

Package ‘Director’

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Title A dynamic visualization tool of multi-level data

Version 1.33.0

Description Director is an R package designed to streamline the visualization of molecular effects in regulatory cascades. It utilizes the R package htmltools and a modified Sankey plugin of the JavaScript library D3 to provide a fast and easy, browser-enabled solution to discovering potentially interesting downstream effects of regulatory and/or co-expressed molecules. The diagrams are robust, interactive, and packaged as highly-portable HTML files that eliminate the need for third-party software to view. This enables a straightforward approach for scientists to interpret the data produced, and bioinformatics developers an alternative means to present relevant data.

URL <https://github.com/kzouchka/Director>

BugReports <https://github.com/kzouchka/Director/issues>

Depends R (>= 4.0)

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Imports htmltools, utils, grDevices

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Contents

append2List	2
createList	3
drawSankey	4
filterNumeric	5
filterRelation	6
filterSubset	7
initSankey	8
makeSankey	9
mesenchymal	10
poorprog	11
writeSankey	11

Index	13
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append2List	<i>append2List</i>
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Description

Appends a data frame containing additional relationship information to an existing List having 6 columns: source, target, description, value, sourcefc, targetfc. Order matters! For example, add a map of transcripts to genes to a List of miRNAs and their target transcripts so that the final List connects miRNAs -> transcripts -> genes.

Usage

```
append2List(List, appendList, description = "description",
             sourcefc = "sourcefc", targetfc = "targetfc", value = "value",
             target = "target", source = "source", appendMatch = TRUE)
```

Arguments

List	Data frame containing the necessary columns above. e.g. Formatted with createList function.
appendList	Data frame or matrix to append to List.
description	Column name of appendList corresponding to the descriptions to append.
sourcefc	Column name of appendList corresponding to the sourcefcs to append.
targetfc	Column name of appendList corresponding to the targetfcs to append.
value	Column name of appendList corresponding to the relationship values to append.
target	Column name of appendList corresponding to the targets to append.
source	Column name of appendList corresponding to the sources to append.
appendMatch	Filter and remove 1) rows in List that contain targets without a corresponding source in appendList, and 2) rows in appendList that contain sources without a corresponding target in List.

Value

a combined List.

Examples

```
tempList <- createList(data.frame(source=c("A","B","C"),
  target=c("D","E","G"),
  description=c("consonant","vowel","consonant"),
  value=runif(3,-1,1),
  sourcefc=runif(3,-2,2),
  targetfc=runif(3,-2,2)))
tempAppendList <- data.frame(source="D",target="I",
  description="vowel",value=runif(1,-1,1),
  sourcefc=runif(1,-2,2), targetfc=runif(1,-2,2))
append2List(tempList,tempAppendList) # Will combine only 1 row from each list.
append2List(tempList,tempAppendList, appendMatch=FALSE) # Will combine all rows
```

<code>createList</code>	<i>createList</i>
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Description

Take a subset of the input data frame or matrix corresponding to the required Sankey values.

Usage

```
createList(inputList, inputFC = NULL, node = "genes", fc = "foldChange",
  source = "source", target = "target", description = "description",
  value = "value", sourcefc = "sourcefc", targetfc = "targetfc")
```

Arguments

<code>inputList</code>	Data frame or matrix containing the necessary parameters described below.
<code>inputFC</code>	Data frame or matrix containing node names (source and target) and corresponding quantitative values. If this input is defined, then input-specific parameters 'node' and 'fc' should be defined. Inputs 'source', 'target', 'description' and 'value' are still referenced from <code>inputList</code> .
<code>node</code>	Column name of <code>inputFC</code> containing names to display of source and target nodes. Paths defined in <code>inputList</code> identify which nodes are sources and which are targets.
<code>fc</code>	Column name of <code>inputFC</code> containing quantitative values representing the nodes.
<code>source</code>	Column name of <code>inputList</code> containing names to display of starting nodes. Paths are drawn from these points to their corresponding target nodes.
<code>target</code>	Column name of <code>inputList</code> containing names to display of destination nodes. Paths are drawn to these point from their corresponding source nodes.

description	Optional column name of inputList containing additional information about connection, e.g. the gene name of a transcript target node, or family name of related target genes.
value	Column name of inputList containing quantitative values representing the relationship between sources and targets.
sourcefc	Column name of inputList containing quantitative values representing the sources.
targetfc	Column name of inputList containing quantitative values representing the targets.

