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Practice session 1 report

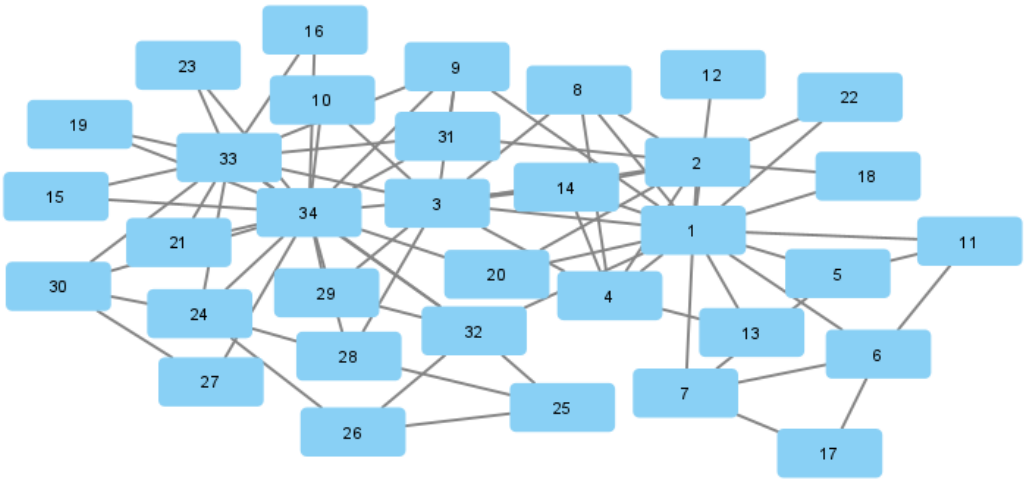
1. Zachary's karate club network: Describes the relationships in a university karate club, well known for studying community structure, in which nodes are splitted into dense connected groups, in this case those centered around the karate teacher and the president of the club. It contains 34 nodes (club members) and 78 edges.

2. Star Wars character network: Describes the interactions between the characters of the first 6 Star Wars films in terms of the number of scenes they speak together. It contains 111 nodes (characters) and 444 edges (interactions).

3. US companies ownership network: Describes the company co-ownership in the US. This network can be represented as directed or undirected, showing the acquisitions of a company. It contains 7172 nodes (companies) and 6721 edges (ownerships).

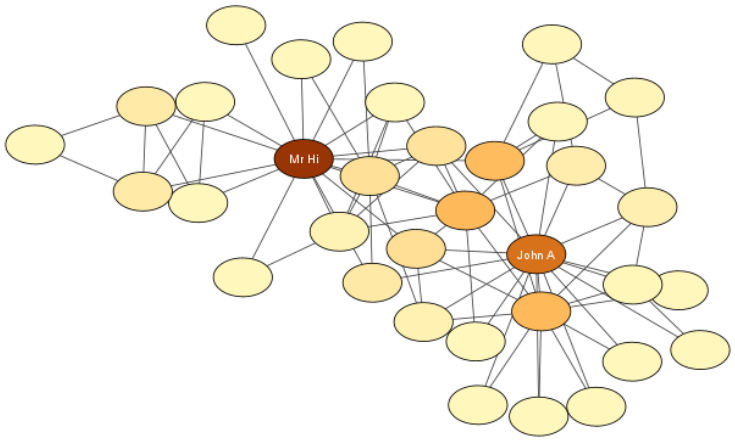
1) Zachary's karate club network

From the network displayed below after the compound spring embedder algorithm, we can see that there are 2 nodes (1 and 34) that seem to be quite popular among the rest as they are the most connected of the network. These nodes correspond to Mr Hi and John A, the karate teacher and club president respectively. Because of how dense the relationships are in these vertices, this visualization could become difficult to read.

