Package 'graphlayouts'

August 20, 2019

Title Additional Layout Algorithms for Network Visualizations

Version 0.5.0

Maintainer David Schoch <david.schoch@manchester.ac.uk>

Description

Several new layout algorithms to visualize networks are provided which are not part of 'igraph'. Most are based on the concept of stress majorization by Gansner et al. (2004) <doi:10.1007/978-3-540-31843-9_25>.
Some more specific algorithms allow to emphasize hidden group structures in networks or focus on specific nodes.

URL https://github.com/schochastics/graphlayouts

BugReports https://github.com/schochastics/graphlayouts/issues

Depends R (>= 3.2.0)

License MIT + file LICENSE

Encoding UTF-8

LazyData true

Imports igraph, Rcpp

Suggests oaqc, testthat, ggraph, ggplot2, knitr, rmarkdown

LinkingTo Rcpp, RcppArmadillo

RoxygenNote 6.1.1

NeedsCompilation yes

Author David Schoch [aut, cre]

Repository CRAN

Date/Publication 2019-08-20 11:30:09 UTC

R topics documented:

`annotate_circle` *annotate concentric circles*

Description

annotate concentric circles

Usage

```
annotate_circle(cent, col = "#00BFFF", format = "", pos = "top",
  text_size = 3)
```

Arguments

`cent`	centrality scores used for layout
`col`	color of text
`format`	either empty string or 'scientific'
`pos`	position of text ('top' or 'bottom')
`text_size`	font size for annotations

Details

this function is best used with layout_with_centrality together with draw_circle.

Value

annotated concentric circles around origin

Examples

```
library(igraph)
library(ggraph)

g <- sample_gnp(10,0.4)
## Not run:
ggraph(g,layout = "centrality",centrality = closeness(g))+
 draw_circle(use = "cent")+
 annotate_circle(closeness(g),pos = "bottom",format = "scientific")+
 geom_edge_link()+
 geom_node_point(shape=21,fill="grey25",size=5)+
 theme_graph()+
 coord_fixed()

## End(Not run)
```

---

draw_circle *Draw concentric circles*

Description

Draw concentric circles

Usage

```
draw_circle(col = "#00BFFF", use = "focus", max.circle)
```

Arguments

col	color of circles
use	one of 'focus' or 'cent'
max.circle	if use = 'focus' specifies the number of circles to draw

Details

this function is best used with a concentric layout such as layout_with_focus and layout_with_centrality.

Value

concentric circles around origin

Examples

```
library(igraph)
library(ggraph)
g <- sample_gnp(10,0.4)

## Not run:
```

```
ggraph(g,layout = "centrality",centrality = degree(g))+
  draw_circle(use = "cent")+
  geom_edge_link()+
  geom_node_point(shape = 21,fill = "grey25",size = 5)+
  theme_graph()+
  coord_fixed()

## End(Not run)
```

`graphlayouts` *graphlayouts: layout algorithms for network visualizations*

Description

The package implements several new layout algorithms to visualize networks. Most are based on the concept of stress majorization. Some more specific algorithms allow to emphasize hidden group structures in networks or focus on specific nodes. The package is best used in conjunction with ggraph.

Details

Some features of the package are:

- `layout_with_stress()` is a state of the art deterministic layout algorithms.
- `layout_as_backbone()` uncovers hidden group structures (if they exist) by emphasizing strongly embedded edges.
- `layout_with_focus()` and `layout_with_centrality()` produce concentric layouts with a focal or most central nodes in the center.
- `layout_with_eigen()` implements some layout algorithms on the basis of eigenvectors
- `layout_with_sparse_stress()` sparse stress for large graphs
- `layout_with_pmds()` pivot MDS for large graphs.
- `layout_as_dynamic()` for longitudinal network data

A detailed tutorial can be found here.

graph_manipulate *Manipulate graph*

Description

functions to manipulate a graph

Usage

```
reorder_edges(g, attr, desc = TRUE)
```

Arguments

g	igraph object
attr	edge attribute name used to sort edges
desc	logical. sort in descending (default) or ascending order

Details

`reorder_edges()` allows to reorder edges according to an attribute so that edges are drawn in the given order.

