Tutorial

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Summary

1. Get ready

Load the required packages:

```
library("igraph")
```

```
##
## Attaching package: 'igraph'

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

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

```
library("ggplot2")
library("reshape2")
```

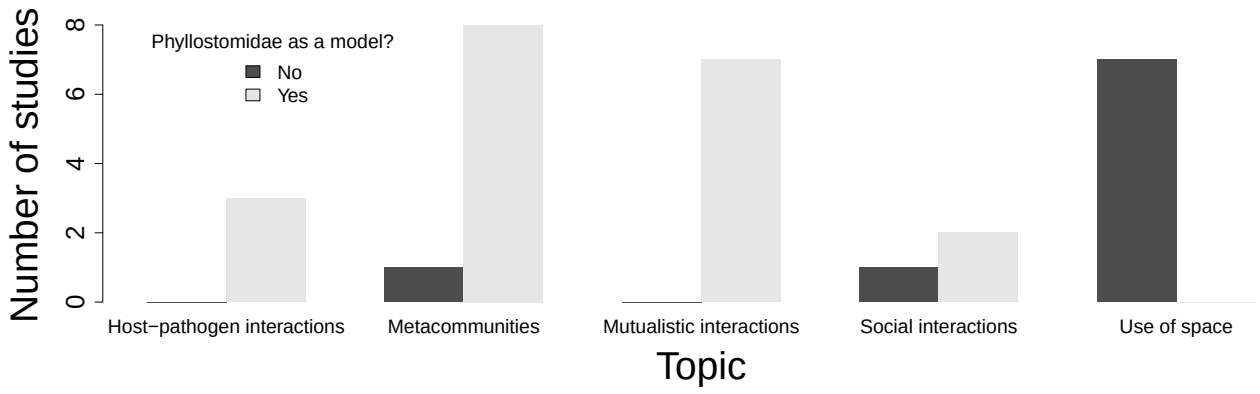
2. Figure 21.1

Import the data:

```
studies = read.delim("Analysis/studies.txt", row.names=1)
```

Plot the barplot:

```
par(mfrow = c(1,1), mar = c(6,7,1,1), xpd=TRUE)
counts <- table(studies$Phyllostomidae, studies$Links)
barplot(counts, main="",
        xlab="Topic",
        ylab = "Number of studies",
        col=gray.colors(length(rownames(counts))),
        border = F,
        beside=TRUE,
        las = 0,
        mgp = c(4,1,0),
        cex.lab=3,
        cex.axis=2,
        cex.main=3,
        cex.sub=3,
        cex.names=1.5)
legend(x = 1,
       y = 8,
       title = "Phyllostomidae as a model?",
       cex = 1.5,
       bty="n",
       fill=gray.colors(length(rownames(counts))),
       legend=rownames(counts))
```




```
par(mfrow = c(1,1))
```

3. Draw Figure 21.2

Use the same data as in Fig.21.1:

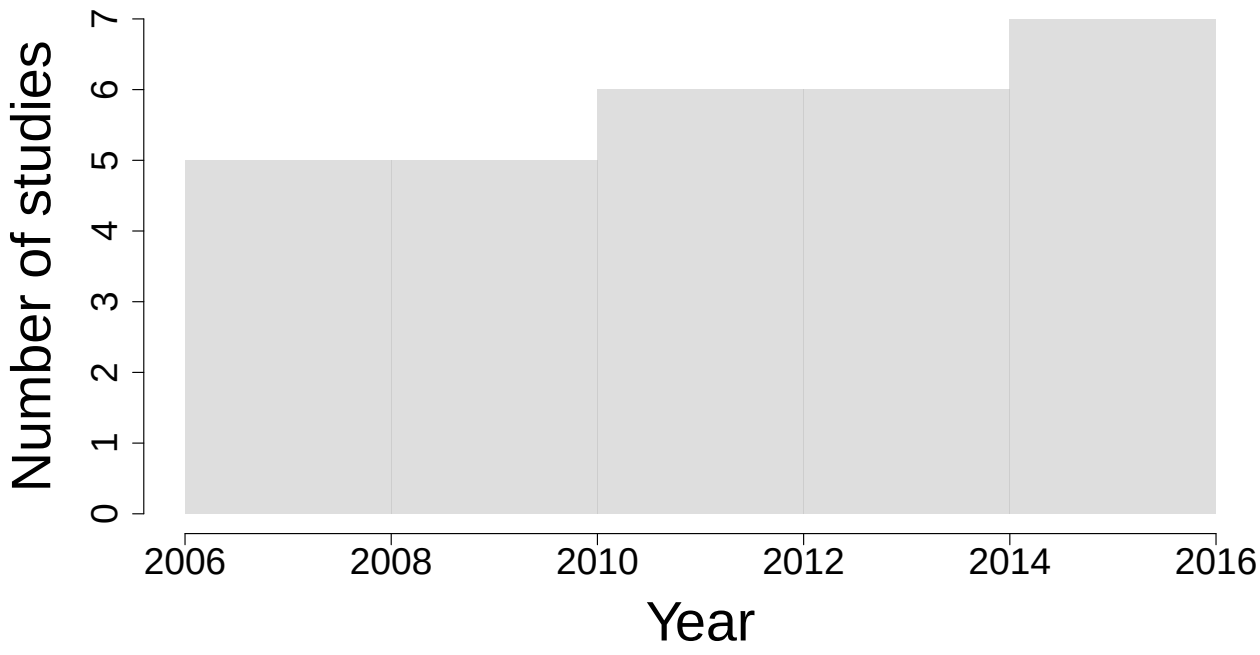
```
head(studies, 3)
```

