

University of British Columbia Okanagan
COSC 421 / DATA 421 / 521 Network Science
Final Exam Part 2

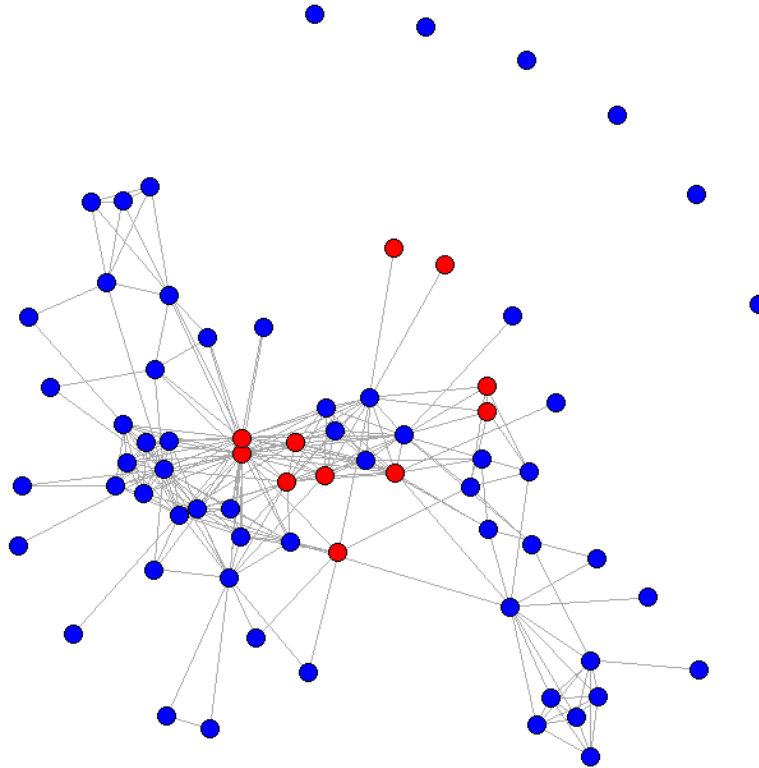
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[4 marks] (a) Draw a plot of the network graph using different vertex colors for vertices identifying their role (field operation member or associate).

Code

```
graph1 <- graph_from_data_frame(edges,nodes,directed = TRUE)
adj_t = as.matrix(get.adjacency(graph1))
g_2 <- graph_from_adjacency_matrix(adj_t, mode = "undirected")
V(g_2)$color <- "blue" #associates
V(g_2)$color[c(1,3,6,28,30,31,36,37,41,43,51)] <- "red" #field operations
```



[5 marks] (b) Use the eigenvalue centrality measure to list the top five central members of the network.

Code

```
eigen.cent <- eigen_centrality(g_2)
eigen.node <- eigen.cent$vector
order <- order(eigen.cent$vector, decreasing = 1)
eigen.node[order]
betweenness <- betweenness(g_2)
nodes$between <- betweenness
closeness <- closeness(g_2)
nodes$close <- closeness
```

In each list of the top 5 members, identify the members of the field operation group by putting * sign after their names.

You may use the following table:

| | Degree Centrality | Closeness Centrality | Betweenness Centrality |
|---|-------------------|----------------------|------------------------|
| 1 | Jamal Zougam* | Jamal Zougam* | Semaan Gaby Eid |
| 2 | Mohamed Chaoui* | Mohamed Chaoui* | Jamal Zougam* |
| 3 | Imad Edin Barakat | Said Berrak* | Mohamed Chaoui* |
| 4 | Said Berrak* | Imad Edin Barakat | Abdeluahid Berrak |
| 5 | Amer Azizi | Jamal Ahmidan* | Imad Edin Barakat |

[2 marks] (c) Find the counts of cliques of given sizes by

Code

```
table(sapply(cliques(g_2),length))
cliques(g_2) [sapply(cliques(g_2), length) == 11]
```

What is the largest size (given by length)? How many cliques are of the largest size?

The largest clique size is 11. There is 2 cliques of this size.

In each list of the clique members, identify the members of the field operation group by putting * sign after their names.

