

Network drawing

Marco Mello

18/09/2020

How to draw networks in R

Ecological Synthesis Lab (SintECO).

Author: Marco Mello.

E-mail: marmello@gmail.com.

See further info in the README file.

Summary

1. Get ready
2. Package bipartite: graph
3. Package bipartite: matrix
4. Package igraph: graph
5. Suggested readings

1. Get ready

Load the required packages:

```
library(bipartite)
```

```
## Loading required package: vegan
```

```
## Loading required package: permute
```

```
## Loading required package: lattice
```

```
## This is vegan 2.5-6
```

```
## Loading required package: sna
```

```
## Loading required package: statnet.common
```

```
##
```

```
## Attaching package: 'statnet.common'
```

```

## The following object is masked from 'package:base':
##
##     order

## Loading required package: network

## network: Classes for Relational Data
## Version 1.16.0 created on 2019-11-30.
## copyright (c) 2005, Carter T. Butts, University of California-Irvine
##             Mark S. Handcock, University of California -- Los Angeles
##             David R. Hunter, Penn State University
##             Martina Morris, University of Washington
##             Skye Bender-deMoll, University of Washington
## For citation information, type citation("network").
## Type help("network-package") to get started.

## sna: Tools for Social Network Analysis
## Version 2.5 created on 2019-12-09.
## copyright (c) 2005, Carter T. Butts, University of California-Irvine
## For citation information, type citation("sna").
## Type help(package="sna") to get started.

## This is bipartite 2.15.
## For latest changes see versionlog in ?"bipartite-package". For citation see: citation("bipartite").
## Have a nice time plotting and analysing two-mode networks.

##
## Attaching package: 'bipartite'

## The following object is masked from 'package:vegan':
##
##     nullmodel

library(igraph)

##
## Attaching package: 'igraph'

## The following object is masked from 'package:bipartite':
##
##     strength

## The following objects are masked from 'package:sna':
##
##     betweenness, bonpow, closeness, components, degree, dyad.census,
##     evcent, hierarchy, is.connected, neighborhood, triad.census

## The following objects are masked from 'package:network':
##
##     %c%, %s%, add.edges, add.vertices, delete.edges, delete.vertices,
##     get.edge.attribute, get.edges, get.vertex.attribute, is.bipartite,
##     is.directed, list.edge.attributes, list.vertex.attributes,
##     set.edge.attribute, set.vertex.attribute

```

```
## The following object is masked from 'package:vegan':
##
##     diversity

## The following object is masked from 'package:permute':
##
##     permute

## The following objects are masked from 'package:stats':
##
##     decompose, spectrum

## The following object is masked from 'package:base':
##
##     union
```

```
library(reshape2)
library(ggplot2)
library(rstudioapi)
```

Set the working directory automatically to the source file location:

```
current_path <- getActiveDocumentContext()$path
setwd(dirname(current_path ))
#print( getwd() )
```

Warnings:

1. This script works both with binary and weighted networks.
2. This script was designed for two-mode (bipartite) networks, but some functions work also for one-mode (unipartite) networks.
3. There is no single magic way to draw all kinds of networks. There are several network drawing algorithms implemented in different R packages and stand-alone software. Study their logic and algorithms, see some papers in which they were used. Think it through, and only then decide which drawing method to use in your study. For guidelines on which drawing algorithm to choose, read the studies suggested in the end of this tutorial.

2. Package bipartite: graph

Create the object to be analyzed. It should be a two-mode matrix formatted for bipartite. The format is actually very simple: A tab-delimited TXT matrix with row and column labels. See the example: a network (net1) analyzed by Bezerra et al. (2009).

```
net1 <- read.table("net1.txt", head=TRUE)
```