```
##   Reference               Reference2 Year Phyllostomidae
## 1 Ancilloto      Ancilloto et al 2012 2012             No
## 2   Andrade        Andrade et al 2013 2013            Yes
## 3    Carter Carter and Wilkinson 2016 2016            Yes
##                       Links                       Links2
## 1      Social interactions             Social, behavior
## 2 Mutualistic interactions Frugivory and Seed dispersal
## 3      Social interactions             Social, behavior
```

```
##                                                                    Nodes
## 1                                    Newborn bats in their rearing groups
## 2 Bats and plants. Unipartite projection with niche overlap of bats' diet.
## 3                                                  20 Desmodus rotundus
##       Mode   Weight
## 1 One-mode Weighted
## 2     Both Weighted
## 3 One-mode     Both
```

Plot the histogram:

```
par(mfrow = c(1,1), mar = c(5,7,1,3))
hist(studies$Year,
     breaks=5,
     col = adjustcolor("grey", alpha.f = .5),
     border = F,
     xlab = "Year",
     ylab = "Number of studies",
     main = "",
     mgp = c(4,1,0),
     cex.lab=3,
     cex.axis=2,
     cex.main=3,
     cex.sub=3)
```




```
par(mfrow = c(1,1))
```

4. Draw Figure 21.3

Import the data:

```
softmat = as.matrix(read.delim("Analysis/software.txt", row.names=1))
```

Inspect the object:

```
class(softmat)
```

```
## [1] "matrix" "array"
```

```
softmat
```

```
##            R Aninhado Matlab Pajek BinMatNest Ucinet Netcarto SocProg NTC
## Ancilloto  0        0      0     0          0      1        0       0   0
## Andrade    1        0      0     0          0      0        0       0   0
## Carter     1        0      0     0          0      0        0       0   1
## Chaverri   0        0      0     1          0      1        0       1   0
## Cisneros   0        0      1     0          0      0        0       0   0
## Fortuna    0        1      0     0          0      0        0       0   0
## Garcia     0        0      0     0          1      0        0       0   0
## Johnson    0        0      0     0          0      1        0       0   0
## Kerth      0        0      1     0          0      0        0       0   0
## Loayza     0        0      0     0          0      0        0       0   1
## Luis       1        0      0     0          0      0        0       0   0
## Mello1     1        1      1     1          0      0        1       0   0
## Mello2     1        1      0     1          0      0        0       0   0
## Mello3     1        0      0     1          0      0        0       0   0
## Meyer      0        0      0     0          1      0        0       0   0
## Muylaert1  1        1      0     0          0      0        0       0   0
## Muylaert2  0        1      0     0          0      0        0       0   0
## Ortega     0        0      0     0          0      0        0       0   0
## Patriquin  0        0      0     0          0      0        0       1   0
## Patterson  0        0      0     0          1      0        0       0   0
## Presley1   0        0      1     0          0      0        0       0   0
## Presley2   1        0      0     0          0      0        0       0   0
## Rhodes     0        0      0     0          0      0        0       0   0
## Rosas      1        0      0     0          0      0        0       0   0
## Sarmento   0        1      1     0          0      0        1       0   0
## Struebig   0        0      0     0          1      0        0       0   0
## Varzinczak 0        1      0     0          0      0        0       0   0
## Webber     1        0      0     0          0      0        0       0   0
## Zarazua    1        0      0     0          0      0        0       0   0
##            JMP_SPSS Netdraw Undefined
## Ancilloto         0       0         0
## Andrade           0       0         0
## Carter            0       0         0
## Chaverri          0       1         0
## Cisneros          0       0         0
## Fortuna           0       0         0
## Garcia            0       0         0
## Johnson           0       0         0
## Kerth             0       0         0
## Loayza            0       0         0
## Luis              0       0         0
```

```
## Mello1            0       0         0
## Mello2            0       0         0
## Mello3            0       0         0
## Meyer             0       0         0
## Muylaert1         0       0         0
## Muylaert2         0       0         0
## Ortega            0       0         1
## Patriquin         0       0         0
## Patterson         0       0         0
## Presley1          1       0         0
## Presley2          0       0         0
## Rhodes            0       0         1
## Rosas             0       0         0
## Sarmento          0       0         0
## Struebig          0       0         0
## Varzinczak        0       0         0
## Webber            0       0         0
## Zarazua           0       0         0
```

Create an igraph object:

```
softnet <- graph_from_incidence_matrix(softmat, weighted = NULL)
```

Inspect the object:

```
class(softnet)
```

```
## [1] "igraph"
```

```
softnet
```

```
## IGRAPH 2c4f30d UN-B 41 44 --
## + attr: type (v/l), name (v/c)
## + edges from 2c4f30d (vertex names):
##  [1] Ancilloto--Ucinet     Andrade  --R          Carter   --R
##  [4] Carter   --NTC        Chaverri --Pajek      Chaverri --Ucinet
##  [7] Chaverri --SocProg    Chaverri --Netdraw    Cisneros --Matlab
## [10] Fortuna  --Aninhado   Garcia   --BinMatNest Johnson  --Ucinet
## [13] Kerth    --Matlab     Loayza   --NTC        Luis     --R
## [16] Mello1   --R          Mello1   --Aninhado   Mello1   --Matlab
## [19] Mello1   --Pajek      Mello1   --Netcarto   Mello2   --R
## [22] Mello2   --Aninhado   Mello2   --Pajek      Mello3   --R
## + ... omitted several edges
```

