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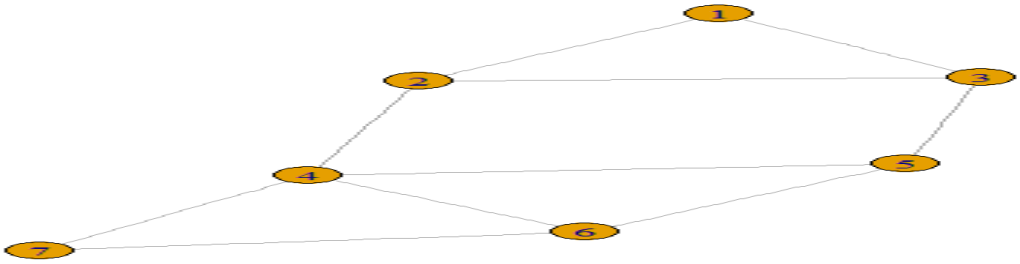
Practical No 1

Aim:

Write a program to compute the following for a given a network: (i) number of edges, (ii) number of nodes; (iii) degree of node; (iv) node with lowest degree; (v) the adjacency list; (vi) matrix of the graph.

```
>library(igraph)
>g <- graph.formula(1-2, 1-3, 2-3, 2-4, 3-5, 4-5, 4-6,4-7, 5-6, 6-7)
>plot(g)
```



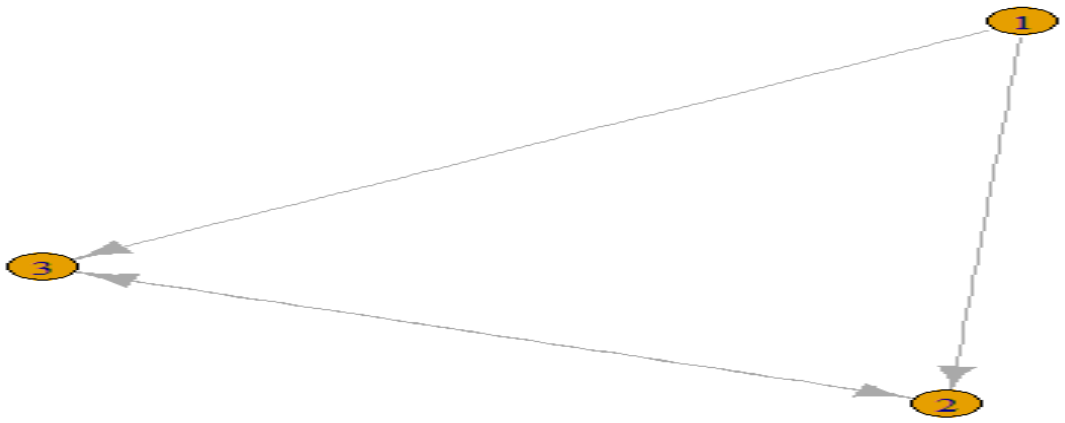
1)number of edges

```
> ecount(g)
[1] 10
```

2)no of nodes

```
> vcount(g)
[1] 7
```

3)Degree Of nodes




```
> degree(g)
1 2 3 4 5 6 7
2 3 3 4 3 3 2
> dg <- graph.formula(1-+2, 1-+3, 2++3)
> plot(dg)
> degree(dg, mode="in")
1 2 3
0 2 2
> degree(dg, mode="out")
1 2 3
2 1 1
```

4) Node with lowest degree

```
>V(dg)$name[degree(dg)==min(degree(dg))]
[1] "1"
```

Node with highest degree

```
> V(dg)$name[degree(dg)==max(degree(dg))]
[1] "2" "3"
```

5) To find neighbours / adjacency list:

```
> neighbors(g,5)
[1] 3 4 6
> neighbors(g,2)
[1] 1 3 4
> get.adjlist(dg)
$`1`
[1] 2 3
$`2`
[1] 1 3 3
$`3`
[1] 1 2 2
```

6)Adjacency Matrix

```
>  get.adjacency(g)
7 x 7 sparse Matrix of class "dgCMatrix"
  1 2 3 4 5 6 7
 1 . 1 1 . . . .
 2 1 . 1 1 . . .
 3 1 1 . . 1 . .
 4 . 1 . . 1 1 1
 5 . . 1 1 . 1 .
 6 . . . 1 1 . 1
 7 . . . 1 . 1 .
```

Practical No 2

Aim:

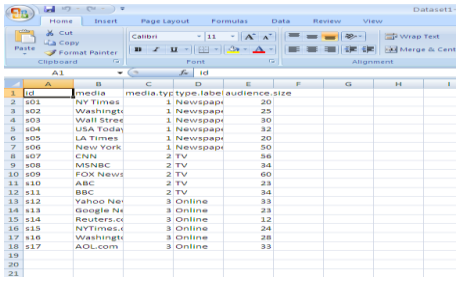
Perform following tasks: (i) View data collection forms and/or import onemode/two-mode datasets; (ii) Basic Networks matrices transformations

(i) View data collection forms and/or import one-mode/ two-mode datasets;

```
getwd()
[1] "C:/Users/admin/Documents"
> setwd("d:/SNA_pract")
```

Reading data from a csv file

```
>nodes <- read.csv("nodes.csv", header=T, , as.is=T)
```



```
> head(nodes)
```

Output:-

```
  id              media media.type type.label audience.size
1 s01          NY Times          1  Newspaper            20
2 s02 Washington Post          1  Newspaper            25
```

