Course: Social Network Analysis

Project I

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TASK 1

To begin with, we imported the CSV file from a URL in R-studio. We converted the dataset from list type to data frame type for convenience. Continuing, we took a subset of the original dataset by selecting only the required columns of our dataset (Source, Target, weight). After all of the above we created an undirected weighted graph using the "igraph" library.

TASK 2

Then for the undirected weighted graph that we created we performed some calculations in order to explore its basic properties. First of all, we calculated the number of vertices and edges. With the former (vertices) being equal to 796 and the latter (edges) being equal to 2823. Then, we calculated the diameter of the graph, which is equal to 53. We also count the number of triangles, which is equal to 5655. Furthermore, we computed the top-10 characters based on their degree value. The results we got are demonstrated on the table below (Table 1).

Character	**Degree**
Tyrion-Lannister	122
Jon-Snow	114
Jaime-Lannister	101
Cersei-Lannister	97
Stannis-Baratheon	89
Arya-Stark	84
Catelyn-Stark	75
Sansa-Stark	75
Eddard-Stark	74
Robb-Stark	74

Table 1: *Top-10 characters of the network as far as their degree is concerned*

Moreover, we computed the top-10 characters based on their weighted degree value. The results we got are demonstrated on the table below (Table 2).

Character	Weighted Degree
Tyrion-Lannister	2873
Jon-Snow	2757
Cersei-Lannister	2232
Joffrey-Baratheon	1762
Eddard-Stark	1649
Daenerys-Targaryen	1608
Jaime-Lannister	1569
Sansa-Stark	1547
Bran-Stark	1508
Robert-Baratheon	1488

Table 2: *Top-10 characters of the network as far as their weighted degree is concerned*

TASK 3

Continuing, we plot the entire network (Figure 1) for all the characters. We also plot the network only for the characters that are connected with more than or equal to 10 other characters (i.e., nodes with degree greater than or equal to 10).

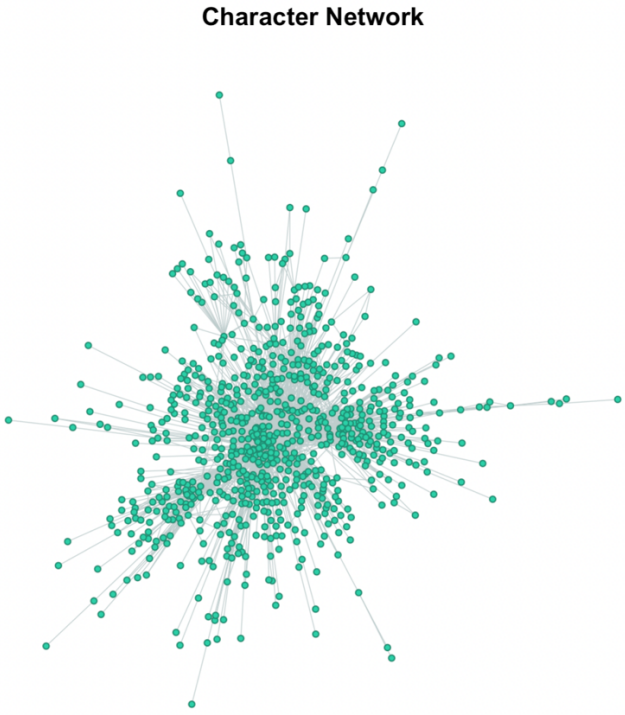

Figure 1: *Character Network*

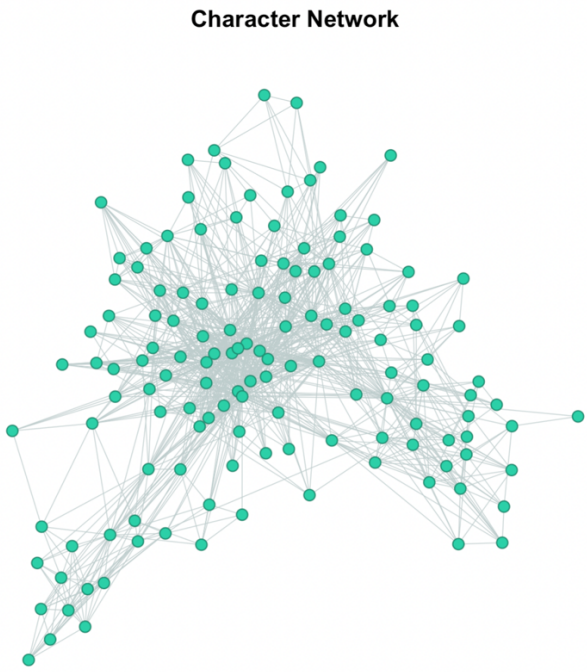

Figure 2: *Character Network for nodes with degree greater than or equal to 10.*

Continuing, we calculated the edge density for each of the above graphs. The edge density for the whole network (Figure 1) is equal to approximately 0.0089, while the edge density for the subgraph (Figure 2) is equal to approximately 0.1170. We can observe that the value of the edge density for the subgraph is higher than that of the entire network (0.1170 > 0.0089). That happens because the number of subgraph's edges is closer (compared to the entire graph) to the maximal number of edges this subgraph could have. While the number of entire graph's edges is not that close (as subgraph is) to the maximal number of edges the entire graph could have. In other words, the ratio of pairs connected with an edge is higher in the subgraph compared to the ratio of pairs connected with an edge in the entire network. Hence, the subgraph can be considered to be a denser graph than the entire network graph.