Value

manipulated graph

Author(s)

David Schoch

Examples

```
library(igraph)
library(ggraph)

g <- sample_gnp(10,0.5)
E(g)$attr <- 1:ecount(g)
gn <- reorder_edges(g,"attr")
```

`layout_backbone` *backbone graph layout*

Description

emphasizes a hidden group structure if it exists in the graph. Calculates a layout for a sparsified network only including the most embedded edges. Deleted edges are added back after the layout is calculated.

Usage

```
layout_as_backbone(g, keep = 0.2, backbone = TRUE)

layout_igraph_backbone(g, keep = 0.2, backbone = TRUE, circular)
```

Arguments

g	igraph object
keep	fraction of edges to keep during backbone calculation
backbone	logical. Return edge ids of the backbone (Default: TRUE)
circular	not used

Details

The layout_igraph_* function should not be used directly. It is only used as an argument for plotting with 'igraph'. 'ggraph' natively supports the layout.

Value

list of xy coordinates and vector of edge ids included in the backbone

References

Nocaj, A., Ortmann, M., & Brandes, U. (2015). Untangling the hairballs of multi-centered, small-world online social media networks. Journal of Graph Algorithms and Applications: JGAA, 19(2), 595-618.

Examples

```
library(igraph)

g <- sample_islands(9,20,0.4,9)
g <- simplify(g)
V(g)$grp <- as.character(rep(1:9,each=20))
bb <- layout_as_backbone(g,keep=0.4)

# add backbone links as edge attribute
E(g)$col <- FALSE
```

```
E(g)$col[bb$backbone] <- TRUE
```

`layout_centrality` *radial centrality layout*

Description

arranges nodes in concentric circles according to a centrality index.

Usage

```
layout_with_centrality(g, cent, scale = TRUE, iter = 500,
  tol = 1e-04, tseq = seq(0, 1, 0.2))

layout_igraph_centrality(g, cent, scale = TRUE, iter = 500,
  tol = 1e-04, tseq = seq(0, 1, 0.2), circular)
```

Arguments

`g`	igraph object
`cent`	centrality scores
`scale`	logical. should centrality scores be scaled to $[0, 100]$? (Default: TRUE)
`iter`	number of iterations during stress optimization
`tol`	stopping criterion for stress optimization
`tseq`	numeric vector. increasing sequence of coefficients to combine regular stress and constraint stress. See details.
`circular`	not used

Details

The function optimizes a convex combination of regular stress and a constrained stress function which forces nodes to be arranged on concentric circles. The vector `tseq` is the sequence of parameters used for the convex combination. In iteration i of the algorithm $tseq[i]$ is used to combine regular and constraint stress as $(1 - tseq[i]) * stress_{regular} + tseq[i] * stress_{constraint}$. The sequence must be increasing, start at zero and end at one. The default setting should be a good choice for most graphs.

The layout_igraph_* function should not be used directly. It is only used as an argument for plotting with 'igraph'. 'ggraph' natively supports the layout.

Value

matrix of xy coordinates

References

Brandes, U., & Pich, C. (2011). More flexible radial layout. Journal of Graph Algorithms and Applications, 15(1), 157-173.

Examples

```
library(igraph)
library(ggraph)

g <- sample_gnp(10,0.4)
## Not run:
ggraph(g,layout="centrality",centrality = closeness(g))+
  draw_circle(use = "cent")+
  geom_edge_link0()+
  geom_node_point(shape = 21,fill = "grey25",size = 5)+
  theme_graph()+
  coord_fixed()

## End(Not run)
```

---

layout_dynamic *dynamic graph layout*

Description

Create layouts for longitudinal networks.

Usage

```
layout_as_dynamic(gList, weights = NA, alpha = 0.5, iter = 500,
  tol = 1e-04)
```

Arguments

gList	list of igraph objects. Each network must contain the same set of nodes.
weights	possibly a numeric vector with edge weights. If this is NULL and the graph has a weight edge attribute, then the attribute is used. If this is NA then no weights are used (even if the graph has a weight attribute). By default, weights are ignored. See details for more.
alpha	weighting of reference layout. See details.
iter	number of iterations during stress optimization
tol	stopping criterion for stress optimization

Details

The reference layout is calculated based on the union of all graphs. The parameter alpha controls the influence of the reference layout. For alpha=1, only the reference layout is used and all graphs have the same layout. For alpha=0, the stress layout of each individual graph is used. Values in-between interpolate between the two layouts.

