

# Complex Networks Communities

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# 1 Exercise 1

Using CFinder, the Clique Percolation Method was applied, and the communities shown below are detected.



Figure 1:  $K = 3$

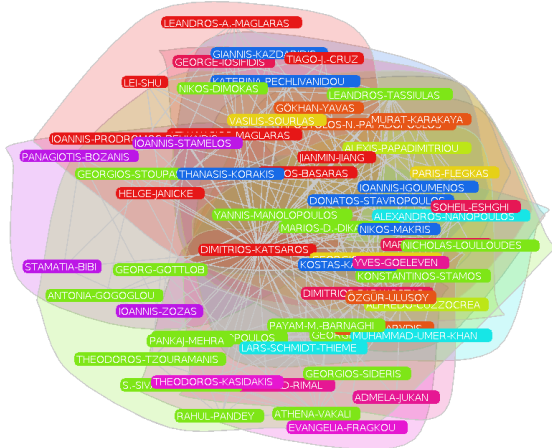


Figure 2:  $K = 4$

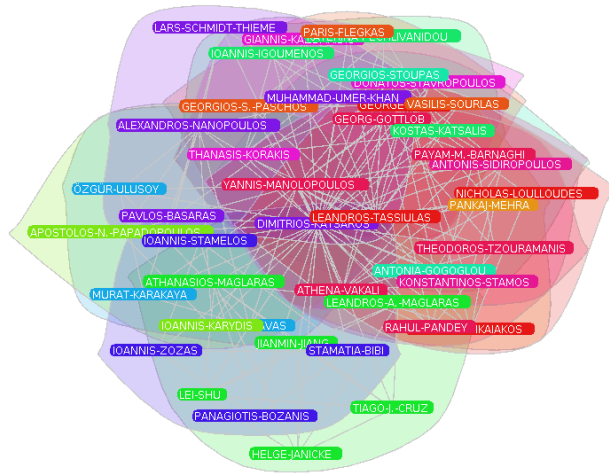


Figure 3:  $K = 5$

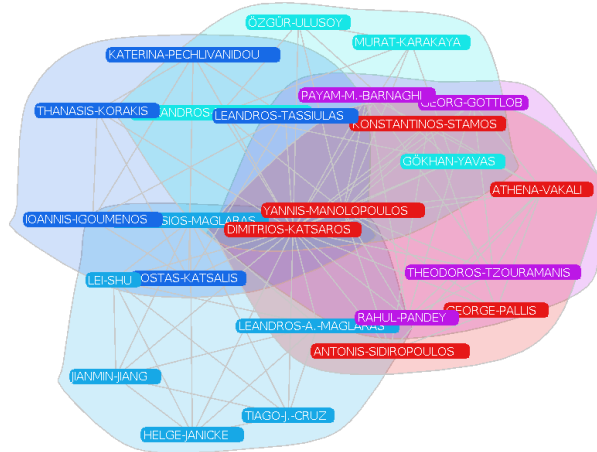


Figure 4:  $K = 6$

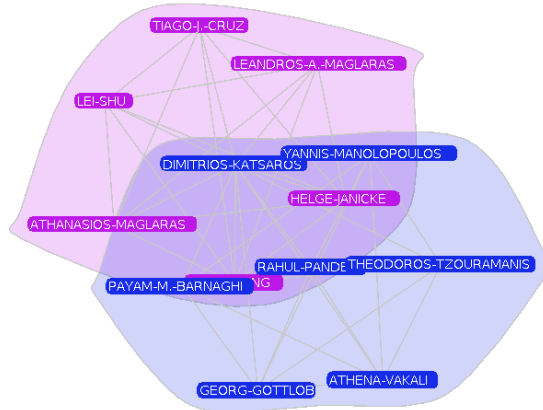


Figure 5:  $K = 7$

## 2 Exercise 2

## 2.1 Tree Comparison

The Girvan-Newman algorithm is applied both by recalculating the edge betweenness centrality for each node and not after removing each edge. The two implementations of the same algorithm produce different trees. When removing an edge, the edge betweenness centrality of the other edges is also affected. Thus, the algorithm might select a distinct edge to delete on the next iteration. Contrary to when recalculation of the edge betweenness centrality is applied, when it is not recalculated, the series of edges for removal is predetermined from the first iteration.