```
E(softnet)
```

```
## + 44/44 edges from 2c4f30d (vertex names):
##  [1] Ancilloto--Ucinet     Andrade  --R          Carter   --R
##  [4] Carter   --NTC        Chaverri --Pajek      Chaverri --Ucinet
##  [7] Chaverri --SocProg    Chaverri --Netdraw    Cisneros --Matlab
## [10] Fortuna  --Aninhado   Garcia   --BinMatNest Johnson  --Ucinet
```

```
## [13] Kerth    --Matlab     Loayza   --NTC        Luis     --R
## [16] Mello1   --R          Mello1   --Aninhado   Mello1   --Matlab
## [19] Mello1   --Pajek      Mello1   --Netcarto   Mello2   --R
## [22] Mello2   --Aninhado   Mello2   --Pajek      Mello3   --R
## [25] Mello3   --Pajek      Meyer    --BinMatNest Muylaert1--R
## [28] Muylaert1--Aninhado   Muylaert2--Aninhado   Ortega   --Undefined
## + ... omitted several edges
```

```
V(softnet)
```

```
## + 41/41 vertices, named, from 2c4f30d:
##  [1] Ancilloto  Andrade    Carter     Chaverri   Cisneros   Fortuna
##  [7] Garcia     Johnson    Kerth      Loayza     Luis       Mello1
## [13] Mello2     Mello3     Meyer      Muylaert1  Muylaert2  Ortega
## [19] Patriquin  Patterson  Presley1   Presley2   Rhodes     Rosas
## [25] Sarmento   Struebig   Varzinczak Webber     Zarazua    R
## [31] Aninhado   Matlab     Pajek      BinMatNest Ucinet     Netcarto
## [37] SocProg    NTC        JMP_SPSS   Netdraw    Undefined
```

Name the two sets of vertices: rows will be "software" and columns, "references":

```
V(softnet)$set = ifelse(V(softnet)$type == FALSE, "software", "reference")
V(softnet)$set
```

```
##  [1] "software"  "software"  "software"  "software"  "software"  "software"
##  [7] "software"  "software"  "software"  "software"  "software"  "software"
## [13] "software"  "software"  "software"  "software"  "software"  "software"
## [19] "software"  "software"  "software"  "software"  "software"  "software"
## [25] "software"  "software"  "software"  "software"  "software"  "reference"
## [31] "reference" "reference" "reference" "reference" "reference" "reference"
## [37] "reference" "reference" "reference" "reference" "reference"
```

Set the layout for the graph:

```
lref <- layout.fruchterman.reingold(softnet)
```

Set the edge curvatures:

```
curvesref = curve_multiple(softnet)
```

Set the edge mode and width:

```
E(softnet)$arrow.mode = 0
E(softnet)$width = 1
```

Set the node shapes:

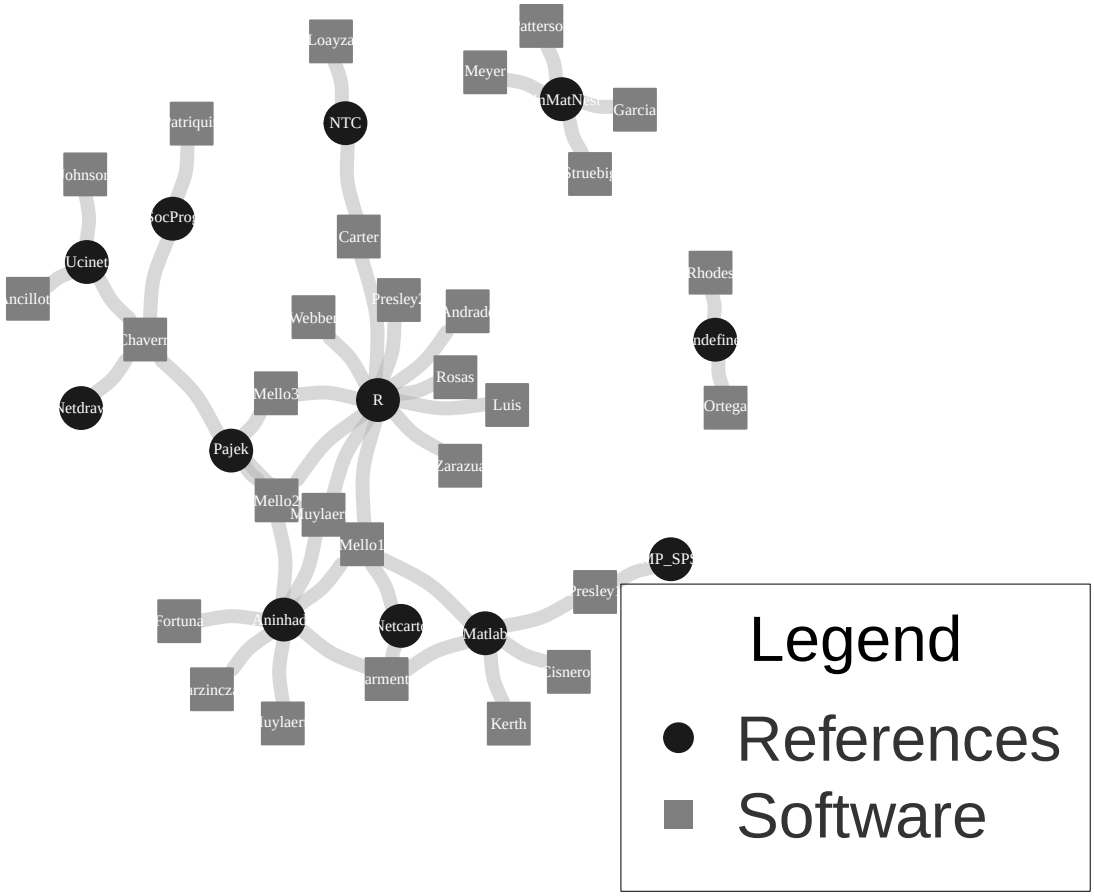
```
V(softnet)$shape = V(softnet)$set
V(softnet)$shape = gsub("reference","circle",V(softnet)$shape)
V(softnet)$shape = gsub("software","square",V(softnet)$shape)
```

Set the node colors:

```
V(softnet)$color = V(softnet)$set
V(softnet)$color = gsub("reference","grey10",V(softnet)$color)
V(softnet)$color = gsub("software","grey50",V(softnet)$color)
```

Draw the graph with node colors by class:

```
par(mfrow = c(1,1))
plot(softnet,
     vertex.color = V(softnet)$color,
     vertex.frame.color = V(softnet)$color,
     #vertex.shape = vertexshape,
     vertex.size = 12,
     #vertex.size = V(softnet)$size,
     vertex.label = V(softnet)$name,
     vertex.label.color = "white",
     vertex.label.cex = .5,
     edge.color = adjustcolor("grey70", alpha.f = .5),
     #edge.color = "#FFFD00",
     #edge.curved = curvesref,
     edge.curved = 0.2,
     edge.width = 7,
     #layout = layout_in_circle,
     layout = lref)
legend(x = 0.7,y = -0.6, legend = c("References", "Software"),
       pch = c(19,15), title="Legend",
       text.col = "gray20", title.col = "black", box.lwd = 0,
       cex = 2, col=c("grey10", "grey50"))
```




```
par(mfrow = c(1,1))
```

5. Draw Figure 21.4

Import the data:

```
sarmentomat = as.matrix(read.delim("Analysis/sarmento.txt", row.names=1))
```

Inspect the object:

```
class(sarmentomat)
```

```
## [1] "matrix" "array"
```

```
sarmentomat
```

```
##                         Cecropia_pachystachya Ficus_gomelleira Piper_aduncum
## Carollia_perspicillata                     31                1           107
## Rhinophylla_pumilio                         0                0             0
## Artibeus_fimbriatus                         1                5             0
## Artibeus_lituratus                          2                2             1
## Artibeus_cinereus                           0                3             1
```

```
## Trachops_cirrhosus                      1                0             1
## Artibeus_planirostris                   2                5             0
## Artibeus_obscurus                       0                2             0
## Glossophaga_soricina                    1                0             0
## Plathyrrinus_lineatus                   1                1             0
## Trinycteris_nicefori                    0                0             1
## Phyllostomus_elongatus                  0                0             0
## Chiroxiphia_pareola                     4                0             0
## Pipra_rubrocapilla                      0                0             0
## Manacus_manacus                         0                0             1
## Saltator_maximus                        3                0             1
## Turdus_albicollis                       0                0             0
## Mionectes_oleagineus                    0                0             0
## Dysithamnus_mentalis                    0                0             0
## Euphonia_violacea                       0                0             0
## Turdus_sp                               0                0             0
## Tangara_cayana                          0                1             0
##                        Piper_marginatum Clidemia_debilis Melastomataceae
## Carollia_perspicillata               26                0               1
## Rhinophylla_pumilio                   0                0               0
## Artibeus_fimbriatus                   0                0               0
## Artibeus_lituratus                    0                0               0
## Artibeus_cinereus                     2                0               0
## Trachops_cirrhosus                    0                0               0
## Artibeus_planirostris                 0                0               0
## Artibeus_obscurus                     1                0               0
## Glossophaga_soricina                  0                0               0
## Plathyrrinus_lineatus                 0                0               0
## Trinycteris_nicefori                  0                0               0
## Phyllostomus_elongatus                2                0               0
## Chiroxiphia_pareola                   0                9               0
## Pipra_rubrocapilla                    0                6               1
## Manacus_manacus                       0                5               2
## Saltator_maximus                      0                1               0
## Turdus_albicollis                     0                0               0
## Mionectes_oleagineus                  0                0               1
## Dysithamnus_mentalis                  0                0               0
## Euphonia_violacea                     0                0               0
## Turdus_sp                             0                0               0
## Tangara_cayana                        0                0               0
##                        Piper_arboreum M42 Miconia_prasina Miconia_sp2 Poaceae
## Carollia_perspicillata             51  11               0           0       0
## Rhinophylla_pumilio                 0   2               0           0       0
## Artibeus_fimbriatus                 1   0               0           0       0
## Artibeus_lituratus                  1   0               0           0       0
## Artibeus_cinereus                   0   0               0           0       0
## Trachops_cirrhosus                  0   0               0           0       0
## Artibeus_planirostris               0   0               0           0       0
## Artibeus_obscurus                   0   0               0           0       0
## Glossophaga_soricina                0   1               0           0       0
## Plathyrrinus_lineatus               0   0               0           0       0
## Trinycteris_nicefori                0   0               0           0       0
## Phyllostomus_elongatus              0   0               0           0       0
## Chiroxiphia_pareola                 0   0               4           1       2
```