Be careful when using weights. In most cases, the inverse of the edge weights should be used to ensure that the endpoints of an edges with higher weights are closer together (weights=1/E(g)$weight).

Value

list of coordinates for each graph

References

Brandes, U. and Indlekofer, N. and Mader, M. (2012). Visualization methods for longitudinal social networks and stochastic actor-oriented modeling. *Social Networks* 34 (3) 291-308

Examples

```
library(igraph)
g1 <- sample_gnp(20,0.2)
g2 <- sample_gnp(20,0.2)
g3 <- sample_gnp(20,0.2)

xy <- layout_as_dynamic(list(g1,g2,g3))

# layout for first network
xy[[1]]
```

---

layout_focus *radial focus layout*

Description

arrange nodes in concentric circles around a focal node according to their distance from the focus.

Usage

```
layout_with_focus(g, v, weights = NA, iter = 500, tol = 1e-04)

layout_igraph_focus(g, v, weights = NA, iter = 500, tol = 1e-04,
  circular)
```

Arguments

g	igraph object
v	id of focal node to be placed in the center
weights	possibly a numeric vector with edge weights. If this is NULL and the graph has a weight edge attribute, then the attribute is used. If this is NA then no weights are used (even if the graph has a weight attribute). By default, weights are ignored. See details for more.
iter	number of iterations during stress optimization
tol	stopping criterion for stress optimization
circular	not used

Details

Be careful when using weights. In most cases, the inverse of the edge weights should be used to ensure that the endpoints of an edges with higher weights are closer together (weights=1/E(g)$weight).

The layout_igraph_* function should not be used directly. It is only used as an argument for plotting with 'igraph'. 'ggraph' natively supports the layout.

Value

a list containing xy coordinates and the distances to the focal node

References

Brandes, U., & Pich, C. (2011). More flexible radial layout. *Journal of Graph Algorithms and Applications*, 15(1), 157-173.

Examples

```
library(igraph)
library(ggraph)
g <- sample_gnp(10,0.4)
coords <- layout_with_focus(g,v = 1)
coords
```

---

layout_manipulate *manipulate layout*

Description

functions to manipulate an existing layout

Usage

```
layout_rotate(xy, angle)

layout_mirror(xy, axis = "vertical")
```

Arguments

xy	graph layout
angle	angle for rotation
axis	mirror horizontal or vertical

Details

These functions are mostly useful for deterministic layouts such as layout_with_stress

Value

manipulated matrix of xy coordinates

Author(s)

David Schoch

Examples

```
library(igraph)
g <- sample_gnp(50,0.3)

xy <- layout_with_stress(g)

#rotate 90 degrees
xy <- layout_rotate(xy,90)

# flip horizontally
xy <- layout_mirror(xy,"horizontal")
```

---

layout_pmds *pivot MDS graph layout*

Description

similar to layout_with_mds but uses only a small set of pivots for MDS. Considerably faster than MDS and thus applicable for larger graphs.

Usage

```
layout_with_pmds(g, pivots, weights = NA)

layout_igraph_pmds(g, pivots, weights = NA, circular)
```

Arguments

g	igraph object
pivots	number of pivots
weights	possibly a numeric vector with edge weights. If this is NULL and the graph has a weight edge attribute, then the attribute is used. If this is NA then no weights are used (even if the graph has a weight attribute). By default, weights are ignored. See details for more.
circular	not used

Details

Be careful when using weights. In most cases, the inverse of the edge weights should be used to ensure that the endpoints of an edges with higher weights are closer together (weights=1/E(g)$weight)

The layout_igraph_* function should not be used directly. It is only used as an argument for plotting with 'igraph'. 'ggraph' natively supports the layout.

Value

matrix of xy coordinates

Author(s)

David Schoch

References

Brandes, U. and Pich, C. (2006). Eigensolver Methods for Progressive Multidimensional Scaling of Large Data. In *International Symposium on Graph Drawing* (pp. 42-53). Springer

Examples

```
## Not run:
library(igraph)
library(ggraph)

g <- sample_gnp(1000,0.01)

xy <- layout_with_pmds(g,pivots = 100)

## End(Not run)
```

`layout_sparse_stress` *sparse stress graph layout*

Description

stress majorization for larger graphs based on a set of pivot nodes.

