Package 'multigraph'

July 23, 2025

Type Package

Title Plot and Manipulate Multigraphs

Version 0.99-3

Depends R (>= 3.6.0), multiplex (>= 3.0.0)

Imports methods

Date 2024-05-14

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Description Functions to plot and manipulate multigraphs, signed and valued graphs, bipartite graphs, multilevel graphs, and Cayley graphs with various layout options.

URL https://github.com/mplex/multigraph/

BugReports https://github.com/mplex/multigraph/issues/

Repository CRAN

License GPL-3

NeedsCompilation no

Date/Publication 2024-05-14 09:03:12 UTC

Contents

`multigraph-package` *Plot and Manipulate Multigraphs*

Description

Functions to create and manipulate multigraphs, bipartite graphs, Cayley graphs, and valued multilevel graphs.

Details

Package:	multigraph
Type:	Package
Version:	0.99-3 (devel)
Depends:	**multiplex** (>= 3.0.0)
Date:	14 May 2024
License:	GPL-3

This package contains functions to plot diverse types of graphs representing complex network structures. For one-mode data, it is possible to depict signed and valued multigraphs and bipartite graphs for two-mode data as well. Moreover, multilevel graphs that *combine* one- and two-mode network data are represented with the latest function. Finally, Cayley graphs serve to depict relations among the ties in multiplex networks recorded in the algebraic object semigroup.

Note that this package is still under development.

Author(s)

J. Antonio Rivero Ostoic

Maintainer: Antonio Rivero Ostoic <multiplex@post.com>

References

Ostoic, J.A.R. *Algebraic Analysis of Social Networks: Models, Methods and Applications Using R*, Wiley, 2021

Ostoic, J.A.R. "Algebraic Analysis of Multiple Social Networks with `multiplex`." *Journal of Statistical Software*, 91(11), 1-41. <doi:10.18637/jss.v092.i11>

See Also

`multiplex-package`, `incubs`, `zbind`, `transf`

bmgraph *Bipartite multigraph*

Description

A function to create and manipulate bipartite multigraphs

Usage

```
bmgraph(net, layout = c("bip", "bip3", "bip3e", "bipc", "force", "rand", "circ",
     "stress", "CA", "circ2"), scope, coord, alpha = c(1, 1, 1), showLbs, showAtts,
       att = NULL, lbat = "1", main = NULL, cex.main, bg, mar, directed, valued,
       collRecip, cex, pos, lwd, lty, col, ecol, vcol, vcol0, asp, seed = NULL,
      maxiter = 100, bwd, clu, pch, rot, mirrorX, mirrorY, mirrorV, mirrorH, hds,
     vedist, jitter, sort, add, adc, perm, ffamily, fstyle, fsize, fcol, vclu, ...)
```

Arguments

net	data frame or array representing the two-mode network (see *details*)
layout	the visualization layout: • bip (default) bipartite graph • bip3 bipartite graph with three columns • bip3e bipartite graph with three columns for events • bipc "clustered" bipartite graph • force force-directed algorithm • rand random • circ circular • stress stress-majorization algorithm • CA correspondence analysis • circ2 two semi-circles
scope	(optional) scope of the graph (see *details*)
coord	(optional) data frame with the coordinates of the vertices; if coordinates are given then the layout option is ignored
alpha	vector (vertex, edge, bg) with the alpha color transparency
showLbs	(optional and logical) whether or not to show the vertex labels when dimnames available
showAtts	(optional and logical) whether or not to show the vertex attribute labels
att	(optional) a vector or an array representing the vertex attributes
lbat	(optional) labels for the vertex attributes
main	(optional) title of the plot
cex.main	(optional) size of the plot's title
bg	(optional) background color of the plot

