Package ‘Giotto’

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Title Spatial single-cell transcriptomics pipeline.

Version 0.1.4

Description Pipeline to process, analyze and visualize (spatial) single-cell expression data.

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LazyData true

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Depends data.table (>= 1.12.2),
ggplot2 (>= 3.1.1),
base (>= 3.5.1),
utils (>= 3.5.1),
R (>= 3.5.1)

Imports Rtsne (>= 0.15),
uwot (>= 0.0.0.9010),
multinet (>= 3.0.2),
FactoMineR (>= 1.34),
factoextra (>= 1.0.5),
cowplot (>= 0.9.4),
grDevices,
RColorBrewer (>= 1.1-2),
jackstraw (>= 1.3),
dbscan (>= 1.1-3),
ggalluvial (>= 0.9.1),
scales (>= 1.0.0),
ComplexHeatmap (>= 1.20.0),
qvalue (>= 2.14.1),
lfa (>= 1.12.0),
igraph (>= 1.2.4.1),
plotly,
reticulate,
magrittr,
limma,
ggdendro,
smfishHmrf,
matrixStats (>= 0.55.0),
IRanges,
devtools,
reshape2,

ggraph

Suggests knitr,
rmarkdown,
MAST,
scran (>= 1.10.1),
png,
tiff,
biomaRt

biocViews

VignetteBuilder knitr

Remotes lambdamoses/smfishhmrf-r

R topics documented:

addCellMetadata *addCellMetadata*

Description

adds cell metadata to the giotto object

Usage

```
addCellMetadata(
  gobject,
  new_metadata,
  by_column = FALSE,
  column_cell_ID = NULL
)
```

Arguments

`gobject`	giotto object
`new_metadata`	new cell metadata to use (data.table, data.frame, ...)
`by_column`	merge metadata based on cell_ID column in pDataDT (default = FALSE)
`column_cell_ID`	column name of new metadata to use if by_column = TRUE

Details

You can add additional cell metadata in two manners: 1. Provide a data.table or data.frame with cell annotations in the same order as the cell_ID column in pDataDT(gobject) 2. Provide a data.table or data.frame with cell annotations and specificy which column contains the cell IDs, these cell IDs need to match with the cell_ID column in pDataDT(gobject)

Value

giotto object

Examples

```
addCellMetadata(gobject)
```

addCellStatistics *addCellStatistics*

Description

adds cells statistics to the giotto object

Usage

```
addCellStatistics(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  detection_threshold = 0,
  return_gobject = TRUE
)
```

Arguments

`gobject` giotto object

`expression_values`
expression values to use

`detection_threshold`
detection threshold to consider a gene detected

`return_gobject` boolean: return giotto object (default = TRUE)

Details

This function will add the following statistics to cell metadata:

- nr_genes: Denotes in how many genes are detected per cell
- perc_genes: Denotes what percentage of genes is detected per cell
- total_expr: Shows the total sum of gene expression per cell

Value

giotto object if return_gobject = TRUE

Examples

```
addCellStatistics(gobject)
```

---

addGeneMetadata *addGeneMetadata*

Description

adds gene metadata to the giotto object

Usage

```
addGeneMetadata(gobject, new_metadata, by_column = F, column_gene_ID = NULL)
```

Arguments

`gobject` giotto object

`new_metadata` new metadata to use

`by_column` merge metadata based on gene_ID column in fDataDT

`column_cell_ID` column name of new metadata to use if by_column = TRUE

Details

You can add additional gene metadata in two manners: 1. Provide a data.table or data.frame with gene annotations in the same order as the gene_ID column in fDataDT(gobject) 2. Provide a data.table or data.frame with gene annotations and specificy which column contains the gene IDs, these gene IDs need to match with the gene_ID column in fDataDT(gobject)

Value

giotto object

Examples

```
addGeneMetadata(gobject)
```

---

addGeneStatistics *addGeneStatistics*

Description

adds gene statistics to the giotto object

Usage

```
addGeneStatistics(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  detection_threshold = 0,
  return_gobject = TRUE
)
```

Arguments

`gobject` giotto object

`expression_values`
expression values to use

`detection_threshold`
detection threshold to consider a gene detected

`return_gobject` boolean: return giotto object (default = TRUE)

Details

This function will add the following statistics to gene metadata:

- nr_cells: Denotes in how many cells the gene is detected
- per_cells: Denotes in what percentage of cells the gene is detected
- total_expr: Shows the total sum of gene expression in all cells
- mean_expr: Average gene expression in all cells
- mean_expr_det: Average gene expression in cells with detectable levels of the gene

Value

giotto object if return_gobject = TRUE

Examples

```
addGeneStatistics(gobject)
```

---

addHMRF *addHMRF*

Description

Add selected results from doHMRF to the giotto object

Usage

```
addHMRF(gobject, HMRFoutput, k = NULL, betas_to_add = NULL, hmrf_name = NULL)
```

Arguments

`gobject`	giotto object
`HMRFoutput`	HMRF output from doHMRF()
`k`	number of domains
`betas_to_add`	results from different betas that you want to add
`name`	specify a custom name

Details

Description ...

Value

giotto object

Examples

```
addHMRF(gobject)
```

addNetworkLayout *addNetworkLayout*

Description

Add a network layout for a selected nearest neighbor network

Usage

```
addNetworkLayout(
  gobject,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  layout_type = c("drl"),
  options_list = NULL,
  layout_name = "layout",
  return_gobject = TRUE
)
```

Arguments

`gobject`	giotto object
`nn_network_to_use`	kNN or sNN
`network_name`	name of NN network to be used
`layout_type`	layout algorithm to use
`options_list`	list of options for selected layout
`layout_name`	name for layout
`return_gobject`	boolean: return giotto object (default = TRUE)

Details

This function creates layout coordinates based on the provided kNN or sNN. Currently only the force-directed graph layout "drl", see `layout_with_drl`, is implemented. This provides an alternative to tSNE or UMAP based visualizations.

Value

giotto object with updated layout for selected NN network

Examples

```
addNetworkLayout(gobject)
```

addStatistics *addStatistics*

Description

adds genes and cells statistics to the giotto object

Usage

```
addStatistics(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  detection_threshold = 0,
  return_gobject = TRUE
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`detection_threshold`	detection threshold to consider a gene detected
`return_gobject`	boolean: return giotto object (default = TRUE)

Details

See `addGeneStatistics` and `addCellStatistics`

Value

giotto object if return_gobject = TRUE, else a list with results

Examples

```
addStatistics(gobject)
```

adjustGiottoMatrix *adjustGiottoMatrix*

Description

normalize and/or scale expresion values of Giotto object

Usage

```
adjustGiottoMatrix(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  batch_columns = NULL,
  covariate_columns = NULL,
  return_gobject = TRUE,
  update_slot = c("custom")
)
```

Arguments

`gobject` giotto object

`expression_values` expression values to use

`batch_columns` metadata columns that represent different batch (max = 2)

`covariate_columns` metadata columns that represent covariates to regress out

`return_gobject` boolean: return giotto object (default = TRUE)

`update_slot` expression slot that will be updated (default = custom)

Details

This function implements the `limma::removeBatchEffect` function to remove known batch effects and to adjust expression values according to provided covariates.

Value

giotto object

Examples

```
adjustGiottoMatrix(gobject)
```

aes_string2 *aes_string2*

Description

makes sure aes_string can also be used with names that start with numeric values

Usage

```
aes_string2(...)
```

allCellCellcommunicationsScores

allCellCellcommunicationsScores

Description

All Cell-Cell communication scores based on spatial expression of interacting cells

Usage

```
allCellCellcommunicationsScores(
  gobject,
  spatial_network_name = "spatial_network",
  cluster_column = "cell_types",
  random_iter = 100,
  gene_set_1,
  gene_set_2,
  log2FC_addendum = 0.1,
  min_observations = 2,
  verbose = c("a little", "a lot", "none")
)
```

Arguments

`gobject`	giotto object to use
`spatial_network_name`	spatial network to use for identifying interacting cells
`cluster_column`	cluster column with cell type information
`random_iter`	number of iterations
`gene_set_1`	first specific gene set from gene pairs
`gene_set_2`	second specific gene set from gene pairs
`log2FC_addendum`	addendum to add when calculating log2FC
`min_observations`	minimum number of interactions needed to be considered
`verbose`	verbose

Details

Statistical framework to identify if pairs of genes (such as ligand-receptor combinations) are expressed at higher levels than expected based on a reshuffled null distribution of gene expression values in cells that are spatially in proximity to eachother.. More details will follow soon.

Value

Cell-Cell communication scores for gene pairs based on spatial interaction

Examples

```
allCellCellcommunicationsScores(gobject)
```

all_plots_save_function *all_plots_save_function*

Description

Function to automatically save plots to directory of interest

Usage

```
all_plots_save_function(
  gobject,
  plot_object,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  default_save_name = "giotto_plot",
  save_format = NULL,
  show_saved_plot = F,
  ncol = 1,
  nrow = 1,
  scale = 1,
  base_width = NULL,
  base_height = NULL,
  base_aspect_ratio = NULL,
  units = NULL,
  dpi = NULL,
  limitsize = TRUE,
  ...
)
```

Arguments

`gobject`	giotto object
`plot_object`	object to plot
`save_dir`	directory to save to
`save_folder`	folder in save_dir to save to
`save_name`	name of plot
`save_format`	format (e.g. png, tiff, pdf, ...)
`show_saved_plot`	load & display the saved plot
`ncol`	number of columns
`nrow`	number of rows
`scale`	scale
`base_width`	width
`base_height`	height
`base_aspect_ratio`	aspect ratio

`units`	units
`dpi`	Plot resolution
`limitsize`	When TRUE (the default), ggsave will not save images larger than 50x50 inches, to prevent the common error of specifying dimensions in pixels.
`...`	additional parameters to ggplot_save_function or general_save_function

See Also

general_save_function

Examples

```
all_plots_save_function(gobject)
```

annotateGiotto *annotateGiotto*

Description

Converts cluster results into provided annotation.

Usage

```
annotateGiotto(
  gobject,
  annotation_vector = NULL,
  cluster_column = NULL,
  name = "cell_types"
)
```

Arguments

`gobject`	giotto object
`annotation_vector`	named annotation vector (names = cluster ids)
`cluster_column`	cluster column to convert to annotation names
`name`	new name for annotation column

Details

You need to specifify which (cluster) column you want to annotate and you need to provide an annotation vector like this:

- 1. identify the cell type of each cluster
- 2. create a vector of these cell types, e.g. cell_types = c('T-cell', 'B-cell', 'Stromal')
- 3. provide original cluster names to previous vector, e.g. names(cell_types) = c(2, 1, 3)

Value

giotto object

Examples

```
annotateGiotto(gobject)
```

`annotateSpatialNetwork` *annotateSpatialNetwork*

Description

Annotate spatial network with cell metadata information.

Usage

```
annotateSpatialNetwork(
  gobject,
  spatial_network_name = "spatial_network",
  cluster_column
)
```

Arguments

`gobject`	giotto object
`spatial_network_name`	name of spatial network to use
`cluster_column`	name of column to use for clusters

Value

annotated network in data.table format

Examples

```
annotateSpatialNetwork(gobject)
```

`annotate_spatlocs_with_spatgrid_2D` *annotate_spatlocs_with_spatgrid_2D*

Description

annotate spatial locations with 2D spatial grid information

Usage

```
annotate_spatlocs_with_spatgrid_2D(spatloc, spatgrid)
```

Arguments

`spatloc`	spatial_locs slot from giotto object
`spatgrid`	selected spatial_grid slot from giotto object

Value

annotated spatial location data.table

Examples

```
annotate_spatlocs_with_spatgrid_2D()
```

annotate_spatlocs_with_spatgrid_3D

annotate_spatlocs_with_spatgrid_3D

Description

annotate spatial locations with 3D spatial grid information

Usage

```
annotate_spatlocs_with_spatgrid_3D(spatloc, spatgrid)
```

Arguments

spatloc	spatial_locs slot from giotto object
spatgrid	selected spatial_grid slot from giotto object

Value

annotated spatial location data.table

Examples

```
annotate_spatlocs_with_spatgrid_3D()
```

average_gene_gene_expression_in_groups

average_gene_gene_expression_in_groups

Description

calculate average expression per cluster

Usage

```
average_gene_gene_expression_in_groups(
  gobject,
  cluster_column = "cell_types",
  gene_set_1,
  gene_set_2
)
```

Arguments

gobject giotto object to use

cluster_column cluster column with cell type information

gene_set_1 first specific gene set from gene pairs

gene_set_2 second specific gene set from gene pairs

Details

Details will follow soon.

Value

data.table with average expression scores for each cluster

Examples

```
average_gene_gene_expression_in_groups(gobject)
```

binGetSpatialGenes *binGetSpatialGenes*

Description

Rapid computation of genes that are spatially clustered

Usage

```
binGetSpatialGenes(
  gobject,
  bin_method = c("kmeans", "rank"),
  expression_values = c("normalized", "scaled", "custom"),
  subset_genes = NULL,
  spatial_network_name = "spatial_network",
  nstart = 3,
  iter_max = 10,
  percentage_rank = 10,
  do_fisher_test = F,
  community_expectation = 5,
  verbose = F
)
```

Arguments

gobject giotto object

bin_method method to binarize gene expression

expression_values expression values to use

subset_genes only select a subset of genes to test

spatial_network_name name of spatial network to use (default = 'spatial_network')

`nstart`	kmeans: nstart parameter
`iter_max`	kmeans: iter.max parameter
`do_fisher_test`	perform fisher test
`community_expectation`	cell degree expectation in spatial communities
`verbose`	be verbose
`rank_percentage`	percentage of top cells for binarization

Details

We provide two ways to identify spatial genes based on gene expression binarization. Both methods are identicial except for how binarization is performed.

- 1. binarize: Each gene is binarized (0 or 1) in each cell with **kmeans** (k = 2) or based on **rank** percentile
- 2. network: Alll cells are connected through a k-nearest neighbor network
- 3. contingency table: A contingency table is calculated based on all pairwise cell-cell interactions (0-0, 0-1, 1-0 or 1-1)
- 4. For each gene an odds-ratio (OR) and fisher.test (optional) is calculated

Additionally 2 other statistics are provided:

- Number of cells with high expression (binary = 1)
- total and ratio of highly connected cells: Cells with a connectivity higher than community_expectation

By selecting a subset of likely spatial genes (e.g. highly variable genes) the function will be much faster.

Value

data.table with results (see details)

Examples

```
binGetSpatialGenes(gobject)
```

`calculateHVG` *calculateHVG*

Description

compute highly variable genes

Usage

```
calculateHVG(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  method = c("cov_groups", "cov_loess"),
  reverse_log_scale = FALSE,
  logbase = 2,
  expression_threshold = 0,
  nr_expression_groups = 20,
  zscore_threshold = 1.5,
  HVGname = "hvg",
  difference_in_cov = 0.1,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "HVGplot",
  return_gobject = TRUE
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`method`	method to calculate highly variable genes
`reverse_log_scale`	reverse log-scale of expression values (default = FALSE)
`logbase`	if reverse_log_scale is TRUE, which log base was used?
`expression_threshold`	expression threshold to consider a gene detected
`nr_expression_groups`	number of expression groups for cov_groups
`zscore_threshold`	zscore to select hvg for cov_groups
`HVGname`	name for highly variable genes in cell metadata
`difference_in_cov`	minimum difference in coefficient of variance required
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`return_gobject`	boolean: return giotto object (default = TRUE)

Details

Currently we provide 2 ways to calculate highly variable genes: **1. high coeff of variance (COV) within groups:**
First genes are binned (*nr_expression_groups*) into average expression groups and the COV for each gene is converted into a z-score within each bin. Genes with a z-score higher than the threshold (*zscore_threshold*) are considered highly variable.

2. high COV based on loess regression prediction:
A predicted COV is calculated for each gene using loess regression (COV~log(mean expression)) Genes that show a higher than predicted COV (*difference_in_cov*) are considered highly variable.

Value

giotto object highly variable genes appended to gene metadata (fDataDT)

Examples

```
calculateHVG(gobject)
```

---

calculateMetaTable *calculateMetaTable*

Description

calculates the average gene expression for one or more (combined) annotation columns.

Usage

```
calculateMetaTable(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  metadata_cols = NULL,
  selected_genes = NULL
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`metadata_cols`	annotation columns found in pDataDT(gobject)
`selected_genes`	subset of genes to use

Value

data.table with average expression values for each gene per (combined) annotation

Examples

```
calculateMetaTable(gobject)
```

calculateMetaTableCells

calculateMetaTableCells

Description

calculates the average metadata values for one or more (combined) annotation columns.

Usage

```
calculateMetaTableCells(
  gobject,
  value_cols = NULL,
  metadata_cols = NULL,
  spat_enr_names = NULL
)
```

Arguments

gobject	giotto object
value_cols	metadata or enrichment value columns to use
metadata_cols	annotation columns found in pDataDT(gobject)
spat_enr_names	which spatial enrichment results to include

Value

data.table with average metadata values per (combined) annotation

Examples

```
    calculateMetaTableCells(gobject)
```

calculate_spatial_genes_python

calculate_spatial_genes_python

Description

Calculate spatial genes using distance matrix.

Usage

```
calculate_spatial_genes_python(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  metric = "euclidean",
  subset_genes = NULL,
  rbp_p = 0.95,
  examine_top = 0.3,
  python_path = NULL
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`metric`	distance metric to use
`subset_genes`	only run on this subset of genes
`rbp_p`	fractional binarization threshold
`examine_top`	top fraction to evaluate with silhouette
`python_path`	specify specific path to python if required

Details

Description of how we compute spatial pattern genes.

Value

data.table with spatial scores

Examples

```
calculate_spatial_genes_python(gobject)
```

`cellProximityBarplot` *cellProximityBarplot*

Description

Create barplot from cell-cell proximity scores

Usage

```
cellProximityBarplot(
  gobject,
  CPscore,
  min_orig_ints = 5,
  min_sim_ints = 5,
  p_val = 0.05,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "cellProximityBarplot"
)
```

Arguments

`gobject`	giotto object
`CPscore`	CPscore, output from cellProximityEnrichment()
`min_orig_ints`	filter on minimum original cell-cell interactions
`min_sim_ints`	filter on minimum simulated cell-cell interactions
`p_val`	p-value
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param

Details

This function creates a barplot that shows the spatial proximity enrichment or depletion of cell type pairs.

Value

ggplot barplot

Examples

```
    cellProximityBarplot(CPscore)
```

`cellProximityEnrichment`

cellProximityEnrichment

Description

Compute cell-cell interaction enrichment (observed vs expected)

Usage

```
cellProximityEnrichment(
  gobject,
  spatial_network_name = "spatial_network",
  cluster_column,
  number_of_simulations = 100
)
```

Arguments

`gobject`	giotto object
`spatial_network_name`	name of spatial network to use
`cluster_column`	name of column to use for clusters
`number_of_simulations`	number of simulations to create expected observations

Details

Spatial proximity enrichment or depletion between pairs of cell types is calculated by calculating the observed over the expected frequency of cell-cell proximity interactions. The expected frequency is the average frequency calculated from a number of spatial network simulations. Each individual simulation is obtained by reshuffling the cell type labels of each node (cell) in the spatial network.

Value

List of cell Proximity scores (CPscores) in data.table format. The first data.table (raw_sim_table) shows the raw observations of both the original and simulated networks. The second data.table (enrichm_res) shows the enrichment results.

Examples

```
cellProximityEnrichment(gobject)
```

cellProximityHeatmap *cellProximityHeatmap*

Description

Create heatmap from cell-cell proximity scores

Usage

```
cellProximityHeatmap(
  gobject,
  CPscore,
  scale = T,
  order_cell_types = T,
  color_breaks = NULL,
  color_names = NULL,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "cellProximityHeatmap"
)
```

Arguments

gobject	giotto object
CPscore	CPscore, output from cellProximityEnrichment()
scale	scale cell-cell proximity interaction scores
order_cell_types	order cell types based on enrichment correlation
color_breaks	numerical vector of length 3 to represent min, mean and maximum
color_names	character color vector of length 3
show_plot	show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
default save name for saving, don't change, change save_name in save_param

Details

This function creates a heatmap that shows the spatial proximity enrichment or depletion of cell type pairs.

Value

ggplot heatmap

Examples

```
cellProximityHeatmap(CPscore)
```

cellProximityNetwork *cellProximityNetwork*

Description

Create network from cell-cell proximity scores

Usage

```
cellProximityNetwork(
  gobject,
  CPscore,
  remove_self_edges = FALSE,
  self_loop_strength = 0.1,
  color_depletion = "lightgreen",
  color_enrichment = "red",
  rescale_edge_weights = TRUE,
  edge_weight_range_depletion = c(0.1, 1),
  edge_weight_range_enrichment = c(1, 5),
  layout = "Fruchterman",
  only_show_enrichment_edges = F,
  edge_width_range = c(0.1, 2),
  node_size = 4,
  node_text_size = 6,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "cellProximityNetwork"
)
```

Arguments

`gobject` giotto object

`CPscore` CPscore, output from cellProximityEnrichment()

`remove_self_edges` remove enrichment/depletion edges with itself

`self_loop_strength` size of self-loops

`color_depletion` color for depleted cell-cell interactions

`color_enrichment` color for enriched cell-cell interactions

`rescale_edge_weights` rescale edge weights (boolean)

`edge_weight_range_depletion` numerical vector of length 2 to rescale depleted edge weights

`edge_weight_range_enrichment` numerical vector of length 2 to rescale enriched edge weights

`layout` layout algorithm to use to draw nodes and edges

`only_show_enrichment_edges` show only the enriched pairwise scores

`edge_width_range` range of edge width

`node_size` size of nodes

`node_text_size` size of node labels

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don't change, change save_name in save_param

Details

This function creates a network that shows the spatial proximity enrichment or depletion of cell type pairs.

Value

igraph plot

Examples

```
cellProximityNetwork(CPscore)
```

cellProximitySpatPlot *cellProximitySpatPlot*

Description

Visualize 2D cell-cell interactions according to spatial coordinates in ggplot mode

Usage

```
cellProximitySpatPlot(gobject, ...)
```

Arguments

`gobject`	giotto object
`interaction_name`	cell-cell interaction name
`cluster_column`	cluster column with cell clusters
`sdimx`	x-axis dimension name (default = 'sdimx')
`sdimy`	y-axis dimension name (default = 'sdimy')
`cell_color`	color for cells (see details)
`cell_color_code`	named vector with colors
`color_as_factor`	convert color column to factor
`show_other_cells`	decide if show cells not in network
`show_network`	show underlying spatial network
`network_color`	color of spatial network
`spatial_network_name`	name of spatial network to use
`show_grid`	show spatial grid
`grid_color`	color of spatial grid
`spatial_grid_name`	name of spatial grid to use
`coord_fix_ratio`	fix ratio between x and y-axis
`show_legend`	show legend
`point_size_select`	size of selected points
`point_select_border_col`	border color of selected points
`point_select_border_stroke`	stroke size of selected points
`point_size_other`	size of other points

`point_other_border_col`
: border color of other points

`point_other_border_stroke`
: stroke size of other points

`show_plot`
: show plots

`return_plot`
: return ggplot object

`save_plot`
: directly save the plot [boolean]

`save_param`
: list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don't change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

See Also

`cellProximitySpatPlot2D` and `cellProximitySpatPlot3D` for 3D

Examples

```
cellProximitySpatPlot(gobject)
```

`cellProximitySpatPlot2D`

cellProximitySpatPlot2D

Description

Visualize 2D cell-cell interactions according to spatial coordinates in ggplot mode

Usage

```
cellProximitySpatPlot2D(
  gobject,
  interaction_name = NULL,
  cluster_column = NULL,
  sdimx = "sdimx",
  sdimy = "sdimy",
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  show_other_cells = F,
  show_network = F,
  show_other_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  coord_fix_ratio = 1,
  show_legend = T,
  point_size_select = 2,
  point_select_border_col = "black",
  point_select_border_stroke = 0.05,
  point_size_other = 1,
  point_alpha_other = 0.3,
  point_other_border_col = "lightgrey",
  point_other_border_stroke = 0.01,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "cellProximitySpatPlot2D"
)
```

Arguments

gobject	giotto object
interaction_name	cell-cell interaction name
cluster_column	cluster column with cell clusters
sdimx	x-axis dimension name (default = 'sdimx')
sdimy	y-axis dimension name (default = 'sdimy')
cell_color	color for cells (see details)
cell_color_code	named vector with colors
color_as_factor	convert color column to factor
show_other_cells	decide if show cells not in network
show_network	show underlying spatial network
network_color	color of spatial network
spatial_network_name	name of spatial network to use
show_grid	show spatial grid
grid_color	color of spatial grid
spatial_grid_name	name of spatial grid to use
coord_fix_ratio	fix ratio between x and y-axis
show_legend	show legend
point_size_select	size of selected points

`point_select_border_col`
: border color of selected points

`point_select_border_stroke`
: stroke size of selected points

`point_size_other`
: size of other points

`point_other_border_col`
: border color of other points

`point_other_border_stroke`
: stroke size of other points

`show_plot` show plots

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don’t change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

Examples

```
cellProximitySpatPlot2D(gobject)
```

cellProximitySpatPlot3D *cellProximitySpatPlot2D*

Description

Visualize 3D cell-cell interactions according to spatial coordinates in plotly mode

Usage

```
cellProximitySpatPlot3D(
  gobject,
  interaction_name = NULL,
  cluster_column = NULL,
  sdimx = "sdimx",
  sdimy = "sdimy",
  sdimz = "sdimz",
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  show_other_cells = T,
  show_network = T,
  show_other_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  show_legend = T,
  point_size_select = 4,
  point_size_other = 2,
  point_alpha_other = 0.5,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "cellProximitySpatPlot3D",
  ...
)
```

Arguments

gobject	giotto object
interaction_name	cell-cell interaction name
cluster_column	cluster column with cell clusters
sdimx	x-axis dimension name (default = 'sdimx')
sdimy	y-axis dimension name (default = 'sdimy')
sdimz	z-axis dimension name (default = 'sdimz')
cell_color	color for cells (see details)
cell_color_code	named vector with colors
color_as_factor	convert color column to factor
show_other_cells	decide if show cells not in network
show_network	show underlying spatial network
network_color	color of spatial network
spatial_network_name	name of spatial network to use
show_grid	show spatial grid
grid_color	color of spatial grid
spatial_grid_name	name of spatial grid to use
show_legend	show legend

`point_size_select`
: size of selected points

`point_size_other`
: size of other points

`show_plot` show plots

`return_plot` return plotly object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don't change, change save_name in save_param

Details

Description of parameters.

Value

plotly

Examples

```
cellProximitySpatPlot3D(gobject)
```

`cellProximityVisPlot` *cellProximityVisPlot*

Description

Visualize cell-cell interactions according to spatial coordinates

Usage

```
cellProximityVisPlot(
  gobject,
  interaction_name = NULL,
  cluster_column = NULL,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  show_other_cells = F,
  show_network = F,
  show_other_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  coord_fix_ratio = 1,
  show_legend = T,
  point_size_select = 2,
  point_select_border_col = "black",
  point_select_border_stroke = 0.05,
  point_size_other = 1,
  point_alpha_other = 0.3,
  point_other_border_col = "lightgrey",
  point_other_border_stroke = 0.01,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  plot_method = c("ggplot", "plotly"),
  ...
)
```

Arguments

`gobject` giotto object

`interaction_name` cell-cell interaction name

`cluster_column` cluster column with cell clusters

`sdimx` x-axis dimension name (default = 'sdimx')

`sdimy` y-axis dimension name (default = 'sdimy')

`sdimz` z-axis dimension name (default = 'sdimz')

`cell_color` color for cells (see details)

`cell_color_code` named vector with colors

`color_as_factor` convert color column to factor

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name` name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`spatial_grid_name` name of spatial grid to use

`coord_fix_ratio` fix ratio between x and y-axis

`show_legend` show legend

`point_size_select` size of selected points

`point_select_border_col` border color of selected points

`point_select_border_stroke`
stroke size of selected points

`point_size_other`
size of other points

`point_other_border_col`
border color of other points

`point_other_border_stroke`
stroke size of other points

Details

Description of parameters.

Value

ggplot or plotly

Examples

```
cellProximityVisPlot(gobject)
```

---

cellProximityVisPlot_2D_ggplot
cellProximityVisPlot_2D_ggplot

Description

Visualize 2D cell-cell interactions according to spatial coordinates in ggplot mode

Usage

```
cellProximityVisPlot_2D_ggplot(
  gobject,
  interaction_name = NULL,
  cluster_column = NULL,
  sdimx = NULL,
  sdimy = NULL,
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  show_other_cells = F,
  show_network = F,
  show_other_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  coord_fix_ratio = 1,
  show_legend = T,
  point_size_select = 2,
  point_select_border_col = "black",
  point_select_border_stroke = 0.05,
  point_size_other = 1,
  point_alpha_other = 0.3,
  point_other_border_col = "lightgrey",
  point_other_border_stroke = 0.01,
  ...
)
```

Arguments

`gobject`	giotto object
`interaction_name`	cell-cell interaction name
`cluster_column`	cluster column with cell clusters
`sdimx`	x-axis dimension name (default = 'sdimx')
`sdimy`	y-axis dimension name (default = 'sdimy')
`cell_color`	color for cells (see details)
`cell_color_code`	named vector with colors
`color_as_factor`	convert color column to factor
`show_other_cells`	decide if show cells not in network
`show_network`	show underlying spatial network
`network_color`	color of spatial network
`spatial_network_name`	name of spatial network to use
`show_grid`	show spatial grid
`grid_color`	color of spatial grid
`spatial_grid_name`	name of spatial grid to use
`coord_fix_ratio`	fix ratio between x and y-axis
`show_legend`	show legend
`point_size_select`	size of selected points
`point_select_border_col`	border color of selected points
`point_select_border_stroke`	stroke size of selected points
`point_size_other`	size of other points
`point_other_border_col`	border color of other points
`point_other_border_stroke`	stroke size of other points

Details

Description of parameters.

Value

ggplot

Examples

```
cellProximityVisPlot_2D_ggplot(gobject)
```

---

cellProximityVisPlot_2D_plotly

cellProximityVisPlot_2D_plotly

Description

Visualize 2D cell-cell interactions according to spatial coordinates in plotly mode

Usage

```
cellProximityVisPlot_2D_plotly(
  gobject,
  interaction_name = NULL,
  cluster_column = NULL,
  sdimx = NULL,
  sdimy = NULL,
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  show_other_cells = F,
  show_network = F,
  show_other_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  show_legend = T,
  point_size_select = 2,
  point_size_other = 1,
  point_alpha_other = 0.3,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  ...
)
```

Arguments

`gobject`	giotto object
`interaction_name`	cell-cell interaction name
`cluster_column`	cluster column with cell clusters
`sdimx`	x-axis dimension name (default = 'sdimx')
`sdimy`	y-axis dimension name (default = 'sdimy')
`cell_color`	color for cells (see details)
`cell_color_code`	named vector with colors
`color_as_factor`	convert color column to factor
`show_other_cells`	decide if show cells not in network
`show_network`	show underlying spatial network
`network_color`	color of spatial network
`spatial_network_name`	name of spatial network to use
`show_grid`	show spatial grid
`grid_color`	color of spatial grid
`spatial_grid_name`	name of spatial grid to use
`show_legend`	show legend
`point_size_select`	size of selected points
`coord_fix_ratio`	fix ratio between x and y-axis

Details

Description of parameters.

Value

plotly

Examples

```
cellProximityVisPlot_2D_plotly(gobject)
```

cellProximityVisPlot_3D_plotly *cellProximityVisPlot_3D_plotly*

Description

Visualize 3D cell-cell interactions according to spatial coordinates in plotly mode

Usage

```
cellProximityVisPlot_3D_plotly(
  gobject,
  interaction_name = NULL,
  cluster_column = NULL,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  show_other_cells = F,
  show_network = F,
  show_other_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  show_legend = T,
  point_size_select = 2,
  point_size_other = 1,
  point_alpha_other = 0.5,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  ...
)
```

Arguments

`gobject`	giotto object
`interaction_name`	cell-cell interaction name
`cluster_column`	cluster column with cell clusters
`sdimx`	x-axis dimension name (default = 'sdimx')
`sdimy`	y-axis dimension name (default = 'sdimy')
`sdimz`	z-axis dimension name (default = 'sdimz')

`cell_color` color for cells (see details)

`cell_color_code` named vector with colors

`color_as_factor` convert color column to factor

`show_other_cells` decide if show cells not in network

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name` name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`spatial_grid_name` name of spatial grid to use

`show_legend` show legend

`point_size_select` size of selected points

`coord_fix_ratio` fix ratio between x and y-axis

Details

Description of parameters.

