Exercise 2 - Fakebook Bus

Nodes and Edges Creation

Load libraries

```
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(tidyverse)
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.1 ──

## ✓ ggplot2 3.3.5     ✓ purrr   0.3.4
## ✓ tibble  3.1.5     ✓ dplyr   1.0.7
## ✓ tidyr   1.1.4     ✓ stringr 1.4.0
## ✓ readr   2.0.2     ✓ forcats 0.5.1

## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## x dplyr::as_data_frame() masks tibble::as_data_frame(), igraph::as_data_frame()
## x purrr::compose()       masks igraph::compose()
## x tidyr::crossing()      masks igraph::crossing()
## x dplyr::filter()        masks stats::filter()
## x dplyr::groups()        masks igraph::groups()
## x dplyr::lag()           masks stats::lag()
## x purrr::simplify()      masks igraph::simplify()
```

Create nodes for each seat, where seats 1-6 are seats taken and A-D are seat choices

```
node_list <- data.frame(nodes = c("1","2","3","4","5","6","A","B","C","D"))
node_list
```

```
##    nodes
## 1      1
## 2      2
## 3      3
## 4      4
## 5      5
## 6      6
## 7      A
## 8      B
```

```
## 9      C
## 10     D
```

Create edges between each pair of adjacent seats

```
edge_list <- data.frame(from =
                          c("1","2","2","3","3","3","3","3","4","4","5","5","5","6","6","6","A","A","A",
                            "B","B","B","B","B","C","C","C","C","C","D","D","D","D","D"),
                        to =
                          c("2","1","A","4","5","B","C","D","3","3","3","6","D","5","B","D","2","B","C",
                            "3","6","A","C","D","3","4","A","B","D","3","5","6","B","C"))
edge_list %>% head()
```

```
##   from to
## 1    1  2
## 2    2  1
## 3    2  A
## 4    3  4
## 5    3  5
## 6    3  B
```

Since the network is undirected, we can remove either direction to avoid double counting in centrality.

```
edge_list <- igraph::as_data_frame(igraph::simplify(graph_from_data_frame(edge_list, directed=FALSE)))
```

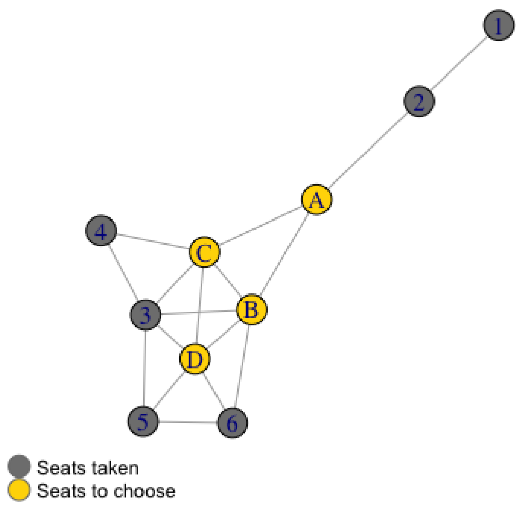
Transform the dataframe into graph

```
fakebook <- graph_from_data_frame(d = edge_list, vertices = node_list, directed = FALSE)
fakebook
```

```
## IGRAPH c37d219 UN-- 10 17 --
## + attr: name (v/c)
## + edges from c37d219 (vertex names):
##  [1] 1--2 2--A 3--4 3--5 3--B 3--C 3--D 4--C 5--6 5--D 6--B 6--D A--B A--C B--C
## [16] B--D C--D
```

Plot the network

```
V(fakebook)$color <-c(rep("gray50",6),rep("gold",4))
plot(fakebook)
legend(x=-1.5, y=-1.1, c("Seats taken","Seats to choose"), pch=21,
col="#777777", pt.bg=c("gray50","gold"), pt.cex=2, cex=.8, bty="n", ncol=1)
```



