaps are split.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```

mat = matrix(rnorm(100), 10)
ht = Heatmap(mat)
ht = draw(ht)
column_dend(ht)
ht = Heatmap(mat, column_km = 2)
ht = draw(ht)
column_dend(ht)

```

---

column\_dend-HeatmapList-method

*Get Column Dendrograms from a hHeatmap List*


---

**Description**

Get Column Dendrograms from a hHeatmap List

**Usage**

```

## S4 method for signature 'HeatmapList'
column_dend(object, name = NULL)

```

**Arguments**

object	A <a href="#">HeatmapList-class</a> object.
name	Name of a specific heatmap.

**Value**

The format of the returned object depends on whether rows/columns of the heatmaps are split.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```

mat = matrix(rnorm(100), 10)
ht_list = Heatmap(mat) + Heatmap(mat)
ht_list = draw(ht_list)
column_dend(ht_list)
ht_list = Heatmap(mat, column_km = 2) + Heatmap(mat, column_km = 2)
ht_list = draw(ht_list)
column_dend(ht_list)
ht_list = Heatmap(mat) %v% Heatmap(mat)
ht_list = draw(ht_list)
column_dend(ht_list)
ht_list = Heatmap(mat, column_km = 2) %v% Heatmap(mat)
ht_list = draw(ht_list)
column_dend(ht_list)

```

column\_order-dispatch *Method dispatch page for column\_order*

---

### Description

Method dispatch page for column\_order.

### Dispatch

column\_order can be dispatched on following classes:

- [column\\_order](#), [Heatmap-method](#), [Heatmap-class](#) class method
- [column\\_order](#), [HeatmapList-method](#), [HeatmapList-class](#) class method

### Examples

```
# no example  
NULL
```

---

column\_order-Heatmap-method  
*Get Column Order from a Aeatmap List*

---

### Description

Get Column Order from a Aeatmap List

### Usage

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

### Arguments

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

### Value

The format of the returned object depends on whether rows/columns of the heatmaps are split.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>



**Examples**

```

mat = matrix(rnorm(100), 10)
ht = Heatmap(mat)
ht = draw(ht)
column_order(ht)
ht = Heatmap(mat, column_km = 2)
ht = draw(ht)
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, name = NULL)

```

**Arguments**

object	A <a href="#">HeatmapList-class</a> object.
name	Name of a specific heatmap.

**Value**

The format of the returned object depends on whether rows/columns of the heatmaps are split.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```

mat = matrix(rnorm(100), 10)
ht_list = Heatmap(mat) + Heatmap(mat)
ht_list = draw(ht_list)
column_order(ht_list)
ht_list = Heatmap(mat, column_km = 2) + Heatmap(mat, column_km = 2)
ht_list = draw(ht_list)
column_order(ht_list)
ht_list = Heatmap(mat) %v% Heatmap(mat)
ht_list = draw(ht_list)
column_order(ht_list)
ht_list = Heatmap(mat, column_km = 2) %v% Heatmap(mat)
ht_list = draw(ht_list)
column_order(ht_list)

```

---

comb_degree	<i>Degrees of the Combination sets</i>
-------------	--

---

**Description**

Degrees of the Combination sets

**Usage**

```
comb_degree(m)
```

**Arguments**

`m` A combination matrix returned by [make\\_comb\\_mat](#).

**Details**

The degree for a combination set is the number of sets that are selected.

**Value**

A vector of degrees of the combination sets.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)
comb_degree(m)
```

---

comb_name	<i>Names of the Combination sets</i>
-----------	--------------------------------------

---

**Description**

Names of the Combination sets

**Usage**

```
comb_name(m, readable = FALSE)
```

**Arguments**

`m` A combination matrix returned by [make\\_comb\\_mat](#).  
`readable` Whether the combination represents as e.g. "A&B&C".

**Details**

The name of the combination sets are formatted as a string of binary bits. E.g. for three sets of "a", "b", "c", the combination set with name "101" corresponds to select set a, not select set b and select set c. The definition of "select" depends on the value of mode from [make\\_comb\\_mat](#).

**Value**

A vector of names of the combination sets.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
          b = sample(letters, 15),
          c = sample(letters, 20))
m = make_comb_mat(lt)
comb_name(m)
comb_name(m, readable = TRUE)
```

---

comb_size	<i>Sizes of the Combination sets</i>
-----------	--------------------------------------

---

**Description**

Sizes of the Combination sets

**Usage**

```
comb_size(m, degree = NULL)
```

**Arguments**

m	A combination matrix returned by <a href="#">make_comb_mat</a> .
degree	degree of the intersection. The value can be a vector.

**Value**

A vector of sizes of the combination sets.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
          b = sample(letters, 15),
          c = sample(letters, 20))
m = make_comb_mat(lt)
comb_size(m)
```

---

compare_heatmap	<i>Compare heatmaps between stats::heatmap() and ComplexHeatmap::heatmap()</i>
-----------------	--

---

**Description**

Compare heatmaps between stats::heatmap() and ComplexHeatmap::heatmap()

**Usage**

```
compare_heatmap(...)
```

**Arguments**

... The same set of arguments passed to stats::heatmap and ComplexHeatmap::heatmap.

**Details**

The function plots two heatmaps, one by stats::heatmap and one by ComplexHeatmap::heatmap. Users can see the difference between the two implementations.

**Examples**

```
mat = matrix(rnorm(100), 10)
compare_heatmap(mat)
```

---

compare_heatmap.2	<i>Compare heatmaps between gplots::heatmap.2() and ComplexHeatmap::heatmap()</i>
-------------------	---

---

**Description**

Compare heatmaps between gplots::heatmap.2() and ComplexHeatmap::heatmap()

**Usage**

```
compare_heatmap.2(...)
```

**Arguments**

... The same set of arguments passed to gplots::heatmap.2 and ComplexHeatmap::heatmap.2.

**Details**

The function plots two heatmaps, one by gplots::heatmap.2 and one by ComplexHeatmap::heatmap.2. Users can see the difference between the two implementations.

**Examples**

```
mat = matrix(rnorm(100), 10)
compare_heatmap.2(mat)
```

---

compare_pheatmap	<i>Compare heatmaps between pheatmap::pheatmap() and ComplexHeatmap::pheatmap()</i>
------------------	---

---

**Description**

Compare heatmaps between pheatmap::pheatmap() and ComplexHeatmap::pheatmap()

**Usage**

```
compare_pheatmap(...)
```

**Arguments**

... The same set of arguments passed to pheatmap::pheatmap and ComplexHeatmap::pheatmap.

**Details**

The function plots two heatmaps, one by pheatmap::pheatmap and one by ComplexHeatmap::pheatmap. Users can see the difference between the two implementations.

**Examples**

```
mat = matrix(rnorm(100), 10)
compare_pheatmap(mat)
```

---

complement_size	<i>Complement Set Size</i>
-----------------	----------------------------

---

**Description**

Complement Set Size

**Usage**

```
complement_size(m)
```

**Arguments**

m A combination matrix returned by [make\\_comb\\_mat](#).

**Value**

If there is no complement set, it returns zero.

**Examples**

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

---

component\_height-dispatch

*Method dispatch page for component\_height*

---

**Description**

Method dispatch page for component\_height.

**Dispatch**

component\_height can be dispatched on following classes:

- [component\\_height,HeatmapList-method, HeatmapList-class](#) class method
- [component\\_height,Heatmap-method, Heatmap-class](#) class method

**Examples**

```
# no example
NULL
```

---

component\_height-Heatmap-method

*Heights of Heatmap Components*

---

**Description**

Heights of Heatmap Components

**Usage**

```
## S4 method for signature 'Heatmap'
component_height(object, k = HEATMAP_LAYOUT_COLUMN_COMPONENT)
```

**Arguments**

object            A [Heatmap-class](#) object.  
 k                Which components in the heatmap. The value should numeric indices or the names of the corresponding column component. See **\*\*Detials\*\***.

**Details**

All column components are: column\_title\_top, column\_dend\_top, column\_names\_top, column\_anno\_top, heatmap\_body, column\_anno\_bottom, column\_names\_bottom, column\_dend\_bottom, column\_title\_bottom.  
 This function is only for internal use.

**Value**

A [unit](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

component\_height-HeatmapList-method  
*Height of Heatmap List Components*

---

**Description**

Height of Heatmap List Components

**Usage**

```
## S4 method for signature 'HeatmapList'
component_height(object, k = HEATMAP_LIST_LAYOUT_COLUMN_COMPONENT)
```

**Arguments**

object            A [HeatmapList-class](#) object.  
 k                Which component in the heatmap list. Values are in `ComplexHeatmap:::HEATMAP_LIST_LAYOUT_COLUMN_COMPONENT`

**Value**

A [unit](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

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, Heatmap-method, Heatmap-class](#) class method
- [component\\_width, HeatmapList-method, HeatmapList-class](#) class method

**Examples**

```
# no example  
NULL
```

---

component\_width-Heatmap-method

*Widths of Heatmap Components*

---

**Description**

Widths of Heatmap Components

**Usage**

```
## S4 method for signature 'Heatmap'  
component_width(object, k = HEATMAP_LAYOUT_ROW_COMPONENT)
```



**Arguments**

object            A [Heatmap-class](#) object.  
 k                Which components in the heatmap. The value should numeric indices or the names of the corresponding row component. See **\*\*Details\*\***.

**Details**

All row components are: row\_title\_left, row\_dend\_left, row\_names\_left, row\_anno\_left, heatmap\_body, row\_anno\_right, row\_names\_right, row\_dend\_right, row\_title\_right.

This function is only for internal use.

**Value**

A [unit](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

component\_width-HeatmapList-method

*Width of Heatmap List Components*

---

**Description**

Width of Heatmap List Components

**Usage**

```
## S4 method for signature 'HeatmapList'
component_width(object, k = HEATMAP_LIST_LAYOUT_ROW_COMPONENT)
```

**Arguments**

object            A [HeatmapList-class](#) object.  
 k                Which component in the heatmap list. Values are in `ComplexHeatmap:::HEATMAP_LIST_LAYOUT_ROW_CO`

**Details**

This function is only for internal use.

**Value**

A [unit](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

copy\_all-AnnotationFunction-method

*Copy the AnnotationFunction Object*

---

**Description**

Copy the AnnotationFunction Object

**Usage**

```
## S4 method for signature 'AnnotationFunction'
copy_all(object)
```

**Arguments**

object            The [AnnotationFunction-class](#) object.

**Details**

In [AnnotationFunction-class](#), there is an environment which stores some external variables for the annotation function (specified by the `var_import` argument when constructing the [AnnotationFunction-class](#) object. This [copy\\_all, AnnotationFunction-method](#) hard copies all the variables into a new isolated environment.

The environment is at `object@var_env`.

**Examples**

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

---

copy\_all-dispatch      *Method dispatch page for copy\_all*

---

**Description**

Method dispatch page for copy\_all.

**Dispatch**

copy\_all can be dispatched on following classes:

- [copy\\_all,SingleAnnotation-method](#), [SingleAnnotation-class](#) class method
- [copy\\_all,AnnotationFunction-method](#), [AnnotationFunction-class](#) class method

**Examples**

```
# no example
NULL
```

---

copy\_all-SingleAnnotation-method  
*Copy the SingleAnnotation object*

---

**Description**

Copy the SingleAnnotation object

**Usage**

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

**Arguments**

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

**Details**

Since the SingleAnnotation object always contains an [AnnotationFunction-class](#) object, it calls [copy\\_all,AnnotationFunction-method](#) to hard copy the variable environment.

**Examples**

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

---

 decorate\_annotation     *Decorate Heatmap Annotation*


---

**Description**

Decorate Heatmap Annotation

**Usage**

```
decorate_annotation(annotation, code, slice = 1, envir = new.env(parent = parent.frame()))
```

**Arguments**

annotation	Name of the annotation.
code	Code that adds graphics in the selected heatmap annotation.
slice	Index of the row slices or the column slice in the heatmap.
envir	Where to look for variables inside code.

**Details**

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

**Value**

The function returns no value.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-decoration.html>

**Examples**

```
set.seed(123)
ha1 = HeatmapAnnotation(df = data.frame(type = rep(letters[1:2], 5)))
ha2 = rowAnnotation(point = anno_points(runif(10), which = "row"))
Heatmap(matrix(rnorm(100), 10), name = "mat", km = 2,
  top_annotation = ha1) + ha2
decorate_annotation("type", {
  grid.circle(x = unit(c(0.2, 0.4, 0.6, 0.8), "npc"),
    gp = gpar(fill = "#FF000080"))
})
decorate_annotation("point", {
```

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

---

decorate\_column\_dend *Decorate Heatmap Column Dendrograms*

---

## Description

Decorate Heatmap Column Dendrograms

## Usage

```
decorate_column_dend(..., envir = new.env(parent = parent.frame()))
```

## Arguments

... Pass to [decorate\\_dend](#).  
envir Where to look for variables inside code.

## Details

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

## Value

The function returns no value.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

---

decorate\_column\_names *Decorate Heatmap Column Names*

---

**Description**

Decorate Heatmap Column Names

**Usage**

```
decorate_column_names(..., envir = new.env(parent = parent.frame()))
```

**Arguments**

... Pass to [decorate\\_dimnames](#).  
envir Where to look for variables inside code.

**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**

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

---

decorate\_column\_title *Decorate Heatmap Column Titles*

---

**Description**

Decorate Heatmap Column Titles

**Usage**

```
decorate_column_title(..., envir = new.env(parent = parent.frame()))
```

**Arguments**

... Pass to `decorate_title`.  
 envir Where to look for variables inside code.

**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**

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

---

decorate_dend	<i>Decorate Heatmap Dendrograms</i>
---------------	-------------------------------------

---

**Description**

Decorate Heatmap Dendrograms

**Usage**

```
decorate_dend(heatmap, code, slice = 1, which = c("column", "row"),
  envir = new.env(parent = parent.frame()))
```

**Arguments**

heatmap Name of the heatmap.  
 code Code that adds graphics in the selected heatmap dendrogram.  
 slice Index of the row slice or column slice in the heatmap.  
 which Is the dendrogram on rows or on columns?  
 envir Where to look for variables inside code.

**Details**

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

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

**Value**

This function returns no value.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-decoration.html>

**Examples**

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

---

decorate_dimnames	<i>Decorate Heatmap Dimension Names</i>
-------------------	---

---

**Description**

Decorate Heatmap Dimension Names

**Usage**

```
decorate_dimnames(heatmap, code, slice = 1, which = c("column", "row"),
  envir = new.env(parent = parent.frame()))
```

**Arguments**

heatmap	Name of the heatmap.
code	Code that adds graphics in the selected viewport.
slice	Index of the row slice or column slice in the heatmap.
which	on rows or on columns?
envir	where to look for variables inside code.



## Details

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  $i^{\text{th}}$  name is located at:

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

## Value

The function returns no value.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

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

---

decorate\_heatmap\_body *Decorate Heatmap Bodies*

---

## Description

Decorate Heatmap Bodies

## Usage

```
decorate_heatmap_body(heatmap, code,
  slice = 1, row_slice = slice, column_slice = 1,
  envir = new.env(parent = parent.frame()))
```

## Arguments

heatmap	Name of the heatmap which is set as name argument in <a href="#">Heatmap</a> function.
code	Code that adds graphics in the selected heatmap body.
slice	Index of the row slice in the heatmap.
row_slice	Index of the row slice in the heatmap.
column_slice	Index of the column slice in the heatmap.
envir	Where to look for variables inside code.

## Details

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

## Value

This function returns no value.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-decoration.html>

## Examples

```
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 Row Dendrograms*

---

## Description

Decorate Heatmap Row Dendrograms

## Usage

```
decorate_row_dend(..., envir = new.env(parent = parent.frame()))
```

## Arguments

...	Pass to <a href="#">decorate_dend</a> .
envir	Where to look for variables inside code?

## 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**

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

---

decorate\_row\_names      *Decorate Heatmap Row Names*

---

**Description**

Decorate Heatmap Row Names

**Usage**

```
decorate_row_names(..., envir = new.env(parent = parent.frame()))
```

**Arguments**

...	Pass to <a href="#">decorate_dimnames</a> .
envir	Where to look for variables inside code.

**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**

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

---

decorate\_row\_title     *Decorate Heatmap Row Titles*

---

**Description**

Decorate Heatmap Row Titles

**Usage**

```
decorate_row_title(..., envir = new.env(parent = parent.frame()))
```

**Arguments**

...            Pass to [decorate\\_title](#).  
envir          Where to look for variables inside code.

**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**

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

---

decorate\_title     *Decorate Heatmap Titles*

---

**Description**

Decorate Heatmap Titles

**Usage**

```
decorate_title(heatmap, code, slice = 1, which = c("column", "row"),  
              envir = new.env(parent = parent.frame()))
```

**Arguments**

heatmap	Name of the heatmap.
code	Code that adds graphics in the selected viewport.
slice	Index of the row slice or column slice in the heatmap.
which	Is it a row title or a column title?
envir	Where to look for variables inside code.

**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`, runs code to that viewport and finally goes back to the original viewport.

**Value**

The function returns no value.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-decoration.html>

**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)
```

---

default\_axis\_param      *The Default Parameters for Annotation Axis*

---

**Description**

The Default Parameters for Annotation Axis

**Usage**

```
default_axis_param(which)
```

**Arguments**

which	Whether it is for column annotation or row annotation?
-------	--

**Details**

There are following parameters for the annotation axis:

**at** The breaks of axis. By default it is automatically inferred.

**labels** The corresponding axis labels.

**labels\_rot** The rotation of the axis labels.

**gp** Graphc parameters of axis labels. The value should be a [unit](#) object.

**side** If it is for column annotation, the value should only be one of left and right. If it is for row annotation, the value should only be one of top and bottom.

**facing** Whether the axis faces to the outside of the annotation region or inside. Sometimes when appending more than one heatmaps, the axes of column annotations of one heatmap might overlap to the neighbouring heatmap, setting facing to inside may invoid it.

**direction** The direction of the axis. Value should be "normal" or "reverse".

All the parameters are passed to [annotation\\_axis\\_grob](#) to construct an axis grob.

**Examples**

```
default_axis_param("column")
default_axis_param("row")
```

---

default_get_type	<i>Default get_type for oncoPrint()</i>
------------------	---

---

**Description**

Default get\_type for oncoPrint()

**Usage**

```
default_get_type(x)
```

**Arguments**

x                    A strings which encode multiple altertations.

**Details**

It recognizes following separators: ; : , |.

**Examples**

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

---

dendrogramGrob	<i>Grob for Dendrogram</i>
----------------	----------------------------

---

## Description

Grob for Dendrogram

## Usage

```
dendrogramGrob(dend, facing = c("bottom", "top", "left", "right"),
  order = c("normal", "reverse"), gp = gpar())
```

## Arguments

dend	A <a href="#">dendrogram</a> object.
facing	Facing of the dendrogram.
order	If it is set to reverse, the first leaf is put on the right if the dendrogram is horizontal and it is put on the top if the dendrogram is vertical.
gp	Graphic parameters for the dendrogram segments. If any of col, lwd or lty is set in the edgePar attribute of a node, the corresponding value defined in gp will be overwritten for this node, so gp is like global graphic parameters for dendrogram segments.

## Details

If dend has not been processed by [adjust\\_dend\\_by\\_x](#), internally [adjust\\_dend\\_by\\_x](#) is called to add x attributes to each node/leaf.

## Value

A [grob](#) object which is constructed by [segmentsGrob](#).

## Examples

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

---

dend_heights	<i>Height of the Dendrograms</i>
--------------	----------------------------------

---

**Description**

Height of the Dendrograms

**Usage**

```
dend_heights(x)
```

**Arguments**

x a [dendrogram](#) object or a list of [dendrogram](#) objects.

**Examples**

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

---

dend_xy	<i>Coordinates of the Dendrogram</i>
---------	--------------------------------------

---

**Description**

Coordinates of the Dendrogram

**Usage**

```
dend_xy(dend)
```

**Arguments**

dend a [dendrogram](#) object.

**Details**

dend will be processed by [adjust\\_dend\\_by\\_x](#) if it is processed yet.

**Value**

A list of leaf positions (x) and dendrogram height (y).