TASK 4

In this task we had to calculate two centrality measures (closeness and betweenness) for the characters (i.e., nodes) of our dataset. We were asked to print the top 15 characters according to their closeness (Table 3) and betweenness score (Table 4). The results we got are demonstrated on the tables below (Table 3 & Table 4).

Character	Closeness
Jaime-Lannister	0.0001205
Robert-Baratheon	0.0001162
Stannis-Baratheon	0.0001146
Theon-Greyjoy	0.0001146
Jory-Cassel	0.0001141
Tywin-Lannister	0.0001137
Tyrion-Lannister	0.0001130
Cersei-Lannister	0.0001129
Brienne-of-Tarth	0.0001124
Jon-Snow	0.0001118
Joffrey-Baratheon	0.0001105
Rodrik-Cassel	0.0001103
Eddard-Stark	0.0001092
Doran-Martell	0.0001088
Robb-Stark	0.0001088

Table 3: *Top-15 based on their closeness score.*

Character	Betweenness
Jon-Snow	41698.94
Theon-Greyjoy	38904.51
Jaime-Lannister	36856.35
Daenerys-Targaryen	29728.50
Stannis-Baratheon	29325.18
Robert-Baratheon	29201.60
Tyrion-Lannister	28917.83
Cersei-Lannister	24409.67
Tywin-Lannister	20067.94
Robb-Stark	19870.45
Arya-Stark	19354.54
Barristan-Selmy	17769.29
Eddard-Stark	17555.36
Sansa-Stark	15913.44
Brienne-of-Tarth	15614.41

Table 3: *Top-15 based on their betweenness score.*

As far as character Jon Snow is concerned, we can observe that he is ranked in the 10th place in terms of closeness score, which means that he may not be the most capable node (character) at spreading information efficiently through the graph (through the other characters). However, if we take a look in his rank based on betweenness score (Table 4), we can observe that he is ranked in the 1st place, which means that he is a very influential node (character) in terms of information flow in the network. That basically means that Jon Snow has more control over the network (i.e., over the other characters), as more information will pass through him.

TASK 5

In this final step of this assignment, we will rank the characters of our network based on their PageRank value. In the next figure (Figure 3) we can see the network based on the PageRank value. We should mention that the size of each node is based on their PageRank value (i.e., the bigger the PageRank value of the character the bigger the radius of its node).

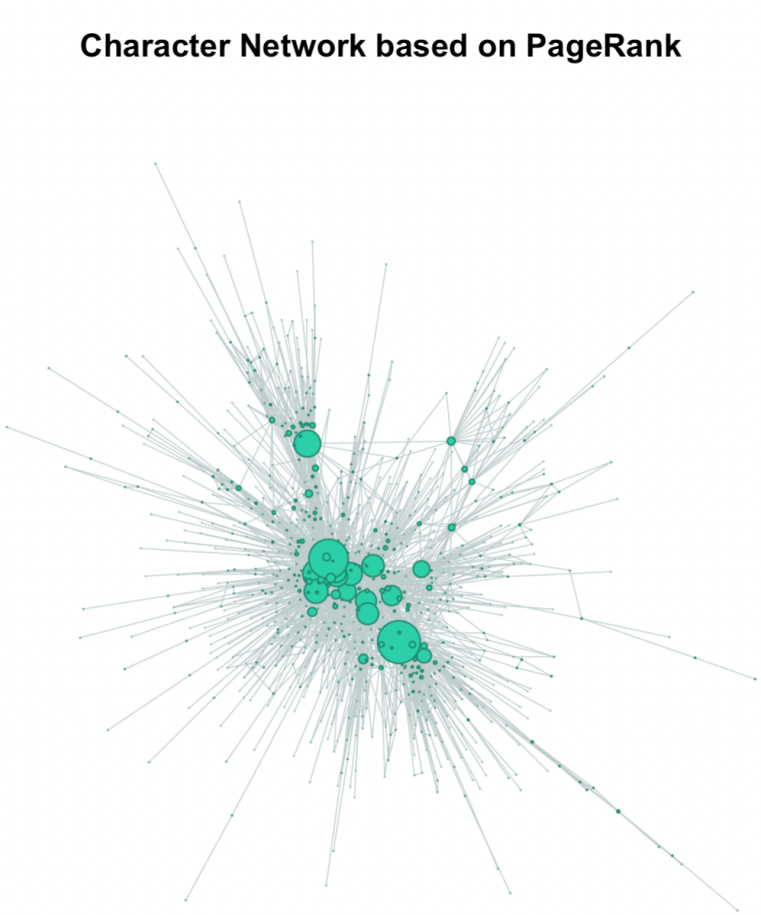

Figure 3: *Character Network based on PageRank.*