

Igraph Links 2017

Introduction

Select the working directory

```
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(sand)

## Warning: package 'sand' was built under R version 3.3.3
## Loading required package: igraphdata
##
## Statistical Analysis of Network Data with R
## Type in C2 (+ENTER) to start with Chapter 2.
```

Creating Graphs

Undirected Graphs

```
g <- graph.formula(1-2, 1-3, 2-3, 2-4, 3-5, 4-5, 4-6,
                  4-7, 5-6, 6-7)
V(g)

## + 7/7 vertices, named:
## [1] 1 2 3 4 5 6 7

E(g)

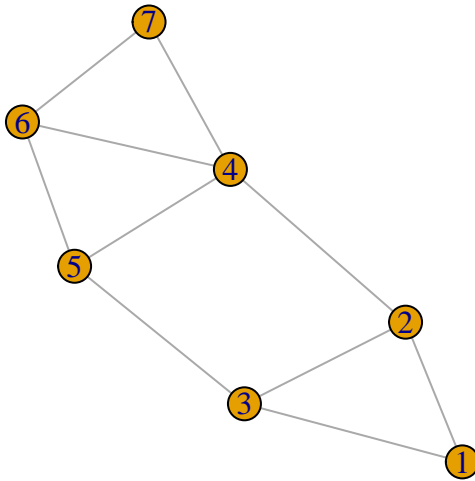
## + 10/10 edges (vertex names):
## [1] 1--2 1--3 2--3 2--4 3--5 4--5 4--6 4--7 5--6 6--7

str(g)

## IGRAPH UN-- 7 10 --
## + attr: name (v/c)
## + edges (vertex names):
## 1 -- 2, 3
## 2 -- 1, 3, 4
## 3 -- 1, 2, 5
## 4 -- 2, 5, 6, 7
```

```
## 5 -- 3, 4, 6
## 6 -- 4, 5, 7
## 7 -- 4, 6
```

```
plot(g)
```

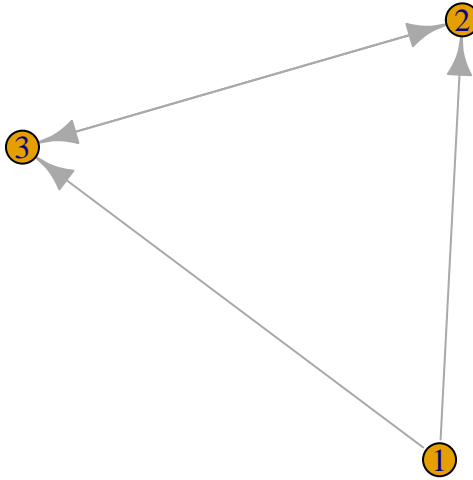


Directed Graphs

```
y <- c(1:5)
```

```
dg <- graph.formula(1->2, 1->3, 2->3)
```

```
plot(dg)
```



```
dg.1 <- graph.formula(Sam->Mary, Sam->Tom, Mary->Tom)
```

```
str(dg.1)
```

```
## IGRAPH DN-- 3 4 --
## + attr: name (v/c)
## + edges (vertex names):
## [1] Sam ->Mary Sam ->Tom Mary->Tom Tom ->Mary
```

Representations of Graphs

```
edgelist <- get.edgelist(g)
head(edgelist)
```

```
##      [,1] [,2]
## [1,] "1"  "2"
## [2,] "1"  "3"
## [3,] "2"  "3"
## [4,] "2"  "4"
## [5,] "3"  "5"
## [6,] "4"  "5"
```

```
matrix <- as.matrix(get.adjacency(g))
head(matrix)
```

```
##    1 2 3 4 5 6 7
```

```
## 1 0 1 1 0 0 0 0
## 2 1 0 1 1 0 0 0
## 3 1 1 0 0 1 0 0
## 4 0 1 0 0 1 1 1
## 5 0 0 1 1 0 1 0
## 6 0 0 0 1 1 0 1
```