## Examples

```
m = matrix(rnorm(100), 10)
dend1 = as.dendrogram(hclust(dist(m)))
dend_xy(dend1)

dend1 = adjust_dend_by_x(dend1, sort(runif(10)))
dend_xy(dend1)

dend1 = adjust_dend_by_x(dend1, unit(1:10, "cm"))
dend_xy(dend1)
```

---

densityHeatmap

*Visualize Density Distribution by Heatmap*

---

## Description

Visualize Density Distribution by Heatmap

## Usage

```
densityHeatmap(data,
  density_param = list(na.rm = TRUE),

  col = rev(brewer.pal(11, "Spectral")),
  color_space = "LAB",
  ylab = deparse(substitute(data)),
  column_title = paste0("Density heatmap of ", deparse(substitute(data))),
  title = column_title,
  ylim = NULL,
  range = ylim,

  title_gp = gpar(fontsize = 14),
  ylab_gp = gpar(fontsize = 12),
  tick_label_gp = gpar(fontsize = 10),
  quantile_gp = gpar(fontsize = 10),
  show_quantiles = TRUE,

  column_order = NULL,
  column_names_side = "bottom",
  show_column_names = TRUE,
  column_names_max_height = unit(6, "cm"),
  column_names_gp = gpar(fontsize = 12),
  column_names_rot = 90,

  cluster_columns = FALSE,
  clustering_distance_columns = "ks",
  clustering_method_columns = "complete",
```

```
mc.cores = 1, cores = mc.cores,
...)
```

### Arguments

<code>data</code>	A matrix or a list. If it is a matrix, density is calculated by columns.
<code>density_param</code>	Parameters send to <a href="#">density</a> , <code>na.rm</code> is enforced to be TRUE.
<code>col</code>	A vector of colors that density values are mapped to.
<code>color_space</code>	The color space in which colors are interpolated. Pass to <a href="#">colorRamp2</a> .
<code>ylab</code>	Label on y-axis.
<code>column_title</code>	Title of the heatmap.
<code>title</code>	Same as <code>column_title</code> .
<code>ylim</code>	Ranges on the y-axis.
<code>range</code>	Same as <code>ylim</code> .
<code>title_gp</code>	Graphic parameters for title.
<code>ylab_gp</code>	Graphic parameters for y-labels.
<code>tick_label_gp</code>	Graphic parameters for y-ticks.
<code>quantile_gp</code>	Graphic parameters for the quantiles.
<code>show_quantiles</code>	Whether show quantile lines.
<code>column_order</code>	Order of columns.
<code>column_names_side</code>	Pass to <a href="#">Heatmap</a> .
<code>show_column_names</code>	Pass to <a href="#">Heatmap</a> .
<code>column_names_max_height</code>	Pass to <a href="#">Heatmap</a> .
<code>column_names_gp</code>	Pass to <a href="#">Heatmap</a> .
<code>column_names_rot</code>	Pass to <a href="#">Heatmap</a> .
<code>cluster_columns</code>	Whether cluster columns?
<code>clustering_distance_columns</code>	There is a specific distance method <code>ks</code> which is the Kolmogorov-Smirnov statistic between two distributions. For other methods, the distance is calculated on the density matrix.
<code>clustering_method_columns</code>	Pass to <a href="#">Heatmap</a> .
<code>mc.cores</code>	Multiple cores for calculating <code>ks</code> distance. This argument will be removed in future versions.
<code>cores</code>	Multiple cores for calculating <code>ks</code> distance.
<code>...</code>	Pass to <a href="#">Heatmap</a> .

**Details**

To visualize data distribution in a matrix or in a list, we normally use boxplot or violinplot. We can also use colors to map the density values and visualize distribution of values through a heatmap. It is useful if you have huge number of columns in data to visualize.

The density matrix is generated with 500 rows ranging between the maximum and minimal values in all densities.

**Value**

A `Heatmap-class` object. It can only add other heatmaps/annotations vertically.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/other-high-level-plots.html#density-heatmap>

**Examples**

```
matrix = matrix(rnorm(100), 10); colnames(matrix) = letters[1:10]
densityHeatmap(matrix)

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

ha = HeatmapAnnotation(points = anno_points(runif(10)),
  anno = rep(c("A", "B"), each = 5), col = list(anno = c("A" = "red", "B" = "blue")))
densityHeatmap(matrix, top_annotation = ha)
densityHeatmap(matrix, top_annotation = ha) %v% Heatmap(matrix, height = unit(6, "cm"))
```

---

dim.Heatmap

*Dimension of the Heatmap*

---

**Description**

Dimension of the Heatmap

**Usage**

```
## S3 method for class 'Heatmap'
dim(x)
```

**Arguments**

x                    A `Heatmap-class` object.

**Examples**

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

---

`dist2`*Calculate Pairwise Distance from a Matrix*

---

**Description**

Calculate Pairwise Distance from a Matrix

**Usage**

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

**Arguments**

<code>x</code>	A matrix or a list. If it is a matrix, the distance is calculated by rows.
<code>pairwise_fun</code>	A function which calculates distance between two vectors.
<code>...</code>	Pass to <a href="#">as.dist</a> .

**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**

```
lt = lapply(1:10, function(i) {
  sample(letters, sample(6:10, 1))
})
dist2(lt, function(x, y) {
  length(intersect(x, y))/length(union(x, y))
})
```

---

`draw-AnnotationFunction-method`*Draw the AnnotationFunction Object*

---

### Description

Draw the AnnotationFunction Object

### Usage

```
## S4 method for signature 'AnnotationFunction'  
draw(object, index, k = 1, n = 1, test = FALSE, ...)
```

### Arguments

<code>object</code>	The <a href="#">AnnotationFunction-class</a> object.
<code>index</code>	Index of observations.
<code>k</code>	Current slice index.
<code>n</code>	Total number of slices.
<code>test</code>	Is it in test mode? The value can be logical or a text which is plotted as the title of plot.
<code>...</code>	Pass to <a href="#">viewport</a> .

### Details

Normally it is called internally by the [SingleAnnotation-class](#).

When `test` is set to `TRUE`, the annotation graphic is directly drawn, which is generally for testing purpose.

### Examples

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

---

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,AnnotationFunction-method](#), [AnnotationFunction-class](#) class method
- [draw,Heatmap-method](#), [Heatmap-class](#) class method
- [draw,Legends-method](#), [Legends-class](#) class method
- [draw,SingleAnnotation-method](#), [SingleAnnotation-class](#) class method
- [draw,HeatmapList-method](#), [HeatmapList-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 <a href="#">Heatmap-class</a> object.
internal	If TRUE, it is only used inside the calling of <a href="#">draw,HeatmapList-method</a> . It only draws the heatmap without legends where the legend will be drawn by <a href="#">draw,HeatmapList-method</a> .
test	Only for testing. If it is TRUE, the heatmap body is directly drawn.
...	Pass to <a href="#">draw,HeatmapList-method</a> .

**Details**

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

There are some arguments which control the some settings of the heatmap such as legends. Please go to [draw,HeatmapList-method](#) for these arguments.

**Value**

A [HeatmapList-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

draw-HeatmapAnnotation-method  
*Draw the Heatmap Annotations*

---

**Description**

Draw the Heatmap Annotations

**Usage**

```
## S4 method for signature 'HeatmapAnnotation'
draw(object, index, k = 1, n = 1, ...,
      test = FALSE, anno_mark_param = list())
```

**Arguments**

object	A <a href="#">HeatmapAnnotation-class</a> object.
index	A vector of indices.
k	The current slice index for the annotation if it is split.
n	Total number of slices.
...	Pass to <a href="#">viewport</a> which contains all the annotations.
test	Is it in test mode? The value can be logical or a text which is plotted as the title of plot.
anno_mark_param	It contains specific parameters for drawing <a href="#">anno_mark</a> and pass to the <a href="#">draw,SingleAnnotation-method</a> .

**Value**

No value is returned.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

draw-HeatmapList-method

*Draw a list of heatmaps*

---

**Description**

Draw a list of heatmaps

**Usage**

```
## S4 method for signature 'HeatmapList'
draw(object,
      newpage = TRUE,
      background = "white",

      row_title = character(0),
      row_title_side = c("left", "right"),
      row_title_gp = gpar(fontsize = 13),
      column_title = character(0),
      column_title_side = c("top", "bottom"),
      column_title_gp = gpar(fontsize = 13),

      heatmap_legend_side = c("right", "left", "bottom", "top"),
      merge_legends = FALSE,
      show_heatmap_legend = TRUE,
      heatmap_legend_list = list(),
      annotation_legend_side = c("right", "left", "bottom", "top"),
      show_annotation_legend = TRUE,
      annotation_legend_list = list(),
      align_heatmap_legend = NULL,
      align_annotation_legend = NULL,
      legend_grouping = c("adjusted", "original"),

      gap = unit(2, "mm"),
```



```
ht_gap = gap,

main_heatmap = which(sapply(object@ht_list, inherits, "Heatmap"))[1],
padding = GLOBAL_PADDING,
adjust_annotation_extension = NULL,

auto_adjust = TRUE,
row_dend_side = c("original", "left", "right"),
row_sub_title_side = c("original", "left", "right"),
column_dend_side = c("original", "top", "bottom"),
column_sub_title_side = c("original", "top", "bottom"),

row_gap = NULL,
cluster_rows = NULL,
cluster_row_slices = 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,
row_km = km,
row_km_repeats = NULL,
row_split = split,
height = NULL,
heatmap_height = NULL,

column_gap = NULL,
cluster_columns = NULL,
cluster_column_slices = NULL,
clustering_distance_columns = NULL,
clustering_method_columns = NULL,
column_dend_width = NULL,
show_column_dend = NULL,
column_dend_reorder = NULL,
column_dend_gp = NULL,
column_order = NULL,
column_km = NULL,
column_km_repeats = NULL,
column_split = NULL,
width = NULL,
heatmap_width = NULL,

use_raster = NULL,
raster_device = NULL,
```

```

raster_quality = NULL,
raster_device_param = NULL,
raster_resize = NULL,

post_fun = NULL,
save_last = ht_opt$save_last,

### global setting
heatmap_row_names_gp = NULL,
heatmap_column_names_gp = NULL,
heatmap_row_title_gp = NULL,
heatmap_column_title_gp = NULL,
legend_title_gp = NULL,
legend_title_position = NULL,
legend_labels_gp = NULL,
legend_grid_height = NULL,
legend_grid_width = NULL,
legend_border = NULL,
legend_gap = NULL,
heatmap_border = NULL,
annotation_border = NULL,
fastcluster = NULL,
simple_anno_size = NULL,
show_parent_dend_line = NULL)

```

### Arguments

object	a <a href="#">HeatmapList-class</a> object.
newpage	whether create a new page for the graphics. If you want to arrange multiple plots in one page, I suggest to use <a href="#">grid.grabExpr</a> .
background	Background color of the whole plot.
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 to put heatmap legend
merge_legends	merge heatmap legends and annotation legends to put into one column.
show_heatmap_legend	whether show all heatmap legends
heatmap_legend_list	use-defined legends which are put after the heatmap legends

annotation_legend_side	side of the annotation legends
show_annotation_legend	whether show annotation legends
annotation_legend_list	user-defined legends which are put after the annotation legends
align_heatmap_legend	How to align the legends to heatmap. Possible values are "heatmap_center", "heatmap_top" and "global_center". If the value is NULL, it automatically picks the proper value from the three options.
align_annotation_legend	How to align the legends to heatmap. Possible values are "heatmap_center", "heatmap_top" and "global_center".
legend_grouping	How the legends are grouped. Values should be "adjusted" or "original". If it is set as "original", all annotation legends are grouped together.
gap	gap between heatmaps/annotations
ht_gap	same as gap.
main_heatmap	index of main heatmap. The value can be a numeric index or the heatmap name
padding	padding of the whole plot. The value is a unit vector of length 4, which corresponds to bottom, left, top and right.
adjust_annotation_extension	whether take annotation name into account when calculating positions of graphic elements.
auto_adjust	whether apply automatic adjustment? The auto-adjustment includes turning off dendrograms, titles and row/columns for non-main heatmaps.
row_dend_side	side of the dendrogram from the main heatmap
row_sub_title_side	side of the row title from the main heatmap
column_dend_side	side of the dendrogram from the main heatmap
column_sub_title_side	side of the column title from the main heatmap
row_gap	this modifies row_gap of the main heatmap
cluster_rows	this modifies cluster_rows of the main heatmap
cluster_row_slices	this modifies cluster_row_slices of the main heatmap
clustering_distance_rows	this modifies clustering_distance_rows of the main heatmap
clustering_method_rows	this modifies clustering_method_rows of the main heatmap
row_dend_width	this modifies row_dend_width of the main heatmap
show_row_dend	this modifies show_row_dend of the main heatmap

`row_dend_reorder` this modifies `row_dend_reorder` of the main heatmap  
`row_dend_gp` this modifies `row_dend_gp` of the main heatmap  
`row_order` this modifies `row_order` of the main heatmap  
`km` = this modifies `km` of the main heatmap  
`split` this modifies `split` of the main heatmap  
`row_km` this modifies `row_km` of the main heatmap  
`row_km_repeats` this modifies `row_km_repeats` of the main heatmap  
`row_split` this modifies `row_split` of the main heatmap  
`height` this modifies `height` of the main heatmap  
`heatmap_height` this modifies `heatmap_height` of the main heatmap  
`column_gap` this modifies `column_gap` of the main heatmap  
`cluster_columns`  
this modifies `cluster_columns` of the main heatmap  
`cluster_column_slices`  
this modifies `cluster_column_slices` of the main heatmap  
`clustering_distance_columns`  
this modifies `clustering_distance_columns` of the main heatmap  
`clustering_method_columns`  
this modifies `clustering_method_columns` of the main heatmap  
`column_dend_width`  
this modifies `column_dend_width` of the main heatmap  
`show_column_dend`  
this modifies `show_column_dend` of the main heatmap  
`column_dend_reorder`  
this modifies `column_dend_reorder` of the main heatmap  
`column_dend_gp` this modifies `column_dend_gp` of the main heatmap  
`column_order` this modifies `column_order` of the main heatmap  
`column_km` this modifies `column_km` of the main heatmap  
`column_km_repeats`  
this modifies `column_km_repeats` of the main heatmap  
`column_split` this modifies `column_split` of the main heatmap  
`width` this modifies `width` of the main heatmap  
`heatmap_width` this modifies `heatmap_width` of the main heatmap  
`use_raster` this modifies `use_raster` of every heatmap.  
`raster_device` this modifies `raster_device` of every heatmap.  
`raster_quality` this modifies `raster_quality` of every heatmap.  
`raster_device_param`  
this modifies `raster_device_param` of every heatmap.  
`raster_resize` this modifies `raster_resize` of every heatmap.

post_fun	A self-defined function will be executed after all the heatmaps are drawn.
save_last	Whether to save the last plot?
heatmap_row_names_gp	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
heatmap_column_names_gp	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
heatmap_row_title_gp	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
heatmap_column_title_gp	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
legend_title_gp	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
legend_title_position	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
legend_labels_gp	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
legend_grid_height	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
legend_grid_width	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
legend_border	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
legend_gap	Gap between legends. The value should be a vector of two units. One for gaps between vertical legends and one for the horizontal legends. If only one single unit is specified, the same gap set for the vertical and horizontal legends.
heatmap_border	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
annotation_border	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
fastcluster	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
simple_anno_size	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done
show_parent_dend_line	this set the value in <a href="#">ht_opt</a> and reset back after the plot is done

### 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 [HeatmapList-class](#) object for which the layout has been created.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/a-list-of-heatmaps.html>

**Examples**

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

---

draw-Legends-method    *Draw the Legends*

---

**Description**

Draw the Legends

**Usage**

```
## S4 method for signature 'Legends'
draw(object, x = unit(0.5, "npc"), y = unit(0.5, "npc"), just = "centre", test = FALSE)
```

**Arguments**

object	The <code>grob</code> object returned by <code>Legend</code> or <code>packLegend</code> .
x	The x position of the legends, measured in current viewport.
y	The y position of the legends, measured in current viewport.
just	Justification of the legends.
test	Only used for testing.

**Details**

In the legend `grob`, there should always be a viewport attached which is like a wrapper of all the graphic elements in a legend. If in the object, there is already a viewport attached, it will modify the `x`, `y` and `valid.just` of the viewport. If there is not viewport attached, a viewport with specified `x`, `y` and `valid.just` is created and attached.

You can also directly use `grid.draw` to draw the legend object, but you can only control the position of the legends by first creating a parent viewport and adjusting the position of the parent viewport.

**Examples**

```
lgd = Legend(at = 1:4, title = "foo")
draw(lgd, x = unit(0, "npc"), y = unit(0, "npc"), just = c("left", "bottom"))

# and a similar version of grid.draw
pushViewport(viewport(x = unit(0, "npc"), y = unit(0, "npc"), just = c("left", "bottom")))
grid.draw(lgd)
popViewport()
```

---

`draw-SingleAnnotation-method`*Draw the Single Annotation*

---

**Description**

Draw the Single Annotation

**Usage**

```
## S4 method for signature 'SingleAnnotation'  
draw(object, index, k = 1, n = 1, test = FALSE,  
      anno_mark_param = list())
```

**Arguments**

<code>object</code>	A <a href="#">SingleAnnotation-class</a> object.
<code>index</code>	A vector of indices.
<code>k</code>	The index of the slice.
<code>n</code>	Total number of slices. <code>k</code> and <code>n</code> are used to adjust annotation names. E.g. if <code>k</code> is 2 and <code>n</code> is 3, the annotation names are not drawn.
<code>test</code>	Is it in test mode? The value can be logical or a text which is plotted as the title of plot.
<code>anno_mark_param</code>	It contains specific parameters for drawing <a href="#">anno_mark</a> .

**Value**

No value is returned.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

draw\_annotation-Heatmap-method

*Draw Heatmap Annotations on the Heatmap*

---

## Description

Draw Heatmap Annotations on the Heatmap

## Usage

```
## S4 method for signature 'Heatmap'  
draw_annotation(object, which = c("top", "bottom", "left", "right"), k = 1, ...)
```

## Arguments

object	A <a href="#">Heatmap-class</a> object.
which	The position of the heatmap annotation.
k	Slice index.
...	Pass to <a href="#">viewport</a> which includes the complete heatmap annotation.

## Details

A viewport is created which contains column/top annotations.

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

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



---

draw\_annotation\_legend-HeatmapList-method  
*Draw legends for All Annotations*

---

## Description

Draw legends for All Annotations

## Usage

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

## Arguments

object	A <a href="#">HeatmapList-class</a> object.
legend_list	A list of self-defined legends, should be wrapped into <a href="#">grob</a> objects. It is normally constructed by <a href="#">Legend</a> .
...	Other arguments.

## Details

We call the "annotation legends" as the secondary legends. For horizontal heatmap list, the legends are those from all top/bottom annotations, and for vertical heatmap list, the legends are those from all left/right annotations.

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

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

---

draw\_dend-Heatmap-method

*Draw Heatmap Dendrograms*

---

## Description

Draw Heatmap Dendrograms

## Usage

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

## Arguments

object	A <a href="#">Heatmap-class</a> object.
which	Are the dendrograms put on the row or on the column of the heatmap?
k	Slice index.
max_height	maximal height of dendrogram.
...	Pass to <a href="#">viewport</a> which includes the complete heatmap dendrograms.

## Details

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

## Value

This function returns no value.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## See Also

[grid.dendrogram](#)

## Examples

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

---

`draw_dimnames-Heatmap-method`*Draw row names or column names*

---

**Description**

Draw row names or column names

**Usage**

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

**Arguments**

<code>object</code>	A <a href="#">Heatmap-class</a> object.
<code>which</code>	Are the names put on the row or on the column of the heatmap?
<code>k</code>	Slice index.
<code>...</code>	Pass to <a href="#">viewport</a> which includes the complete heatmap row/column names.

**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**

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

---

draw\_heatmap\_body-Heatmap-method  
*Draw Heatmap Body*

---

## Description

Draw Heatmap Body

## Usage

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

## Arguments

object	A <a href="#">Heatmap-class</a> object.
kr	Row slice index.
kc	Column slice index.
...	Pass to <a href="#">viewport</a> which includes the slice of heatmap body.

## Details

A viewport is created which contains subset rows and columns 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

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

---

draw\_heatmap\_legend-HeatmapList-method

*Draw legends for All Heatmaps*

---

## Description

Draw legends for All Heatmaps

## Usage

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

## Arguments

object	A <a href="#">HeatmapList-class</a> object.
legend_list	A list of self-defined legends, should be wrapped into <a href="#">grob</a> objects. It is normally constructed by <a href="#">Legend</a> .
...	Other arguments.

## Details

Actually we call the "heatmap legends" as the main legends. For horizontal heatmap list, the legends are those from heatmap/row annotation/left/right annotation. For vertical heatmap list, the legends are those from heatmap/column annotation/top/bottom annotation. if `merge_legends` is true in [draw,HeatmapList-method](#), then it contains all legends shown on the plot.

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

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

---

draw\_heatmap\_list-HeatmapList-method  
*Draw the List of Heatmaps*

---

**Description**

Draw the List of Heatmaps

**Usage**

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

**Arguments**

object            A [HeatmapList-class](#) object.

**Details**

It only draws the list of heatmaps without legends and titles.

This function is only for internal use.

**Value**

This function returns no value.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

draw\_title-dispatch    *Method dispatch page for draw\_title*

---

### Description

Method dispatch page for draw\_title.

### Dispatch

draw\_title can be dispatched on following classes:

- [draw\\_title, HeatmapList-method, HeatmapList-class](#) class method
- [draw\\_title, Heatmap-method, Heatmap-class](#) class method

### Examples

```
# no example
NULL
```

---

draw\_title-Heatmap-method  
*Draw Heatmap Title*

---

### Description

Draw Heatmap Title

### Usage

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

### Arguments

object	A <a href="#">Heatmap-class</a> object.
which	Is title put on the row or on the column of the heatmap?
k	Slice index.
...	Pass to <a href="#">viewport</a> which includes the complete heatmap title.

### 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**

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

---

`draw_title-HeatmapList-method`  
*Draw Heatmap List Title*

---

**Description**

Draw Heatmap List Title

**Usage**

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

**Arguments**

<code>object</code>	A <a href="#">HeatmapList-class</a> object.
<code>which</code>	Is it a row title or a column title.

**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**

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

---

extract_comb	<i>Extract Elements in a Combination set</i>
--------------	--

---

**Description**

Extract Elements in a Combination set

**Usage**

```
extract_comb(m, comb_name)
```

**Arguments**

m                    A combination matrix returned by [make\\_comb\\_mat](#).  
comb\_name            The valid combination set name should be from [comb\\_name](#).