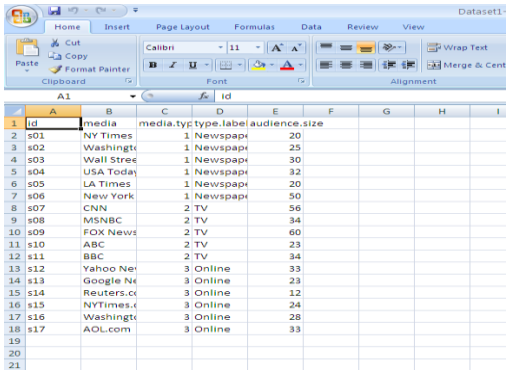
3 s03 Wall Street Journal 1 Newspaper 30

4 s04 USA Today 1 Newspaper 32

5 s05 LA Times 1 Newspaper 20

6 s06 New York Post 1 Newspaper 50

> links <- read.csv("edges.csv", header=T, as.is=T)



	A	B	C	D	E	F	G	H	I
1	id	media	media.type	type.label	audience.size				
2	s01	NY Times	1	Newspaper	20				
3	s02	Washingto	1	Newspaper	25				
4	s03	Wall Stree	1	Newspaper	30				
5	s04	USA Today	1	Newspaper	32				
6	s05	LA Times	1	Newspaper	20				
7	s06	New York	1	Newspaper	50				
8	s07	CNN	2	TV	56				
9	s08	MSNBC	2	TV	34				
10	s09	FOX News	2	TV	60				
11	s10	ABC	2	TV	23				
12	s11	BBC	2	TV	34				
13	s12	Yahoo Ne	3	Online	33				
14	s13	Google Ne	3	Online	23				
15	s14	Reuters.c	3	Online	12				
16	s15	NYTimes.c	3	Online	24				
17	s16	Washingto	3	Online	28				
18	s17	AOL.com	3	Online	33				
19									
20									
21									

> head(links)

Output:-

	from	to	weight	type
1	s01	s02	10	hyperlink
2	s01	s02	12	hyperlink
3	s01	s03	22	hyperlink
4	s01	s04	21	hyperlink
5	s04	s11	22	mention
6	s05	s15	21	mention

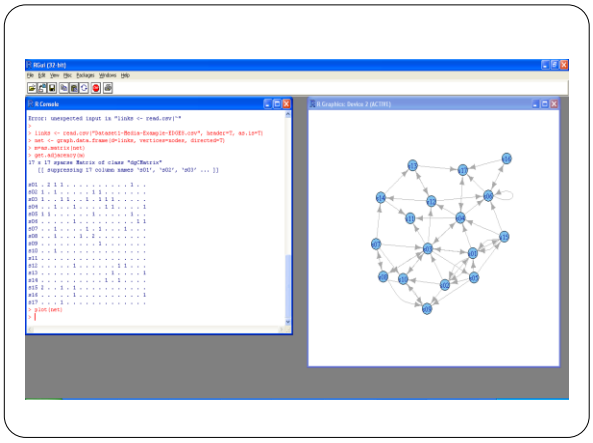
(ii) Basic Networks matrices transformations

> net <- graph.data.frame(d=links, vertices=nodes, directed=T)

> m=as.matrix(net)

>get.adjacency(m)

>plot(net)



Practical N0 3

Aim:

Compute the following node level measures: (i) Density; (ii) Degree; (iii) Reciprocity; (iv) Transitivity; (v) Centralization; (vi) Clustering.

1)Density

>vcount(g)

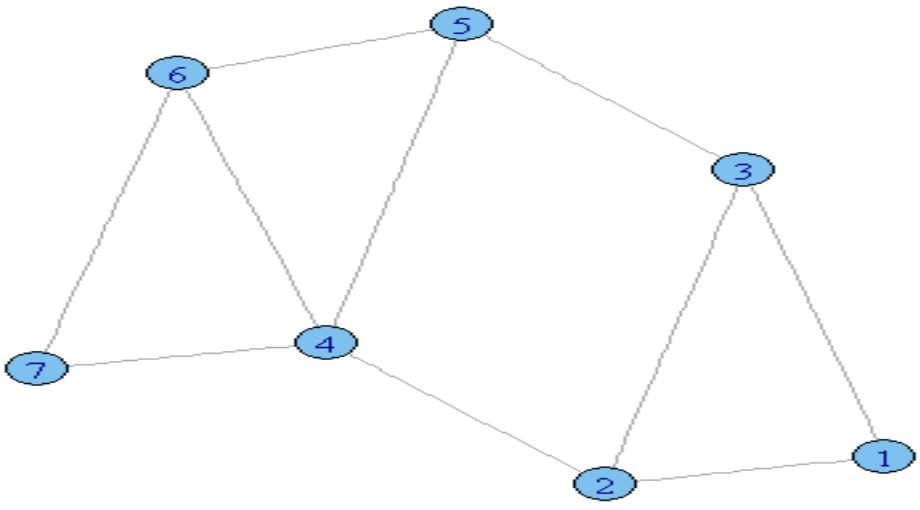
[1] 7

> ecount(g)

[1] 10

> ecount(g)/(vcount(g)*(vcount(g)-1)/2)

[1] 0.4719



2) Degree

> degree(net)