Check whether the network loaded correctly:

```
net1
```

```
##          Caenea Cfuscata Ccaxiensis Ctarsata Cflavifrons Ctrigonoides
## Dpubipetala      1368      1364        740        460        416        256
## Bgardnerana      924       320       2108        464        284         0
## Bmuricata        764       680        528        308        404       300
## Heteropteryssp1   740       656        528        332         0       324
## Heteropteryssp2   604       452        432        200         0         0
## Dbracteosa       556       512        356        132       524         0
## Cchasei          504       816         0         0         0         0
## Sparalias        396       468        108        140       272       652
## Bstellaris       292       300        244        116         0         0
## Bschizoptera     268       196         0         0       164         0
## Sauriculatum     240       164         68         0       196         0
## Sciliatum        228       224        124        120         0         0
## Janisandra       188       244         0         96         0         0
##          Cobsoleta Epicharissp2 Amellifera Centrissp3 Centrissp1
## Dpubipetala          0          328          364          368         0
## Bgardnerana          0           0           28           0         0
## Bmuricata            0          28           0           0         0
## Heteropteryssp1      0        116        116           0         0
## Heteropteryssp2      0           0           0           0         0
## Dbracteosa           0           0           0           0         0
## Cchasei              0           0           0           0         0
## Sparalias           912        364          44           0       368
## Bstellaris           0           0           0           0         0
## Bschizoptera         0           0           0           0         0
## Sauriculatum         0           0           0           0         0
## Sciliatum            0           0           0           0         0
## Janisandra           0           0           0           0         0
##          Xylocopasp Xgriseszens
## Dpubipetala          0           0
## Bgardnerana          0           0
## Bmuricata           76           0
## Heteropteryssp1      0           0
## Heteropteryssp2      0           0
## Dbracteosa           0           0
## Cchasei              0           0
## Sparalias           164          84
## Bstellaris           0           0
## Bschizoptera         0           0
## Sauriculatum         0           0
## Sciliatum            0           0
## Janisandra           0           0
```

Check the dimensions of the network:

```
dim(net1)
```

```
## [1] 13 13
```

Draw the graph:

```
plotweb(net1,

  #Set the drawing method. Experiment with other values.
  method="cca",

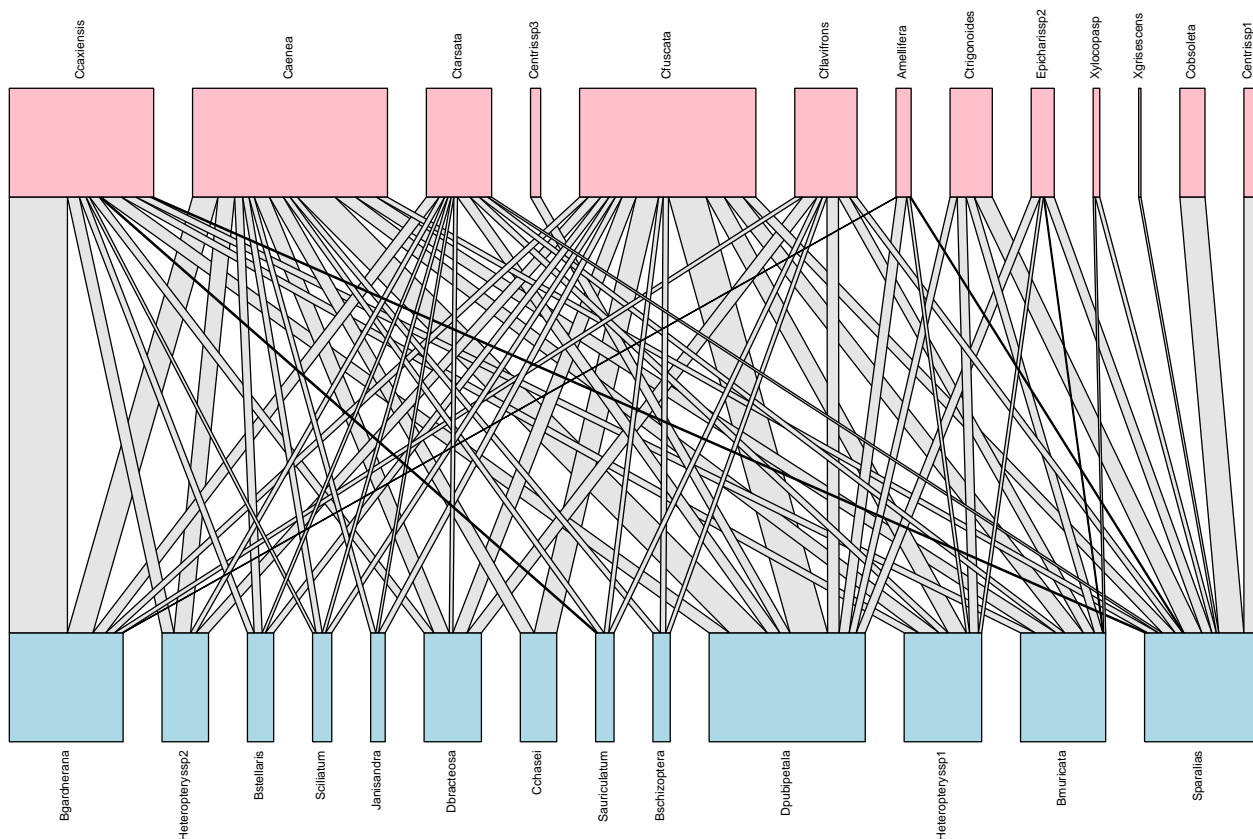
  #Set the color of the row nodes
  col.low="lightblue",

  #Set the color of the column nodes
  col.high="pink",

  #Set the link color
  col.interaction="grey90",

  #Set the rotation of node labels
  text.rot="90",

  #Set the size of node labels
  labsize=1)
```