## 2.2 Tree Similarity

To check whether two trees are identical or not, we can recursively create a set of parent-children pairs of nodes for each tree and compare the computed groups from each tree. However, if we want to calculate the similarity between two trees, an algorithm like [this](#) can be applied. Each node, however, must be processed to contain a hash computed regarding the contents of its data.

### 3 Exercise 3

After the co-authors' graph is exported to CNT format, the AviNet tool is used to calculate CiBC communities. The communities can be seen bellow.

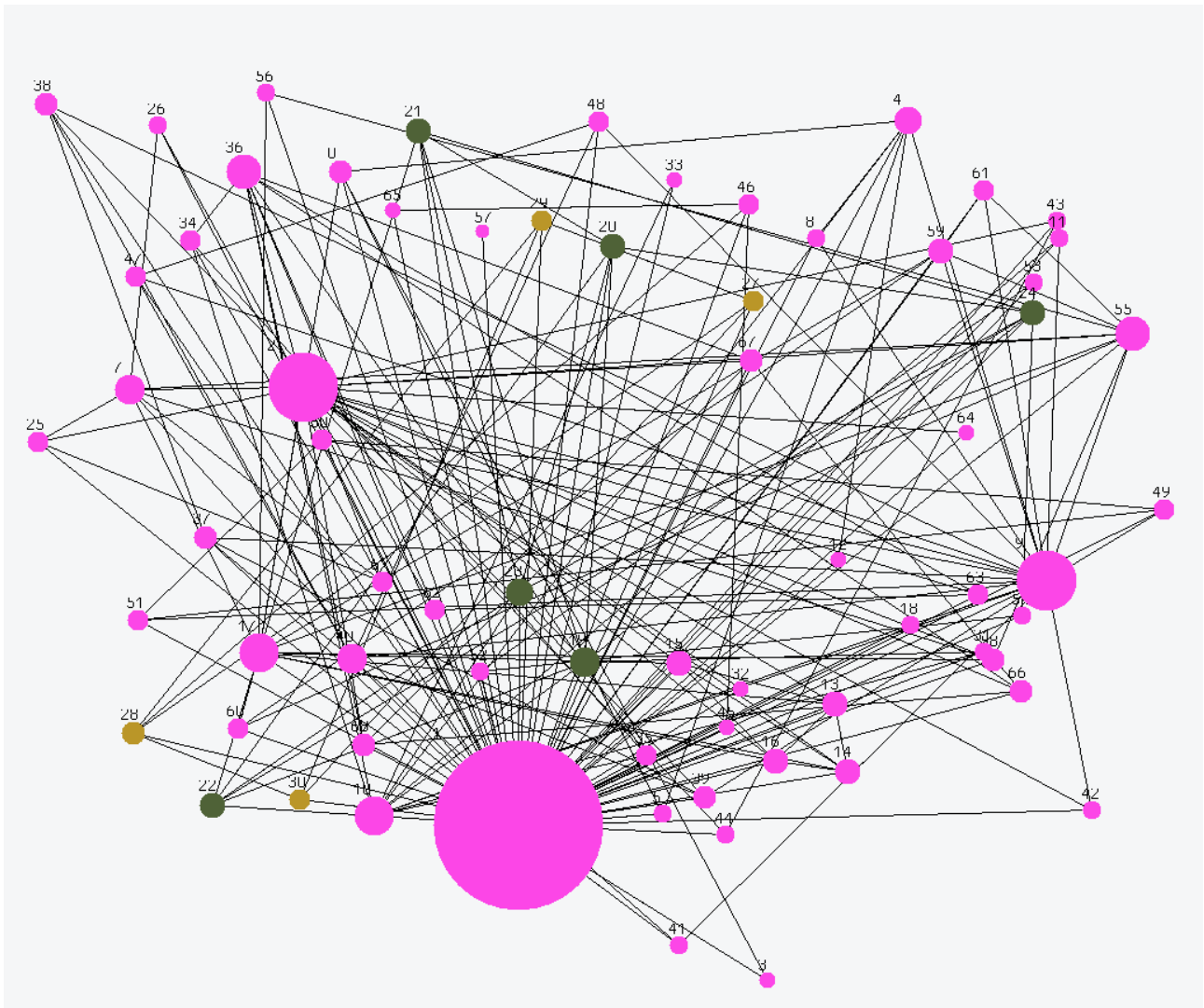
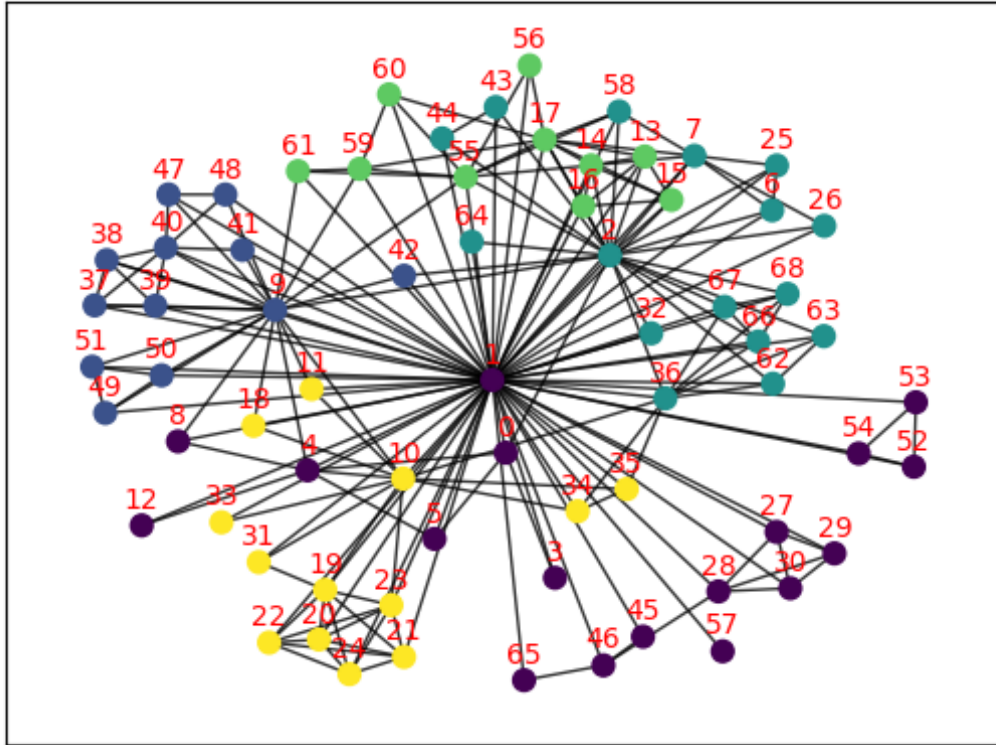