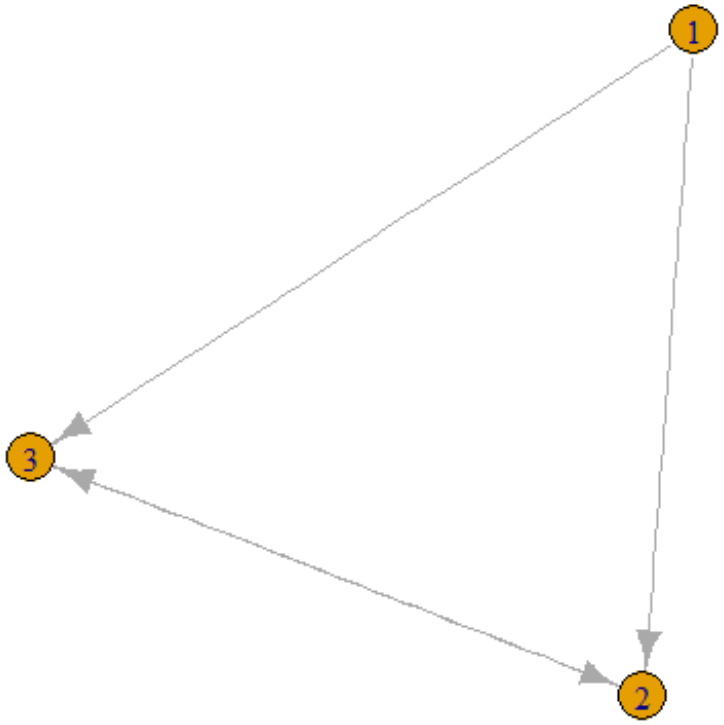
s01 s02 s03 s04 s05 s06 s07 s08 s09 s10 s11 s12

10 7 13 9 5 8 5 6 5 5 3 6

s13 s14 s15 s16 s17

4 4 6 3 5

3) **Reciprocity:**



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

>plot(dg)

> reciprocity(dg)

[1] 0.5

- **Formula**

> dyad.census(dg)

$mut

[1] 1

$asym

[1] 2

$null

[1] 0

> 2*dyad.census(dg)$mut/ecount(dg)

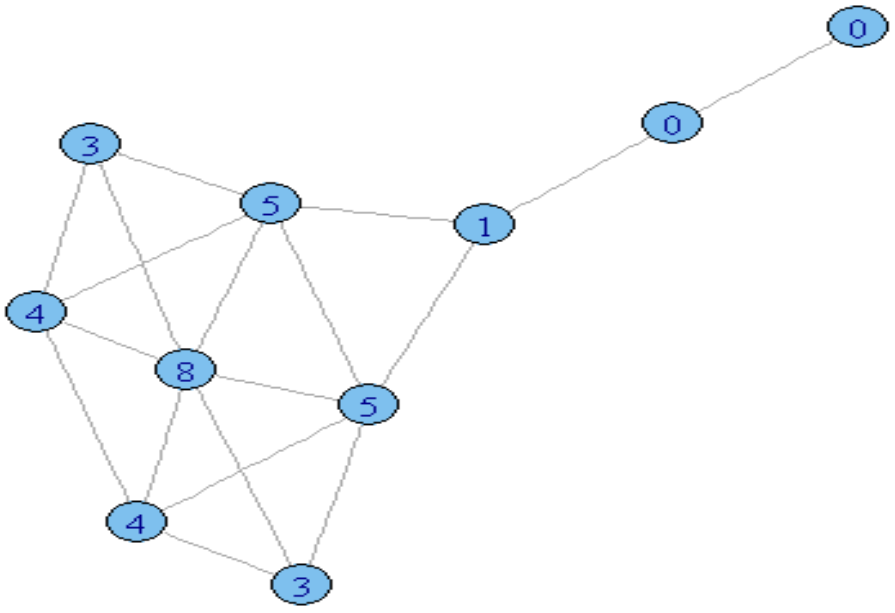
[1] 0.5

4)Transitivity

> kite <- graph.famous("Krackhardt_Kite")

> atri <- adjacent.triangles(kite)

> plot(kite, vertex.label=atri)



```
> transitivity(kite, type="local")
 [1] 0.6666667 0.6666667 1.0000000 0.5333333 1.0000000 0.5000000
 [7] 0.5000000 0.3333333 0.0000000       NaN
```

Formula

```
> adjacent.triangles(kite) / (degree(kite) * (degree(kite)-1)/2)
 [1] 0.6666667 0.6666667 1.0000000 0.5333333 1.0000000 0.5000000
 [7] 0.5000000 0.3333333 0.0000000       NaN
```

5)Centralization

- **Degree of centrality**

```
> centralization.degree(net, mode="in", normalized=T)
```

- **Closeness Centralization**

```
> closeness(net, mode="all", weights=NA)
> centralization.closeness(net, mode="all", normalized=T
```

- **Betweeness Centrality**

```
> betweenness(net, directed=T, weights=NA)
> edge.betweenness(net, directed=T, weights=NA)
> centralization.betweenness(net, directed=T, normalized=T)
```