`mar`	(optional) margins of the plot
`directed`	(optional and logical) whether or not the graph is directed or undirected
`valued`	(optional and logical) whether or not the graph is valued or with dichotomous data
`collRecip`	(optional and logical) whether or not collapse reciprocated edges in the undirected graph
`cex`	(optional) size of the vertices
`pos`	(optional) position of the vertices' labels (`0` means "at the center of the vertex")
`lwd`	(optional) width of the edges; ignored if `valued` is set to `TRUE`
`lty`	(optional) shape of the edges
`col`	(optional) alias for `vcol`
`ecol`	(optional) color of the edges
`vcol`	(optional) color of the vertices
`vcol0`	(optional) color of the vertices' contour (only works for `pch` `21` through `25`
`asp`	(optional) aspect ratio of the plot
`seed`	(optional) random seed number for the vertices' initial coordinates. Ignored except for `force`, `stress` and `rand`
`maxiter`	(optional) maximum number of iterations in layout algorithms. Ignored except for `force`, `stress` and `rand`
`bwd`	(optional) width of the bundle edges: ranges from `0` (edges collapsed) to the default `1` (depending on the vertices' size), and for `valued` a value greater than one is possible
`clu`	(optional) clustering of the vertices (see *details*)
`pch`	(optional) symbol representing the vertices
`rot`	(optional) clockwise rotation of the graph in degrees
`mirrorX`	(optional) mirror of the X axis
`mirrorY`	(optional) mirror of the Y axis
`mirrorV`	*same as* `mirrorX`
`mirrorH`	*same as* `mirrorY`
`hds`	(optional and experimental) arcs' head scale
`vedist`	(optional and experimental) a real number with vertex - edge distance
`jitter`	(optional) jitter in `stress` or `CA`
`sort`	(optional and logical) sort the vertex labels
`add`	(optional) add nodes to the graph's domain
`adc`	(optional) add nodes to the graph's codomain
`perm`	(optional) a list of vectors for the permutation of network members in both the domain and codomain
`ffamily`	(optional) font family
`fstyle`	(optional) font style

`fsize`	(optional) font size
`fcol`	(optional) font color
`vclu`	(optional) clustering information in both the domain and the codomain in a list of vectors with integers or `NULL` (see *details*)
`...`	Additional argument items (see e.g. `par`)

Details

Bipartite graphs serve as visual aids for two-mode networks. While these networks are typically represented as data frames, they can also be visualized using three-dimensional arrays, where each level corresponds to a specific type of connection, resulting in parallel edges within the bipartite graph. Additionally, a bipartite network can be generated using a force-directed algorithm to create a visual representation.

With bipartite graphs consisting of two sets of vertices, clustering information, such as vertex colors, can be stored in a list `vclu` with two vectors, one for each vertex set. It is possible to group all members of a vertex set into a single class by setting the corresponding vector to `NULL`.

Value

A plot of the two-mode network as a bipartite graph or multigraph with a projection

Author(s)

Antonio Rivero Ostoic

See Also

`multigraph`, `frcd`, `stsm`, `conc`

Examples

```
## two binary relations among three elements
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 3 ) )

## network as bipartite graph
bmgraph(arr)

## with a force directed algorithm
bmgraph(arr, layout = "force")

## with a Correspondence Analysis method
bmgraph(arr, layout = "CA", asp = NA)
```

ccgraph *Cayley colour graph*

Description

A function to create and manipulate bipartite Cayley colour graphs

Usage

```
ccgraph(x, main=NULL, seed=0, maxiter=100, alpha=c(1, 1, 1), scope, loops,
        collRecip, undRecip, showLbs, cex.main, conc, coord, clu, cex, lwd,
        pch, lty, bwd, bwd2, att, bg, mar, pos, asp, ecol, vcol, vcol0, lbs,
        col, lbat, swp, swp2, scl, mirrorX, mirrorY, mirrorD, mirrorL, mirrorV,
        mirrorH, rot, hds, vedist, ffamily, fstyle, fsize, fcol, nr, gens, ...)
```