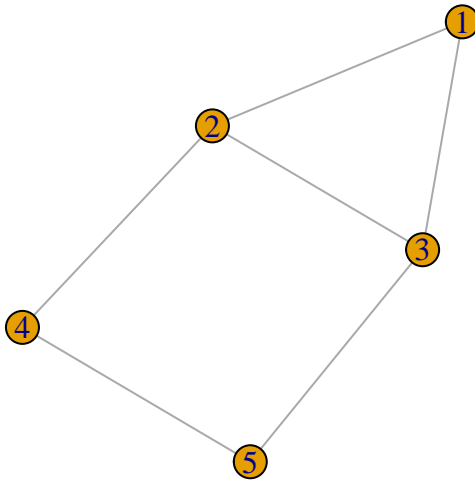
```
adjlist <- get.adjlist(g)
adjlist
```

```
## $`1`
## + 2/7 vertices, named:
## [1] 2 3
##
## $`2`
## + 3/7 vertices, named:
## [1] 1 3 4
##
## $`3`
## + 3/7 vertices, named:
## [1] 1 2 5
##
## $`4`
## + 4/7 vertices, named:
## [1] 2 5 6 7
##
## $`5`
## + 3/7 vertices, named:
## [1] 3 4 6
##
## $`6`
## + 3/7 vertices, named:
## [1] 4 5 7
##
## $`7`
## + 2/7 vertices, named:
## [1] 4 6
```

Operations on graphs

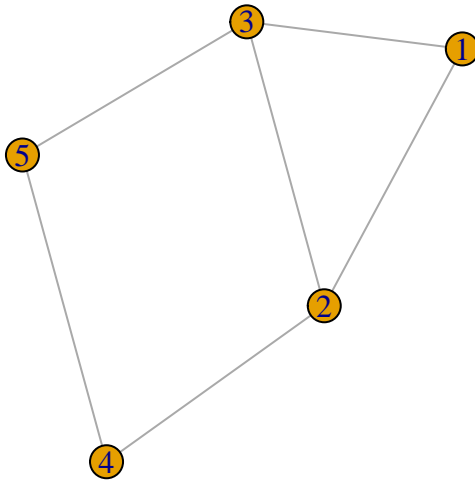
Consider the subgraph of g induced by the first five vertices.

```
h <- induced.subgraph(g, 1:5)
plot(h)
```



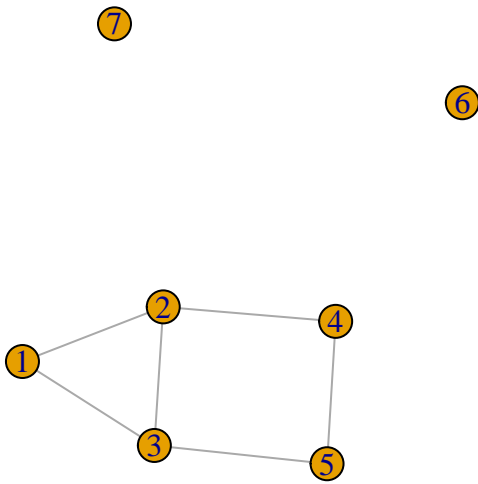
Also, we could remove vertices 6 and 7 from `g` to generate `h`

```
h <- g - vertices(c(6,7))  
plot(h)
```

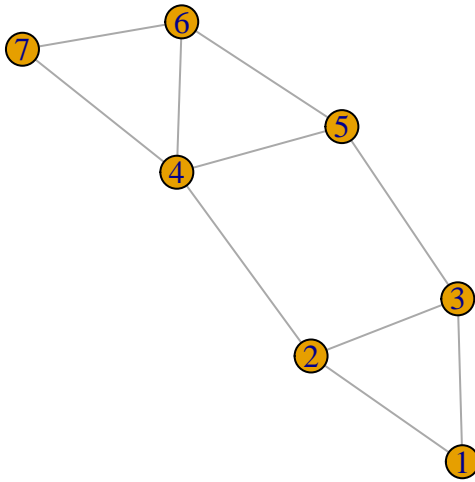


Recovering g from h by adding these two vertices and the appropriate edges

```
h <- h + vertices(c(6,7))  
plot(h)
```