```
## Pipra_rubrocapilla                  0   0               2           3       1
## Manacus_manacus                     0   0               0           2       1
## Saltator_maximus                    0   0               0           0       0
## Turdus_albicollis                   0   0               0           0       0
## Mionectes_oleagineus                0   0               0           0       0
## Dysithamnus_mentalis                0   0               0           0       0
## Euphonia_violacea                   0   0               0           0       0
## Turdus_sp                           0   0               1           0       0
## Tangara_cayana                      0   0               0           0       0
##                         Clidemia_hirta M6 Vismia_guianensis M44 Piper_sp5 M46
## Carollia_perspicillata               1  0                35   9         7   6
## Rhinophylla_pumilio                  2  0                 0   2         1   1
## Artibeus_fimbriatus                  0  0                 0   0         0   0
## Artibeus_lituratus                   0  0                 0   0         0   0
## Artibeus_cinereus                    0  0                 0   0         0   0
## Trachops_cirrhosus                   0  0                 1   0         0   0
## Artibeus_planirostris                0  0                 0   0         0   0
## Artibeus_obscurus                    0  0                 0   0         0   0
## Glossophaga_soricina                 0  0                 0   0         0   0
## Plathyrrinus_lineatus                0  0                 0   0         0   0
## Trinycteris_nicefori                 0  0                 0   0         0   0
## Phyllostomus_elongatus               0  0                 0   0         0   0
## Chiroxiphia_pareola                  1  1                 0   0         0   0
## Pipra_rubrocapilla                   0  1                 0   0         0   0
## Manacus_manacus                      0  1                 0   0         0   0
## Saltator_maximus                     0  0                 0   0         0   0
## Turdus_albicollis                    0  0                 0   0         0   0
## Mionectes_oleagineus                 0  0                 0   0         0   0
## Dysithamnus_mentalis                 0  0                 0   0         0   0
## Euphonia_violacea                    0  0                 0   0         0   0
## Turdus_sp                            0  0                 0   0         0   0
## Tangara_cayana                       0  0                 0   0         0   0
##                         M24 Vismia_sp M2 M11 Schefflera_morototonii Miconia_sp1
## Carollia_perspicillata    0         0  0   0                      0           0
## Rhinophylla_pumilio       0         0  0   0                      0           0
## Artibeus_fimbriatus       0         0  0   0                      0           0
## Artibeus_lituratus        0         0  0   0                      0           0
## Artibeus_cinereus         0         0  0   0                      0           0
## Trachops_cirrhosus        0         0  0   0                      0           0
## Artibeus_planirostris     0         0  0   0                      0           0
## Artibeus_obscurus         0         0  0   0                      0           0
## Glossophaga_soricina      0         0  0   0                      0           0
## Plathyrrinus_lineatus     0         0  0   0                      0           0
## Trinycteris_nicefori      0         0  0   0                      0           0
## Phyllostomus_elongatus    0         0  0   0                      0           0
## Chiroxiphia_pareola       1         0  1   1                      0           0
## Pipra_rubrocapilla        0         1  0   0                      0           1
## Manacus_manacus           2         1  0   1                      1           1
## Saltator_maximus          0         0  0   0                      0           0
## Turdus_albicollis         0         0  1   0                      1           0
## Mionectes_oleagineus      0         0  0   0                      0           0
## Dysithamnus_mentalis      0         0  0   0                      0           0
## Euphonia_violacea         0         0  0   0                      0           0
## Turdus_sp                 0         0  0   0                      0           0
```

```
## Tangara_cayana           0         0  0   0                    0           0
##                       Psychotria_sp M47 Piper_sp4 Solanum_rugosum
## Carollia_perspicillata             0   0         1              10
## Rhinophylla_pumilio                0   1         0               0
## Artibeus_fimbriatus                0   0         1               0
## Artibeus_lituratus                 0   0         0               0
## Artibeus_cinereus                  0   0         0               0
## Trachops_cirrhosus                 0   0         0               0
## Artibeus_planirostris              0   0         0               0
## Artibeus_obscurus                  0   0         0               0
## Glossophaga_soricina               0   0         0               0
## Plathyrrinus_lineatus              0   0         0               0
## Trinycteris_nicefori               0   1         0               0
## Phyllostomus_elongatus             0   0         0               0
## Chiroxiphia_pareola                0   0         0               0
## Pipra_rubrocapilla                 1   0         0               0
## Manacus_manacus                    1   0         0               0
## Saltator_maximus                   0   0         0               0
## Turdus_albicollis                  0   0         0               0
## Mionectes_oleagineus               0   0         0               0
## Dysithamnus_mentalis               0   0         0               0
## Euphonia_violacea                  0   0         0               0
## Turdus_sp                          0   0         0               0
## Tangara_cayana                     0   0         0               0
##                       Solanum_americanum Piper_caldense M52 M53 Piper_sp2 M55
## Carollia_perspicillata                 8             6   5   5         4   4
## Rhinophylla_pumilio                    0             0   0   0         0   0
## Artibeus_fimbriatus                    0             0   0   0         0   0
## Artibeus_lituratus                     0             0   0   0         0   0
## Artibeus_cinereus                      0             0   0   0         0   0
## Trachops_cirrhosus                     0             0   0   0         0   0
## Artibeus_planirostris                  0             0   0   0         0   0
## Artibeus_obscurus                      0             0   0   0         0   0
## Glossophaga_soricina                   0             0   0   0         0   0
## Plathyrrinus_lineatus                  0             0   0   0         0   0
## Trinycteris_nicefori                   0             0   0   0         0   0
## Phyllostomus_elongatus                 0             0   0   0         0   0
## Chiroxiphia_pareola                    0             0   0   0         0   0
## Pipra_rubrocapilla                     0             0   0   0         0   0
## Manacus_manacus                        0             0   0   0         0   0
## Saltator_maximus                       0             0   0   0         0   0
## Turdus_albicollis                      0             0   0   0         0   0
## Mionectes_oleagineus                   0             0   0   0         0   0
## Dysithamnus_mentalis                   0             0   0   0         0   0
## Euphonia_violacea                      0             0   0   0         0   0
## Turdus_sp                              0             0   0   0         0   0
## Tangara_cayana                         0             0   0   0         0   0
##                       Fabaceae_sp1 M5 Fabaceae_sp2 M58 M59 M3 Fabaceae_sp3 M10
## Carollia_perspicillata            3  0            2   2   0  0            0   0
## Rhinophylla_pumilio               0  0            0   0   2  0            0   0
## Artibeus_fimbriatus               0  0            0   0   0  0            0   0
## Artibeus_lituratus                0  0            0   0   0  0            0   0
## Artibeus_cinereus                 0  0            0   0   0  0            0   0
## Trachops_cirrhosus                0  0            0   0   0  0            0   0
```