Tip: There are many other parameters that can be set to customize the drawing. Explore them!

3. Package bipartite: matrix

Use the same network as before. Just take a look at it to remember what it looks like:

```
net1
```

```
##          Caenea Cfuscata Ccaxiensis Ctarsata Cflavifrons Ctrigonoides
## Dpubipetala      1368      1364          740          460          416          256
## Bgardnerana       924       320         2108          464          284           0
## Bmuricata         764       680          528          308          404          300
## Heteropteryssp1    740       656          528          332           0          324
## Heteropteryssp2    604       452          432          200           0           0
## Dbracteosa        556       512          356          132          524           0
## Cchasei           504       816           0           0           0           0
## Sparalias         396       468          108          140          272          652
## Bstellaris        292       300          244          116           0           0
## Bschizoptera       268       196           0           0          164           0
## Sauriculatum       240       164           68           0          196           0
## Sciliatum          228       224          124          120           0           0
## Janisandra        188       244           0          96           0           0
##          Cobsoleta Epicharissp2 Amellifera Centrissp3 Centrissp1
## Dpubipetala         0          328          364          368           0
## Bgardnerana         0           0           28           0           0
## Bmuricata           0           28           0           0           0
## Heteropteryssp1      0          116          116           0           0
## Heteropteryssp2      0           0           0           0           0
## Dbracteosa           0           0           0           0           0
## Cchasei              0           0           0           0           0
## Sparalias           912          364           44           0          368
## Bstellaris           0           0           0           0           0
## Bschizoptera         0           0           0           0           0
## Sauriculatum         0           0           0           0           0
## Sciliatum            0           0           0           0           0
## Janisandra           0           0           0           0           0
##          Xylocopasp Xgriseszens
## Dpubipetala         0           0
## Bgardnerana         0           0
## Bmuricata           76           0
## Heteropteryssp1      0           0
## Heteropteryssp2      0           0
## Dbracteosa           0           0
## Cchasei              0           0
## Sparalias           164          84
## Bstellaris           0           0
## Bschizoptera         0           0
## Sauriculatum         0           0
## Sciliatum            0           0
## Janisandra           0           0
```

