Game Of Nodes: The Song of Ice and Fire Saga

A Social and Network Analysis and Case-study

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1. Introduction:

While identifying real world interactions and ties may require an arduous effort in terms of tracking, cleaning, and exploring the data to understand the bigger picture, fictions and movies greatly simplifies this effort through its scripts, plots, and screenplays. Meanwhile, providing us with deeper insights which can be translated into the studies and understandings of the real world. One such complex and vast system that has been the talk of the recent decade in the cinematic and art world is the Game of Thrones Saga.

Studying performance and art has not been a recent discovery. It can be traced back as late as 335 BC to the works of Aristotle. Gustav Freytag later introduced visualization to storytelling in the late 19th century which gave birth to the now widely used terms, Exposition, Complication, Climax and Resolution in critiquing plots. Storylines are termed plots because you can create a visual picture of the direction in which the storyline and character development is moving. So, the combination of data visualization and criticism goes back 150 years. [3]

It is worth noting a very fine distinction when it comes to distinguishing characters in a storyline. While most of them have the same main character, hero, and a protagonist there is a distinct difference to these terms. "A main character often appears in the work, a hero has a laudable personal trait, and a protagonist struggle, is compelled to act and their choices advance the plot and determine the fate around them". [4]

So how do you distinguish these heroes, main characters, and protagonists in a vast multitude of a universe with interweaving plots like the Game of Thrones. "Recently, writer Mike Carey used the term "fractal protagonists" to describe the characters in such a vast narrative world. In other words, the answer to "who is the protagonist" depends on where you look, and at what scale you consider the storyline. Game of Thrones is populated by fractal protagonists, most notably Jon, Daenerys, Tyrion, Sansa, Arya, Cersei, and Jaime". [4]

2. Dataset, Background research and Research Question

The dataset was created by GitHub\u\mathbeveridge "by linking two characters each time their names (or nicknames) appear within 15 words of one another". [5] An undirected edge is created between 2 characters when two characters appear together in a scene, when a character is talking about another character, when a character listens to another character talk about a third one and so on. Admittedly,

this is not the most robust approach, but the authors of the dataset were able to arrive at the threshold of the number of words to consider and arrived at 15 words which provided the best results.

Various other fan sites and web scraping has been used in order to account for the disambiguation issue caused when two characters have the same name, for example Jon Snow and Jon Arryn referred to as Jon. Similarly common words such as King, Queen and Lord have also been replaced with the respective names of the characters wherever applicable to make the dataset as accurate as possible. Mathbeverigde (2017)