```
## Artibeus_planirostris             0  0            0   0   0  0           0   0
## Artibeus_obscurus                 0  0            0   0   0  0           0   0
## Glossophaga_soricina              0  0            0   0   0  0           0   0
## Plathyrrinus_lineatus             0  0            0   0   0  0           0   0
## Trinycteris_nicefori              0  0            0   0   0  0           0   0
## Phyllostomus_elongatus            0  0            0   0   0  0           0   0
## Chiroxiphia_pareola               0  2            0   0   0  1           1   0
## Pipra_rubrocapilla                0  0            0   0   0  0           0   1
## Manacus_manacus                   0  0            0   0   0  0           0   0
## Saltator_maximus                  0  0            0   0   0  0           0   0
## Turdus_albicollis                 0  0            0   0   0  0           0   0
## Mionectes_oleagineus              0  0            0   0   0  0           0   0
## Dysithamnus_mentalis              0  0            0   0   0  0           0   0
## Euphonia_violacea                 0  0            0   0   0  0           0   0
## Turdus_sp                         0  0            0   0   0  0           0   0
## Tangara_cayana                    0  0            0   0   0  0           0   0
##                         M15 M17 M18 Melastomataceae2 M21 M25 M26 M27 M28
## Carollia_perspicillata    0   0   0                0   0   0   0   0   0
## Rhinophylla_pumilio       0   0   0                0   0   0   0   0   0
## Artibeus_fimbriatus       0   0   0                0   0   0   0   0   0
## Artibeus_lituratus        0   0   0                0   0   0   0   0   0
## Artibeus_cinereus         0   0   0                0   0   0   0   0   0
## Trachops_cirrhosus        0   0   0                0   0   0   0   0   0
## Artibeus_planirostris     0   0   0                0   0   0   0   0   0
## Artibeus_obscurus         0   0   0                0   0   0   0   0   0
## Glossophaga_soricina      0   0   0                0   0   0   0   0   0
## Plathyrrinus_lineatus     0   0   0                0   0   0   0   0   0
## Trinycteris_nicefori      0   0   0                0   0   0   0   0   0
## Phyllostomus_elongatus    0   0   0                0   0   0   0   0   0
## Chiroxiphia_pareola       1   0   0                0   0   0   1   1   1
## Pipra_rubrocapilla        0   0   0                0   1   1   0   0   0
## Manacus_manacus           0   0   0                0   0   0   0   0   0
## Saltator_maximus          0   0   0                1   0   0   0   0   0
## Turdus_albicollis         0   1   1                0   0   0   0   0   0
## Mionectes_oleagineus      0   0   0                0   0   0   0   0   0
## Dysithamnus_mentalis      0   0   0                0   0   0   0   0   0
## Euphonia_violacea         0   0   0                0   0   0   0   0   0
## Turdus_sp                 0   0   0                0   0   0   0   0   0
## Tangara_cayana            0   0   0                0   0   0   0   0   0
##                         Rubiaceae M30 M31 M33 Cordia_sp M36 M37 M38 M39
## Carollia_perspicillata          0   0   0   0         0   0   0   0   0
## Rhinophylla_pumilio             0   0   0   0         0   0   0   0   0
## Artibeus_fimbriatus             0   0   0   0         0   0   0   0   0
## Artibeus_lituratus              0   0   0   0         0   0   0   0   0
## Artibeus_cinereus               0   0   0   0         0   0   0   0   0
## Trachops_cirrhosus              0   0   0   0         0   0   0   0   0
## Artibeus_planirostris           0   0   0   0         0   0   0   0   0
## Artibeus_obscurus               0   0   0   0         0   0   0   0   0
## Glossophaga_soricina            0   0   0   0         0   0   0   0   0
## Plathyrrinus_lineatus           0   0   0   0         0   0   0   0   0
## Trinycteris_nicefori            0   0   0   0         0   0   0   0   0
## Phyllostomus_elongatus          0   0   0   0         0   0   0   0   0
## Chiroxiphia_pareola             0   1   0   0         1   0   0   1   0
## Pipra_rubrocapilla              1   0   0   0         0   0   0   0   0
```