Arguments

x	an algebraic structure, typically a "Semigroup" object class
main	(optional) title of the plot
seed	(optional) random seed number for the vertices' initial coordinates; ignored except for force, stress and rand
maxiter	(optional) maximum number of iterations in layout algorithms; ignored except for force, stress and rand
alpha	vector (vertex, edge, bg) with the alpha color transparency
scope	(optional) scope of the graph (see details)
loops	(optional, logical, and experimental) plot graph loops?
collRecip	(optional and logical) whether or not collapse reciprocated edges in the undirected graph
undRecip	(optional and logical) whether or not plot reciprocated edges as undirected
showLbs	(optional and logical) whether or not show the vertex labels when dimnames available
cex.main	(optional) size of the plot's title
conc	(optional and logical) whether the layout is concentric or not
coord	(optional) data frame with the coordinates of the vertices; if coordinates are given then the layout option is ignored
clu	(optional) clustering of the vertices (see *details*)
cex	(optional) size of the vertices
lwd	(optional) width of the edges; ignored if valued is set to TRUE
pch	(optional) symbol representing the vertices
lty	(optional) shape of the edges

`bwd`	(optional) width of the bundle edges. Ranges from `0` (edges collapsed) to the default `1` (depending on the vertices' size), and for `valued` a value greater than one is possible
`bwd2`	(optional) width of the bundle loop edges.
`att`	(optional) a vector or an array representing the vertex attributes
`bg`	(optional) background color of the plot
`mar`	(optional) margins of the plot
`pos`	(optional) position of the vertices' labels (`0` means "at the center of the vertex")
`asp`	(optional) aspect ratio of the plot
`ecol`	(optional) color of the edges
`vcol`	(optional) color of the vertices
`vcol0`	(optional) color of the vertices' contour (only works for `pch` `21` through `25`
`lbs`	(optional) vertex labels
`col`	(optional) alias for `vcol`
`lbat`	(optional) labels for the vertex attributes
`swp`	(optional and logical) whether or not to swap the bundle patterns
`swp2`	(optional and logical) whether or not to swap reciprocals
`scl`	(optional and experimental) numerical scalar (x and y) or vector (x, y) of the graph's scale
`mirrorX`	(optional) mirror of the X axis
`mirrorY`	(optional) mirror of the Y axis
`mirrorD`	(optional) mirror reflection across diagonal $Y = X$
`mirrorL`	(optional) mirror reflection across diagonal $Y = -X$
`mirrorV`	same as `mirrorX`
`mirrorH`	same as `mirrorY`
`rot`	(optional) clockwise rotation of the graph in degrees
`hds`	(optional and experimental) arcs' head scale
`vedist`	(optional and experimental) a real number with vertex - edge distance
`ffamily`	the font family
`fstyle`	the font style
`fsize`	the font size
`fcol`	the font color
`nr`	for `conc` layout, number of radii
`gens`	(optional when absent) semigroup generators in `x`
`...`	Additional argument items (see e.g. `par`)

Details

The Cayley colour graph is a graphical representation of the relationships among relations in the relational structure of a given multiplex network. Both nodes and directed edges represent string relations, and each shape (and color) corresponds to a specific generator relation of the semigroup structure.

Value

A plot of the semigroup or group structure.

Author(s)

Antonio Rivero Ostoic

See Also

semigroup, multigraph, frcd, conc

Examples

```
## Create an abstract semigroup from random data
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 1 ) )

S <- semigroup(arr)

## plot semigroup's Cayley graph
ccgraph(S)
```

---

conc *Concentric layout*

Description

A function to compute the graph coordinated system with a concentric layout

Usage

```
conc(net, nr, irot, inv, flip, mirror=c("N","X","Y","D","L"), ...)
```

Arguments

net	an array representing the network relations
nr	a scalar with the number of radii, or a vector with the clustering of the actors.
irot	a scalar or vector with the "internal rotation" for each circle from closer to the center point to further away
inv	(optional and logical) should the circles be with an inverted ordering?
flip	(optional and logical) should the alternating circles be flipped?
mirror	mirror transformation • N identity (default) • X reflection through the vertical center line • Y reflection through the horizontal center line • D reflection across diagonal $Y = X$ • L reflection across diagonal $Y = -X$
...	Additional argument items

Details

In a Euclidean plane computes the coordinated system with a concentric layout with at least two radii (unless $n = 1$). In case that the number of radii is not specified in `nr`, approx. half of the vertices are located at one radius and half in another one.