Through initial data exploration and visualization, we see a standard network graph with different ties strengths and characters are well represented. Examining the figure 1 and table 1, a clear pattern emerges. "For large cin−cout the network contains strong community structure, and the algorithm reliably classifies essentially all nodes into the correct groups, as we would expect of any effective algorithm" Newman, M., Clauset, A (2016)
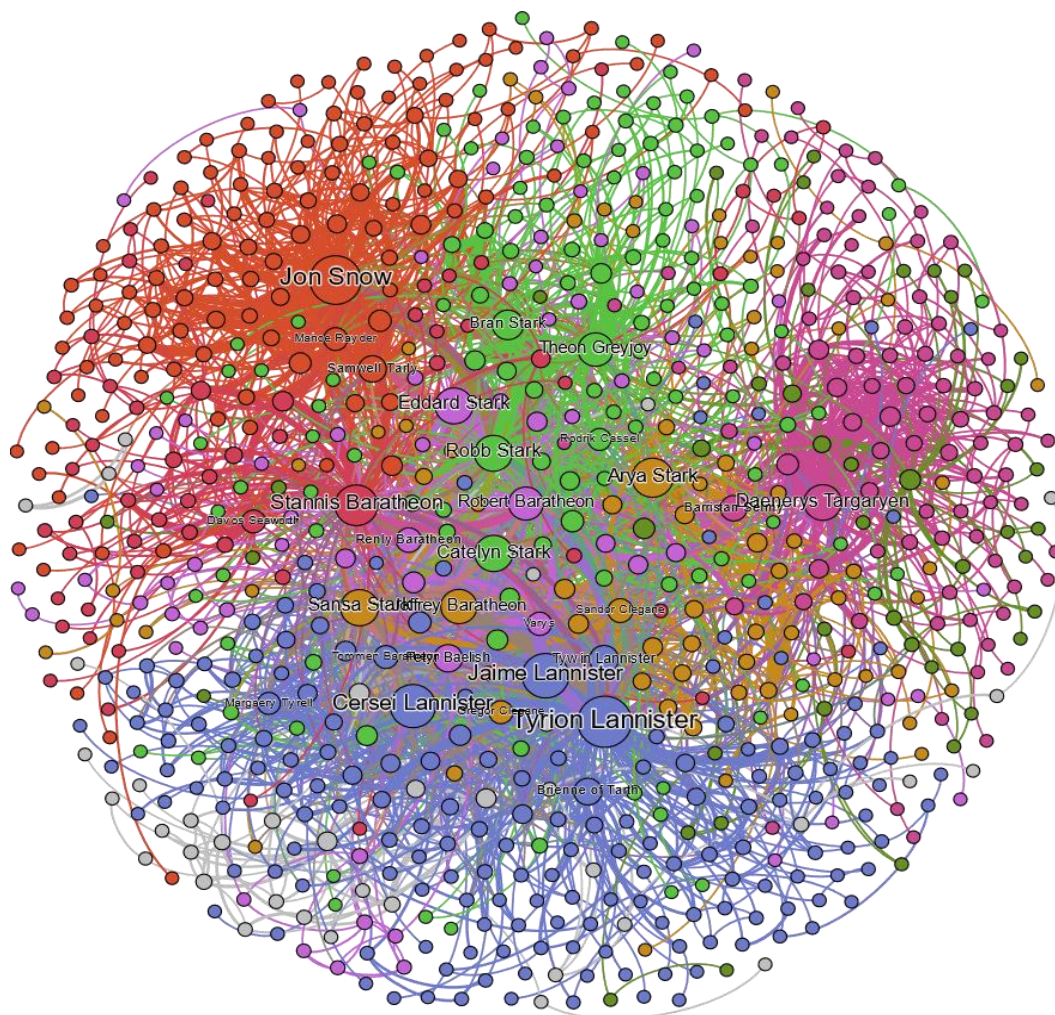

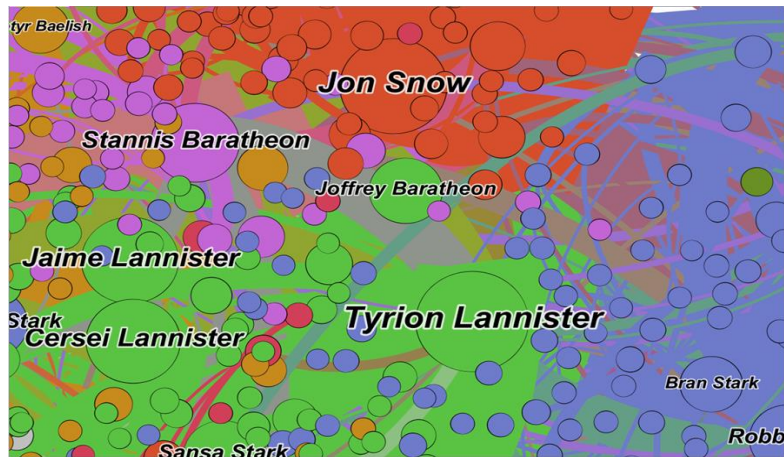*Figure 1: Initial representation of the nodes and edges in Gephi*

Figure 2: A detailed view of the nodes and edges from the previous image

Metric	Average Degree	Average Weighted Degree	Average Path Length	Network Diameter	Graph Density	Average Clustering Coefficient
Value	7.093	81.982	3.416	9.2	0.01	0.653

Table 1: Network Statistics

2.1 Research Question

In this study we try to explore this plethora of plots to try and paint a picture on

- Community detection to identify the different kingdoms and how they interact throughout the series
- Character arc representation taken by the main characters
- Fractal protagonists across different scaling
- Key players and central figures in every book using character centrality diagram
- Role of weak ties in the development of the plot
- Nature of Ties: Identifying friends and foes
- How is a balance achieved in the network where most factions are mutual enemies?