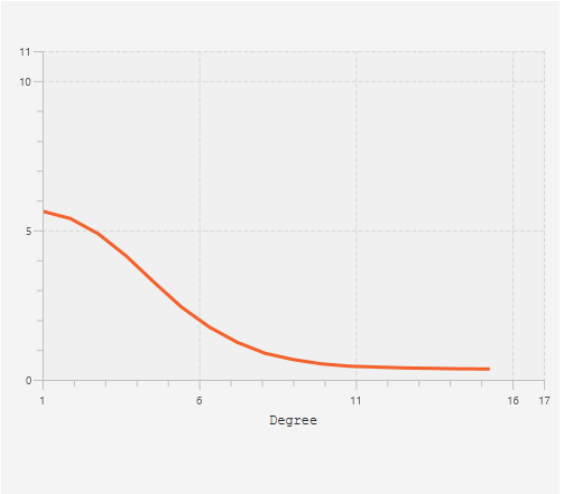


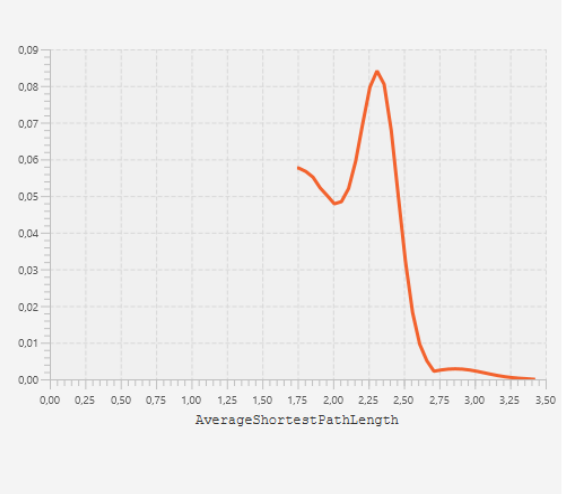
Force-directed algorithms or **spring embedders** are used to calculate the layout of a graph using information contained within the structure of a graph with the aim to produce a clear and simple visualization. It considers nodes as metal objects that are connected by springs and can repel or attract each other, exerting forces. When a state of equilibrium is reached with a sufficiently large number of iterations, the nodes do not exert any more forces so there is not a change in positions and the final ones are displayed by the algorithm.

The nodes with the greatest betweenness centrality measure are 1 (0.437) and 34 (0.304) that correspond to the teacher and president. The network with node fill color indicating centrality measure is shown below, where a higher betweenness centrality is associated with a darker color.

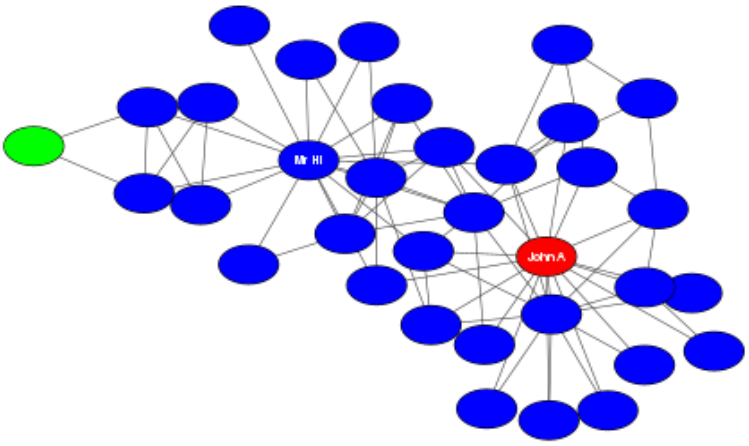


Degree distribution and average shortest path lengths distribution are shown below.