Usage

```
layout_with_sparse_stress(g, pivots, weights = NA, iter = 500)

layout_igraph_sparse_stress(g, pivots, weights = NA, iter = 500,
  circular)
```

Arguments

`g`	igraph object
`pivots`	number of pivots
`weights`	ignored
`iter`	number of iterations during stress optimization
`circular`	not used

Details

The layout_igraph_* function should not be used directly. It is only used as an argument for plotting with 'igraph'. 'ggraph' natively supports the layout.

Value

matrix of xy coordinates

Author(s)

David Schoch

References

Ortmann, M. and Klimenta, M. and Brandes, U. (2016).A Sparse Stress Model. https://arxiv.org/pdf/1608.08909.pdf

Examples

```
## Not run:
library(igraph)
library(ggraph)

g <- sample_gnp(1000,0.005)
```

```
ggraph(g,layout = "sparse_stress",pivots = 100)+
  geom_edge_link0(edge_colour = "grey66")+
  geom_node_point(shape = 21,fill = "grey25",size = 5)+
  theme_graph()

## End(Not run)
```

`layout_spectral` *spectral graph layouts*

Description

Using a set of eigenvectors of matrices associated with a graph as coordinates

Usage

```
layout_with_eigen(g, type = "laplacian", ev = "smallest")

layout_igraph_eigen(g, type = "laplacian", ev = "smallest", circular)
```

Arguments

`g`	igraph object
`type`	matrix to be used for spectral decomposition. either 'adjacency' or 'laplacian'
`ev`	eigenvectors to be used. Either 'smallest' or 'largest'.
`circular`	not used

Details

The layout_igraph_* function should not be used directly. It is only used as an argument for plotting with 'igraph'. 'ggraph' natively supports the layout.

Value

matrix of xy coordinates

Author(s)

David Schoch

Examples

```
library(igraph)

g <- sample_gnp(50,0.2)

xy <- layout_with_eigen(g,type = "adjacency",ev = "largest")

xy <- layout_with_eigen(g,type = "adjacency",ev = "smallest")

xy <- layout_with_eigen(g,type = "laplacian",ev = "largest")

xy <- layout_with_eigen(g,type = "laplacian",ev = "smallest")
```

---

layout_stress *stress majorization graph layout*

Description

force-directed graph layout based on stress majorization.

Usage

```
layout_with_stress(g, weights = NA, iter = 500, tol = 1e-04,
  mds = TRUE, bbox = 30)

layout_igraph_stress(g, weights = NA, iter = 500, tol = 1e-04,
  mds = TRUE, bbox = 30, circular)
```

Arguments

g	igraph object
weights	possibly a numeric vector with edge weights. If this is NULL and the graph has a weight edge attribute, then the attribute is used. If this is NA then no weights are used (even if the graph has a weight attribute). By default, weights are ignored. See details for more.
iter	number of iterations during stress optimization
tol	stopping criterion for stress optimization
mds	should an MDS layout be used as initial layout (default: TRUE)
bbox	constrain dimension of output. Only relevant to determine the placement of disconnected graphs
circular	not used

Details

Be careful when using weights. In most cases, the inverse of the edge weights should be used to ensure that the endpoints of an edges with higher weights are closer together (weights=1/E(g)$weight).

The layout_igraph_* function should not be used directly. It is only used as an argument for plotting with 'igraph'. 'ggraph' natively supports the layout.

Value

matrix of xy coordinates

References

Gansner, E. R., Koren, Y., & North, S. (2004). Graph drawing by stress majorization. *In International Symposium on Graph Drawing* (pp. 239-250). Springer, Berlin, Heidelberg.

Examples

```
library(igraph)
library(ggraph)
set.seed(665)

g <- sample_pa(100,1,1,directed = FALSE)

# calculate layout manualy
xy <- layout_with_stress(g)

# use it with ggraph
## Not run:
ggraph(g,layout = "stress")+
  geom_edge_link0(edge_width = 0.2,colour = "grey")+
  geom_node_point(col = "black",size = 0.3)+
  theme_graph()

## End(Not run)
```

Index