- Identifying the longest plotlines and hidden players influencing the plot

3. Initial Data Exploration

3.1 The Network (Books 1-5):

The network that consists of all the characters from 5 books of The Song of Ice and Fire series consists of 796 characters (nodes) 2823 connections (weighted edges). Character names are sized by PageRank centrality and nodes are sized by betweenness centrality and the thickness represents the weights. The visual plot can be observed in Figure 3.
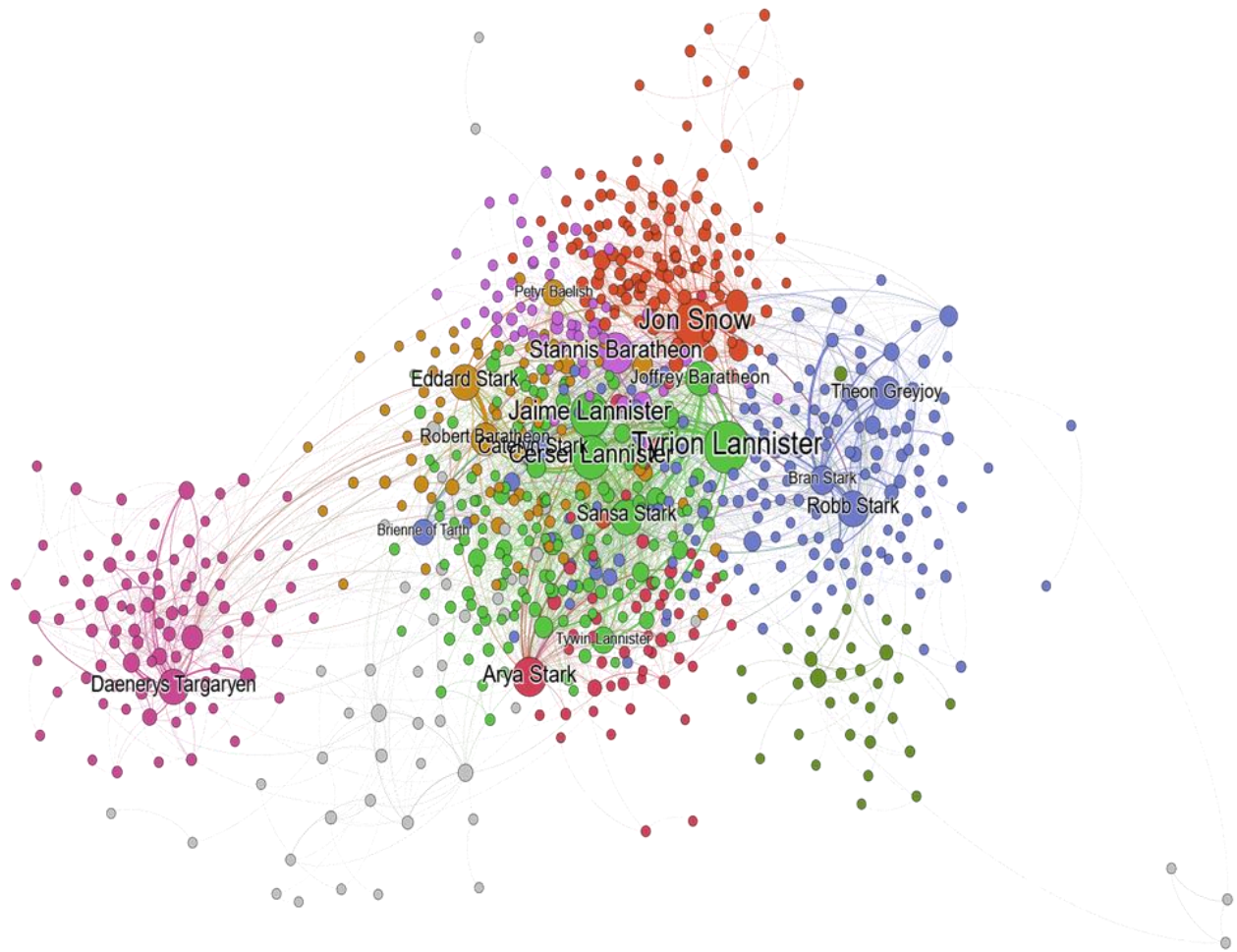