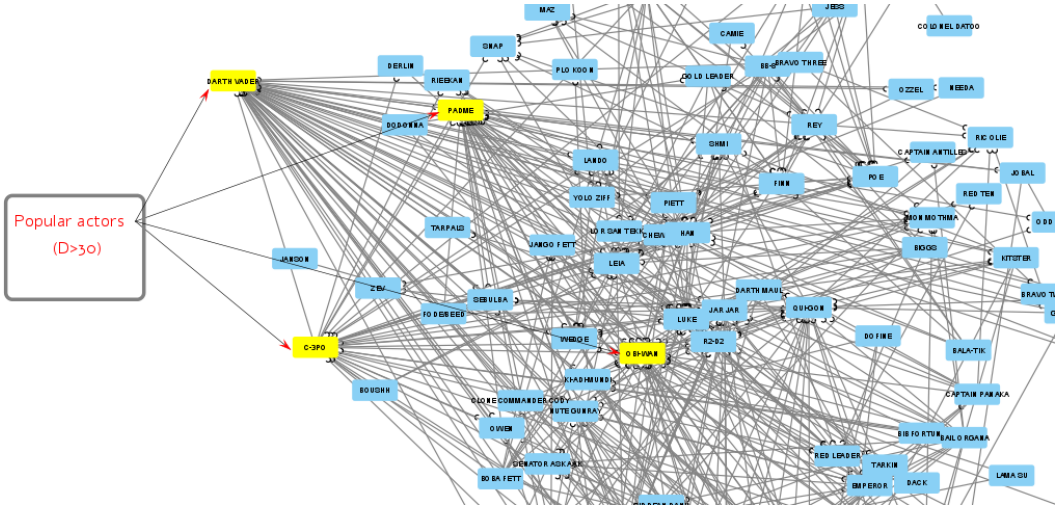


When running the ClusterMaker2 app on the network, we can see that the groups created are very different to the actual partition of the karate club. In fact none of the members are assigned to president John A (node 34) group, with all of them joining Mr Hill (node 1), except from node 17 which is by itself at the left side of the network.



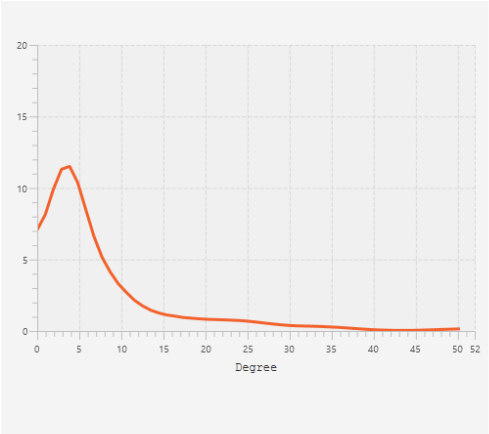
2) Star Wars character network

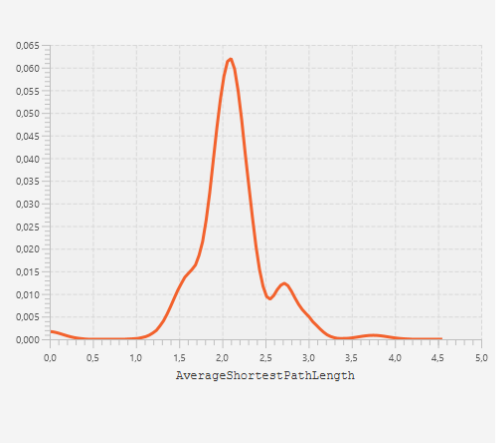
First we show the popular actors with degrees higher than 30, which are Darth Vader, Obi-Wan, C-3PO and Padme. Then, the list of characters represented by the nodes is displayed (shared name, name, and number of scenes). It makes sense that these nodes have a larger number of connections because they represent the main characters of the saga and are involved in many scenes with other secondary characters.