The clustering of the actors may be used to establish the location of the vertices in different radii as a numerical, character, or factor vector.

Value

A data frame with a coordinated system with two columns representing the abscissa and the ordinate in a two-dimensional rectangular Cartesian coordinate system.

Author(s)

Antonio Rivero Ostoic

See Also

`multigraph`, `bmgraph`, `frcd`, `stsm`

Examples

```
## Create the data: two binary relations among three elements
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 3 ) )

## Coordinates for the concentric layout with two radii
coord <- conc(arr, nr = 2)

## Plot multigraph with customized coordinates
multigraph(arr, coord = coord)
```

`frcd` *Force directed layout*

Description

A function to compute the graph coordinated system with a force directed layout algorithm

Usage

```
frcd(net, seed = seed, maxiter, drp, scl, mov, ...)
```

Arguments

net	an array representing the network relations
seed	(mandatory) the seed of the initial layout (see *details*)
maxiter	(optional) the maximum number of iterations
...	Additional argument items
scl	(optional and experimental) numerical scalar (x and y) or vector (x, y) of the graph's scale
mov	(optional and experimental) numerical scalar (x and y) or vector (x, y) to move the graph
drp	(optional) for valued networks, drop values less than specified

Details

This function is meant as an internal routine for graph visualization with a force-directed layout procedure. However, it can be used to set the coordinate system with the coord option in functions multigraph and in bmgraph. In such case, the coordinate system of the graph starts with a random displacement of nodes where NULL in the seed argument implies an initial seed based on the computer clock watch, and the number of iterations in maxiter is $60 + n$.

Value

A data frame with a coordinated system with two columns representing the abscissa and the ordinate in a two-dimensional rectangular Cartesian coordinate system.

Author(s)

Antonio Rivero Ostoic

References

Fruchterman, T.M.J., & Reingold, E.M. Graph drawing by force-directed placement. *Software-Practice & Experience*, 21(11), 1129-1164. 1991.

See Also

multigraph, bmgraph, stsm, conc

Examples

```
## Create the data: two binary relations among three elements
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 3 ) )

## Coordinates for the force directed layout with random start
coord <- frcd(arr, seed = NULL)

## Plot multigraph with customized coordinates
multigraph(arr, coord = coord)
```

mlgraph *Multilevel graph*

Description

A function to create and manipulate multilevel graphs

Usage

```
mlgraph(net, layout = c("circ", "force", "stress", "rand", "conc", "bip"), main = NULL,
     seed = NULL, maxiter = 100, directed = TRUE, alpha = c(1, 1, 1), scope, collRecip,
     undRecip, showLbs, showAtts, cex.main, coord, clu, cex, lwd, pch, lty, bwd, bwd2,
     att, bg, mar, pos, asp, ecol, vcol, vcol0, col, lbat, swp, loops, swp2, mirrorX,
     mirrorY, mirrorD, mirrorL, lbs, mirrorV, mirrorH, rot, hds, scl, vedist, ffamily,
        fstyle, fsize, fcol, valued, modes, elv, lng, nr, ...)
```

Arguments

net	a "Multilevel" class object or a three dimensional array with clustering information
layout	the visualization layout: • circ circular • force force-directed • stress stress-majorization • rand random • conc concentric • bip as bipartite graph
main	(optional) title of the plot
seed	(optional) random seed number for the vertices' initial coordinates. Ignored except for force, stress and rand
maxiter	(optional) maximum number of iterations in layout algorithms. Ignored except for force, stress and rand
directed	(logical) whether or not the graph is directed or undirected
alpha	vector (vertex, edge, bg) with the alpha color transparency
scope	(optional) scope of the graph (see details)
collRecip	(optional and logical) whether or not collapse reciprocated edges in the undirected graph
undRecip	(optional and logical) whether or not plot reciprocated edges as undirected
showLbs	(optional and logical) whether or not to show the vertex labels
showAtts	(optional and logical) whether or not to show the vertex attribute labels
cex.main	(optional) size of the plot's title