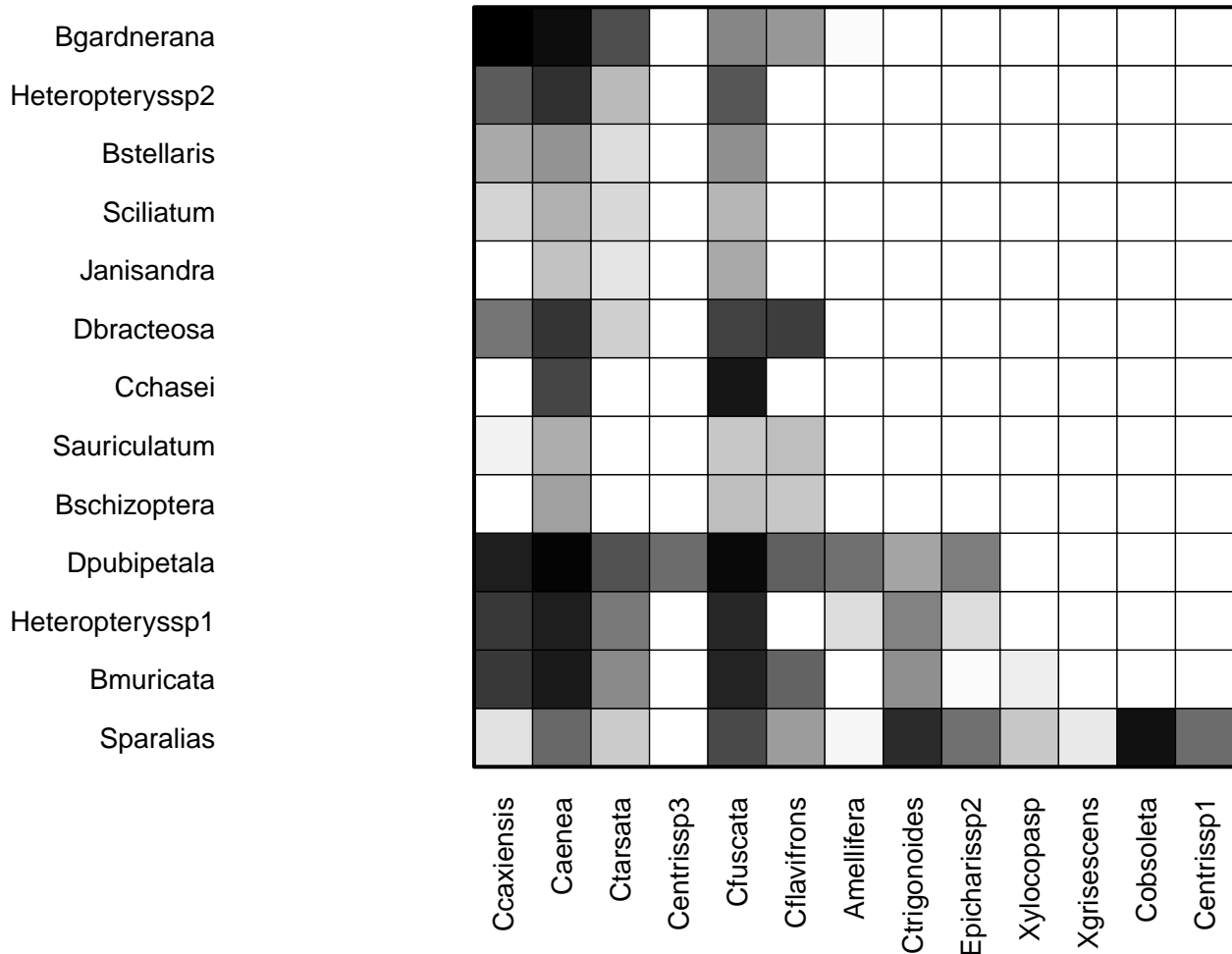
Draw the matrix:

```
visweb(net1,

#Set the drawing mode.
type="diagonal",

#Set the cell fills.
square="interaction")
```

```
## Warning in visweb(net1, type = "diagonal", square = "interaction"): Object
## converted to matrix.
```



Tip: There are many other parameters that can be set to customize the drawing. Explore them!

4. Package igraph: graph

Transform the previous bipartite object into an igraph object:

```
net2 <- graph_from_incidence_matrix(net1,
                                     #Here you inform whether it's a binary or weighted network.
                                     weighted = T)
```