Value

plotly

Examples

```
cellProximityVisPlot_3D_plotly(gobject)
```

---

changeGiottoInstructions

changeGiottoInstructions

Description

Function to change one or more instructions from giotto object

Usage

```
changeGiottoInstructions(
  gobject,
  params = NULL,
  new_values = NULL,
  return_gobject = TRUE
)
```

Arguments

gobject	giotto object
params	parameter(s) to change
new_values	new value(s) for parameter(s)
return_gobject	(boolean) return giotto object

Value

named vector with giotto instructions

Examples

```
changeGiottoInstructions()
```

---

clusterCells *clusterCells*

Description

cluster cells using a variety of different methods

Usage

```
clusterCells(
  gobject,
  cluster_method = c("leiden", "louvain_community", "louvain_multinet", "randomwalk",
    "sNNclust", "kmeans", "hierarchical"),
  name = "cluster_name",
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  pyth_leid_resolution = 1,
  pyth_leid_weight_col = "weight",
  pyth_leid_part_type = c("RBConfigurationVertexPartition", "ModularityVertexPartition"),
  pyth_leid_init_memb = NULL,
  pyth_leid_iterations = 1000,
  pyth_louv_resolution = 1,
  pyth_louv_weight_col = NULL,
  python_louv_random = F,
  python_path = NULL,
  louvain_gamma = 1,
  louvain_omega = 1,
  walk_steps = 4,
  walk_clusters = 10,
  walk_weights = NA,
  sNNclust_k = 20,
  sNNclust_eps = 4,
  sNNclust_minPts = 16,
  borderPoints = TRUE,
  expression_values = c("normalized", "scaled", "custom"),
  genes_to_use = NULL,
  dim_reduction_to_use = c("cells", "pca", "umap", "tsne"),
  dim_reduction_name = "pca",
  dimensions_to_use = 1:10,
  distance_method = c("original", "pearson", "spearman", "euclidean", "maximum",
    "manhattan", "canberra", "binary", "minkowski"),
  km_centers = 10,
  km_iter_max = 100,
  km_nstart = 1000,
  km_algorithm = "Hartigan-Wong",
  hc_agglomeration_method = c("ward.D2", "ward.D", "single", "complete", "average",
    "mcquitty", "median", "centroid"),
  hc_k = 10,
  hc_h = NULL,
  return_gobject = TRUE,
  set_seed = T,
  seed_number = 1234
)
```

Arguments

`gobject`	giotto object
`cluster_method`	community cluster method to use
`name`	name for new clustering result
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use
`pyth_leid_resolution`	resolution for leiden
`pyth_leid_weight_col`	column to use for weights
`pyth_leid_part_type`	partition type to use
`pyth_leid_init_memb`	initial membership
`pyth_leid_iterations`	number of iterations
`pyth_louv_resolution`	resolution for louvain
`pyth_louv_weight_col`	python louvain param: weight column
`python_louv_random`	python louvain param: random
`python_path`	specify specific path to python if required
`louvain_gamma`	louvain param: gamma or resolution
`louvain_omega`	louvain param: omega
`walk_steps`	randomwalk: number of steps
`walk_clusters`	randomwalk: number of clusters
`walk_weights`	randomwalk: weight column
`sNNclust_k`	SNNclust: k neighbors to use

`sNNclust_eps`	SNNclust: epsilon
`sNNclust_minPts`	SNNclust: min points
`borderPoints`	SNNclust: border points
`expression_values`	expression values to use
`genes_to_use`	= NULL,
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	name of reduction 'pca',
`dimensions_to_use`	dimensions to use
`distance_method`	distance method
`km_centers`	kmeans centers
`km_iter_max`	kmeans iterations
`km_nstart`	kmeans random starting points
`km_algorithm`	kmeans algorithm
`hc_agglomeration_method`	hierarchical clustering method
`hc_k`	hierachical number of clusters
`hc_h`	hierarchical tree cutoff
`return_gobject`	boolean: return giotto object (default = TRUE)
`set_seed`	set seed
`seed_number`	number for seed

Details

Wrapper for the different clustering methods.

Value

giotto object with new clusters appended to cell metadata

See Also

`doLeidenCluster`, `doLouvainCluster_community`, `doLouvainCluster_multinet`, `doLouvainCluster`, `doRandomWalkCluster`, `doSNNCluster`, `doKmeans`, `doHclust`

Examples

```
clusterCells(gobject)
```

clusterSpatialCorGenes *clusterSpatialCorGenes*

Description

Cluster based on spatially correlated genes

Usage

```
clusterSpatialCorGenes(
  spatCorObject,
  name = "spat_clus",
  hclust_method = "ward.D",
  k = 10,
  return_obj = TRUE
)
```

Arguments

spatCorObject	spatial correlation object
name	name for spatial clustering results
hclust_method	method for hierarchical clustering
k	number of clusters to extract
return_obj	return spatial correlation object (spatCorObject)

Value

spatCorObject or cluster results

Examples

```
clusterSpatialCorGenes(gobject)
```

combineMetadata *combineMetadata*

Description

This function combines the cell metadata with spatial locations and enrichment results from createSpatialEnrich

Usage

```
combineMetadata(gobject, spat_enr_names = NULL)
```

Arguments

gobject	Giotto object
spat_enr_names	names of spatial enrichment results to include

Value

Extended cell metadata in data.table format.

Examples

```
combineMetadata(gobject)
```

---

convertEnsemblToGeneSymbol

convertEnsemblToGeneSymbol

Description

This function convert ensembl gene IDs from a matrix to official gene symbols

Usage

```
convertEnsemblToGeneSymbol(matrix, species = c("mouse", "human"))
```

Arguments

`matrix`	an expression matrix with ensembl gene IDs as rownames
`species`	species to use for gene symbol conversion

Details

This function requires that the biomaRt library is installed

Value

expression matrix with gene symbols as rownames

Examples

```
convertEnsemblToGeneSymbol(matrix)
```

---

createGiottoInstructions

createGiottoInstructions

Description

Function to set global instructions for giotto functions

Usage

```
createGiottoInstructions(
  python_path = NULL,
  show_plot = NULL,
  return_plot = NULL,
  save_plot = NULL,
  save_dir = NULL,
  plot_format = NULL,
  dpi = NULL,
  units = NULL,
  height = NULL,
  width = NULL
)
```

Arguments

`python_path`	path to python binary to use
`show_plot`	print plot to console, default = TRUE
`return_plot`	return plot as object, default = TRUE
`save_plot`	automatically save plot, dafault = FALSE
`save_dir`	path to directory where to save plots
`dpi`	resolution for raster images
`height`	height of plots
`width`	width of plots

Value

named vector with giotto instructions

Examples

```
createGiottoInstructions()
```

`createGiottoObject` *create Giotto object*

Description

Function to create a giotto object

Usage

```
createGiottoObject(
  raw_exprs,
  spatial_locs = NULL,
  norm_expr = NULL,
  norm_scaled_expr = NULL,
  custom_expr = NULL,
  cell_metadata = NULL,
  gene_metadata = NULL,
  spatial_network = NULL,
  spatial_network_name = NULL,
  spatial_grid = NULL,
  spatial_grid_name = NULL,
  spatial_enrichment = NULL,
  spatial_enrichment_name = NULL,
  dimension_reduction = NULL,
  nn_network = NULL,
  offset_file = NULL,
  instructions = NULL
)
```

Arguments

`raw_exprs` matrix with raw expression counts [required]

`spatial_locs` data.table or data.frame with coordinates for cell centroids

`norm_expr` normalized expression values

`norm_scaled_expr` scaled expression values

`custom_expr` custom expression values

`cell_metadata` cell annotation metadata

`gene_metadata` gene annotation metadata

`spatial_network` list of spatial network(s)

`spatial_network_name` list of spatial network name(s)

`spatial_grid` list of spatial grid(s)

`spatial_grid_name` list of spatial grid name(s)

`spatial_enrichment` list of spatial enrichment score(s) for each spatial region

`spatial_enrichment_name` list of spatial enrichment name(s)

`dimension_reduction` list of dimension reduction(s)

`nn_network` list of nearest neighbor network(s)

`offset_file` file used to stitch fields together (optional)

`instructions` list of instructions or output result from createGiottoInstructions

Details

[**Requirements**] To create a giotto object you need to provide at least a matrix with genes as row names and cells as column names. To include spatial information about cells (or regions) you need to provide a data.table or data.frame with coordinates for all spatial dimensions. This can be 2D (x and y) or 3D (x, y, x).The row order for the cell coordinates should be the same as the column order for the provided expression data.

[**Instructions**] Additionally an instruction file, generated manually or with `createGiottoInstructions` can be provided to instructions, if not a default instruction file will be created for the Giotto object.

[**Multiple fields**] In case a dataset consists of multiple fields, like seqFISH+ for example, an offset file can be provided to stitch the different fields together. `stitchFieldCoordinates` can be used to generate such an offset file.

[**Processed data**] Processed count data, such as normalized data, can be provided using one of the different expression slots (norm_expr, norm_scaled_expr, custom_expr).

[**Metadata**] Cell and gene metadata can be provided using the cell and gene metadata slots. This data can also be added afterwards using the `addGeneMetadata` or `addCellMetadata` functions.

[**Other information**] Additional information can be provided through the appropriate slots:

- spatial networks
- spatial girds
- spatial enrichments
- dimensions reductions
- nearest neighbours networks

Value

giotto object

Examples

```
createGiottoObject(raw_exprs, spatial_locs)
```

`createHeatmap_DT` *createHeatmap_DT*

Description

creates order for clusters

Usage

```
createHeatmap_DT(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  cluster_column = NULL,
  cluster_order = c("size", "correlation", "custom"),
  cluster_custom_order = NULL,
  cluster_cor_method = "pearson",
  cluster_hclust_method = "ward.D",
  gene_order = c("custom", "correlation"),
  gene_custom_order = NULL,
  gene_cor_method = "pearson",
  gene_hclust_method = "complete"
)
```

Arguments

gobject	giotto object
expression_values	expression values to use
genes	genes to use
cluster_column	name of column to use for clusters
cluster_order	method to determine cluster order
cluster_custom_order	custom order for clusters
cluster_cor_method	method for cluster correlation
cluster_hclust_method	method for hierarchical clustering of clusters
gene_order	method to determine gene order
gene_custom_order	custom order for genes
gene_cor_method	method for gene correlation
gene_hclust_method	method for hierarchical clustering of genes

Details

Creates input data.tables for plotHeatmap function.

Value

list

Examples

```
createHeatmap_DT(gobject)
```

---

createMetagenes *createMetagenes*

Description

This function creates an average metagene for gene clusters.

Usage

```
createMetagenes(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  gene_clusters,
  name = "metagene",
  return_gobject = TRUE
)
```

Arguments

`gobject`	Giotto object
`expression_values`	expression values to use
`gene_clusters`	numerical vector with genes as names
`name`	name of the metagene results
`return_gobject`	return giotto object

Details

An example for the 'gene_clusters' could be like this: cluster_vector = c(1, 1, 2, 2); names(cluster_vector) = c('geneA', 'geneB', 'geneC', 'geneD')

Value

giotto object

Examples

```
createMetagenes(gobject)
```

createNearestNetwork *createNearestNetwork*

Description

create a nearest neighbour (NN) network

Usage

```
createNearestNetwork(
  gobject,
  type = c("sNN", "kNN"),
  dim_reduction_to_use = "pca",
  dim_reduction_name = "pca",
  dimensions_to_use = 1:10,
  genes_to_use = NULL,
  expression_values = c("normalized", "scaled", "custom"),
  name = "sNN.pca",
  return_gobject = TRUE,
  k = 30,
  minimum_shared = 5,
  top_shared = 3,
  verbose = T,
  ...
)
```

Arguments

`gobject`	giotto object
`type`	sNN or kNN
`dim_reduction_to_use`	dimension reduction method to use
`dim_reduction_name`	name of dimension reduction set to use
`dimensions_to_use`	number of dimensions to use as input
`genes_to_use`	if dim_reduction_to_use = NULL, which genes to use
`expression_values`	expression values to use
`name`	arbitrary name for NN network
`return_gobject`	boolean: return giotto object (default = TRUE)
`k`	number of k neighbors to use
`minimum_shared`	minimum shared neighbors
`top_shared`	keep at ...
`verbose`	be verbose
`...`	additional parameters for kNN and sNN functions from dbscan

Details

This function creates a k-nearest neighbour (kNN) or shared nearest neighbour (sNN) network based on the provided dimension reduction space. To run it directly on the gene expression matrix set *dim_reduction_to_use = NULL.*

See also `kNN` and `sNN` for more information about how the networks are created.

Output for kNN:

- from: cell_ID for source cell
- to: cell_ID for target cell
- distance: distance between cells
- weight: weight = 1/(1 + distance)

Output for sNN:

- from: cell_ID for source cell
- to: cell_ID for target cell
- distance: distance between cells
- weight: 1/(1 + distance)
- shared: number of shared neighbours
- rank: ranking of pairwise cell neighbours

For sNN networks two additional parameters can be set:

- minimum_shared: minimum number of shared neighbours needed
- top_shared: keep this number of the top shared neighbours, irrespective of minimum_shared setting

Value

giotto object with updated NN network

Examples

```
createNearestNetwork(gobject)
```

createSpatialEnrich *createSpatialEnrich*

Description

Function to calculate gene signature enrichment scores per spatial position using a hypergeometric test.

Usage

```
createSpatialEnrich(
  gobject,
  enrich_method = c("PAGE", "rank", "hypergeometric"),
  sign_matrix,
  expression_values = c("normalized", "scaled", "custom"),
  reverse_log_scale = TRUE,
  logbase = 2,
  output_enrichment = c("original", "zscore"),
  name = "PAGE",
  return_gobject = TRUE
)
```

Arguments

gobject	Giotto object
enrich_method	method for gene signature enrichment calculation
sign_matrix	Matrix of signature genes for each cell type / process
expression_values	expression values to use
reverse_log_scale	reverse expression values from log scale
logbase	log base to use if reverse_log_scale = TRUE
output_enrichment	how to return enrichment output
name	to give to spatial enrichment results, default = PAGE
return_gobject	return giotto object

Details

For details see the individual functions:

- PAGE: PAGEEnrich
- PAGE: rankEnrich
- PAGE: hyperGeometricEnrich

Value

Giotto object or enrichment results if return_gobject = FALSE

Examples

```
createSpatialEnrich(gobject)
```

---

createSpatialGrid *createSpatialGrid*

Description

Create a spatial grid.

Usage

```
createSpatialGrid(
  gobject,
  sdimx_stepsize = NULL,
  sdimy_stepsize = NULL,
  sdimz_stepsize = NULL,
  minimum_padding = 1,
  name = "spatial_grid",
  return_gobject = TRUE
)
```

Arguments

`gobject`	giotto object
`sdimx_stepsize`	stepsize along the x-axis
`sdimy_stepsize`	stepsize along the y-axis
`sdimz_stepsize`	stepsize along the z-axis
`minimum_padding`	minimum padding on the edges
`name`	name for spatial grid (default = 'spatial_grid')
`return_gobject`	boolean: return giotto object (default = TRUE)

Details

Creates a spatial grid with defined x, y (and z) dimensions. The dimension units are based on the provided spatial location units.

Value

giotto object with updated spatial grid slot

Examples

```
createSpatialGrid(gobject)
```

createSpatialGrid_2D *createSpatialGrid_2D*

Description

create a spatial grid for 2D spatial data.

Usage

```
createSpatialGrid_2D(
  gobject,
  sdimx_stepsize = NULL,
  sdimy_stepsize = NULL,
  minimum_padding = 1,
  name = "spatial_grid",
  return_gobject = TRUE
)
```

Arguments

`gobject`	giotto object
`sdimx_stepsize`	stepsize along the x-axis
`sdimy_stepsize`	stepsize along the y-axis
`minimum_padding`	minimum padding on the edges
`name`	name for spatial grid (default = 'spatial_grid')
`return_gobject`	boolean: return giotto object (default = TRUE)

Details

Creates a spatial grid with defined x, y (and z) dimensions. The dimension units are based on the provided spatial location units.

Value

giotto object with updated spatial grid slot

Examples

```
    createSpatialGrid_2D(gobject)
```

createSpatialGrid_3D *createSpatialGrid_3D*

Description

Create a spatial grid for 3D spatial data.

Usage

```
createSpatialGrid_3D(
  gobject,
  sdimx_stepsize = NULL,
  sdimy_stepsize = NULL,
  sdimz_stepsize = NULL,
  minimum_padding = 1,
  name = "spatial_grid",
  return_gobject = TRUE
)
```

Arguments

`gobject`	giotto object
`sdimx_stepsize`	stepsize along the x-axis
`sdimy_stepsize`	stepsize along the y-axis
`sdimz_stepsize`	stepsize along the z-axis
`minimum_padding`	minimum padding on the edges
`name`	name for spatial grid (default = 'spatial_grid')
`return_gobject`	boolean: return giotto object (default = TRUE)

Details

Creates a spatial grid with defined x, y (and z) dimensions. The dimension units are based on the provided spatial location units.

Value

giotto object with updated spatial grid slot

Examples

```
createSpatialGrid_3D(gobject)
```

createSpatialNetwork *createSpatialNetwork*

Description

Create a spatial network based on cell centroid physical distances.

Usage

```
createSpatialNetwork(
  gobject,
  k = 4,
  dimensions = "all",
  maximum_distance = NULL,
  minimum_k = 0,
  name = "spatial_network",
  verbose = F,
  return_gobject = TRUE
)
```

Arguments

gobject	giotto object
k	number of nearest neighbors based on physical distance
dimensions	which spatial dimensions to use (default = all)
maximum_distance	distance cuttof for nearest neighbors to consider
minimum_k	minimum nearest neigbhours if maximum_distance != NULL
name	name for spatial network (default = 'spatial_network')
verbose	verbose
return_gobject	boolean: return giotto object (default = TRUE)

Details

Creates a spatial network connecting single-cells based on their physical distance to each other. Number of neighbors can be determined by k, maximum distance from each cell with or without setting a minimum k for each cell.

dimensions: default = 'all' which takes all possible dimensions. Alternatively you can provide a character vector that specififies the spatial dimensions to use, e.g. c("sdimx', "sdimy") or a numerical vector, e.g. 2:3

maximum_distance: to create a network based on maximum distance only, you also need to set k to a very high value, e.g. k = 100

Value

giotto object with updated spatial network slot

Examples

```
createSpatialNetwork(gobject)
```

create_average_detection_DT *create_average_detection_DT*

Description

calculates average gene detection for a cell metadata factor (e.g. cluster)

Usage

```
create_average_detection_DT(
  gobject,
  meta_data_name,
  expression_values = c("normalized", "scaled", "custom"),
  detection_threshold = 0
)
```

Arguments

`gobject`	giotto object
`meta_data_name`	name of metadata column to use
`expression_values`	which expression values to use
`detection_threshold`	detection threshold to consider a gene detected

Value

data.table with average gene epression values for each factor

create_average_DT *create_average_DT*

Description

calculates average gene expression for a cell metadata factor (e.g. cluster)

Usage

```
create_average_DT(
  gobject,
  meta_data_name,
  expression_values = c("normalized", "scaled", "custom")
)
```

Arguments

`gobject`	giotto object
`meta_data_name`	name of metadata column to use
`expression_values`	which expression values to use

Value

data.table with average gene epression values for each factor

---

`create_cell_type_random_cell_IDs`

create_cell_type_random_cell_IDs

Description

creates randomized cell ids within a selection of cell types

Usage

```
create_cell_type_random_cell_IDs(
  gobject,
  cluster_column = "cell_types",
  needed_cell_types
)
```

Arguments

`gobject` giotto object to use

`cluster_column` cluster column with cell type information

`needed_cell_types` vector of cell type names for which a random id will be found

Details

Details will follow.

Value

list of randomly sampled cell ids with same cell type composition

Examples

```
create_cell_type_random_cell_IDs(gobject)
```

create_cluster_matrix *create_cluster_matrix*

Description

creates aggregated matrix for a given clustering

Usage

```
create_cluster_matrix(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  gene_subset = NULL
)
```

Examples

```
    create_cluster_matrix(gobject)
```

create_dimObject *create_dimObject*

Description

Creates an object that stores a dimension reduction output

Usage

```
create_dimObject(
  name = "test",
  reduction_method = NULL,
  coordinates = NULL,
  misc = NULL,
  my_rownames = NULL
)
```

Arguments

name	arbitrary name for object
reduction_method	method used to reduce dimensions
coordinates	accepts the coordinates after dimension reduction
misc	any additional information will be added to this slot

Value

number of distinct colors

decide_cluster_order *decide_cluster_order*

Description

creates order for clusters

Usage

```
decide_cluster_order(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  cluster_column = NULL,
  cluster_order = c("size", "correlation", "custom"),
  cluster_custom_order = NULL,
  cor_method = "pearson",
  hclust_method = "ward.D"
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`genes`	genes to use
`cluster_column`	name of column to use for clusters
`cluster_order`	method to determine cluster order
`cluster_custom_order`	custom order for clusters
`cor_method`	method for correlation
`hclust_method`	method for hierarchical clustering

Details

Calculates order for clusters.

Value

custom

Examples

```
decide_cluster_order(gobject)
```

detectSpatialCorGenes *detectSpatialCorGenes*

Description

Detect genes that are spatially correlated

Usage

```
detectSpatialCorGenes(
  gobject,
  method = c("grid", "network"),
  expression_values = c("normalized", "scaled", "custom"),
  subset_genes = NULL,
  spatial_network_name = "spatial_network",
  network_smoothing = NULL,
  spatial_grid_name = "spatial_grid",
  min_cells_per_grid = 4,
  cor_method = c("pearson", "kendall", "spearman")
)
```

Arguments

gobject	giotto object
method	method to use for spatial averaging
expression_values	gene expression values to use
subset_genes	subset of genes to use
spatial_network_name	name of spatial network to use
network_smoothing	smoothing factor beteen 0 and 1 (default: automatic)
spatial_grid_name	name of spatial grid to use
min_cells_per_grid	minimum number of cells to consider a grid
b	smoothing factor beteen 0 and 1 (default: automatic)

Details

For method = network, it expects a fully connected spatial network. You can make sure to create a fully connected network by setting minimal_k > 0 in the `createSpatialNetwork` function.

- 1. grid-averaging: average gene expression values within a predefined spatial grid
- 2. network-averaging: smoothens the gene expression matrix by averaging the expression within one cell by using the neighbours within the predefined spatial network. b is a smoothening factor that defaults to 1 - 1/k, where k is the median number of k-neighbors in the selected spatial network. Setting b = 0 means no smoothing and b = 1 means no contribution from its own expression.

The spatCorObject can be further explored with showSpatialCorGenes()

Value

returns a spatial correlation object: "spatCorObject"

See Also

showSpatialCorGenes

Examples

```
detectSpatialCorGenes(gobject)
```

---

detectSpatialPatterns *detectSpatialPatterns*

Description

Identify spatial patterns through PCA on average expression in a spatial grid.

Usage

```
detectSpatialPatterns(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  spatial_grid_name = "spatial_grid",
  min_cells_per_grid = 4,
  scale_unit = F,
  ncp = 100,
  show_plot = T,
  PC_zscore = 1.5
)
```

Arguments

`gobject` giotto object

`expression_values`
expression values to use

`spatial_grid_name`
name of spatial grid to use (default = 'spatial_grid')

`min_cells_per_grid`
minimum number of cells in a grid to be considered

`scale_unit` scale features

`ncp` number of principal components to calculate

`show_plot` show plots

`PC_zscore` minimum z-score of variance explained by a PC

Details

Steps to identify spatial patterns:

- 1. average gene expression for cells within a grid, see createSpatialGrid
- 2. perform PCA on the average grid expression profiles
- 3. convert variance of principlal components (PCs) to z-scores and select PCs based on a z-score threshold

Value

spatial pattern object 'spatPatObj'

Examples

```
detectSpatialPatterns(gobject)
```

---

dimCellPlot *dimCellPlot*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
dimCellPlot(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  spat_enr_names = NULL,
  cell_annotation_values,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimCellPlot"
)
```

Arguments

`gobject` giotto object

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`spat_enr_names` names of spatial enrichment results to include

`cell_annotation_values` numeric cell annotation columns

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color_gradient` vector with 3 colors for numeric data

`gradient_midpoint` midpoint for color gradient

`gradient_limits` vector with lower and upper limits

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

other_point_size	size of not selected cells
show_cluster_center	plot center of selected clusters
show_center_label	plot label of selected clusters
center_point_size	size of center points
label_size	size of labels
label_fontface	font of labels
edge_alpha	column to use for alpha of the edges
point_size	size of point (cell)
point_border_col	color of border around points
point_border_stroke	stroke size of border around points
show_legend	show legend
legend_text	size of legend text
axis_text	size of axis text
axis_title	size of axis title
show_plot	show plot
return_plot	return ggplot object
save_plot	directly save the plot [boolean]
save_param	list of saving parameters from all_plots_save_function
default_save_name	default save name for saving, don't change, change save_name in save_param
cell_color	color for cells (see details)
color_as_factor	convert color column to factor
cell_color_code	named vector with colors
title	title for plot, defaults to cell_color parameter

Details

Description of parameters. For 3D plots see dimCellPlot2D

Value

ggplot

Examples

```
dimCellPlot(gobject)
```

dimCellPlot2D *dimCellPlot2D*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
dimCellPlot2D(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  spat_enr_names = NULL,
  cell_annotation_values,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimCellPlot2D"
)
```

Arguments

gobject giotto object

dim_reduction_to_use
dimension reduction to use

dim_reduction_name
dimension reduction name

dim1_to_use dimension to use on x-axis

dim2_to_use dimension to use on y-axis

spat_enr_names names of spatial enrichment results to include

cell_annotation_values
numeric cell annotation columns

show_NN_network
show underlying NN network

nn_network_to_use
type of NN network to use (kNN vs sNN)

network_name name of NN network to use, if show_NN_network = TRUE

cell_color_gradient
vector with 3 colors for numeric data

gradient_midpoint
midpoint for color gradient

gradient_limits
vector with lower and upper limits

select_cell_groups
select subset of cells/clusters based on cell_color parameter

select_cells select subset of cells based on cell IDs

show_other_cells
display not selected cells

other_cell_color
color of not selected cells

other_point_size
size of not selected cells

show_cluster_center
plot center of selected clusters

show_center_label
plot label of selected clusters

center_point_size
size of center points

label_size size of labels

label_fontface font of labels

edge_alpha column to use for alpha of the edges

point_size size of point (cell)

point_border_col
color of border around points

`point_border_stroke`	stroke size of border around points
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`title`	title for plot, defaults to cell_color parameter

Details

Description of parameters. For 3D plots see `dimPlot3D`

Value

ggplot

Examples

```
dimCellPlot2D(gobject)
```

`dimGenePlot` *dimGenePlot*

Description

Visualize cells and gene expression according to dimension reduction coordinates

Usage

```
dimGenePlot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  network_color = "lightgray",
  edge_alpha = NULL,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  genes_high_color = "red",
  genes_mid_color = "white",
  genes_low_color = "blue",
  point_border_col = "black",
  point_border_stroke = 0.1,
  midpoint = 0,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimGenePlot"
)
```

Arguments

gobject	giotto object
expression_values	gene expression values to use
genes	genes to show
dim_reduction_to_use	dimension reduction to use
dim_reduction_name	dimension reduction name
dim1_to_use	dimension to use on x-axis
dim2_to_use	dimension to use on y-axis
show_NN_network	show underlying NN network
nn_network_to_use	type of NN network to use (kNN vs sNN)
network_name	name of NN network to use, if show_NN_network = TRUE
edge_alpha	column to use for alpha of the edges
scale_alpha_with_expression	scale expression with ggplot alpha parameter
point_size	size of point (cell)
point_border_col	color of border around points
point_border_stroke	stroke size of border around points

`midpoint`	size of point (cell)
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_legend`	show legend
`show_plot`	show plots
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`...`	parameters for cowplot::save_plot()

Details

Description of parameters.

Value

ggplot

See Also

`dimGenePlot3D`

Examples

```
dimGenePlot(gobject)
```

`dimGenePlot2D` *dimGenePlot2D*

Description

Visualize cells and gene expression according to dimension reduction coordinates

Usage

```
dimGenePlot2D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  network_color = "lightgray",
  edge_alpha = NULL,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  genes_high_color = "red",
  genes_mid_color = "white",
  genes_low_color = "blue",
  point_border_col = "black",
  point_border_stroke = 0.1,
  midpoint = 0,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimGenePlot2D"
)
```

Arguments

`gobject` giotto object

`expression_values` gene expression values to use

`genes` genes to show

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`edge_alpha` column to use for alpha of the edges

`scale_alpha_with_expression` scale expression with ggplot alpha parameter

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`midpoint` size of point (cell)

`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_legend`	show legend
`show_plot`	show plots
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`...`	parameters for cowplot::save_plot()

Details

Description of parameters.

Value

ggplot

See Also

`dimGenePlot3D`

Examples

```
dimGenePlot2D(gobject)
```

`dimGenePlot3D` *dimGenePlot3D*

Description

Visualize cells and gene expression according to dimension reduction coordinates

Usage

```
dimGenePlot3D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = 3,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  network_color = "lightgray",
  cluster_column = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  edge_alpha = NULL,
  point_size = 2,
  genes_high_color = NULL,
  genes_mid_color = "white",
  genes_low_color = "blue",
  show_legend = T,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimGenePlot3D"
)
```

Arguments

gobject	giotto object
expression_values	gene expression values to use
genes	genes to show
dim_reduction_to_use	dimension reduction to use
dim_reduction_name	dimension reduction name
dim1_to_use	dimension to use on x-axis
dim2_to_use	dimension to use on y-axis
dim3_to_use	dimension to use on z-axis
show_NN_network	show underlying NN network
nn_network_to_use	type of NN network to use (kNN vs sNN)
network_name	name of NN network to use, if show_NN_network = TRUE
edge_alpha	column to use for alpha of the edges
point_size	size of point (cell)
show_legend	show legend
show_plot	show plots
return_plot	return ggplot object
save_plot	directly save the plot [boolean]
save_param	list of saving parameters from all_plots_save_function
default_save_name	default save name for saving, don't change, change save_name in save_param
...	parameters for cowplot::save_plot()

Details

Description of parameters.

Value

ggplot

Examples

```
dimGenePlot3D(gobject)
```

`dimPlot` *dimPlot*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
dimPlot(
  gobject,
  group_by = NULL,
  group_by_subset = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  spat_enr_names = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  point_shape = c("border", "no_border"),
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  title = NULL,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimPlot"
)
```

Arguments

gobject giotto object

group_by_subset
subset the group_by factor column

dim_reduction_to_use
dimension reduction to use

dim_reduction_name
dimension reduction name

dim1_to_use dimension to use on x-axis

dim2_to_use dimension to use on y-axis

spat_enr_names names of spatial enrichment results to include

show_NN_network
show underlying NN network

nn_network_to_use
type of NN network to use (kNN vs sNN)

network_name name of NN network to use, if show_NN_network = TRUE

cell_color color for cells (see details)

color_as_factor
convert color column to factor

cell_color_code
named vector with colors

cell_color_gradient
vector with 3 colors for numeric data

gradient_midpoint
midpoint for color gradient

gradient_limits
vector with lower and upper limits

select_cell_groups
select subset of cells/clusters based on cell_color parameter

`select_cells`	select subset of cells based on cell IDs
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	size of not selected cells
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`title`	title for plot, defaults to cell_color parameter
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`groub_by`	create multiple plots based on cell annotation column

Details

Description of parameters, see `dimPlot2D`. For 3D plots see `dimPlot3D`

Value

ggplot

Examples

```
dimPlot(gobject)
```

---

dimPlot2D *dimPlot2D*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
dimPlot2D(
  gobject,
  group_by = NULL,
  group_by_subset = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  spat_enr_names = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  point_shape = c("border", "no_border"),
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  title = NULL,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimPlot2D"
)
```

Arguments

`gobject` giotto object

`group_by_subset` subset the group_by factor column

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`spat_enr_names` names of spatial enrichment results to include

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`cell_color_gradient` vector with 3 colors for numeric data

`gradient_midpoint` midpoint for color gradient

`gradient_limits` vector with lower and upper limits

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size` size of not selected cells

`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`title`	title for plot, defaults to cell_color parameter
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`groub_by`	create multiple plots based on cell annotation column

Details

Description of parameters. For 3D plots see `dimPlot3D`

Value

ggplot

Examples