**Details**

It returns the combination set.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)
extract_comb(m, "110")
```

---

frequencyHeatmap	<i>Visualize Frequency Distribution by Heatmap</i>
------------------	--

---

**Description**

Visualize Frequency Distribution by Heatmap

**Usage**

```

frequencyHeatmap(data,
  breaks = "Sturges",
  stat = c("count", "density", "proportion"),

  col = brewer.pal(9, "Blues"),
  color_space = "LAB",
  ylab = deparse(substitute(data)),
  column_title = paste0("Frequency heatmap of ", deparse(substitute(data))),
  title = column_title,
  ylim = NULL,
  range = ylim,

  title_gp = gpar(fontsize = 14),
  ylab_gp = gpar(fontsize = 12),
  tick_label_gp = gpar(fontsize = 10),

  column_order = NULL,
  column_names_side = "bottom",
  show_column_names = TRUE,
  column_names_max_height = unit(6, "cm"),
  column_names_gp = gpar(fontsize = 12),
  column_names_rot = 90,
  cluster_columns = FALSE,

  use_3d = FALSE,
  ...)

```

**Arguments**

<code>data</code>	A matrix or a list. If it is a matrix, density is calculated by columns.
<code>breaks</code>	Pass to <a href="#">hist</a> . Please only set equal bin size.
<code>stat</code>	Statistic to use.
<code>col</code>	A vector of colors that density values are mapped to.
<code>color_space</code>	The color space in which colors are interpolated. Pass to <a href="#">colorRamp2</a> .
<code>ylab</code>	Label on y-axis.
<code>column_title</code>	Title of the heatmap.
<code>title</code>	Same as <code>column_title</code> .
<code>ylim</code>	Ranges on the y-axis.
<code>range</code>	Same as <code>ylim</code> .
<code>title_gp</code>	Graphic parameters for title.
<code>ylab_gp</code>	Graphic parameters for y-labels.
<code>tick_label_gp</code>	Graphic parameters for y-ticks.
<code>column_order</code>	Order of columns.

column_names_side	Pass to <a href="#">Heatmap</a> .
show_column_names	Pass to <a href="#">Heatmap</a> .
column_names_max_height	Pass to <a href="#">Heatmap</a> .
column_names_gp	Pass to <a href="#">Heatmap</a> .
column_names_rot	Pass to <a href="#">Heatmap</a> .
cluster_columns	Whether cluster columns?
use_3d	Whether to visualize the frequencies as a 3D heatmap with <a href="#">Heatmap3D</a> ?
...	Pass to <a href="#">Heatmap</a> or <a href="#">Heatmap3D</a> (if use_3d = TRUE).

**Value**

A [Heatmap-class](#) object. It can oly add other heatmaps/annotations vertically.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```
matrix = matrix(rnorm(100), 10); colnames(matrix) = letters[1:10]
frequencyHeatmap(matrix)
frequencyHeatmap(matrix, use_3d = TRUE)
```

---

full_comb_code	<i>Full set of code of combination sets</i>
----------------	---

---

**Description**

Full set of code of combination sets

**Usage**

```
full_comb_code(n, complement = FALSE)
```

**Arguments**

n	Number of sets
complement	Whether include the code for complement set?

**Examples**

```

full_comb_code(2)
full_comb_code(3)
full_comb_code(4)
full_comb_code(4, TRUE)

```

---

getXY\_in\_parent\_vp      *Convert XY in a Parent Viewport*

---

**Description**

Convert XY in a Parent Viewport

**Usage**

```
getXY_in_parent_vp(u, vp_name = "ROOT")
```

**Arguments**

u	A list of two units which correspond to x and y.
vp_name	The name of the parent viewport.

**Details**

It converts a coordinate measured in current viewport to the coordinate in a parent viewport.

In the conversion, all units are recalculated as absolute units, so if you change the size of the interactive graphic window, you need to rerun the function.

**Value**

A list of two units.

**Examples**

```

grid.newpage()
pushViewport(viewport(x = 0.5, y = 0.5, width = 0.5, height = 0.5, just = c("left", "bottom")))
grid.rect()
grid.points(x = unit(2, "cm"), y = unit(2, "cm"), pch = 1)
u = list(x = unit(2, "cm"), y = unit(2, "cm"))
u2 = getXY_in_parent_vp(u)
popViewport()
grid.rect(gp = gpar(col = "red"))
grid.points(x = u2$x, u2$y, pch = 2)

```

---

`get_color_mapping_list-HeatmapAnnotation-method`  
*Get a List of ColorMapping objects*

---

### **Description**

Get a List of ColorMapping objects

### **Usage**

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

### **Arguments**

`object`            A [HeatmapAnnotation-class](#) object.

### **Details**

Color mappings 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**

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

---

get\_legend\_param\_list-HeatmapAnnotation-method  
*Get a List of Annotation Legend Parameters*

---

**Description**

Get a List of Annotation Legend Parameters

**Usage**

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

**Arguments**

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

**Details**

The annotation legend 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.annotation\_axis    *Draw Annotation Axis*

---

**Description**

Draw Annotation Axis

**Usage**

```
grid.annotation_axis(at = NULL, labels = at, labels_rot = 0, gp = gpar(),  
                    side = "left", facing = "outside", direction = "normal")
```

**Arguments**

at	Break values. If it is not specified, it is inferred from data scale in current viewport.
labels	Corresponding labels.
labels_rot	Rotations of labels.
gp	Graphic parameters.
side	side of the axis of the annotation viewport.
facing	Facing of the axis.
direction	direction of the axis. Value should be "normal" or "reverse".

**Details**

It uses [annotation\\_axis\\_grob](#) to construct the grob object, then use [grid.draw](#) to draw the axis.

**Examples**

```
# See examples in `annotation_axis_grob`
NULL
```

---

grid.boxplot

*Draw a Single Boxplot*


---

**Description**

Draw a Single Boxplot

**Usage**

```
grid.boxplot(value, pos, outline = TRUE, box_width = 0.6,
             pch = 1, size = unit(2, "mm"), gp = gpar(fill = "#CCCCCC"),
             direction = c("vertical", "horizontal"))
```

**Arguments**

value	A vector of numeric values.
pos	Position of the boxplot.
outline	Whether draw outlines?
box_width	width of the box.
pch	Point type.
size	Point size.
gp	Graphic parameters.
direction	Whether the box is vertical or horizontal.

**Details**

All the values are measured with native coordinate.

**Examples**

```
lt = list(rnorm(100), rnorm(100))
grid.newpage()
pushViewport(viewport(xscale = c(0.5, 2.5), yscale = range(lt)))
grid.boxplot(lt[[1]], pos = 1, gp = gpar(fill = "red"))
grid.boxplot(lt[[2]], pos = 2, gp = gpar(fill = "green"))
popViewport()
```

---

grid.dendrogram	<i>Draw the Dendrogram</i>
-----------------	----------------------------

---

**Description**

Draw the Dendrogram

**Usage**

```
grid.dendrogram(dend, ..., test = FALSE)
```

**Arguments**

dend	A <a href="#">dendrogram</a> object.
...	Pass to <a href="#">dendrogramGrob</a> .
test	Is it in test mode? If it is in test mode, a viewport is created by calculating proper xlim and ylim.

**Details**

[grid.dendrogram](#) supports drawing dendrograms with self-defined leaf positions. The positions of leaves can be defined by [adjust\\_dend\\_by\\_x](#). Also the dendrogram can be customized by setting the edgePar attribute for each node (basically for controlling the style of segments), e.g. by [color\\_branches](#).

To draw the dendrogram, a viewport should be firstly created. [dend\\_xy](#) can be used to get the positions of leaves and height of the dendrogram.

**Examples**

```
m = matrix(rnorm(100), 10)
dend = as.dendrogram(hclust(dist(m)))
grid.newpage()
pushViewport(viewport(xscale = c(0, 10.5), yscale = c(0, dend_heights(dend)),
  width = 0.9, height = 0.9))
grid.dendrogram(dend)
```



```
popViewport()

grid.dendrogram(dend, test = TRUE)

require(dendextend)
dend = color_branches(dend, k = 2)
dend = adjust_dend_by_x(dend, unit(sort(runif(10)*10), "cm"))
grid.dendrogram(dend, test = TRUE)
```

---

grid.draw.Legends      *Draw the Legends*

---

## Description

Draw the Legends

## Usage

```
## S3 method for class 'Legends'
grid.draw(x, recording = TRUE)
```

## Arguments

x                    The [grob](#) object returned by [Legend](#) or [packLegend](#).

recording            Pass to [grid.draw](#).

## Details

This function is actually an S3 method of the Legends class for the [grid.draw](#) general method. It applies [grid.draw](#) on the grob slot of the object.

## Examples

```
lgd = Legend(at = 1:4, title = "foo")
pushViewport(viewport(x = unit(0, "npc"), y = unit(0, "npc"), just = c("left", "bottom")))
grid.draw(lgd)
popViewport()
```

---

 gt\_render

 Mark the text for the rendering by gridtext package
 

---

## Description

Mark the text for the rendering by gridtext package

## Usage

```
gt_render(x, ...)
```

## Arguments

`x` Text labels. The value can be a vector.  
`...` Other parameters passed to [richtext\\_grob](#).

## Details

Text marked by [gt\\_render](#) will be rendered by [richtext\\_grob](#) function.

## Examples

```
if(requireNamespace("gridtext")) {
  mat = matrix(rnorm(100), 10)
  rownames(mat) = letters[1:10]
  ht = Heatmap(mat,
    column_title = gt_render("Some <span style='color:blue'>blue text in bold.</span><br>And italics text.<br>"),
    column_title_gp = gpar(box_fill = "orange"),
    row_labels = gt_render(letters[1:10], padding = unit(c(2, 10, 2, 10), "pt")),
    row_names_gp = gpar(box_col = "red"),
    row_km = 2,
    row_title = gt_render(c("title1", "title2")),
    row_title_gp = gpar(box_fill = "yellow"),
    heatmap_legend_param = list(
      title = gt_render("<span style='color:orange'>Legend title</span>"),
      title_gp = gpar(box_fill = "grey"),
      at = c(-3, 0, 3),
      labels = gt_render(c("*negative* three", "zero", "*positive* three"))
    )
  )
  ht = rowAnnotation(
    foo = anno_text(gt_render(sapply(LETTERS[1:10], strrep, 10), align_widths = TRUE),
      gp = gpar(box_col = "blue", box_lwd = 2),
      just = "right",
      location = unit(1, "npc")
    )
  ) + ht
  draw(ht)
}
```

---

Heatmap

*Constructor method for Heatmap class*

---

## Description

Constructor method for Heatmap class

## Usage

```
Heatmap(matrix, col, name,
  na_col = "grey",
  color_space = "LAB",
  rect_gp = gpar(col = NA),
  border = NA,
  border_gp = gpar(col = "black"),
  cell_fun = NULL,
  layer_fun = NULL,
  jitter = FALSE,

  row_title = character(0),
  row_title_side = c("left", "right"),
  row_title_gp = gpar(fontsize = 13.2),
  row_title_rot = switch(row_title_side[1], "left" = 90, "right" = 270),
  column_title = character(0),
  column_title_side = c("top", "bottom"),
  column_title_gp = gpar(fontsize = 13.2),
  column_title_rot = 0,

  cluster_rows = TRUE,
  cluster_row_slices = TRUE,
  clustering_distance_rows = "euclidean",
  clustering_method_rows = "complete",
  row_dend_side = c("left", "right"),
  row_dend_width = unit(10, "mm"),
  show_row_dend = TRUE,
  row_dend_reorder = is.logical(cluster_rows) || is.function(cluster_rows),
  row_dend_gp = gpar(),
  cluster_columns = TRUE,
  cluster_column_slices = 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 = is.logical(cluster_columns) || is.function(cluster_columns),
```

```
row_order = NULL,
column_order = NULL,

row_labels = rownames(matrix),
row_names_side = c("right", "left"),
show_row_names = TRUE,
row_names_max_width = unit(6, "cm"),
row_names_gp = gpar(fontsize = 12),
row_names_rot = 0,
row_names_centered = FALSE,
column_labels = colnames(matrix),
column_names_side = c("bottom", "top"),
show_column_names = TRUE,
column_names_max_height = unit(6, "cm"),
column_names_gp = gpar(fontsize = 12),
column_names_rot = 90,
column_names_centered = FALSE,

top_annotation = NULL,
bottom_annotation = NULL,
left_annotation = NULL,
right_annotation = NULL,

km = 1,
split = NULL,
row_km = km,
row_km_repeats = 1,
row_split = split,
column_km = 1,
column_km_repeats = 1,
column_split = NULL,
gap = unit(1, "mm"),
row_gap = unit(1, "mm"),
column_gap = unit(1, "mm"),
show_parent_dend_line = ht_opt$show_parent_dend_line,

heatmap_width = unit(1, "npc"),
width = NULL,
heatmap_height = unit(1, "npc"),
height = NULL,

show_heatmap_legend = TRUE,
heatmap_legend_param = list(title = name),

use_raster = NULL,
raster_device = c("CairoPNG", "CairoJPEG", "CairoTIFF", "png", "jpeg", "tiff", "agg_png"),
raster_quality = 1,
raster_device_param = list(),
```

```

raster_resize_mat = FALSE,
raster_by_magick = requireNamespace("magick", quietly = TRUE),
raster_magick_filter = NULL,

post_fun = NULL)

```

## Arguments

<code>matrix</code>	A matrix. Either numeric or character. If it is a simple vector, it will be converted to a one-column matrix.
<code>col</code>	A vector of colors if the color mapping is discrete or a color mapping function if the matrix is continuous numbers (should be generated by <code>colorRamp2</code> ). If the matrix is continuous, the value can also be a vector of colors so that colors can be interpolated. Pass to <code>ColorMapping</code> . For more details and examples, please refer to <a href="https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#colors">https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#colors</a> .
<code>name</code>	Name of the heatmap. By default the heatmap name is used as the title of the heatmap legend.
<code>na_col</code>	Color for NA values.
<code>rect_gp</code>	Graphic parameters for drawing rectangles (for heatmap body). The value should be specified by <code>gpar</code> and fill parameter is ignored.
<code>color_space</code>	The color space in which colors are interpolated. Only used if <code>matrix</code> is numeric and <code>col</code> is a vector of colors. Pass to <code>colorRamp2</code> .
<code>border</code>	Whether draw border. The value can be logical or a string of color.
<code>border_gp</code>	Graphic parameters for the borders. If you want to set different parameters for different heatmap slices, please consider to use <code>decorate_heatmap_body</code> .
<code>cell_fun</code>	Self-defined function to add graphics on each cell. Seven parameters will be passed into this function: <code>j</code> , <code>i</code> , <code>x</code> , <code>y</code> , <code>width</code> , <code>height</code> , <code>fill</code> which are column index, row index in <code>matrix</code> , coordinate of the cell, the width and height of the cell and the filled color. <code>x</code> , <code>y</code> , <code>width</code> and <code>height</code> are all <code>unit</code> objects.
<code>layer_fun</code>	Similar as <code>cell_fun</code> , but is vectorized. Check <a href="https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#customize-the-heatmap-body">https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#customize-the-heatmap-body</a> .
<code>jitter</code>	Random shifts added to the matrix. The value can be logical or a single numeric value. If it is <code>TRUE</code> , random values from uniform distribution between 0 and $1e-10$ are generated. If it is a numeric value, the range for the uniform distribution is (0, <code>jitter</code> ). It is mainly to solve the problem of "Error: node stack overflow" when there are too many identical rows/columns for plotting the dendrograms. ADD: From version 2.5.6, the error of node stack overflow has been fixed, now this argument is ignored.
<code>row_title</code>	Title on the row.
<code>row_title_side</code>	Will the title be put on the left or right of the heatmap?
<code>row_title_gp</code>	Graphic parameters for row title.
<code>row_title_rot</code>	Rotation of row title. Only 0, 90, 270 are allowed to set.

<code>column_title</code>	Title on the column.
<code>column_title_side</code>	Will the title be put on the top or bottom of the heatmap?
<code>column_title_gp</code>	Graphic parameters for column title.
<code>column_title_rot</code>	Rotation of column titles. Only 0, 90, 270 are allowed to set.
<code>cluster_rows</code>	If the value is a logical, it controls whether to make cluster on rows. The value can also be a <code>hclust</code> or a <code>dendrogram</code> which already contains clustering. Check <a href="https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#clustering">https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#clustering</a> .
<code>cluster_row_slices</code>	If rows are split into slices, whether perform clustering on the slice means?
<code>clustering_distance_rows</code>	It can be a pre-defined character which is in ("euclidean", "maximum", "manhattan", "canberra", "binary", "minkowski", "pearson", "spearman", "kendall"). It can also be a function. If the function has one argument, the input argument should be a matrix and the returned value should be a <code>dist</code> object. If the function has two arguments, the input arguments are two vectors and the function calculates distance between these two vectors.
<code>clustering_method_rows</code>	Method to perform hierarchical clustering, pass to <code>hclust</code> .
<code>row_dend_side</code>	Should the row dendrogram be put on the left or right of the heatmap?
<code>row_dend_width</code>	Width of the row dendrogram, should be a <code>unit</code> object.
<code>show_row_dend</code>	Whether show row dendrogram?
<code>row_dend_gp</code>	Graphic parameters for the dendrogram segments. If users already provide a <code>dendrogram</code> object with edges rendered, this argument will be ignored.
<code>row_dend_reorder</code>	Apply reordering on row dendrograms. The value can be a logical value or a vector which contains weight which is used to reorder rows. The reordering is applied by <code>reorder.dendrogram</code> .
<code>cluster_columns</code>	Whether make cluster on columns? Same settings as <code>cluster_rows</code> .
<code>cluster_column_slices</code>	If columns are split into slices, whether perform clustering on the slice means?
<code>clustering_distance_columns</code>	Same setting as <code>clustering_distance_rows</code> .
<code>clustering_method_columns</code>	Method to perform hierarchical clustering, pass to <code>hclust</code> .
<code>column_dend_side</code>	Should the column dendrogram be put on the top or bottom of the heatmap?
<code>column_dend_height</code>	height of the column cluster, should be a <code>unit</code> object.
<code>show_column_dend</code>	Whether show column dendrogram?

<code>column_dend_gp</code>	Graphic parameters for dendrogram segments. Same settings as <code>row_dend_gp</code> .
<code>column_dend_reorder</code>	Apply reordering on column dendrograms. Same settings as <code>row_dend_reorder</code> .
<code>row_order</code>	Order of rows. Manually setting row order turns off clustering.
<code>column_order</code>	Order of column.
<code>row_labels</code>	Optional row labels which are put as row names in the heatmap.
<code>row_names_side</code>	Should the row names be put on the left or right of the heatmap?
<code>show_row_names</code>	Whether show row names.
<code>row_names_max_width</code>	Maximum width of row names viewport.
<code>row_names_gp</code>	Graphic parameters for row names.
<code>row_names_rot</code>	Rotation of row names.
<code>row_names_centered</code>	Should row names put centered?
<code>column_labels</code>	Optional column labels which are put as column names in the heatmap.
<code>column_names_side</code>	Should the column names be put on the top or bottom of the heatmap?
<code>column_names_max_height</code>	Maximum height of column names viewport.
<code>show_column_names</code>	Whether show column names.
<code>column_names_gp</code>	Graphic parameters for drawing text.
<code>column_names_rot</code>	Rotation of column names.
<code>column_names_centered</code>	Should column names put centered?
<code>top_annotation</code>	A <a href="#">HeatmapAnnotation</a> object.
<code>bottom_annotation</code>	A <a href="#">HeatmapAnnotation</a> object.
<code>left_annotation</code>	It should be specified by <a href="#">rowAnnotation</a> .
<code>right_annotation</code>	it should be specified by <a href="#">rowAnnotation</a> .
<code>km</code>	Apply 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 slice, hierarchical clustering is still applied with parameters above.
<code>split</code>	A vector or a data frame by which the rows are split. But if <code>cluster_rows</code> is a clustering object, <code>split</code> can be a single number indicating to split the dendrogram by <a href="#">cutree</a> .
<code>row_km</code>	Same as <code>km</code> .
<code>row_km_repeats</code>	Number of k-means runs to get a consensus k-means clustering. Note if <code>row_km_repeats</code> is set to more than one, the final number of groups might be smaller than <code>row_km</code> , but this might means the original <code>row_km</code> is not a good choice.

<code>row_split</code>	Same as <code>split</code> .
<code>column_km</code>	K-means clustering on columns.
<code>column_km_repeats</code>	Number of k-means runs to get a consensus k-means clustering. Similar as <code>row_km_repeats</code> .
<code>column_split</code>	Split on columns. For heatmap splitting, please refer to <a href="https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#heatmap-split">https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#heatmap-split</a> .
<code>gap</code>	Gap between row slices if the heatmap is split by rows. The value should be a <code>unit</code> object.
<code>row_gap</code>	Same as <code>gap</code> .
<code>column_gap</code>	Gap between column slices.
<code>show_parent_dend_line</code>	When heatmap is split, whether to add a dashed line to mark parent dendrogram and children dendrograms?
<code>width</code>	Width of the heatmap body.
<code>height</code>	Height of the heatmap body.
<code>heatmap_width</code>	Width of the whole heatmap (including heatmap components)
<code>heatmap_height</code>	Height of the whole heatmap (including heatmap components). Check <a href="https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#size-of-the-heatmap">https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#size-of-the-heatmap</a> .
<code>show_heatmap_legend</code>	Whether show heatmap legend?
<code>heatmap_legend_param</code>	A list contains parameters for the heatmap legends. See <code>color_mapping_legend</code> , <code>ColorMapping-method</code> for all available parameters.
<code>use_raster</code>	Whether render the heatmap body as a raster image. It helps to reduce file size when the matrix is huge. If number of rows or columns is more than 2000, it is by default turned on. Note if <code>cell_fun</code> is set, <code>use_raster</code> is enforced to be <code>FALSE</code> .
<code>raster_device</code>	Graphic device which is used to generate the raster image.
<code>raster_quality</code>	A value larger than 1.
<code>raster_device_param</code>	A list of further parameters for the selected graphic device. For raster image support, please check <a href="https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#heatmap-as-raster-image">https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html#heatmap-as-raster-image</a> .
<code>raster_resize_mat</code>	Whether resize the matrix to let the dimension of the matrix the same as the dimension of the raster image? The value can be logical. If it is <code>TRUE</code> , <code>mean</code> is used to summarize the sub matrix which corresponds to a single pixel. The value can also be a summary function, e.g. <code>max</code> .
<code>raster_by_magick</code>	Whether to use <code>image_resize</code> to scale the image.



