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Practice Session 01: Cytoscape Basics and Advanced

The purpose of this report is to show my work in learning how to use the basic and advanced functions of Cytoscape.

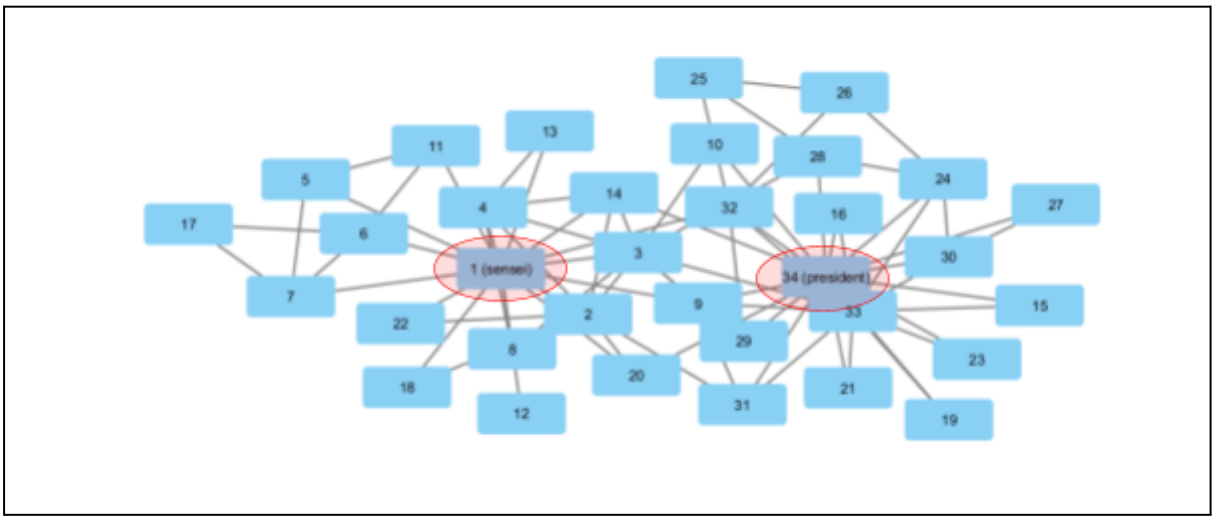
Section 1

Table with the number of nodes and edges in the networks used throughout this practice:

Table	Karate Club	Student Cooperation	Marvel	Game of Thrones	Flights
Nodes	34	185	6421	84	41
Edges	78	360	167112	216	141