```
## Manacus_manacus                0   0   0   1         0   0   0   0   0
## Saltator_maximus               0   0   0   0         0   0   0   0   0
## Turdus_albicollis              0   0   0   0         0   0   0   0   0
## Mionectes_oleagineus           0   0   1   0         0   0   1   0   0
## Dysithamnus_mentalis           0   0   0   0         0   0   0   0   1
## Euphonia_violacea              0   0   0   0         0   1   0   0   0
## Turdus_sp                      0   0   0   0         0   0   0   0   0
## Tangara_cayana                 0   0   0   0         0   0   0   0   0
##                         Piper_sp3 Solanum_sp Piper_sp1 Passifloraceae M64
## Carollia_perspicillata          1          1         1              1   0
## Rhinophylla_pumilio             0          0         0              0   0
## Artibeus_fimbriatus             0          0         0              0   1
## Artibeus_lituratus              0          0         0              0   0
## Artibeus_cinereus               0          0         0              0   0
## Trachops_cirrhosus              0          0         0              0   0
## Artibeus_planirostris           0          0         0              0   0
## Artibeus_obscurus               0          0         0              0   0
## Glossophaga_soricina            0          0         0              0   0
## Plathyrrinus_lineatus           0          0         0              0   0
## Trinycteris_nicefori            0          0         0              0   0
## Phyllostomus_elongatus          0          0         0              0   0
## Chiroxiphia_pareola             0          0         0              0   0
## Pipra_rubrocapilla              0          0         0              0   0
## Manacus_manacus                 0          0         0              0   0
## Saltator_maximus                0          0         0              0   0
## Turdus_albicollis               0          0         0              0   0
## Mionectes_oleagineus            0          0         0              0   0
## Dysithamnus_mentalis            0          0         0              0   0
## Euphonia_violacea               0          0         0              0   0
## Turdus_sp                       0          0         0              0   0
## Tangara_cayana                  0          0         0              0   0
##                         Solanaceae M66 M67
## Carollia_perspicillata           1   1   1
## Rhinophylla_pumilio              0   0   0
## Artibeus_fimbriatus              0   0   0
## Artibeus_lituratus               0   0   0
## Artibeus_cinereus                0   0   0
## Trachops_cirrhosus               0   0   0
## Artibeus_planirostris            0   0   0
## Artibeus_obscurus                0   0   0
## Glossophaga_soricina             0   0   0
## Plathyrrinus_lineatus            0   0   0
## Trinycteris_nicefori             0   0   0
## Phyllostomus_elongatus           0   0   0
## Chiroxiphia_pareola              0   0   0
## Pipra_rubrocapilla               0   0   0
## Manacus_manacus                  0   0   0
## Saltator_maximus                 0   0   0
## Turdus_albicollis                0   0   0
## Mionectes_oleagineus             0   0   0
## Dysithamnus_mentalis             0   0   0
## Euphonia_violacea                0   0   0
## Turdus_sp                        0   0   0
## Tangara_cayana                   0   0   0
```

Create an igraph object:

```
sarmentonet <- graph_from_incidence_matrix(sarmentomat,
                                           directed = F, weighted = TRUE)
```

Inspect the object:

```
class(sarmentonet)
```

```
## [1] "igraph"
```

```
sarmentonet
```

```
## IGRAPH 69a5ea6 UNWB 89 124 --
## + attr: type (v/l), name (v/c), weight (e/n)
## + edges from 69a5ea6 (vertex names):
##  [1] Carollia_perspicillata--Cecropia_pachystachya
##  [2] Carollia_perspicillata--Ficus_gomelleira
##  [3] Carollia_perspicillata--Piper_aduncum
##  [4] Carollia_perspicillata--Piper_marginatum
##  [5] Carollia_perspicillata--Melastomataceae
##  [6] Carollia_perspicillata--Piper_arboreum
##  [7] Carollia_perspicillata--M42
##  [8] Carollia_perspicillata--Clidemia_hirta
## + ... omitted several edges
```

```
E(sarmentonet)
```

```
## + 124/124 edges from 69a5ea6 (vertex names):
##  [1] Carollia_perspicillata--Cecropia_pachystachya
##  [2] Carollia_perspicillata--Ficus_gomelleira
##  [3] Carollia_perspicillata--Piper_aduncum
##  [4] Carollia_perspicillata--Piper_marginatum
##  [5] Carollia_perspicillata--Melastomataceae
##  [6] Carollia_perspicillata--Piper_arboreum
##  [7] Carollia_perspicillata--M42
##  [8] Carollia_perspicillata--Clidemia_hirta
##  [9] Carollia_perspicillata--Vismia_guianensis
## [10] Carollia_perspicillata--M44
## + ... omitted several edges
```

```
V(sarmentonet)
```

```
## + 89/89 vertices, named, from 69a5ea6:
##  [1] Carollia_perspicillata Rhinophylla_pumilio    Artibeus_fimbriatus
##  [4] Artibeus_lituratus     Artibeus_cinereus      Trachops_cirrhosus
##  [7] Artibeus_planirostris  Artibeus_obscurus      Glossophaga_soricina
## [10] Plathyrrinus_lineatus  Trinycteris_nicefori   Phyllostomus_elongatus
## [13] Chiroxiphia_pareola    Pipra_rubrocapilla     Manacus_manacus
## [16] Saltator_maximus       Turdus_albicollis      Mionectes_oleagineus
## [19] Dysithamnus_mentalis   Euphonia_violacea      Turdus_sp
```

```
## [22] Tangara_cayana          Cecropia_pachystachya  Ficus_gomelleira
## [25] Piper_aduncum           Piper_marginatum       Clidemia_debilis
## [28] Melastomataceae         Piper_arboreum         M42
## + ... omitted several vertices
```

Specify which nodes represent which taxonomic groups:

```
V(sarmentonet)$set[1:12] = "Bats"
```

```
## Warning in vattrs[[name]][index] <- value: número de itens para para substituir
## não é um múltiplo do comprimento do substituto
```

```
V(sarmentonet)$set[13:22] = "Birds"
V(sarmentonet)$set[23:89] = "Plants"
```

Set the layout for the graphs:

```
lsar <- layout_nicely(sarmentonet)
```

Set the edge curvatures:

```
curvessar = curve_multiple(sarmentonet)
```

Set the edge mode and width:

```
E(sarmentonet)$arrow.mode = 0
E(sarmentonet)$width = E(sarmentonet)$weight/5+1
```

Calculate the Louvain modularity (resolution = 1.0):

```
sarmentonet.lou = cluster_louvain(sarmentonet)
```

Import the "diamond" vertex shape:

```
source("Analysis/MyTriangle.R")
```

Set the vertex shapes:

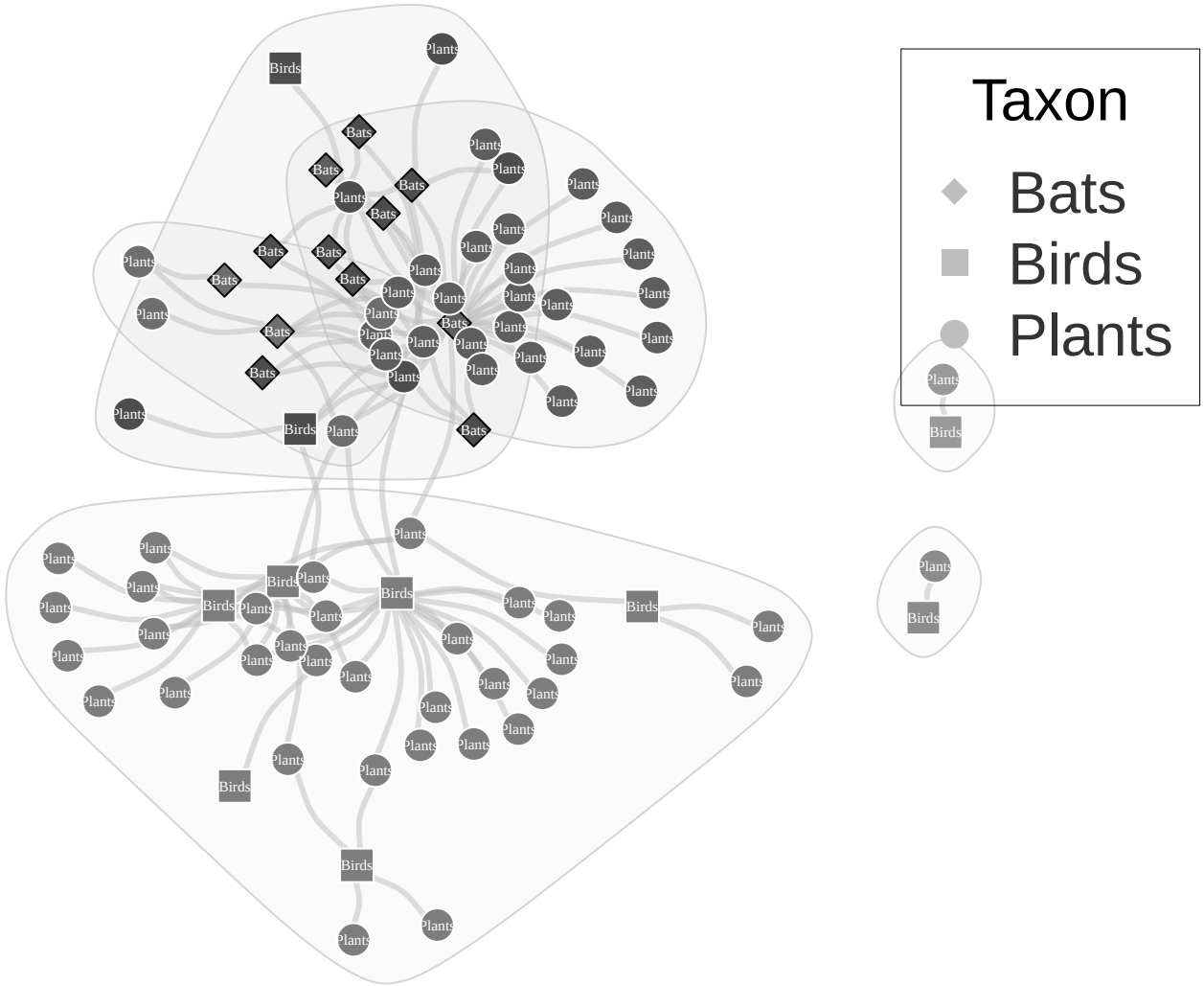
```
V(sarmentonet)$shape = V(sarmentonet)$set
V(sarmentonet)$shape = gsub("Bats","diamond",V(sarmentonet)$shape)
V(sarmentonet)$shape = gsub("Birds","square",V(sarmentonet)$shape)
V(sarmentonet)$shape = gsub("Plants","circle",V(sarmentonet)$shape)
```

Set the colors for the nodes and clouds based on the modularity analysis:

```
colrs <- gray.colors(length(sarmentonet.lou), start = 0.3,
                     end = 0.6, gamma = 1.5, alpha = NULL)
V(sarmentonet)$color <- colrs[sarmentonet.lou$membership]
clouds = gray.colors(length(sarmentonet.lou), start = 0.7,
                     end = 0.9, gamma = 1.5, alpha = 0.1)
```

Plot the graph with node colors by Louvain modularity (grey tones) + clouds around modules:

```
par(mfrow=c(1,1),mar=c(1,1,1,5))
plot(sarmentonet.lou,
     sarmentonet,
     col = V(sarmentonet)$color,
     mark.border="lightgrey",
     mark.col=clouds,
     vertex.size=7.5,
     vertex.label=V(sarmentonet)$set,
     vertex.label.color="white",
     vertex.label.cex=.5,
     edge.color = adjustcolor("grey", alpha.f = .5),
     edge.curved=0.3,
     edge.width = 3,
     layout=lsar)
legend(x = 0.9,y = 1.0, legend = c("Bats", "Birds", "Plants"),
       pch = c(18,15,19),  title="Taxon",
       text.col = "gray20", title.col = "black",
       box.lwd = 0, cex = 2, col=c("grey", "grey", "grey"))
```



```r
par(mfrow=c(1,1))
```