`raster_magick_filter` Pass to filter argument of `image_resize`. A character scalar and all possible values are in `filter_types`. The default is "Lanczos".

`post_fun` A function which will be executed after the heatmap list is drawn.

### Details

The initialization function only applies parameter checking and fill values to the slots with some validation.

Following methods can be applied to the `Heatmap-class` object:

- `show, Heatmap-method`: draw a single heatmap with default parameters
- `draw, Heatmap-method`: draw a single heatmap.
- + or `%v%` append heatmaps and 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>

### See Also

<https://jokergoo.github.io/ComplexHeatmap-reference/book/a-single-heatmap.html>

### Examples

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

---

Heatmap-class	<i>Class for a Single Heatmap</i>
---------------	-----------------------------------

---

### Description

Class for a Single Heatmap

### Details

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

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

---

Heatmap3D

*3D Heatmap*

---

## Description

3D Heatmap

## Usage

```
Heatmap3D(matrix,  
  ...,  
  bar_rel_width = 0.6,  
  bar_rel_height = 0.6,  
  bar_max_length = unit(1, "cm"),  
  bar_angle = 60,  
  row_names_side = "left",  
  show_row_dend = FALSE,  
  show_column_dend = FALSE)
```

**Arguments**

<code>matrix</code>	The input matrix. Values should be non-negative.
<code>...</code>	All pass to <a href="#">Heatmap</a> .
<code>bar_rel_width</code>	A factor between 0 and 1.
<code>bar_rel_height</code>	A factor between 0 and 1.
<code>bar_max_length</code>	Maximal length of bars. Value should be in absolute unit.
<code>bar_angle</code>	Angle for the projection.
<code>row_names_side</code>	Row names are by default put on the left side of the heatmap.
<code>show_row_dend</code>	By default the dendrogram is not drawn.
<code>show_column_dend</code>	By default the dendrogram is not drawn.

**Details**

For large matrices, the plotting might be slow.

**Examples**

```
m = matrix(sample(100, 36), 6)
Heatmap3D(m)
```

---

HeatmapAnnotation	<i>Constructor Method for HeatmapAnnotation class</i>
-------------------	---

---

**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"),
  gp = gpar(col = NA),
  border = FALSE,
  gap = unit(1, "points"),

  show_annotation_name = TRUE,
  annotation_label = NULL,
  annotation_name_gp = gpar(),
  annotation_name_offset = NULL,
  annotation_name_side = ifelse(which == "column", "right", "bottom"),
  annotation_name_rot = NULL,
```

```

annotation_name_align = FALSE,

annotation_height = NULL,
annotation_width = NULL,
height = NULL,
width = NULL,
simple_anno_size = ht_opt$simple_anno_size,
simple_anno_size_adjust = FALSE)

```

## Arguments

...	Name-value pairs where the names correspond to annotation names and values can be a vector, a matrix and an annotation function. Each pair is sent to <a href="#">SingleAnnotation</a> to construct a single annotation.
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 contain color mapping to df or simple annotations defined in .... See <a href="#">SingleAnnotation</a> 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. See <a href="#">color_mapping_legend, ColorMapping-me</a> for all possible options.
show_legend	Whether show annotation legends. The value can be one single value or a vector.
which	Are these row annotations or column annotations?
gp	Graphic parameters for simple annotations (with fill parameter ignored).
border	border of single annotations.
gap	Gap between annotations. It can be a single value or a vector of <a href="#">unit</a> objects.
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 drawn either on top or at the bottom. The value can be a vector.
annotation_label	Labels for the annotations. By default it is the same as individual annotation names.
annotation_name_gp	Graphic parameters for annotation names. Graphic parameters can be vectors.
annotation_name_offset	Offset to the annotation names, a <a href="#">unit</a> object. The value can be a vector.
annotation_name_side	Side of the annotation names.
annotation_name_rot	Rotation of the annotation names. The value can be a vector.
annotation_name_align	Whether to align the annotation names.

annotation_height	Height of each annotation if annotations are column annotations.
annotation_width	Width of each annotation if annotations are row annotations.
height	Height of the whole column annotations.
width	Width of the whole heatmap annotations.
simple_anno_size	Size of the simple annotation.
simple_anno_size_adjust	Whether also adjust the size of simple annotations when adjusting the whole heatmap annotation.

### Details

For arguments `show_legend`, `border`, `annotation_name_offset`, `annotation_name_side`, `annotation_name_rot`, `show_annotation_name`, they can be set as named vectors to modify values for some of the annotations, e.g. assuming you have an annotation with name `foo`, you can specify `border = c(foo = TRUE)` in `HeatmapAnnotation`.

There are three ways to specify heatmap annotations:

1. If the annotation is simply a vector or a matrix, it can be specified like `HeatmapAnnotation(foo = 1:10)`.
2. If the annotations are already stored as a data frame, it can be specified like `HeatmapAnnotation(df = df)`.
3. For complex annotations, users can use the pre-defined annotation functions such as `anno_points`: `HeatmapAnnotation(foo = anno_points(1:10))`.

For more details and examples, please check <https://jokergoo.github.io/ComplexHeatmap-reference/book/heatmap-annotations.html>.

### Value

A `HeatmapAnnotation-class` object.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### See Also

There are two helper functions: `rowAnnotation` and `columnAnnotation`.

### Examples

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

---

HeatmapAnnotation-class

*Class for Heatmap Annotations*

---

### Description

Class for Heatmap Annotations

### Details

A complex heatmap contains a list of annotations which are represented as 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.

### 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

```
# There is no example  
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.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

HeatmapList-class	<i>Class for a list of heatmaps</i>
-------------------	-------------------------------------

---

**Description**

Class for a list of heatmaps

**Details**

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

**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**

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

---

heatmap\_legend\_size-HeatmapList-method  
*Size of the Heatmap Legends*

---

## Description

Size of the Heatmap Legends

## Usage

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

## Arguments

object	A <a href="#">HeatmapList-class</a> object.
legend_list	A list of self-defined legend, should be wrapped into <a href="#">grob</a> objects. It is normally constructed by <a href="#">Legend</a> .
...	Other arguments.

## Details

Internally, all heatmap legends are packed by [packLegend](#) as a single [grob](#) object.  
This function is only for internal use.

## Value

A [unit](#) object.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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



---

height.AnnotationFunction  
*Height of the AnnotationFunction Object*

---

**Description**

Height of the AnnotationFunction Object

**Usage**

```
## S3 method for class 'AnnotationFunction'  
height(x, ...)
```

**Arguments**

x                   The [AnnotationFunction-class](#) object.  
...                  Other arguments.

**Details**

Internally used.

**Examples**

```
anno = anno_points(1:10)  
ComplexHeatmap::height(anno)  
anno = anno_points(1:10, which = "row")  
ComplexHeatmap::height(anno)
```

---

height.Heatmap           *Height of the Heatmap*

---

**Description**

Height of the Heatmap

**Usage**

```
## S3 method for class 'Heatmap'  
height(x, ...)
```

**Arguments**

x                   The [HeatmapList-class](#) object returned by [draw,Heatmap-method](#).  
...                  Other arguments.

**Examples**

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

---

```
height.HeatmapAnnotation
```

*Height of the HeatmapAnnotation Object*

---

**Description**

Height of the HeatmapAnnotation Object

**Usage**

```
## S3 method for class 'HeatmapAnnotation'  
height(x, ...)
```

**Arguments**

x	The <a href="#">HeatmapAnnotation-class</a> object.
...	Other arguments.

**Details**

Internally used.

**Examples**

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

---

```
height.HeatmapList
```

*Height of the Heatmap List*

---

**Description**

Height of the Heatmap List

**Usage**

```
## S3 method for class 'HeatmapList'  
height(x, ...)
```

**Arguments**

x                    The `HeatmapList`-class object returned by `draw,HeatmapList-method`.  
...                   Other arguments.

**Examples**

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

---

height.Legends	<i>Height of the Legends</i>
----------------	------------------------------

---

**Description**

Height of the Legends

**Usage**

```
## S3 method for class 'Legends'  
height(x, ...)
```

**Arguments**

x                    The `grob` object returned by `Legend` or `packLegend`.  
...                   Other arguments.

**Value**

The returned unit x is always in mm.

**Examples**

```
lgd = Legend(labels = 1:10, title = "foo", legend_gp = gpar(fill = "red"))  
ComplexHeatmap::height(lgd)
```

height.SingleAnnotation

*Height of the SingleAnnotation object*

---

### Description

Height of the SingleAnnotation object

### Usage

```
## S3 method for class 'SingleAnnotation'  
height(x, ...)
```

### Arguments

x	The <a href="#">SingleAnnotation-class</a> object.
...	Other arguments.

### Details

Internally used.

### Examples

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

---

heightAssign.AnnotationFunction

*Assign the Height to the AnnotationFunction Object*

---

### Description

Assign the Height to the AnnotationFunction Object

### Usage

```
## S3 replacement method for class 'AnnotationFunction'  
height(x, ...) <- value
```

### Arguments

x	The <a href="#">AnnotationFunction-class</a> object.
value	A <a href="#">unit</a> object.
...	Other arguments.

### Details

Internally used.

### Examples

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

---

```
heightAssign.HeatmapAnnotation  
    Assign the Height to the HeatmapAnnotation Object
```

---

### Description

Assign the Height to the HeatmapAnnotation Object

### Usage

```
## S3 replacement method for class 'HeatmapAnnotation'  
height(x, ...) <- value
```

### Arguments

x	The <a href="#">HeatmapAnnotation-class</a> object.
value	A <a href="#">unit</a> object.
...	Other arguments.

### Details

Internally used.

### Examples

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

---

```
heightAssign.SingleAnnotation
```

*Assign the Height to the SingleAnnotation Object*

---

### Description

Assign the Height to the SingleAnnotation Object

### Usage

```
## S3 replacement method for class 'SingleAnnotation'  
height(x, ...) <- value
```

### Arguments

x	The <a href="#">SingleAnnotation-class</a> object.
value	A <a href="#">unit</a> object.
...	Other arguments.

### Details

Internally used.

### Examples

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

---

```
heightDetails.annotation_axis
```

*Height for annotation\_axis Grob*

---

### Description

Height for annotation\_axis Grob

### Usage

```
## S3 method for class 'annotation_axis'  
heightDetails(x)
```

### Arguments

x	The annotation_axis grob returned by <a href="#">annotation_axis_grob</a> .
---	---

**Details**

The physical height of the grob can be get by `convertWidth(grobHeight(axis_grob), "mm")`.

**Examples**

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

---

heightDetails.legend *Grob height for packed\_legends*

---

**Description**

Grob height for packed\_legends

**Usage**

```
## S3 method for class 'legend'  
heightDetails(x)
```

**Arguments**

x                    A legend object.

**Examples**

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

---

heightDetails.legend\_body  
*Grob height for legend\_body*

---

**Description**

Grob height for legend\_body

**Usage**

```
## S3 method for class 'legend_body'  
heightDetails(x)
```

**Arguments**

x                    A legend\_body object.

**Examples**

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

---

```
heightDetails.packed_legends
Grob height for packed_legends
```

---

**Description**

Grob height for packed\_legends

**Usage**

```
## S3 method for class 'packed_legends'
heightDetails(x)
```

**Arguments**

x                    A packed\_legends object.

**Examples**

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

---

```
ht_global_opt            Global Options for Heatmaps
```

---

**Description**

Global Options for Heatmaps

**Usage**

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

**Arguments**

...	Options.
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	Wwitch to local mode.
ADD	Add new options.



**Details**

This function is deprecated. Please use [ht\\_opt](#) instead. However, changes by this function will also be synchronized in [ht\\_opt](#).

**Examples**

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

---

ht_opt	<i>Global Options for Heatmaps</i>
--------	------------------------------------

---

**Description**

Global Options for Heatmaps

**Usage**

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

**Arguments**

...	Options, see 'Details' section.
RESET	Reset all the option values.
READ.ONLY	Please ignore this argument.
LOCAL	Please ignore this argument.
ADD	Please ignore this argument.

**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.

There are following parameters to control all heatmaps:

**heatmap\_row\_names\_gp** set row\_names\_gp in all [Heatmap](#).  
**heatmap\_column\_names\_gp** set column\_names\_gp in all [Heatmap](#).  
**heatmap\_row\_title\_gp** set row\_title\_gp in all [Heatmap](#).  
**heatmap\_column\_title\_gp** set column\_title\_gp in all [Heatmap](#).  
**heatmap\_border** set border in all [Heatmap](#).

Following parameters control the legends:

**legend\_title\_gp** set title\_gp in all heatmap legends and annotation legends.

**legend\_title\_position** set `title_position` in all heatmap legends and annotation legends.  
**legend\_labels\_gp** set `labels_gp` in all heatmap legends and annotation legends.  
**legend\_grid\_width** set `grid_width` in all heatmap legends and annotation legends.  
**legend\_grid\_height** set `grid_height` in all heatmap legends and annotation legends.  
**legend\_border** set `border` in all heatmap legends and annotation legends.  
**legend\_gap** Gap between legends. The value should be a vector of two units. One for gaps between vertical legends and one for the horizontal legends. If only one single unit is specified, the same gap set for the vertical and horizontal legends.

Following parameters control heatmap annotations:

**annotation\_border** border in all `HeatmapAnnotation`.  
**simple\_anno\_size** size for the simple annotation.

Following parameters control the space between heatmap components:

**DENDROGRAM\_PADDING** space between dendrograms and heatmap body.  
**DIMNAME\_PADDING** space between row/column names and heatmap body.  
**TITLE\_PADDING** space between row/column titles and heatmap body. The value can have length of two which corresponds to the bottom and top padding.  
**COLUMN\_ANN\_PADDING** space between column annotations and heatmap body.  
**ROW\_ANN\_PADDING** space between row annotations and heatmap body.  
**HEATMAP\_LEGEND\_PADDING** space between heatmap legends and heatmaps  
**ANNOTATION\_LEGEND\_PADDING** space between annotation legends and heatmaps

Other parameters:

**fast\_hclust** whether use `hclust` to speed up clustering?  
**show\_parent\_dend\_line** when heatmap is split, whether to add a dashed line to mark parent dendrogram and children dendrograms?

You can get or set option values by the traditional way (like `options`) or by `$` operator:

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

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

Reset to the default values by `ht_opt(RESET = TRUE)`.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### Examples

```
ht_opt
```

---

ht_size	<i>Calculate the width and height of the heatmaps</i>
---------	---

---

**Description**

Calculate the width and height of the heatmaps

**Usage**

```
ht_size(ht)
```

**Arguments**

ht                   A [Heatmap-class](#) or [HeatmapList-class](#) object.

**Value**

A list of two elements: width and height.

**Examples**

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

---

is_abs_unit	<i>Test Whether it is an Absolute Unit</i>
-------------	--

---

**Description**

Test Whether it is an 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 assumes [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(grobWidth(textGrob("foo")))
is_abs_unit(unit(1, "mm") + unit(1, "npc"))
```

---

Legend

*Make a Single Legend*


---

**Description**

Make a Single Legend

**Usage**

```
Legend(at, labels = at, col_fun, name = NULL, grob = NULL,
       break_dist = NULL, nrow = NULL, ncol = 1, by_row = FALSE,
       grid_height = unit(4, "mm"),
       grid_width = unit(4, "mm"),
       gap = unit(2, "mm"), column_gap = gap, row_gap = unit(0, "mm"),
       labels_gp = gpar(fontsize = 10), labels_rot = 0,
       border = NULL, background = "#EEEEEE",
       type = "grid", graphics = NULL, 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", "leftcenter-rot", "lefttop-rot"),
       title_gap = unit(2, "mm"))
```

**Arguments**

at	Breaks of the legend. The values can be either numeric or character. If it is not specified, the values of labels are taken as labels.
labels	Labels corresponding to at. If it is not specified, the values of at are taken as labels.
col_fun	A color mapping function which is used to make a continuous legend. Use <a href="#">colorRamp2</a> to generate the color mapping function. If at is missing, the breaks recorded in the color mapping function are used for at.

<code>name</code>	Name of the legend, internally used.
<code>grob</code>	The legend body can be specified by a pre-constructed <code>grob</code> object.
<code>break_dist</code>	A zooming factor to control relative distance of two neighbouring break values. The length of it should be <code>length(at) - 1</code> or a scalar.
<code>nrow</code>	For legend which is represented as grids, <code>nrow</code> controls number of rows of the grids if the grids are arranged into multiple rows.
<code>ncol</code>	Similar as <code>nrow</code> , <code>ncol</code> controls number of columns of the grids if the grids are arranged into multiple columns. Note at a same time only one of <code>nrow</code> and <code>ncol</code> can be specified.
<code>by_row</code>	Are the legend grids arranged by rows or by columns?
<code>grid_height</code>	The height of legend grid. It can also control the height of the continuous legend if it is horizontal.
<code>grid_width</code>	The width of legend grid. It can also control the width of the continuous legend if it is vertical.
<code>gap</code>	If legend grids are put into multiple rows or columns, this controls the gap between neighbouring rows or columns, measured as a <code>unit</code> object.
<code>column_gap</code>	The same as <code>gap</code> .
<code>row_gap</code>	Space between legend rows.
<code>labels_gp</code>	Graphic parameters for labels.
<code>labels_rot</code>	Text rotation for labels. It should only be used for horizontal continuous legend.
<code>border</code>	Color of legend grid borders. It also works for the ticks in the continuous legend.
<code>background</code>	Background colors for the grids. It is used when points and lines are the legend graphics.
<code>type</code>	Type of legends. The value can be one of <code>grid</code> , <code>points</code> , <code>lines</code> and <code>boxplot</code> .
<code>graphics</code>	Self-defined graphics for legends. The value should be a list of functions. Each function should accept four arguments: <code>x</code> and <code>y</code> : positions of the legend grid (center point), <code>w</code> and <code>h</code> : width and height of the legend grid.
<code>legend_gp</code>	Graphic parameters for the legend grids. You should control the filled color of the legend grids by <code>gpar(fill = ...)</code> .
<code>pch</code>	Type of points if points are used as legend. Note you can use single-letter as <code>pch</code> , e.g. <code>pch = 'A'</code> . There are three additional integers that are valid for <code>pch</code> : 26 and 27 for single diagonal lines and 28 for double diagonal lines.
<code>size</code>	Size of points.
<code>legend_height</code>	Height of the whole legend body. It is only used for vertical continuous legend.
<code>legend_width</code>	Width of the whole legend body. It is only used for horizontal continuous legend.
<code>direction</code>	Direction of the legend, vertical or horizontal?
<code>title</code>	Title of the legend.
<code>title_gp</code>	Graphic parameters of the title.
<code>title_position</code>	Position of title relative to the legend. <code>topleft</code> , <code>topcenter</code> , <code>leftcenter-rot</code> and <code>lefttop-rot</code> are only for vertical legend and <code>leftcenter</code> , <code>lefttop</code> are only for horizontal legend.
<code>title_gap</code>	Gap between title and the legend body.

**Details**

Most of the argument can also be set in `heatmap_legend_param` argument in [Heatmap](#) or `annotation_legend_param` argument in [HeatmapAnnotation](#) to configure legend styles for heatmap and annotations.

**Value**

A [Legends-class](#) object.

**See Also**

[packLegend](#) packs multiple legends into one [Legends-class](#) object.

See examples of configuring legends: <https://jokergoo.github.io/ComplexHeatmap-reference/book/legends.html>

**Examples**

```
lgd = Legend(labels = month.name[1:6], title = "foo", legend_gp = gpar(fill = 1:6))
draw(lgd, test = "add labels and title")

require(circlize)
col_fun = colorRamp2(c(0, 0.5, 1), c("blue", "white", "red"))
lgd = Legend(col_fun = col_fun, title = "foo")
draw(lgd, test = "only col_fun")

col_fun = colorRamp2(c(0, 0.5, 1), c("blue", "white", "red"))
lgd = Legend(col_fun = col_fun, title = "foo", at = c(0, 0.1, 0.15, 0.5, 0.9, 0.95, 1))
draw(lgd, test = "unequal interval breaks")
```

---

Legends

---

*Constructor method for Legends class*


---

**Description**

Constructor method for Legends class

**Usage**

```
Legends(...)
```

**Arguments**

... arguments.

**Details**

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

**Value**

No value is returned.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

Legends-class	<i>The Class for Legends</i>
---------------	------------------------------

---

**Description**

The Class for Legends

**Details**

This is a very simple class for legends that it only has one slot which is the real [grob](#) of the legends. Construct a single legend by [Legend](#) and a group of legends by [packLegend](#).

**Examples**

```
lgd = Legend(at = 1:4)
lgd
lgd@grob
```

---

length.HeatmapAnnotation	<i>Number of Annotations</i>
--------------------------	------------------------------

---

**Description**

Number of Annotations

**Usage**

```
## S3 method for class 'HeatmapAnnotation'
length(x)
```

**Arguments**

x                    A [HeatmapAnnotation-class](#) object.

**Examples**

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

---

length.HeatmapList     *Length of the HeatmapList object*

---

**Description**

Length of the HeatmapList object

**Usage**

```
## S3 method for class 'HeatmapList'
length(x)
```

**Arguments**

x                    A [HeatmapList-class](#) object

**Examples**

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

---

list\_components        *List All Heatmap Components*

---

**Description**

List All Heatmap Components

**Usage**

```
list_components(pattern = NULL)
```

**Arguments**

pattern              A regular expression.



**Value**

A vector of viewport names.

**Examples**

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

---

list_to_matrix	<i>Convert a List of Sets to a Binary Matrix</i>
----------------	--

---

**Description**

Convert a List of Sets to a Binary Matrix

**Usage**

```
list_to_matrix(lt, universal_set = NULL)
```

**Arguments**

lt                    A list of vectors.  
universal\_set        The universal set.

**Details**

It converts the list which have m sets to a binary matrix with n rows and m columns where n is the size of universal set.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 5),
         b = sample(letters, 10),
         c = sample(letters, 15))
list_to_matrix(lt)
list_to_matrix(lt, universal_set = letters)
```

---

make\_column\_cluster-Heatmap-method  
*Make Cluster on Columns*

---

### Description

Make Cluster on Columns

### Usage

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

### Arguments

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

### Details

The function will fill or adjust `column_dend_list`, `column_order_list`, `column_title` and `matrix_param` slots.