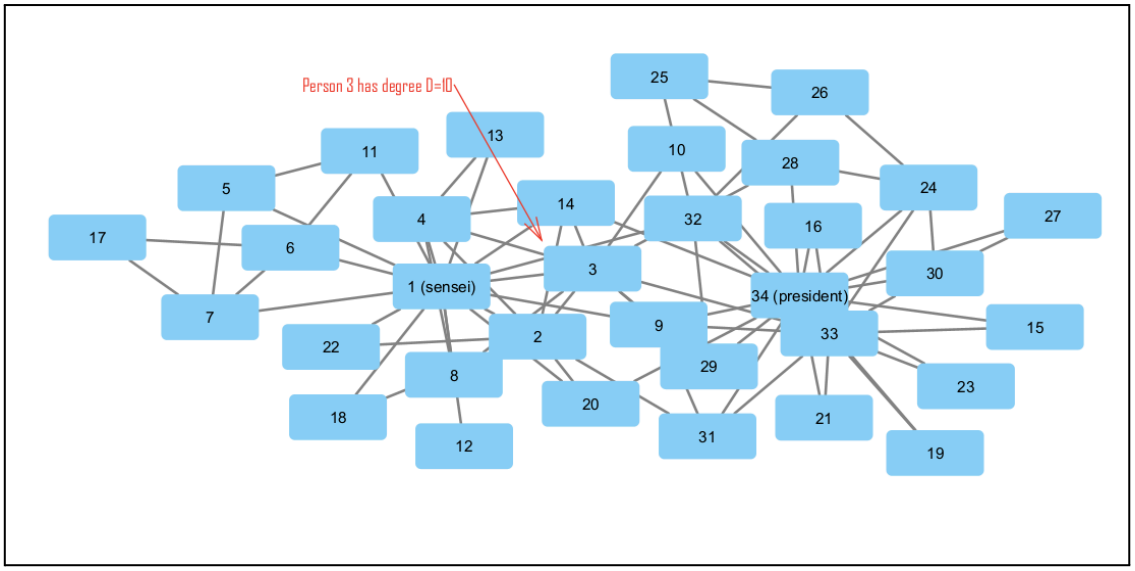
Section 2

1.1



Here I have circled in red the two nodes with the highest degree: the sensei and the president. They have respective degrees of 16 and 17. I found this by using the table below the graph. I assume that they are the most connected because of their unique social characteristics, one being the teacher and the other being the president, while the rest (i assume) are just students.

One person that has a degree larger than 9 is person 3, who has degree 10.

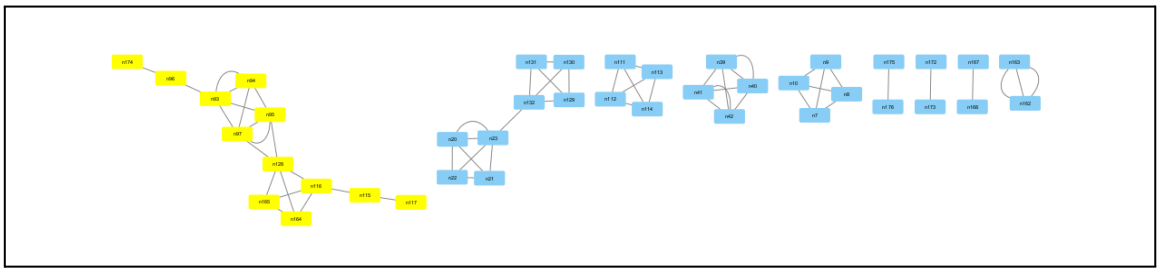


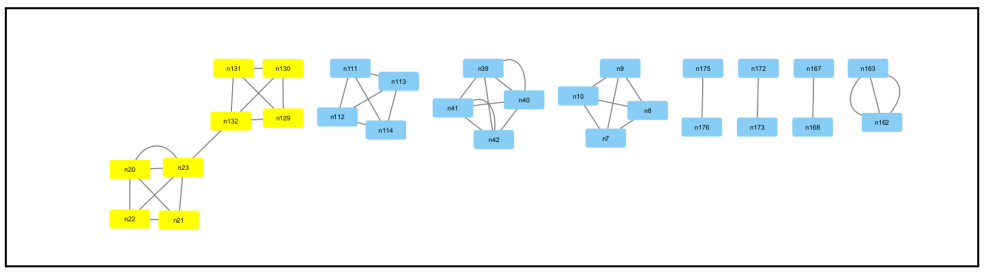
The Compound Spring Embedder:

From what I've understood, the fundamental way that this method works is by assigning certain (locally) repulsive forces to the nodes to ensure that they space out evenly, and then assigning attractive forces along the edges to keep the connected nodes close to each other. If balanced properly, the opposing forces work together to homogenize edge length and reduce edge crossings. I found it really interesting that these forces are often based on real life forces like springs, magnetism, gravity and electrostatics. Once the forces are assigned I assume a computer calculates iterations of the system till it reaches equilibrium, or otherwise a very committed mathematician.

