Athens University of Economics and Business
Department of Management Science and Technology

Social Network Analysis
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A Song of Ice and Fire

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Question 1

‘A Song of Ice and Fire’ network

The first task we need to perform is to create an igraph graph using the Game of Thrones characters. First step would be to download the CSV file from Github and load the igraph library. We then read the CSV file and we remove the columns “Type” and “id” since we don’t need them for our project. Then we create the undirected weighted graph

Question 2

Network Properties

Next, having created an igraph graph, we will need to calculate the following:

• **Number of vertices**: 796
• **Number of edges**: 2823
• **Diameter of the graph**: 53
• **Number of triangles**: 5655 (we had to divide the sum of triangles by 3 because our graph is undirected so the triangles with the same people are counted thrice)
• The **top-10 characters** of the network as far as their **degree** is concerned

Characters	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

• The **top-10 characters** of the network as far as their **weighted degree** is concerned

Characters	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

Question 3

Subgraph

After that, our task is to plot the entire network of characters:

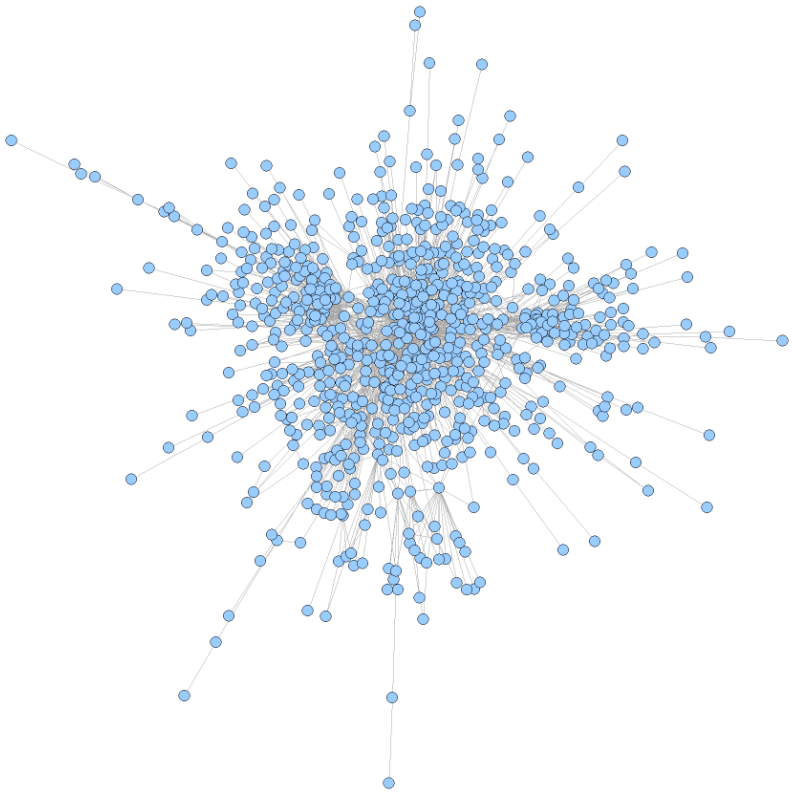

Figure 1: Plot of the entire network

Then, by discarding nodes that have less than 10 connections in the network, we will create a subgraph of the network, and plot the subgraph.

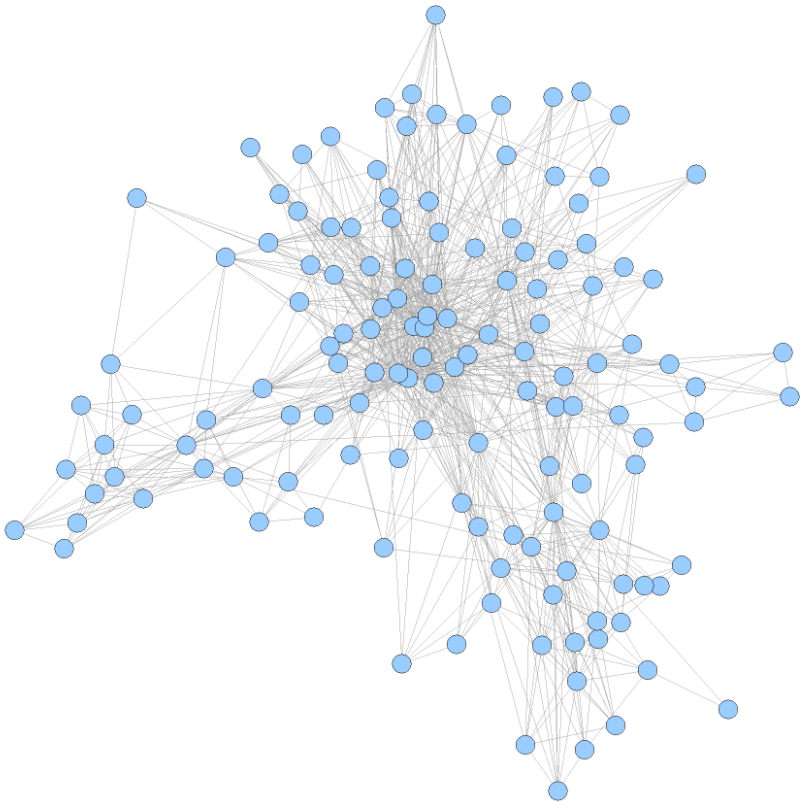

Figure 2: Plot of the subgraph (nodes that have less than 10 connections were discarded)