Check the network's main information:

```
net2

## IGRAPH 510d41c UNWB 26 71 --
## + attr: type (v/l), name (v/c), weight (e/n)
```

```
## + edges from 510d41c (vertex names):
## [1] Dpubipetala--Caenea      Dpubipetala--Cfuscata
## [3] Dpubipetala--Ccaxiensis  Dpubipetala--Ctarsata
## [5] Dpubipetala--Cflavifrons Dpubipetala--Ctrigonoides
## [7] Dpubipetala--Epicharissp2 Dpubipetala--Amellifera
## [9] Dpubipetala--Centrissp3  Bgardnerana--Caenea
## [11] Bgardnerana--Cfuscata    Bgardnerana--Ccaxiensis
## [13] Bgardnerana--Ctarsata    Bgardnerana--Cflavifrons
## [15] Bgardnerana--Amellifera  Bmuricata --Caenea
## + ... omitted several edges
```

#Check the vertices and edges of the igraph object:

```
V(net2)
```

```
## + 26/26 vertices, named, from 510d41c:
## [1] Dpubipetala      Bgardnerana      Bmuricata      Heteropteryssp1
## [5] Heteropteryssp2 Dbracteosa       Cchasei        Sparalias
## [9] Bstellaris       Bschizoptera     Sauriculatum   Sciliatum
## [13] Janisandra       Caenea           Cfuscata       Ccaxiensis
## [17] Ctarsata         Cflavifrons      Ctrigonoides   Cobsolata
## [21] Epicharissp2     Amellifera       Centrissp3      Centrissp1
## [25] Xylocopasp       Xgrisescens
```

```
E(net2)
```

```
## + 71/71 edges from 510d41c (vertex names):
## [1] Dpubipetala --Caenea      Dpubipetala --Cfuscata
## [3] Dpubipetala --Ccaxiensis  Dpubipetala --Ctarsata
## [5] Dpubipetala --Cflavifrons Dpubipetala --Ctrigonoides
## [7] Dpubipetala --Epicharissp2 Dpubipetala --Amellifera
## [9] Dpubipetala --Centrissp3  Bgardnerana --Caenea
## [11] Bgardnerana --Cfuscata    Bgardnerana --Ccaxiensis
## [13] Bgardnerana --Ctarsata    Bgardnerana --Cflavifrons
## [15] Bgardnerana --Amellifera  Bmuricata --Caenea
## [17] Bmuricata --Cfuscata      Bmuricata --Ccaxiensis
## [19] Bmuricata --Ctarsata      Bmuricata --Cflavifrons
## + ... omitted several edges
```