Value

a data.frame List

Examples

```
nodevals <- runif(5,-2,2)
templist <- data.frame(source=c("A","B","C","D"),
  target=c("C","D","E","E"),
  addedInfo=c("c","d","vowel","vowel"),
  relationValue=runif(4,-1,1),
  sourceValue=nodevals[1:4],
  targetValue=nodevals[c(3,4,5,5)])
tempFC <- data.frame(genes=c("A","B","C","D","E"), foldChange=runif(5,-2,2))
# inputList only
createList(templist, description="addedInfo", value="relationValue",
  sourcefc="sourceValue", targetfc="targetValue")
# inputList and inputFC
createList(templist, tempFC, value="relationValue",sourcefc="sourceValue",
  targetfc="targetValue")
```

drawSankey

drawSankey

Description

Create an HTML document that can be viewed and saved to file. Diagram properties can be modified in this function, `makeSankey()` and `initSankey()`.

Usage

```
drawSankey(List, height = NULL, legendfont = "sans-serif",
  legendsize = 12, width = 1000, caption = "Sankey figure",
  nodeValue = "node values", pathValue = "path values", directory = NULL)
```

Arguments

List	Data frame containing 6 columns: source, target, description, value, sourcefc, targetfc.
height	Pixel height of the figure to draw. If empty, the figure will be given a pixel height proportional to the number of rows in List up to a maximum 1800px or minimum of 300px. These can be overridden by defining this parameter.
legendfont	Font of the legend text.
legendsize	Font size of the legend text.
width	Pixel width of the figure to draw. By default, 1000px.
caption	Sankey figure caption. HTML formatting is possible.
nodeValue	Description of node scale in legend.
pathValue	Description of path scale in legend.
directory	Absolute path to output directory. If null, the working directory obtained from getwd() will be used. This is required if D3 and sankey JS files were downloaded with initSankey().

Value

HTML document containing diagram.

Examples

```
Level1 <- createList(poorprog$Level1)
Level2 <- createList(poorprog$Level2)
templist <- append2List(Level1,Level2)
initSankey()
templist2 <- makeSankey(templist, averagePath=TRUE)
sankey <- drawSankey(templist2)
library(htmltools) # can also be launched with
html_print(sankey)
```

filterNumeric

filterNumeric

Description

Filter a quantitative column in List for minimum, maximum, or absolute value.

Usage

```
filterNumeric(List, column, min = NULL, max = NULL, absolute = NULL)
```

Arguments

List	Data frame containing 6 columns: source, target, description, value, sourcefc, targetfc.
column	Name of column in List to filter.
min	Minimum value to filter for in column.
max	Maximum value to filter for in column.
absolute	Absolute value to filter for in column.

Value

a filtered List

Examples

```
templist <- createList(data.frame(source=c("A","B","C"),
  target=c("D","E","G"),
  description=c("consonant","vowel","consonant"),
  value=runif(3,-1,1),
  sourcefc=runif(3,-2,2),
  targetfc=runif(3,-2,2)))
filterNumeric(templist,"sourcefc", absolute=0.5)
filterNumeric(templist, "targetfc", max=0) # only take down-regulated targets
```

filterRelation	<i>filterRelation</i>
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Description

Filter source-target relationships in List for a specific type: inversely related sourcefc-targetfc pairs only (inverseFC), positively related sourcefc-targetfc pairs only (correlatedFC), negative value scores only (inverseValue), or positive value scores only (correlatedValue). Default is to not apply any filtering.

Usage

```
filterRelation(List, relation = c("none", "inverseFC", "correlatedFC",
  "inverseValue", "correlatedValue"), sourcefc = "sourcefc",
  targetfc = "targetfc", value = "value")
```

Arguments

List	Data frame containing 6 columns: source, target, description, value, sourcefc, targetfc.
relation	One of: none, inverseFC, correlatedFC, inverseValue, correlatedValue. Default is none.
sourcefc	Column name of List corresponding to sourcefcs to filter.
targetfc	Column name of List correspondig to targetfcs to filter.
value	Column name of List correspondig to value to filter.