- **Eigenvector centrality**

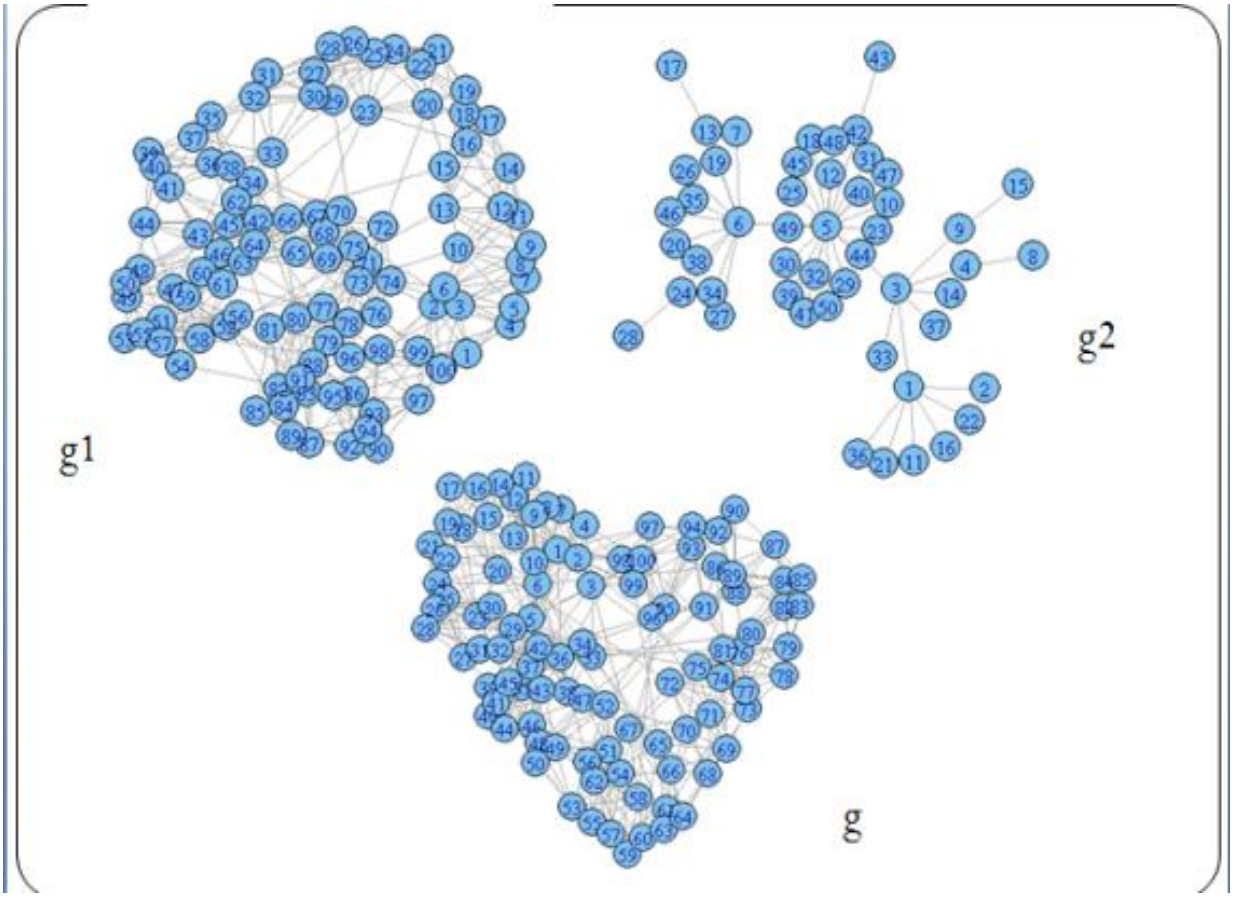
```
> centralization.evcent(net, directed=T, normalized=T)
```

6) **Clustering**

```
>library(igraph)
 # let's generate two networks and merge them into one graph.
>g2 <- barabasi.game(50, p=2, directed=F)
```

```
>g1 <- watts.strogatz.game(1, size=100, nei=5, p=0.05)
>g <- graph.union(g1,g2)

#Let's remove multi-edges and loops
>g <- simplify(g)
```



Practical No 4

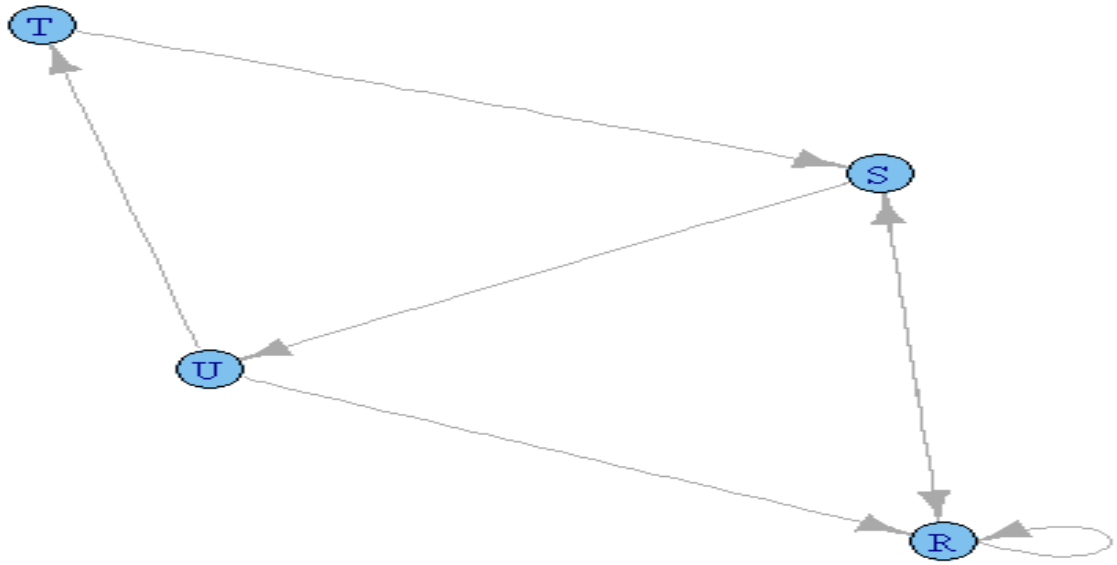
Aim:

For a given network find the following: (i) Length of the shortest path from a given node to another node; (ii) the density of the graph