```
dimPlot2D(gobject)
```

dimPlot2D_single *dimPlot2D_single*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
dimPlot2D_single(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  spat_enr_names = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  point_shape = c("border", "no_border"),
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  title = NULL,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dimPlot2D_single"
)
```

Arguments

gobject giotto object

dim_reduction_to_use
dimension reduction to use

dim_reduction_name
dimension reduction name

dim1_to_use dimension to use on x-axis

dim2_to_use dimension to use on y-axis

spat_enr_names names of spatial enrichment results to include

show_NN_network
show underlying NN network

nn_network_to_use
type of NN network to use (kNN vs sNN)

network_name name of NN network to use, if show_NN_network = TRUE

cell_color color for cells (see details)

color_as_factor
convert color column to factor

cell_color_code
named vector with colors

cell_color_gradient
vector with 3 colors for numeric data

gradient_midpoint
midpoint for color gradient

gradient_limits
vector with lower and upper limits

select_cell_groups
select subset of cells/clusters based on cell_color parameter

select_cells select subset of cells based on cell IDs

show_other_cells
display not selected cells

other_cell_color
color of not selected cells

other_point_size
size of not selected cells

show_cluster_center
plot center of selected clusters

show_center_label
plot label of selected clusters

center_point_size
size of center points

label_size size of labels

label_fontface font of labels

edge_alpha column to use for alpha of the edges

`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`title`	title for plot, defaults to cell_color parameter
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don’t change, change save_name in save_param

Details

Description of parameters. For 3D plots see `dimPlot3D`

Value

ggplot

Examples

```
dimPlot2D_single(gobject)
```

---

dimPlot3D *dimPlot3D*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
dimPlot3D(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = 3,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 2,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  color_as_factor = T,
  cell_color = NULL,
  cell_color_code = NULL,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 4,
  edge_alpha = NULL,
  point_size = 3,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "dim3D"
)
```

Arguments

`gobject` giotto object

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size` size of not selected cells

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`color_as_factor` convert color column to factor

`cell_color` color for cells (see details)

`cell_color_code`
: named vector with colors

`show_cluster_center`
: plot center of selected clusters

`show_center_label`
: plot label of selected clusters

`center_point_size`
: size of center points

`label_size`
: size of labels

`edge_alpha`
: column to use for alpha of the edges

`point_size`
: size of point (cell)

`show_plot`
: show plot

`return_plot`
: return ggplot object

`save_plot`
: directly save the plot [boolean]

`save_param`
: list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don't change, change save_name in save_param

`show_legend`
: show legend

Details

Description of parameters.

Value

plotly

Examples

```
dimPlot3D(gobject)
```

`direction_test_CPG` *direction_test_CPG*

Description

shows direction of change

Usage

```
direction_test(x, min_fdr = 0.05)
```

Examples

```
direction_test_CPG()
```

doHclust *doHclust*

Description

cluster cells using hierarchical clustering algorithm

Usage

```
doHclust(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes_to_use = NULL,
  dim_reduction_to_use = c("cells", "pca", "umap", "tsne"),
  dim_reduction_name = "pca",
  dimensions_to_use = 1:10,
  distance_method = c("pearson", "spearman", "original", "euclidean", "maximum",
    "manhattan", "canberra", "binary", "minkowski"),
  agglomeration_method = c("ward.D2", "ward.D", "single", "complete", "average",
    "mcquitty", "median", "centroid"),
  k = 10,
  h = NULL,
  name = "hclust",
  return_gobject = TRUE,
  set_seed = T,
  seed_number = 1234
)
```

Arguments

gobject	giotto object
expression_values	expression values to use
genes_to_use	subset of genes to use
dim_reduction_to_use	dimension reduction to use
dim_reduction_name	dimensions reduction name
dimensions_to_use	dimensions to use
distance_method	distance method
agglomeration_method	agglomeration method for hclust
k	number of final clusters
h	cut hierarchical tree at height = h
name	name for hierarchical clustering
return_gobject	boolean: return giotto object (default = TRUE)
set_seed	set seed
seed_number	number for seed

Details

Description on how to use Kmeans clustering method.

Value

giotto object with new clusters appended to cell metadata

See Also

hclust

Examples

```
doHclust(gobject)
```

---

doHMRF *doHMRF*

Description

Run HMRF

Usage

```
doHMRF(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  spatial_network_name = "spatial_network",
  spatial_genes = NULL,
  spatial_dimensions = c("sdimx", "sdimy", "sdimz"),
  dim_reduction_to_use = NULL,
  dim_reduction_name = "pca",
  dimensions_to_use = 1:10,
  name = "test",
  k = 10,
  betas = c(0, 2, 50),
  tolerance = 1e-10,
  zscore = c("none", "rowcol", "colrow"),
  numinit = 100,
  python_path = NULL,
  output_folder = NULL,
  overwrite_output = TRUE
)
```

Arguments

`gobject` giotto object

`expression_values`
expression values to use

`spatial_network_name`
name of spatial network to use for HMRF

`spatial_genes` spatial genes to use for HMRF

`spatial_dimensions`
select spatial dimensions to use, default is all possible dimensions

`dim_reduction_to_use`
use another dimension reduction set as input

`dim_reduction_name`
name of dimension reduction set to use

`dimensions_to_use`
number of dimensions to use as input

`name` name of HMRF run

`k` number of HMRF domains

`betas` betas to test for

`tolerance` tolerance

`zscore` zscore

`numinit` number of initializations

`python_path` python path to use

`output_folder` output folder to save results

`overwrite_output`
overwrite output folder

Details

Description of HMRF parameters ...

Value

Creates a directory with results that can be viewed with viewHMRFresults

Examples

```
doHMRF(gobject)
```

`doKmeans` *doKmeans*

Description

cluster cells using kmeans algorithm

Usage

```
doKmeans(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes_to_use = NULL,
  dim_reduction_to_use = c("cells", "pca", "umap", "tsne"),
  dim_reduction_name = "pca",
  dimensions_to_use = 1:10,
  distance_method = c("original", "pearson", "spearman", "euclidean", "maximum",
    "manhattan", "canberra", "binary", "minkowski"),
  centers = 10,
  iter_max = 100,
  nstart = 1000,
  algorithm = "Hartigan-Wong",
  name = "kmeans",
  return_gobject = TRUE,
  set_seed = T,
  seed_number = 1234
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`genes_to_use`	subset of genes to use
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimensions reduction name
`dimensions_to_use`	dimensions to use
`distance_method`	distance method
`centers`	number of final clusters
`iter_max`	kmeans maximum iterations
`nstart`	kmeans nstart
`algorithm`	kmeans algorithm
`name`	name for kmeans clustering
`return_gobject`	boolean: return giotto object (default = TRUE)
`set_seed`	set seed
`seed_number`	number for seed

Details

Description on how to use Kmeans clustering method.

Value

giotto object with new clusters appended to cell metadata

See Also

`kmeans`

Examples

```
doKmeans(gobject)
```

doLeidenCluster *doLeidenCluster*

Description

cluster cells using a NN-network and the Leiden community detection algorithm

Usage

```
doLeidenCluster(
  gobject,
  name = "leiden_clus",
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  python_path = NULL,
  resolution = 1,
  weight_col = "weight",
 partition_type = c("RBConfigurationVertexPartition", "ModularityVertexPartition"),
  init_membership = NULL,
  n_iterations = 1000,
  return_gobject = TRUE,
  set_seed = T,
  seed_number = 1234,
  ...
)
```

Arguments

`gobject` giotto object

`name` name for cluster

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use

`python_path` specify specific path to python if required

`resolution` resolution

`weight_col` weight column to use for edges

`partition_type` The type of partition to use for optimisation.

`init_membership` initial membership of cells for the partition

`n_iterations` number of interations to run the Leiden algorithm. If the number of iterations is negative, the Leiden algorithm is run until an iteration in which there was no improvement.

`return_gobject` boolean: return giotto object (default = TRUE)

`set_seed` set seed

`seed_number` number for seed

Details

This function is a wrapper for the Leiden algorithm implemented in python, which can detect communities in graphs of millions of nodes (cells), as long as they can fit in memory. See the https://github.com/vtraag/leidenalgleidenalg github page or the https://leidenalg.readthedocs.io/en/stable/index.htmlreadthedocs page for more information.

Partition types available and information:

- RBConfigurationVertexPartition: Implements Reichardt and Bornholdt's Potts model with a configuration null model. This quality function is well-defined only for positive edge weights. This quality function uses a linear resolution parameter.
- ModularityVertexPartition: Implements modularity. This quality function is well-defined only for positive edge weights. It does *not* use the resolution parameter

Set *weight_col = NULL* to give equal weight (=1) to each edge.

Value

giotto object with new clusters appended to cell metadata

Examples

```
doLeidenCluster(gobject)
```

---

doLeidenSubCluster *doLeidenSubCluster*

Description

Further subcluster cells using a NN-network and the Leiden algorithm

Usage

```
doLeidenSubCluster(
  gobject,
  name = "sub_pleiden_clus",
  cluster_column = NULL,
  selected_clusters = NULL,
 hvg_param = list(reverse_log_scale = T, difference_in_variance = 1, expression_values
    = "normalized"),
  hvg_min_perc_cells = 5,
  hvg_mean_expr_det = 1,
  use_all_genes_as_hvg = FALSE,
  min_nr_of_hvg = 5,
  pca_param = list(expression_values = "normalized", scale_unit = T),
  nn_param = list(dimensions_to_use = 1:20),
  k_neighbors = 10,
  resolution = 0.5,
  n_iterations = 500,
  python_path = NULL,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  return_gobject = TRUE,
  verbose = T
)
```

Arguments

gobject giotto object

name name for new clustering result

cluster_column cluster column to subcluster

selected_clusters only do subclustering on these clusters

hvg_param parameters for calculateHVG

hvg_min_perc_cells threshold for detection in min percentage of cells

hvg_mean_expr_det threshold for mean expression level in cells with detection

use_all_genes_as_hvg forces all genes to be HVG and to be used as input for PCA

min_nr_of_hvg minimum number of HVG, or all genes will be used as input for PCA

pca_param parameters for runPCA

nn_param parameters for parameters for createNearestNetwork

k_neighbors number of k for createNearestNetwork

resolution resolution of Leiden clustering

n_iterations number of interations to run the Leiden algorithm.

python_path specify specific path to python if required

nn_network_to_use type of NN network to use (kNN vs sNN)

network_name name of NN network to use

return_gobject boolean: return giotto object (default = TRUE)

verbose verbose

Details

This function performs subclustering using the Leiden algorithm on selected clusters. The systematic steps are:

- 1. subset Giotto object
- 2. identify highly variable genes
- 3. run PCA
- 4. create nearest neighbouring network
- 5. do Leiden clustering

Value

giotto object with new subclusters appended to cell metadata

See Also

doLeidenCluster

Examples

```
doLeidenSubCluster(gobject)
```

---

doLouvainCluster *doLouvainCluster*

Description

cluster cells using a NN-network and the Louvain algorithm.

Usage

```
doLouvainCluster(
  gobject,
  version = c("community", "multinet"),
  name = "louvain_clus",
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  python_path = NULL,
  resolution = 1,
  weight_col = NULL,
  gamma = 1,
  omega = 1,
  louv_random = F,
  return_gobject = TRUE,
  set_seed = F,
  seed_number = 1234,
  ...
)
```

Arguments

gobject	giotto object
version	implemented version of Louvain clustering to use
name	name for cluster
nn_network_to_use	type of NN network to use (kNN vs sNN)
network_name	name of NN network to use
python_path	[community] specify specific path to python if required
resolution	[community] resolution
gamma	[multinet] Resolution parameter for modularity in the generalized louvain method.
omega	[multinet] Inter-layer weight parameter in the generalized louvain method.
return_gobject	boolean: return giotto object (default = TRUE)
set_seed	set seed
seed_number	number for seed

Details

Louvain clustering using the community or multinet implementation of the louvain clustering algorithm.

Value

giotto object with new clusters appended to cell metadata

See Also

doLouvainCluster_community and doLouvainCluster_multinet

Examples

```
doLouvainCluster(gobject)
```

---

doLouvainCluster_community

doLouvainCluster_community

Description

cluster cells using a NN-network and the Louvain algorithm from the community module in Python

Usage

```
doLouvainCluster_community(
  gobject,
  name = "louvain_clus",
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  python_path = NULL,
  resolution = 1,
  weight_col = NULL,
  louv_random = F,
  return_gobject = TRUE,
  set_seed = F,
  seed_number = 1234,
  ...
)
```

Arguments

`gobject` giotto object

`name` name for cluster

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use

`python_path` specify specific path to python if required

`resolution` resolution

`weight_col`	weight column to use for edges
`louv_random`	Will randomize the node evaluation order and the community evaluation order to get different partitions at each call
`return_gobject`	boolean: return giotto object (default = TRUE)
`set_seed`	set seed
`seed_number`	number for seed

Details

This function is a wrapper for the Louvain algorithm implemented in Python, which can detect communities in graphs of nodes (cells). See the https://python-louvain.readthedocs.io/en/latest/index.htmlreadthedocs page for more information.

Set *weight_col = NULL* to give equal weight (=1) to each edge.

Value

giotto object with new clusters appended to cell metadata

Examples

```
doLouvainCluster_community(gobject)
```

doLouvainCluster_multinet *doLouvainCluster_multinet*

Description

cluster cells using a NN-network and the Louvain algorithm from the multinet package in R.

Usage

```
doLouvainCluster_multinet(
  gobject,
  name = "louvain_clus",
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  gamma = 1,
  omega = 1,
  return_gobject = TRUE,
  set_seed = F,
  seed_number = 1234,
  ...
)
```

Arguments

gobject	giotto object
name	name for cluster
nn_network_to_use	type of NN network to use (kNN vs sNN)
network_name	name of NN network to use
gamma	Resolution parameter for modularity in the generalized louvain method.
omega	Inter-layer weight parameter in the generalized louvain method.
return_gobject	boolean: return giotto object (default = TRUE)
set_seed	set seed
seed_number	number for seed

Details

See glouvain_ml from the multinet package in R for more information.

Value

giotto object with new clusters appended to cell metadata

Examples

```
doLouvainCluster_multinet(gobject)
```

doLouvainSubCluster *doLouvainSubCluster*

Description

subcluster cells using a NN-network and the Louvain algorithm

Usage

```
doLouvainSubCluster(
  gobject,
  name = "sub_louvain_clus",
  version = c("community", "multinet"),
  cluster_column = NULL,
  selected_clusters = NULL,
  hvg_param = list(reverse_log_scale = T, difference_in_variance = 1, expression_values
    = "normalized"),
  hvg_min_perc_cells = 5,
  hvg_mean_expr_det = 1,
  use_all_genes_as_hvg = FALSE,
  min_nr_of_hvg = 5,
  pca_param = list(expression_values = "normalized", scale_unit = T),
  nn_param = list(dimensions_to_use = 1:20),
  k_neighbors = 10,
  resolution = 0.5,
  gamma = 1,
  omega = 1,
  python_path = NULL,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  return_gobject = TRUE,
  verbose = T
)
```

Arguments

`gobject` giotto object

`name` name for new clustering result

`version` version of Louvain algorithm to use

`cluster_column` cluster column to subcluster

`selected_clusters` only do subclustering on these clusters

`hvg_param` parameters for calculateHVG

`hvg_min_perc_cells` threshold for detection in min percentage of cells

`hvg_mean_expr_det` threshold for mean expression level in cells with detection

`use_all_genes_as_hvg` forces all genes to be HVG and to be used as input for PCA

`min_nr_of_hvg` minimum number of HVG, or all genes will be used as input for PCA

`pca_param` parameters for runPCA

`nn_param` parameters for parameters for createNearestNetwork

`k_neighbors` number of k for createNearestNetwork

`resolution` resolution for community algorithm

`gamma` gamma

`omega` omega

`python_path` specify specific path to python if required

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use

`return_gobject` boolean: return giotto object (default = TRUE)

`verbose` verbose

Details

This function performs subclustering using the Louvain algorithm on selected clusters. The systematic steps are:

- 1. subset Giotto object
- 2. identify highly variable genes
- 3. run PCA
- 4. create nearest neighbouring network
- 5. do Louvain clustering

Value

giotto object with new subclusters appended to cell metadata

See Also

doLouvainCluster_multinet and doLouvainCluster_community

Examples

```
doLouvainSubCluster(gobject)
```

---

doLouvainSubCluster_community

doLouvainSubCluster_community

Description

subcluster cells using a NN-network and the Louvain community detection algorithm

Usage

```
doLouvainSubCluster_community(
  gobject,
  name = "sub_louvain_comm_clus",
  cluster_column = NULL,
  selected_clusters = NULL,
 hvg_param = list(reverse_log_scale = T, difference_in_variance = 1, expression_values
    = "normalized"),
  hvg_min_perc_cells = 5,
  hvg_mean_expr_det = 1,
  use_all_genes_as_hvg = FALSE,
  min_nr_of_hvg = 5,
  pca_param = list(expression_values = "normalized", scale_unit = T),
  nn_param = list(dimensions_to_use = 1:20),
  k_neighbors = 10,
  resolution = 0.5,
  python_path = NULL,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  return_gobject = TRUE,
  verbose = T
)
```

Arguments

gobject	giotto object
name	name for new clustering result
cluster_column	cluster column to subcluster
selected_clusters	only do subclustering on these clusters

`hvg_param` parameters for calculateHVG

`hvg_min_perc_cells`
threshold for detection in min percentage of cells

`hvg_mean_expr_det`
threshold for mean expression level in cells with detection

`use_all_genes_as_hvg`
forces all genes to be HVG and to be used as input for PCA

`min_nr_of_hvg` minimum number of HVG, or all genes will be used as input for PCA

`pca_param` parameters for runPCA

`nn_param` parameters for parameters for createNearestNetwork

`k_neighbors` number of k for createNearestNetwork

`resolution` resolution

`python_path` specify specific path to python if required

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use

`return_gobject` boolean: return giotto object (default = TRUE)

`verbose` verbose

Details

This function performs subclustering using the Louvain community algorithm on selected clusters. The systematic steps are:

- 1. subset Giotto object
- 2. identify highly variable genes
- 3. run PCA
- 4. create nearest neighbouring network
- 5. do Louvain community clustering

Value

giotto object with new subclusters appended to cell metadata

See Also

`doLouvainCluster_community`

Examples

```
doLouvainSubCluster_community(gobject)
```

doLouvainSubCluster_multinet *doLouvainSubCluster_multinet*

Description

subcluster cells using a NN-network and the Louvain multinet detection algorithm

Usage

```
doLouvainSubCluster_multinet(
  gobject,
  name = "sub_louvain_mult_clus",
  cluster_column = NULL,
  selected_clusters = NULL,
  hvg_param = list(reverse_log_scale = T, difference_in_variance = 1, expression_values
    = "normalized"),
  hvg_min_perc_cells = 5,
  hvg_mean_expr_det = 1,
  use_all_genes_as_hvg = FALSE,
  min_nr_of_hvg = 5,
  pca_param = list(expression_values = "normalized", scale_unit = T),
  nn_param = list(dimensions_to_use = 1:20),
  k_neighbors = 10,
  gamma = 1,
  omega = 1,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  return_gobject = TRUE,
  verbose = T
)
```

Arguments

gobject	giotto object
name	name for new clustering result
cluster_column	cluster column to subcluster
selected_clusters	only do subclustering on these clusters
hvg_param	parameters for calculateHVG
hvg_min_perc_cells	threshold for detection in min percentage of cells
hvg_mean_expr_det	threshold for mean expression level in cells with detection
use_all_genes_as_hvg	forces all genes to be HVG and to be used as input for PCA
min_nr_of_hvg	minimum number of HVG, or all genes will be used as input for PCA
pca_param	parameters for runPCA

`nn_param` parameters for parameters for createNearestNetwork

`k_neighbors` number of k for createNearestNetwork

`gamma` gamma

`omega` omega

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use

`return_gobject` boolean: return giotto object (default = TRUE)

`verbose` verbose

`python_path` specify specific path to python if required

Details

This function performs subclustering using the Louvain multinet algorithm on selected clusters. The systematic steps are:

- 1. subset Giotto object
- 2. identify highly variable genes
- 3. run PCA
- 4. create nearest neighbouring network
- 5. do Louvain multinet clustering

Value

giotto object with new subclusters appended to cell metadata

See Also

`doLouvainCluster_multinet`

Examples

```
doLouvainSubCluster_multinet(gobject)
```

`doRandomWalkCluster` *doRandomWalkCluster*

Description

Cluster cells using a random walk approach.

Usage

```
doRandomWalkCluster(
  gobject,
  name = "random_walk_clus",
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  walk_steps = 4,
  walk_clusters = 10,
  walk_weights = NA,
  return_gobject = TRUE,
  set_seed = F,
  seed_number = 1234,
  ...
)
```

Arguments

`gobject`	giotto object
`name`	name for cluster
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use
`walk_steps`	number of walking steps
`walk_clusters`	number of final clusters
`walk_weights`	cluster column defining the walk weights
`return_gobject`	boolean: return giotto object (default = TRUE)
`set_seed`	set seed
`seed_number`	number for seed

Details

See `cluster_walktrap` function from the igraph package in R for more information.

Value

giotto object with new clusters appended to cell metadata

Examples

```
doRandomWalkCluster(gobject)
```

doSNNCluster *doSNNCluster*

Description

Cluster cells using a SNN cluster approach.

Usage

```
doSNNCluster(
  gobject,
  name = "sNN_clus",
  nn_network_to_use = "kNN",
  network_name = "kNN.pca",
  k = 20,
  eps = 4,
  minPts = 16,
  borderPoints = TRUE,
  return_gobject = TRUE,
  set_seed = F,
  seed_number = 1234,
  ...
)
```

Arguments

gobject	giotto object
name	name for cluster
nn_network_to_use	type of NN network to use (only works on kNN)
network_name	name of kNN network to use
k	Neighborhood size for nearest neighbor sparsification to create the shared NN graph.
eps	Two objects are only reachable from each other if they share at least eps nearest neighbors.
minPts	minimum number of points that share at least eps nearest neighbors for a point to be considered a core points.
borderPoints	should borderPoints be assigned to clusters like in DBSCAN?
return_gobject	boolean: return giotto object (default = TRUE)
set_seed	set seed
seed_number	number for seed

Details

See sNNclust from dbscan package

Value

giotto object with new clusters appended to cell metadata

Examples

```
doSNNCluster(gobject)
```

`do_spatial_grid_averaging`
do_spatial_grid_averaging

Description

smooth gene expression over a defined spatial grid

Usage

```
do_spatial_grid_averaging(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  subset_genes = NULL,
  spatial_grid_name = "spatial_grid",
  min_cells_per_grid = 4
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`subset_genes`	subset of genes to use
`spatial_grid_name`	name of spatial grid to use
`min_cells_per_grid`	minimum number of cells to consider a grid

Value

matrix with smoothened gene expression values based on spatial grid

Examples

```
do_spatial_grid_averaging(gobject)
```

do_spatial_knn_smoothing *do_spatial_knn_smoothing*

Description

smooth gene expression over a kNN spatial network

Usage

```
do_spatial_knn_smoothing(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  subset_genes = NULL,
  spatial_network_name = "spatial_network",
  b = NULL
)
```

Arguments

`gobject` giotto object

`expression_values` gene expression values to use

`subset_genes` subset of genes to use

`spatial_network_name` name of spatial network to use

`b` smoothing factor beteen 0 and 1 (default: automatic)

Details

This function will smoothen the gene expression values per cell according to its neighbors in the selected spatial network.
b is a smoothening factor that defaults to 1 - 1/k, where k is the median number of k-neighbors in the selected spatial network. Setting b = 0 means no smoothing and b = 1 means no contribution from its own expression.

Value

matrix with smoothened gene expression values based on kNN spatial network

Examples

```
do_spatial_knn_smoothing(gobject)
```

dt_to_matrix *dt_to_matrix*

Description

converts data.table to matrix

Usage

```
dt_to_matrix(x)
```

Examples

```
    dt_to_matrix(x)
```

exportGiottoViewer *exportGiottoViewer*

Description

compute highly variable genes

Usage

```
exportGiottoViewer(
  gobject,
  output_directory = NULL,
  spat_enr_names = NULL,
  factor_annotations,
  numeric_annotations,
  dim_reductions,
  dim_reduction_names,
  expression_values = c("scaled", "normalized", "custom"),
  dim_red_rounding = NULL,
  dim_red_rescale = c(-20, 20),
  expression_rounding = 2,
  overwrite_dir = T,
  verbose = T
)
```

Arguments

`gobject` giotto object

`output_directory`
directory where to save the files

`spat_enr_names` spatial enrichment results to include for annotations

`factor_annotations`
giotto cell annotations to view as factor

`numeric_annotations`	giotto cell annotations to view as numeric
`dim_reductions`	high level dimension reductions to view
`dim_reduction_names`	specific dimension reduction names
`expression_values`	expression values to use in Viewer
`dim_red_rounding`	numerical indicating how to round the coordinates
`dim_red_rescale`	numericals to rescale the coordinates
`expression_rounding`	numerical indicating how to round the expression data
`overwrite_dir`	overwrite files in the directory if it already existed
`verbose`	be verbose

Details

Giotto Viewer expects the results from Giotto Analyzer in a specific format, which is provided by this function. To include enrichment results from `createSpatialEnrich` include the provided spatial enrichment name (default PAGE or rank) and add the gene signature names (.e.g cell types) to the numeric annotations parameter.

Value

writes the necessary output to use in Giotto Viewer

Examples

```
exportGiottoViewer(gobject)
```

`exprOnlyCellCellcommunicationScores` *exprOnlyCellCellcommunicationScores*

Description

Cell-Cell communication scores based on expression only

Usage

```
exprOnlyCellCellcommunicationScores(
  gobject,
  cluster_column = "cell_types",
  random_iter = 100,
  gene_set_1,
  gene_set_2,
  log2FC_addendum = 0.1,
  verbose = T
)
```

Arguments

gobject	giotto object to use
cluster_column	cluster column with cell type information
random_iter	number of iterations
gene_set_1	first specific gene set from gene pairs
gene_set_2	second specific gene set from gene pairs
log2FC_addendum	addendum to add when calculating log2FC
verbose	verbose

Details

Statistical framework to identify if pairs of genes (such as ligand-receptor combinations) are expressed at higher levels than expected based on a reshuffled null distribution of gene expression values, without considering the spatial position of cells. More details will follow soon.

Value

Cell-Cell communication scores for gene pairs based on expression only

Examples

```
exprOnlyCellCellcommunicationScores(gobject)
```

---

extended_gini_fun *extended_gini_fun*

Description

calculate gini coefficient on a minimum length vector

Usage

```
extended_gini_fun(x, weights = rep(1, length = length(x)), minimum_length = 16)
```

Value

gini coefficient

`extractNearestNetwork` *extractNearestNetwork*

Description

Extracts a NN-network from a Giotto object

Usage

```
extractNearestNetwork(
  gobject,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  output = c("igraph", "data.table")
)
```

Arguments

`gobject`	giotto object
`nn_network_to_use`	kNN or sNN
`network_name`	name of NN network to be used
`output`	return a igraph or data.table object

Value

igraph or data.table object

Examples

```
extractNearestNetwork(gobject)
```

`fDataDT` *fDataDT*

Description

show gene metadata

Usage

```
fDataDT(gobject)
```

Arguments

`gobject`	giotto object

Value

data.table with gene metadata

Examples

```
pDataDT(gobject)
```

filterCombinations *filterCombinations*

Description

Shows how many genes and cells are lost with combinations of thresholds.

Usage

```
filterCombinations(
  gobject,
  expression_values = c("raw", "normalized", "scaled", "custom"),
  expression_thresholds = c(1, 2),
  gene_det_in_min_cells = c(5, 50),
  min_det_genes_per_cell = c(200, 400),
  scale_x_axis = "identity",
  x_axis_offset = 0,
  scale_y_axis = "identity",
  y_axis_offset = 0,
  show_plot = TRUE
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`expression_thresholds`	all thresholds to consider a gene expressed
`gene_det_in_min_cells`	minimum number of cells that should express a gene to consider that gene further
`min_det_genes_per_cell`	minimum number of expressed genes per cell to consider that cell further
`scale_x_axis`	ggplot transformation for x-axis (e.g. log2)
`x_axis_offset`	x-axis offset to be used together with the scaling transformation
`scale_y_axis`	ggplot transformation for y-axis (e.g. log2)
`y_axis_offset`	y-axis offset to be used together with the scaling transformation
`show_plot`	show plot

Details

Creates a scatterplot that visualizes the number of genes and cells that are lost with a specific combination of a gene and cell threshold given an arbitrary cutoff to call a gene expressed. This function can be used to make an informed decision at the filtering step with filterGiotto.

Value

list of data.table and ggplot object

Examples

```
filterCombinations(gobject)
```

filterCPGscores *filterCPGscores*

Description

visualize Cell Proximity Gene enrichment scores

Usage

```
filterCPGscores(
  CPGscore,
  min_cells = 5,
  min_fdr = 0.05,
  min_spat_diff = 0.2,
  min_log2_fc = 0.5,
  keep_int_duplicates = TRUE,
  direction = c("both", "up", "down")
)
```

Arguments

`min_cells`	min number of cells threshold
`min_fdr`	false_discovery threshold
`min_spat_diff`	spatial difference threshold
`min_log2_fc`	min log2 fold-change
`keep_int_duplicates`	keep both cell_A-cell_B and cell_B-cell_A
`direction`	expression changes to keep
`method`	visualization method

Details

This function filters the output from getCellProximityGeneScores based on false-discovery rate, minimum absolute difference, minimum log fold-change and direction of change.

Value

Gene to gene scores in data.table format

Examples

```
filterCPGscores(CPGscore)
```

filterDistributions *filterDistributions*

Description

show gene or cell distribution after filtering on expression threshold

Usage

```
filterDistributions(
  gobject,
  expression_values = c("raw", "normalized", "scaled", "custom"),
  expression_threshold = 1,
  detection = c("genes", "cells"),
  plot_type = c("histogram", "violin"),
  nr_bins = 30,
  fill_color = "lightblue",
  scale_axis = "identity",
  axis_offset = 0,
  show_plot = TRUE
)
```

Arguments

gobject	giotto object
expression_values	expression values to use
expression_threshold	threshold to consider a gene expressed
detection	consider genes or cells
plot_type	type of plot
nr_bins	number of bins for histogram plot
fill_color	fill color for plots
scale_axis	ggplot transformation for axis (e.g. log2)
axis_offset	offset to be used together with the scaling transformation
show_plot	show plot

Value

ggplot object

Examples

```
filterDistributions(gobject)
```

filterGiotto *filterGiotto*

Description

filter Giotto object based on expression threshold

Usage

```
filterGiotto(
  gobject,
  expression_values = c("raw", "normalized", "scaled", "custom"),
  expression_threshold = 1,
  gene_det_in_min_cells = 100,
  min_det_genes_per_cell = 100,
  verbose = F
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`expression_threshold`	threshold to consider a gene expressed
`gene_det_in_min_cells`	minimum # of cells that need to express a gene
`min_det_genes_per_cell`	minimum # of genes that need to be detected in a cell
`verbose`	verbose

Details

The function `filterCombinations` can be used to explore the effect of different parameter values.

Value

giotto object

Examples

```
    filterGiotto(gobject)
```

findGiniMarkers *findGiniMarkers*

Description

Identify marker genes for selected clusters based on gini detection and expression scores.

Usage

```
findGiniMarkers(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  subset_clusters = NULL,
  group_1 = NULL,
  group_2 = NULL,
  min_expr_gini_score = 0.5,
  min_det_gini_score = 0.5,
  detection_threshold = 0,
  rank_score = 1
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`cluster_column`	clusters to use
`subset_clusters`	selection of clusters to compare
`group_1`	group 1 cluster IDs from cluster_column for pairwise comparison
`group_2`	group 2 cluster IDs from cluster_column for pairwise comparison
`min_expr_gini_score`	filter on minimum gini coefficient for expression
`min_det_gini_score`	filter on minimum gini coefficient for detection
`detection_threshold`	detection threshold for gene expression
`rank_score`	rank scores to include

Details

Detection of marker genes using the https://en.wikipedia.org/wiki/Gini_coefficientgini coefficient is based on the following steps/principles per gene:

- 1. calculate average expression per cluster
- 2. calculate detection fraction per cluster
- 3. calculate gini-coefficient for av. expression values over all clusters

- 4. calculate gini-coefficient for detection fractions over all clusters
- 5. convert gini-scores to rank scores
- 6. for each gene create combined gini score = av. expr gini x detection gini
- 7. for each gene create and sort on combined rank score = expr rank x detection rank

As a results "top gini" genes are genes that are very selectivily expressed in a specific cluster, however not always expressed in all cells of that cluster. In other words highly specific, but not necessarily sensitive at the single-cell level.