Figure 3: Community Detection using Gephi

3.2 Community Detection

"In a complex network, each node centrality metric offers a different perspective on the dataset and the most precise analysis can be obtained by taking into consideration not only a multitude of these metrics, but also the community structure of the whole network" Mester A et. al (2021)

Looking at figures 3 and 4 we can distinctly distinguish that there are 10 communities represented along with their most prominent members in each

- King's Landing (Green): Tyrion, Jamie, Cersei, Sansa, Joffrey
- The Wall (Red): Jon Snow, Samwell
- The North (Blue): Catelyn, Robb, Brann
- Essos (Pink): Daenerys, Barristan, Jorah
- The Ironborn (Violet): Theon, Ramsay

This aligns precisely with the actual storyline of the novel and provides us with the insights to carry further analysis on the character arcs and importance. The walkTrap algorithm is being used to find the number of dense clusters in the network. "In general, communities in networks have more intra connectivity (inside communities) than inter connectivity (between communities). Thus, it is expected to have more edges inside those groups than between them. When implementing a short random walk, the probability that both the starting and ending points will be in the same group rather than in different groups is thus higher. Algorithms based on random walks like Walktrap [Pons and Latapy, 2005] use this idea to detect communities in networks"
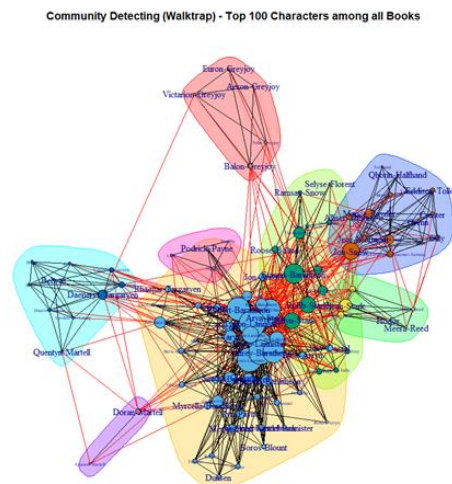

Figure 4: Community detection using WalkTrap Algorithm in R

3.3 Centralities

Nodes aren't all made equal. Some nodes play an outsized role in the network, either because they have a large number of connections or because they are strategically located to help connect the network's distant components. In fact, a node might be significant or influential in a variety of ways.

We focus on five alternative centrality metrics in our investigation, each of which conveys a different dynamic. These measurements of centrality have been utilized in a variety of domains, including

sociology, economics, and computer science. There is no single "correct" metric of centrality. It's important to interpret these numbers considering our expert knowledge in the underlying area, just as it is with other Data Science methodologies to derive insights on the bigger picture.

In our case, we explore Degree, Weighted Degree, Eigenvector, PageRank and Betweenness for the Song of Ice and Fire series to understand and rank the prominence of each character and try to relate it to the role they played in carrying the plot in a certain direction. Below is a consolidated summary of the 10 main characters and their respective centralities ranked. The same will be explored in detail in the further sections.
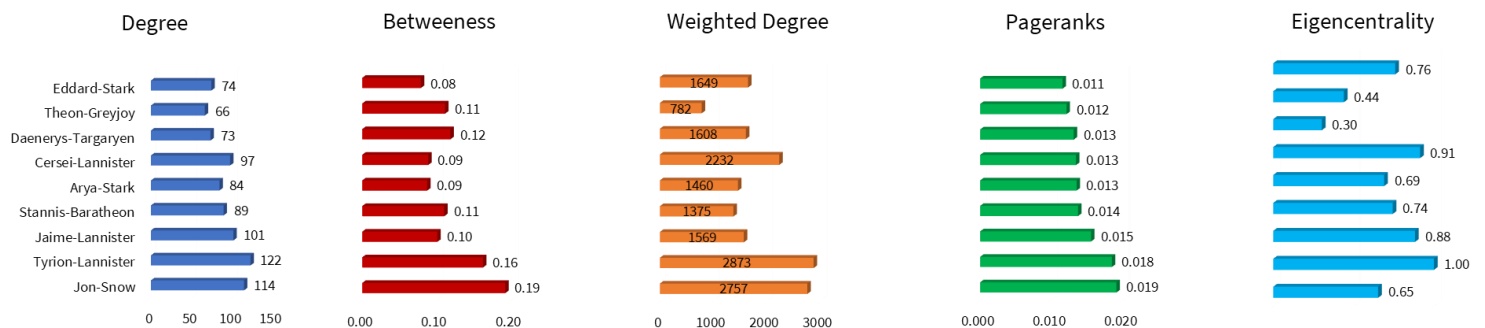
Figure 5: Ranking each individual Centrality measures based on characters