1.2

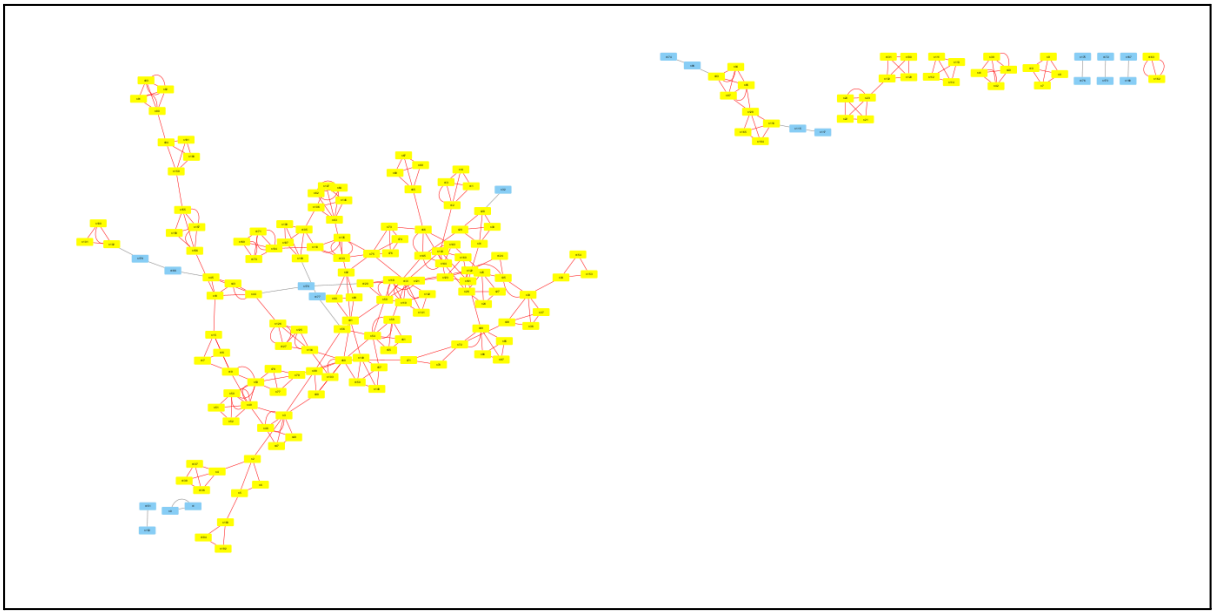
I used the select largest subnetwork tool and deleted the largest one twice. Here are the second and third largest connected components of the graph:





Extracting cliques:

To help with this step I downloaded an app called MClique to find all the cliques for me as this is a very big graph. In this image all the connected components are selected. According to MClique there are 53 cliques (of N>=3) and they have a total of 166 nodes and 342 edges. A large majority of the network's 185 nodes and 360 edges.

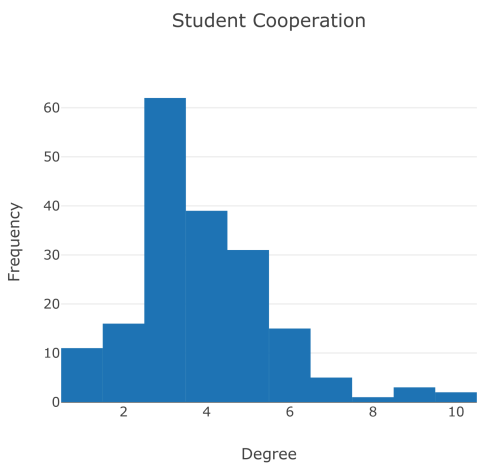


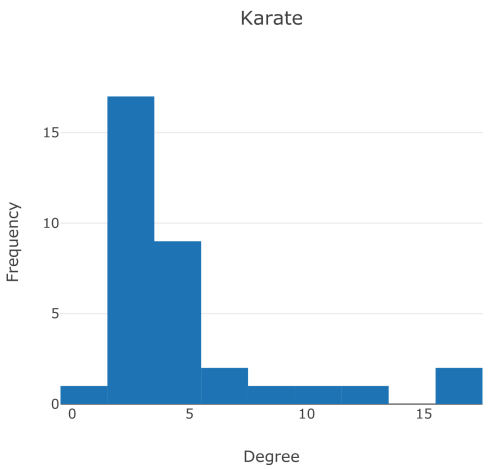
Section 3

3.1

Here are the degree distribution graphs of both networks:

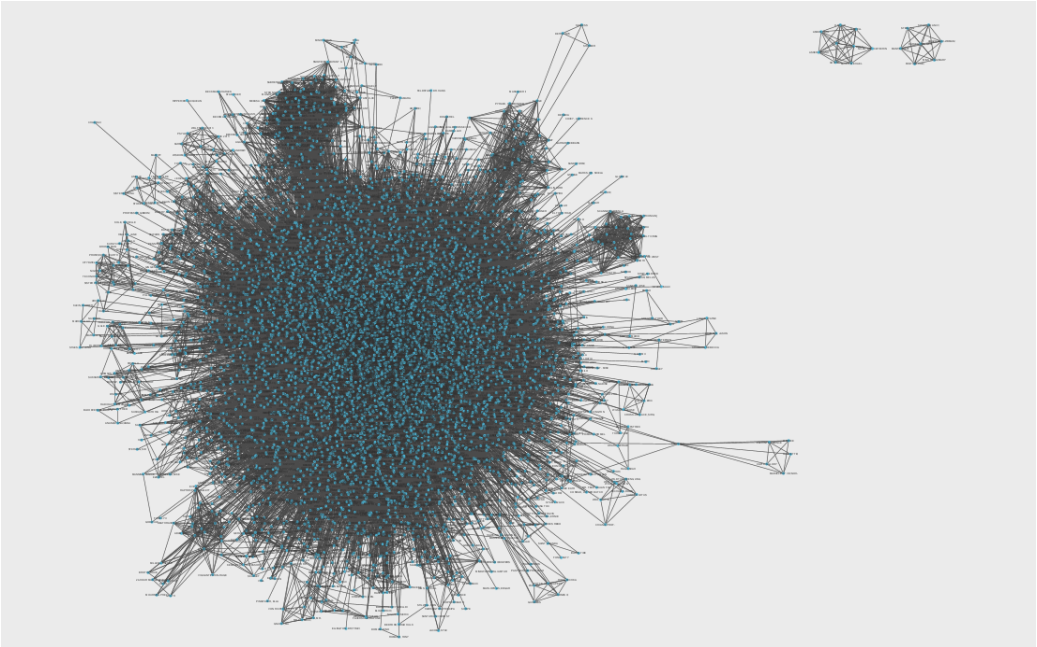
Despite being different in size, the two histograms really have similar shapes. Maybe this points to a consistent pattern of human (social) nature, which stays constant across group size and context.





Section 4

4.1



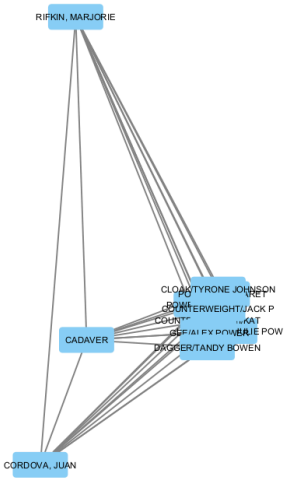
CAPTAIN AMERICA	1905
SPIDER-MAN/PETER PARKER	1737
IRON MAN/TONY STARK	1521
THING/BEN GRIMM	1416
MR. FANTASTIC/REED RICHARDS	1377
WOLVERINE/LOGAN	1368
HUMAN TORCH/JOHNNY S	1361
SCARLET WITCH/WANDA	1322
THOR/DR. DONALD BLAK	1289
BEAST/HENRY &HANK& P	1265
VISION	1238
INVISIBLE WOMAN/SUE	1236
HAWK	1175
WASP/JANET VAN DYNE	1091
ANT-MAN/DR. HENRY J.	1082
CYCLOPS/SCOTT SUMMER	1078
SHE-HULK/JENNIFER WA	1071
STORM/ORORO MUNROE S	1070
ANGEL/WARREN KENNETH	1070
DR. STRANGE/STEPHEN	1065

This is the graph of Marvel heroes. I changed the color and style because I think it looks super cool in blue and black. To find the 20 nodes with the highest degree I used ‘analyze network’ and sorted by highest degree:

I copy pasted the name and degree columns into google sheets to make them be adjacent.