To perform differential expression between cluster groups you need to specificy cluster IDs to the parameters *group_1* and *group_2*.

Value

data.table with marker genes

Examples

```
findGiniMarkers(gobject)
```

---

findGiniMarkers_one_vs_all *findGiniMarkers_one_vs_all*

Description

Identify marker genes for all clusters in a one vs all manner based on gini detection and expression scores.

Usage

```
findGiniMarkers_one_vs_all(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  subset_clusters = NULL,
  min_expr_gini_score = 0.5,
  min_det_gini_score = 0.5,
  detection_threshold = 0,
  min_genes = 10,
  verbose = TRUE
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`cluster_column`	clusters to use
`subset_clusters`	selection of clusters to compare

`min_expr_gini_score`
: filter on minimum gini coefficient on expression

`min_det_gini_score`
: filter on minimum gini coefficient on detection

`detection_threshold`
: detection threshold for gene expression

`min_genes` minimum genes to keep per cluster, overrides pval and logFC

`verbose` be verbose

Value

data.table with marker genes

See Also

findGiniMarkers

Examples

```
findGiniMarkers_one_vs_all(gobject)
```

`findMarkers` *findMarkers*

Description

Identify marker genes for selected clusters.

Usage

```
findMarkers(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  method = c("scran", "gini", "mast"),
  subset_clusters = NULL,
  group_1 = NULL,
  group_2 = NULL,
  min_expr_gini_score = 0.5,
  min_det_gini_score = 0.5,
  detection_threshold = 0,
  rank_score = 1,
  group_1_name = NULL,
  group_2_name = NULL,
  adjust_columns = NULL,
  ...
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`cluster_column`	clusters to use
`method`	method to use to detect differentially expressed genes
`subset_clusters`	selection of clusters to compare
`group_1`	group 1 cluster IDs from cluster_column for pairwise comparison
`group_2`	group 2 cluster IDs from cluster_column for pairwise comparison
`min_expr_gini_score`	gini: filter on minimum gini coefficient for expression
`min_det_gini_score`	gini: filter minimum gini coefficient for detection
`detection_threshold`	gini: detection threshold for gene expression
`rank_score`	gini: rank scores to include
`group_1_name`	mast: custom name for group_1 clusters
`group_2_name`	mast: custom name for group_2 clusters
`adjust_columns`	mast: column in pDataDT to adjust for (e.g. detection rate)
`...`	additional parameters for the findMarkers function in scran or zlm function in MAST

Details

Wrapper for all individual functions to detect marker genes for clusters.

Value

data.table with marker genes

See Also

`findScranMarkers`, `findGiniMarkers` and `findMastMarkers`

Examples

```
findMarkers(gobject)
```

`findMarkers_one_vs_all`

findMarkers_one_vs_all

Description

Identify marker genes for all clusters in a one vs all manner.

Usage

```
findMarkers_one_vs_all(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  subset_clusters = NULL,
  method = c("scran", "gini", "mast"),
  pval = 0.01,
  logFC = 0.5,
  min_genes = 10,
  min_expr_gini_score = 0.5,
  min_det_gini_score = 0.5,
  detection_threshold = 0,
  rank_score = 1,
  adjust_columns = NULL,
  verbose = TRUE,
  ...
)
```

Arguments

`gobject` giotto object

`expression_values` gene expression values to use

`cluster_column` clusters to use

`subset_clusters` selection of clusters to compare

`method` method to use to detect differentially expressed genes

`pval` scran & mast: filter on minimal p-value

`logFC` scan & mast: filter on logFC

`min_genes` minimum genes to keep per cluster, overrides pval and logFC

`min_expr_gini_score` gini: filter on minimum gini coefficient for expression

`min_det_gini_score` gini: filter minimum gini coefficient for detection

`detection_threshold` gini: detection threshold for gene expression

`rank_score` gini: rank scores to include

`adjust_columns` mast: column in pDataDT to adjust for (e.g. detection rate) `verbose` be verbose

`...` additional parameters for the findMarkers function in scran or zlm function in MAST

Details

Wrapper for all one vs all functions to detect marker genes for clusters.

Value

data.table with marker genes

See Also

`findScranMarkers_one_vs_all`, `findGiniMarkers_one_vs_all` and `findMastMarkers_one_vs_all`

Examples

```
findMarkers_one_vs_all(gobject)
```

`findMastMarkers` *findMastMarkers*

Description

Identify marker genes for selected clusters based on the MAST package.

Usage

```
findMastMarkers(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  group_1 = NULL,
  group_1_name = NULL,
  group_2 = NULL,
  group_2_name = NULL,
  adjust_columns = NULL,
  ...
)
```

Arguments

`gobject` giotto object

`expression_values`
gene expression values to use

`cluster_column` clusters to use

`group_1` group 1 cluster IDs from cluster_column for pairwise comparison

`group_1_name` custom name for group_1 clusters

`group_2` group 2 cluster IDs from cluster_column for pairwise comparison `group_2_name` custom name for group_2 clusters

`adjust_columns` column in pDataDT to adjust for (e.g. detection rate)

`...` additional parameters for the zlm function in MAST

Details

This is a minimal convenience wrapper around the `zlm` from the MAST package to detect differentially expressed genes.

Value

data.table with marker genes

Examples

```
findMastMarkers(gobject)
```

`findMastMarkers_one_vs_all`

findMastMarkers_one_vs_all

Description

Identify marker genes for all clusters in a one vs all manner based on the MAST package.

Usage

```
findMastMarkers_one_vs_all(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  subset_clusters = NULL,
  adjust_columns = NULL,
  pval = 0.001,
  logFC = 1,
  min_genes = 10,
  verbose = TRUE,
  ...
)
```

Arguments

`gobject` giotto object

`expression_values` gene expression values to use

`cluster_column` clusters to use

`subset_clusters` selection of clusters to compare

`adjust_columns` column in pDataDT to adjust for (e.g. detection rate)

`pval` filter on minimal p-value

`logFC`	filter on logFC
`min_genes`	minimum genes to keep per cluster, overrides pval and logFC
`verbose`	be verbose
`...`	additional parameters for the zlm function in MAST

Value

data.table with marker genes

See Also

findMastMarkers

Examples

```
findMastMarkers_one_vs_all(gobject)
```

---

findScranMarkers *findScranMarkers*

Description

Identify marker genes for all or selected clusters based on scran's implementation of findMarkers.

Usage

```
findScranMarkers(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  subset_clusters = NULL,
  group_1 = NULL,
  group_2 = NULL,
  ...
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`cluster_column`	clusters to use
`subset_clusters`	selection of clusters to compare
`group_1`	group 1 cluster IDs from cluster_column for pairwise comparison
`group_2`	group 2 cluster IDs from cluster_column for pairwise comparison
`...`	additional parameters for the findMarkers function in scran

Details

This is a minimal convenience wrapper around the `findMarkers` function from the scran package.

To perform differential expression between cluster groups you need to specificy cluster IDs to the parameters *group_1* and *group_2*.

Value

data.table with marker genes

Examples

```
findScranMarkers(gobject)
```

`findScranMarkers_one_vs_all`

findScranMarkers_one_vs_all

Description

Identify marker genes for all clusters in a one vs all manner based on scran's implementation of findMarkers.

Usage

```
findScranMarkers_one_vs_all(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  subset_clusters = NULL,
  pval = 0.01,
  logFC = 0.5,
  min_genes = 10,
  verbose = TRUE,
  ...
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`cluster_column`	clusters to use
`subset_clusters`	subset of clusters to use
`pval`	filter on minimal p-value
`logFC`	filter on logFC
`min_genes`	minimum genes to keep per cluster, overrides pval and logFC
`verbose`	be verbose
`...`	additional parameters for the findMarkers function in scran

Value

data.table with marker genes

See Also

findScranMarkers

Examples

```
findScranMarkers_one_vs_all(gobject)
```

find_grid_2D *find_grid_2D*

Description

find grid location in 2D

Usage

```
find_grid_2D(grid_DT, x_loc, y_loc)
```

find_grid_3D *find_grid_3D*

Description

find grid location in 3D

Usage

```
find_grid_3D(grid_DT, x_loc, y_loc, z_loc)
```

find_grid_x *find_grid_x*

Description

find grid location on x-axis

Usage

```
find_grid_x(grid_DT, x_loc)
```

`find_grid_y` *find_grid_y*

Description

find grid location on y-axis

Usage

```
find_grid_y(grid_DT, y_loc)
```

`find_grid_z` *find_grid_z*

Description

find grid location on z-axis

Usage

```
find_grid_z(grid_DT, z_loc)
```

`fish_function` *fish_function*

Description

perform fisher exact test

Usage

```
fish_function(x_to, x_from)
```

`fish_function2` *fish_function2*

Description

perform fisher exact test

Usage

```
fish_function2(A, B, C, D)
```

FSV_show *FSV_show*

Description

Visualize spatial varible genes caculated by spatial_DE

Usage

```
FSV_show(
  results,
  ms_results = NULL,
  size = c(4, 2, 1),
  color = c("blue", "green", "red"),
  sig_alpha = 0.5,
  unsig_alpha = 0.5
)
```

Arguments

`results`	results caculated by spatial_DE
`ms_results`	ms_results caculated by spatial_DE
`size`	indicate different levels of qval
`color`	indicate different SV features
`sig_alpha`	transparency of significant genes
`unsig_alpha`	transparency of unsignificant genes

Details

Description of parameters.

Value

nothing

Examples

```
FSV_show(results)
```

GenePattern_show *GenePattern_show*

Description

Visualize genes distribution patterns calculated by spatial_AEH

Usage

```
GenePattern_show(
  gobject = NULL,
  AEH_results = NULL,
  sdimx = NULL,
  sdimy = NULL,
  point_size = 3,
  point_alpha = 1,
  low_color = "blue",
  mid_color = "white",
  high_color = "red",
  midpoint = 0
)
```

Arguments

`gobject`	giotto object
`AEH_results`	results from spatial_AEH
`sdimx`	x axis of spatial locus
`sdimy`	y axis of spatial locus
`point_size`	size of points to indicate cells
`point_alpha`	transparency of points to indicate cells
`low_color`	color to indicate low score level
`mid_color`	color to indicate middle score level
`high_color`	color to indicate high score level
`midpoint`	point to set mid_color

Details

Description of parameters.

Value

nothing

Examples

```
GenePattern_show(gobject,AEH_results)
```

general_save_function *general_save_function*

Description

Function to automatically save plots to directory of interest

Usage

```
general_save_function(
  gobject,
  plot_object,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  default_save_name = "giotto_plot",
  save_format = c("png", "tiff", "pdf", "svg"),
  show_saved_plot = F,
  base_width = NULL,
  base_height = NULL,
  base_aspect_ratio = NULL,
  units = NULL,
  dpi = NULL,
  ...
)
```

Arguments

`gobject`	giotto object
`plot_object`	non-ggplot object to plot
`save_dir`	directory to save to
`save_folder`	folder in save_dir to save to
`save_name`	name of plot
`save_format`	format (e.g. png, tiff, pdf, ...)
`show_saved_plot`	load & display the saved plot
`base_width`	width
`base_height`	height
`base_aspect_ratio`	aspect ratio
`units`	units
`dpi`	Plot resolution

Examples

```
general_save_function(gobject)
```

get10Xmatrix *get10Xmatrix*

Description

This function creates an expression matrix from a 10X structured folder

Usage

```
get10Xmatrix(path_to_data)
```

Arguments

path_to_data	path to the 10X folder

Details

A typical 10X folder is named raw_feature_bc_matrix or raw_feature_bc_matrix. It has 3 files:

- barcodes
- features.tsv.gz
- matrix.mtx.gz

Value

expression matrix from 10X

Examples

```
get10Xmatrix(10Xmatrix)
```

getCellProximityGeneScores *getCellProximityGeneScores*

Description

Compute cell-cell interaction enrichment (observed vs expected)

Usage

```
getCellProximityGeneScores(
  gobject,
  spatial_network_name = "spatial_network",
  cluster_column = "louvain_clus.1",
  selected_genes = NULL,
  expression_values = c("normalized", "scaled", "custom"),
  do_diff_test = TRUE,
  diff_test = c("t.test", "wilcox"),
  minimum_unique_cells = NA,
  fold_change_addendum = 0.1,
  in_two_directions = TRUE,
  exclude_selected_cells_from_test = F,
  verbose = T
)
```

Arguments

`gobject` giotto object

`spatial_network_name` name of spatial network to use

`cluster_column` name of column to use for clusters

`selected_genes` selection of genes to perform calculations for

`expression_values` expression values to use

`do_diff_test` perform differential test

`diff_test` which differential expression test

`minimum_unique_cells` minimum number of cells needed to proceed

`fold_change_addendum` constant to add when calculating log2 fold-change

`in_two_directions` shows enrichment in both directions: cell1-cell2, cell2-cell1

`exclude_selected_cells_from_test` exclude certain cells from test

`verbose` verbose

Details

Function to calculate if genes are differentially expressed in cell types when they interact (according to physical proximity) with other cell types. The results data.table contains the following columns:

- genes: All or selected list of tested genes
- cell_expr_1: average gene expression in cell type 1 from unified_int cell-cell interaction
- cell_expr_2: average gene expression in cell type 2 from unified_int cell-cell interaction
- comb_expr: combined average gene expression in cell type 1 and 2 from unified_int cell-cell interaction
- all_cell_expr_1: average gene expression for all cells from cell type 1
- all_cell_expr_2: average gene expression for all cells from cell type 2
- all_comb_expr: combined average gene expression for all cells from cell type 1 and 2
- pval_1: p-value from test between interacting cells and all cells from cell type 1
- pval_2: p-value from test between interacting cells and all cells from cell type 2
- cell_type_1: first cell type of cell-cell interaction
- cell_type_2: second cell type of cell-cell interaction
- interaction: the cell-cell interaction, based on physical proximity
- nr_1: number of cell type 1 in the unified cell-cell interaction
- nr_2: number of cell type 2 in the unified cell-cell interaction

- all_nr_1: number of all cell type 1 in the whole dataset
- all_nr_2: number of all cell type 2 in the whole dataset
- diff_spat: difference between comb_expr and all_comb_expr
- diff_spat_1: difference between cell_expr_1 and all_cell_expr_1
- diff_spat_2: difference between cell_expr_1 and all_cell_expr_1
- log2fc_spat_1: fold-change of diff_spat_1
- log2fc_spat_2: fold-change of diff_spat_2
- log2fc_spat: fold-change of diff_spat
- type_int: type of interaction
- unified_int: interaction with alphabetically sorted cell type 1 and cell type 2
- unif_int_rank: 1 or 2
- fdr_1: fdr from test between interacting cells and all cells from cell type 1
- fdr_2: fdr from test between interacting cells and all cells from cell type 2

Value

Cell Proximity Gene scores (CPGscores) in data.table format

Examples

```
getCellProximityGeneScores(gobject)
```

getClusterSimilarity *getClusterSimilarity*

Description

Creates data.table with pairwise correlation scores between each cluster.

Usage

```
getClusterSimilarity(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  cor = c("pearson", "spearman")
)
```

Arguments

gobject	giotto object
expression_values	expression values to use
cluster_column	name of column to use for clusters
cor	correlation score to calculate distance

Details

Creates data.table with pairwise correlation scores between each cluster and the group size (# of cells) for each cluster. This information can be used together with mergeClusters to combine very similar or small clusters into bigger clusters.

Value

data.table

Examples

```
getClusterSimilarity(gobject)
```

---

getDendrogramSplits *getDendrogramSplits*

Description

Split dendrogram at each node and keep the leave (label) information..

Usage

```
getDendrogramSplits(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  cor = c("pearson", "spearman"),
  distance = "ward.D",
  h = NULL,
  h_color = "red",
  show_dend = TRUE,
  verbose = TRUE
)
```

Arguments

gobject	giotto object
expression_values	expression values to use
cluster_column	name of column to use for clusters
cor	correlation score to calculate distance
distance	distance method to use for hierarchical clustering
h	height of horizontal lines to plot
h_color	color of horizontal lines
show_dend	show dendrogram
verbose	be verbose

Details

Creates a data.table with three columns and each row represents a node in the dendrogram. For each node the height of the node is given together with the two subdendrograms. This information can be used to determine in a hierarchical manner differentially expressed marker genes at each node.

Value

data.table object

Examples

```
getDendrogramSplits(gobject)
```

`getDistinctColors` *getDistinctColors*

Description

Returns a number of distint colors based on the RGB scale

Usage

```
getDistinctColors(n)
```

Arguments

n	number of colors wanted

Value

number of distinct colors

`getGeneToGeneScores` *getGeneToGeneScores*

Description

Compute gene-gene enrichment scores.

Usage

```
getGeneToGeneScores(
  CPGscore,
  selected_genes = NULL,
  specific_genes_1 = NULL,
  specific_genes_2 = NULL,
  min_cells = 5,
  min_fdr = 0.05,
  min_spat_diff = 0.2,
  min_log2_fc = 0.5,
  direction = c("both", "up", "down"),
  fold_change_addendum = 0.1,
  verbose = TRUE
)
```

Arguments

`CPGscore`	CPGscore, output from getCellProximityGeneScores()
`selected_genes`	select subset of genes
`specific_genes_1`	specific source genes (see details)
`specific_genes_2`	specific target genes (see details)
`min_cells`	min number of cells threshold
`min_spat_diff`	spatial difference threshold
`min_log2_fc`	log2 fold-change threshold
`direction`	up or downregulation or both
`fold_change_addendum`	constant to add when calculating log2 fold-change
`verbose`	verbose
`min_pval`	p-value threshold

Details

This converts the single gene cell proximityscores into pairwise combinations of genes, which allows you to determine if 2 genes are differentially expressed in interacting cell types.

Value

Gene to gene scores in data.table format

Examples

```
getGeneToGeneScores(CPGscore)
```

`get_cell_to_cell_sorted_name_conversion` *get_cell_to_cell_sorted_name_conversion*

Description

creates unified cell-cell interaction names

Usage

```
get_cell_to_cell_sorted_name_conversion(all_cell_types)
```

Examples

```
get_cell_to_cell_sorted_name_conversion()
```

get_interaction_gene_enrichment *get_interaction_gene_enrichment*

Description

Computes gene enrichment between all interactions

Usage

```
get_interaction_gene_enrichment(
  spatial_network,
  unified_int_col = "unified_int",
  source_col = "source_clus",
  source_IDs = "from",
  neighb_col = "neighb_clus",
  neighb_IDs = "to",
  expression_matrix,
  cell_annotation,
  annotation_ID = "uniq_ID",
  cell_type_col,
  do_diff_test = T,
  diff_test = c("t.test", "wilcox"),
  minimum_unique_cells = NA,
  exclude_selected_cells_from_test = T,
  verbose = T
)
```

Examples

```
get_interaction_gene_enrichment()
```

get_specific_interaction_gene_enrichment *get_specific_interaction_gene_enrichment*

Description

Computes gene enrichment between specified interaction

Usage

```
get_specific_interaction_gene_enrichment(
  sub_spatial_network,
  source_col = "source_clus",
  source_IDs = "from",
  neighb_col = "neighb_clus",
  neighb_IDs = "to",
  expression_matrix,
  interaction_name = "to_specify",
  cell_annotation,
  annotation_ID = "uniq_ID",
  cell_type_col,
  do_diff_test = T,
  diff_test = c("t.test", "wilcox"),
  minimum_unique_cells = NA,
  exclude_selected_cells_from_test = T
)
```

Examples

```
get_specific_interaction_gene_enrichment()
```

ggplot_save_function *ggplot_save_function*

Description

Function to automatically save plots to directory of interest

Usage

```
ggplot_save_function(
  gobject,
  plot_object,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  default_save_name = "giotto_plot",
  save_format = NULL,
  show_saved_plot = F,
  ncol = 1,
  nrow = 1,
  scale = 1,
  base_width = NULL,
  base_height = NULL,
  base_aspect_ratio = NULL,
  units = NULL,
  dpi = NULL,
  limitsize = TRUE,
  ...
)
```

Arguments

gobject	giotto object
plot_object	ggplot object to plot
save_dir	directory to save to
save_folder	folder in save_dir to save to

`save_name`	name of plot
`save_format`	format (e.g. png, tiff, pdf, ...)
`show_saved_plot`	load & display the saved plot
`ncol`	number of columns
`nrow`	number of rows
`scale`	scale
`base_width`	width
`base_height`	height
`base_aspect_ratio`	aspect ratio
`units`	units
`dpi`	Plot resolution
`limitsize`	When TRUE (the default), ggsave will not save images larger than 50x50 inches, to prevent the common error of specifying dimensions in pixels.

See Also

`cowplot::save_plot`

Examples

```
ggplot_save_function(gobject)
```

giotto-class *S4 giotto Class*

Description

Framework of giotto object to store and work with spatial expression data

Slots

`raw_exprs` raw expression counts

`norm_expr` normalized expression counts

`norm_scaled_expr` normalized and scaled expression counts

`custom_expr` custom normalized counts

`spatial_locs` spatial location coordinates for cells

`cell_metadata` metadata for cells

`gene_metadata` metadata for genes

`cell_ID` unique cell IDs

`gene_ID` unique gene IDs

`spatial_network` spatial network in data.table/data.frame format

`spatial_grid` spatial grid in data.table/data.frame format

`dimension_reduction` slot to save dimension reduction coordinates `nn_network` nearest neighbor network in igraph format

`parameters` slot to save parameters that have been used

`instructions` slot for global function instructions

`offset_file` offset file used to stitch together image fields

`OS_platform` Operating System to run Giotto analysis on

heatmSpatialCorGenes *heatmSpatialCorGenes*

Description

Create heatmap of spatially correlated genes

Usage

```
heatmSpatialCorGenes(
  gobject,
  spatCorObject,
  use_clus_name = NULL,
  show_cluster_annot = TRUE,
  show_row_dend = T,
  show_column_dend = F,
  show_row_names = F,
  show_column_names = F,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "heatmSpatialCorGenes",
  ...
)
```

Arguments

`gobject` giotto object

`spatCorObject` spatial correlation object

`use_clus_name` name of clusters to visualize (from clusterSpatialCorGenes())

`show_cluster_annot` show cluster annotation on top of heatmap

`show_row_dend` show row dendrogram

`show_column_dend` show column dendrogram

`show_row_names` show row names

`show_column_names` show column names

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
default save name for saving, don't change, change save_name in save_param

`...` additional parameters to the `Heatmap` function from ComplexHeatmap

Value

Heatmap generated by ComplexHeatmap

Examples

```
heatmSpatialCorGenes(gobject)
```

hyperGeometricEnrich *hyperGeometricEnrich*

Description

Function to calculate gene signature enrichment scores per spatial position using a hypergeometric test.

Usage

```
hyperGeometricEnrich(
  gobject,
  sign_matrix,
  expression_values = c("normalized", "scaled", "custom"),
  reverse_log_scale = TRUE,
  logbase = 2,
  output_enrichment = c("original", "zscore")
)
```

Arguments

`gobject` Giotto object

`sign_matrix` Matrix of signature genes for each cell type / process

`expression_values`
expression values to use

`reverse_log_scale`
reverse expression values from log scale

`logbase` log base to use if reverse_log_scale = TRUE

`output_enrichment`
how to return enrichment output

Details

The enrichment score is calculated based on the p-value from the hypergeometric test, -log10(p-value).

Value

data.table with enrichment results

Examples

```
hyperGeometricEnrich(gobject)
```

kmeans_binarize *kmeans_binarize*

Description

create binarized scores using kmeans

Usage

```
kmeans_binarize(x, nstart = 3, iter.max = 10)
```

loadHMRF *loadHMRF*

Description

load previous HMRF

Usage

```
loadHMRF(
  name_used = "test",
  output_folder_used,
  k_used = 10,
  betas_used,
  python_path_used
)
```

Arguments

name_used	name of HMRF that was run
output_folder_used	output folder that was used
k_used	number of HMRF domains that was tested
betas_used	betas that were tested
python_path_used	python path that was used

Details

Description of HMRF parameters ...

Value

reloads a previous ran HMRF from doHRMF

Examples

```
loadHMRF(gobject)
```

makeSignMatrixPAGE *makeSignMatrixPAGE*

Description

Function to convert a list of signature genes (e.g. for cell types or processes) into a binary matrix format that can be used with the PAGE enrichment option.

Usage

```
makeSignMatrixPAGE(sign_names, sign_list)
```

Arguments

sign_names	vector with names for each provided gene signature
sign_list	list of genes (signature)

Value

matrix

See Also

PAGEEnrich

Examples

```
makeSignMatrixPAGE()
```

makeSignMatrixRank *makeSignMatrixRank*

Description

Function to convert a single-cell count matrix and a corresponding single-cell cluster vector into a rank matrix that can be used with the Rank enrichment option.

Usage

```
makeSignMatrixRank(sc_matrix, sc_cluster_ids, gobject = NULL)
```

Arguments

`sign_names`	vector with names for each provided gene signature
`sign_list`	list of genes (signature)

Value

matrix

See Also

`rankEnrich`

Examples

```
makeSignMatrixRank()
```

`make_simulated_network` *make_simulated_network*

Description

Simulate random network.

Usage

```
make_simulated_network(
  gobject,
  spatial_network_name = "spatial_network",
  cluster_column,
  number_of_simulations = 100
)
```

Examples

```
make_simulated_network(gobject)
```

`mergeClusters` *mergeClusters*

Description

Merge selected clusters based on pairwise correlation scores and size of cluster.

Usage

```
mergeClusters(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  cor = c("pearson", "spearman"),
  new_cluster_name = "merged_cluster",
  min_cor_score = 0.8,
  max_group_size = 20,
  force_min_group_size = 10,
  return_gobject = TRUE,
  verbose = TRUE
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`cluster_column`	name of column to use for clusters
`cor`	correlation score to calculate distance
`new_cluster_name`	new name for merged clusters
`min_cor_score`	min correlation score to merge pairwise clusters
`max_group_size`	max cluster size that can be merged
`force_min_group_size`	size of clusters that will be merged with their most similar neighbor(s)
`return_gobject`	return giotto object
`verbose`	be verbose

Details

Merge selected clusters based on pairwise correlation scores and size of cluster. To avoid large clusters to merge the max_group_size can be lowered. Small clusters can be forcibly merged with their most similar pairwise cluster by adjusting the force_min_group_size parameter. Clusters smaller than this value will be merged independent on the provided min_cor_score value.
A giotto object is returned by default, if FALSE then the merging vector will be returned.

Value

Giotto object

Examples

```
mergeClusters(gobject)
```

mygini_fun *mygini_fun*

Description

calculate gini coefficient

Usage

```
mygini_fun(x, weights = rep(1, length(x)))
```

Value

gini coefficient

nnDT_to_kNN *nnDT_to_kNN*

Description

Convert a nearest network data.table to a kNN object

Usage

```
nnDT_to_kNN(nnDT)
```

Arguments

nnDT	nearest neighbor network in data.table format

Value

kNN object

node_clusters *node_clusters*

Description

Merge selected clusters based on pairwise correlation scores and size of cluster.

Usage

```
node_clusters(hclus_obj, verbose = TRUE)
```

Arguments

hclus_obj	hclus object
verbose	be verbose

Value

list of splitted dendrogram nodes from high to low node height

Examples

```
node_clusters(hclus_obj)
```

---

normalizeGiotto *normalizeGiotto*

Description

normalize and/or scale expresion values of Giotto object

Usage

```
normalizeGiotto(
  gobject,
  norm_methods = c("standard", "osmFISH"),
  library_size_norm = TRUE,
  scalefactor = 6000,
  log_norm = TRUE,
  logbase = 2,
  scale_genes = T,
  scale_cells = T,
  scale_order = c("first_genes", "first_cells"),
  verbose = F
)
```

Arguments

gobject	giotto object
norm_methods	normalization method to use
library_size_norm	normalize cells by library size
scalefactor	scale factor to use after library size normalization
log_norm	transform values to log-scale
logbase	log base to use to log normalize expression values
scale_genes	z-score genes over all cells
scale_cells	z-score cells over all genes
scale_order	order to scale genes and cells
verbose	be verbose

Details

Currently there are two 'methods' to normalize your raw counts data.

A. The standard method follows the standard protocol which can be adjusted using the provided parameters and follows the following order:

- 1. Data normalization for total library size and scaling by a custom scale-factor.
- 2. Log transformation of data.
- 3. Z-scoring of data by genes and/or cells.

B. The normalization method as provided by the osmFISH paper is also implemented:

- 1. First normalize genes, for each gene divide the counts by the total gene count and multiply by the total number of genes.
- 2. Next normalize cells, for each cell divide the normalized gene counts by the total counts per cell and multiply by the total number of cells.

This data will be saved in the Giotto slot for custom expression.

Value

giotto object

Examples

```
normalizeGiotto(gobject)
```

OR_function2 *OR_function2*

Description

calculate odds-ratio

Usage

```
OR_function2(A, B, C, D)
```

PAGEEnrich *PAGEEnrich*

Description

Function to calculate gene signature enrichment scores per spatial position using PAGE.

Usage

```
PAGEEnrich(
  gobject,
  sign_matrix,
  expression_values = c("normalized", "scaled", "custom"),
  reverse_log_scale = TRUE,
  logbase = 2,
  output_enrichment = c("original", "zscore")
)
```

Arguments

`gobject`	Giotto object
`sign_matrix`	Matrix of signature genes for each cell type / process
`expression_values`	expression values to use
`reverse_log_scale`	reverse expression values from log scale
`logbase`	log base to use if reverse_log_scale = TRUE
`output_enrichment`	how to return enrichment output

Details

sign_matrix: a binary matrix with genes as row names and cell-types as column names. Alternatively a list of signature genes can be provided to makeSignMatrixPAGE, which will create the matrix for you.

The enrichment Z score is calculated by using method (PAGE) from Kim SY et al., BMC bioinformatics, 2005 as $Z = ((Sm\check{}mu) * m^(1/2))/delta$. For each gene in each spot, mu is the fold change values versus the mean expression and delta is the standard deviation. Sm is the mean fold change value of a specific marker gene set and m is the size of a given marker gene set.

Value

data.table with enrichment results

See Also

makeSignMatrixPAGE

Examples

```
PAGEEnrich(gobject)
```

pDataDT *pDataDT*

Description

show cell metadata

Usage

```
pDataDT(gobject)
```

Arguments

gobject	giotto object

Value

data.table with cell metadata

Examples

```
pDataDT(gobject)
```

plotCPGscores *plotCPGscores*

Description

Create heatmap from cell-cell proximity scores

Usage

```
plotCPGscores(
  CPGscores,
  selected_interactions = NULL,
  selected_genes = NULL,
  detail_plot = T,
  simple_plot = F,
  simple_plot_facet = c("interaction", "genes"),
  facet_scales = "fixed",
  facet_ncol = length(selected_genes),
  facet_nrow = length(selected_interactions),
  show_plot = F
)
```

Arguments

`CPGscores`	CPGscores, output from getCellProximityGeneScores()
`selected_interactions`	interactions to show
`selected_genes`	genes to show
`detail_plot`	show detailed info in both interacting cell types
`simple_plot`	show a simplified plot
`simple_plot_facet`	facet on interactions or genes with simple plot
`facet_scales`	ggplot facet scales paramter
`facet_ncol`	ggplot facet ncol parameter
`facet_nrow`	ggplot facet nrow parameter
`show_plot`	show plot

Details

Give more details ...

Value

ggplot barplot

Examples

```
plotCPGscores(CPGscores)
```

`plotGTGscores` *plotGTGscores*

Description

Create heatmap from cell-cell proximity scores

Usage