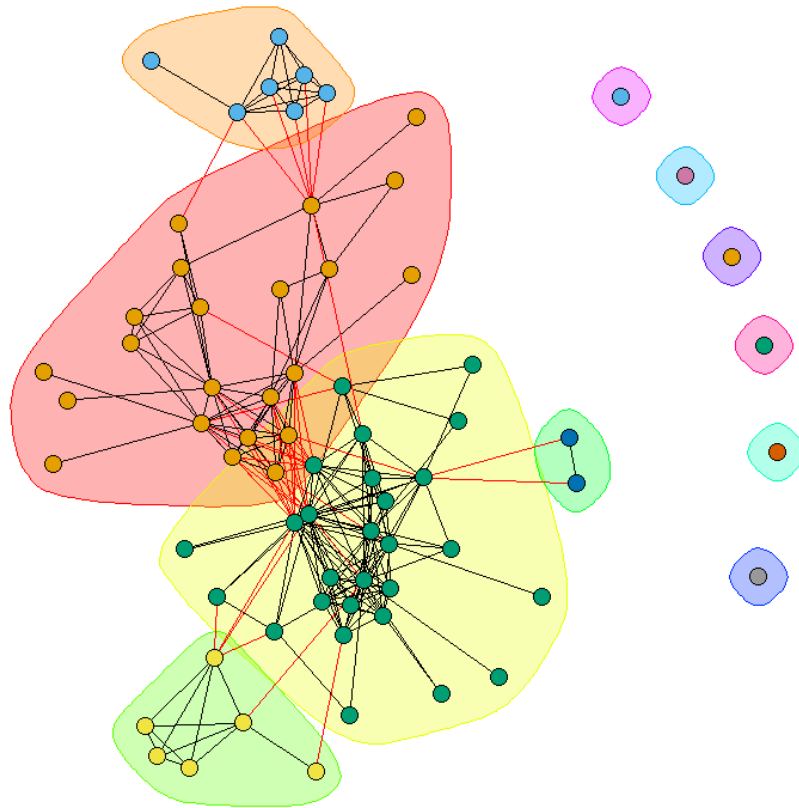
| Clique 1 | Clique 2 |
|---------------------|------------------------|
| Jamal Zougam* | Jamal Zougam* |
| Mohamed Chaoui* | Mohamed Chaoui* |
| Imad Edin Barakat | Vinay Kholy |
| Amer Azizi | Suresh Kumar |
| Abu Musad Alsakaoui | Abderahim Zbakh |
| Mohamed Atta | Naima Oulad Akcha |
| Ramzi Binalshibh | Basel Ghayoun* |
| Mohamed Belfatmi | S B Abdelmajid Fakhet* |
| Said Bahaji | Jamal Ahmidan* |
| Galeb Kalaje | Hamid Ahmidan |
| Shakur | Said Berrak* |

[3 marks] (d) Using the community detection method of your choice, find the communities in this network. Plot the network graph by using the colour for each vertex by its community membership. Use appropriate vertex size so that communities are clearly visible.

Code

```
graph1 <- as.undirected(graph1, mode="collapse")
wc <- walktrap.community(graph1)
modularity(wc)
membership(wc)
nodes$community <- membership(wc)

plot(wc,graph1,layout=layout.fruchterman.reingold,
vertex.size=5, vertex.label.cex=.15,edge.arrow.size=.15,
vertex.label=NA)
```



[2 marks] (e) How many communities did your algorithm detect? Report the modularity value for the communities partitioning.

```
modularity(wc)
```

The walktrap community algorithm detected 11 communities. The modularity value is 0.415.

[2 marks] (f) What are sizes of these communities? Show in the following table:

| Community | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|-----------|----|---|----|---|---|---|---|---|---|----|----|
| Frequency | 22 | 7 | 27 | 6 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |

[2 marks] (g) How well do the communities match with the roles of network members: field operation member or associate? Use the `table` function in R to create a cross-table of counts of vertices in each community-role level combination.

```
table(nodes$Role,nodes$community)
```

```
## Community      1  2  3  4  5  6  7  8  9 10 11
## Associate      15  7 23  6  2  1  1  1  1  1  1
## FieldOperation  7  0  4  0  0  0  0  0  0  0  0
```

Looking at this table we can see that there are 2 communities in the field operation, community 1 and 3. These communities are also the largest for the associate category which means that the communities are a good match with the roles of the network members as most of them are in one community 7/11.