Figure 6:  $S = 1$

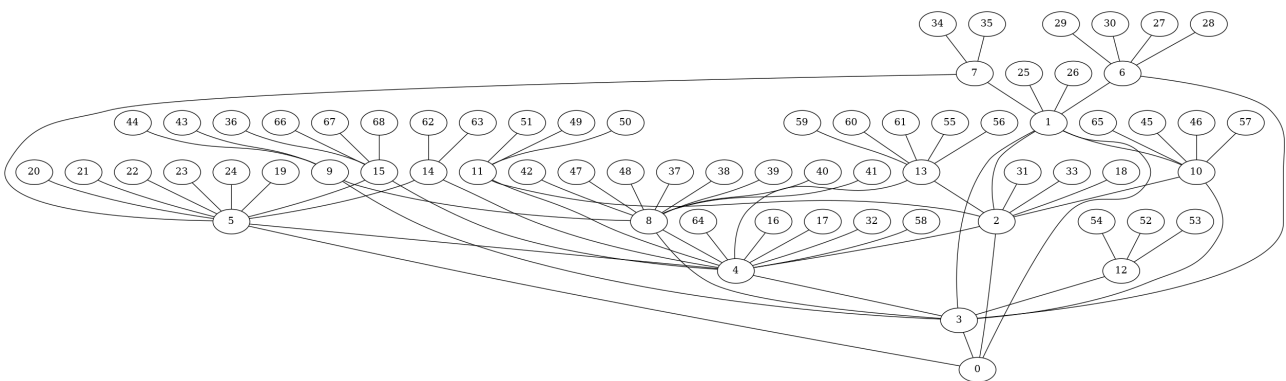
## 4 Exercise 4

The modularity optimization algorithm presented [here](#) or [here](#) was applied using Python3 on the co-authors' graph and the communities are visualized below.



## 5 Exercise 5

The Louvain algorithm is applied to the co-authors' graph. By converting the algorithm's output to a DOT file and using Graphviz, the communities are visualized below.



## 6 Notes

An additional PDF containing which number corresponds to which name is also included in the submission files.