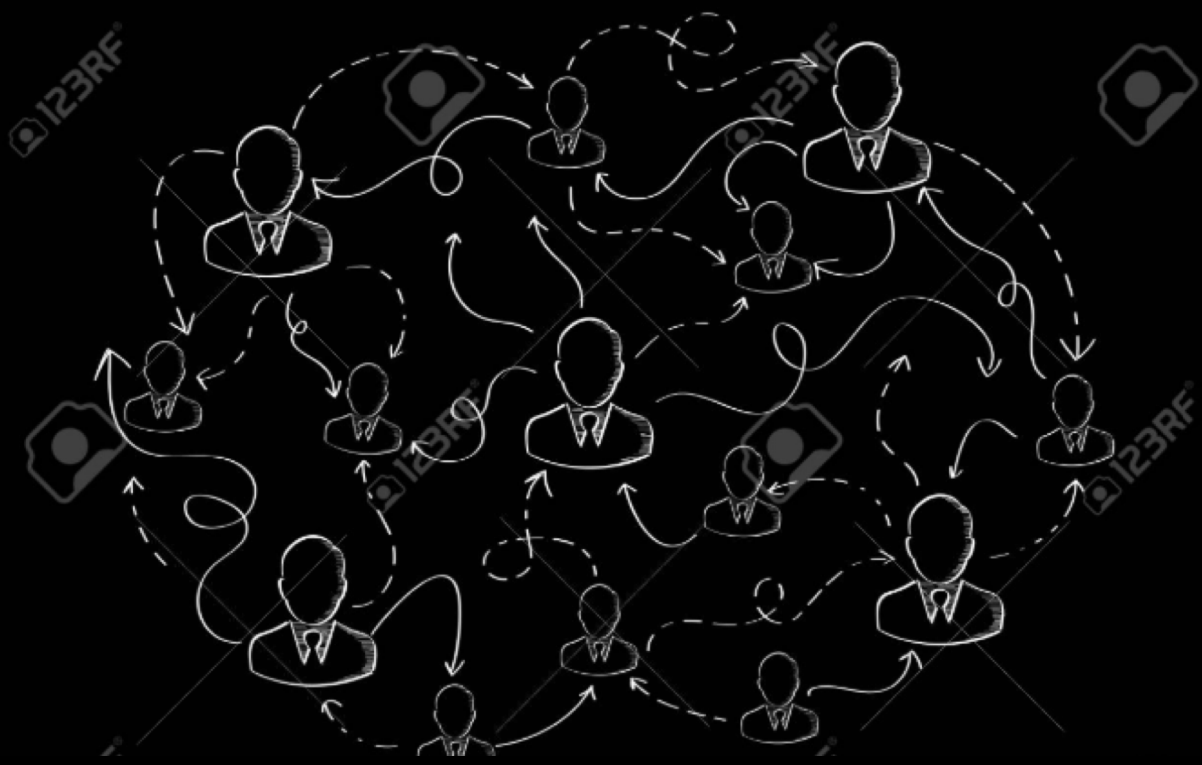
Network Analysis & Visualization with R and igraph

Course: Social Network Analysis



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Question 1: 'A Song of Ice and Fire' network

The provided csv has been loaded out of which the columns *Type* and *ID* were omitted since they were not requested for the creation of the undirected weighted graph. The edges of this graph can be found below.

```
IGRAPH da0d9ff UNW- 796 2823 --
+ attr: name (v/c), weight (e/n)
+ edges from da0d9ff (vertex names):
[1] Addam-Marbrand--Brynden-Tully     Addam-Marbrand--Cersei-Lannister
[3] Addam-Marbrand--Gyles-Rosby       Addam-Marbrand--Jaime-Lannister
[5] Addam-Marbrand--Jalabhar-Xho      Addam-Marbrand--Joffrey-Baratheon
[7] Addam-Marbrand--Kevan-Lannister   Addam-Marbrand--Lyle-Crakehall
[9] Addam-Marbrand--Oberyn-Martell    Addam-Marbrand--Tyrion-Lannister
[11] Addam-Marbrand--Tywin-Lannister   Addam-Marbrand--Varys
+ ... omitted several edges
```