coord	(optional) data frame with the coordinates of the vertices. If coordinates are given then the layout option is ignored
clu	(optional) clustering of the vertices as a list of vectors with integers or NULL (see *details*)
cex	(optional) size of the vertices
lwd	(optional) width of the edges; ignored if valued is set to TRUE
pch	(optional) symbol representing the vertices
lty	(optional) shape of the edges
bwd	(optional) width of the bundle edges. Ranges from 0 (edges collapsed) to the default 1 (depending on the vertices' size), and for valued a value greater than one is possible
bwd2	(optional) width of the bundle loop edges.
att	(optional) a vector or an array representing the vertex attributes
bg	(optional) background color of the plot
mar	(optional) margins of the plot
pos	(optional) position of the vertices' labels (0 means "at the center of the vertex")
asp	(optional) aspect ratio of the plot
ecol	(optional) color of the edges
vcol	(optional) color of the vertices
vcol0	(optional) color of the vertices' contour (only works for pch 21 through 25
col	(optional) alias for vcol
lbat	(optional) labels for the vertex attributes
swp	(optional and logical) whether or not to swap the bundle patterns
loops	(optional, logical, and experimental) plot graph loops?
swp2	(optional and logical) whether or not to swap reciprocals
mirrorX	(optional) mirror of the X axis
mirrorY	(optional) mirror of the Y axis
mirrorD	(optional) mirror reflection across diagonal $Y = X$
mirrorL	(optional) mirror reflection across diagonal $Y = -X$
lbs	(optional) vertex labels
mirrorV	same as mirrorX
mirrorH	same as mirrorY
rot	(optional) clockwise rotation of the graph in degrees
hds	(optional and experimental) arcs' head scale
scl	(optional and experimental) numerical scalar (x and y) or vector (x, y) of the graph's scale
vedist	(optional and experimental) a real number with vertex - edge distance
ffamily	the font family

fstyle	the font style
fsize	the font size
fcol	the font color
valued	(optional and logical) whether the graph is depicyed as valued or not
modes	(optional) a vector indicating which matrices are domains and which codomains (works only with a "Multilevel" class object)
elv	(experimental) control loops 1
lng	(experimental) control loops 2
nr	integer or NULL with the number of radii for conc layout (see *details*)
...	Additional argument items (see e.g. par)

Details

Multilevel graphs serve to represent networks with different "levels" such as different domains in the network structure. A characteristic of multilevel networks is the existence of ties within and across domains.

Since this function can handle a large number of arguments, these can be stored as a list object that is passed through the scope option. In this case, a vector made of lists and scalars or combinations of these is accepted.

The bundle width specified by bwd and bwd2 ranges from 0 (edges collapsed) to the default 1 (depending on the vertices' size). For the valued option, a number greater than one is possible.

In a multilevel structure, argument clu is to class network members and it is possible to class all members of the domain or co-domain into a single class by setting the vector to NULL. Similarly, NULL in argument nr for the conc layout implies the use of two radii, one for each domain.

Value

A plot of the multilevel graph structure for the network

Note

Multilevel graphs depend on multilevel class objects

Author(s)

Antonio Rivero Ostoic

See Also

mlvl, multigraph, bmgraph, frcd, stsm, conc

Examples

```
## Not run:
# create network data as arrays
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 3 ) )
arr2 <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 3 ) )

# create multilevel class object and plot multilevel graph
require(multiplex)
mlvl(arr, arr2) |>
  mlgraph()
## End(**Not run**)
```

`multigraph` *Multigraphs and valued multigraphs*

Description

A function to create and manipulate multigraphs and valued multigraphs with different layout options