4.2

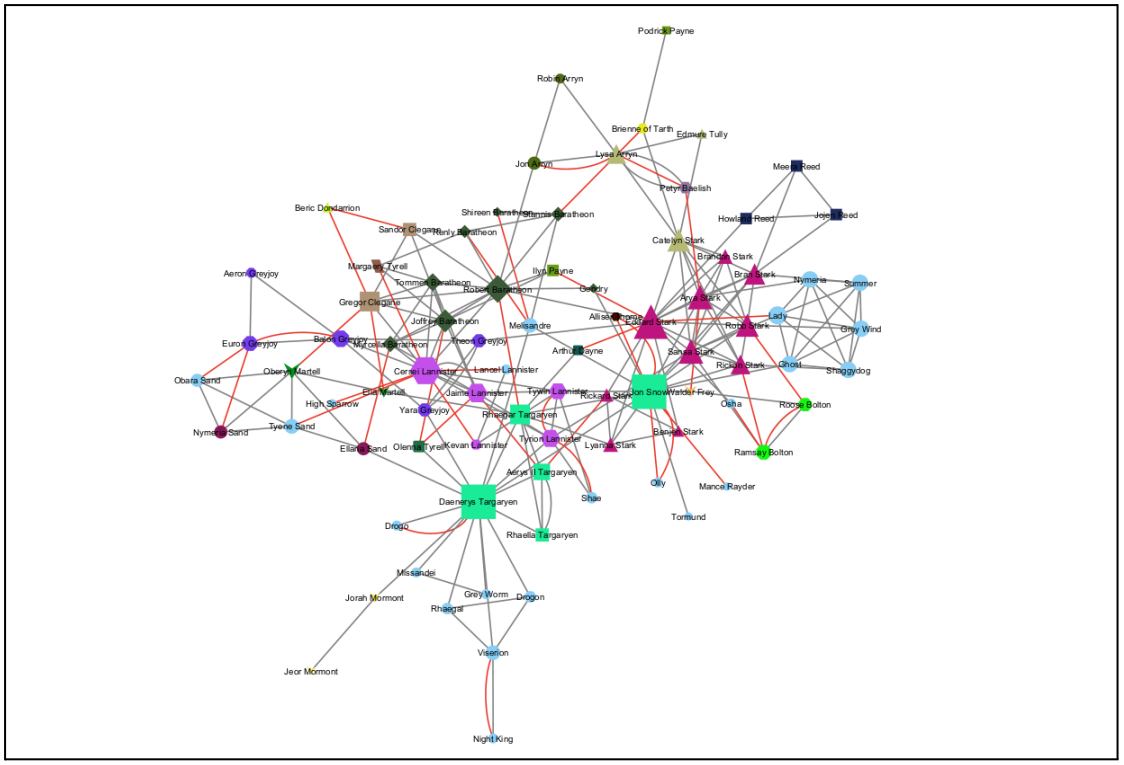
I looked for characters with small degrees and liked the name ‘Cadaver’. Here is the extracted network of his neighbors:



It’s pretty big considering this character only had degree 10. Logically it has 11 nodes and it also has 55 edges.

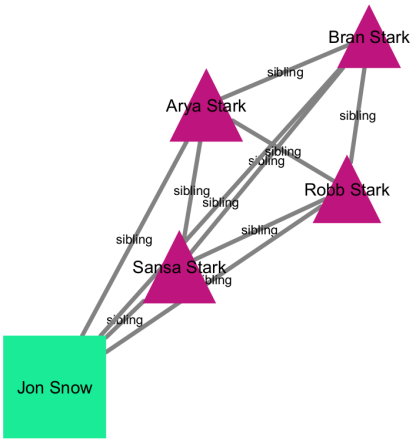
Section 5

5.1

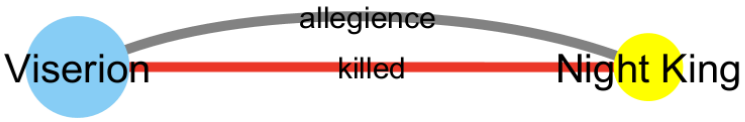


Above is the map of all of Game of Thrones. I set random colors, but had to set the shapes manually. Now for the extraction of a clique of 4 or more characters:

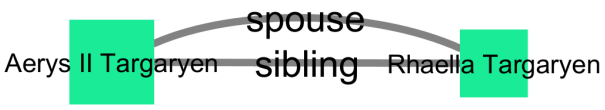
This particular clique has 5 nodes and 10 edges and involves: Jon Snow, Arya Stark, Bran Stark, Sansa Stark, Robb Stark.



I haven't chosen a particularly interesting clique because apparently they're all siblings. I guess Jon Snow is from another father.



Here is a multi-edge. Apparently Night King and Viserion had an alliance but nevertheless one killed the other.



This multi-edge is rather disturbing. Rhaella and Aerys are both siblings and spouses. This seems like a strange show.

Observations about how "house of birth" is distributed:

They definitely cluster, where a neighbor of any given node is more likely to be of the same house of birth. The existence of the "sibling" relation seems to be the main factor driving this clustering. There are a couple big clusters of circles and triangles on the right side of the graph that immediately stand out.