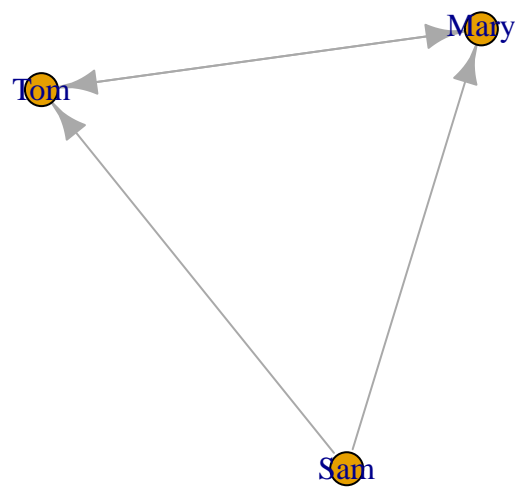


```
g.1 <- h + edges(c(4,6),c(4,7),c(5,6),c(6,7))  
plot(g.1)
```



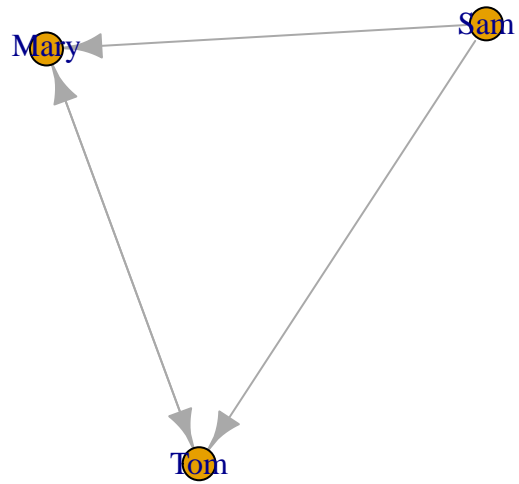
Graph Data

```
dg.2 <- graph.formula(1--2, 1--3, 2++3)
plot(dg.1)
```

Adding Attributes

```
dg.2$name <- "Toy Graph"  
V(dg.2)$name <- c("Sam", "Mary", "Tom")  
plot(dg.2)
```



```
V(dg.2)$gender <- c("M", "F", "M")
```

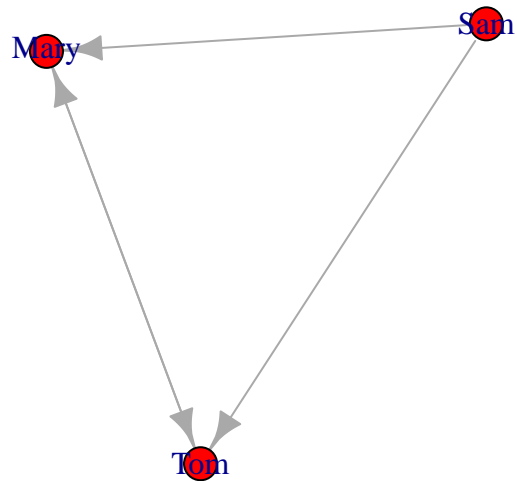
```
V(dg.2)$color <- "red"
```

```
summary(dg.2)
```

```
## IGRAPH DN-- 3 4 -- Toy Graph
```

```
## + attr: name (g/c), name (v/c), gender (v/c), color (v/c)
```

```
plot(dg.2)
```