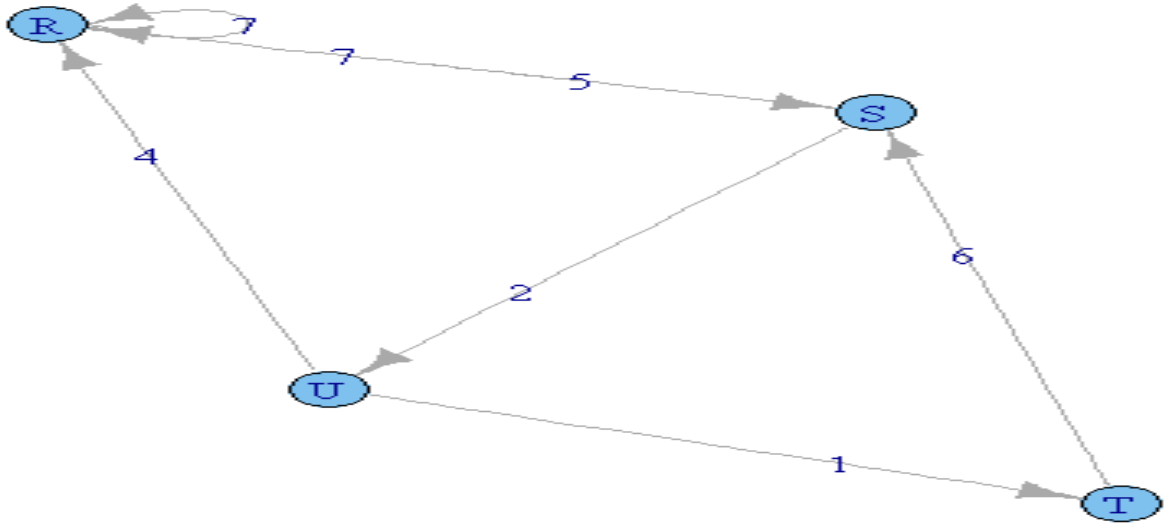
(i) Length of the shortest path from a given

node to another node;

```
> library(igraph)
> matt <- as.matrix(read.table(text=
 "node  R  S  T  U
         R  7  5  0  0
         S  7  0  0  2
         T  0  6  0  0
         U  4  0  1  0", header=T))
> nms <- matt[,1 ]
> matt <- matt[, -1]
> colnames(matt) <- rownames(matt) <- nms
>  matt[is.na(matt)] <- 0
> g <- graph.adjacency(matt, weighted=TRUE)
> plot(g)
```




```
> s.paths <- shortest.paths(g, algorithm = "dijkstra")
> print(s.paths)
  R S T U
R 0 5 5 4
S 5 0 3 2
T 5 3 0 1
U 4 2 1 0
```



```
> shortest.paths(g, v="R", to="S")
  S
R 5
>plot(g, edge.label=E(g)$weight)
```

(ii) the density of the graph;

```
> library(igraph)
> dg <- graph.formula(1-+2, 1-+3, 2++3)
> plot(dg)
> graph.density(dg, loops=TRUE)
[1] 0.4444444
```

- Without considering loops

```
> graph.density(simplify(dg), loops=FALSE)
[1] 0.6666667
```

Practical No 5

Aim:

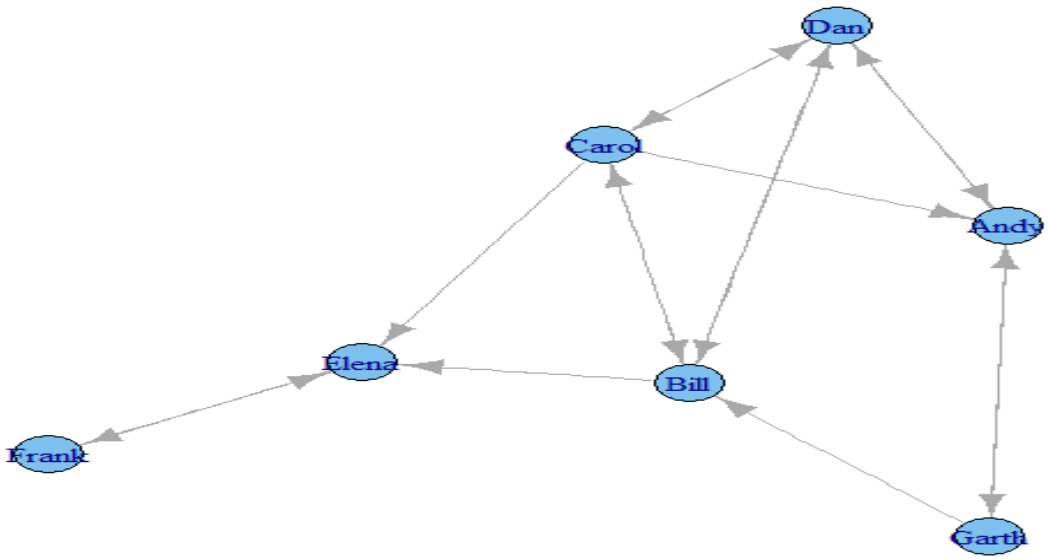
Write a program to distinguish between a network as a matrix, a network as an edge list, and a network as a sociogram (or "network graph") using 3 distinct networks representatives of each.