3.3.1 Degree Centrality and Weighted Degree Centrality

The number of nodes that are directly connected to a node via an edge determines its degree of centrality. This is simply a tally of how many individuals the character has interacted with at least once.

The sum of the weights of the edges incident with the node is the weighted degree of centrality. This is the total number of times the character has interacted with other characters.

With multiple leading characters in each of their respective territories, the Starks and the Lannister's dominate this centrality measure. Despite Daenerys's expansive journey from Essos to the far north she still ranks only at 7th which might explain why she needed Tyrion and John Snow's support in order to reach these areas.

Jaime, Arya, and Stannis underperform when it comes to degree centrality. Jaime has a lower profile than Cersei, which could explain why he doesn't reach the same heights as his sister. Meanwhile, because Stannis isn't a point-of-view character, his interactions are likely to be limited. In Westeros, Arya commands occasional attention, but in Braavos, she follows a more discrete plotline.

Joffrey, Bran, Ned, and Robert are among the overachievers. In the second and third volumes, King Joffrey was on everyone's mind. Bran has less connections than the average person, thus he has a greater ratio of interactions per connection. Finally, the strong axis between Ned and Robert in the first book is self-reinforcing, and King Robert is still mentioned in both Westeros and Essos.

3.3.2 Page Rank Centrality

This is a feedback-looped form of weighted degree centrality. We just get the "fair share" of our neighbor's importance this time. That is, the importance of the neighbor is divided among their neighbors in proportion to the number of encounters with that neighbor. PageRank, on the surface, measures how well you utilize your network contacts. PageRank centrality conveys narrative tension effectively in our scenario. When two essential characters interact, major developments occur.

Page Rank centrality can be considered as one of the most important measures in analyzing the character's dominance and influence in the plot. Jon seems to have the lead by the slightest margin; however, it is very close between him and Tyrion. It is also worth noting the projected character arc of Jon is on an upward trajectory taking the role of a protagonist as he faces tough adversaries in each stage of his life. Tyrion however is in a conundrum and his importance will be determined in the subsequent books.

It is surprising to note Jamie taking the third place beating out the likes of Cercei, Arya, Stannis and Danaerys. Jaime's linking position is advantageous to him. Because Stannis isn't a point-of-view character, he is punished. Cersei's relative confinement to King's Landing handicaps her in this race, while Arya and Daenerys are held back by their seclusion from the War of the Five Kings. Jaime's PageRank has risen in the second half of the novels, similar to Jon's, and we expect this trend to continue.

3.3.3 Eigenvector Centrality

This is a feedback loop with weighted degree centrality. You become more important because of your contacts with "important" people. You earn full credit for knowing someone essential in this metric, even if you don't know them very well. This determines how powerful (in principle) your network is, regardless of whether you are utilizing it to its maximum potential.

For Eigenvector centrality, it is good to be the king, or his closest accomplice and it is no surprise that the people in King's Landing have a commanding lead. Sansa is the top Stark in this category due to her strong marriage ties with the Lannisters. Jon's ranking has taken a hit, understandably, due to his limited interactions with the ruling powers. While Daenerys is without a doubt the least performing individual in this category due to her isolation in the Essos.

3.3.4 Betweenness Centrality

Betweenness centrality identifies nodes in the network that are strategically positioned, implying that information will frequently pass through them. A person in such a position of intermediation gains power and influence. The number of short pathways that pass through a specific node is measured as betweenness centrality. If a node is in a bottleneck between two huge communities, for example, it will have a high betweenness.