Using Data Frames

```
library(sand)
```

```
head(v.attr.lazega)
```

##	Name	Seniority	Status	Gender	Office	Years	Age	Practice	School
## 1	V1	1	1	1	1	31	64	1	1
## 2	V2	2	1	1	1	32	62	2	1
## 3	V3	3	1	1	2	13	67	1	1
## 4	V4	4	1	1	1	31	59	2	3
## 5	V5	5	1	1	2	31	59	1	2
## 6	V6	6	1	1	2	29	55	1	1

```
head(elist.lazega)
```

##	V1	V2
## 1	V1	V17
## 2	V2	V7
## 3	V2	V16
## 4	V2	V17
## 5	V2	V22
## 6	V2	V26

```
g.lazega <- graph.data.frame(elist.lazega, directed="FALSE", vertices=v.attr.lazega)
vcount(g.lazega)
```

```
## [1] 36
```

```
ecount(g.lazega)
```

```
## [1] 115
```

```
list.vertex.attributes(g.lazega)
```

```
## [1] "name"      "Seniority" "Status"    "Gender"    "Office"    "Years"
## [7] "Age"       "Practice"  "School"
```

```
str(g.lazega)
```

```
## IGRAPH UN-- 36 115 --
## + attr: name (v/c), Seniority (v/n), Status (v/n), Gender (v/n),
## | Office (v/n), Years (v/n), Age (v/n), Practice (v/n), School
## | (v/n)
## + edges (vertex names):
## V1 -- V17
## V2 -- V7, V16, V17, V22, V26, V29
## V3 -- V18, V25, V28
## V4 -- V12, V17, V19, V20, V22, V26, V28, V29, V31
## V5 -- V18, V24, V28, V31, V32, V33
## V6 -- V24, V28, V30, V31, V32
## V7 -- V2, V18
## V8 --
## V9 -- V12, V16, V29
## V10 -- V24, V26, V29, V31, V34
## V11 -- V17
## V12 -- V4, V9, V15, V16, V17, V19, V26, V29, V34
## V13 -- V31, V33
## V14 -- V16, V17, V25, V28, V30, V32
## V15 -- V12, V16, V19, V20, V22, V24, V26, V29, V32, V35, V36
## V16 -- V2, V9, V12, V14, V15, V17, V22, V26, V27, V29, V32, V34,
##      V36
## V17 -- V1, V2, V4, V11, V12, V14, V16, V19, V22, V24, V25, V26,
##      V28, V29, V34
## V18 -- V3, V5, V7, V28, V31, V32, V33, V35
## V19 -- V4, V12, V15, V17, V22, V24, V26, V28, V34, V35
## V20 -- V4, V15, V22, V26
## V21 -- V27
## V22 -- V2, V4, V15, V16, V17, V19, V20, V31, V32
## V23 --
## V24 -- V5, V6, V10, V15, V17, V19, V26, V31, V36
## V25 -- V3, V14, V17, V28, V35
## V26 -- V2, V4, V10, V12, V15, V16, V17, V19, V20, V24, V27, V32
## V27 -- V16, V21, V26
## V28 -- V3, V4, V5, V6, V14, V17, V18, V19, V25, V30, V31, V32, V35
## V29 -- V2, V4, V9, V10, V12, V15, V16, V17, V34
## V30 -- V6, V14, V28, V31
## V31 -- V4, V5, V6, V10, V13, V18, V22, V24, V28, V30, V32, V33,
##      V35
```

```
## V32 -- V5, V6, V14, V15, V16, V18, V22, V26, V28, V31, V33, V35
## V33 -- V5, V13, V18, V31, V32
## V34 -- V10, V12, V16, V17, V19, V29
## V35 -- V15, V18, V19, V25, V28, V31, V32
## V36 -- V15, V16, V24
```

```
summary(g.lazega)
```

```
## IGRAPH UN-- 36 115 --
## + attr: name (v/c), Seniority (v/n), Status (v/n), Gender (v/n),
## | Office (v/n), Years (v/n), Age (v/n), Practice (v/n), School
## | (v/n)
```

```
edge.list.lazega <- data.frame(get.edgelist(g.lazega))
```

```
vertices.attributes.lazega <- data.frame(
  name = V(g.lazega)$name,
  seniority = V(g.lazega)$Seniority,
  status = V(g.lazega)$Status
)
```