If `order` is defined, no clustering will be applied.

This function is only for internal use.

### Value

A [Heatmap-class](#) object.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### Examples

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

---

make_comb_mat	<i>Make a Combination Matrix for UpSet Plot</i>
---------------	---

---

### Description

Make a Combination Matrix for UpSet Plot

### Usage

```
make_comb_mat(..., mode = c("distinct", "intersect", "union"),
  top_n_sets = Inf, min_set_size = -Inf,
  universal_set = NULL, complement_size = NULL,
  value_fun = NULL, set_on_rows = TRUE)
```

### Arguments

...	The input sets. If it is represented as a single variable, it should be a matrix/data frame or a list. If it is multiple variables, it should be name-value pairs, see Input section for explanation.
mode	The mode for forming the combination set, see Mode section.
top_n_sets	Number of sets with largest size.
min_set_size	This minimal set size that is used for generating the combination matrix.
universal_set	The universal set. If it is set, the size of the complement set of all sets is also calculated. If it is specified, complement_size is ignored.
complement_size	The size for the complement of all sets. If it is specified, the combination set name will be like "00...".
value_fun	For each combination set, how to calculate the size? If it is a scalar set, the length of the vector is the size of the set, while if it is a region-based set, (i.e. GRanges or IRanges object), the sum of widths of regions in the set is calculated as the size of the set.
set_on_rows	Used internally.

### Value

A matrix also in a class of comb\_mat.

Following functions can be applied to it: [set\\_name](#), [comb\\_name](#), [set\\_size](#), [comb\\_size](#), [comb\\_degree](#), [extract\\_comb](#) and [t.comb\\_mat](#).

### Input

To represent multiple sets, the variable can be represented as:

1. A list of sets where each set is a vector, e.g.:

```
list(set1 = c("a", "b", "c"),
     set2 = c("b", "c", "d", "e"),
     ...)
```

2. A binary matrix/data frame where rows are elements and columns are sets, e.g.:

```
  a b c
h 1 1 1
t 1 0 1
j 1 0 0
u 1 0 1
w 1 0 0
...
```

If the variable is a data frame, the binary columns (only contain 0 and 1) and the logical columns are only kept.

The set can be genomic regions, then it can only be represented as a list of GRanges objects.

### Mode

E.g. for three sets (A, B, C), the UpSet approach splits the combination of selecting elements in the set or not in the set and calculates the sizes of the combination sets. For three sets, all possible combinations are:

```
A B C
1 1 1
1 1 0
1 0 1
0 1 1
1 0 0
0 1 0
0 0 1
```

A value of 1 means to select that set and 0 means not to select that set. E.g., "1 1 0" means to select set A, B while not set C. Note there is no "0 0 0", because the background size is not of interest here. With the code of selecting and not selecting the sets, next we need to define how to calculate the size of that combination set. There are three modes:

1. distinct mode: 1 means in that set and 0 means not in that set, then "1 1 0" means a set of elements also in set A and B, while not in C (i.e. `setdiff(intersect(A,B),C)`). Under this mode, the seven combination sets are the seven partitions in the Venn diagram and they are mutually exclusive.

2. intersect mode: 1 means in that set and 0 is not taken into account, then, "1 1 0" means a set of elements in set A and B, and they can also in C or not in C (i.e. `intersect(A,B)`). Under this mode, the seven combination sets can overlap.

3. union mode: 1 means in that set and 0 is not taken into account. When there are multiple 1, the relationship is OR. Then, "1 1 0" means a set of elements in set A or B, and they can also in C or not in C (i.e. `union(A,B)`). Under this mode, the seven combination sets can overlap.

## Examples

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)

mat = list_to_matrix(lt)
mat
m = make_comb_mat(mat)

## Not run:
require(circlize)
require(GenomicRanges)
lt = lapply(1:4, function(i) generateRandomBed())
lt = lapply(lt, function(df) GRanges(seqnames = df[, 1],
                                   ranges = IRanges(df[, 2], df[, 3])))
names(lt) = letters[1:4]
m = make_comb_mat(lt)

## End(Not run)
```

---

make\_layout-dispatch    *Method dispatch page for make\_layout*

---

## Description

Method dispatch page for make\_layout.

## Dispatch

make\_layout can be dispatched on following classes:

- [make\\_layout, Heatmap-method, Heatmap-class](#) class method
- [make\\_layout, HeatmapList-method, HeatmapList-class](#) class method

## Examples

```
# no example
NULL
```

---

make\_layout-Heatmap-method

*Make the Layout of a Single Heatmap*

---

## Description

Make the Layout of a Single Heatmap

## Usage

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

## Arguments

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

## Details

The layout of the single heatmap will be established by setting the size of each heatmap component. Also how to make graphics for heatmap components will be recorded by saving as functions.

Whether to apply row clustering or column clustering affects the layout, so clustering should be applied first by [prepare, Heatmap-method](#) 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

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

---

make\_layout-HeatmapList-method

*Make Layout for the Heatmap List*

---

## Description

Make Layout for the Heatmap List

## Usage

```
## S4 method for signature 'HeatmapList'
make_layout(object,

  row_title = character(),
  row_title_side = c("left", "right"),
  row_title_gp = gpar(fontsize = 14),
  column_title = character(),
  column_title_side = c("top", "bottom"),
  column_title_gp = gpar(fontsize = 14),

  heatmap_legend_side = c("right", "left", "bottom", "top"),
  merge_legends = FALSE,
  show_heatmap_legend = TRUE,
  heatmap_legend_list = list(),
  annotation_legend_side = c("right", "left", "bottom", "top"),
  show_annotation_legend = TRUE,
  annotation_legend_list = list(),
  align_heatmap_legend = NULL,
  align_annotation_legend = NULL,
  legend_grouping = c("adjusted", "original"),

  ht_gap = unit(2, "mm"),

  main_heatmap = which(sapply(object@ht_list, inherits, "Heatmap"))[1],
  padding = GLOBAL_PADDING,

  auto_adjust = TRUE,
  row_dend_side = c("original", "left", "right"),
  row_sub_title_side = c("original", "left", "right"),
  column_dend_side = c("original", "top", "bottom"),
  column_sub_title_side = c("original", "top", "bottom"),

  row_gap = NULL,
  cluster_rows = NULL,
  cluster_row_slices = 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,
row_km = NULL,
row_km_repeats = NULL,
row_split = NULL,
height = NULL,
heatmap_height = NULL,

column_gap = NULL,
cluster_columns = NULL,
cluster_column_slices = NULL,
clustering_distance_columns = NULL,
clustering_method_columns = NULL,
column_dend_width = NULL,
show_column_dend = NULL,
column_dend_reorder = NULL,
column_dend_gp = NULL,
column_order = NULL,
column_km = NULL,
column_km_repeats = NULL,
column_split = NULL,
width = NULL,
heatmap_width = NULL,

use_raster = NULL,
raster_device = NULL,
raster_quality = NULL,
raster_device_param = NULL,
raster_resize = NULL)

```

### Arguments

object	A <a href="#">HeatmapList-class</a> object.
row_title	Title on the row.
row_title_side	Will the title be put on the left or right of the heatmap list?
row_title_gp	Graphic parameters for the row title.
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 the column title.
heatmap_legend_side	Side of the heatmap legends.



merge_legends	Whether to put heatmap legends and annotation legends together. By default they are put in different viewports.
show_heatmap_legend	Whether show heatmap legends.
heatmap_legend_list	A list of self-defined legends, should be wrapped into a list of <code>grob</code> objects. Normally they are constructed by <code>Legend</code> .
annotation_legend_side	Side of annotation legends.
show_annotation_legend	Whether show annotation legends.
annotation_legend_list	A list of self-defined legends, should be wrapped into a list of <code>grob</code> objects. Normally they are constructed by <code>Legend</code> .
align_heatmap_legend	How to align the legends to heatmap. Possible values are "heatmap_center", "heatmap_top" and "global_center". If the value is NULL, it automatically picks the proper value from the three options.
align_annotation_legend	How to align the legends to heatmap. Possible values are "heatmap_center", "heatmap_top" and "global_center".
legend_grouping	How the legends are grouped. Values should be "adjusted" or "original".
ht_gap	Gap between heatmaps, should be a <code>unit</code> object. It can be a vector of length 1 or the number of heatmaps/annotations.
main_heatmap	Name or index for the main heatmap.
padding	Padding of the whole plot. The four values correspond to the bottom, left, top and right paddings.
auto_adjust	whether apply automatic adjustment? The auto-adjustment includes turning off dendrograms, titles and row/columns for non-main heatmaps.
row_dend_side	If auto-adjustment is on, to put the row dendrograms of the main heatmap to the most left side of the heatmap list or the most right side?
row_sub_title_side	There can be sub titles generated by the splitting of heatmaps. Similar setting as <code>row_dend_side</code> .
column_dend_side	Similar setting as <code>row_dend_side</code> .
column_sub_title_side	Similar setting as <code>row_sub_title_side</code> .
row_gap	Overwrite the corresponding setting in the main heatmap.
cluster_rows	Overwrite the corresponding setting in the main heatmap.
cluster_row_slices	Overwrite the corresponding setting in the main heatmap.

`clustering_distance_rows` Overwrite the corresponding setting in the main heatmap.  
`clustering_method_rows` Overwrite the corresponding setting in the main heatmap.same setting as in [Heatmap](#), if it is specified, `clustering_method_rows` in main heatmap is ignored.  
`row_dend_width` Overwrite the corresponding setting in the main heatmap.  
`show_row_dend` same Overwrite the corresponding setting in the main heatmap.  
`row_dend_reorder` Overwrite the corresponding setting in the main heatmap.  
`row_dend_gp` Overwrite the corresponding setting in the main heatmap.  
`row_order` Overwrite the corresponding setting in the main heatmap.  
`row_km` Overwrite the corresponding setting in the main heatmap.  
`row_km_repeats` Overwrite the corresponding setting in the main heatmap.  
`row_split` Overwrite the corresponding setting in the main heatmap.  
`height` Overwrite the corresponding setting in the main heatmap.  
`heatmap_height` Overwrite the corresponding setting in the main heatmap.  
`column_gap` Overwrite the corresponding setting in the main heatmap.  
`cluster_columns` Overwrite the corresponding setting in the main heatmap.  
`cluster_column_slices` Overwrite the corresponding setting in the main heatmap.  
`clustering_distance_columns` Overwrite the corresponding setting in the main heatmap.  
`clustering_method_columns` Overwrite the corresponding setting in the main heatmap.  
`column_dend_width` column Overwrite the corresponding setting in the main heatmap.  
`show_column_dend` Overwrite the corresponding setting in the main heatmap.  
`column_dend_reorder` Overwrite the corresponding setting in the main heatmap.  
`column_dend_gp` Overwrite the corresponding setting in the main heatmap.  
`column_order` Overwrite the corresponding setting in the main heatmap.  
`column_km` Overwrite the corresponding setting in the main heatmap.  
`column_km_repeats` Overwrite the corresponding setting in the main heatmap.  
`column_split` Overwrite the corresponding setting in the main heatmap.  
`width` Overwrite the corresponding setting in the main heatmap.  
`heatmap_width` Overwrite the corresponding setting in the main heatmap.  
`use_raster` Overwrite the corresponding setting in every heatmap.

raster\_device Overwrite the corresponding setting in every heatmap.  
 raster\_quality Overwrite the corresponding setting in every heatmap.  
 raster\_device\_param Overwrite the corresponding setting in every heatmap.  
 raster\_resize Overwrite the corresponding setting in every heatmap.

### Details

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

This function is only for internal use.

### Value

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

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### Examples

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

---

make\_row\_cluster-Heatmap-method  
*Make Cluster on Rows*

---

### Description

Make Cluster on Rows

### Usage

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

### Arguments

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

### Details

The function will fill or adjust row\_dend\_list, row\_order\_list, row\_title and matrix\_param slots.

If order is defined, no clustering will be applied.

This function is only for internal use.

**Value**

A [Heatmap-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

map\_to\_colors-ColorMapping-method  
*Map Values to Colors*

---

**Description**

Map Values to Colors

**Usage**

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

**Arguments**

object	A <a href="#">ColorMapping-class</a> object.
x	Input values.

**Details**

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

This function provides a uniform way for discrete and continuous color mapping.

**Value**

A vector of colors.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

### Examples

```
cm = ColorMapping(colors = c("A" = "red", "B" = "black"))
map_to_colors(cm, sample(c("A", "B"), 10, replace = TRUE))
require(circlize)
col_fun = colorRamp2(c(0, 1), c("white", "red"))
cm = ColorMapping(col_fun = col_fun)
map_to_colors(cm, runif(10))
```

---

max_text_height	<i>Maximum Height of Text</i>
-----------------	-------------------------------

---

### Description

Maximum Height of Text

### Usage

```
max_text_height(text, gp = gpar(), rot = 0)
```

### Arguments

text	A vector of text.
gp	Graphic parameters for text.
rot	Rotation of the text, scalar.

### Details

It simply calculates maximum height of a list of [textGrob](#) objects.

Note it ignores the text rotation.

### Value

A [unit](#) object.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### See Also

[max\\_text\\_width](#) calculates the maximum width of a text vector.

### Examples

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

---

max_text_width	<i>Maximum Width of Text</i>
----------------	------------------------------

---

### Description

Maximum Width of Text

### Usage

```
max_text_width(text, gp = gpar(), rot = 0)
```

### Arguments

text	A vector of text.
gp	Graphic parameters for text.
rot	Rotation of the text, scalar.

### Details

It simply calculates maximum width of a list of `textGrob` objects.

Note it ignores the text rotation.

### Value

A `unit` object which is in "mm".

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### See Also

`max_text_height` calculates the maximum height of a text vector.

### Examples

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

---

merge_dendrogram	<i>Merge Dendrograms</i>
------------------	--------------------------

---

**Description**

Merge Dendrograms

**Usage**

```
merge_dendrogram(x, y, only_parent = FALSE, ...)
```

**Arguments**

x	The parent dendrogram.
y	The children dendrograms. They are connected to the leaves of the parent dendrogram. So the length of y should be as same as the number of leaves of the parent dendrogram.
only_parent	Whether only returns the parent dendrogram where the height and node positions have been adjusted by children dendrograms.
...	Other arguments.

**Details**

Do not retrieve the order of the merged dendrogram. It is not reliable.

**Examples**

```
m1 = matrix(rnorm(100), nr = 10)
m2 = matrix(rnorm(80), nr = 8)
m3 = matrix(rnorm(50), nr = 5)
dend1 = as.dendrogram(hclust(dist(m1)))
dend2 = as.dendrogram(hclust(dist(m2)))
dend3 = as.dendrogram(hclust(dist(m3)))
dend_p = as.dendrogram(hclust(dist(rbind(colMeans(m1), colMeans(m2), colMeans(m3)))))
dend_m = merge_dendrogram(dend_p, list(dend1, dend2, dend3))
grid.dendrogram(dend_m, test = TRUE)

dend_m = merge_dendrogram(dend_p, list(dend1, dend2, dend3), only_parent = TRUE)
grid.dendrogram(dend_m, test = TRUE)

require(dendextend)
dend1 = color_branches(dend1, k = 1, col = "red")
dend2 = color_branches(dend2, k = 1, col = "blue")
dend3 = color_branches(dend3, k = 1, col = "green")
dend_p = color_branches(dend_p, k = 1, col = "orange")
dend_m = merge_dendrogram(dend_p, list(dend1, dend2, dend3))
grid.dendrogram(dend_m, test = TRUE)
```

---

`names.HeatmapAnnotation`*Annotation Names*

---

**Description**

Annotation Names

**Usage**

```
## S3 method for class 'HeatmapAnnotation'  
names(x)
```

**Arguments**

x                    A [HeatmapAnnotation-class](#) object.

**Examples**

```
ha = HeatmapAnnotation(foo = 1:10, bar = anno_points(10:1))  
names(ha)
```

---

`names.HeatmapList`*Names of the heatmaps/annotations*

---

**Description**

Names of the heatmaps/annotations

**Usage**

```
## S3 method for class 'HeatmapList'  
names(x)
```

**Arguments**

x                    A [HeatmapList-class](#) object

**Examples**

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



---

namesAssign.HeatmapAnnotation  
*Assign Annotation Names*

---

**Description**

Assign Annotation Names

**Usage**

```
## S3 replacement method for class 'HeatmapAnnotation'  
names(x) <- value
```

**Arguments**

x                   A [HeatmapAnnotation-class](#) object.  
value               A vector of new names.

**Examples**

```
ha = HeatmapAnnotation(foo = 1:10, bar = anno_points(10:1))  
names(ha) = c("A", "B")  
names(ha)
```

---

ncol.Heatmap                   *Number of Columns in the Heatmap*

---

**Description**

Number of Columns in the Heatmap

**Usage**

```
## S3 method for class 'Heatmap'  
ncol(x)
```

**Arguments**

x                   A [Heatmap-class](#) object.

**Examples**

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

nobs.AnnotationFunction  
*Number of Observations*

---

**Description**

Number of Observations

**Usage**

```
## S3 method for class 'AnnotationFunction'  
nobs(object, ...)
```

**Arguments**

object           The [AnnotationFunction-class](#) object.  
...               Other arguments.

**Details**

returns NA.

**Examples**

```
anno = anno_points(1:10)  
nobs(anno)
```

---

nobs.HeatmapAnnotation  
*Number of Observations*

---

**Description**

Number of Observations

**Usage**

```
## S3 method for class 'HeatmapAnnotation'  
nobs(object, ...)
```

**Arguments**

object           The [HeatmapAnnotation-class](#) object.  
...               other arguments.

**Value**

If there is no nobs information for any of its [SingleAnnotation-class](#) object, it returns NA.

**Examples**

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

---

nobs.SingleAnnotation *Number of Observations*

---

**Description**

Number of Observations

**Usage**

```
## S3 method for class 'SingleAnnotation'  
nobs(object, ...)
```

**Arguments**

object	The <a href="#">SingleAnnotation-class</a> object.
...	Other arguments.

**Details**

It returns the n slot of the annotaton function. If it does not exist, it returns NA.

**Examples**

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

---

```
normalize_comb_mat
```

*Normalize a list of combination matrice*

---

**Description**

Normalize a list of combination matrice

**Usage**

```
normalize_comb_mat(..., full_comb_sets = FALSE, complement_set = FALSE)
```

**Arguments**

```
...           Combination matrices.
full_comb_sets Whether the combination matrices contain the full sets of combination sets?
complement_set Whether the combination matrices also contain the complement set?
```

**Details**

It normalizes a list of combination matrice to make them have same number and order of sets and combination sets.

The sets (by [set\\_name](#)) from all combination matrice should be the same.

**Examples**

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

---

```
normalize_genomic_signals_to_bins
```

*Overlap genomic signals to the genomic bins*

---

**Description**

Overlap genomic signals to the genomic bins

**Usage**

```
normalize_genomic_signals_to_bins(gr, value, value_column = NULL, method = "weighted",
  empty_value = NA, window = GHEATMAP_ENV$chr_window)
```

**Arguments**

gr	A <a href="#">GRanges</a> object.
value	The corresponding signals corresponding to gr.
value_column	If value is not set and the values are in the meta-columns in gr, you can specify the column indices for these value columns, better to use name indices.
method	One of "weighted", "w0" and "absolute". For the three different methods, please refer to <a href="https://bioconductor.org/packages/release/bioc/vignettes/EnrichedHeatmap/inst/doc/EnrichedHeatmap.html#toc_7">https://bioconductor.org/packages/release/bioc/vignettes/EnrichedHeatmap/inst/doc/EnrichedHeatmap.html#toc_7</a> .
empty_value	The value for the bins where no signal is overlapped.
window	The genomic bins generated from <a href="#">bin_genome</a> .

**Details**

The genomic bins should be generated by [bin\\_genome](#) in advance. The genomic bins are saved internally, so that multiple uses of [bin\\_genome](#) ensure they all return the matrices with the same rows.

It supports following values.

- When neither value nor value\_column is set, it simply overlap gr to the genomic bins and returns a one-column logical matrix which represents whether the current genomic bin overlaps to any signal.
- When the signals are numeric, value can be a numeric vector or a matrix, or value\_column can contain multiple columns. The function returns a numeric matrix where the values are properly averaged depending on what method was used.
- When the signals are character, value can only be a vector or value\_column can only contain one single column. The function returns a one-column character matrix.

**Value**

A matrix with the same row as the genomic bins.

**Examples**