```
plotGTGscores(
  gobject,
  GTGscore,
  selected_interactions = NULL,
  selected_gene_to_gene = NULL,
  detail_plot = T,
  simple_plot = F,
  simple_plot_facet = c("interaction", "genes"),
  facet_scales = "fixed",
  facet_ncol = length(selected_gene_to_gene),
  facet_nrow = length(selected_interactions),
  colors = c("blue", "red"),
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "plotGTGscores"
)
```

Arguments

`gobject` giotto object

`GTGscore` GTGscore, output from getGeneToGeneScores()

`selected_interactions` interactions to show

`detail_plot` show detailed info in both interacting cell types

`simple_plot` show a simplified plot

`simple_plot_facet` facet on interactions or genes with simple plot

`facet_scales` ggplot facet scales paramter

`facet_ncol` ggplot facet ncol parameter

`facet_nrow` ggplot facet nrow parameter

`colors` vector with 2 colors to represent respectively all and selected cells

`show_plot` show plots

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don't change, change save_name in save_param

`selected_genes` genes to show

Details

Give more details ...

Value

ggplot barplot

Examples

```
plotGTGscores(GTGscore)
```

plotHeatmap *plotHeatmap*

Description

Creates heatmap for genes and clusters.

Usage

```
plotHeatmap(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  cluster_column = NULL,
  cluster_order = c("size", "correlation", "custom"),
  cluster_custom_order = NULL,
  cluster_color_code = NULL,
  cluster_cor_method = "pearson",
  cluster_hclust_method = "ward.D",
  gene_order = c("custom", "correlation"),
  gene_custom_order = NULL,
  gene_cor_method = "pearson",
  gene_hclust_method = "complete",
  show_values = c("rescaled", "z-scaled", "original"),
  size_vertical_lines = 1.1,
  gradient_colors = c("blue", "yellow", "red"),
  gene_label_selection = NULL,
  axis_text_y_size = NULL,
  legend_nrows = 1,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "plotHeatmap"
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`genes`	genes to use
`cluster_column`	name of column to use for clusters
`cluster_order`	method to determine cluster order
`cluster_custom_order`	custom order for clusters
`cluster_color_code`	color code for clusters
`cluster_cor_method`	method for cluster correlation

`cluster_hclust_method`
method for hierarchical clustering of clusters

`gene_order` method to determine gene order

`gene_custom_order`
custom order for genes

`gene_cor_method`
method for gene correlation

`gene_hclust_method`
method for hierarchical clustering of genes

`show_values` which values to show on heatmap

`size_vertical_lines`
sizes for vertical lines

`gradient_colors`
colors for heatmap gradient

`gene_label_selection`
subset of genes to show on y-axis

`axis_text_y_size`
size for y-axis text

`legend_nrows` number of rows for the cluster legend

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
default save name

Details

If you want to display many genes there are 2 ways to proceed:

- 1. set axis_text_y_size to a really small value and show all genes
- 2. provide a subset of genes to display to gene_label_selection

Value

ggplot

Examples

```
plotHeatmap(gobject)
```

plotly_axis_scale_2D *plotly_axis_scale_2D*

Description

adjust the axis scale in 3D plotly plot

Usage

```
plotly_axis_scale_2D(
  cell_locations,
  sdimx = NULL,
  sdimy = NULL,
  mode = c("cube", "real", "custom"),
  custom_ratio = NULL
)
```

Arguments

`cell_locations`	spatial_loc in giotto object
`sdimx`	x axis of cell spatial location
`sdimy`	y axis of cell spatial location
`mode`	axis adjustment mode
`custom_ratio`	set the ratio artificially

Value

edges in spatial grid as data.table()

Examples

```
plotly_axis_scale_2D(gobject)
```

plotly_axis_scale_3D *plotly_axis_scale_3D*

Description

adjust the axis scale in 3D plotly plot

Usage

```
plotly_axis_scale_3D(
  cell_locations,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  mode = c("cube", "real", "custom"),
  custom_ratio = NULL
)
```

Arguments

`cell_locations`	spatial_loc in giotto object
`sdimx`	x axis of cell spatial location
`sdimy`	y axis of cell spatial location
`sdimz`	z axis of cell spatial location
`mode`	axis adjustment mode
`custom_ratio`	set the ratio artificially

Value

edges in spatial grid as data.table()

Examples

```
plotly_axis_scale_3D(gobject)
```

plotly_grid *plotly_grid*

Description

provide grid segment to draw in plot_ly()

Usage

```
plotly_grid(
  spatial_grid,
  x_start = "x_start",
  y_start = "y_start",
  x_end = "x_end",
  y_end = "y_end"
)
```

Arguments

`spatial_grid`	spatial_grid in giotto object

Value

edges in spatial grid as data.table()

Examples

```
plotly_grid(gobject)
```

plotly_network *plotly_network*

Description

provide network segment to draw in 3D plot_ly()

Usage

```
plotly_network(
  network,
  x = "sdimx_begin",
  y = "sdimy_begin",
  z = "sdimz_begin",
  x_end = "sdimx_end",
  y_end = "sdimy_end",
  z_end = "sdimz_end"
)
```

Arguments

gobject	network in giotto object

Value

edges in network as data.table()

Examples

```
    plotly_network(gobject)
```

plotMetaDataCellsHeatmap *plotMetaDataCellsHeatmap*

Description

Creates heatmap for numeric cell metadata within aggregated clusters.

Usage

```
plotMetaDataCellsHeatmap(
  gobject,
  metadata_cols = NULL,
  spat_enr_names = NULL,
  value_cols = NULL,
  first_meta_col = NULL,
  second_meta_col = NULL,
  show_values = c("zscores", "original", "zscores_rescaled"),
  custom_cluster_order = NULL,
  clus_cor_method = "pearson",
  clus_cluster_method = "complete",
  custom_values_order = NULL,
  values_cor_method = "pearson",
  values_cluster_method = "complete",
  midpoint = 0,
  x_text_size = 8,
  x_text_angle = 45,
  y_text_size = 8,
  strip_text_size = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "plotMetaDataCellsHeatmap"
)
```

Arguments

`gobject` giotto object

`metadata_cols` annotation columns found in pDataDT(gobject)

`spat_enr_names` spatial enrichment results to include

`value_cols` value columns to use

`first_meta_col` if more than 1 metadata column, select the x-axis factor

`second_meta_col` if more than 1 metadata column, select the facetting factor

`show_values` which values to show on heatmap

`custom_cluster_order` custom cluster order (default = NULL)

`clus_cor_method` correlation method for clusters

`clus_cluster_method` hierarchical cluster method for the clusters

`midpoint` midpoint of show_values

`x_text_size` size of x-axis text

`x_text_angle` angle of x-axis text

`y_text_size` size of y-axis text

`strip_text_size` size of strip text

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don't change, change save_name in save_param

`custom_gene_order` custom gene order (default = NULL)

`gene_cor_method`
: correlation method for genes

`gene_cluster_method`
: hierarchical cluster method for the genes

Details

Creates heatmap for the average values of selected value columns in the different annotation groups.

Value

ggplot or data.table

See Also

`plotMetaDataHeatmap` for gene expression instead of numeric cell annotation data.

Examples

```
plotMetaDataCellsHeatmap(gobject)
```

---

plotMetaDataHeatmap *plotMetaDataHeatmap*

Description

Creates heatmap for genes within aggregated clusters.

Usage

```
plotMetaDataHeatmap(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  metadata_cols = NULL,
  selected_genes = NULL,
  first_meta_col = NULL,
  second_meta_col = NULL,
  show_values = c("zscores", "original", "zscores_rescaled"),
  custom_cluster_order = NULL,
  clus_cor_method = "pearson",
  clus_cluster_method = "complete",
  custom_gene_order = NULL,
  gene_cor_method = "pearson",
  gene_cluster_method = "complete",
  midpoint = 0,
  x_text_size = 10,
  x_text_angle = 45,
  y_text_size = 10,
  strip_text_size = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "plotMetaDataHeatmap"
)
```

Arguments

gobject	giotto object
expression_values	expression values to use
metadata_cols	annotation columns found in pDataDT(gobject)
selected_genes	subset of genes to use
first_meta_col	if more than 1 metadata column, select the x-axis factor
second_meta_col	if more than 1 metadata column, select the facetting factor
show_values	which values to show on heatmap
custom_cluster_order	custom cluster order (default = NULL)
clus_cor_method	correlation method for clusters
clus_cluster_method	hierarchical cluster method for the clusters
custom_gene_order	custom gene order (default = NULL)
gene_cor_method	correlation method for genes
gene_cluster_method	hierarchical cluster method for the genes
midpoint	midpoint of show_values
x_text_size	size of x-axis text
x_text_angle	angle of x-axis text
y_text_size	size of y-axis text
strip_text_size	size of strip text
show_plot	show plot
return_plot	return ggplot object
save_plot	directly save the plot [boolean]
save_param	list of saving parameters from all_plots_save_function
default_save_name	default save name

Details

Creates heatmap for the average expression of selected genes in the different annotation/cluster groups

Value

ggplot or data.table

See Also

plotMetaDataCellsHeatmap for numeric cell annotation instead of gene expression.

Examples

```
plotMetaDataHeatmap(gobject)
```

---

plotPCA *plotPCA*

Description

Short wrapper for PCA visualization

Usage

```
plotPCA(gobject, dim_reduction_name = "pca", default_save_name = "PCA", ...)
```

Arguments

gobject	giotto object
dim_reduction_name	dimension reduction name
default_save_name	default save name for saving, don't change, change save_name in save_param
groub_by	create multiple plots based on cell annotation column
group_by_subset	subset the group_by factor column
dim1_to_use	dimension to use on x-axis
dim2_to_use	dimension to use on y-axis
spat_enr_names	names of spatial enrichment results to include
show_NN_network	show underlying NN network
nn_network_to_use	type of NN network to use (kNN vs sNN)
network_name	name of NN network to use, if show_NN_network = TRUE
cell_color	color for cells (see details)
color_as_factor	convert color column to factor
cell_color_code	named vector with colors
cell_color_gradient	vector with 3 colors for numeric data
gradient_midpoint	midpoint for color gradient
gradient_limits	vector with lower and upper limits

`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	size of not selected cells
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`show_legend`	show legend
`title`	title for plot, defaults to cell_color parameter
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`

Details

Description of parameters, see `dimPlot2D`. For 3D plots see `plotPCA_3D`

Value

ggplot

Examples

```
plotPCA(gobject)
```

plotPCA_2D *plotPCA_2D*

Description

Short wrapper for PCA visualization

Usage

```
plotPCA_2D(
  gobject,
  dim_reduction_name = "pca",
  default_save_name = "PCA_2D",
  ...
)
```

Arguments

`gobject`	giotto object
`dim_reduction_name`	dimension reduction name
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`groub_by`	create multiple plots based on cell annotation column
`group_by_subset`	subset the group_by factor column
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`spat_enr_names`	names of spatial enrichment results to include
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use, if show_NN_network = TRUE
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`cell_color_gradient`	vector with 3 colors for numeric data
`gradient_midpoint`	midpoint for color gradient
`gradient_limits`	vector with lower and upper limits
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter

`select_cells`	select subset of cells based on cell IDs
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	size of not selected cells
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`title`	title for plot, defaults to cell_color parameter
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`

Details

Description of parameters, see `dimPlot2D`. For 3D plots see `plotPCA_3D`

Value

ggplot

Examples

```
plotPCA_2D(gobject)
```

plotPCA_3D *plotPCA_3D*

Description

Visualize cells according to 3D PCA dimension reduction

Usage

```
plotPCA_3D(
  gobject,
  dim_reduction_name = "pca",
  default_save_name = "PCA_3D",
  ...
)
```

Arguments

`gobject` giotto object

`dim_reduction_name`
pca dimension reduction name

`default_save_name`
default save name for saving, ideally change save_name in save_param

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network`
show underlying NN network

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor`
convert color column to factor

`cell_color_code`
named vector with colors

`select_cell_groups`
select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells`
display not selected cells

`other_cell_color`
color of not selected cells

`other_point_size`
size of not selected cells

`show_cluster_center`
plot center of selected clusters

`show_center_label`
: plot label of selected clusters

`center_point_size`
: size of center points

`label_size`
: size of labels

`edge_alpha`
: column to use for alpha of the edges

`point_size`
: size of point (cell)

`show_legend`
: show legend

`show_plot`
: show plot

`return_plot`
: return ggplot object

`save_plot`
: directly save the plot [boolean]

`save_param`
: list of saving parameters from `all_plots_save_function`

Details

Description of parameters.

Value

plotly

Examples

```
plotPCA_3D(gobject)
```

`plotTSNE` *plotTSNE*

Description

Short wrapper for tSNE visualization

Usage

```
plotTSNE(gobject, dim_reduction_name = "tsne", default_save_name = "tSNE", ...)
```

Arguments

`gobject`
: giotto object

`dim_reduction_name`
: dimension reduction name

`default_save_name`
: default save name for saving, don't change, change save_name in save_param

`groub_by`
: create multiple plots based on cell annotation column

`group_by_subset`
: subset the group_by factor column

`dim1_to_use`
: dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`spat_enr_names` names of spatial enrichment results to include

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`cell_color_gradient` vector with 3 colors for numeric data

`gradient_midpoint` midpoint for color gradient

`gradient_limits` vector with lower and upper limits

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size` size of not selected cells

`show_cluster_center` plot center of selected clusters

`show_center_label` plot label of selected clusters

`center_point_size` size of center points

`label_size` size of labels

`label_fontface` font of labels

`edge_alpha` column to use for alpha of the edges

`point_shape` point with border or not (border or no_border)

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`title` title for plot, defaults to cell_color parameter

`show_legend` show legend

`legend_text` size of legend text

`axis_text` size of axis text

axis_title size of axis title

cow_n_col cowplot param: how many columns

cow_rel_h cowplot param: relative height

cow_rel_w cowplot param: relative width

cow_align cowplot param: how to align

show_plot show plot

return_plot return ggplot object

save_plot directly save the plot [boolean]

save_param list of saving parameters from all_plots_save_function

Details

Description of parameters, see dimPlot2D. For 3D plots see plotTSNE_3D

Value

ggplot

Examples

```
plotTSNE(gobject)
```

plotTSNE_2D *plotTSNE_2D*

Description

Short wrapper for tSNE visualization

Usage

```
plotTSNE_2D(
  gobject,
  dim_reduction_name = "tsne",
  default_save_name = "tSNE_2D",
  ...
)
```

Arguments

gobject giotto object

dim_reduction_name
dimension reduction name

default_save_name
default save name for saving, don’t change, change save_name in save_param

groub_by create multiple plots based on cell annotation column

group_by_subset
subset the group_by factor column

`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`spat_enr_names`	names of spatial enrichment results to include
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use, if show_NN_network = TRUE
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`cell_color_gradient`	vector with 3 colors for numeric data
`gradient_midpoint`	midpoint for color gradient
`gradient_limits`	vector with lower and upper limits
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	size of not selected cells
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`title`	title for plot, defaults to cell_color parameter
`show_legend`	show legend
`legend_text`	size of legend text

axis_text	size of axis text
axis_title	size of axis title
cow_n_col	cowplot param: how many columns
cow_rel_h	cowplot param: relative height
cow_rel_w	cowplot param: relative width
cow_align	cowplot param: how to align
show_plot	show plot
return_plot	return ggplot object
save_plot	directly save the plot [boolean]
save_param	list of saving parameters from all_plots_save_function

Details

Description of parameters, see dimPlot2D. For 3D plots see plotTSNE_3D

Value

ggplot

Examples

```
plotTSNE_2D(gobject)
```

plotTSNE_3D *plotTSNE_3D*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
plotTSNE_3D(
  gobject,
  dim_reduction_name = "tsne",
  default_save_name = "TSNE_3D",
  ...
)
```

Arguments

gobject	giotto object
dim_reduction_name	tsne dimension reduction name
default_save_name	default save name for saving, don’t change, change save_name in save_param
dim1_to_use	dimension to use on x-axis
dim2_to_use	dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size` size of not selected cells

`show_cluster_center` plot center of selected clusters

`show_center_label` plot label of selected clusters

`center_point_size` size of center points

`label_size` size of labels

`edge_alpha` column to use for alpha of the edges

`point_size` size of point (cell)

`show_legend` show legend

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

Details

Description of parameters.

Value

plotly

Examples

```
plotTSNE_3D(gobject)
```

plotUMAP *plotUMAP*

Description

Short wrapper for UMAP visualization

Usage

```
plotUMAP(gobject, dim_reduction_name = "umap", default_save_name = "UMAP", ...)
```

Arguments

`gobject` giotto object

`dim_reduction_name` dimension reduction name

`default_save_name` default save name for saving, don't change, change save_name in save_param

`groub_by` create multiple plots based on cell annotation column

`group_by_subset` subset the group_by factor column

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`spat_enr_names` names of spatial enrichment results to include

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`cell_color_gradient` vector with 3 colors for numeric data

`gradient_midpoint` midpoint for color gradient

`gradient_limits` vector with lower and upper limits

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size`	size of not selected cells
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`title`	title for plot, defaults to cell_color parameter
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`

Details

Description of parameters, see `dimPlot2D`. For 3D plots see `plotUMAP_3D`

Value

ggplot

Examples

```
plotUMAP(gobject)
```

plotUMAP_2D *plotUMAP_2D*

Description

Short wrapper for UMAP visualization

Usage

```
plotUMAP_2D(
  gobject,
  dim_reduction_name = "umap",
  default_save_name = "UMAP_2D",
  ...
)
```

Arguments

`gobject` giotto object

`dim_reduction_name` dimension reduction name

`default_save_name` default save name for saving, don't change, change save_name in save_param

`groub_by` create multiple plots based on cell annotation column

`group_by_subset` subset the group_by factor column

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`spat_enr_names` names of spatial enrichment results to include

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`cell_color_gradient` vector with 3 colors for numeric data

`gradient_midpoint` midpoint for color gradient

`gradient_limits` vector with lower and upper limits

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells`	select subset of cells based on cell IDs
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	size of not selected cells
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`title`	title for plot, defaults to cell_color parameter
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`

Details

Description of parameters, see `dimPlot2D`. For 3D plots see `plotUMAP_3D`

Value

ggplot

Examples

```
plotUMAP_2D(gobject)
```

plotUMAP_3D *plotUMAP_3D*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
plotUMAP_3D(
  gobject,
  dim_reduction_name = "umap",
  default_save_name = "UMAP_3D",
  ...
)
```

Arguments

`gobject` giotto object

`dim_reduction_name` umap dimension reduction name

`default_save_name` default save name for saving, don't change, change save_name in save_param

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size` size of not selected cells

`show_cluster_center` plot center of selected clusters

`show_center_label`
: plot label of selected clusters

`center_point_size`
: size of center points

`label_size`	size of labels
`edge_alpha`	column to use for alpha of the edges
`point_size`	size of point (cell)
`show_legend`	show legend
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`

Details

Description of parameters.

Value

plotly

Examples

```
plotUMAP_3D(gobject)
```

---

plot_network_layer_ggplot

plot_network_layer_ggplot

Description

Visualize cells in network layer according to dimension reduction coordinates

Usage

```
plot_network_layer_ggplot(
  ggobject,
  annotated_network_DT,
  edge_alpha = NULL,
  show_legend = T
)
```

Arguments

`annotated_network_DT`
: annotated network data.table of selected cells

`edge_alpha`	alpha of network edges
`show_legend`	show legend
`gobject`	giotto object

Details

Description of parameters.

Value

ggplot

Examples

```
plot_network_layer_ggplot(gobject)
```

`plot_point_layer_ggplot` *plot_point_layer_ggplot*

Description

Visualize cells in point layer according to dimension reduction coordinates

Usage

```
plot_point_layer_ggplot(
  ggobject,
  annotated_DT_selected,
  annotated_DT_other,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = 0,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_legend = T
)
```

Arguments

`annotated_DT_selected`	annotated data.table of selected cells
`annotated_DT_other`	annotated data.table of not selected cells
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`cell_color_gradient`	vector with 3 colors for numeric data
`gradient_midpoint`	midpoint for color gradient
`gradient_limits`	vector with lower and upper limits
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`edge_alpha`	column to use for alpha of the edges
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	size of not selected cells
`show_legend`	show legend
`gobject`	giotto object

Details

Description of parameters.

Value

ggplot

Examples

```
plot_point_layer_ggplot(gobject)
```

---

plot_point_layer_ggplot_noFILL
plot_point_layer_ggplot_noFILL

Description

Visualize cells in point layer according to dimension reduction coordinates without borders

Usage

```
plot_point_layer_ggplot_noFILL(
  ggobject,
  annotated_DT_selected,
  annotated_DT_other,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = 0,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_size = 1,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_legend = T
)
```

Arguments

`annotated_DT_selected`
annotated data.table of selected cells

`annotated_DT_other`
annotated data.table of not selected cells

`cell_color` color for cells (see details)

`color_as_factor`
convert color column to factor

`cell_color_code`
named vector with colors

`cell_color_gradient`
: vector with 3 colors for numeric data

`gradient_midpoint`
: midpoint for color gradient

`gradient_limits`
: vector with lower and upper limits

`select_cell_groups`
: select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`point_size` size of point (cell)

`show_cluster_center`
: plot center of selected clusters

`show_center_label`
: plot label of selected clusters

`center_point_size`
: size of center points

`label_size` size of labels

`label_fontface` font of labels

`edge_alpha` column to use for alpha of the edges

`show_other_cells`
: display not selected cells

`other_cell_color`
: color of not selected cells

`other_point_size`
: size of not selected cells

`show_legend` show legend

`gobject` giotto object

Details

Description of parameters.

Value

ggplot

Examples

```
plot_point_layer_ggplot_noFILL(gobject)
```

plot_spat_point_layer_ggplot *plot_spat_point_layer_ggplot*

Description

creat ggplot point layer for spatial coordinates

Usage

```
plot_spat_point_layer_ggplot(
  ggobject,
  sdimx = NULL,
  sdimy = NULL,
  cell_locations_metadata_selected,
  cell_locations_metadata_other,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_size = 2,
  point_border_col = "lightgrey",
  point_border_stroke = 0.1,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  show_legend = TRUE
)
```

Arguments

`sdimx` x-axis dimension name (default = 'sdimx')

`sdimy` y-axis dimension name (default = 'sdimy')

`cell_locations_metadata_selected`
annotated location from selected cells

`cell_locations_metadata_other`
annotated location from non-selected cells

`cell_color` color for cells (see details)

`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`cell_color_gradient`	vector with 3 colors for numeric data
`gradient_midpoint`	midpoint for color gradient
`gradient_limits`	vector with lower and upper limits
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`show_other_cells`	display not selected cells
`other_cell_color`	color for not selected cells
`other_point_size`	point size for not selected cells
`show_legend`	show legend
`gobject`	giotto object

Details

Description of parameters.

Value

ggplot

Examples

```
plot_spat_point_layer_ggplot(gobject)
```

plot_spat_point_layer_ggplot_noFILL
plot_spat_point_layer_ggplot_noFILL

Description

creat ggplot point layer for spatial coordinates without borders

Usage

```
plot_spat_point_layer_ggplot_noFILL(
  ggobject,
  sdimx = NULL,
  sdimy = NULL,
  cell_locations_metadata_selected,
  cell_locations_metadata_other,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_size = 2,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 4,
  label_fontface = "bold",
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  show_legend = TRUE
)
```

Arguments

`sdimx` x-axis dimension name (default = 'sdimx')

`sdimy` y-axis dimension name (default = 'sdimy')

`cell_locations_metadata_selected`
annotated location from selected cells

`cell_locations_metadata_other`
annotated location from non-selected cells

`cell_color` color for cells (see details)

`color_as_factor`
convert color column to factor

`cell_color_code`
named vector with colors

`cell_color_gradient`
vector with 3 colors for numeric data

`gradient_midpoint`
midpoint for color gradient

`gradient_limits`
vector with lower and upper limits

`select_cell_groups`
select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`point_size` size of point (cell)

`show_cluster_center`
plot center of selected clusters

`show_center_label`
plot label of selected clusters

`center_point_size`
size of center points

`label_size` size of labels

`label_fontface` font of labels

`show_other_cells`
display not selected cells

`other_cell_color`
color for not selected cells

`other_point_size`
point size for not selected cells

`show_legend` show legend

`gobject` giotto object

Details

Description of parameters.

Value

ggplot

Examples

```
plot_spat_point_layer_ggplot_noFILL(gobject)
```

`print.giotto` *print method for giotto class*

Description

print method for giotto class. Prints the chosen number of genes (rows) and cells (columns) from the raw count matrix. Also print the spatial locations for the chosen number of cells.

Usage

```
print.giotto(object, ...)
```

Arguments

`nr_genes`	number of genes (rows) to print
`nr_cells`	number of cells (columns) to print

---

rankEnrich *rankEnrich*

Description

Function to calculate gene signature enrichment scores per spatial position using a rank based approach.

Usage

```
rankEnrich(
  gobject,
  sign_matrix,
  expression_values = c("normalized", "scaled", "custom"),
  reverse_log_scale = TRUE,
  logbase = 2,
  output_enrichment = c("original", "zscore")
)
```

Arguments

`gobject`	Giotto object
`sign_matrix`	Matrix of signature genes for each cell type / process
`expression_values`	expression values to use
`reverse_log_scale`	reverse expression values from log scale
`logbase`	log base to use if reverse_log_scale = TRUE
`output_enrichment`	how to return enrichment output

Details

sign_matrix: a rank-fold matrix with genes as row names and cell-types as column names. Alternatively a scRNA-seq matrix and vector with clusters can be provided to makeSignMatrixRank, which will create the matrix for you.

First a new rank is calculated as R = (R1*R2)^(1/2), where R1 is the rank of fold-change for each gene in each spot and R2 is the rank of each marker in each cell type. The Rank-Biased Precision is then calculated as: RBP = (1 - 0.99) * (0.99)^(R - 1) and the final enrichment score is then calculated as the sum of top 100 RBPs.

Value

data.table with enrichment results

See Also

makeSignMatrixRank

Examples

```
rankEnrich(gobject)
```

---

rankSpatialCorGroups *rankSpatialCorGroups*

Description

Rank spatial correlated clusters according to correlation structure

Usage

```
rankSpatialCorGroups(
  gobject,
  spatCorObject,
  use_clus_name = NULL,
  show_plot = NA,
  return_plot = FALSE,
  save_plot = NA,
  save_param = list(),
  default_save_name = "rankSpatialCorGroups"
)
```

Arguments

gobject	giotto object
spatCorObject	spatial correlation object
use_clus_name	name of clusters to visualize (from clusterSpatialCorGenes())
show_plot	show plot
return_plot	return ggplot object
save_plot	directly save the plot [boolean]
save_param	list of saving parameters from all_plots_save_function
default_save_name	default save name for saving, don't change, change save_name in save_param

Value

data.table with positive (within group) and negative (outside group) scores

Examples

```
rankSpatialCorGroups(gobject)
```

rank_binarize *rank_binarize*

Description

create binarized scores using arbitrary rank of top genes

Usage

```
rank_binarize(x, max_rank = 200)
```

readGiottoInstructions *readGiottoInstrunctions*

Description

Retrieves the instruction associated with the provided parameter

Usage

```
readGiottoInstructions(giotto_instructions, param = NULL)
```

Arguments

`giotto_instructions`
giotto object or result from createGiottoInstructions()

`param` parameter to retrieve

Value

specific parameter

Examples

```
    readGiottoInstrunctions()
```

removeCellAnnotation *removeCellAnnotation*

Description

removes cell annotation of giotto object

Usage

```
removeCellAnnotation(gobject, columns = NULL, return_gobject = TRUE)
```

Arguments

gobject	giotto object
columns	names of columns to remove
return_gobject	boolean: return giotto object (default = TRUE)

Details

if return_gobject = FALSE, it will return the cell metadata

Value

giotto object

Examples

```
removeCellAnnotation(gobject)
```

removeGeneAnnotation *removeGeneAnnotation*

Description

removes gene annotation of giotto object

Usage

```
removeGeneAnnotation(gobject, columns = NULL, return_gobject = TRUE)
```

Arguments

gobject	giotto object
columns	names of columns to remove
return_gobject	boolean: return giotto object (default = TRUE)

Details

if return_gobject = FALSE, it will return the gene metadata

Value

giotto object

Examples

```
removeGeneAnnotation(gobject)
```

replaceGiottoInstructions *replaceGiottoInstructions*

Description

Function to replace all instructions from giotto object

Usage

```
replaceGiottoInstructions(gobject, instructions = NULL)
```

Arguments

gobject	giotto object
instructions	new instructions (e.g. result from createGiottoInstructions)

Value

named vector with giotto instructions

Examples

```
replaceGiottoInstructions()
```

runPCA *runPCA*

Description

runs a Principal Component Analysis

Usage

```
runPCA(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  reduction = c("cells", "genes"),
  name = "pca",
  genes_to_use = NULL,
  return_gobject = TRUE,
  scale_unit = F,
  ncp = 200,
  ...
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`reduction`	cells or genes
`name`	arbitrary name for PCA run
`genes_to_use`	subset of genes to use for PCA
`return_gobject`	boolean: return giotto object (default = TRUE)
`scale_unit`	scale features before PCA
`ncp`	number of principal components to calculate
`...`	additional parameters for PCA (see details)

Details

See PCA for more information about other parameters.

Value

giotto object with updated PCA dimension recuction

Examples

```
runPCA(gobject)
```

---

runtSNE *runtSNE*

Description

run tSNE

Usage

```
runtSNE(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  reduction = c("cells", "genes"),
  dim_reduction_to_use = "pca",
  dim_reduction_name = "pca",
  dimensions_to_use = 1:10,
  name = "tsne",
  genes_to_use = NULL,
  return_gobject = TRUE,
  dims = 2,
  perplexity = 30,
  theta = 0.5,
  do_PCA_first = F,
  set_seed = T,
  seed_number = 1234,
  ...
)
```

Arguments

`gobject` giotto object

`expression_values` expression values to use

`reduction` cells or genes

`dim_reduction_to_use` use another dimension reduction set as input

`dim_reduction_name` name of dimension reduction set to use

`dimensions_to_use` number of dimensions to use as input

`name` arbitrary name for tSNE run

`genes_to_use` if dim_reduction_to_use = NULL, which genes to use

`return_gobject` boolean: return giotto object (default = TRUE)

`dims` tSNE param: number of dimensions to return

`perplexity` tSNE param: perplexity

`theta` tSNE param: theta

`do_PCA_first` tSNE param: do PCA before tSNE (default = FALSE)

`set_seed` use of seed

`seed_number` seed number to use

`...` additional tSNE parameters

Details

See `Rtsne` for more information about these and other parameters.

- Input for tSNE dimension reduction can be another dimension reduction (default = 'pca')
- To use gene expression as input set dim_reduction_to_use = NULL
- multiple tSNE results can be stored by changing the *name* of the analysis

Value

giotto object with updated tSNE dimension recuction

Examples

```
runtSNE(gobject)
```

runUMAP *runUMAP*

Description

run UMAP

Usage

```
runUMAP(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  reduction = c("cells", "genes"),
  dim_reduction_to_use = "pca",
  dim_reduction_name = "pca",
  dimensions_to_use = 1:10,
  name = "umap",
  genes_to_use = NULL,
  return_gobject = TRUE,
  n_neighbors = 40,
  n_components = 2,
  n_epochs = 400,
  min_dist = 0.01,
  n_threads = 1,
  spread = 5,
  set_seed = T,
  seed_number = 1234,
  ...
)
```

Arguments

`gobject` giotto object

`expression_values` expression values to use

`reduction` cells or genes

`dim_reduction_to_use` use another dimension reduction set as input

`dim_reduction_name` name of dimension reduction set to use

`dimensions_to_use` number of dimensions to use as input

`name` arbitrary name for UMAP run

`genes_to_use` if dim_reduction_to_use = NULL, which genes to use

`return_gobject` boolean: return giotto object (default = TRUE)

`n_neighbors` UMAP param: number of neighbors

`n_components` UMAP param: number of components

`n_epochs` UMAP param: number of epochs

`min_dist`	UMAP param: minimum distance
`n_threads`	UMAP param: threads to use
`spread`	UMAP param: spread
`set_seed`	use of seed
`seed_number`	seed number to use
`...`	additional UMAP parameters

Details

See `umap` for more information about these and other parameters.

- Input for UMAP dimension reduction can be another dimension reduction (default = 'pca')
- To use gene expression as input set dim_reduction_to_use = NULL
- multiple UMAP results can be stored by changing the *name* of the analysis

Value

giotto object with updated UMAP dimension recuction

Examples

```
runUMAP(gobject)
```

`selectPatternGenes` *selectPatternGenes*

Description

Select genes correlated with spatial patterns

Usage

```
selectPatternGenes(
  spatPatObj,
  dimensions = 1:5,
  top_pos_genes = 10,
  top_neg_genes = 10,
  min_pos_cor = 0.5,
  min_neg_cor = -0.5,
  return_top_selection = FALSE
)
```

Arguments

`spatPatObj`	Output from detectSpatialPatterns
`dimensions`	dimensions to identify correlated genes for.
`top_pos_genes`	Top positively correlated genes.
`top_neg_genes`	Top negatively correlated genes.
`min_pos_cor`	Minimum positive correlation score to include a gene.
`min_neg_cor`	Minimum negative correlation score to include a gene.

Details

Description.

Value

Data.table with genes associated with selected dimension (PC).

Examples

```
selectPatternGenes(gobject)
```

`select_expression_values` *select_expression_values*

Description

helper function to select expression values

Usage

```
select_expression_values(gobject, values)
```

Arguments

`gobject`	giotto object
`values`	expression values to extract

Value

expression matrix

`show,giotto-method` *show method for giotto class*

Description

show method for giotto class

Usage

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

showClusterDendrogram *showClusterDendrogram*

Description

Creates dendrogram for selected clusters.

Usage

```
showClusterDendrogram(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  cluster_column,
  cor = c("pearson", "spearman"),
  distance = "ward.D",
  h = NULL,
  h_color = "red",
  rotate = FALSE,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "showClusterDendrogram",
  ...
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`cluster_column`	name of column to use for clusters
`cor`	correlation score to calculate distance
`distance`	distance method to use for hierarchical clustering
`h`	height of horizontal lines to plot
`h_color`	color of horizontal lines
`rotate`	rotate dendrogram 90 degrees
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don’t change, change save_name in save_param
`...`	additional parameters for ggdendrogram()

Details

Expression correlation dendrogram for selected clusters.