Value

a filtered List.

Examples

```
tempList <- createList(data.frame(source=c("A","B","C"),
  target=c("D","E","G"),
  description=c("consonant","vowel","consonant"),
  value=runif(3,-1,1),
  sourcefc=runif(3,-2,2),
  targetfc=runif(3,-2,2)))
filterRelation(tempList,"inverseValue")
filterRelation(tempList,"correlatedValue")
filterRelation(tempList,"inverseFC")
filterRelation(tempList,"correlatedFC")
```

 filterSubset

filterSubset

Description

Filter up to two qualitative columns (source and target) in List for a subset of names.

Usage

```
filterSubset(List, sourceSubset = NULL, targetSubset = NULL,
  invert = FALSE, source = "source", target = "target",
  join = c("union", "intersect"))
```

Arguments

List	Data frame containing 6 columns: source, target, description, value, sourcefc, targetfc.
sourceSubset	Vector of source names to keep.
targetSubset	Vector of target names to keep.
invert	Take the inverse selection of defined subset.
source	Column name of List containing source names.
target	Column name of List containing target names.
join	If both subsets are defined, take either union or intersect of subsets found.

Value

a filtered List

Examples

```

templist <- createList(data.frame(source=c("A","B","C"),
  target=c("D","E","G"),
  description=c("consonant","vowel","consonant"),
  value=runif(3,-1,1),
  sourcefc=runif(3,-2,2),
  targetfc=runif(3,-2,2)))
filterSubset(templist,source="source", target="description",
sourceSubset="C", targetSubset="consonant")
filterSubset(templist,target="description", targetSubset="consonant")
filterSubset(templist,target="description", targetSubset="consonant", invert=TRUE)

```

`initSankey`*initSankey*

Description

Internally generates supporting JavaScript and CSS files.

Usage

```

initSankey(pathOpacity = 0.2, pathHover = 0.5,
  font = "lato, helvetica, sans-serif", fontsize = NULL,
  fontsizeProportion = TRUE, d3js = NULL, sankeyjsFile = NULL,
  d3jsMethod = "auto", sankeyjsMethod = "auto")

```

Arguments

<code>pathOpacity</code>	Opacity of connecting path between nodes in the figure.
<code>pathHover</code>	Opacity of connecting path between nodes upon mouseover.
<code>font</code>	Font used for the node names and additional mouseover text in figure.
<code>fontsize</code>	Pixel font size used for the visible node names. Use to adjust range of font sizes (with proportions) or to set a single font size when <code>fontsizeProportion</code> is disabled.
<code>fontsizeProportion</code>	Boolean to enable/disable text being proportional to node widths. When enabled, all node names will appear with parameter <code>fontsize</code> .
<code>d3js</code>	Path to download latest zip version of D3 library. e.g. https://github.com/mbostock/d3/releases/download/ See http://www.d3js.org for more details. If NULL, will use version 3.5.16 currently installed with Director.
<code>sankeyjsFile</code>	Path to download sankey javascript file. If NULL, will use version installed with Director (https://raw.githubusercontent.com/d3/d3-plugins/master/sankey/sankey.js)
<code>d3jsMethod</code>	Function method to use to download D3 library. <code>?download.file</code> for more detail on parameter.
<code>sankeyjsMethod</code>	Function method to use to download sankey script. <code>?download.file</code> for more detail on parameter.

Value

global JavaScript and CSS files.

Examples

```
initSankey() # Generates supporting JavaScript and CSS files.
```

makeSankey

makeSankey

Description

Takes a list of source-target pairs and assigns colours to nodes and connections based on value, sourcefc and targetfc. Output is a list with List\$reference = input List with additional description values, \$valDomain = path values, \$valRange = path colours, \$targetDomain = target names, \$targetRange = target node colours, \$sourceDomain = source names, \$sourceRange = source node colours.