Jon with his multi faced connection with the Night's Watch, Starks, Baratheons and the Greyjoys keeps himself at the top. Tyrion who possibly traveled the most comes second. We notice Daenerys, although far away from the main story, has done well due to her own journey of building her own empire and army.

Characters	Degree	Weighted Degree	Closeness centrality	Betweenness centrality	Page ranks	Eigen centrality
Jon Snow	114	2757	0.445	0.192	0.019	0.652
Tyrion Lannister	122	2873	0.476	0.162	0.018	1.000
Jaime Lannister	101	1569	0.452	0.101	0.015	0.882
Stannis Baratheon	89	1375	0.445	0.110	0.014	0.743
Arya Stark	84	1460	0.431	0.087	0.013	0.690
Cersei Lannister	97	2232	0.455	0.089	0.013	0.914
Daenerys	73	1608	0.383	0.118	0.013	0.302
Theon Greyjoy	66	782	0.423	0.111	0.012	0.439
Eddard Stark	74	1649	0.456	0.079	0.011	0.759
Catelyn Stark	75	1230	0.433	0.055	0.011	0.697
Robb Stark	74	1424	0.444	0.066	0.011	0.696
Sansa Stark	75	1547	0.433	0.049	0.010	0.795
Joffrey Baratheon	69	1762	0.434	0.032	0.009	0.830
Robert Baratheon	65	1488	0.459	0.078	0.009	0.771
Bran Stark	54	1508	0.419	0.045	0.008	0.501

Table 2: Ranking the centrality measures for the top 15 characters

3.3.5 Takeaways from Centrality

Overall, it is evident to the theory that Jon and Danaerys take the hero's journey as they maintain a steady trend throughout the book. While it is compelling to add Tyrion to this list, he might however fit the role of a protagonist along with Sansa and Arya as their journeys are constantly faced with difficult choices which lead them to face adversaries. The title of a main character fits multiple people, including Cercei, Jamie and Stannis.

Figures 6 depict the journey each of the main characters take through book 5 and few inferences are worth noting. Jon has maintained a steady pace throughout. Tyrion, Arya and Cercei seem to have been trending downward while Jamie, Stannis and Daenerys have an upward momentum. This gives us a very worthy picture on what to expect from each of the characters in the consequent books and the theory can be supported through the completion of the television series which supports the same.
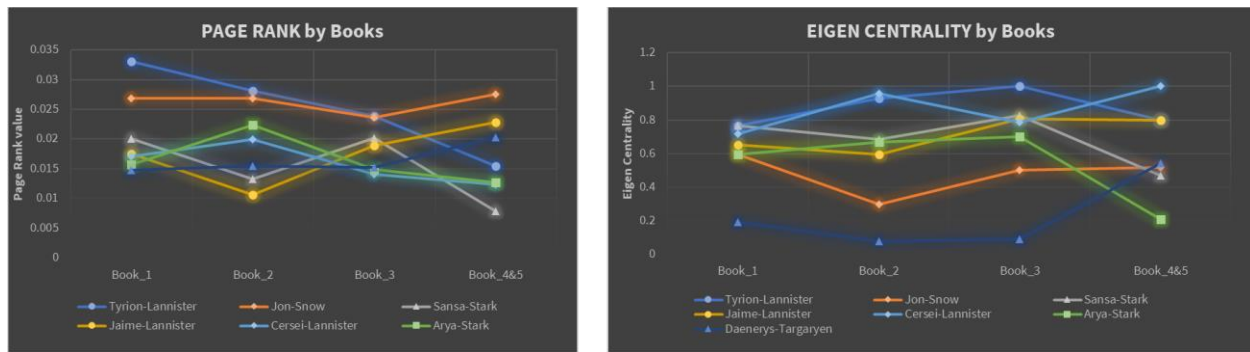
Figure 6: Trend of Page Rank (left) and Eigenvector centrality (right) for the main characters through five books

4. Determining the rise and fall of prominence of characters through centrality

Due to the fractal protagonistic nature of the narrative, we can never conclude that one of the characters is on a hero's journey while the other has taken the anti-hero. However, based on the data available we can try to understand which characters have maintained a steady dominance and the characters that have risen through the journey in the five books in view.

