

# Package ‘multigraph’

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**Type** Package

**Title** Plot and Manipulate Multigraphs

**Version** 0.97-2

**Depends** R (>= 3.5.0), multiplex (>= 2.9.9)

**Imports** methods

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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

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## R topics documented:

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multigraph-package      *Plot and Manipulate Multigraphs*

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## Description

Functions to create and manipulate multigraphs, bipartite graphs, and valued multigraphs

## Details

Package: multigraph  
Type: Package  
Version: 0.97-2 (devel)  
Depends: **multiplex** (>= 2.9.9)  
Date: 7 July 2022  
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.

Note that this package is still under current 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](#)

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bmgraph	<i>Bipartite multigraph</i>
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**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 <i>details</i> )
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 <i>details</i> )
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). For valued a value greater than one is possible
clu	(optional) clustering of the vertices (see <i>details</i> )
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	<i>same as mirrorX</i>
mirrorH	<i>same as mirrorY</i>
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) a list of vectors the clustering information in both the domain and the codomain
...	Additional argument items (see e.g. <a href="#">par</a> )

## Details

Bipartite graphs are visualization devices for two-mode networks. Although this type of data would typically record as a data frame, it is possible to use even three-dimensional arrays where each level corresponds to a particular type of tie. Thus the bipartite graphs, in this case, will be depicted with parallel edges. Besides, it is possible to obtain a figure of the bipartite network using the binomial approach to two-mode data and plot it with a force-directed algorithm.

## 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

```
## 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 this network as Bipartite graph
bmgraph(arr)

## Now with a Force Directed algorithm
bmgraph(arr, layout = "force")

## And 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, ...)
```

## 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 <i>details</i> )
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). 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
...	Additional argument items (see e.g. <a href="#">par</a> )

### 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
arr <- round( replace( array(runif(18), c(3,3,2)), array(runif(18),
  c(3,3,2))>.5, 1 ) )

S <- semigroup(arr)

## plot its 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 `nr` is not specified, 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 coordenates
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
drp	(optional) for valued networks, drop values less than specified
...	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

**Details**

This function is meant as an internal routine for graph visualization. However, it can be used for the coord option both in `multigraph` and in `bmgraph` where NULL in seed implies a random seed based on the clock watch of the computer.

**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 coordenates
multigraph(arr, coord = coord)
```

---

mlgraph	<i>Multilevel graph</i>
---------	-------------------------

---

**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 3D 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 (see <i>details</i> )
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). 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
fcoll	the font color

valued	(optional and logical) whether the graph is depicted 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	for conc layout, number of radii
...	Additional argument items (see e.g. <a href="#">par</a> )

### 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.

### Value

A plot of the multilevel graph structure for the network

### Author(s)

Antonio Rivero Ostoic

### See Also

[mlvl](#), [multigraph](#), [bmgraph](#), [frcd](#), [stsm](#), [conc](#)

### Examples

```
# create multilevel class object  
  
# plot the multilevel graph
```

---

 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, ...)
```

### 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 undirected
loops	(optional, logical) plot loops in the graph?
signed	(optional and logical) whether or not the graph is a signed structure
valued	(optional and logical) whether or not the network is depicted as a valued graph
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 family 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 undirected 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 <i>details</i> )
cex	(optional) the size of the vertices
cex2	(optional) 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 and experimental) the width of the bundle loop edges.
pos	(optional) the position of the vertices' labels (0 means "at the middle of the 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	(optional) vector (vertex, edge, bg) with the alpha color transparency
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 $Y=-X$

<code>mirrorV</code>	(optional) same as <code>mirrorX</code>
<code>mirrorH</code>	(optional) same as <code>mirrorY</code>
<code>scl</code>	(optional and experimental) numerical scalar (x and y) or vector (x, y) of the graph's scale
<code>hds</code>	(optional and experimental) arcs' head scale
<code>vedist</code>	(optional and experimental) a real number with vertex - edge distance
<code>mar</code>	(optional, vector) plot's margins
<code>ffamily</code>	(optional) labels' font family
<code>fstyle</code>	(optional) labels' font style
<code>fsize</code>	(optional) labels' font size
<code>fsize2</code>	(optional) labels' font size for values
<code>fc01</code>	(optional) labels' font color
<code>fc02</code>	(optional) labels' font color for values
<code>lclu</code>	(optional, vector) "levels" in <code>clu</code> (see Details)
<code>sel</code>	(optional, vector) selection of node's labels to plot
<code>new</code>	(optional, logical) new graph on an existing plot?
<code>mai</code>	(optional, vector) plot inner margins
<code>lsc1</code>	(optional) for valued graphs, a real number of the loops' scale
<code>...</code>	(optional) additional argument items (see e.g. <code>par</code> )

## 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.

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 that is valued or signed.

**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 valued graph
multigraph(arr, valued = TRUE)

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

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

## plot with background
multigraph(arr, cex = 3, loops = TRUE)
multigraph("1, 2", new = 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

This function is meant as an internal routine for graph visualization. However, it can be used with the `coord` option both in `multigraph` and in `bmgraph` where `NULL` in `seed` implies a random seed based on the clock watch of the computer.

## 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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