1)a network as a sociogram (or "network graph")

```
> library(igraph)

> ng<-graph.formula(Andy++Garth,Garth-+Bill,Bill-
+Elena,Elena++Frank,Carol-+Andy,Carol-
+Elena,Carol++Dan,Carol++Bill,Dan++Andy,Dan++Bill)

> plot(ng)
```



2) a network as a matrix,

```
> get.adjacency(ng)

7 x 7 sparse Matrix of class "dgCMatrix"
```

	Andy	Garth	Bill	Elena	Frank	Carol	Dan
Andy	.	1	.	.	.	.	1
Garth	1	.	1	.	.	.	.
Bill	.	.	.	1	.	1	1
Elena	.	.	.	.	1	.	.
Frank	.	.	.	1	.	.	.
Carol	1	.	1	1	.	.	1
Dan	1	.	1	.	.	1	.

iii) a network as an edge list.

> E(ng)

Edge sequence:

[1] Andy -> Garth

[2] Andy -> Dan

[3] Garth -> Andy

[4] Garth -> Bill

[5] Bill -> Elena

[6] Bill -> Carol

[7] Bill -> Dan

[8] Elena -> Frank

[9] Frank -> Elena

[10] Carol -> Andy

[11] Carol -> Bill

[12] Carol -> Elena

[13] Carol -> Dan

[14] Dan -> Andy

[15] Dan -> Bill

[16] Dan -> Carol

---get.adjedgelist(ng,mode="in")

$Andy

[1] 3 10 14

$Garth

[1] 1

$Bill

[1] 4 11 15

$Elena

[1] 5 9 12

$Frank

[1] 8

$Carol

[1] 6 16

$Dan

[1] 2 7 13

Practical No 6

Aim:

Write a program to exhibit structural equivalence, automorphic equivalence, and regular equivalence from a network.

i) structural equivalence

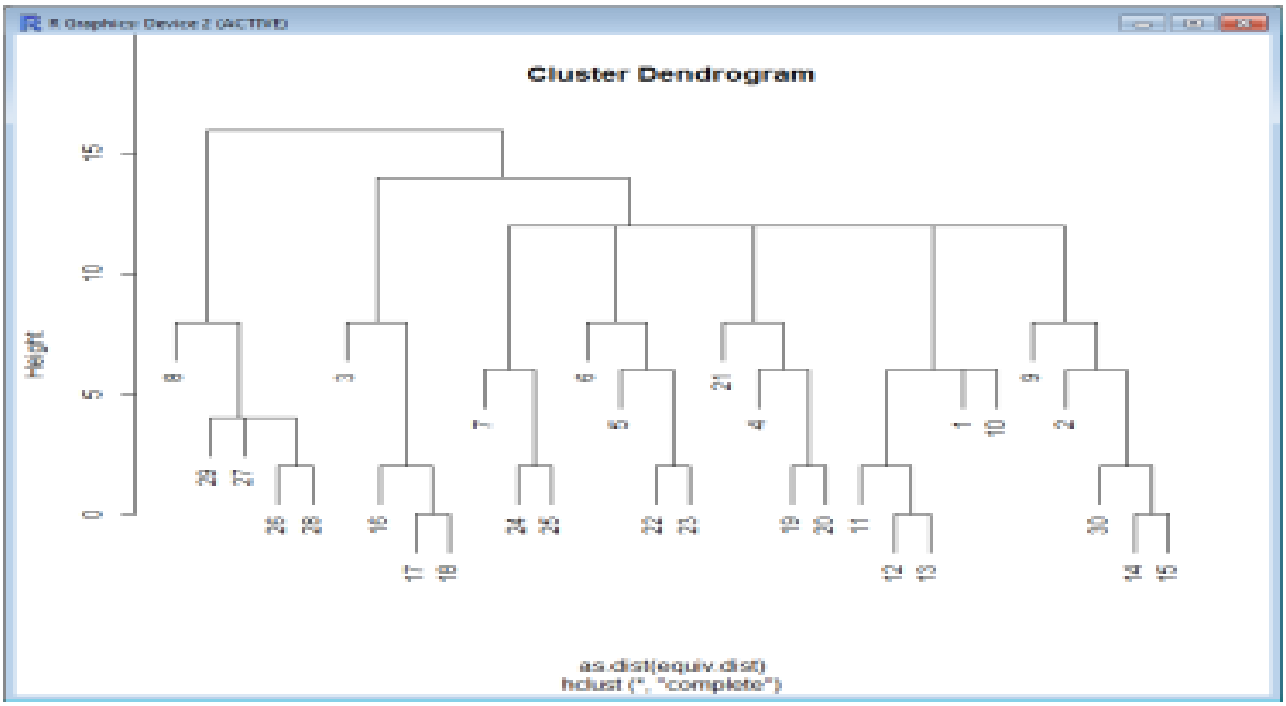
```
> library(sna)

> library(igraph)

> links2 <- read.csv("edges1.csv", header=T, row.names=1)

> eq<-equiv.clust(links2)

> plot(eq)
```

