SCHOOL OF BUSINESS

DEPARTMENT OF MANAGEMENT SCIENCE & TECHNOLOGY

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SOCIAL NETWORK ANALYSIS – PROJECT I

NINAS KONSTANTINOS

f2822108

SUPERVISING INSTRUCTOR

KATIA PAPAKONSTANTINOPOULOU

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Task 1 – Creation of a graph for the "A Song of Ice and Fire" characters

In this task, we were asked to extract all the characters of "A Song of Ice and Fire" by George R. R. Martin and create a graph (network) based on their associations. In addition to their associations, the second file also includes a weight that characterizes each relationship between the characters. The files containing the above information can be found in GitHub in the following links:

- https://github.com/mathbeveridge/asoiaf/blob/master/data/asoiaf-all-nodes.csv for all the characters
- https://github.com/mathbeveridge/asoiaf/blob/master/data/asoiaf-all-edges.csv for their associations

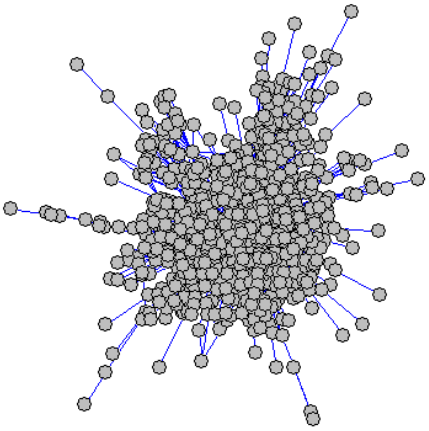
The graph was created in R using the "igraph" library. It should be mentioned that the graph was created having an undirected and weighted structure (each edge-relationship has a different weight).

Task 2 – Identification of the Graph's Basic Properties

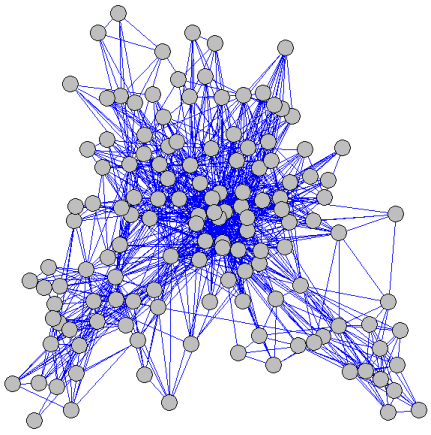
Next, we were asked to identify some basic properties (e.g., number of nodes-characters, relationships and more) of the graph created above. In specific, it was found that there are 796 different vertices-characters in the graph and 2823 different relationships between them. Furthermore, the diameter of the graph, which can be translated as the distance of the shortest path that connects the two most distant characters in the network, was found to be equal to 53 characters. Also, the number of triangles in the graph, which is equivalent to the number of 3-clique groups of interconnected characters in the network, was equal to 5655. Additionally, it was found that the top 10 characters in the network based on their degree (the number of the relationships they are included in) metric are Tyrion Lannister, Jon Snow, Jaime Lannister, Cersei Lannister, Stannis Baratheon, Arya Stark, Catelyn Stark, Sansa Stark, Eddard Stark and Robb Stark in that order. Finally, it was identified that the top 10 characters in the network based on their weighted degree (the weight of each relationship is also considered) are Tyrion Lannister, Jon Snow, Cersei Lannister, Joffrey Baratheon, Eddard Stark, Daenerys Targaryen, Jaime Lannister, Sansa Stark, Bran Stark and Robert Baratheon in that order. It should be mentioned that most of the characters in the graph (6 out of 10) that are the most important according to the degree metric are also important according to the weighted degree metric.

Task 3 – Plot the Network

Next, we were tasked to plot the whole network (Plot 1) and a subgraph that disregards all characters that have less than 10 connections in the network (Plot 2). On top of plotting the networks, we were also tasked to identify the edge density of each graph and comment on it. The edge density is interpreted as the proportion of the potential relationships that are actually present in a graph. It was found that the edge density of the entire graph is equal to 0.0089 and that of the subgraph is equal to 0.117. In other words, the characters in the subgraph are much more connected (more than 10 times) with each other in comparison to the characters included in the entire graph, and thus, the subgraph is much more dense.