Various Measures of Centrality & Visualisation

(i) Betweenness Centrality

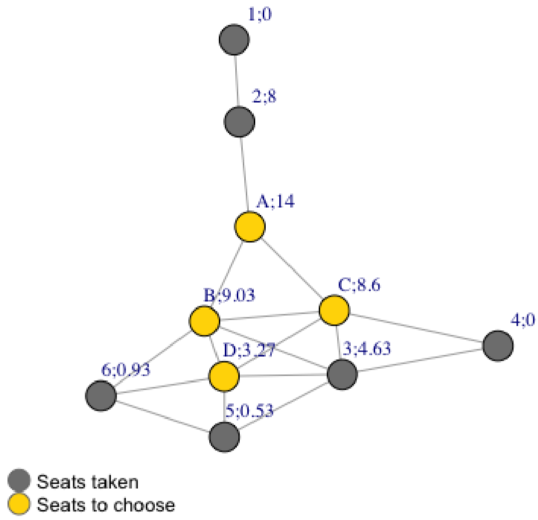
Calculate Betweenness Centrality, which measures the extent to which a node lies on paths between other nodes.

```
V(fakebook)$bc <- betweenness(fakebook)
V(fakebook)$bc
```

```
##  [1]  0.0000000  8.0000000  4.6333333  0.0000000  0.5333333  0.9333333
##  [7] 14.0000000  9.0333333  8.6000000  3.2666667
```

Plot the network graph with labels and Betweenness Centrality values

```
label <- paste(V(fakebook)$name, round(V(fakebook)$bc,2), sep=";")
plot(fakebook, vertex.label = label, vertex.label.cex=0.8, vertex.label.dist=2.5)
legend(x=-1.5, y=-1.1, c("Seats taken","Seats to choose"), pch=21,
col="#777777", pt.bg=c("gray50","gold"), pt.cex=2, cex=.8, bty="n", ncol=1)
```



(ii) Degree Centrality

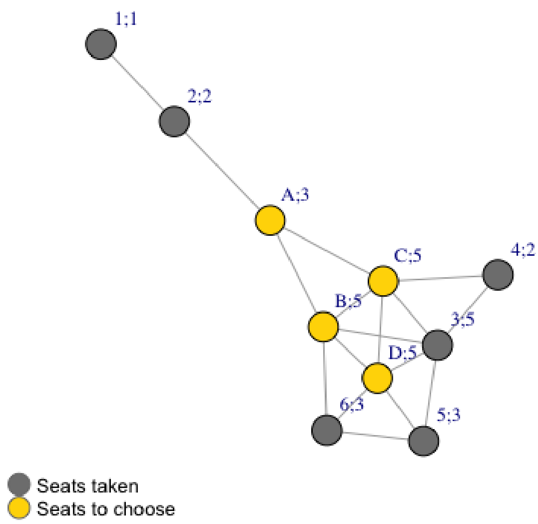
Calculate Degree Centrality, a measure for a node in a network is just its degree, the number of edges connected to it.

```
V(fakebook)$dc <- degree(fakebook)
V(fakebook)$dc
```

```
##  [1] 1 2 5 2 3 3 3 5 5 5
```

Plot the network graph with labels and Degree Centrality values

```
label <- paste(V(fakebook)$name, round(V(fakebook)$dc,2), sep=";")
plot(fakebook, vertex.label = label, vertex.label.cex=0.8, vertex.label.dist=2.5)
legend(x=-1.5, y=-1.1, c("Seats taken","Seats to choose"), pch=21,
col="#777777", pt.bg=c("gray50","gold"), pt.cex=2, cex=.8, bty="n", ncol=1)
```



(iii) Eigenvector

Centrality Calculate Eigenvector Centrality, which awards a number of points proportional to the centrality scores of the neighbors

```
V(fakebook)$ec <- evcent(fakebook)
```

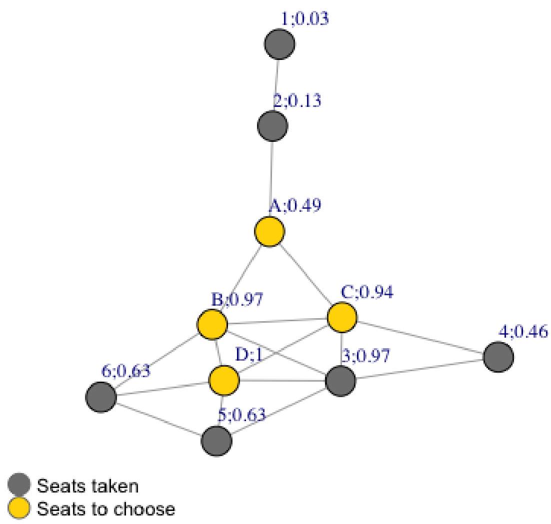
```
## Warning in vattrs[[name]][index] <- value: number of items to replace is not a
## multiple of replacement length
```

```
unlist(V(fakebook)$ec[1])
```

```
##          1          2          3          4          5          6          A
## 0.03059284 0.12661070 0.96744261 0.46122992 0.62726236 0.62852844 0.49339477
##          B          C          D
## 0.97394849 0.94139110 1.00000000
```