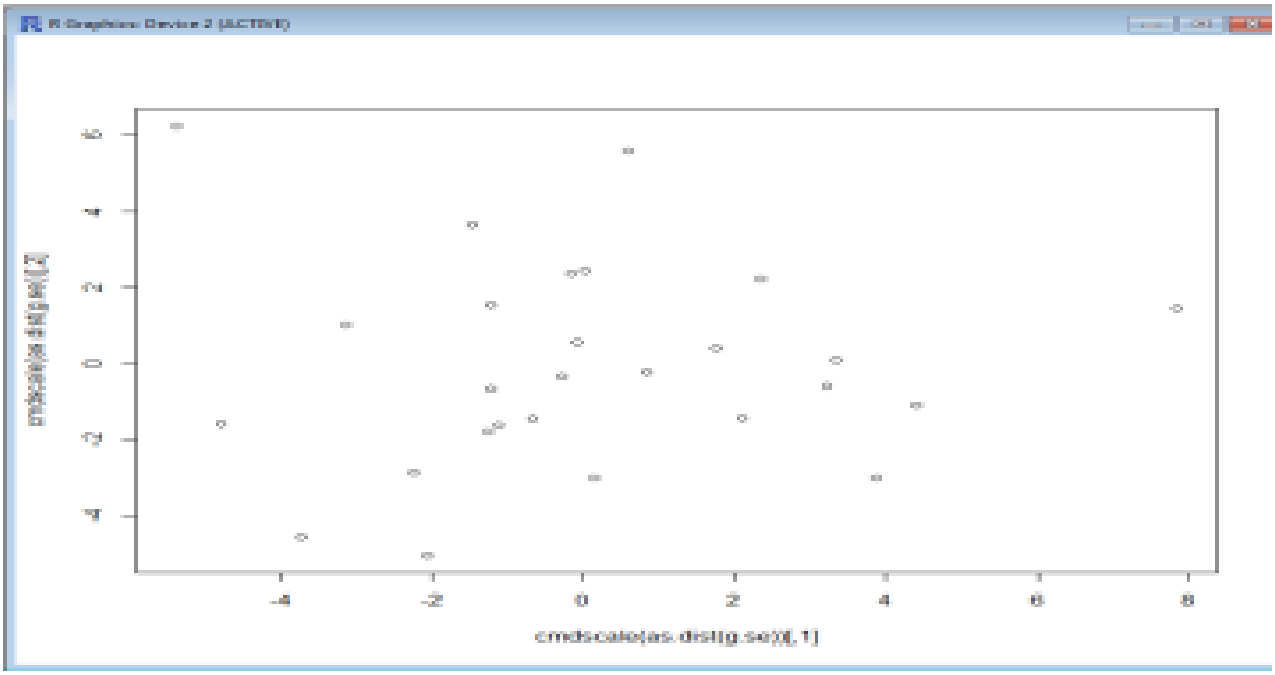


ii) automorphic equivalence,

```
>g.se<-sedist(links2)
```

Plot a metric MDS of vertex positions in two dimensions

>plot(cmdscale(as.dist(g.se)))

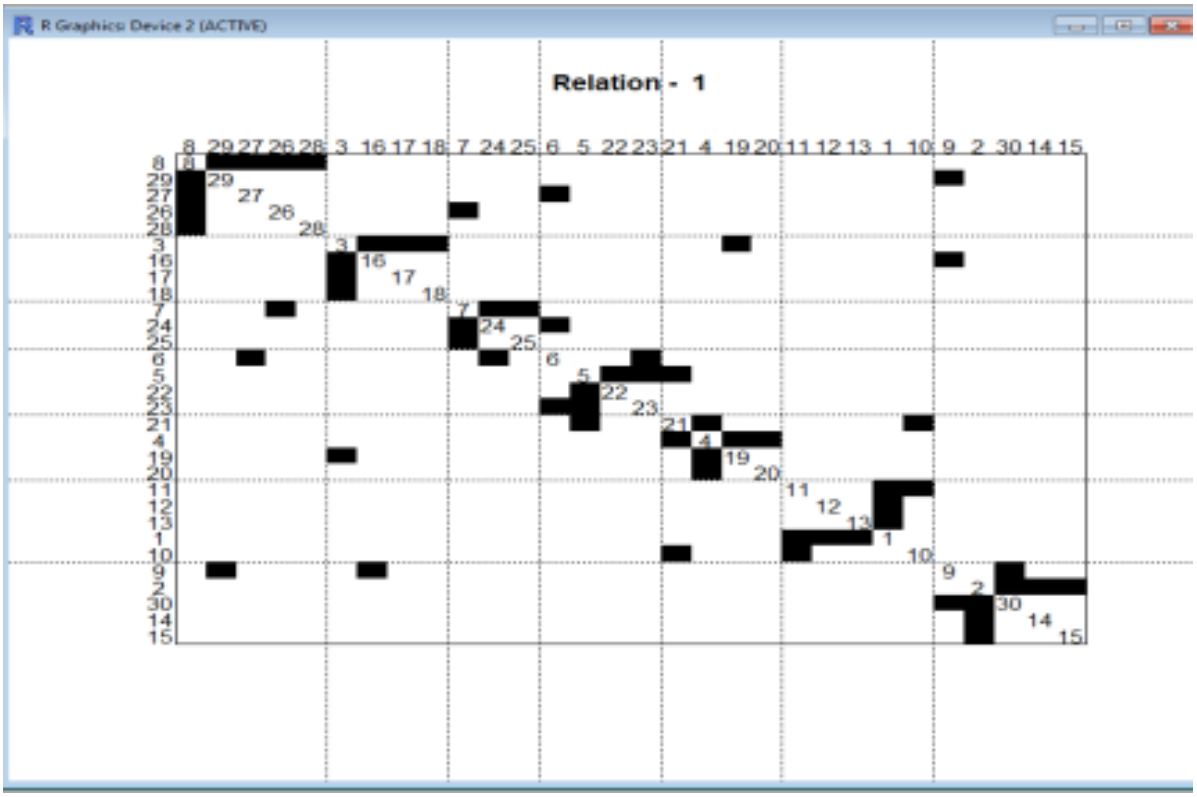


3) regular equivalence from a network.