Value

ggplot

Examples

```
showClusterDendrogram(gobject)
```

---

showClusterHeatmap *showClusterHeatmap*

Description

Creates heatmap based on identified clusters

Usage

```
showClusterHeatmap(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes = "all",
  cluster_column,
  cor = c("pearson", "spearman"),
  distance = "ward.D",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "showClusterHeatmap",
  ...
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`genes`	vector of genes to use, default to 'all'
`cluster_column`	name of column to use for clusters
`cor`	correlation score to calculate distance
`distance`	distance method to use for hierarchical clustering
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`...`	additional parameters for the Heatmap function from ComplexHeatmap

Details

Correlation heatmap of selected clusters.

Value

ggplot

Examples

```
showClusterHeatmap(gobject)
```

`showCPGscores` *showCPGscores*

Description

visualize Cell Proximity Gene enrichment scores

Usage

```
showCPGscores(
  gobject,
  CPGscore,
  method = c("volcano", "cell_barplot", "cell-cell", "cell_sankey"),
  min_cells = 5,
  min_fdr = 0.05,
  min_spat_diff = 0.2,
  min_log2_fc = 0.5,
  keep_int_duplicates = TRUE,
  direction = c("both", "up", "down"),
  cell_color_code = NULL,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "showCPGscores"
)
```

Arguments

`CPGscore`	CPGscore, output from getCellProximityGeneScores()
`method`	visualization method
`min_cells`	min number of cells threshold
`min_fdr`	fdr threshold
`min_spat_diff`	spatial difference threshold
`min_log2_fc`	min log2 fold-change
`keep_int_duplicates`	keep both cell_A-cell_B and cell_B-cell_A
`direction`	up or downregulation or both

`cell_color_code`
: color code for cell types

`show_plot`
: show plot

`return_plot`
: return ggplot object

`save_plot`
: directly save the plot [boolean]

`save_param`
: list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don't change, change save_name in save_param

Details

Give more details ...

Value

Gene to gene scores in data.table format

Examples

```
showCPGscores(CPGscore)
```

`showGeneExpressionProximityScore`

showGeneExpressionProximityScore

Description

Create heatmap from cell-cell proximity scores

Usage

```
showGeneExpressionProximityScore(
  scores,
  selected_gene,
  sort_column = "diff_spat"
)
```

Arguments

`scores`
: CPscore, output from getAverageCellProximityGeneScores()

`selected_gene`
: gene to show

`sort_column`
: column name to use for sorting

Details

Give more details ...

Value

ggplot barplot

Examples

```
showGeneExpressionProximityScore(scores)
```

---

showGiottoInstructions *showGiottoInstructions*

Description

Function to display all instructions from giotto object

Usage

```
showGiottoInstructions(gobject)
```

Arguments

gobject	giotto object

Value

named vector with giotto instructions

Examples

```
showGiottoInstructions()
```

---

showGTGscores *showGTGscores*

Description

visualize Cell Proximity Gene enrichment scores

Usage

```
showGTGscores(
  GTGscore,
  method = c("cell_barplot", "cell-cell", "cell_sankey"),
  min_cells = 5,
  min_pval = 0.05,
  min_spat_diff = 0.2,
  min_log2_fc = 0.5,
  direction = c("both", "up", "down"),
  cell_color_code = NULL,
  show_plot = T,
  specific_genes_1 = NULL,
  specific_genes_2 = NULL,
  first_cell_name = "ligand cell",
  second_cell_name = "receptor cell",
  return_DT = F
)
```

Arguments

`method`	visualization method
`min_cells`	min number of cells threshold
`min_pval`	p-value threshold
`min_spat_diff`	spatial difference threshold
`min_log2_fc`	log2 fold-change threshold
`direction`	up or downregulation or both
`cell_color_code`	color code for cell types
`show_plot`	print plot
`specific_genes_1`	subset of genes, matched with specific_genes_2
`specific_genes_2`	subset of genes, matched with specific_genes_1
`first_cell_name`	name for first cells
`second_cell_name`	name for second cells
`CPGscore`	CPGscore, output from getCellProximityGeneScores()

Details

Give more details ...

Value

ggplot

Examples

```
showGTGscores(CPGscore)
```

showIntExpressionProximityScore

showIntExpressionProximityScore

Description

Create heatmap from cell-cell proximity scores

Usage

```
showIntExpressionProximityScore(
  scores,
  selected_interaction,
  sort_column = "diff_spat",
  show_enriched_n = 5,
  show_depleted_n = 5
)
```

Arguments

`scores` scores, output from getAverageCellProximityGeneScores()

`selected_interaction` interaction to show

`sort_column` column name to use for sorting

`show_enriched_n` show top enriched interactions

`show_depleted_n` show top depleted interactions

Details

Give more details ...

Value

ggplot barplot

Examples

```
showIntExpressionProximityScore(scores)
```

`showPattern` *showPattern*

Description

show patterns for 2D spatial data

Usage

```
showPattern(gobject, spatPatObj, ...)
```

Arguments

`gobject` giotto object

`spatPatObj` Output from detectSpatialPatterns

`dimension` dimension to plot

`trim` Trim ends of the PC values.

`background_color` background color for plot

`grid_border_color` color for grid

`show_legend` show legend of ggplot

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don’t change, change save_name in save_param

Value

ggplot

See Also

showPattern2D

Examples

```
showPattern(gobject)
```

---

showPattern2D *showPattern2D*

Description

show patterns for 2D spatial data

Usage

```
showPattern2D(
  gobject,
  spatPatObj,
  dimension = 1,
  trim = c(0.02, 0.98),
  background_color = "white",
  grid_border_color = "grey",
  show_legend = T,
  point_size = 1,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "showPattern2D"
)
```

Arguments

`gobject`	giotto object
`spatPatObj`	Output from detectSpatialPatterns
`dimension`	dimension to plot
`trim`	Trim ends of the PC values.
`background_color`	background color for plot
`grid_border_color`	color for grid
`show_legend`	show legend of ggplot
`show_plot`	show plot
`return_plot`	return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don't change, change save_name in save_param

Value

ggplot

Examples

```
showPattern2D(gobject)
```

`showPattern3D` *showPattern3D*

Description

show patterns for 3D spatial data

Usage

```
showPattern3D(
  gobject,
  spatPatObj,
  dimension = 1,
  trim = c(0.02, 0.98),
  background_color = "white",
  grid_border_color = "grey",
  show_legend = T,
  point_size = 1,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "showPattern3D"
)
```

Arguments

`gobject` giotto object

`spatPatObj` Output from detectSpatialPatterns

`dimension` dimension to plot

`trim` Trim ends of the PC values.

`background_color` background color for plot

grid_border_color	color for grid
show_legend	show legend of plot
point_size	adjust the point size
axis_scale	scale the axis
custom_ratio	cutomize the scale of the axis
x_ticks	the tick number of x_axis
y_ticks	the tick number of y_axis
z_ticks	the tick number of z_axis
show_plot	show plot
return_plot	return plot object
save_plot	directly save the plot [boolean]
save_param	list of saving parameters from all_plots_save_function
default_save_name	default save name for saving, don't change, change save_name in save_param

Value

plotly

Examples

```
showPattern3D(gobject)
```

---

showPatternGenes *showPatternGenes*

Description

show genes correlated with spatial patterns

Usage

```
showPatternGenes(
  gobject,
  spatPatObj,
  dimension = 1,
  top_pos_genes = 5,
  top_neg_genes = 5,
  point_size = 1,
  return_DT = FALSE,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "showPatternGenes"
)
```

Arguments

`gobject`	giotto object
`spatPatObj`	Output from detectSpatialPatterns
`dimension`	dimension to plot genes for.
`top_pos_genes`	Top positively correlated genes.
`top_neg_genes`	Top negatively correlated genes.
`point_size`	size of points
`return_DT`	if TRUE, it will return the data.table used to generate the plots
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from all_plots_save_function()
`default_save_name`	default save name for saving, don't change, change save_name in save_param

Value

ggplot

Examples

```
showPatternGenes(gobject)
```

`showProcessingSteps` *showProcessingSteps*

Description

shows the sequential processing steps that were performed in a summarized format

Usage

```
showProcessingSteps(gobject)
```

Arguments

`gobject`	giotto object

Value

list of processing steps and names

Examples

```
showProcessingSteps(gobject)
```

showSpatialCorGenes *showSpatialCorGenes*

Description

Shows and filters spatially correlated genes

Usage

```
showSpatialCorGenes(
  spatCorObject,
  use_clus_name = NULL,
  selected_clusters = NULL,
  genes = NULL,
  min_spat_cor = 0.5,
  min_expr_cor = NULL,
  min_cor_diff = NULL,
  min_rank_diff = NULL,
  show_top_genes = NULL
)
```

Arguments

spatCorObject	spatial correlation object
use_clus_name	cluster information to show
selected_clusters	subset of clusters to show
genes	subset of genes to show
min_spat_cor	filter on minimum spatial correlation
min_expr_cor	filter on minimum single-cell expression correlation
min_cor_diff	filter on minimum correlation difference (spatial vs expression)
min_rank_diff	filter on minimum correlation rank difference (spatial vs expression)
show_top_genes	show top genes per gene

Value

data.table with filtered information

Examples

```
showSpatialCorGenes(gobject)
```

showTopGeneToGene *showTopGeneToGene*

Description

Show enriched/depleted gene-gene enrichments

Usage

```
showTopGeneToGene(
  GTGscore,
  top_interactions = 10,
  direction = c("increased", "decreased"),
  complement_data = T,
  subset_cell_ints = NULL,
  subset_genes = NULL
)
```

Arguments

`GTGscore`	GTGscore, output from getGeneToGeneScores()
`top_interactions`	number of top gene-gene enrichments to show
`direction`	show top increased or decreased gene-gene enrichments
`complement_data`	include non-enriched gene-gene scores from other cell-cell interactions
`subset_cell_ints`	subset cell-cell interactions to show
`subset_genes`	subset genes to show

Details

Give more details ...

Value

ggplot barplot

Examples

```
showTopGeneToGene(scores)
```

signPCA *signPCA*

Description

identify significant prinicipal components (PCs)

Usage

```
signPCA(
  gobject,
  method = c("screeplot", "jackstraw"),
  expression_values = c("normalized", "scaled", "custom"),
  reduction = c("cells", "genes"),
  genes_to_use = NULL,
  scale_unit = T,
  ncp = 50,
  scree_labels = T,
  scree_ylim = c(0, 10),
  jack_iter = 10,
  jack_threshold = 0.01,
  jack_verbose = T,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "signPCA",
  ...
)
```

Arguments

gobject	giotto object
method	method to use to identify significant PCs
expression_values	expression values to use
reduction	cells or genes
genes_to_use	subset of genes to use for PCA
scale_unit	scale features before PCA
ncp	number of principal components to calculate
scree_labels	show labels on scree plot
scree_ylim	y-axis limits on scree plot
jack_iter	number of interations for jackstraw
jack_threshold	p-value threshold to call a PC significant
jack_verbose	show progress of jackstraw method
show_plot	show plot
return_plot	return ggplot object

`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from all_plots_save_function()
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`...`	additional parameters for PCA

Details

Two different methods can be used to assess the number of relevant or significant prinicipal components (PC's).
1. Screeplot works by plotting the explained variance of each individual PC in a barplot allowing you to identify which PC does not show a significant contribution anymore (= 'elbow method').
2. The Jackstraw method uses the `permutationPA` function. By systematically permuting genes it identifies robust, and thus significant, PCs.
multiple PCA results can be stored by changing the *name* parameter

Value

ggplot object for scree method and maxtrix of p-values for jackstraw

Examples

```
signPCA(gobject)
```

`spatCellPlot` *spatCellPlot*

Description

Visualize cells according to spatial coordinates

Usage

```
spatCellPlot(
  gobject,
  sdimx = "sdimx",
  sdimy = "sdimy",
  spat_enr_names = NULL,
  cell_annotation_values,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_cluster_center = F,
  show_center_label = F,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  show_network = F,
  spatial_network_name = "spatial_network",
  network_color = NULL,
  network_alpha = 1,
  show_grid = F,
  spatial_grid_name = "spatial_grid",
  grid_color = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  other_cells_alpha = 0.1,
  coord_fix_ratio = NULL,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatCellPlot"
)
```

Arguments

`gobject` giotto object

`sdimx` x-axis dimension name (default = 'sdimx')

`sdimy` y-axis dimension name (default = 'sdimy')

`spat_enr_names` names of spatial enrichment results to include

`cell_annotation_values`
numeric cell annotation columns

`cell_color_gradient`
vector with 3 colors for numeric data

`gradient_midpoint`
midpoint for color gradient

`gradient_limits`
vector with lower and upper limits

`select_cell_groups`
select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`point_size` size of point (cell)

`point_border_col`
color of border around points

`point_border_stroke`	stroke size of border around points
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`show_network`	show underlying spatial network
`spatial_network_name`	name of spatial network to use
`network_color`	color of spatial network
`network_alpha`	alpha of spatial network
`show_grid`	show spatial grid
`spatial_grid_name`	name of spatial grid to use
`grid_color`	color of spatial grid
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	point size of not selected cells
`other_cells_alpha`	alpha of not selected cells
`coord_fix_ratio`	fix ratio between x and y-axis
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

Examples

```
spatCellPlot(gobject)
```

`spatCellPlot2D` *spatCellPlot2D*

Description

Visualize cells according to spatial coordinates

Usage

```
spatCellPlot2D(
  gobject,
  sdimx = "sdimx",
  sdimy = "sdimy",
  spat_enr_names = NULL,
  cell_annotation_values,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_cluster_center = F,
  show_center_label = F,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  show_network = F,
  spatial_network_name = "spatial_network",
  network_color = NULL,
  network_alpha = 1,
  show_grid = F,
  spatial_grid_name = "spatial_grid",
  grid_color = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  other_cells_alpha = 0.1,
  coord_fix_ratio = NULL,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatCellPlot2D"
)
```

Arguments

`gobject` giotto object

`sdimx` x-axis dimension name (default = 'sdimx')

`sdimy` y-axis dimension name (default = 'sdimy')

`spat_enr_names` names of spatial enrichment results to include

`cell_annotation_values` numeric cell annotation columns

`cell_color_gradient` vector with 3 colors for numeric data

`gradient_midpoint` midpoint for color gradient

`gradient_limits` vector with lower and upper limits

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`show_cluster_center` plot center of selected clusters

`show_center_label` plot label of selected clusters

`center_point_size` size of center points

`label_size` size of labels

`label_fontface` font of labels

`show_network` show underlying spatial network

`spatial_network_name` name of spatial network to use

`network_color` color of spatial network

`network_alpha` alpha of spatial network

`show_grid` show spatial grid

`spatial_grid_name` name of spatial grid to use `grid_color` color of spatial grid

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size` point size of not selected cells

`other_cells_alpha` alpha of not selected cells

`coord_fix_ratio` fix ratio between x and y-axis

`show_legend` show legend

`legend_text` size of legend text

`axis_text` size of axis text

`axis_title` size of axis title

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don’t change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

Examples

```
spatCellPlot2D(gobject)
```

`spatDimCellPlot` *spatDimCellPlot*

Description

Visualize numerical features of cells according to spatial AND dimension reduction coordinates in 2D

Usage

```
spatDimCellPlot(
  gobject,
  plot_alignment = c("vertical", "horizontal"),
  spat_enr_names = NULL,
  cell_annotation_values,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  sdimx = "sdimx",
  sdimy = "sdimy",
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  dim_point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  spat_point_size = 1,
  spat_point_border_col = "black",
  spat_point_border_stroke = 0.1,
  dim_show_cluster_center = F,
  dim_show_center_label = T,
  dim_center_point_size = 4,
  dim_center_point_border_col = "black",
  dim_center_point_border_stroke = 0.1,
  dim_label_size = 4,
  dim_label_fontface = "bold",
  spat_show_cluster_center = F,
  spat_show_center_label = F,
  spat_center_point_size = 4,
  spat_center_point_border_col = "black",
  spat_center_point_border_stroke = 0.1,
  spat_label_size = 4,
  spat_label_fontface = "bold",
  show_NN_network = F,
  nn_network_to_use = "sNN",
  nn_network_name = "sNN.pca",
  dim_edge_alpha = 0.5,
  spat_show_network = F,
  spatial_network_name = "spatial_network",
  spat_network_color = "red",
  spat_network_alpha = 0.5,
  spat_show_grid = F,
  spatial_grid_name = "spatial_grid",
  spat_grid_color = "green",
  show_other_cells = TRUE,
  other_cell_color = "grey",
  dim_other_point_size = 0.5,
  spat_other_point_size = 0.5,
  spat_other_cells_alpha = 0.5,
  coord_fix_ratio = NULL,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimCellPlot"
)
```

Arguments

`gobject`	giotto object
`plot_alignment`	direction to align plot
`spat_enr_names`	names of spatial enrichment results to include
`cell_annotation_values`	numeric cell annotation columns
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`sdimx`	= spatial dimension to use on x-axis
`sdimy`	= spatial dimension to use on y-axis
`cell_color_gradient`	vector with 3 colors for numeric data
`gradient_midpoint`	midpoint for color gradient
`gradient_limits`	vector with lower and upper limits
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`dim_point_size`	size of points in dim. reduction space
`dim_point_border_col`	border color of points in dim. reduction space
`dim_point_border_stroke`	border stroke of points in dim. reduction space
`spat_point_size`	size of spatial points

`spat_point_border_col`
border color of spatial points

`spat_point_border_stroke`
border stroke of spatial points

`dim_show_cluster_center`
show the center of each cluster

`dim_show_center_label`
provide a label for each cluster

`dim_center_point_size`
size of the center point

`dim_center_point_border_col`
border color of center point

`dim_center_point_border_stroke`
stroke size of center point

`dim_label_size` size of the center label

`dim_label_fontface`
font of the center label

`spat_show_cluster_center`
show the center of each cluster

`spat_show_center_label`
provide a label for each cluster

`spat_center_point_size`
size of the center point

`spat_label_size`
size of the center label

`spat_label_fontface`
font of the center label

`show_NN_network`
show underlying NN network

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`nn_network_name`
name of NN network to use, if show_NN_network = TRUE

`dim_edge_alpha` column to use for alpha of the edges

`spat_show_network`
show spatial network

`spatial_network_name`
name of spatial network to use

`spat_network_color`
color of spatial network

`spat_show_grid` show spatial grid

`spatial_grid_name`
name of spatial grid to use

`spat_grid_color`
color of spatial grid

`show_other_cells`
display not selected cells

`other_cell_color`
color of not selected cells

`dim_other_point_size`
: size of not selected dim cells

`spat_other_point_size`
: size of not selected spat cells

`spat_other_cells_alpha`
: alpha of not selected spat cells

`coord_fix_ratio`
: ratio for coordinates

`cow_n_col` cowplot param: how many columns

`cow_rel_h` cowplot param: relative height

`cow_rel_w` cowplot param: relative width

`cow_align` cowplot param: how to align

`show_legend` show legend

`legend_text` size of legend text

`axis_text` size of axis text

`axis_title` size of axis title

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don’t change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

Examples

```
spatDimCellPlot(gobject)
```

`spatDimCellPlot2D` *spatDimCellPlot2D*

Description

Visualize numerical features of cells according to spatial AND dimension reduction coordinates in 2D

Usage

```
spatDimCellPlot2D(
  gobject,
  plot_alignment = c("vertical", "horizontal"),
  spat_enr_names = NULL,
  cell_annotation_values,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  sdimx = "sdimx",
  sdimy = "sdimy",
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  dim_point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  spat_point_size = 1,
  spat_point_border_col = "black",
  spat_point_border_stroke = 0.1,
  dim_show_cluster_center = F,
  dim_show_center_label = T,
  dim_center_point_size = 4,
  dim_center_point_border_col = "black",
  dim_center_point_border_stroke = 0.1,
  dim_label_size = 4,
  dim_label_fontface = "bold",
  spat_show_cluster_center = F,
  spat_show_center_label = F,
  spat_center_point_size = 4,
  spat_center_point_border_col = "black",
  spat_center_point_border_stroke = 0.1,
  spat_label_size = 4,
  spat_label_fontface = "bold",
  show_NN_network = F,
  nn_network_to_use = "sNN",
  nn_network_name = "sNN.pca",
  dim_edge_alpha = 0.5,
  spat_show_network = F,
  spatial_network_name = "spatial_network",
  spat_network_color = "red",
  spat_network_alpha = 0.5,
  spat_show_grid = F,
  spatial_grid_name = "spatial_grid",
  spat_grid_color = "green",
  show_other_cells = TRUE,
  other_cell_color = "grey",
  dim_other_point_size = 0.5,
  spat_other_point_size = 0.5,
  spat_other_cells_alpha = 0.5,
  coord_fix_ratio = NULL,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimCellPlot2D"
)
```

Arguments

`gobject` giotto object

`plot_alignment` direction to align plot

`spat_enr_names` names of spatial enrichment results to include

`cell_annotation_values` numeric cell annotation columns

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`sdimx` = spatial dimension to use on x-axis

`sdimy` = spatial dimension to use on y-axis

`cell_color_gradient` vector with 3 colors for numeric data

`gradient_midpoint` midpoint for color gradient

`gradient_limits` vector with lower and upper limits

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`dim_point_size` size of points in dim. reduction space

`dim_point_border_col` border color of points in dim. reduction space

`dim_point_border_stroke` border stroke of points in dim. reduction space

`spat_point_size` size of spatial points

spat_point_border_col
border color of spatial points

spat_point_border_stroke
border stroke of spatial points

dim_show_cluster_center
show the center of each cluster

dim_show_center_label
provide a label for each cluster

dim_center_point_size
size of the center point

dim_center_point_border_col
border color of center point

dim_center_point_border_stroke
stroke size of center point

dim_label_size
size of the center label

dim_label_fontface
font of the center label

spat_show_cluster_center
show the center of each cluster

spat_show_center_label
provide a label for each cluster

spat_center_point_size
size of the center point

spat_label_size
size of the center label

spat_label_fontface
font of the center label

show_NN_network
show underlying NN network

nn_network_to_use
type of NN network to use (kNN vs sNN)

nn_network_name
name of NN network to use, if show_NN_network = TRUE

dim_edge_alpha
column to use for alpha of the edges

spat_show_network
show spatial network

spatial_network_name
name of spatial network to use

spat_network_color
color of spatial network

spat_show_grid
show spatial grid

spatial_grid_name
name of spatial grid to use

spat_grid_color
color of spatial grid

show_other_cells
display not selected cells

other_cell_color
color of not selected cells

`dim_other_point_size`
: size of not selected dim cells

`spat_other_point_size`
: size of not selected spat cells

`spat_other_cells_alpha`
: alpha of not selected spat cells

`coord_fix_ratio`
: ratio for coordinates

`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don’t change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

Examples

```
spatDimCellPlot2D(gobject)
```

`spatDimGenePlot` *spatDimGenePlot*

Description

Visualize cells according to spatial AND dimension reduction coordinates in ggplot mode

Usage

```
spatDimGenePlot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  plot_alignment = c("vertical", "horizontal"),
  genes,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  show_NN_network = F,
  show_spatial_network = F,
  show_spatial_grid = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  edge_alpha_dim = NULL,
  scale_alpha_with_expression = FALSE,
  spatial_network_name = "spatial_network",
  spatial_grid_name = "spatial_grid",
  spat_point_size = 1,
  spat_point_border_col = "black",
  spat_point_border_stroke = 0.1,
  midpoint = 0,
  genes_high_color = "red",
  genes_mid_color = "white",
  genes_low_color = "blue",
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimGenePlot"
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`plot_alignment`	direction to align plot
`genes`	genes to show
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name

`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`point_size`	size of point (cell)
`dim_point_border_col`	color of border around points
`dim_point_border_stroke`	stroke size of border around points
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use, if show_NN_network = TRUE
`edge_alpha_dim`	dim reduction plot: column to use for alpha of the edges
`scale_alpha_with_expression`	scale expression with ggplot alpha parameter
`spatial_network_name`	name of spatial network to use
`spatial_grid_name`	name of spatial grid to use
`spat_point_size`	spatial plot: point size
`spat_point_border_col`	color of border around points
`spat_point_border_stroke`	stroke size of border around points
`midpoint`	size of point (cell)
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_legend`	show legend
`show_plot`	show plots
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don’t change, change save_name in save_param
`dim_point_size`	dim reduction plot: point size

Details

Description of parameters.

Value

ggplot

See Also

spatDimGenePlot3D

Examples

```
spatDimGenePlot(gobject)
```

---

spatDimGenePlot2D *spatDimGenePlot2D*

Description

Visualize cells according to spatial AND dimension reduction coordinates in ggplot mode

Usage

```
spatDimGenePlot2D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  plot_alignment = c("vertical", "horizontal"),
  genes,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  show_NN_network = F,
  show_spatial_network = F,
  show_spatial_grid = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  edge_alpha_dim = NULL,
  scale_alpha_with_expression = FALSE,
  spatial_network_name = "spatial_network",
  spatial_grid_name = "spatial_grid",
  spat_point_size = 1,
  spat_point_border_col = "black",
  spat_point_border_stroke = 0.1,
  midpoint = 0,
  genes_high_color = "red",
  genes_mid_color = "white",
  genes_low_color = "blue",
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimGenePlot2D"
)
```

Arguments

`gobject` giotto object

`expression_values` gene expression values to use

`plot_alignment` direction to align plot

`genes` genes to show

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`point_size` size of point (cell)

`dim_point_border_col` color of border around points

`dim_point_border_stroke` stroke size of border around points

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`edge_alpha_dim` dim reduction plot: column to use for alpha of the edges

`scale_alpha_with_expression` scale expression with ggplot alpha parameter

`spatial_network_name` name of spatial network to use

`spatial_grid_name` name of spatial grid to use

`spat_point_size` spatial plot: point size

`spat_point_border_col` color of border around points

`spat_point_border_stroke` stroke size of border around points

`midpoint` size of point (cell)

`cow_n_col` cowplot param: how many columns

`cow_rel_h` cowplot param: relative height

`cow_rel_w` cowplot param: relative width

`cow_align` cowplot param: how to align

`show_legend`	show legend
`show_plot`	show plots
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`dim_point_size`	dim reduction plot: point size

Details

Description of parameters.

Value

ggplot

See Also

`spatDimGenePlot3D`

Examples

```
spatDimGenePlot2D(gobject)
```

---

spatDimGenePlot3D *spatDimGenePlot3D*

Description

Visualize cells according to spatial AND dimension reduction coordinates in ggplot mode

Usage

```
spatDimGenePlot3D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  plot_alignment = c("horizontal", "vertical"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = NULL,
  sdimx = "sdimx",
  sdimy = "sdimy",
  sdimz = "sdimz",
  genes,
  cluster_column = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1.5,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  label_size = 16,
  genes_low_color = "blue",
  genes_mid_color = "white",
  genes_high_color = "red",
  dim_point_size = 3,
  nn_network_alpha = 0.5,
  show_spatial_network = F,
  spatial_network_name = "spatial_network",
  network_color = "lightgray",
  spatial_network_alpha = 0.5,
  show_spatial_grid = F,
  spatial_grid_name = "spatial_grid",
  spatial_grid_color = NULL,
  spatial_grid_alpha = 0.5,
  spatial_point_size = 3,
  legend_text_size = 12,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimGenePlot3D"
)
```

Arguments

`gobject` giotto object

`expression_values` gene expression values to use

`plot_alignment` direction to align plot

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`genes` genes to show

`show_NN_network` show underlying NN network

`nn_network_to_use`
: type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`dim_point_size` dim reduction plot: point size

`spatial_network_name`
: name of spatial network to use

`spatial_grid_name`
: name of spatial grid to use

`spatial_point_size`
: spatial plot: point size

`show_plot` show plots

`return_plot` return plotly object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
: default save name for saving, don't change, change save_name in save_param

`edge_alpha_dim` dim reduction plot: column to use for alpha of the edges

`scale_alpha_with_expression`
: scale expression with ggplot alpha parameter

`point_size` size of point (cell)

`show_legend` show legend

Details

Description of parameters.

Value

plotly

Examples

```
spatDimGenePlot3D(gobject)
```

`spatDimPlot` *spatDimPlot*

Description

Visualize cells according to spatial AND dimension reduction coordinates 2D

Usage

```
spatDimPlot(
  gobject,
  plot_alignment = c("vertical", "horizontal"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  sdimx = "sdimx",
  sdimy = "sdimy",
  spat_enr_names = NULL,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  dim_point_shape = c("border", "no_border"),
  dim_point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  spat_point_shape = c("border", "no_border"),
  spat_point_size = 1,
  spat_point_border_col = "black",
  spat_point_border_stroke = 0.1,
  dim_show_cluster_center = F,
  dim_show_center_label = T,
  dim_center_point_size = 4,
  dim_center_point_border_col = "black",
  dim_center_point_border_stroke = 0.1,
  dim_label_size = 4,
  dim_label_fontface = "bold",
  spat_show_cluster_center = F,
  spat_show_center_label = F,
  spat_center_point_size = 4,
  spat_label_size = 4,
  spat_label_fontface = "bold",
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  nn_network_alpha = 0.05,
  show_spatial_network = F,
  spat_network_name = "spatial_network",
  spat_network_color = "blue",
  spat_network_alpha = 0.5,
  show_spatial_grid = F,
  spat_grid_name = "spatial_grid",
  spat_grid_color = "blue",
  show_other_cells = T,
  other_cell_color = "lightgrey",
  dim_other_point_size = 1,
  spat_other_point_size = 1,
  spat_other_cells_alpha = 0.5,
  dim_show_legend = F,
  spat_show_legend = F,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimPlot"
)
```

Arguments

`gobject`	giotto object
`plot_alignment`	direction to align plot
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`sdimx`	= spatial dimension to use on x-axis
`sdimy`	= spatial dimension to use on y-axis
`spat_enr_names`	names of spatial enrichment results to include
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`cell_color_gradient`	vector with 3 colors for numeric data
`gradient_midpoint`	midpoint for color gradient
`gradient_limits`	vector with lower and upper limits
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`dim_point_shape`	point with border or not (border or no_border)
`dim_point_size`	size of points in dim. reduction space
`dim_point_border_col`	border color of points in dim. reduction space
`dim_point_border_stroke`	border stroke of points in dim. reduction space

`spat_point_shape`
point with border or not (border or no_border)

`spat_point_size`
size of spatial points

`spat_point_border_col`
border color of spatial points

`spat_point_border_stroke`
border stroke of spatial points

`dim_show_cluster_center`
show the center of each cluster

`dim_show_center_label`
provide a label for each cluster

`dim_center_point_size`
size of the center point

`dim_center_point_border_col`
border color of center point

`dim_center_point_border_stroke`
stroke size of center point

`dim_label_size` size of the center label

`dim_label_fontface`
font of the center label

`spat_show_cluster_center`
show the center of each cluster

`spat_show_center_label`
provide a label for each cluster

`spat_center_point_size`
size of the center point

`spat_label_size`
size of the center label

`spat_label_fontface`
font of the center label

`show_NN_network`
show underlying NN network

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`nn_network_alpha`
column to use for alpha of the edges

`show_spatial_network`
show spatial network

`spat_network_name`
name of spatial network to use

`spat_network_color`
color of spatial network

`show_spatial_grid`
show spatial grid

`spat_grid_name` name of spatial grid to use

`spat_grid_color`
color of spatial grid

`show_other_cells`
display not selected cells

`other_cell_color`
color of not selected cells

`dim_other_point_size`
size of not selected dim cells

`spat_other_point_size`
size of not selected spat cells

`spat_other_cells_alpha`
alpha of not selected spat cells

`dim_show_legend`
show legend of dimension reduction plot

`spat_show_legend`
show legend of spatial plot

`legend_text` size of legend text

`axis_text` size of axis text

`axis_title` size of axis title

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
default save name for saving, don't change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

See Also

`spatDimPlot2D` and `spatDimPlot3D` for 3D visualization.