```
## Not run:
require(circlize)
require(GenomicRanges)

chr_window = bin_genome("hg19")

#### the first is a numeric matrix #####
bed1 = generateRandomBed(nr = 1000, nc = 10)
gr1 = GRanges(seqnames = bed1[, 1], ranges = IRanges(bed1[, 2], bed1[, 3]))

num_mat = normalize_genomic_signals_to_bins(gr1, bed1[, -(1:3)])

#### the second is a character matrix #####
bed_list = lapply(1:10, function(i) {
```

```

generateRandomBed(nr = 1000, nc = 1,
  fun = function(n) sample(c("gain", "loss"), n, replace = TRUE))
})
char_mat = NULL
for(i in 1:10) {
  bed = bed_list[[i]]
  bed = bed[sample(nrow(bed), 20), , drop = FALSE]
  gr_cnv = GRanges(seqnames = bed[, 1], ranges = IRanges(bed[, 2], bed[, 3]))

  char_mat = cbind(char_mat, normalize_genomic_signals_to_bins(gr_cnv, bed[, 4]))
}

#### two numeric columns #####
bed2 = generateRandomBed(nr = 100, nc = 2)
gr2 = GRanges(seqnames = bed2[, 1], ranges = IRanges(bed2[, 2], bed2[, 3]))

v = normalize_genomic_signals_to_bins(gr2, bed2[, 4:5])

##### a list of genes need to be highlighted
bed3 = generateRandomBed(nr = 40, nc = 0)
gr3 = GRanges(seqnames = bed3[, 1], ranges = IRanges(bed3[, 2], bed3[, 2]))
gr3$gene = paste0("gene_", 1:length(gr3))

mtch = as.matrix(findOverlaps(chr_window, gr3))
at = mtch[, 1]
labels = mcols(gr3)[mtch[, 2], 1]

##### order of the chromosomes #####
chr = as.vector(seqnames(chr_window))
chr_level = paste0("chr", c(1:22, "X", "Y"))
chr = factor(chr, levels = chr_level)

#### make the heatmap #####
subgroup = rep(c("A", "B"), each = 5)

ht_opt$TITLE_PADDING = unit(c(4, 4), "points")
ht_list = Heatmap(num_mat, name = "mat", col = colorRamp2(c(-1, 0, 1), c("green", "white", "red")),
  row_split = chr, cluster_rows = FALSE, show_column_dend = FALSE,
  column_split = subgroup, cluster_column_slices = FALSE,
  column_title = "numeric matrix",
  top_annotation = HeatmapAnnotation(subgroup = subgroup, annotation_name_side = "left",
  row_title_rot = 0, row_title_gp = gpar(fontsize = 10), border = TRUE,
  row_gap = unit(0, "points")) +
  Heatmap(char_mat, name = "CNV", col = c("gain" = "red", "loss" = "blue"),
  border = TRUE, column_title = "character matrix") +
  rowAnnotation(label = anno_mark(at = at, labels = labels)) +
  rowAnnotation(pt = anno_points(v, gp = gpar(col = 4:5), pch = c(1, 16)),
  width = unit(2, "cm")) +
  rowAnnotation(bar = anno_barplot(v[, 1], gp = gpar(col = ifelse(v[, 1] > 0, 2, 3))),
  width = unit(2, "cm"))
draw(ht_list, merge_legend = TRUE)

##### or horizontally ###

```

```

ht_list = Heatmap(t(num_mat), name = "mat", col = colorRamp2(c(-1, 0, 1), c("green", "white", "red")),
  column_split = chr, cluster_columns = FALSE, show_row_dend = FALSE,
  row_split = subgroup, cluster_row_slices = FALSE,
  row_title = "numeric matrix",
  left_annotation = rowAnnotation(subgroup = subgroup, show_annotation_name = FALSE,
    annotation_legend_param = list(
      subgroup = list(direction = "horizontal", title_position = "lefttop", nrow = 1))),
  column_title_gp = gpar(fontsize = 10), border = TRUE,
  column_gap = unit(0, "points"),
  column_title = ifelse(seq_along(chr_level) % 2 == 0, paste0("\n", chr_level), paste0(chr_level, "\n")),
  heatmap_legend_param = list(direction = "horizontal", title_position = "lefttop")) %v%
Heatmap(t(char_mat), name = "CNV", col = c("gain" = "red", "loss" = "blue"),
  border = TRUE, row_title = "character matrix",
  heatmap_legend_param = list(direction = "horizontal", title_position = "lefttop", nrow = 1)) %v%
HeatmapAnnotation(label = anno_mark(at = at, labels = labels, side = "bottom")) %v%
HeatmapAnnotation(pt = anno_points(v, gp = gpar(col = 4:5), pch = c(1, 16)),
  annotation_name_side = "left", height = unit(2, "cm")) %v%
HeatmapAnnotation(bar = anno_barplot(v[, 1], gp = gpar(col = ifelse(v[,1] > 0, 2, 3))),
  annotation_name_side = "left", height = unit(2, "cm"))
draw(ht_list, heatmap_legend_side = "bottom", merge_legend = TRUE)

## End(Not run)

```

---

nrow.Heatmap

*Number of Rows in the Heatmap*


---

## Description

Number of Rows in the Heatmap

## Usage

```

## S3 method for class 'Heatmap'
nrow(x)

```

## Arguments

x [A Heatmap-class](#) object.

## Examples

```

# There is no example
NULL

```

---

`oncoPrint`*Make oncoPrint*

---

## Description

Make oncoPrint

## Usage

```
oncoPrint(mat, name,
  get_type = default_get_type,
  alter_fun,
  alter_fun_is_vectorized = NULL,
  col = NULL,

  top_annotation = HeatmapAnnotation(cbar = anno_oncoprint_barplot()),
  right_annotation = rowAnnotation(rbar = anno_oncoprint_barplot()),
  left_annotation = NULL,
  bottom_annotation = NULL,

  show_pct = TRUE,
  pct_gp = gpar(fontsize = 10),
  pct_digits = 0,
  pct_side = "left",

  row_labels = NULL,
  show_row_names = TRUE,
  row_names_side = "right",
  row_names_gp = pct_gp,
  row_split = NULL,

  column_labels = NULL,
  column_names_gp = gpar(fontsize = 10),
  column_split = NULL,

  row_order = NULL,
  column_order = NULL,
  cluster_rows = FALSE,
  cluster_columns = FALSE,

  remove_empty_columns = FALSE,
  remove_empty_rows = FALSE,
  show_column_names = FALSE,
  heatmap_legend_param = NULL,
  ...)
```



**Arguments**

mat	The value should be a character matrix which encodes multiple alterations or a list of matrices for which every matrix contains binary value representing whether the alteration is present or absent. When the value is a list, the names of the list represent alteration types. You can use <a href="#">unify_mat_list</a> to make all matrix having same row names and column names.
name	Name of the oncoPrint. Not necessary to specify.
get_type	If different alterations are encoded in the matrix as complex strings, this self-defined function determines how to extract them. It only works when mat is a matrix. The default value is <a href="#">default_get_type</a> .
alter_fun	A single function or a list of functions which defines how to add graphics for different alterations. You can use <a href="#">alter_graphic</a> to automatically generate for rectangles and points.
alter_fun_is_vectorized	Whether alter_fun is implemented vectorized. Internally the function will guess.
col	A vector of color for which names correspond to alteration types.
top_annotation	Annotation put on top of the oncoPrint. By default it is barplot which shows the number of genes with a certain alteration in each sample.
right_annotation	Annotation put on the right of the oncoPrint. By default it is barplot which shows the number of samples with a certain alteration in each gene.
left_annotation	Annotation put on the left of the oncoPrint.
bottom_annotation	Annotation put at the bottom of the oncoPrint.
show_pct	whether show percent values on the left of the oncoprint?
pct_gp	Graphic parameters for percent values
pct_digits	Digits for the percent values.
pct_side	Side of the percent values to the oncoPrint. This argument is currently disabled.
row_labels	Labels as the row names of the oncoPrint.
show_row_names	Whether show row names?
row_names_side	Side of the row names to the oncoPrint. This argument is currently disabled.
row_names_gp	Graphic parameters for the row names.
row_split	Pass to <a href="#">Heatmap</a> .
column_labels	Pass to <a href="#">Heatmap</a> .
column_names_gp	Pass to <a href="#">Heatmap</a> .
column_split	Pass to <a href="#">Heatmap</a> .
row_order	Order of rows. By default rows are sorted by the number of occurrence of the alterations.

cluster\_rows    If it is set, it must be a dendrogram/hclust object.  
 cluster\_columns    If it is set, it must be a dendrogram/hclust object.  
 column\_order    Order of columns. By default the columns are sorted to show the mutual exclusivity of alterations.  
 remove\_empty\_columns    If there is no alteration in some samples, whether remove them on the oncoPrint?  
 remove\_empty\_rows    If there is no alteration in some samples, whether remove them on the oncoPrint?  
 show\_column\_names    Whether show column names?  
 heatmap\_legend\_param    pass to [Heatmap](#).  
 ...    Pass to [Heatmap](#).

### Details

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

<https://jokergoo.github.io/ComplexHeatmap-reference/book/oncoprint.html> gives details for configuring a oncoPrint.

### Value

A [Heatmap-class](#) object which means you can add other heatmaps or annotations to it.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### Examples

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

---

order.comb_mat	<i>Order of the Combination Sets</i>
----------------	--------------------------------------

---

### Description

Order of the Combination Sets

### Usage

```
order.comb_mat(m, decreasing = TRUE, on = "comb_set")
```

**Arguments**

m	A combination matrix returned by <a href="#">make_comb_mat</a> .
on	On sets or on combination sets?
decreasing	Whether the ordering is applied decreasingly.

**Details**

It first sorts by the degree of the combination sets then by the combination matrix.

**Examples**

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

---

packLegend	<i>Pack Legends</i>
------------	---------------------

---

**Description**

Pack Legends

**Usage**

```
packLegend(..., gap = unit(4, "mm"), row_gap = unit(4, "mm"), column_gap = unit(4, "mm"),
  direction = c("vertical", "horizontal"),
  max_width = NULL, max_height = NULL, list = NULL)
```

**Arguments**

...	A list of objects returned by <a href="#">Legend</a> .
gap	Gap between two neighbouring legends. The value is a <a href="#">unit</a> object with length of one. It is the same as <code>row_gap</code> if the direction is vertical and the same as <code>column_gap</code> if the direction is horizontal.
row_gap	Horizontal gaps between legends.
column_gap	Vertical gaps between legends.
direction	The direction to arrange legends.
max_width	The maximal width of the total packed legends. It only works for horizontal arrangement. If the total width of the legends exceeds it, the legends will be arranged into multiple rows.
max_height	Similar as <code>max_width</code> , but for the vertical arrangement of legends.
list	The list of legends can be specified as a list.

**Value**

A `Legends-class` object.

**See Also**

<https://jokergoo.github.io/ComplexHeatmap-reference/book/legends.html#a-list-of-legends>

**Examples**

```
require(circlize)
col_fun = colorRamp2(c(0, 0.5, 1), c("blue", "white", "red"))
lgd1 = Legend(at = 1:6, legend_gp = gpar(fill = 1:6), title = "legend1")
lgd2 = Legend(col_fun = col_fun, title = "legend2", at = c(0, 0.25, 0.5, 0.75, 1))
pd = packLegend(lgd1, lgd2)
draw(pd, test = "two legends")
pd = packLegend(lgd1, lgd2, direction = "horizontal")
draw(pd, test = "two legends packed horizontally")
```

---

pheatmap

*Translate pheatmap::pheatmap to ComplexHeatmap::Heatmap*

---

**Description**

Translate pheatmap::pheatmap to ComplexHeatmap::Heatmap

**Usage**

```
pheatmap(mat,
  color = colorRampPalette(rev(brewer.pal(n = 7, name = "RdYlBu")))(100),
  kmeans_k = NA,
  breaks = NA,
  border_color = ifelse(nrow(mat) < 100 & ncol(mat) < 100, "grey60", NA),
  cellwidth = NA,
  cellheight = NA,
  scale = "none",
  cluster_rows = TRUE,
  cluster_cols = TRUE,
  clustering_distance_rows = "euclidean",
  clustering_distance_cols = "euclidean",
  clustering_method = "complete",
  clustering_callback = NA,
  cutree_rows = NA,
  cutree_cols = NA,
  treeheight_row = ifelse(class(cluster_rows) == "hclust" || cluster_rows, 50, 0),
  treeheight_col = ifelse(class(cluster_cols) == "hclust" || cluster_cols, 50, 0),
  legend = TRUE,
  legend_breaks = NA,
```

```

legend_labels = NA,
annotation_row = NA,
annotation_col = NA,
annotation = NA,
annotation_colors = NA,
annotation_legend = TRUE,
annotation_names_row = TRUE,
annotation_names_col = TRUE,
drop_levels = TRUE,
show_rownames = TRUE,
show_colnames = TRUE,
main = NA,
fontsize = 10,
fontsize_row = fontsize,
fontsize_col = fontsize,
angle_col = c("270", "0", "45", "90", "315"),
display_numbers = FALSE,
number_format = "%.2f",
number_color = "grey30",
fontsize_number = 0.8 * fontsize,
gaps_row = NULL,
gaps_col = NULL,
labels_row = NULL,
labels_col = NULL,
filename = NA,
width = NA,
height = NA,
silent = FALSE,
na_col = "#DDDDDD",
name = " ",

# argument specific for Heatmap()
heatmap_legend_param = list(),
...,
run_draw = TRUE)

```

### Arguments

mat	The input matrix.
color	The same as in <a href="#">pheatmap</a> . Here you don't necessarily need to generate a long color vector. The discrete colors sent to <a href="#">colorRampPalette</a> are also OK here. E.g. <code>colorRampPalette(rev(brewer.pal(n = 7, name = "RdYlBu")))(100)</code> can be simply replaced as <code>rev(brewer.pal(n = 7, name = "RdYlBu"))</code> .
kmeans_k	The same as in <a href="#">pheatmap</a> .
breaks	The same as in <a href="#">pheatmap</a> .
border_color	The same as in <a href="#">pheatmap</a> .
cellwidth	The same as in <a href="#">pheatmap</a> .

cellheight	The same as in <a href="#">pheatmap</a> .
scale	The same as in <a href="#">pheatmap</a> .
cluster_rows	The same as in <a href="#">pheatmap</a> .
cluster_cols	The same as in <a href="#">pheatmap</a> .
clustering_distance_rows	The same as in <a href="#">pheatmap</a> .
clustering_distance_cols	The same as in <a href="#">pheatmap</a> .
clustering_method	The same as in <a href="#">pheatmap</a> .
clustering_callback	The same as in <a href="#">pheatmap</a> .
cutree_rows	The same as in <a href="#">pheatmap</a> .
cutree_cols	The same as in <a href="#">pheatmap</a> .
treeheight_row	The same as in <a href="#">pheatmap</a> .
treeheight_col	The same as in <a href="#">pheatmap</a> .
legend	The same as in <a href="#">pheatmap</a> .
legend_breaks	The same as in <a href="#">pheatmap</a> .
legend_labels	The same as in <a href="#">pheatmap</a> .
annotation_row	The same as in <a href="#">pheatmap</a> .
annotation_col	The same as in <a href="#">pheatmap</a> .
annotation	The same as in <a href="#">pheatmap</a> .
annotation_colors	The same as in <a href="#">pheatmap</a> .
annotation_legend	The same as in <a href="#">pheatmap</a> .
annotation_names_row	The same as in <a href="#">pheatmap</a> .
annotation_names_col	The same as in <a href="#">pheatmap</a> .
drop_levels	Enforced to be TRUE.
show_rownames	The same as in <a href="#">pheatmap</a> .
show_colnames	The same as in <a href="#">pheatmap</a> .
main	The same as in <a href="#">pheatmap</a> .
fontsize	The same as in <a href="#">pheatmap</a> .
fontsize_row	The same as in <a href="#">pheatmap</a> .
fontsize_col	The same as in <a href="#">pheatmap</a> .
angle_col	The same as in <a href="#">pheatmap</a> .
display_numbers	The same as in <a href="#">pheatmap</a> .

number_format	The same as in <a href="#">pheatmap</a> .
number_color	The same as in <a href="#">pheatmap</a> .
fontsize_number	The same as in <a href="#">pheatmap</a> .
gaps_row	The same as in <a href="#">pheatmap</a> .
gaps_col	The same as in <a href="#">pheatmap</a> .
labels_row	The same as in <a href="#">pheatmap</a> .
labels_col	The same as in <a href="#">pheatmap</a> .
filename	Not supported.
width	Not supported.
height	Not supported.
silent	Not supported.
na_col	The same as in <a href="#">pheatmap</a> .
name	Name of the heatmap. This argument is passed to <a href="#">Heatmap</a> .
heatmap_legend_param	Pass to <a href="#">Heatmap</a> .
...	Other arguments passed to <a href="#">Heatmap</a> .
run_draw	Whether to run <code>draw()</code> function to the heatmap object.

### Details

This function aims to execute `pheatmap::pheatmap` code purely with `ComplexHeatmap`.

### Value

A `Heatmap-class` object.

### See Also

See [https://jokergoo.github.io/2020/05/06/translate-from-pheatmap-to-complexheatmap/compare\\_pheatmap](https://jokergoo.github.io/2020/05/06/translate-from-pheatmap-to-complexheatmap/compare_pheatmap) that compares heatmaps between `pheatmap::pheatmap()` and `ComplexHeatmap::pheatmap()`.

### Examples

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

pindex

*Get Values in a Matrix by Pair-wise Indices***Description**

Get Values in a Matrix by Pair-wise Indices

**Usage**

```
pindex(m, i, j)
```

**Arguments**

<code>m</code>	A matrix or a 3-dimension array.
<code>i</code>	Row indices or the indices in the first dimension.
<code>j</code>	Column indices or the indices in the second dimension.

**Value**

If `m` is a matrix, the value returned is a vector `c(m[i1, j1], m[i2, j2], ...)`.

If `m` is an array, the value returned is a matrix `rbind(m[i1, j1, ], m[i2, j2, ], ...)`.

**Examples**

```
m = matrix(rnorm(100), 10)
m2 = m[m > 0]
ind = do.call("rbind", lapply(1:10, function(ci) {
  i = which(m[, ci] > 0)
  cbind(i = i, j = rep(ci, length(i)))
}))
pindex(m, ind[, 1], ind[, 2])
identical(pindex(m, ind[, 1], ind[, 2]), m[m > 0])

# 3d array
arr = array(1:27, dim = c(3, 3, 3))
pindex(arr, 1:2, 2:3)
identical(pindex(arr, 1:2, 2:3),
  rbind(arr[1, 2, ], arr[2, 3, ]))
```



---

prepare-Heatmap-method  
*Prepare the Heatmap*

---

## Description

Prepare the Heatmap

## Usage

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

## Arguments

object	A <a href="#">Heatmap-class</a> object.
process_rows	Whether to process rows of the heatmap.
process_columns	Whether to process columns of the heatmap.

## Details

The preparation of the heatmap includes following steps:

- making clustering on rows (by calling [make\\_row\\_cluster, Heatmap-method](#))
- making clustering on columns (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

The [Heatmap-class](#) object.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

---

`print.comb_mat`      *Print the comb\_mat Object*

---

### Description

Print the comb\_mat Object

### Usage

```
## S3 method for class 'comb_mat'  
print(x, ...)
```

### Arguments

`x`                    A combination matrix returned by [make\\_comb\\_mat](#).  
`...`                 Other arguments

### Examples

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

---

`restore_matrix`      *Restore the index vector to index matrix in layer\_fun*

---

### Description

Restore the index vector to index matrix in layer\_fun

### Usage

```
restore_matrix(j, i, x, y)
```

### Arguments

`j`                    Column indices directly from layer\_fun.  
`i`                    Row indices directly from layer\_fun.  
`x`                    Position on x-direction directly from layer\_fun.  
`y`                    Position on y-direction directly from layer\_fun.

## Details

The values that are sent to `layer_fun` are all vectors (for the vectorization of the grid graphic functions), however, the heatmap slice where `layer_fun` is applied to, is still represented by a matrix, thus, it would be very convenient if all the arguments in `layer_fun` can be converted to the sub-matrix for the current slice. Here, as shown in above example, `restore_matrix` does the job. `restore_matrix` directly accepts the first four argument in `layer_fun` and returns an index matrix, where rows and columns correspond to the rows and columns in the current slice, from top to bottom and from left to right. The values in the matrix are the natural order of e.g. vector `j` in current slice.

For following code:

```
Heatmap(small_mat, name = "mat", col = col_fun,
        row_km = 2, column_km = 2,
        layer_fun = function(j, i, x, y, w, h, fill) {
          ind_mat = restore_matrix(j, i, x, y)
          print(ind_mat)
        }
)
```

The first output which is for the top-left slice:

```
      [,1] [,2] [,3] [,4] [,5]
[1,]    1    4    7   10   13
[2,]    2    5    8   11   14
[3,]    3    6    9   12   15
```

As you see, this is a three-row and five-column index matrix where the first row corresponds to the top row in the slice. The values in the matrix correspond to the natural index (i.e. 1, 2, ...) in `j`, `i`, `x`, `y`, ... in `layer_fun`. Now, if we want to add values on the second column in the top-left slice, the code which is put inside `layer_fun` would look like:

```
for(ind in ind_mat[, 2]) {
  grid.text(small_mat[i[ind], j[ind]], x[ind], y[ind], ...)
}
```

## Examples

```
set.seed(123)
mat = matrix(rnorm(81), nr = 9)
Heatmap(mat, row_km = 2, column_km = 2,
        layer_fun = function(j, i, x, y, width, height, fill) {
          ind_mat = restore_matrix(j, i, x, y)
          print(ind_mat)
        })
```

```
set.seed(123)
mat = matrix(round(rnorm(81), 2), nr = 9)
Heatmap(mat, row_km = 2, column_km = 2,
```

```

layer_fun = function(j, i, x, y, width, height, fill) {
  ind_mat = restore_matrix(j, i, x, y)
  ind = unique(c(ind_mat[2, ], ind_mat[, 3]))
  grid.text(pindex(mat, i[ind], j[ind]), x[ind], y[ind])
})

```

---

re\_size-HeatmapAnnotation-method

*Resize the Width or Height of Heatmap Annotations*


---

## Description

Resize the Width or Height of Heatmap Annotations

## Usage

```

## S4 method for signature 'HeatmapAnnotation'
re_size(object,
  annotation_height = NULL,
  annotation_width = NULL,
  height = NULL,
  width = NULL,
  simple_anno_size = object@param$simple_anno_size,
  simple_anno_size_adjust = object@param$simple_anno_size_adjust)

```

## Arguments

object	A <a href="#">HeatmapAnnotation-class</a> object.
annotation_height	A vector of of annotation heights in <a href="#">unit</a> class.
annotation_width	A vector of of annotation widths in <a href="#">unit</a> class.
height	The height of the complete heatmap annotation.
width	The width of the complete heatmap annotation.
simple_anno_size	The size of one line of the simple annotation.
simple_anno_size_adjust	Whether adjust the size of the simple annotation?

## Details

The function only adjust height for column annotations and width for row annotations.

The basic rules are (take height and annotation\_height for example):

1. If annotation\_height is set and all annotation\_height are absolute units, height is ignored.
2. If annotation\_height contains non-absolute units, height also need to be set and the non-absolute units should be set in a simple form such as 1:10 or unit(1, "null").
3. simple\_anno\_size

is only used when `annotation_height` is `NULL`. 4. If only `height` is set, non-simple annotation is adjusted while keeps simple annotation unchanged. 5. If only `height` is set and all annotations are simple annotations, all annotations are adjusted, and `simple_anno_size` is disabled. 6. If `simple_anno_size_adjust` is `FALSE`, the size of the simple annotations will not change.

### Examples

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

---

rowAnnotation	<i>Construct Row Annotations</i>
---------------	----------------------------------

---

### Description

Construct Row Annotations

### Usage

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

### Arguments

... Pass to [HeatmapAnnotation](#).

### Details

The function is identical to

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

### Value

A [HeatmapAnnotation-class](#) object.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

### Examples

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

---

row\_anno\_barplot      *Barplots as Row Annotation*

---

**Description**

Barplots as Row Annotation

**Usage**

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

**Arguments**

...                    pass to [anno\\_barplot](#).

**Details**

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

You can directly use [anno\\_barplot](#) for row annotation if you call it in [rowAnnotation](#).

**Value**

See help page of [anno\\_barplot](#).

**Examples**

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

---

row\_anno\_boxplot      *Boxplots as Row Annotation*

---

**Description**

Boxplots as Row Annotation

**Usage**

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

**Arguments**

...                    pass to [anno\\_boxplot](#).

**Details**

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

You can directly use [anno\\_boxplot](#) for row annotation if you call it in [rowAnnotation](#).

**Value**

See help page of [anno\\_boxplot](#).

**Examples**

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

---

row_anno_density	<i>Density as Row Annotation</i>
------------------	----------------------------------

---

**Description**

Density as Row Annotation

**Usage**

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

**Arguments**

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

**Details**

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

You can directly use [anno\\_density](#) for row annotation if you call it in [rowAnnotation](#).

**Value**

See help page of [anno\\_density](#).

**Examples**

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





**Details**

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

You can directly use [anno\\_points](#) for row annotation if you call it in [rowAnnotation](#).

**Value**

See help page of [anno\\_points](#).

**Examples**

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

---

row_anno_text	<i>Text as Row Annotation</i>
---------------	-------------------------------

---

**Description**

Text as Row Annotation

**Usage**

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

**Arguments**

... pass to [anno\\_text](#).

**Details**

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

You can directly use [anno\\_text](#) for row annotation if you call it in [rowAnnotation](#).

**Value**

See help page of [anno\\_text](#).

**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

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

### Arguments

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

### Value

The format of the returned object depends on whether rows/columns of the heatmaps are split.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```
mat = matrix(rnorm(100), 10)
ht = Heatmap(mat)
ht = draw(ht)
row_dend(ht)
ht = Heatmap(mat, row_km = 2)
ht = draw(ht)
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, name = NULL)
```

**Arguments**

object	A <a href="#">HeatmapList-class</a> object.
name	Name of a specific heatmap.

**Value**

The format of the returned object depends on whether rows/columns of the heatmaps are split.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```
mat = matrix(rnorm(100), 10)
ht_list = Heatmap(mat) + Heatmap(mat)
ht_list = draw(ht_list)
row_dend(ht_list)
ht_list = Heatmap(mat, row_km = 2) + Heatmap(mat)
ht_list = draw(ht_list)
row_dend(ht_list)
ht_list = Heatmap(mat, row_km = 2) %v% Heatmap(mat)
ht_list = draw(ht_list)
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

The format of the returned object depends on whether rows/columns of the heatmaps are split.

### Author(s)

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```
mat = matrix(rnorm(100), 10)
ht = Heatmap(mat)
ht = draw(ht)
row_order(ht)
ht = Heatmap(mat, row_km = 2)
ht = draw(ht)
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, name = NULL)
```

**Arguments**

object	A <a href="#">HeatmapList-class</a> object.
name	Name of a specific heatmap.

**Value**

The format of the returned object depends on whether rows/columns of the heatmaps are split.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

```
mat = matrix(rnorm(100), 10)
ht_list = Heatmap(mat) + Heatmap(mat)
ht_list = draw(ht_list)
row_order(ht_list)
ht_list = Heatmap(mat, row_km = 2) + Heatmap(mat)
ht_list = draw(ht_list)
row_order(ht_list)
ht_list = Heatmap(mat, row_km = 2) %v% Heatmap(mat)
ht_list = draw(ht_list)
row_order(ht_list)
```

---

set\_component\_height-Heatmap-method

*Set Height of Heatmap Component*

---

## Description

Set Height of Heatmap Component

## Usage

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

## Arguments

object	A <a href="#">Heatmap-class</a> object.
k	Which column component? The value should a numeric index or the name of the corresponding column component. See <b>**Details**</b> .
v	Height of the component, a <a href="#">unit</a> object.

## Details

All column components are: column\_title\_top, column\_dend\_top, column\_names\_top, column\_anno\_top, heatmap\_body, column\_anno\_bottom, column\_names\_bottom, column\_dend\_bottom, column\_title\_bottom.

This function is only for internal use.

## Value

The [Heatmap-class](#) object.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

---

set\_component\_width-Heatmap-method  
*Set Width of Heatmap Component*

---

## Description

Set Width of Heatmap Component

## Usage

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

## Arguments

object	A <a href="#">Heatmap-class</a> object.
k	Which row component? The value should a numeric index or the name of the corresponding row component. See <b>**Details**</b> .
v	width of the component, a <a href="#">unit</a> object.

## Details

All row components are: row\_title\_left, row\_dend\_left, row\_names\_left, row\_anno\_left, heatmap\_body, row\_anno\_right, row\_names\_right, row\_dend\_right, row\_title\_right.

This function is only for internal use.

## Value

The [Heatmap-class](#) object.

## Author(s)

Zuguang Gu <z.gu@dkfz.de>

## Examples

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

set\_name                      *Set Names*

---

**Description**

Set Names

**Usage**

```
set_name(m)
```

**Arguments**

m                      A combination matrix returned by [make\\_comb\\_mat](#).

**Value**

A vector of set names.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)
set_name(m)
```

---

set\_nameAssign                *Modify Set Names*

---

**Description**

Modify Set Names

**Usage**

```
set_name(x, ...) <- value
```

**Arguments**

x                      A combination matrix returned by [make\\_comb\\_mat](#).  
value                  New set names.  
...                    Other arguments.



**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)
set_name(m) = c("A", "B", "C")
m
```

---

set_size	<i>Set Sizes</i>
----------	------------------

---

**Description**

Set Sizes

**Usage**

```
set_size(m)
```

**Arguments**

m                    A combination matrix returned by [make\\_comb\\_mat](#).

**Value**

A vector of set sizes.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)
set_size(m)
```

---

```
show-AnnotationFunction-method  
    Print the AnnotationFunction Object
```

---

**Description**

Print the AnnotationFunction Object

**Usage**

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

**Arguments**

object            The [AnnotationFunction-class](#) object.

**Examples**

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

---

```
show-ColorMapping-method  
    Print the ColorMapping Object
```

---

**Description**

Print the ColorMapping Object

**Usage**

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

**Arguments**

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

**Value**

This function returns no value.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

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

---

**Description**

Method dispatch page for show.

**Dispatch**

show can be dispatched on following classes:

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

**Examples**

```
# no example  
NULL
```

---

show-Heatmap-method	<i>Draw the Single Heatmap with Defaults</i>
---------------------	--

---

**Description**

Draw the Single Heatmap with Defaults

**Usage**

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

**Arguments**

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

**Details**

It actually 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**

The [HeatmapList-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

show-HeatmapAnnotation-method

*Print the HeatmapAnnotation object*

---

**Description**

Print the HeatmapAnnotation object

**Usage**

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

**Arguments**

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

**Value**

No value is returned.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

show-HeatmapList-method

*Draw a list of heatmaps with default parameters*

---

### Description

Draw a list of heatmaps with default parameters

### Usage

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

### Arguments

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

### Details

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

### Value

This function returns no value.

### Examples

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

---

show-SingleAnnotation-method

*Print the SingleAnnotation object*

---

### Description

Print the SingleAnnotation object

### Usage

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

**Arguments**

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

**Value**

No value is returned.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

---

SingleAnnotation            *Constructor Method for SingleAnnotation Class*

---

**Description**

Constructor Method for SingleAnnotation Class

**Usage**

```
SingleAnnotation(name, value, col, fun,
  label = NULL,
  na_col = "grey",
  which = c("column", "row"),
  show_legend = TRUE,
  gp = gpar(col = NA),
  border = FALSE,
  legend_param = list(),
  show_name = TRUE,
  name_gp = gpar(fontsize = 12),
  name_offset = NULL,
  name_side = ifelse(which == "column", "right", "bottom"),
  name_rot = NULL,
  simple_anno_size = ht_opt$simple_anno_size,
  width = NULL, height = NULL)
```

**Arguments**

name	Name for the annotation. If it is not specified, an internal name is assigned.
value	A vector or a matrix of discrete or continuous values.
col	Colors corresponding to value. If the mapping is discrete, the value of col should be a named vector; If the mapping is continuous, the value of col should be a color mapping function.
fun	A user-defined function to add annotation graphics. The argument of this function should be at least a vector of index that corresponds to rows or columns. Normally the function should be constructed by <a href="#">AnnotationFunction</a> if you want the annotation supports splitting. See <b>**Details**</b> for more explanation.
label	Label for the annotation. By default is the annotation name.
na_col	Color for NA values in the simple annotations.
which	Whether the annotation is a row annotation or a column annotation?
show_legend	If it is a simple annotation, whether show legend in the final heatmap?
gp	Since simple annotation is represented as rows of grids. This argument controls graphic parameters for the simple annotation. The fill parameter is ignored here.
border	border, only work for simple annotation
legend_param	Parameters for the legend. See <a href="#">color_mapping_legend</a> , <a href="#">ColorMapping-method</a> for all possible options.
show_name	Whether show annotation name?
name_gp	Graphic parameters for annotation name.
name_offset	Offset to the annotation, a <a href="#">unit</a> object.
name_side	'right' and 'left' for column annotations and 'top' and 'bottom' for row annotations
name_rot	Rotation of the annotation name.
simple_anno_size	size of the simple annotation.
width	The width of the plotting region (the viewport) that the annotation is drawn. If it is a row annotation, the width must be an absolute unit.
height	The height of the plotting region (the viewport) that the annotation is drawn. If it is a column annotation, the width must be an absolute unit.

**Details**

A single annotation is a basic unit of complex heatmap annotations where the heatmap annotations are always a list of single annotations. An annotation can be simply heatmap-like (here we call it simple annotation) or more complex like points, lines, boxes (for which we call it complex annotation).

In the [SingleAnnotation](#) constructor, value, col, na\_col are used to construct a [anno\\_simple](#) annotation function which is generated internally by [AnnotationFunction](#). The legend of the simple annotation can be automatically generated,

For constructing a complex annotation, users need to use `fun` which is a user-defined function. Normally it is constructed by `AnnotationFunction`. One big advantage for using `AnnotationFunction` is the annotation function or the graphics drawn by the annotation function can be split according to row splitting or column splitting of the heatmap. Users can also provide a "pure" function which is a normal R function for the `fun` argument. The function only needs one argument which is a vector of index for rows or columns depending whether it is a row annotation or column annotation. The other two optional arguments are the current slice index and total number of slices. See `**Examples**` section for an example. If it is a normal R function, it will be constructed into the `AnnotationFunction-class` object internally.

The `SingleAnnotation-class` is a simple wrapper on top of `AnnotationFunction-class` only with annotation name added.

The class also stored the "extended area" relative to the area for the annotation graphics. The extended areas are those created by annotation names and axes.

### 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 directly used to generate complex annotations: `anno_simple`, `anno_points`, `anno_lines`, `anno_barplot`, `anno_histogram`, `anno_boxplot`, `anno_density`, `anno_text`, `anno_joyplot`, `anno_horizon`, `anno_image`, `anno_block`, `anno_summary` and `anno_mark`.

### Examples

```
ha = SingleAnnotation(value = 1:10)
draw(ha, test = "single column annotation")

m = cbind(1:10, 10:1)
colnames(m) = c("a", "b")
ha = SingleAnnotation(value = m)
draw(ha, test = "matrix as column annotation")

anno = anno_barplot(matrix(nc = 2, c(1:10, 10:1)))
ha = SingleAnnotation(fun = anno)
draw(ha, test = "anno_barplot as input")

fun = local({
  # because there variables outside the function for use, we put it a local environment
  value = 1:10
  function(index, k = 1, n = 1) {
    pushViewport(viewport(xscale = c(0.5, length(index) + 0.5), yscale = range(value)))
    grid.points(seq_along(index), value[index])
    grid.rect()
  }
})
```



```
        if(k == 1) grid.yaxis()
        popViewport()
    }
})
ha = SingleAnnotation(fun = fun, height = unit(4, "cm"))
draw(ha, index = 1:10, test = "self-defined function")
```

---

SingleAnnotation-class

*Class for a Single Annotation*

---

## Description

Class for a Single Annotation

## Details

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

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

---

```
size.AnnotationFunction
```

*Size of the AnnotationFunction Object*

---

### Description

Size of the AnnotationFunction Object

### Usage

```
## S3 method for class 'AnnotationFunction'
size(x, ...)
```

### Arguments

x                    The [AnnotationFunction-class](#) object.  
 ...                  Other arguments.

### Details

It returns the width if it is a row annotation and the height if it is a column annotation.  
 Internally used.

### Examples

```
anno = anno_points(1:10)
ComplexHeatmap::size(anno)
anno = anno_points(1:10, which = "row")
ComplexHeatmap::size(anno)
```

---

```
size.HeatmapAnnotation
```

*Size of the HeatmapAnnotation Object*

---

### Description

Size of the HeatmapAnnotation Object

### Usage

```
## S3 method for class 'HeatmapAnnotation'
size(x, ...)
```

### Arguments

x                    The [HeatmapAnnotation-class](#) object.  
...                   Other arguments.

### Details

It returns the width if it is a row annotation and the height if it is a column annotation.  
Internally used.

### Examples

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

---

size.SingleAnnotation *Size of the SingleAnnotation Object*

---

### Description

Size of the SingleAnnotation Object

### Usage

```
## S3 method for class 'SingleAnnotation'  
size(x, ...)
```

### Arguments

x                    The [SingleAnnotation-class](#) object.  
...                   Other arguments.

### Details

It returns the width if it is a row annotation and the height if it is a column annotation.  
Internally used.

### Examples

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

sizeAssign.AnnotationFunction

*Assign the Size to the AnnotationFunction Object*

---

### Description

Assign the Size to the AnnotationFunction Object

### Usage

```
## S3 replacement method for class 'AnnotationFunction'  
size(x, ...) <- value
```

### Arguments

x	The <code>AnnotationFunction-class</code> object.
value	A <code>unit</code> object.
...	Other arguments.

### Details

It assigns to the width if it is a row annotation and the height if it is a column annotation.

Internally used.

### Examples

```
anno = anno_points(1:10)  
ComplexHeatmap:::size(anno) = unit(4, "cm")  
ComplexHeatmap:::size(anno)
```

---

sizeAssign.HeatmapAnnotation

*Assign the Size to the HeatmapAnnotation Object*

---

### Description

Assign the Size to the HeatmapAnnotation Object

### Usage

```
## S3 replacement method for class 'HeatmapAnnotation'  
size(x, ...) <- value
```

**Arguments**

x                   The `HeatmapAnnotation-class` object.  
 value               A `unit` object.  
 ...                 Other arguments.

**Details**

It assigns the width if it is a row annotation and the height if it is a column annotation.  
 Internally used.

**Examples**

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

---

```
sizeAssign.SingleAnnotation
```

*Assign the Size to the SingleAnnotation Object*

---

**Description**

Assign the Size to the SingleAnnotation Object

**Usage**

```
## S3 replacement method for class 'SingleAnnotation'
size(x, ...) <- value
```

**Arguments**

x                   The `SingleAnnotation-class` object.  
 value               A `unit` object.  
 ...                 Other arguments.

**Details**

It assigns to the width if it is a row annotation and the height if it is a column annotation.  
 Internally used.

**Examples**

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

---

smartAlign2	<i>Adjust positions of rectangular shapes</i>
-------------	---

---

**Description**

Adjust positions of rectangular shapes

**Usage**

```
smartAlign2(start, end, range, plot = FALSE)
```

**Arguments**

start	position which corresponds to the start (bottom or left) of the rectangle-shapes.
end	position which corresponds to the end (top or right) of the rectangular shapes.
range	data ranges (the minimal and maximal values)
plot	Whether plot the correspondance between the original positions and the adjusted positions. Only for testing.

**Details**

This is an improved version of the [smartAlign](#).

It adjusts the positions of the rectangular shapes to make them do not overlap

**Examples**

```
range = c(0, 10)
pos1 = rbind(c(1, 2), c(5, 7))
smartAlign2(pos1, range = range, plot = TRUE)

range = c(0, 10)
pos1 = rbind(c(-0.5, 2), c(5, 7))
smartAlign2(pos1, range = range, plot = TRUE)

pos1 = rbind(c(-1, 2), c(3, 4), c(5, 6), c(7, 11))
pos1 = pos1 + runif(length(pos1), max = 0.3, min = -0.3)
mfrow = par("mfrow")
par(mfrow = c(3, 3))
for(i in 1:9) {
  ind = sample(4, 4)
  smartAlign2(pos1[ind, ], range = range, plot = TRUE)
}
par(mfrow = mfrow)

pos1 = rbind(c(3, 6), c(4, 7))
smartAlign2(pos1, range = range, plot = TRUE)

pos1 = rbind(c(1, 8), c(3, 10))
smartAlign2(pos1, range = range, plot = TRUE)
```

---

str.comb_mat	<i>str method</i>
--------------	-------------------

---

**Description**

str method

**Usage**

```
## S3 method for class 'comb_mat'  
str(object, ...)
```

**Arguments**

object	A combination matrix returned by <a href="#">make_comb_mat</a> .
...	Other arguments.

**Examples**

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

---

subset_gp	<i>Subset a gpar Object</i>
-----------	-----------------------------

---

**Description**

Subset a gpar Object

**Usage**

```
subset_gp(gp, i)
```

**Arguments**

gp	A <a href="#">gpar</a> object.
i	A vector of indices.

**Value**

A [gpar](#) object.

**Examples**

```
gp = gpar(col = 1:10, fill = 1)  
subset_gp(gp, 1:5)
```

---

subset\_matrix\_by\_row    *Subset the Matrix by Rows*

---

**Description**

Subset the Matrix by Rows

**Usage**

```
subset_matrix_by_row(x, i)
```

**Arguments**

x	A matrix.
i	The row indices.

**Details**

Mainly used for constructing the [AnnotationFunction-class](#) object.

**Examples**

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

---

subset\_vector    *Subset the vector*

---

**Description**

Subset the vector

**Usage**

```
subset_vector(x, i)
```

**Arguments**

x	A vector.
i	The indices.

**Details**

Mainly used for constructing the [AnnotationFunction-class](#) object.



**Examples**

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

---

summary.Heatmap	<i>Print the Summary of a Heatmap</i>
-----------------	---------------------------------------

---

**Description**

Print the Summary of a Heatmap

**Usage**

```
## S3 method for class 'Heatmap'  
summary(object, ...)
```

**Arguments**

object	A <a href="#">Heatmap-class</a> object.
...	Other arguments.