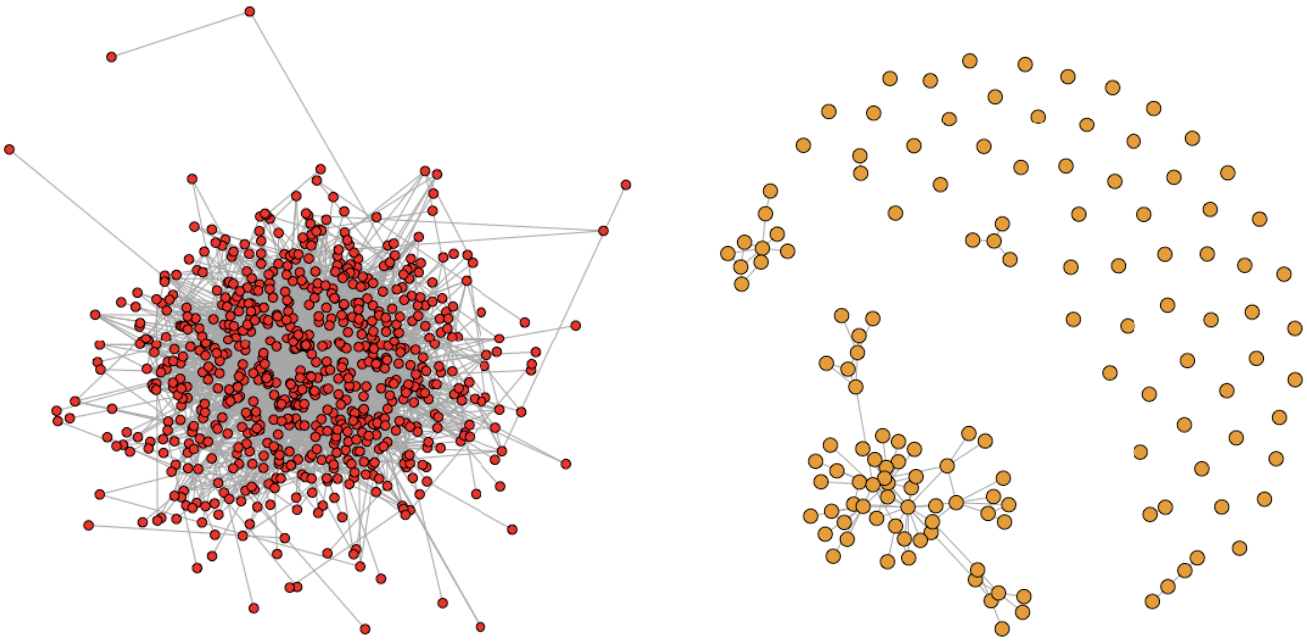
Question 2: Network Properties

The requested properties related with the graph can be found below.

```
# Number of vertices
796

# Number of edges
2823

# Diameter
53

# Top 10 characters (degrees)

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

# Top 10 characters (weighted degrees)

Addam-Marbrand      Aegon-Frey-(son-of-Stevron)
      56                         18
Aegon-I-Targaryen Aegon-Targaryen-(son-of-Rhaegar)
      41                         136
Aegon-V-Targaryen   Aemon-Targaryen-(Dragonknight)
      6                           3
Aemon-Targaryen-(Maester-Aemon)     Aenys-Frey
                395                        19
Aeron-Greyjoy     Aerys-I-Targaryen
     151                   3
```

Question 3: Subgraph

The following plots of the created graph and subgraph respectively can be seen in this section.



(a) Graph plot

(b) Subgraph plot

As calculated, the edge density of the graph points at 0.008921968 while this of the subgraph is 0.01148562. As it is known, edge density describes the portion of the potential edges in a network that are actual edges.

The specific subgraph includes the top 10 nodes with the greater number of connections (edges) with the other nodes and therefore the above-mentioned portion in this case is greater than the portion which exists for the whole network in which other nodes with less connections exist.

Question 4: Centrality

- The top 15 nodes regarding *closeness centrality* are the ones presented below.

```
Jaime-Lannister  Robert-Baratheon     Theon-Greyjoy       Jory-Cassel
 0.0001193460      0.0001137527        0.0001135203       0.0001131734


Stannis-Baratheon   Tywin-Lannister  Cersei-Lannister   Tyrion-Lannister
  0.0001131606        0.0001128286     0.0001116695       0.0001114454


Brienne-of-Tarth      Jon-Snow       Joffrey-Baratheon     Rodrik-Cassel
  0.0001112718      0.0001106072         0.0001093733        0.0001083658


Doran-Martell      Eddard-Stark       Harys-Swyft
0.0001079098       0.0001073192       0.0001072961
```

- The top 15 nodes regarding *betweenness centrality* are the ones presented below.

```
Jon-Snow          Theon-Greyjoy    Jaime-Lannister
41698.94            38904.51           36856.35


Daenerys-Targaryen  Stannis-Baratheon   Robert-Baratheon
     29728.50            29325.18           29201.60


Tyrion-Lannister   Cersei-Lannister    Tywin-Lannister
    28917.83           24409.67           20067.94


Robb-Stark         Arya-Stark       Barristan-Selmy
 19870.45           19354.54           17769.29


Eddard-Stark        Sansa-Stark      Brienne-of-Tarth
  17555.36           15913.44           15614.41
```

Based on the retrieved results, the character 'Jon-Snow' ranks **tenth** regarding closeness centrality and **first** as far as betweenness centrality is concerned. Therefore, it seems that this character is the top node which acts as a 'bridge' between the nodes of the network (i.e. it is the character that influences the most the flow around the network), but it is not the best placed character to influence the entire network most quickly.

Question 5: Ranking and Visualization

The PageRank value of the characters is initially calculated. Some indicative results can be found below.

	page.rank
Jon-Snow	0.0357053880
Tyrion-Lannister	0.0329109420
Cersei-Lannister	0.0236646144
Daenerys-Targaryen	0.0222804028
Jaime-Lannister	0.0197900132
Eddard-Stark	0.0189642609
Arya-Stark	0.0185717098
Stannis-Baratheon	0.0180509896
Joffrey-Baratheon	0.0174603705
Robb-Stark	0.0173607150
Bran-Stark	0.0167203236
Sansa-Stark	0.0163254704
Robert-Baratheon	0.0156995273

Based on these calculated PageRank values, the requested plot of the graph is created as seen below.