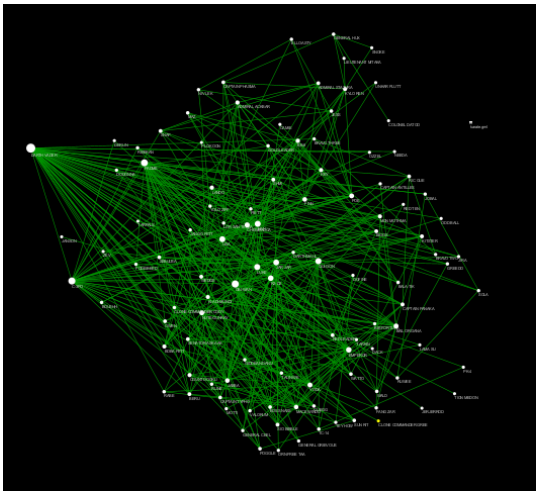
Shared name	Name	Number of scenes
8	OBI-WAN	148
0	DARTH VADER	190
18	PADME	75
24	C-3PO	151

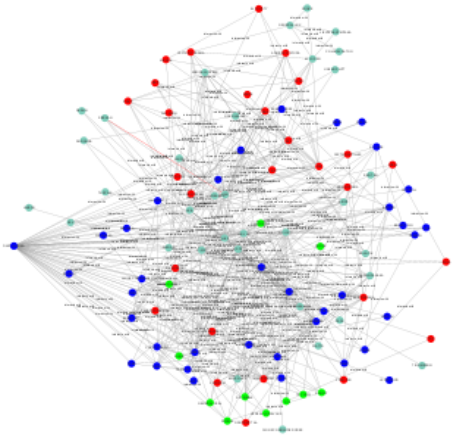
Degree distribution and average shortest path lengths distributions are shown below.





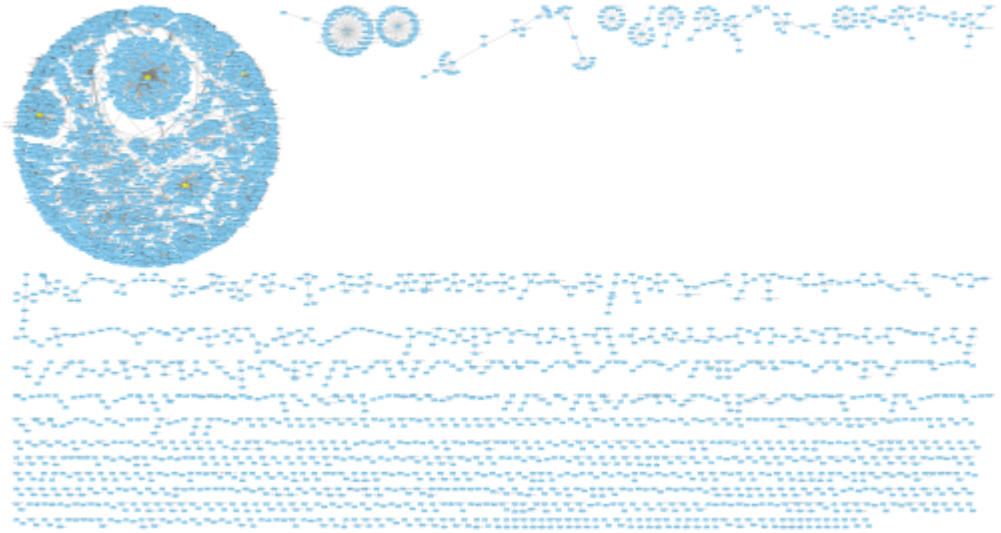
At the left, the network is illustrated (in default black style) with node size representing the degree value, where higher degrees are associated with bigger nodes. At the right, the ClusterMaker2 is applied to the network and the three greatest clusters are represented by red, green and blue colors. These clusters could contain related characters that often talk together or interact in several scenes and could therefore belong to the same trilogy.





3) US companies ownership network

This network contains more than 1 connected component, where each one represents the acquisitions or investments of a company. The larger degree nodes are located in the main component of the network and represent the companies with a greater co-ownership, including Liberty Group Publishing, News, CNHI and Clear Channel Communications (D > 150). Below, the network is illustrated once the edge weighted spring embedder is applied.



I hereby declare that, except for the code provided by the course instructors, all of my code, report, and figures were produced by myself.