Following that, the edge density of the entire graph and the subgraph were calculated. The edge density for the entire graph is 0.009 and for the subgraph it's 0.117. The low densities mean that most characters are only related to a few others. If the edge density had the maximum value 1 every character would have a connection with every other character, implying that every vertex would be connected to every other vertex. By removing characters with less than 10 connections from the graph, we were able to keep the characters that were the most connected with other characters (we could call them as the most popular). As a result, our subgraph has a higher edge density than the entire network.

Question 4

Centrality

For this question we will need to calculate the top-15 nodes according to closeness and betweenness centrality.

• The **top-15 characters** of the network based on closeness centrality

Characters	Closeness
Jaime-Lannister	0.000120598
Robert-Baratheon	0.000116279
Stannis-Baratheon	0.000114692
Theon-Greyjoy	0.000114613
Jory-Cassel	0.000114155
Tywin-Lannister	0.000113766
Tyrion-Lannister	0.000113007
Cersei-Lannister	0.000112969
Brienne-of-Tarth	0.000112448
Jon-Snow	0.000111894
Joffrey-Baratheon	0.000110509
Rodrik-Cassel	0.000110363
Eddard-Stark	0.000109218
Doran-Martell	0.000108861
Robb-Stark	0.00010885

• The **top-15 characters** of the network based on betweenness centrality

Characters	Betweenness
Jon-Snow	41698.94
Theon-Greyjoy	38904.51
Jaime-Lannister	36856.35
Daenerys-Targaryen	29728.5
Stannis-Baratheon	29325.18
Robert-Baratheon	29201.6
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

In addition, we are asked to determine where Jon Snow ranks in these two categories. Jon Snow has closeness 0.0001118944 and betweenness 41698.94. We will need to find where Jon Snow ranks amongst the other characters. He ranks 10th in closeness centrality, which means that starting from "Jon-Snow" in order to reach another vertex, we need to pass through more vertices on average compared to other characters that rank higher than Jon. Regarding betweenness, he ranks 1st which basically means that he acts as a bridge along the shortest path between two other vertices.

Question 5

Ranking and Visualization

The final step of this project is to rank the characters of the network with regard to their PageRank value. The **top-5 characters** with the highest PageRank value are the following:

Characters	PageRank
Jon-Snow	0.03570539
Tyrion-Lannister	0.03291094
Cersei-Lannister	0.02366461
Daenerys-Targaryen	0.0222804
Jaime-Lannister	0.01979001

We will then create a plot of the graph that uses these values to appropriately set the nodes' size so that the nodes that are ranked higher are more evident.

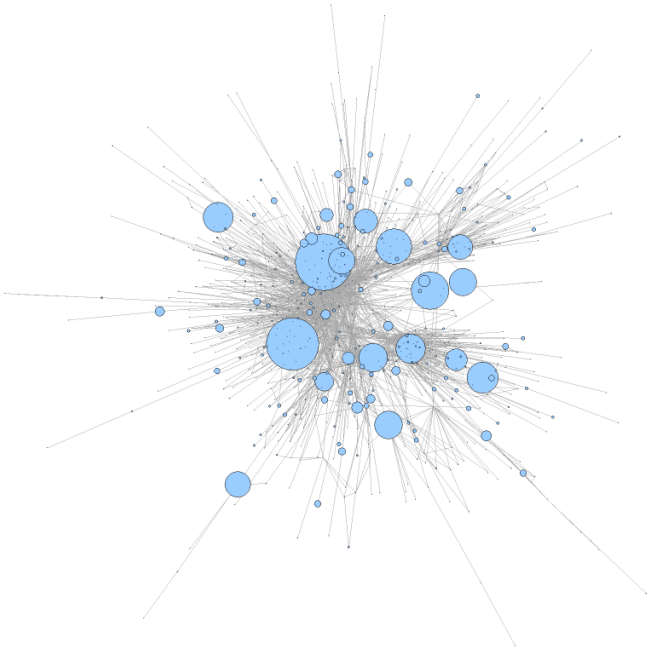

Figure 3: Plot of the graph that uses PageRank to appropriately set the nodes' size