Examples

```
spatDimPlot(gobject)
```

spatDimPlot2D *spatDimPlot2D*

Description

Visualize cells according to spatial AND dimension reduction coordinates 2D

Usage

```
spatDimPlot2D(
  gobject,
  plot_alignment = c("vertical", "horizontal"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  sdimx = "sdimx",
  sdimy = "sdimy",
  spat_enr_names = NULL,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  dim_point_shape = c("border", "no_border"),
  dim_point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  spat_point_shape = c("border", "no_border"),
  spat_point_size = 1,
  spat_point_border_col = "black",
  spat_point_border_stroke = 0.1,
  dim_show_cluster_center = F,
  dim_show_center_label = T,
  dim_center_point_size = 4,
  dim_center_point_border_col = "black",
  dim_center_point_border_stroke = 0.1,
  dim_label_size = 4,
  dim_label_fontface = "bold",
  spat_show_cluster_center = F,
  spat_show_center_label = F,
  spat_center_point_size = 4,
  spat_label_size = 4,
  spat_label_fontface = "bold",
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  nn_network_alpha = 0.05,
  show_spatial_network = F,
  spat_network_name = "spatial_network",
  spat_network_color = "blue",
  spat_network_alpha = 0.5,
  show_spatial_grid = F,
  spat_grid_name = "spatial_grid",
  spat_grid_color = "blue",
  show_other_cells = T,
  other_cell_color = "lightgrey",
  dim_other_point_size = 1,
  spat_other_point_size = 1,
  spat_other_cells_alpha = 0.5,
  dim_show_legend = F,
  spat_show_legend = F,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimPlot2D"
)
```

Arguments

`gobject` giotto object

`plot_alignment` direction to align plot

`dim_reduction_to_use`
dimension reduction to use

`dim_reduction_name`
dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`sdimx` = spatial dimension to use on x-axis

`sdimy` = spatial dimension to use on y-axis

`spat_enr_names` names of spatial enrichment results to include

`cell_color` color for cells (see details)

`color_as_factor`
convert color column to factor

`cell_color_code`
named vector with colors

`cell_color_gradient`
vector with 3 colors for numeric data

`gradient_midpoint`
midpoint for color gradient

`gradient_limits`
vector with lower and upper limits

`select_cell_groups`
select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`dim_point_shape`
point with border or not (border or no_border)

`dim_point_size` size of points in dim. reduction space

`dim_point_border_col`
border color of points in dim. reduction space

`dim_point_border_stroke`
border stroke of points in dim. reduction space

`spat_point_shape`
point with border or not (border or no_border)

`spat_point_size`
size of spatial points

`spat_point_border_col`
border color of spatial points

`spat_point_border_stroke`
border stroke of spatial points

`dim_show_cluster_center`
show the center of each cluster

`dim_show_center_label`
provide a label for each cluster

`dim_center_point_size`
size of the center point

`dim_center_point_border_col`
border color of center point

`dim_center_point_border_stroke`
stroke size of center point

`dim_label_size` size of the center label

`dim_label_fontface`
font of the center label

`spat_show_cluster_center`
show the center of each cluster

`spat_show_center_label`
provide a label for each cluster

`spat_center_point_size`
size of the center point

`spat_label_size`
size of the center label

`spat_label_fontface`
font of the center label

`show_NN_network`
show underlying NN network

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`nn_network_alpha`
column to use for alpha of the edges

`show_spatial_network`
show spatial network

`spat_network_name`
name of spatial network to use

`spat_network_color`
color of spatial network

`show_spatial_grid`
show spatial grid

`spat_grid_name` name of spatial grid to use

`spat_grid_color`
color of spatial grid

`show_other_cells`
display not selected cells

`other_cell_color`
color of not selected cells

`dim_other_point_size`
size of not selected dim cells

`spat_other_point_size`
size of not selected spat cells

`spat_other_cells_alpha`
alpha of not selected spat cells

`dim_show_legend`
show legend of dimension reduction plot

`spat_show_legend`
show legend of spatial plot

`legend_text` size of legend text

`axis_text` size of axis text

`axis_title` size of axis title

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
default save name for saving, don't change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

See Also

`spatDimPlot3D`

Examples

```
spatDimPlot2D(gobject)
```

spatDimPlot3D *spatDimPlot3D*

Description

Visualize cells according to spatial AND dimension reduction coordinates in plotly mode

Usage

```
spatDimPlot3D(
  gobject,
  plot_alignment = c("horizontal", "vertical"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = 3,
  sdimx = "sdimx",
  sdimy = "sdimy",
  sdimz = "sdimz",
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 16,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1.5,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  dim_point_size = 3,
  nn_network_alpha = 0.5,
  show_spatial_network = F,
  spatial_network_name = "spatial_network",
  network_color = "lightgray",
  spatial_network_alpha = 0.5,
  show_spatial_grid = F,
  spatial_grid_name = "spatial_grid",
  spatial_grid_color = NULL,
  spatial_grid_alpha = 0.5,
  spatial_point_size = 3,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  legend_text_size = 12,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatDimPlot3D"
)
```

Arguments

`gobject` giotto object

`plot_alignment` direction to align plot

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`sdimx` = spatial dimension to use on x-axis

`sdimy` = spatial dimension to use on y-axis

`sdimz` = spatial dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`show_cluster_center` show the center of each cluster

`show_center_label` provide a label for each cluster

`center_point_size` size of the center point

`label_size` size of the center label

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`other_point_size` size of not selected cells

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`dim_point_size`	size of points in dim. reduction space
`nn_network_alpha`	column to use for alpha of the edges
`show_spatial_network`	show spatial network
`spatial_network_name`	name of spatial network to use
`spatial_network_alpha`	alpha of spatial network
`show_spatial_grid`	show spatial grid
`spatial_grid_name`	name of spatial grid to use
`spatial_grid_color`	color of spatial grid
`spatial_point_size`	size of spatial points
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`dim_point_border_col`	border color of points in dim. reduction space
`dim_point_border_stroke`	border stroke of points in dim. reduction space
`spatial_network_color`	color of spatial network
`spatial_other_point_size`	size of not selected spatial points
`spatial_other_cells_alpha`	alpha of not selected spatial points
`dim_other_point_size`	size of not selected dim. reduction points
`show_legend`	show legend

Details

Description of parameters.

Value

plotly

Examples

```
spatDimPlot3D(gobject)
```

spatGenePlot *spatGenePlot*

Description

Visualize cells and gene expression according to spatial coordinates

Usage

```
spatGenePlot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  genes_high_color = "darkred",
  genes_mid_color = "white",
  genes_low_color = "darkblue",
  show_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  edge_alpha = NULL,
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  midpoint = 0,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatGenePlot"
)
```

Arguments

gobject giotto object

expression_values
gene expression values to use

genes genes to show

genes_high_color
color represents high gene expression

genes_mid_color
color represents middle gene expression

`genes_low_color` color represents low gene expression

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name` name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`spatial_grid_name` name of spatial grid to use

`midpoint` expression midpoint

`scale_alpha_with_expression` scale expression with ggplot alpha parameter

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`show_legend` show legend

`cow_n_col` cowplot param: how many columns

`cow_rel_h` cowplot param: relative height

`cow_rel_w` cowplot param: relative width

`cow_align` cowplot param: how to align

`show_plot` show plots

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don’t change, change save_name in save_param

`...` parameters for cowplot::save_plot()

Details

Description of parameters.

Value

ggplot

See Also

`spatGenePlot3D` and `spatGenePlot2D`

Examples

```
spatGenePlot(gobject)
```

spatGenePlot2D *spatGenePlot2D*

Description

Visualize cells and gene expression according to spatial coordinates

Usage

```
spatGenePlot2D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  genes_high_color = "darkred",
  genes_mid_color = "white",
  genes_low_color = "darkblue",
  show_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  edge_alpha = NULL,
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  midpoint = 0,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatGenePlot2D"
)
```

Arguments

`gobject` giotto object

`expression_values`
gene expression values to use

`genes` genes to show

`genes_high_color`
color represents high gene expression

`genes_mid_color`
color represents middle gene expression

`genes_low_color` color represents low gene expression

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name` name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`spatial_grid_name` name of spatial grid to use

`midpoint` expression midpoint

`scale_alpha_with_expression` scale expression with ggplot alpha parameter

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`show_legend` show legend

`cow_n_col` cowplot param: how many columns

`cow_rel_h` cowplot param: relative height

`cow_rel_w` cowplot param: relative width

`cow_align` cowplot param: how to align

`show_plot` show plots

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don’t change, change save_name in save_param

`...` parameters for cowplot::save_plot()

Details

Description of parameters.

Value

ggplot

See Also

`spatGenePlot3D`

Examples

```
spatGenePlot2D(gobject)
```

spatGenePlot3D *spatGenePlot3D*

Description

Visualize cells and gene expression according to spatial coordinates

Usage

```
spatGenePlot3D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  show_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  edge_alpha = NULL,
  show_grid = F,
  cluster_column = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  genes_high_color = NULL,
  genes_mid_color = "white",
  genes_low_color = "blue",
  spatial_grid_name = "spatial_grid",
  point_size = 2,
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatGenePlot3D"
)
```

Arguments

`gobject` giotto object

`expression_values`
gene expression values to use

`genes` genes to show

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name`	name of spatial network to use
`show_grid`	show spatial grid
`genes_high_color`	color represents high gene expression
`genes_mid_color`	color represents middle gene expression
`genes_low_color`	color represents low gene expression
`spatial_grid_name`	name of spatial grid to use
`point_size`	size of point (cell)
`show_legend`	show legend
`show_plot`	show plots
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`grid_color`	color of spatial grid
`midpoint`	expression midpoint
`scale_alpha_with_expression`	scale expression with ggplot alpha parameter
`...`	parameters for cowplot::save_plot()

Details

Description of parameters.

Value

ggplot

Examples

```
spatGenePlot3D(gobject)
```

`Spatial_AEH` *Spatial_AEH*

Description

calculate automatic expression histology with spatialDE method

Usage

```
Spatial_AEH(
  gobject = NULL,
  results = NULL,
  pattern_num = 5,
  l = 1.05,
  show_AEH = T,
  sdimx = NULL,
  sdimy = NULL,
  point_size = 3,
  point_alpha = 1,
  low_color = "blue",
  mid_color = "white",
  high_color = "red",
  midpoint = 0,
  python_path = NULL
)
```

Arguments

`gobject`	Giotto object
`results`	output from spatial_DE
`pattern_num`	the number of gene expression patterns
`show_AEH`	show AEH plot
`python_path`	specify specific path to python if required

Details

Description.

Value

a list or a dataframe of SVs

Examples

```
Spatial_AEH(gobject)
```

`Spatial_DE` *Spatial_DE*

Description

calculate spatial varible genes with spatialDE method

Usage

```
Spatial_DE(
  gobject = NULL,
  show_plot = T,
  size = c(4, 2, 1),
  color = c("blue", "green", "red"),
  sig_alpha = 0.5,
  unsig_alpha = 0.5,
  python_path = NULL
)
```

Arguments

`gobject`	Giotto object
`show_plot`	show FSV plot
`python_path`	specify specific path to python if required

Details

Description.

Value

a list or a dataframe of SVs

Examples

```
Spatial_DE(gobject)
```

---

spatPlot *spatPlot*

Description

Visualize cells according to spatial coordinates

Usage

```
spatPlot(
  gobject,
  group_by = NULL,
  group_by_subset = NULL,
  sdimx = "sdimx",
  sdimy = "sdimy",
  spat_enr_names = NULL,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_shape = c("border", "no_border"),
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_cluster_center = F,
  show_center_label = F,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  show_network = F,
  spatial_network_name = "spatial_network",
  network_color = NULL,
  network_alpha = 1,
  show_grid = F,
  spatial_grid_name = "spatial_grid",
  grid_color = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  other_cells_alpha = 0.1,
  coord_fix_ratio = NULL,
  title = NULL,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatPlot"
)
```

Arguments

`gobject` giotto object

`group_by_subset`
subset the group_by factor column

`sdimx` x-axis dimension name (default = ’sdimx’)

`sdimy` y-axis dimension name (default = ’sdimy’)

`spat_enr_names` names of spatial enrichment results to include

`cell_color` color for cells (see details)

`color_as_factor`
convert color column to factor

cell_color_code
named vector with colors

cell_color_gradient
vector with 3 colors for numeric data

gradient_midpoint
midpoint for color gradient

gradient_limits
vector with lower and upper limits

select_cell_groups
select subset of cells/clusters based on cell_color parameter

select_cells select subset of cells based on cell IDs

point_shape point with border or not (border or no_border)

point_size size of point (cell)

point_border_col
color of border around points

point_border_stroke
stroke size of border around points

show_cluster_center
plot center of selected clusters

show_center_label
plot label of selected clusters

center_point_size
size of center points

label_size size of labels

label_fontface font of labels

show_network show underlying spatial network

spatial_network_name
name of spatial network to use

network_color color of spatial network

network_alpha alpha of spatial network

show_grid show spatial grid

spatial_grid_name
name of spatial grid to use

grid_color color of spatial grid

show_other_cells
display not selected cells

other_cell_color
color of not selected cells

other_point_size
point size of not selected cells

other_cells_alpha
alpha of not selected cells

coord_fix_ratio
fix ratio between x and y-axis

title title of plot

show_legend show legend

`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`groub_by`	create multiple plots based on cell annotation column

Details

Description of parameters.

Value

ggplot

See Also

`spatPlot3D`

Examples

```
spatPlot(gobject)
```

---

spatPlot2D *spatPlot2D*

Description

Visualize cells according to spatial coordinates

Usage

```
spatPlot2D(
  gobject,
  group_by = NULL,
  group_by_subset = NULL,
  sdimx = "sdimx",
  sdimy = "sdimy",
  spat_enr_names = NULL,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_shape = c("border", "no_border"),
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_cluster_center = F,
  show_center_label = F,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  show_network = F,
  spatial_network_name = "spatial_network",
  network_color = NULL,
  network_alpha = 1,
  show_grid = F,
  spatial_grid_name = "spatial_grid",
  grid_color = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  other_cells_alpha = 0.1,
  coord_fix_ratio = NULL,
  title = NULL,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatPlot2D"
)
```

Arguments

gobject	giotto object
group_by_subset	subset the group_by factor column
sdimx	x-axis dimension name (default = 'sdimx')

`sdimy`	y-axis dimension name (default = 'sdimy')
`spat_enr_names`	names of spatial enrichment results to include
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`cell_color_gradient`	vector with 3 colors for numeric data
`gradient_midpoint`	midpoint for color gradient
`gradient_limits`	vector with lower and upper limits
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`point_shape`	point with border or not (border or no_border)
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`label_fontface`	font of labels
`show_network`	show underlying spatial network
`spatial_network_name`	name of spatial network to use
`network_color`	color of spatial network
`network_alpha`	alpha of spatial network
`show_grid`	show spatial grid
`spatial_grid_name`	name of spatial grid to use
`grid_color`	color of spatial grid
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	point size of not selected cells

`other_cells_alpha`	alpha of not selected cells
`coord_fix_ratio`	fix ratio between x and y-axis
`title`	title of plot
`show_legend`	show legend
`legend_text`	size of legend text
`axis_text`	size of axis text
`axis_title`	size of axis title
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_param`	list of saving parameters from `all_plots_save_function`
`default_save_name`	default save name for saving, don't change, change save_name in save_param
`groub_by`	create multiple plots based on cell annotation column

Details

Description of parameters.

Value

ggplot

See Also

`spatPlot3D`

Examples

```
spatPlot2D(gobject)
```

spatPlot2D_single *spatPlot2D_single*

Description

Visualize cells according to spatial coordinates

Usage

```
spatPlot2D_single(
  gobject,
  sdimx = "sdimx",
  sdimy = "sdimy",
  spat_enr_names = NULL,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  cell_color_gradient = c("blue", "white", "red"),
  gradient_midpoint = NULL,
  gradient_limits = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  point_shape = c("border", "no_border"),
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_cluster_center = F,
  show_center_label = F,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  show_network = F,
  spatial_network_name = "spatial_network",
  network_color = NULL,
  network_alpha = 1,
  show_grid = F,
  spatial_grid_name = "spatial_grid",
  grid_color = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 1,
  other_cells_alpha = 0.1,
  coord_fix_ratio = NULL,
  title = NULL,
  show_legend = T,
  legend_text = 8,
  axis_text = 8,
  axis_title = 8,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spatPlot2D_single"
)
```

Arguments

gobject giotto object

sdimx x-axis dimension name (default = 'sdimx')

sdimy y-axis dimension name (default = 'sdimy')

spat_enr_names names of spatial enrichment results to include

cell_color color for cells (see details)

color_as_factor convert color column to factor

cell_color_code named vector with colors

cell_color_gradient vector with 3 colors for numeric data

gradient_midpoint midpoint for color gradient

gradient_limits vector with lower and upper limits

select_cell_groups select subset of cells/clusters based on cell_color parameter

select_cells select subset of cells based on cell IDs

point_shape point with border or not (border or no_border)

point_size size of point (cell)

point_border_col color of border around points

point_border_stroke stroke size of border around points

show_cluster_center plot center of selected clusters

show_center_label plot label of selected clusters

center_point_size size of center points

label_size size of labels

label_fontface font of labels

show_network show underlying spatial network

spatial_network_name name of spatial network to use

network_color color of spatial network

network_alpha alpha of spatial network

show_grid show spatial grid

`spatial_grid_name`
name of spatial grid to use

`grid_color` color of spatial grid

`show_other_cells`
display not selected cells

`other_cell_color`
color of not selected cells

`other_point_size`
point size of not selected cells

`other_cells_alpha`
alpha of not selected cells

`coord_fix_ratio`
fix ratio between x and y-axis

`title` title of plot

`show_legend` show legend

`legend_text` size of legend text

`axis_text` size of axis text

`axis_title` size of axis title

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name`
default save name for saving, don't change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

See Also

`spatPlot3D`

Examples

```
spatPlot2D_single(gobject)
```

spatPlot3D *spatPlot3D*

Description

Visualize cells according to spatial coordinates

Usage

```
spatPlot3D(
  gobject,
  sdimx = "sdimx",
  sdimy = "sdimy",
  sdimz = "sdimz",
  point_size = 3,
  cell_color = NULL,
  cell_color_code = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_network = F,
  network_color = NULL,
  network_alpha = 1,
  other_cell_alpha = 0.5,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  title = "",
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "spat3D"
)
```

Arguments

gobject	giotto object
sdimx	x-axis dimension name (default = 'sdimx')
sdimy	y-axis dimension name (default = 'sdimy')
sdimz	z-axis dimension name (default = 'sdimy')

`point_size` size of point (cell)

`cell_color` color for cells (see details)

`cell_color_code` named vector with colors

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name` name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`spatial_grid_name` name of spatial grid to use

`title` title of plot

`show_legend` show legend

`axis_scale` the way to scale the axis

`custom_ratio` customize the scale of the plot

`x_ticks` set the number of ticks on the x-axis

`y_ticks` set the number of ticks on the y-axis

`z_ticks` set the number of ticks on the z-axis

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_param` list of saving parameters from `all_plots_save_function`

`default_save_name` default save name for saving, don’t change, change save_name in save_param

Details

Description of parameters.

Value

ggplot

Examples

```
spatPlot3D(gobject)
```

specificCellCellcommunicationScores *specificCellCellcommunicationScores*

Description

Specific Cell-Cell communication scores based on spatial expression of interacting cells

Usage

```
specificCellCellcommunicationScores(
  gobject,
  spatial_network_name = "spatial_network",
  cluster_column = "cell_types",
  random_iter = 100,
  cell_type_1 = "astrocyte",
  cell_type_2 = "endothelial",
  gene_set_1,
  gene_set_2,
  log2FC_addendum = 0.1,
  min_observations = 2,
  verbose = T
)
```

Arguments

gobject	giotto object to use
spatial_network_name	spatial network to use for identifying interacting cells
cluster_column	cluster column with cell type information
random_iter	number of iterations
cell_type_1	first cell type
cell_type_2	second cell type
gene_set_1	first specific gene set from gene pairs
gene_set_2	second specific gene set from gene pairs
log2FC_addendum	addendum to add when calculating log2FC
min_observations	minimum number of interactions needed to be considered
verbose	verbose

Details

Statistical framework to identify if pairs of genes (such as ligand-receptor combinations) are expressed at higher levels than expected based on a reshuffled null distribution of gene expression values in cells that are spatially in proximity to eachother.. More details will follow soon.

Value

Cell-Cell communication scores for gene pairs based on spatial interaction

Examples

```
specificCellCellcommunicationScores(gobject)
```

split_dendrogram_in_two

split_dendrogram_in_two

Description

Merge selected clusters based on pairwise correlation scores and size of cluster.

Usage

```
split_dendrogram_in_two(dend)
```

Arguments

dend	dendrogram object

Value

list of two dendrograms and height of node

Examples

```
split_dendrogram_in_two(dend)
```

stitchFieldCoordinates

stitchFieldCoordinates

Description

Helper function to stitch field coordinates together to form one complete picture

Usage

```
stitchFieldCoordinates(
  location_file,
  offset_file,
  cumulate_offset_x = F,
  cumulate_offset_y = F,
  field_col = "Field of View",
  X_coord_col = "X",
  Y_coord_col = "Y",
  reverse_final_x = F,
  reverse_final_y = T
)
```

Arguments

`location_file` location dataframe with X and Y coordinates

`offset_file` dataframe that describes the offset for each field (see details)

`cumulate_offset_x`
(boolean) Do the x-axis offset values need to be cumulated?

`cumulate_offset_y`
(boolean) Do the y-axis offset values need to be cumulated?

`field_col` column that indicates the field within the location_file

`X_coord_col` column that indicates the x coordinates

`Y_coord_col` column that indicates the x coordinates

`reverse_final_x`
(boolean) Do the final x coordinates need to be reversed?

`reverse_final_y`
(boolean) Do the final y coordinates need to be reversed?

Details

Stitching of fields:

- 1. have cell locations: at least 3 columns: field, X, Y
- 2. create offset file: offset file has 3 columns: field, x_offset, y_offset
- 3. create new cell location file by stitching original cell locations with stitchFieldCoordinates
- 4. provide new cell location file to `createGiottoObject`

Value

Updated location dataframe with new X ['X_final'] and Y ['Y_final'] coordinates

Examples

```
stitchFieldCoordinates(gobject)
```

`subClusterCells` *subClusterCells*

Description

subcluster cells

Usage

```
subClusterCells(
  gobject,
  name = "sub_clus",
  cluster_method = c("leiden", "louvain_community", "louvain_multinet"),
  cluster_column = NULL,
  selected_clusters = NULL,
 hvg_param = list(reverse_log_scale = T, difference_in_variance = 1, expression_values
   = "normalized"),
  hvg_min_perc_cells = 5,
  hvg_mean_expr_det = 1,
  use_all_genes_as_hvg = FALSE,
  min_nr_of_hvg = 5,
  pca_param = list(expression_values = "normalized", scale_unit = T),
  nn_param = list(dimensions_to_use = 1:20),
  k_neighbors = 10,
  resolution = 1,
  gamma = 1,
  omega = 1,
  python_path = NULL,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  return_gobject = TRUE,
  verbose = T
)
```

Arguments

`gobject` giotto object

`name` name for new clustering result

`cluster_method` clustering method to use

`cluster_column` cluster column to subcluster

`selected_clusters` only do subclustering on these clusters

`hvg_param` parameters for calculateHVG

`hvg_min_perc_cells` threshold for detection in min percentage of cells

`hvg_mean_expr_det` threshold for mean expression level in cells with detection

`use_all_genes_as_hvg` forces all genes to be HVG and to be used as input for PCA

`min_nr_of_hvg` minimum number of HVG, or all genes will be used as input for PCA

`pca_param` parameters for runPCA

`nn_param` parameters for parameters for createNearestNetwork

`k_neighbors` number of k for createNearestNetwork

`resolution` resolution

`gamma` gamma

`omega` omega

`python_path` specify specific path to python if required

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use

`return_gobject` boolean: return giotto object (default = TRUE)

`verbose` verbose

Details

This function performs subclustering on selected clusters. The systematic steps are:

- 1. subset Giotto object
- 2. identify highly variable genes
- 3. run PCA
- 4. create nearest neighbouring network
- 5. do clustering

Value

giotto object with new subclusters appended to cell metadata

See Also

doLouvainCluster_multinet, doLouvainCluster_community and @seealso doLeidenCluster

Examples

```
subClusterCells(gobject)
```

---

subsetGiotto *subsetGiotto*

Description

subsets Giotto object including previous analyses.

Usage

```
subsetGiotto(gobject, cell_ids = NULL, gene_ids = NULL, verbose = FALSE)
```

Arguments

gobject	giotto object
cell_ids	cell IDs to keep
gene_ids	gene IDs to keep
verbose	be verbose

Value

giotto object

Examples

```
subsetGiotto(gobject)
```

subsetGiottoLocs *subsetGiottoLocs*

Description

subsets Giotto object based on spatial locations

Usage

```
subsetGiottoLocs(
  gobject,
  x_max = NULL,
  x_min = NULL,
  y_max = NULL,
  y_min = NULL,
  z_max = NULL,
  z_min = NULL,
  return_gobject = T,
  verbose = FALSE
)
```

Arguments

gobject	giotto object
x_max	maximum x-coordinate
x_min	minimum x-coordinate
y_max	maximum y-coordinate
y_min	minimum y-coordinate
z_max	maximum z-coordinate
z_min	minimum z-coordinate
return_gobject	return Giotto object

Details

if return_gobject = FALSE, then a filtered combined metadata data.table will be returned

Value

giotto object

Examples

```
    subsetGiottoLocs(gobject)
```

viewHMRFresults *viewHMRFresults*

Description

View results from doHMRF.

Usage

```
viewHMRFresults(
  gobject,
  HMRFoutput,
  k = NULL,
  betas_to_view = NULL,
  third_dim = NULL,
  ...
)
```

Arguments

gobject	giotto object
HMRFoutput	HMRF output from doHMRF
k	number of HMRF domains
betas_to_view	results from different betas that you want to view
...	paramters to visPlot()

Details

Description ...

Value

spatial plots with HMRF domains

See Also

visPlot

Examples

```
viewHMRFresults(gobject)
```

viewHMRFresults2D *viewHMRFresults2D*

Description

View results from doHMRF.

Usage

```
viewHMRFresults2D(
  gobject,
  HMRFoutput,
  k = NULL,
  betas_to_view = NULL,
  third_dim = NULL,
  ...
)
```

Arguments

gobject	giotto object
HMRFoutput	HMRF output from doHMRF
k	number of HMRF domains
betas_to_view	results from different betas that you want to view
...	paramters to visPlot()

Details

Description ...

Value

spatial plots with HMRF domains

See Also

spatPlot2D

Examples

```
    viewHMRFresults2D(gobject)
```

viewHMRFresults3D *viewHMRFresults3D*

Description

View results from doHMRF.

Usage

```
viewHMRFresults3D(
  gobject,
  HMRFoutput,
  k = NULL,
  betas_to_view = NULL,
  third_dim = NULL,
  ...
)
```

Arguments

gobject	giotto object
HMRFoutput	HMRF output from doHMRF
k	number of HMRF domains
betas_to_view	results from different betas that you want to view
...	paramters to visPlot()

Details

Description ...

Value

spatial plots with HMRF domains

See Also

spatPlot3D

Examples

```
    viewHMRFresults3D(gobject)
```

violinPlot *violinPlot*

Description

Creates violinplot for selected clusters

Usage

```
violinPlot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  cluster_column,
  cluster_custom_order = NULL,
  color_violin = c("genes", "cluster"),
  cluster_color_code = NULL,
  strip_position = c("top", "right", "left", "bottom"),
  strip_text = 7,
  axis_text_x_size = 10,
  axis_text_y_size = 6,
  show_plot = NA,
  return_plot = NA,
  save_plot = NA,
  save_param = list(),
  default_save_name = "violinPlot"
)
```

Arguments

`gobject`	giotto object
`expression_values`	expression values to use
`genes`	genes to plot
`cluster_column`	name of column to use for clusters
`cluster_custom_order`	custom order of clusters
`color_violin`	color violin according to genes or clusters
`cluster_color_code`	color code for clusters
`strip_position`	position of gene labels
`strip_text`	size of strip text
`axis_text_x_size`	size of x-axis text
`axis_text_y_size`	size of y-axis text
`show_plot`	show plot
`return_plot`	return ggplot object

save_plot directly save the plot [boolean]

save_param list of saving parameters from all_plots_save_function

default_save_name
default save name for saving, don't change, change save_name in save_param

Value

ggplot

Examples

```
violinPlot(gobject)
```

---

visDimGenePlot *visDimGenePlot*

Description

Visualize cells and gene expression according to dimension reduction coordinates

Usage

```
visDimGenePlot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  network_color = "lightgray",
  edge_alpha = NULL,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  genes_high_color = NULL,
  genes_mid_color = "white",
  genes_low_color = "blue",
  point_border_col = "black",
  point_border_stroke = 0.1,
  midpoint = 0,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  plot_method = c("ggplot", "plotly"),
  show_plots = F
)
```

Arguments

`gobject` giotto object

`expression_values` gene expression values to use

`genes` genes to show

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`edge_alpha` column to use for alpha of the edges

`scale_alpha_with_expression` scale expression with ggplot alpha parameter

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`midpoint` size of point (cell)

`cow_n_col` cowplot param: how many columns

`cow_rel_h` cowplot param: relative height

`cow_rel_w` cowplot param: relative width

`cow_align` cowplot param: how to align

`show_legend` show legend

`show_plots` show plots

Details

Description of parameters.

Value

ggplot

Examples

```
visDimGenePlot(gobject)
```

visDimGenePlot_2D_ggplot

visDimGenePlot_2D_ggplot

Description

Visualize cells and gene expression according to dimension reduction coordinates

Usage

```
visDimGenePlot_2D_ggplot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  network_color = "lightgray",
  edge_alpha = NULL,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  genes_high_color = "red",
  genes_mid_color = "white",
  genes_low_color = "blue",
  point_border_col = "black",
  point_border_stroke = 0.1,
  midpoint = 0,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  show_plots = F
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`genes`	genes to show
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`edge_alpha` column to use for alpha of the edges

`scale_alpha_with_expression` scale expression with ggplot alpha parameter

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`midpoint` size of point (cell)

`cow_n_col` cowplot param: how many columns

`cow_rel_h` cowplot param: relative height

`cow_rel_w` cowplot param: relative width

`cow_align` cowplot param: how to align

`show_legend` show legend

`show_plots` show plots

Details

Description of parameters.

Value

ggplot

Examples

```
visDimGenePlot_2D_ggplot(gobject)
```

---

visDimGenePlot_3D_plotly *visDimGenePlot_3D_plotly*

Description

Visualize cells and gene expression according to dimension reduction coordinates

Usage

```
visDimGenePlot_3D_plotly(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = 3,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  network_color = "lightgray",
  edge_alpha = NULL,
  point_size = 1,
  genes_high_color = NULL,
  genes_mid_color = "white",
  genes_low_color = "blue",
  show_legend = T,
  show_plots = F
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`genes`	genes to show
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`dim3_to_use`	dimension to use on z-axis
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use, if show_NN_network = TRUE
`edge_alpha`	column to use for alpha of the edges
`point_size`	size of point (cell)
`show_legend`	show legend
`show_plots`	show plots

Details

Description of parameters.