Plot 1. Plot of the whole network



Plot 2. Subgraph of the network

Task 4 – Calculation of Centrality Measures

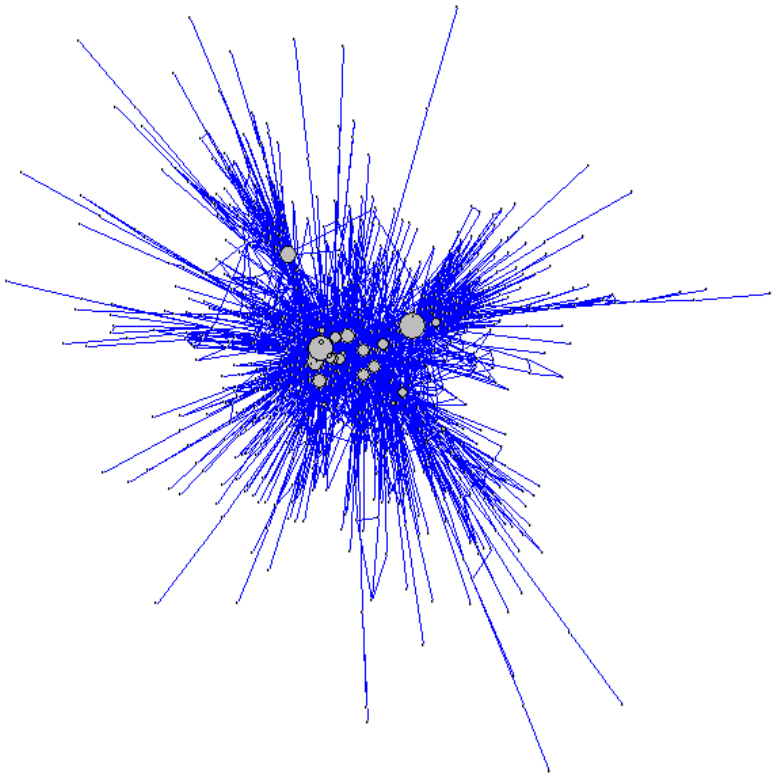
Following, we were asked to calculate the top 15 characters in the network based on their betweenness and closeness centrality measures. The betweenness centrality measure for a character-x is the proportion of the shortest paths that connects two different characters and includes the character-x divided by the number all the shortest paths that connect the two characters. The closeness centrality of a character-x measures his/her average inverse distance to the rest of the characters. It was found that the top 15 characters according to their betweenness centrality are Jon Snow, Theon Greyjoy, Jaime Lannister, Daenerys Targaryen, Stannis Baratheon, Robert Baratheon, Tyrion Lannister, Cersei Lannister, Tywin Lannister, Robb Stark, Arya Stark, Barristan Selmy, Eddard Stark, Sansa Stark and Brienne of Tarth in that order. On the other hand, the top 15 characters according to their closeness centrality are Jaime Lannister, Robert Baratheon, Stannis Baratheon, Theon Greyjoy, Jory Cassel, Tywin Lannister, Tyrion Lannister, Cersei Lannister, Brienne of Tarth, Jon-Snow, Joffrey Baratheon, Rodrik Cassel, Eddard Stark, Doran Martell and Robb-Stark in that order. It is worth mentioning that most of the characters that belong in one of the above lists does not belong to the other. In other words, characters with high betweenness centrality do not necessarily have high closeness centrality.

In addition, we were tasked to identify the position in which the character "Jon Snow" is ranked according to both of the above metrics. It was discovered that Jon Snow was in the 1^{st} position in terms of betweenness and in the 10^{th} position in terms of closeness. In other words, Jon Snow was the character that is the most critical character in terms of connecting the rest of the characters and the most important of all characters in information passing throughout the whole network. Furthermore, as stated above, he is the 10^{th} character in terms of closeness, which means he is the 10^{th} fastest character from which, when information spreads, reaches the rest of the network.

Task 5 – Implementation of PageRank method

Finally, we were asked to rank all the characters in the network using the PageRank evaluation method. The PageRank value is greater for characters that are associated with lots of other characters and especially from important characters. Important characters are considered those that have a great number of connections, and those that have a greater impact on the evaluation of how important another character is. It was also found that the 5 most important characters according to their PageRank values are Jon Snow, Tyrion Lannister, Cersei Lannister, Daenerys Targaryen and Jaime Lannister in that order. Concluding, we were asked to plot the whole network and to assign the appropriate size to each character respective to their

PageRank values (Plot 3), so as to make the important characters more evident in the plot compared to the less important ones.



Plot 3. PageRank Plot