Usage

```
multigraph(net, layout = c("circ", "force", "stress", "conc", "rand"), scope,
          directed=TRUE, loops, signed, valued, values, lbs, showLbs, att, lbat,
       showAtts, main=NULL, cex.main, col.main, font.main, coord, collRecip, undRecip,
       seed=NULL, maxiter=100, clu, cex, cex2, pch, lwd, lty, vcol, vcol0, col, ecol,
       bwd, bwd2, pos, bg, bg2, asp, drp, add, swp, swp2, alpha=c(1, 1, 1, 1), rot,
       mirrorX, mirrorY, mirrorD, mirrorL, mirrorV, mirrorH, scl, hds, vedist, mar,
         ffamily, fstyle, fsize, fsize2, fcol, fcol2, lclu, sel, new, mai, lscl,
           rm.isol, ...)
```

Arguments

`net`	an array; usually with three dimensions of stacked matrices where the multiple relations are placed.
`layout`	the visualization layout: • `circ` circular • `force` force-directed • `stress` stress-majorization • `conc` concentric • `rand` random
`scope`	(optional) the scope of the graph (see *details*)
`directed`	(logical) whether or not the graph is directed or unidirected

loops	(optional, logical, and experimental) plot graph loops?
signed	(optional and logical) whether or not the graph is a signed structure
valued	(optional and logical) whether the graph is depicyed as valued or not
values	(optional and logical) print the values of the bonds in edges?
lbs	(optional) the vertices labels
showLbs	(optional and logical) whether or not show the vertex labels
att	(optional) a vector or an array representing the vertex attributes
lbat	(optional) the labels for the vertices' attributes
showAtts	(optional and logical) whether or not show the vertex attribute labels
main	(optional) title of the plot
cex.main	(optional) the size of the plot's title
col.main	(optional) the color of the plot's title
font.main	(optional) the font of the plot's title
coord	(optional) data frame with the coordinates of the vertices. If coordinates are given then the layout option is ignored
collRecip	(optional and logical) whether or not collapse reciprocated edges in the unidirected graph
undRecip	(optional and logical) whether or not plot reciprocated edges as undirected
seed	(optional) the random seed number for the vertices' initial coordinates. Ignored for circ and conc
maxiter	(optional) the maximum number of iterations in layout algorithms. Only for force, stress, and rand
clu	(optional) the clustering of the vertices (see *details*)
cex	(optional) the size of the vertices
cex2	the size of the background for the values with the valued option
pch	(optional) the symbol representing the vertices
lwd	(optional) the width of the edges; ignored if valued is set to TRUE
lty	(optional) the shape of the edges
vcol	(optional) the color of the vertices
vcol0	(optional) the color of the vertices' contour (only works for pch 21 through 25
col	(optional) alias for vcol
ecol	(optional) the color of the edges
bwd	(optional) the width of the bundle edges.
bwd2	(optional) the width of the bundle loop edges.
pos	(optional) the position of the vertices' labels (0 means "in middle of vertex")
bg	(optional) the background color of the plot
bg2	(optional) the background color for values
asp	(optional) the aspect ratio of the plot

drp	(optional) for valued networks, drop values less than the specified
add	(optional) nodes to add to the graph
swp	(optional and logical) whether or not swap the bundle patterns
swp2	(optional and logical) whether or not swap reciprocals
alpha	vector (vertex, edge, bg) with the alpha color transparecy
rot	(optional) clockwise rotation of the graph in degrees
mirrorX	(optional) mirror of the X axis
mirrorY	(optional) mirror of the Y axis
mirrorD	(optional) mirror reflection across diagonal $Y = X$
mirrorL	(optional) mirror reflection across diagonal $Y = -X$
mirrorV	same as mirrorX
mirrorH	same as mirrorY
scl	(optional and experimental) numerical scalar (x and y) or vector (x, y) of the graph's scale
hds	(optional and experimental) arcs' head scale
vedist	(optional and experimental) a real number with vertex - edge distance
mar	(optional) the margins of the plot
ffamily	the font family
fstyle	the font style
fsize	the font size
fsize2	the font size for values
fcol	the font color
fcol2	the font color for values
lclu	(optional, vector) "levels" in clu (see *details*)
sel	(optional, vector) selection of node's labels to plot
new	(optional, logical) new graph on an existing plot?
mai	(optional, vector) plot inner margins
lscl	(optional for valued graphs) loop scale
rm.isol	(optional) remove isolated vertices?
...	Additional argument items (see e.g. par)