Value

ggplot

Examples

```
visDimGenePlot_3D_plotly(gobject)
```

---

visDimPlot *visDimPlot*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
visDimPlot(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  plot_method = c("ggplot", "plotly"),
  show_legend = T,
  show_plot = F,
  return_plot = TRUE,
  save_plot = F,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  save_format = NULL,
  show_saved_plot = F,
  ...
)
```

Arguments

`gobject` giotto object

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`show_cluster_center` plot center of selected clusters

`show_center_label` plot label of selected clusters

`center_point_size` size of center points

`label_size` size of labels

`label_fontface` font of labels

`edge_alpha` column to use for alpha of the edges

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`show_legend` show legend

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_dir` directory to save the plot

`save_folder`	(optional) folder in directory to save the plot
`save_name`	name of plot
`save_format`	format of plot (e.g. tiff, png, pdf, ...)
`show_saved_plot`	load & display the saved plot

Details

Description of parameters.

Value

ggplot or plotly

Examples

```
visDimPlot(gobject)
```

`visDimPlot_2D_ggplot` *visDimPlot_2D_ggplot*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
visDimPlot_2D_ggplot(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  center_point_border_col = "black",
  center_point_border_stroke = 0.1,
  label_size = 4,
  label_fontface = "bold",
  edge_alpha = NULL,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  show_plot = F,
  return_plot = TRUE,
  save_plot = F,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  save_format = NULL,
  show_saved_plot = F,
  ...
)
```

Arguments

`gobject`	giotto object
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use, if show_NN_network = TRUE
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`select_cell_groups`	select subset of cells/clusters based on cell_color parameter
`select_cells`	select subset of cells based on cell IDs
`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`other_point_size`	size of not selected cells
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points

`label_size` size of labels

`label_fontface` font of labels

`edge_alpha` column to use for alpha of the edges

`point_size` size of point (cell)

`point_border_col` color of border around points

`point_border_stroke` stroke size of border around points

`show_legend` show legend

Details

Description of parameters.

Value

ggplot

Examples

```
visDimPlot_2D_ggplot(gobject)
```

`visDimPlot_2D_plotly` *visDimPlot_2D_plotly*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
visDimPlot_2D_plotly(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  color_as_factor = T,
  cell_color = NULL,
  cell_color_code = NULL,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 4,
  edge_alpha = NULL,
  point_size = 5
)
```

Arguments

gobject giotto object

dim_reduction_to_use
dimension reduction to use

dim_reduction_name
dimension reduction name

dim1_to_use dimension to use on x-axis

dim2_to_use dimension to use on y-axis

show_NN_network
show underlying NN network

nn_network_to_use
type of NN network to use (kNN vs sNN)

network_name name of NN network to use, if show_NN_network = TRUE

color_as_factor
convert color column to factor

cell_color color for cells (see details)

cell_color_code
named vector with colors

show_cluster_center
plot center of selected clusters

show_center_label
plot label of selected clusters

center_point_size
size of center points

label_size size of labels

edge_alpha column to use for alpha of the edges

point_size size of point (cell)

Details

Description of parameters.

Value

plotly

Examples

```
visDimPlot_2D_plotly(gobject)
```

visDimPlot_3D_plotly *visDimPlot_3D_plotly*

Description

Visualize cells according to dimension reduction coordinates

Usage

```
visDimPlot_3D_plotly(
  gobject,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = 3,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  color_as_factor = T,
  cell_color = NULL,
  cell_color_code = NULL,
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 4,
  edge_alpha = NULL,
  point_size = 1
)
```

Arguments

`gobject`	giotto object
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`dim3_to_use`	dimension to use on z-axis
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)

`network_name`	name of NN network to use, if show_NN_network = TRUE
`color_as_factor`	convert color column to factor
`cell_color`	color for cells (see details)
`cell_color_code`	named vector with colors
`show_cluster_center`	plot center of selected clusters
`show_center_label`	plot label of selected clusters
`center_point_size`	size of center points
`label_size`	size of labels
`edge_alpha`	column to use for alpha of the edges
`point_size`	size of point (cell)

Details

Description of parameters.

Value

plotly

Examples

```
visDimPlot_3D_plotly(gobject)
```

visForceLayoutPlot *visForceLayoutPlot*

Description

Visualize cells according to forced layout algorithm coordinates

Usage

```
visForceLayoutPlot(
  gobject,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  layout_name = "layout",
  dim1_to_use = 1,
  dim2_to_use = 2,
  show_NN_network = T,
  cell_color = NULL,
  color_as_factor = TRUE,
  cell_color_code = NULL,
  edge_alpha = NULL,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  show_plot = F,
  return_plot = TRUE,
  save_plot = F,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  save_format = NULL,
  show_saved_plot = F,
  ...
)
```

Arguments

`gobject`	giotto object
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	NN network to use
`layout_name`	name of layout to use
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`show_NN_network`	show underlying NN network
`cell_color`	color for cells (see details)
`color_as_factor`	convert color column to factor
`cell_color_code`	named vector with colors
`edge_alpha`	column to use for alpha of the edges
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`show_legend`	show legend
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_dir`	directory to save the plot
`save_folder`	(optional) folder in directory to save the plot
`save_name`	name of plot
`save_format`	format of plot (e.g. tiff, png, pdf, ...)
`show_saved_plot`	load & display the saved plot

Details

Description of parameters.

Value

ggplot

Examples

```
visForceLayoutPlot(gobject)
```

---

visGenePlot *visGenePlot*

Description

Visualize cells and gene expression according to spatial coordinates

Usage

```
visGenePlot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  genes_high_color = NULL,
  genes_mid_color = "white",
  genes_low_color = "blue",
  show_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  edge_alpha = NULL,
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  midpoint = 0,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  plot_method = c("ggplot", "plotly"),
  show_plots = F
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`genes`	genes to show
`genes_high_color`	color represents high gene expression
`genes_mid_color`	color represents middle gene expression
`genes_low_color`	color represents low gene expression
`show_network`	show underlying spatial network
`network_color`	color of spatial network
`spatial_network_name`	name of spatial network to use
`show_grid`	show spatial grid
`grid_color`	color of spatial grid
`spatial_grid_name`	name of spatial grid to use
`midpoint`	expression midpoint
`scale_alpha_with_expression`	scale expression with ggplot alpha parameter
`point_size`	size of point (cell)
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`show_legend`	show legend
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`axis_scale`	three mode to adjust axis scale
`x_ticks`	number of ticks on x axis
`y_ticks`	number of ticks on y axis
`z_ticks`	number of ticks on z axis
`plot_method`	two methods of plot
`show_plots`	show plots

Details

Description of parameters.

Value

ggplot or plotly

Examples

```
visGenePlot(gobject)
```

---

visGenePlot_2D_ggplot *visGenePlot_2D_ggplot*

Description

Visualize cells and gene expression according to spatial coordinates

Usage

```
visGenePlot_2D_ggplot(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  genes_high_color = "darkred",
  genes_mid_color = "white",
  genes_low_color = "darkblue",
  show_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  edge_alpha = NULL,
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  midpoint = 0,
  scale_alpha_with_expression = FALSE,
  point_size = 1,
  point_border_col = "black",
  point_border_stroke = 0.1,
  show_legend = T,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_plots = F
)
```

Arguments

`gobject` giotto object

`expression_values`
gene expression values to use

`genes` genes to show

`genes_high_color`
color represents high gene expression

`genes_mid_color`
color represents middle gene expression

`genes_low_color`
color represents low gene expression

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name`
name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`spatial_grid_name`
name of spatial grid to use

`midpoint` expression midpoint

`scale_alpha_with_expression`
scale expression with ggplot alpha parameter

`point_size` size of point (cell)

`point_border_col`
color of border around points

`point_border_stroke`
stroke size of border around points

`show_legend` show legend

`cow_n_col` cowplot param: how many columns

`cow_rel_h` cowplot param: relative height

`cow_rel_w` cowplot param: relative width

`cow_align` cowplot param: how to align

`show_plots` show plots

Details

Description of parameters.

Value

ggplot

Examples

```
visGenePlot_2D_ggplot(gobject)
```

`visGenePlot_3D_plotly` *visGenePlot_3D_plotly*

Description

Visualize cells and gene expression according to spatial coordinates

Usage

```
visGenePlot_3D_plotly(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  genes,
  show_network = F,
  network_color = NULL,
  spatial_network_name = "spatial_network",
  edge_alpha = NULL,
  show_grid = F,
  genes_high_color = NULL,
  genes_mid_color = "white",
  genes_low_color = "blue",
  spatial_grid_name = "spatial_grid",
  point_size = 1,
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plots = F
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`genes`	genes to show
`show_network`	show underlying spatial network
`network_color`	color of spatial network
`spatial_network_name`	name of spatial network to use
`show_grid`	show spatial grid
`genes_high_color`	color represents high gene expression
`genes_mid_color`	color represents middle gene expression
`genes_low_color`	color represents low gene expression
`spatial_grid_name`	name of spatial grid to use
`point_size`	size of point (cell)
`show_legend`	show legend
`axis_scale`	three mode to adjust axis scale
`x_ticks`	number of ticks on x axis
`y_ticks`	number of ticks on y axis

`z_ticks`	number of ticks on z axis
`show_plots`	show plots
`grid_color`	color of spatial grid
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align

Details

Description of parameters.

Value

plotly

Examples

```
visGenePlot_3D_plotly(gobject)
```

visPlot *visPlot*

Description

Visualize cells according to spatial coordinates

Usage

```
visPlot(
  gobject,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  show_network = F,
  network_color = NULL,
  network_alpha = 1,
  other_cell_alpha = 0.1,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  grid_alpha = 1,
  spatial_grid_name = "spatial_grid",
  coord_fix_ratio = 0.6,
  title = "",
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  plot_method = c("ggplot", "plotly"),
  show_plot = F,
  return_plot = TRUE,
  save_plot = F,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  save_format = NULL,
  show_saved_plot = F,
  ...
)
```

Arguments

gobject	giotto object
sdimx	x-axis dimension name (default = 'sdimx')
sdimy	y-axis dimension name (default = 'sdimy')
sdimz	z-axis dimension name (default = 'sdimz')
point_size	size of point (cell)
point_border_col	color of border around points
point_border_stroke	stroke size of border around points
cell_color	color for cells (see details)
cell_color_code	named vector with colors
color_as_factor	convert color column to factor
select_cell_groups	select subset of cells/clusters based on cell_color parameter
select_cells	select subset of cells based on cell IDs
show_other_cells	display not selected cells
other_cell_color	color of not selected cells
show_network	show underlying spatial network
network_color	color of spatial network
spatial_network_name	name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`spatial_grid_name` name of spatial grid to use

`coord_fix_ratio` fix ratio between x and y-axis

`title` title of plot

`show_legend` show legend

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_dir` directory to save the plot

`save_folder` (optional) folder in directory to save the plot

`save_name` name of plot

`save_format` format of plot (e.g. tiff, png, pdf, ...)

`show_saved_plot` load & display the saved plot

Details

Description of parameters.

Value

ggplot

Examples

```
visPlot(gobject)
```

`visPlot_2D_ggplot` *visPlot_2D_ggplot*

Description

Visualize cells according to spatial coordinates

Usage

```
visPlot_2D_ggplot(
  gobject,
  sdimx = NULL,
  sdimy = NULL,
  point_size = 3,
  point_border_col = "black",
  point_border_stroke = 0.1,
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  show_network = F,
  network_color = NULL,
  network_alpha = 1,
  other_cells_alpha = 0.1,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  spatial_grid_name = "spatial_grid",
  coord_fix_ratio = 0.6,
  title = "",
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = F,
  return_plot = TRUE,
  save_plot = F,
  save_dir = NULL,
  save_folder = NULL,
  save_name = NULL,
  save_format = NULL,
  show_saved_plot = F,
  ...
)
```

Arguments

`gobject` giotto object

`sdimx` x-axis dimension name (default = 'sdimx')

`sdimy` y-axis dimension name (default = 'sdimy')

`point_size` size of point (cell)

`point_border_col`
color of border around points

`point_border_stroke`
stroke size of border around points

`cell_color` color for cells (see details)

`cell_color_code`
named vector with colors

`color_as_factor`
convert color column to factor

`select_cell_groups`
select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells`	display not selected cells
`other_cell_color`	color of not selected cells
`show_network`	show underlying spatial network
`network_color`	color of spatial network
`spatial_network_name`	name of spatial network to use
`show_grid`	show spatial grid
`grid_color`	color of spatial grid
`spatial_grid_name`	name of spatial grid to use
`coord_fix_ratio`	fix ratio between x and y-axis
`title`	title of plot
`show_legend`	show legend
`show_plot`	show plot
`return_plot`	return ggplot object
`save_plot`	directly save the plot [boolean]
`save_dir`	directory to save the plot
`save_folder`	(optional) folder in directory to save the plot
`save_name`	name of plot
`save_format`	format of plot (e.g. tiff, png, pdf, ...)
`show_saved_plot`	load & display the saved plot

Details

Description of parameters.

Value

ggplot

Examples

```
visPlot_2D_ggplot(gobject)
```

visPlot_2D_plotly *visPlot_2D_plotly*

Description

Visualize cells according to spatial coordinates

Usage

```
visPlot_2D_plotly(
  gobject,
  sdimx = NULL,
  sdimy = NULL,
  point_size = 3,
  cell_color = NULL,
  cell_color_code = NULL,
  color_as_factor = T,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_network = F,
  network_color = "lightgray",
  network_alpha = 1,
  other_cell_alpha = 0.5,
  spatial_network_name = "spatial_network",
  show_grid = F,
  grid_color = NULL,
  grid_alpha = 1,
  spatial_grid_name = "spatial_grid",
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  show_plot = F
)
```

Arguments

`gobject`	giotto object
`sdimx`	x-axis dimension name (default = 'sdimx')
`sdimy`	y-axis dimension name (default = 'sdimy')
`point_size`	size of point (cell)
`cell_color`	color for cells (see details)
`cell_color_code`	named vector with colors
`color_as_factor`	convert color column to factor

`select_cell_groups`
: select a subset of the groups from cell_color

`show_network` show underlying spatial network

`network_color` color of spatial network

`spatial_network_name`
: name of spatial network to use

`show_grid` show spatial grid

`grid_color` color of spatial grid

`grid_alpha` alpha of spatial grid

`spatial_grid_name`
: name of spatial grid to use

`show_legend` show legend

`show_plot` show plot

Details

Description of parameters.

Value

plotly

Examples

```
visPlot_2D_plotly(gobject)
```

visPlot_3D_plotly *visPlot_3D_plotly*

Description

Visualize cells according to spatial coordinates

Usage

```
visPlot_3D_plotly(
  gobject,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  point_size = 3,
  cell_color = NULL,
  cell_color_code = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  other_point_size = 0.5,
  show_network = F,
  network_color = NULL,
  network_alpha = 1,
  other_cell_alpha = 0.5,
  spatial_network_name = "spatial_network",
  spatial_grid_name = "spatial_grid",
  title = "",
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = F
)
```

Arguments

`gobject`	giotto object
`sdimx`	x-axis dimension name (default = 'sdimx')
`sdimy`	y-axis dimension name (default = 'sdimy')
`sdimz`	z-axis dimension name (default = 'sdimz')
`point_size`	size of point (cell)
`cell_color`	color for cells (see details)
`cell_color_code`	named vector with colors
`select_cell_groups`	select a subset of the groups from cell_color
`show_network`	show underlying spatial network
`network_color`	color of spatial network
`spatial_network_name`	name of spatial network to use
`spatial_grid_name`	name of spatial grid to use
`title`	title of plot
`show_legend`	show legend
`show_plot`	show plot
`point_border_col`	color of border around points
`point_border_stroke`	stroke size of border around points
`color_as_factor`	convert color column to factor
`show_grid`	show spatial grid
`grid_color`	color of spatial grid
`coord_fix_ratio`	fix ratio between x and y-axis

Details

Description of parameters.

Value

ggplot

Examples

```
visPlot_3D_plotly(gobject)
```

`visSpatDimGenePlot` *visSpatDimGenePlot*

Description

integration of visSpatDimGenePlot_2D(ggplot) and visSpatDimGenePlot_3D(plotly)

Usage

```
visSpatDimGenePlot(
  gobject,
  plot_method = c("ggplot", "plotly"),
  expression_values = c("normalized", "scaled", "custom"),
  plot_alignment = c("horizontal", "vertical"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = NULL,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  genes,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  edge_alpha_dim = NULL,
  scale_alpha_with_expression = FALSE,
  label_size = 16,
  genes_low_color = "blue",
  genes_mid_color = "white",
  genes_high_color = "red",
  dim_point_size = 3,
  nn_network_alpha = 0.5,
  show_spatial_network = F,
  spatial_network_name = "spatial_network",
  network_color = "lightgray",
  spatial_network_alpha = 0.5,
  show_spatial_grid = F,
  spatial_grid_name = "spatial_grid",
  spatial_grid_color = NULL,
  spatial_grid_alpha = 0.5,
  spatial_point_size = 3,
  spatial_point_border_col = "black",
  spatial_point_border_stroke = 0.1,
  legend_text_size = 12,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  midpoint = 0,
  point_size = 1,
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  show_legend = T,
  show_plots = F
)
```

Arguments

`gobject`	giotto object
`expression_values`	gene expression values to use
`plot_alignment`	direction to align plot
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`dim3_to_use`	dimension to use on z-axis
`sdimx`	x-axis dimension name (default = ’sdimx’)
`sdimy`	y-axis dimension name (default = ’sdimy’)
`sdimz`	z-axis dimension name (default = ’sdimz’)
`genes`	genes to show
`dim_point_border_col`	color of border around points
`dim_point_border_stroke`	stroke size of border around points
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use, if show_NN_network = TRUE

`edge_alpha_dim`	dim reduction plot: column to use for alpha of the edges
`scale_alpha_with_expression`	scale expression with ggplot alpha parameter
`label_size`	size for the label
`genes_low_color`	color to represent low expression of gene
`genes_high_color`	color to represent high expression of gene
`dim_point_size`	dim reduction plot: point size
`spatial_network_name`	name of spatial network to use
`spatial_grid_name`	name of spatial grid to use
`spatial_point_size`	spatial plot: point size
`spatial_point_border_col`	color of border around points
`spatial_point_border_stroke`	stroke size of border around points
`legend_text_size`	the size of the text in legend
`axis_scale`	three modes to adjust axis scale ratio
`custom_ratio`	set the axis scale ratio on custom
`x_ticks`	number of ticks on x axis
`y_ticks`	number of ticks on y axis
`z_ticks`	number of ticks on z axis
`midpoint`	size of point (cell)
`point_size`	size of point (cell)
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_legend`	show legend
`show_plot`	show plot

Details

Description of parameters.

Value

ggplot or plotly

Examples

```
visSpatDimGenePlot(gobject)
```

visSpatDimGenePlot_2D *visSpatDimGenePlot_2D*

Description

Visualize cells according to spatial AND dimension reduction coordinates in ggplot mode

Usage

```
visSpatDimGenePlot_2D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  plot_alignment = c("horizontal", "vertical"),
  genes,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  show_NN_network = F,
  show_spatial_network = F,
  show_spatial_grid = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  edge_alpha_dim = NULL,
  scale_alpha_with_expression = FALSE,
  spatial_network_name = "spatial_network",
  spatial_grid_name = "spatial_grid",
  spatial_point_size = 1,
  spatial_point_border_col = "black",
  spatial_point_border_stroke = 0.1,
  midpoint = 0,
  genes_high_color = "red",
  genes_mid_color = "white",
  genes_low_color = "blue",
  cow_n_col = 2,
  cow_rel_h = 1,
  cow_rel_w = 1,
  cow_align = "h",
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  show_legend = T,
  show_plots = F
)
```

Arguments

gobject	giotto object

`expression_values`	gene expression values to use
`plot_alignment`	direction to align plot
`genes`	genes to show
`dim_reduction_to_use`	dimension reduction to use
`dim_reduction_name`	dimension reduction name
`dim1_to_use`	dimension to use on x-axis
`dim2_to_use`	dimension to use on y-axis
`point_size`	size of point (cell)
`dim_point_border_col`	color of border around points
`dim_point_border_stroke`	stroke size of border around points
`show_NN_network`	show underlying NN network
`nn_network_to_use`	type of NN network to use (kNN vs sNN)
`network_name`	name of NN network to use, if show_NN_network = TRUE
`edge_alpha_dim`	dim reduction plot: column to use for alpha of the edges
`scale_alpha_with_expression`	scale expression with ggplot alpha parameter
`spatial_network_name`	name of spatial network to use
`spatial_grid_name`	name of spatial grid to use
`spatial_point_size`	spatial plot: point size
`spatial_point_border_col`	color of border around points
`spatial_point_border_stroke`	stroke size of border around points
`midpoint`	size of point (cell)
`cow_n_col`	cowplot param: how many columns
`cow_rel_h`	cowplot param: relative height
`cow_rel_w`	cowplot param: relative width
`cow_align`	cowplot param: how to align
`show_legend`	show legend
`dim_point_size`	dim reduction plot: point size
`show_plot`	show plot

Details

Description of parameters.

Value

ggplot

Examples

```
visSpatDimGenePlot_2D(gobject)
```

---

visSpatDimGenePlot_3D *visSpatDimGenePlot_3D*

Description

Visualize cells according to spatial AND dimension reduction coordinates in plotly mode

Usage

```
visSpatDimGenePlot_3D(
  gobject,
  expression_values = c("normalized", "scaled", "custom"),
  plot_alignment = c("horizontal", "vertical"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = NULL,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  genes,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  label_size = 16,
  genes_low_color = "blue",
  genes_mid_color = "white",
  genes_high_color = "red",
  dim_point_size = 3,
  nn_network_alpha = 0.5,
  show_spatial_network = F,
  spatial_network_name = "spatial_network",
  network_color = "lightgray",
  spatial_network_alpha = 0.5,
  show_spatial_grid = F,
  spatial_grid_name = "spatial_grid",
  spatial_grid_color = NULL,
  spatial_grid_alpha = 0.5,
  spatial_point_size = 3,
  legend_text_size = 12,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL
)
```

Arguments

`gobject` giotto object

`plot_alignment` direction to align plot

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`genes_low_color` color represent high gene expression (see details)

`genes_high_color` color represent high gene expression (see details)

`nn_network_alpha` column to use for alpha of the edges

`show_spatial_network` show spatial network

`spatial_network_name` name of spatial network to use

`network_color` color of spatial/nn network

`spatial_network_alpha` alpha of spatial network

`show_spatial_grid` show spatial grid

`spatial_grid_name` name of spatial grid to use

`spatial_grid_color` color of spatial grid

`spatial_grid_alpha` alpha of spatial grid

`legend_text_size` text size of legend

`show_legend` show legend

`show_plot` show plot

Details

Description of parameters.

Value

plotly

Examples

```
visSpatDimPlot_3D(gobject)
```

visSpatDimPlot *visSpatDimPlot*

Description

integration of visSpatDimPlot_2D and visSpatDimPlot_3D

Usage

```
visSpatDimPlot(
  gobject,
  plot_method = c("ggplot", "plotly"),
  plot_alignment = NULL,
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = NULL,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = NULL,
  label_fontface = "bold",
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  dim_point_size = 3,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  nn_network_alpha = NULL,
  show_spatial_network = F,
  spatial_network_name = "spatial_network",
  network_color = "lightgray",
  spatial_network_alpha = 0.5,
  show_spatial_grid = F,
  spatial_grid_name = "spatial_grid",
  spatial_grid_color = NULL,
  spatial_grid_alpha = 0.5,
  spatial_point_size = 3,
  legend_text_size = 12,
  spatial_point_border_col = "black",
  spatial_point_border_stroke = 0.1,
  show_legend = T,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  show_plot = F
)
```

Arguments

`gobject` giotto object

`plot_alignment` direction to align plot

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`select_cell_groups` select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells` display not selected cells

`other_cell_color` color of not selected cells

`nn_network_alpha` column to use for alpha of the edges

`show_spatial_network` show spatial network

`spatial_network_name`
: name of spatial network to use

`spatial_network_alpha`
: alpha of spatial network

`show_spatial_grid`
: show spatial grid

`spatial_grid_name`
: name of spatial grid to use

`spatial_grid_color`
: color of spatial grid

`spatial_grid_alpha`
: alpha of spatial grid

`legend_text_size`
: text size of legend

`show_legend` show legend

`show_plot` show plot

`plot_mode` choose the mode to draw plot : ggplot or plotly

`spatial_network_color`
: color of spatial network

Details

Description of parameters.

Value

ggplot or plotly

Examples

```
visSpatDimPlot(gobject)
```

`visSpatDimPlot_2D` *visSpatDimPlot_2D*

Description

Visualize cells according to spatial AND dimension reduction coordinates in ggplot2 mode

Usage

```
visSpatDimPlot_2D(
  gobject,
  plot_alignment = c("vertical", "horizontal"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  sdimx = NULL,
  sdimy = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 4,
  label_fontface = "bold",
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  select_cell_groups = NULL,
  select_cells = NULL,
  show_other_cells = T,
  other_cell_color = "lightgrey",
  dim_plot_mode = NULL,
  dim_point_size = 1,
  dim_point_border_col = "black",
  dim_point_border_stroke = 0.1,
  nn_network_alpha = 0.05,
  show_spatial_network = F,
  spatial_network_name = "spatial_network",
  spatial_network_color = NULL,
  show_spatial_grid = F,
  spatial_grid_name = "spatial_grid",
  spatial_grid_color = NULL,
  spatial_point_size = 1,
  spatial_point_border_col = "black",
  spatial_point_border_stroke = 0.1,
  show_legend = T,
  show_plot = F,
  plot_method = "ggplot"
)
```

Arguments

`gobject` giotto object

`plot_alignment` direction to align plot

`dim_reduction_to_use`
dimension reduction to use

`dim_reduction_name`
dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`show_NN_network`
show underlying NN network

`nn_network_to_use`
type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor`
: convert color column to factor

`cell_color_code`
: named vector with colors

`select_cell_groups`
: select subset of cells/clusters based on cell_color parameter

`select_cells` select subset of cells based on cell IDs

`show_other_cells`
: display not selected cells

`other_cell_color`
: color of not selected cells

`nn_network_alpha`
: column to use for alpha of the edges

`show_spatial_network`
: show spatial network

`spatial_network_name`
: name of spatial network to use

`spatial_network_color`
: color of spatial network

`show_spatial_grid`
: show spatial grid

`spatial_grid_name`
: name of spatial grid to use

`spatial_grid_color`
: color of spatial grid

`show_legend` show legend

`show_plot` show plot

`return_plot` return ggplot object

`save_plot` directly save the plot [boolean]

`save_dir` directory to save the plot

`save_folder` (optional) folder in directory to save the plot

`save_name` name of plot

`save_format` format of plot (e.g. tiff, png, pdf, ...)

`show_saved_plot`
: load & display the saved plot

Details

Description of parameters.

Value

ggplot

Examples

```
visSpatDimPlot_2D(gobject)
```

visSpatDimPlot_3D *visSpatDimPlot_3D*

Description

Visualize cells according to spatial AND dimension reduction coordinates in plotly mode

Usage

```
visSpatDimPlot_3D(
  gobject,
  plot_alignment = c("horizontal", "vertical"),
  dim_reduction_to_use = "umap",
  dim_reduction_name = "umap",
  dim1_to_use = 1,
  dim2_to_use = 2,
  dim3_to_use = NULL,
  sdimx = NULL,
  sdimy = NULL,
  sdimz = NULL,
  show_NN_network = F,
  nn_network_to_use = "sNN",
  network_name = "sNN.pca",
  show_cluster_center = F,
  show_center_label = T,
  center_point_size = 4,
  label_size = 16,
  cell_color = NULL,
  color_as_factor = T,
  cell_color_code = NULL,
  dim_point_size = 3,
  nn_network_alpha = 0.5,
  show_spatial_network = F,
  spatial_network_name = "spatial_network",
  network_color = "lightgray",
  spatial_network_alpha = 0.5,
  show_spatial_grid = F,
  spatial_grid_name = "spatial_grid",
  spatial_grid_color = NULL,
  spatial_grid_alpha = 0.5,
  spatial_point_size = 3,
  axis_scale = c("cube", "real", "custom"),
  custom_ratio = NULL,
  x_ticks = NULL,
  y_ticks = NULL,
  z_ticks = NULL,
  legend_text_size = 12
)
```

Arguments

gobject	giotto object

`plot_alignment` direction to align plot

`dim_reduction_to_use` dimension reduction to use

`dim_reduction_name` dimension reduction name

`dim1_to_use` dimension to use on x-axis

`dim2_to_use` dimension to use on y-axis

`dim3_to_use` dimension to use on z-axis

`show_NN_network` show underlying NN network

`nn_network_to_use` type of NN network to use (kNN vs sNN)

`network_name` name of NN network to use, if show_NN_network = TRUE

`cell_color` color for cells (see details)

`color_as_factor` convert color column to factor

`cell_color_code` named vector with colors

`nn_network_alpha` column to use for alpha of the edges

`show_spatial_network` show spatial network

`spatial_network_name` name of spatial network to use

`spatial_network_alpha` alpha of spatial network

`show_spatial_grid` show spatial grid

`spatial_grid_name` name of spatial grid to use

`spatial_grid_color` color of spatial grid

`spatial_grid_alpha` alpha of spatial grid

`legend_text_size` text size of legend

`spatial_network_color` color of spatial network

`show_legend` show legend

`show_plot` show plot

Details

Description of parameters.

Value

plotly

Examples

```
visSpatDimPlot_3D(gobject)
```

writeHMRFresults *writeHMRFresults*

Description

write results from doHMRF to a data.table.

Usage

```
writeHMRFresults(
  gobject,
  HMRFoutput,
  k = NULL,
  betas_to_view = NULL,
  print_command = F
)
```

Arguments

`gobject`	giotto object
`HMRFoutput`	HMRF output from doHMRF
`k`	k to write results for
`betas_to_view`	results from different betas that you want to view
`print_command`	see the python command

Value

data.table with HMRF results for each b and the selected k

Examples

```
writeHMRFresults(gobject)
```

write_giotto_viewer_annotation *write_giotto_viewer_annotation*

Description

write out factor-like annotation data from a giotto object for the Viewer

Usage

```
write_giotto_viewer_annotation(
  annotation,
  annot_name = "test",
  output_directory = getwd()
)
```

Arguments

`annotation` annotation from the data.table from giotto object

`annot_name` name of the annotation

`output_directory`
directory where to save the files

Value

write a .txt and .annot file for the selection annotation

`write_giotto_viewer_dim_reduction`
write_giotto_viewer_dim_reduction

Description

write out dimensional reduction data from a giotto object for the Viewer

Usage

```
write_giotto_viewer_dim_reduction(
  dim_reduction_cell,
  dim_red = NULL,
  dim_red_name = NULL,
  dim_red_rounding = NULL,
  dim_red_rescale = c(-20, 20),
  output_directory = getwd()
)
```

Arguments

`dim_reduction_cell`
dimension reduction slot from giotto object

`dim_red` high level name of dimension reduction

`dim_red_name` specific name of dimension reduction to use

`dim_red_rounding`
numerical indicating how to round the coordinates

`dim_red_rescale`
numericals to rescale the coordinates

`output_directory`
directory where to save the files

Value

write a .txt and .annot file for the selection annotation

write_giotto_viewer_numeric_annotation *write_giotto_viewer_numeric_annotation*

Description

write out numeric annotation data from a giotto object for the Viewer

Usage

```
write_giotto_viewer_numeric_annotation(
  annotation,
  annot_name = "test",
  output_directory = getwd()
)
```

Arguments

`annotation`	annotation from the data.table from giotto object
`annot_name`	name of the annotation
`output_directory`	directory where to save the files

Value

write a .txt and .annot file for the selection annotation

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