Blockmodeling

> b<-blockmodel(links2,eq,h=10)

> plot(b)


R Graphics: Device 2 (ACTIVE)
Relation - 1
8 29 27 26 28 3 16 17 18 7 24 25 6 5 22 23 21 4 19 20 11 12 13 1 10 9 2 30 14 15

Practical No 7

Aim:

Create sociograms for the persons-by-persons network and the committee-bycommittee network for a given relevant problem. Create one-mode network and two-node network for the same.

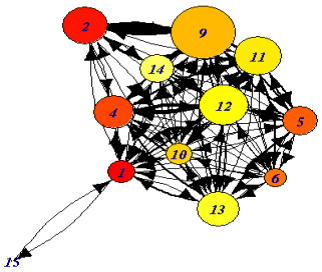
>library(Dominance)

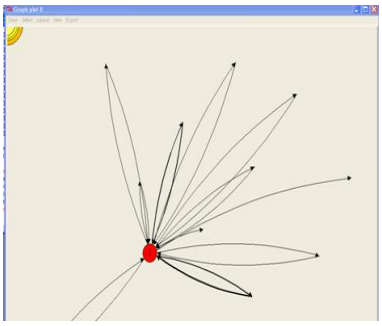
>data(data_Network_1)

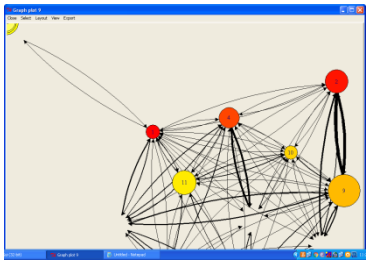
set 1 for action you want to show

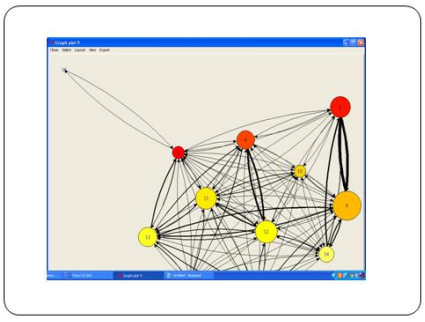
>bytes= "00111111111000000000"

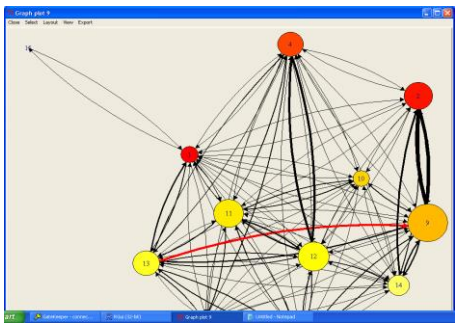
>Sociogram(data_Network_1,bytes)











```
> print(data_Network_1)
    Name Beschreibung item.number dominance.order  age  sex action.from.
1      1       Pferd1           1               1   NA    2            4
2      2       Pferd2           2               2   NA    1            9
3      3       Pferd3           3              NA   NA    1            4
4      4       Pferd4           4               5   NA    1           12
5      5       Pferd5           5              10   NA    1            5
6      6       Pferd6           6               3   NA    1            9
7      7       Pferd7           7               6   NA    1            5
8      8       Pferd8           8              NA   NA    1            9

    action.to kind.of.action                time test.2.kind.of.action
1           9              11                <NA>                      3
2           4              11 2009-06-07 03:30:00                      3
3          12              11                <NA>                      3
4           4              11                <NA>                      3
5           9              11                <NA>                      3
6           5              11                <NA>                      3

    test.3.kind.of.acttion           name.of.action action.number classification
1                        3                  leading             1              1
2                        3                following             2              2
3                        3                 approach             3              1
4                        3                     bite             4              1
5                        3           threat to bite             5              1
6                        3                     kick             6              1

    weighting
1           1
2          -1
3           1
4           1
5           1
6           1
```

Practical N0 8

Aim:

Perform SVD analysis of a network.

```
>library(igraph)
>a <- matrix(c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1), 9, 4)
>print(a)
 [,1] [,2] [,3] [,4]
 [1,]    1    1    0    0
 [2,]    1    1    0    0
 [3,]    1    1    0    0
 [4,]    1    0    1    0
 [5,]    1    0    1    0
 [6,]    1    0    1    0
 [7,]    1    0    0    1
 [8,]    1    0    0    1
 [9,]    1    0    0    1
> svd(a)
d
[1] 3.464102e+00 1.732051e+00 1.732051e+00 9.687693e-17
 $u
          [,1]       [,2]       [,3]          [,4]
```

```
 [1,] -0.3333333  0.4687136  0.05029703  3.375152e-01
 [2,] -0.3333333  0.4687136  0.05029703 -8.126230e-01
 [3,] -0.3333333  0.4687136  0.05029703  4.751078e-01
 [4,] -0.3333333 -0.2779153  0.38076936  1.160461e-16
 [5,] -0.3333333 -0.2779153  0.38076936  1.160461e-16
 [6,] -0.3333333 -0.2779153  0.38076936  1.160461e-16
 [7,] -0.3333333 -0.1907983 -0.43106639 -7.755807e-17
 [8,] -0.3333333 -0.1907983 -0.43106639 -7.755807e-17
 [9,] -0.3333333 -0.1907983 -0.43106639 -7.755807e-17

$v
          [,1]          [,2]        [,3] [,4]
[1,] -0.8660254 -2.464364e-17  0.00000000  0.5
[2,] -0.2886751  8.118358e-01  0.08711702 -0.5
[3,] -0.2886751 -4.813634e-01  0.65951188 -0.5
[4,] -0.2886751 -3.304723e-01 -0.74662890 -0.5
```