Importing and Exporting Data

Uploading vertices and edges

```
vertices <- read.csv("Igraph_vertices.csv", stringsAsFactors = FALSE)
head(vertices)
```

```
##   Name Seniority Status Gender Office Years Age Practice School
## 1  V1          1      1      1      1    31  64          1      1
## 2  V2          2      1      1      1    32  62          2      1
## 3  V3          3      1      1      2    13  67          1      1
## 4  V4          4      1      1      1    31  59          2      3
## 5  V5          5      1      1      2    31  59          1      2
## 6  V6          6      1      1      2    29  55          1      1
```

```
edges <- read.csv("Igraph_edges.csv", stringsAsFactors = FALSE)
head(edges)
```

```
##   V1 V2
## 1 V1 V17
## 2 V2 V7
## 3 V2 V16
## 4 V2 V17
## 5 V2 V22
## 6 V2 V26
```

```
g.lazega.1 <- graph.data.frame(edges, directed = "FALSE", vertices = vertices)
summary(g.lazega.1)
```

```
## IGRAPH UN-- 36 115 --
## + attr: name (v/c), Seniority (v/n), Status (v/n), Gender (v/n),
## | Office (v/n), Years (v/n), Age (v/n), Practice (v/n), School
## | (v/n)
```

Uploading matrix format

```
matrix.lazega <- read.csv("Igraph_matrix_1.csv", stringsAsFactors = FALSE)

matrix.lazega.1 <- as.matrix(matrix.lazega)

g.matrix.lazega <- graph.adjacency(adjmatrix = matrix.lazega.1,
                                   mode = "undirected")
summary(g.matrix.lazega)

## IGRAPH UN-- 36 115 --
## + attr: name (v/c)
```

Uploading graph object

```
lazega <- read.graph("lazega.graphml", format = "graphml")
summary(lazega)

## IGRAPH UN-- 36 115 --
## + attr: name (v/c), Seniority (v/n), Status (v/n), Gender (v/n),
## | Office (v/n), Years (v/n), Age (v/n), Practice (v/n), School
## | (v/n), id (v/c)
```

Exporting graph objects as vertices and edges

```
write.csv(v.attr.lazega, "lazega_vertices.csv", row.names = FALSE)

write.csv(elist.lazega, "lazega_edges.csv", row.names = FALSE)
```

Exporting graph objects as graph objects

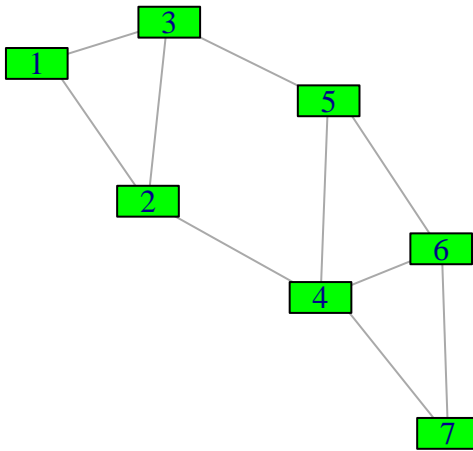
```
write.graph(g.lazega, "lazega.graphml", format = "graphml")
```