Plot the network graph with labels and Closeness Centrality values

```
label <- paste(V(fakebook)$name, round(unlist(V(fakebook)$ec[1]),2), sep=";")
plot(fakebook, vertex.label = label, vertex.label.cex=0.8, vertex.label.dist=2.5)
legend(x=-1.5, y=-1.1, c("Seats taken","Seats to choose"), pch=21,
col="#777777", pt.bg=c("gray50","gold"), pt.cex=2, cex=.8, bty="n", ncol=1)
```



(iv) Closeness Centrality

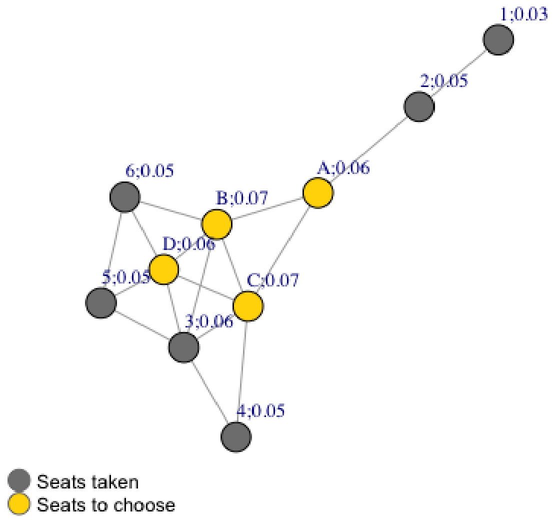
Calculate Closeness Centrality, a centrality score that measures the mean distance from a node to other nodes.

```
V(fakebook)$cc <- closeness(fakebook)
V(fakebook)$cc
```

```
##  [1] 0.03333333 0.04545455 0.06250000 0.05000000 0.04761905 0.05263158
##  [7] 0.06250000 0.07142857 0.07142857 0.06250000
```

Plot the network graph with labels and Closeness Centrality values

```
label <- paste(V(fakebook)$name, round(V(fakebook)$cc,2), sep=";")
plot(fakebook, vertex.label = label, vertex.label.cex=0.8, vertex.label.dist=2.5)
legend(x=-1.5, y=-1.1, c("Seats taken","Seats to choose"), pch=21,
col="#777777", pt.bg=c("gray50","gold"), pt.cex=2, cex=.8, bty="n", ncol=1)
```



Choice of a Seat

Considering the 4 centrality measures, we can summarize the following benefits for the 4 seats to choose.

1. Betweenness Centrality: A (14.00) > B (9.03) > C (8.6) > D (3.27). A is on the most shortest paths the nodes lie on and has the greatest influence over the flow of information between seats, followed by B. This might be useful in leading / facilitating group communications but less important in individual networking scenario.

2. Degree Centrality: B (5) = C (5) = D (5) > A (3). We can talk to 5 adjacent persons sitting at B / C / D to maximize the number of connections, while only 3 at A. This is crucial in developing informal connections on Fakebook bus.

3. Eigenvector Centrality: D (1) > B (0.97) > C (0.94) > A (0.49). We can consider high eigenvector centrality with seats D / B / C if we want to network with important person who knows more people from adjacent seats. This might not directly applicable to building informal connections through adjacent seating, and is hence a reference than a determining factor.

4. Closeness Centrality: B (0.07) = C (0.07) > A (0.06) = D (0.06). B / C has the shortest mean distance from a node to another node. It's often used in social and other network studies and supports seat selection in our case.

Overall, I would choose seat B which is located at the centre,because it has the highest degree centrality and closeness centrality, and relatively high betweeness centrality.Through seat B, we can enjoy the benefit of building up the maximum 5 informal connections with adjacent seats. It also has the advantage to extend further connections through seat A and seat D once bonding is established, which is critical to pass on messages with seats 1 & 2 in the front and of similar mean distance reaching out to all seats respectively to co-create the Fakebook bus vibes.

Yet, choosing seat B would be not so beneficial if the bus is not fully loaded, perhaps someone call in sick or choose other transportation alternative. For example, if seat A is empty, the highest degree centrality will go to seat D, making B a less appealing choice. Other factors like how influential the person is (personality, job title, department, etc.), their willingness to mingle and actual time they sit next to you shall also be taken into consideration in real life scenarios.