Draw the graph:

```
plot.igraph(net2,

  # Set the drawing mode.
  # This package contains several drawing methods; try them!
  layout=layout_nicely,

  # Set node shapes
  vertex.shape = "circle",

  # Set node sizes
  vertex.size = 12,
```



```

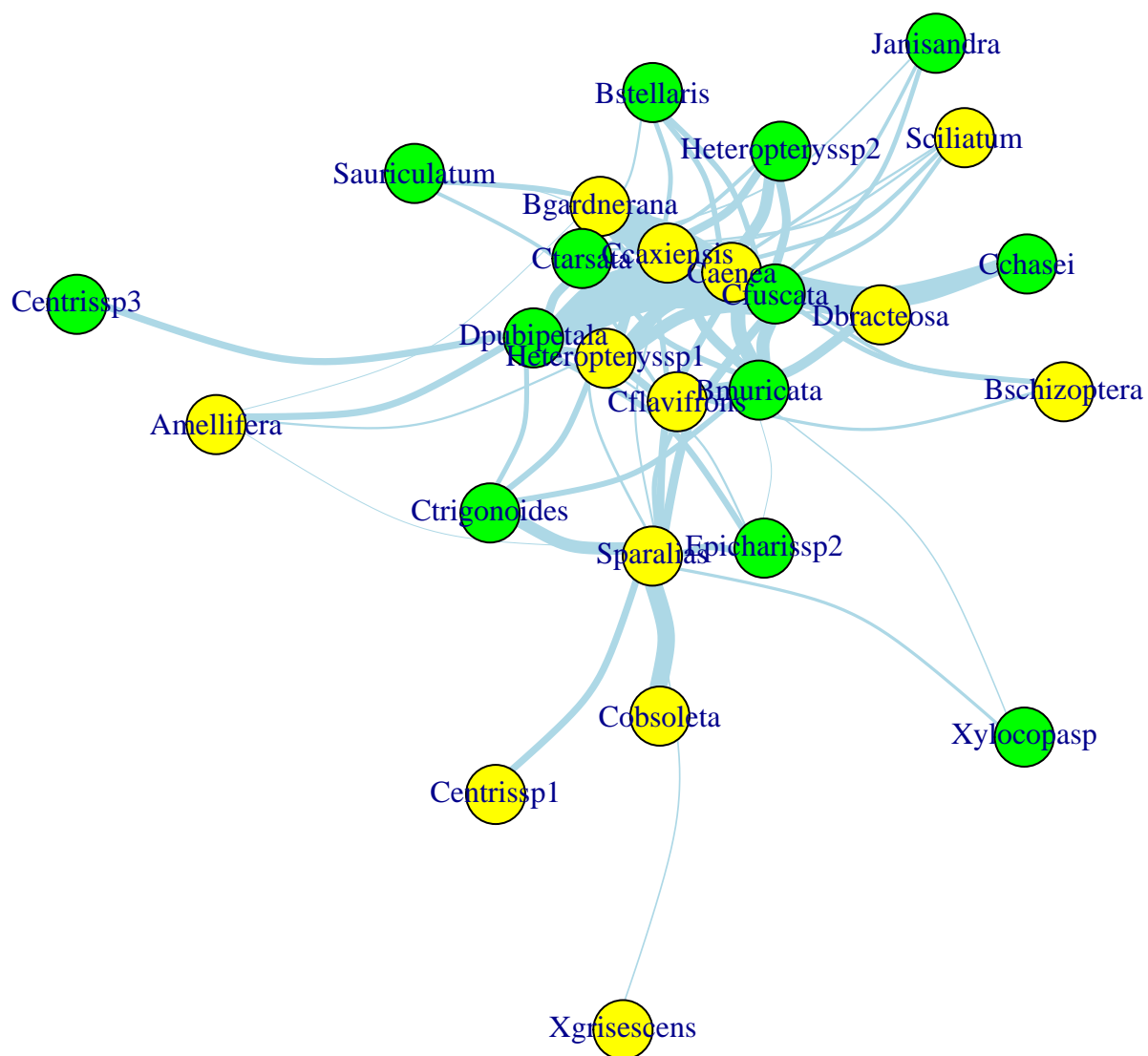
# Set link width proportional to link weights
# You can transform the values, if they are too different or too large
edge.width = E(net2)$weight/100,

# Set node colors
vertex.color = c("green", "yellow"),

# Set link colors
edge.color = "lightblue",

# Set link curvature from 0 to 1
edge.curved=0.3
)

```



Tip: There are many other parameters that can be set to customize the drawing. Explore them!

5. Suggested readings

1. Ognyanova K. 2017. Static and dynamic network visualization with R. Available at: <http://kateto.net/network-visualization>.
2. Pocock, M. J. O., D. M. Evans, C. Fontaine, M. Harvey, R. Julliard, Ó. McLaughlin, J. Silvertown, A. Tamaddoni-Nezhad, P. C. L. White, and D. A. Bohan. 2016. The Visualisation of Ecological Networks, and Their Use as a Tool for Engagement, Advocacy and Management. In G. Woodward and D. A. Bohan (Eds.) *Advances in Ecological Research*. pp. 41–85, Academic Press, Cambridge. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0065250415000355> [Accessed March 27, 2017].
3. Marai, G. E., B. Pinaud, K. Bühler, A. Lex, and J. H. Morris. 2019. Ten simple rules to create biological network figures for communication F. Lewitter (Ed.). *PLOS Comput. Biol.* 15: e1007244. Available at: <https://doi.org/10.1371/journal.pcbi.1007244>.
4. Mello MAR, Muylaert RL, Pinheiro RBP & Félix GMF. 2016. Guia para análise de redes ecológicas. Edição dos autores, Belo Horizonte. 112 p. ISBN-13: 978-85-921757-0-2. Available at: www.marcomello.org
5. Barabasi, A.L. (2016) *Network Science*, 1st ed. Cambridge University Press, Cambridge. Available at: <http://barabasi.com/networksciencebook/>.
6. Bascompte, J. & Jordano, P. (2014) *Mutualistic Networks*, 1st ed. Princeton University Press, Princeton.