Plotting

Basics

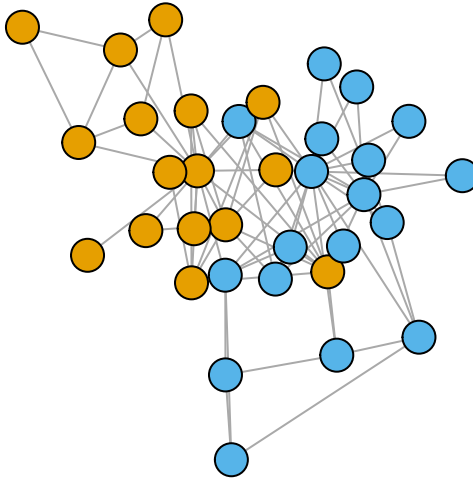
```
plot(g, vertex.size = 30, vertex.shape = "rectangle",
     vertex.color = "green")
title("Toy Graph")
```

Toy Graph



Example of SAND

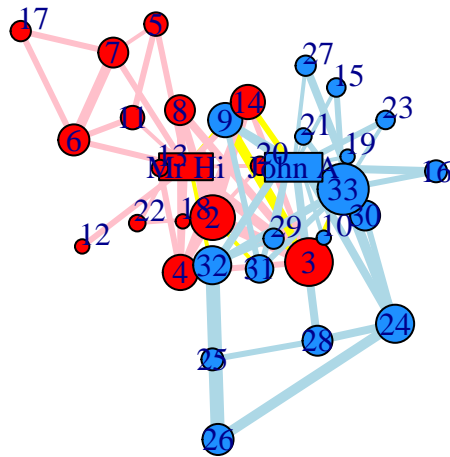
```
library(igraphdata)
data(karate)
# Reproducible layout
set.seed(42)
l <- layout_kamada_kawai(karate)
# Plot undecorated first.
par(mfrow=c(1,1))
plot(karate, layout=l, vertex.label=NA)
```



```

# Now decorate, starting with labels.
V(karate)$label <- sub("Actor ", "", V(karate)$name)
# Two leaders get shapes different from club members.
V(karate)$shape <- "circle"
V(karate)[c("Mr Hi", "John A")]$shape <- "rectangle"
# Differentiate two factions by color.
V(karate)[Faction == 1]$color <- "red"
V(karate)[Faction == 2]$color <- "dodgerblue"
# Vertex area proportional to vertex strength
# (i.e., total weight of incident edges).
V(karate)$size <- 4*sqrt(graph.strength(karate))
V(karate)$size2 <- V(karate)$size * .5
# Weight edges by number of common activities
E(karate)$width <- E(karate)$weight
# Color edges by within/between faction.
F1 <- V(karate)[Faction==1]
F2 <- V(karate)[Faction==2]
E(karate)[ F1 %--% F1 ]$color <- "pink"
E(karate)[ F2 %--% F2 ]$color <- "lightblue"
E(karate)[ F1 %--% F2 ]$color <- "yellow"
# Offset vertex labels for smaller points (default=0).
V(karate)$label.dist <-
  ifelse(V(karate)$size >= 10, 0, 0.75)
# Plot decorated graph, using same layout.
plot(karate, layout=l)

```

Exercise

1. Create a directed graph of 5 vertices

```
dg.ex <- graph.formula(1-2, 1-3, 2-3, 3-4, 4-5, 3-5)
```

2. Add attributes: name, gender and color

```
V(dg.ex)$name <- c("mary", "Vivi", "Martha", "Sebas", "Mateo")
V(dg.ex)$gender <- c("f", "f", "f", "m", "m")
V(dg.ex)$color <- c("pink", "pink", "pink", "blue", "blue")
```

3. Get edge and attribute list

```
edge.list <- data.frame(get.edgelist(dg.ex))

vertices.attributes <- data.frame(
  name = V(dg.ex)$name,
```

```
gender = V(dg.ex)$gender,  
color = V(dg.ex)$color)
```

4. Create a graph object from the edge list

```
dg.ex.1 <- graph.data.frame(edgelist, directed = FALSE)
```

5. Save the graph in “graphml” format

```
write.graph(dg.ex.1, "graph_exercise.graphml", "graphml")
```