Details

Multigraphs are graphs having parallel edges depicting different types of relations in a network. By default, a circular layout is applied where each type of tie has a distinctive shape and gray color scale. For better visualization, undirected multigraphs automatically collapse the reciprocal relations, and there is an argument to prevent this from happening. It is possible to combine the symbols and colors of vertices by assigning a class to each network member in the clustering option. Vertices can also have different sizes by specifying the argument with a vector with a length size similar to the network order.

Since this function can handle a large number of arguments, these can be stored as a list object that is passed through the `scope` option. In this case, a vector made of lists and scalars or combinations of these is accepted for describing characteristics.

The bundle width specified by `bwd` (and `bwd2` for loops) ranges from `0` (edges collapsed) to the default `1` (depending on the vertices' size). For the `valued` option, numbers higher than one are possible. Use `vedist` to adjust vertex–edge distance for large and dense networks.

In some cases, such as when working with dynamic networks, it is needed to specify the ordering of the "levels" of the clustering information given in `clu`, and this is done in argument `lclu`.

When using `new` for plotting the graph with a background image, the previous plot(s), however, can require having an equivalent command to `graphics::plot.new()` (cf. e.g. `sdam::plot.map()` function).

Value

A plot of the network as a multigraph or a valued multigraph.

Author(s)

Antonio Rivero Ostoic

See Also

`bmgraph`, `ccgraph`, `frcd`, `stsm`, `conc`

Examples

```
## Create the data: two binary relations among three elements
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 3 ) )

## Plot the multigraph of this network
multigraph(arr)

## Now with a force directed algorithm
multigraph(arr, layout = "force")

## As weighted graph
multigraph(arr, weighted = TRUE)

## As signed graph
multigraph(arr, signed = TRUE)

## With loops and a costumized vertex size
multigraph(arr, cex = 3, loops = TRUE)
```

`stsm` *Stress majorization layout*

Description

A function to compute the graph coordinated system with a stress majorization layout algorithm

Usage

```
stsm(net, seed = seed, maxiter = 40, drp, jitter, method, ...)
```

Arguments

`net`	an array representing the network relations
`seed`	(mandatory) the seed of the initial layout (see *details*)
`maxiter`	(optional) the maximum number of iterations
`drp`	(optional) for `valued` networks, drop values less than specified
`jitter`	(optional) jitter in the layout
`method`	(optional) initial distance method (default `binary`)
`...`	Additional argument items

Details

Like the function `frcd`, this routine serves as an internal tool for graph visualization. It is also designed to establish the coordinate system using the `coord` option within the `multigraph` and `bmgraph` functions. In this scenario, the graph's coordinate system commences with nodes randomly positioned, and if `NULL` is entered in the `seed` argument, an initial seed will be generated based on the computer clock watch where the number of iterations in `maxiter` is 40.

Value

A data frame with a coordinated system with two columns representing the abscissa and the ordinate in a two-dimensional rectangular Cartesian coordinate system.

Author(s)

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References

Gansner, E.R., Koren, Y., & North, S. *Graph drawing by stress majorization*. In Graph Drawing: 12th International Symposium, gd 2004, New York, NY, USA, September 29 - October 2, 2004, revised selected papers. Berlin Heidelberg: Springer. pp. 239-250. 2005.

See Also

`multigraph`, `bmgraph`, `frcd`, `conc`

Examples

```
## Create the data: two binary relations among three elements
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
       c(3,3,2))>.5, 3 ) )

## Coordinates for the stress majorization layout with random start
coord <- stsm(arr, seed = NULL)

## Plot multigraph with customized coordinates
multigraph(arr, coord = coord)
```

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