**Examples**

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

---

summary.HeatmapList	<i>Summary of a Heatmap List</i>
---------------------	----------------------------------

---

**Description**

Summary of a Heatmap List

**Usage**

```
## S3 method for class 'HeatmapList'  
summary(object, ...)
```

**Arguments**

object	A <a href="#">HeatmapList-class</a> object.
...	Other arguments.

**Examples**

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

---

t.comb_mat	<i>Transpose the Combination Matrix</i>
------------	---

---

**Description**

Transpose the Combination Matrix

**Usage**

```
## S3 method for class 'comb_mat'
t(x)
```

**Arguments**

x                    A combination matrix returned by `make_comb_mat`.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)
t(m)
```

---

test_alter_fun	<i>Test alter_fun for oncoPrint()</i>
----------------	---------------------------------------

---

**Description**

Test alter\_fun for oncoPrint()

**Usage**

```
test_alter_fun(fun, type, asp_ratio = 1)
```

**Arguments**

fun                    The alter\_fun for `oncoPrint`. The value can be a list of functions or a single function. See <https://jokergoo.github.io/ComplexHeatmap-reference/book/oncoprint.html#define-the-alter-fun>

type                   A vector of alteration types. It is only used when fun is a single function.

asp\_ratio              The aspect ratio (width/height) for the small rectangles.

**Details**

This function helps you to have a quick view of how the graphics for each alteration type and combinations look like.

**Examples**

```
alter_fun = list(
  mut1 = function(x, y, w, h) grid.rect(x, y, w, h, gp = gpar(fill = "red", col = NA)),
  mut2 = function(x, y, w, h) grid.rect(x, y, w, h, gp = gpar(fill = "blue", col = NA)),
  mut3 = function(x, y, w, h) grid.rect(x, y, w, h, gp = gpar(fill = "yellow", col = NA)),
  mut4 = function(x, y, w, h) grid.rect(x, y, w, h, gp = gpar(fill = "purple", col = NA)),
  mut5 = function(x, y, w, h) grid.rect(x, y, w, h, gp = gpar(lwd = 2)),
  mut6 = function(x, y, w, h) grid.points(x, y, pch = 16),
  mut7 = function(x, y, w, h) grid.segments(x - w*0.5, y - h*0.5, x + w*0.5, y + h*0.5, gp = gpar(lwd = 2))
)
test_alter_fun(alter_fun)
```

---

unify\_mat\_list

*Unify a List of Matrix*


---

**Description**

Unify a List of Matrix

**Usage**

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

**Arguments**

mat_list	A list of matrix. All of them should have dimension names.
default	Default values for the newly added rows and columns.

**Details**

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

**Value**

A list of matrix

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**Examples**

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

UpSet

*Make the UpSet plot***Description**

Make the UpSet plot

**Usage**

```
UpSet(m,
      comb_col = "black",
      pt_size = unit(3, "mm"), lwd = 2,
      bg_col = "#F0F0F0", bg_pt_col = "#CCCCCC",
      set_order = order(set_size(m), decreasing = TRUE),
      comb_order = if(attr(m, "param")$set_on_rows) {
        order.comb_mat(m[set_order, ], decreasing = TRUE)
      } else {
        order.comb_mat(m[, set_order], decreasing = TRUE)
      },
      top_annotation = upset_top_annotation(m),
      right_annotation = upset_right_annotation(m),
      row_names_side = "left",
      ...)
```

**Arguments**

<code>m</code>	A combination matrix returned by <a href="#">make_comb_mat</a> . The matrix can be transposed to switch the position of sets and combination sets.
<code>comb_col</code>	The color for the dots representing combination sets.
<code>pt_size</code>	The point size for the dots representing combination sets.
<code>lwd</code>	The line width for the combination sets.
<code>bg_col</code>	Color for the background rectangles.
<code>bg_pt_col</code>	Color for the dots representing the set is not selected.
<code>set_order</code>	The order of sets.
<code>comb_order</code>	The order of combination sets.
<code>top_annotation</code>	A <a href="#">HeatmapAnnotation</a> object on top of the combination matrix.
<code>right_annotation</code>	A <a href="#">HeatmapAnnotation</a> object on the right of the combination matrix.
<code>row_names_side</code>	The side of row names.
<code>...</code>	Other arguments passed to <a href="#">Heatmap</a> .

## Details

By default, the sets are on rows and combination sets are on columns. The positions of the two types of sets can be switched by transposing the matrix.

When sets are on rows, the default top annotation is the barplot showing the size of each combination sets and the default right annotation is the barplot showing the size of the sets. The annotations are simply constructed by `HeatmapAnnotation` and `anno_barplot` with some parameters pre-set. Users can check the source code of `upset_top_annotation` and `upset_right_annotation` to find out how the annotations are defined.

To change or to add annotations, users just need to define a new `HeatmapAnnotation` object. E.g. if we want to change the side of the axis and name on top annotation:

```
Upset(..., top_annotation =
  HeatmapAnnotation(
    "Intersection size" = anno_barplot(
      comb_size(m),
      border = FALSE,
      gp = gpar(fill = "black"),
      height = unit(2, "cm"),
      axis_param = list(side = "right")
    ),
    annotation_name_side = "right",
    annotation_name_rot = 0)
)
```

To add more annotations on top, users just add it in `HeatmapAnnotation`:

```
Upset(..., top_annotation =
  HeatmapAnnotation(
    "Intersection size" = anno_barplot(
      comb_size(m),
      border = FALSE,
      gp = gpar(fill = "black"),
      height = unit(2, "cm"),
      axis_param = list(side = "right")
    ),
    "anno1" = anno_points(...),
    "anno2" = some_vector,
    annotation_name_side = "right",
    annotation_name_rot = 0)
)
```

And so is for the right annotations.

`UpSet` returns a `Heatmap-class` object, which means, you can add it with other heatmaps and annotations by `+` or `%v%`.

**Examples**

```

set.seed(123)
lt = list(a = sample(letters, 10),
          b = sample(letters, 15),
          c = sample(letters, 20))
m = make_comb_mat(lt)
UpSet(m)
UpSet(t(m))

m = make_comb_mat(lt, mode = "union")
UpSet(m)
UpSet(m, comb_col = c(rep(2, 3), rep(3, 3), 1))

# compare two UpSet plots
set.seed(123)
lt1 = list(a = sample(letters, 10),
            b = sample(letters, 15),
            c = sample(letters, 20))
m1 = make_comb_mat(lt1)
set.seed(456)
lt2 = list(a = sample(letters, 10),
            b = sample(letters, 15),
            c = sample(letters, 20))
m2 = make_comb_mat(lt2)

max1 = max(c(set_size(m1), set_size(m2)))
max2 = max(c(comb_size(m1), comb_size(m2)))

UpSet(m1, top_annotation = upset_top_annotation(m1, ylim = c(0, max2)),
      right_annotation = upset_right_annotation(m1, ylim = c(0, max1)),
      column_title = "UpSet1") +
UpSet(m2, top_annotation = upset_top_annotation(m2, ylim = c(0, max2)),
      right_annotation = upset_right_annotation(m2, ylim = c(0, max1)),
      column_title = "UpSet2")

```

---

upset\_right\_annotation

*Default UpSet Right Annotation*


---

**Description**

Default UpSet Right Annotation

**Usage**

```

upset_right_annotation(m,
  gp = gpar(fill = "black"),
  width = unit(ifelse(set_on_rows, 2, 3), "cm"),
  show_annotation_name = TRUE,

```

```

annotation_name_gp = gpar(),
annotation_name_offset = NULL,
annotation_name_side = "bottom",
annotation_name_rot = NULL,
...)
```

### Arguments

<code>m</code>	A combination matrix which is as same as the one for <a href="#">UpSet</a> .
<code>gp</code>	Graphic parameters for bars.
<code>width</code>	Width of the right annotation.
<code>show_annotation_name</code>	Whether show annotation names?
<code>annotation_name_gp</code>	Graphic parameters for anntation names.
<code>annotation_name_offset</code>	Offset to the annotation name, a <a href="#">unit</a> object.
<code>annotation_name_side</code>	Side of the annotation name.
<code>annotation_name_rot</code>	Rotation of the annotation name, it can only take values in <code>c(00, 90, 180, 270)</code> .
<code>...</code>	Passed to <a href="#">anno_barplot</a> .

### Details

The default right annotation is actually barplot implemented by [anno\\_barplot](#). For how to set the right annotation or left annotation in [UpSet](#), please refer to [UpSet](#).

If you want to use [decorate\\_annotation](#) function, the annotation name for the "sets" is `set_size` and the annotation name for the "intersection sets" are `intersection_size` and if under the union mode, it is `union_size`.

### Examples

```

# There is no example
NULL
```

---

`upset_top_annotation` *Default UpSet Top Annotation*

---

### Description

Default UpSet Top Annotation

**Usage**

```
upset_top_annotation(m,
  gp = gpar(fill = "black"),
  height = unit(ifelse(set_on_rows, 3, 2), "cm"),
  show_annotation_name = TRUE,
  annotation_name_gp = gpar(),
  annotation_name_offset = NULL,
  annotation_name_side = "left",
  annotation_name_rot = 0,
  ...)
```

**Arguments**

<code>m</code>	A combination matrix which is as same as the one for <a href="#">UpSet</a> .
<code>gp</code>	Graphic parameters for bars.
<code>height</code>	The height of the top annotation.
<code>show_annotation_name</code>	Whether show annotation names?
<code>annotation_name_gp</code>	Graphic parameters for anntation names.
<code>annotation_name_offset</code>	Offset to the annotation name, a <a href="#">unit</a> object.
<code>annotation_name_side</code>	Side of the annotation name.
<code>annotation_name_rot</code>	Rotation of the annotation name, it can only take values in <code>c(00, 90, 180, 270)</code> .
<code>...</code>	Passed to <a href="#">anno_barplot</a> .

**Details**

The default top annotation is actually barplot implemented by [anno\\_barplot](#). For how to set the top annotation or bottom annotation in [UpSet](#), please refer to [UpSet](#).

If you want to use [decorate\\_annotation](#) function, the annotation name for the "sets" is `set_size` and the annotation name for the "intersection sets" are `intersection_size` and if under the union mode, it is `union_size`.

**Examples**

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



---

`width.AnnotationFunction`*Width of the AnnotationFunction Object*

---

**Description**

Width of the AnnotationFunction Object

**Usage**

```
## S3 method for class 'AnnotationFunction'  
width(x, ...)
```

**Arguments**

<code>x</code>	A <a href="#">AnnotationFunction-class</a> object.
<code>...</code>	Other arguments.

**Details**

Internally used.

**Examples**

```
anno = anno_points(1:10)  
ComplexHeatmap::width(anno)  
anno = anno_points(1:10, which = "row")  
ComplexHeatmap::width(anno)
```

---

`width.Heatmap`*Width of the Heatmap*

---

**Description**

Width of the Heatmap

**Usage**

```
## S3 method for class 'Heatmap'  
width(x, ...)
```

**Arguments**

<code>x</code>	The <a href="#">HeatmapList-class</a> object returned by <a href="#">draw,Heatmap-method</a> .
<code>...</code>	Other arguments.

**Examples**

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

---

```
width.HeatmapAnnotation
```

*Width of the HeatmapAnnotation Object*

---

**Description**

Width of the HeatmapAnnotation Object

**Usage**

```
## S3 method for class 'HeatmapAnnotation'
width(x, ...)
```

**Arguments**

x                    The `HeatmapAnnotation-class` object.  
 ...                 Other arguments.

**Details**

Internally used.

**Examples**

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

---

```
width.HeatmapList
```

*Width of the Heatmap List*

---

**Description**

Width of the Heatmap List

**Usage**

```
## S3 method for class 'HeatmapList'
width(x, ...)
```

**Arguments**

x                    The `HeatmapList`-class object returned by `draw, HeatmapList-method`.  
...                   Other arguments.

**Examples**

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

---

width.Legends	<i>Width of the Legends</i>
---------------	-----------------------------

---

**Description**

Width of the Legends

**Usage**

```
## S3 method for class 'Legends'  
width(x, ...)
```

**Arguments**

x                    The `grob` object returned by `Legend` or `packLegend`.  
...                   Other arguments.

**Value**

The returned unit x is always in mm.

**Examples**

```
lgd = Legend(labels = 1:10, title = "foo", legend_gp = gpar(fill = "red"))  
ComplexHeatmap::width(lgd)
```

width.SingleAnnotation

*Width of the SingleAnnotation Object*

---

### Description

Width of the SingleAnnotation Object

### Usage

```
## S3 method for class 'SingleAnnotation'  
width(x, ...)
```

### Arguments

x	The <a href="#">SingleAnnotation-class</a> object.
...	Other arguments.

### Details

Internally used.

### Examples

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

---

widthAssign.AnnotationFunction

*Assign the Width to the AnnotationFunction Object*

---

### Description

Assign the Width to the AnnotationFunction Object

### Usage

```
## S3 replacement method for class 'AnnotationFunction'  
width(x, ...) <- value
```

### Arguments

x	The <a href="#">AnnotationFunction-class</a> object.
...	Other arguments.
value	A <a href="#">unit</a> object.

**Details**

Internally used.

**Examples**

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

---

```
widthAssign.HeatmapAnnotation  
    Assign the Width to the HeatmapAnnotation Object
```

---

**Description**

Assign the Width to the HeatmapAnnotation Object

**Usage**

```
## S3 replacement method for class 'HeatmapAnnotation'  
width(x, ...) <- value
```

**Arguments**

x	The <a href="#">HeatmapAnnotation-class</a> object.
value	A <a href="#">unit</a> object.
...	Other arguments.

**Details**

Internally used.

**Examples**

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

---

```
widthAssign.SingleAnnotation
    Assign the Width to the SingleAnnotation Object
```

---

**Description**

Assign the Width to the SingleAnnotation Object

**Usage**

```
## S3 replacement method for class 'SingleAnnotation'
width(x, ...) <- value
```

**Arguments**

x	The <a href="#">SingleAnnotation-class</a> object.
value	A <a href="#">unit</a> object.
...	Other arguments.

**Details**

Internally used.

**Examples**

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

---

```
widthDetails.annotation_axis
    Width for annotation_axis Grob
```

---

**Description**

Width for annotation\_axis Grob

**Usage**

```
## S3 method for class 'annotation_axis'
widthDetails(x)
```

**Arguments**

x	The annotation_axis grob returned by <a href="#">annotation_axis_grob</a> .
---	---

**Details**

The physical width of the grob can be get by `convertWidth(grobWidth(axis_grob), "mm")`.

**Examples**

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

---

`widthDetails.legend`    *Grob width for packed\_legends*

---

**Description**

Grob width for packed\_legends

**Usage**

```
## S3 method for class 'legend'
widthDetails(x)
```

**Arguments**

`x`                    A legend object.

**Examples**

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

---

`widthDetails.legend_body`  
*Grob width for legend\_body*

---

**Description**

Grob width for legend\_body

**Usage**

```
## S3 method for class 'legend_body'
widthDetails(x)
```

**Arguments**

`x`                    A legend\_body object.

**Examples**

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

---

```
widthDetails.packed_legends
      Grob width for packed_legends
```

---

**Description**

Grob width for packed\_legends

**Usage**

```
## S3 method for class 'packed_legends'
widthDetails(x)
```

**Arguments**

x                    A packed\_legends object.

**Examples**

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

---

```
[.AnnotationFunction    Subset an AnnotationFunction Object
```

---

**Description**

Subset an AnnotationFunction Object

**Usage**

```
## S3 method for class 'AnnotationFunction'
x[i]
```

**Arguments**

x                    An [AnnotationFunction-class](#) object.  
i                    A vector of indices.



## Details

One good thing for designing the [AnnotationFunction-class](#) is it can be subsetted, and this is the base for the splitting of the annotations.

## Examples

```
anno = anno_simple(1:10)
anno[1:5]
draw(anno[1:5], test = "subset of column annotation")
```

---

[.comb\_mat

*Subset the Combination Matrix*

---

## Description

Subset the Combination Matrix

## Usage

```
## S3 method for class 'comb_mat'
x[i, j, drop = FALSE]
```

## Arguments

x	A combination matrix returned by <a href="#">make_comb_mat</a> .
i	Indices on rows.
j	Indices on columns.
drop	It is always reset to FALSE internally.

## Details

If sets are on rows of the combination matrix, the row indices correspond to sets and column indices correspond to combination sets, and if sets are on columns of the combination matrix, rows correspond to the combination sets.

If the index is one-dimension, e.g. `x[i]`, the index always corresponds to the combination sets.

You should not subset by the sets. It will give you wrong combination set size. The subsetting on sets are only used internally.

This subsetting method is mainly for subsetting combination sets, i.e., users can first use [comb\\_size](#) to get the size of each combination set, and filter them by the size.

**Examples**

```
set.seed(123)
lt = list(a = sample(letters, 10),
         b = sample(letters, 15),
         c = sample(letters, 20))
m = make_comb_mat(lt)
m2 = m[, comb_size(m) >= 3]
comb_size(m2)
m[comb_size(m) >= 3]
```

---

`[.gridtext]`*Subset method of gridtext class*

---

**Description**

Subset method of gridtext class

**Usage**

```
## S3 method for class 'gridtext'
x[index]
```

**Arguments**

<code>x</code>	A vector of labels generated by <code>gt_render</code> .
<code>index</code>	Index

**Details**

Internally used.

**Examples**

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

---

[.Heatmap                      *Subset a Heatmap*

---

**Description**

Subset a Heatmap

**Usage**

```
## S3 method for class 'Heatmap'  
x[i, j]
```

**Arguments**

x	A <a href="#">Heatmap-class</a> object.
i	Row indices.
j	Column indices.

**Details**

This functionality is quite experimental. It should be applied before the layout is initialized.

**Examples**

```
m = matrix(rnorm(100), nrow = 10)  
rownames(m) = letters[1:10]  
colnames(m) = LETTERS[1:10]  
ht = Heatmap(m)  
ht[1:5, ]  
ht[1:5]  
ht[, 1:5]  
ht[1:5, 1:5]
```

---

[.HeatmapAnnotation      *Subset the HeatmapAnnotation object*

---

**Description**

Subset the HeatmapAnnotation object

**Usage**

```
## S3 method for class 'HeatmapAnnotation'  
x[i, j]
```

**Arguments**

x	A <a href="#">HeatmapAnnotation-class</a> object.
i	Index of observations.
j	Index of annotations.

**Examples**

```

ha = HeatmapAnnotation(foo = 1:10, bar = anno_points(10:1),
sth = cbind(1:10, 10:1))
ha[1:5, ]
ha[, c("foo", "bar")]
ha[, 1:2]
ha[1:5, c("foo", "sth")]

```

---

[.HeatmapList                    *Subset a HeatmapList object*

---

**Description**

Subset a HeatmapList object

**Usage**

```

## S3 method for class 'HeatmapList'
x[i, j]

```

**Arguments**

x	A <a href="#">HeatmapList-class</a> object
i	row indices
j	column indices

**Details**

If the heatmap list is horizontal, i is the row indices and j corresponds to heatmap names and single annotation names. and if the heatlist is vertical, i corresponds to heatmap/annotation names and j is the column indices.

**Examples**

```

ht_list = Heatmap(matrix(rnorm(100), 10), name = "rnorm") +
  rowAnnotation(foo = 1:10, bar = anno_points(10:1)) +
  Heatmap(matrix(runif(100), 10), name = "runif")
summary(ht_list[1:5, ])
summary(ht_list[1:5, 1])
summary(ht_list[1:5, "rnorm"])
summary(ht_list[1:5, c("rnorm", "foo")])

```

```

ht_list = Heatmap(matrix(rnorm(100), 10), name = "rnorm") %%
  columnAnnotation(foo = 1:10, bar = anno_points(10:1)) %%
  Heatmap(matrix(runif(100), 10), name = "runif")
summary(ht_list[, 1:5])
summary(ht_list[1, 1:5])
summary(ht_list["rnorm", 1:5])
summary(ht_list[c("rnorm", "foo"), 1:5])

```

---

[.SingleAnnotation      *Subset an SingleAnnotation Object*

---

## Description

Subset an SingleAnnotation Object

## Usage

```

## S3 method for class 'SingleAnnotation'
x[i]

```

## Arguments

x	An <a href="#">SingleAnnotation-class</a> object.
i	A vector of indices.

## Details

The SingleAnnotation class object is subsetable only if the containing [AnnotationFunction-class](#) object is subsetable. All the anno\_\* functions are subsetable, so if the SingleAnnotation object is constructed by one of these functions, it is also subsetable.

## Examples

```

ha = SingleAnnotation(value = 1:10)
ha[1:5]
draw(ha[1:5], test = "ha[1:5]")

```

---

`%v%`*Vertically Add Heatmaps or Annotations to a Heatmap List*

---

**Description**

Vertically Add Heatmaps or Annotations to a Heatmap List

**Usage**

```
x %v% y
```

**Arguments**

x	A <a href="#">Heatmap-class</a> object, a <a href="#">HeatmapAnnotation-class</a> object or a <a href="#">HeatmapList-class</a> object.
y	A <a href="#">Heatmap-class</a> object, a <a href="#">HeatmapAnnotation-class</a> object or a <a href="#">HeatmapList-class</a> 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 column annotations.

x and y can also be NULL.

**Value**

A [HeatmapList-class](#) object.

**Author(s)**

Zuguang Gu <z.gu@dkfz.de>

**See Also**

[+.AdditiveUnit](#) operator is used for horizontal heatmap list.

**Examples**

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

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