Usage

```
makeSankey(List, averagePath = FALSE, nodeMin = "blue", nodeMax = "red",
  pathMin = "blue", pathMax = "red", noughtColor = "#f5f5f0",
  nought = 0, noughtPath = NULL, noughtPathColor = NULL)
```

Arguments

List	Data frame containing 6 columns: source, target, description, value, sourcefc, targetfc.
averagePath	Boolean to either keep List\$value as-is, or calculate List\$value for intermediary nodes (i.e. source nodes that were previously target nodes) as an average of previous path List\$values.
nodeMin	Colour assigned to minimum node value.
nodeMax	Colour assigned to maximum node value.
pathMin	Colour assigned to minimum path value.
pathMax	Colour assigned to maximum path value.
noughtColor	Colour assigned to nought value.
nought	'Zero' value dividing node and paths into two distinct sets. i.e. positive and negative.
noughtPath	Optional parameter that sets a different 'zero' value for paths than for nodes.
noughtPathColor	Optional parameter that assigns a different colour to the path 'zero' value from the node 'zero' value.

Value

a list of data.frames and colour vectors.

Examples

```
templist <- createList(data.frame(source=c("A","B","C"),
  target=c("D","E","G"),
  description=c("consonant","vowel","consonant"),
  value=runif(3,-1,1),
  sourcefc=runif(3,-2,2),
  targetfc=runif(3,-2,2)))
initSankey()
templist2 <- makeSankey(templist)
```

mesenchymal

Analysis results of Yang et al.'s (2013) master microRNA regulatory network

Description

Data frames listing a set of genes differentially expressed between mesenchymal and three other serous ovarian cancer subtypes, eight key miRNAs predicted to target them, and significantly enriched pathways (FDR < 0.1). Each row contains a miRNA-gene/gene-pathway pair, a description, expression correlation (path values), and expression fold-change (node values).

Usage

```
ovca
```

Format

a list instance containing 2 data frames.

Value

data frame

Source

The Cancer Genome Atlas. Yang et al., 2013.

poorprog	<i>Analysis results for poor prognosis serous ovarian cancer</i>
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Description

Data frames listing a set of genes differentially expressed between long surviving (good prognosis) and short surviving (poor prognosis) cases, their putative targeting miRNAs, and significantly enriched pathways (FDR < 0.1). Each row contains a miRNA-gene/gene-pathway pair, a description, expression correlation (path values), and expression fold-change (node values).

Usage

```
ovca
```

Format

a list instance containing 2 data frames.

Value

data frame

Source

The Cancer Genome Atlas

writeSankey	<i>writeSankey</i>
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Description

Save sankey figure as a simple HTML file accessible outside of R and shiny. Functions `initSankey`, `makeSankey` and `drawSankey` must be performed before this step to ensure a proper figure is saved.

Usage

```
writeSankey(name = NULL, title = NULL, directory = NULL)
```

Arguments

name	Name to give file. If no path given, the working directory OR path set in <code>Director</code> will be used. Same name will be given as the title.
title	Title of the HTML file produced. The file name is used by default.
directory	Absolute path to output directory. If null, the working directory obtained from <code>getwd()</code> will be used. If no absolute path is given (i.e. no "/" is grepped), it will assume a new folder will be created in the working directory.

Value

a dynamic HTML file in the specified directory that is readable in any internet browser so long as the 'www' subfolder is included.

Examples

```
Level1 <- createList(poorprog$Level1)
Level2 <- createList(poorprog$Level2)
tempList <- append2List(Level1,Level2)
initSankey() # initializes working directory
tempList2 <- makeSankey(tempList, averagePath=TRUE) # Calculate node and path values
sankey <- drawSankey(tempList2)
writeSankey("temp") # Save figure as the file 'temp.html' in working directory.
```

Index

- * **append**
 - append2List, 2
- * **download**
 - initSankey, 8
- * **draw**
 - drawSankey, 4
- * **filter**
 - filterNumeric, 5
 - filterRelation, 6
 - filterSubset, 7
- * **html**
 - writeSankey, 11
- * **input**
 - createList, 3
- * **sankey**
 - drawSankey, 4
 - initSankey, 8
 - makeSankey, 9
 - writeSankey, 11

append2List, 2

createList, 3

drawSankey, 4

filterNumeric, 5

filterRelation, 6

filterSubset, 7

initSankey, 8

makeSankey, 9

mesenchymal, 10

poorprog, 11

writeSankey, 11