To do this, we create a character centrality diagram (CCD) for the top characters, which is a scatter plot graph depicted as follows:

- PageRank Centrality, a measure of the character's importance, is plotted on the x-axis
- Eigenvector Centrality, a measure of a character's status, is plotted on the y-axis
- Weighted Degree Centrality, a measure of the number of interactions, is represented by the color size of bubble

These graphs are explained in detail below and depicted in Figures 7 and 8

Book 1 inference:

From Figure 7, Tyrion stands out among these seven characters. The enormous distribution of Status (Eigenvector Centrality) throughout a relatively short range of Importance is the network's most striking characteristic (PageRank Centrality). The scale of the characters is not evident currently. PageRank Centrality (Importance) and Eigenvector Centrality (Status) both give a different tale.

Another intriguing aspect of this simple narrative is that a character's location reveals anything about their journey. Characters below the diagonal face difficulties because they create more energy than their connections can sustain. Those above the diagonal, on the other hand, are not fully utilizing the connections offered.

By the fifth book (Figure 7 right), these characters had begun to converge on a diagonal line (though most characters lie just below this line). In other words, these characters' Importance and Status have equivalent values. This results in a fractal protagonist's ranking (and scaling) that is constant. Cersei, Tyrion, and Jon are at the top of the list, with Daenerys and Arya at the bottom.

Meanwhile, the ranking based on the number of encounters (weighted degree) differs from the other two. When read from left to right, the colors in the figure are a jumble.
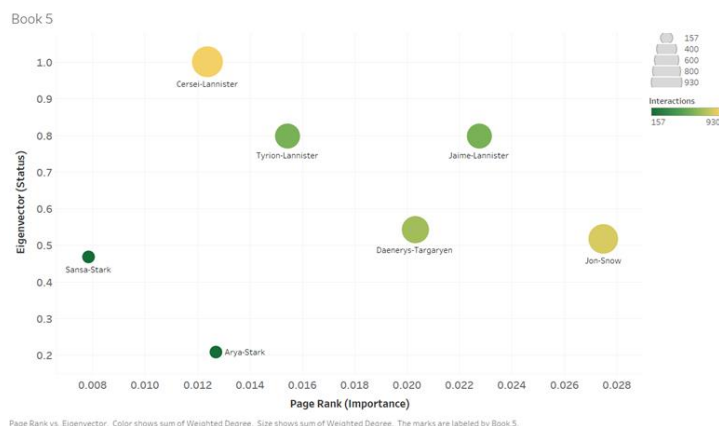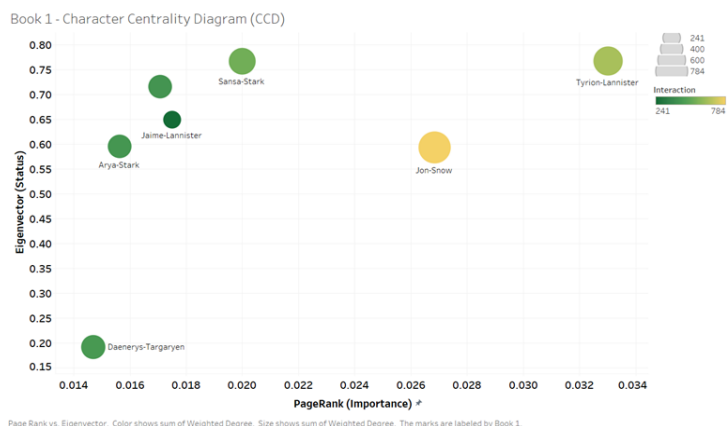

Figure 7: Character Centrality Diagram for top seven characters for Book 1 (left) and Book 5 (right)

5. Determining the Key-Players and Central figures in every Book

We've had a look at all the different centrality measures which has helped us get a picture of who the crucial characters in the books are. While the centralities quantized each character with a number and evaluated them, we still lack information on how they move across the network with each subsequent book, and how the network adjusts to accommodate their movement. The following analysis will show us exactly this, we'll first plot the network between the top 100 characters based on the earlier derived centrality measures, then we'll proceed book by book and see how the network evolves as these characters weave in and out of importance.

Below figure 8 depicts the network of the top 100 characters based on our evaluations, plotted in R.
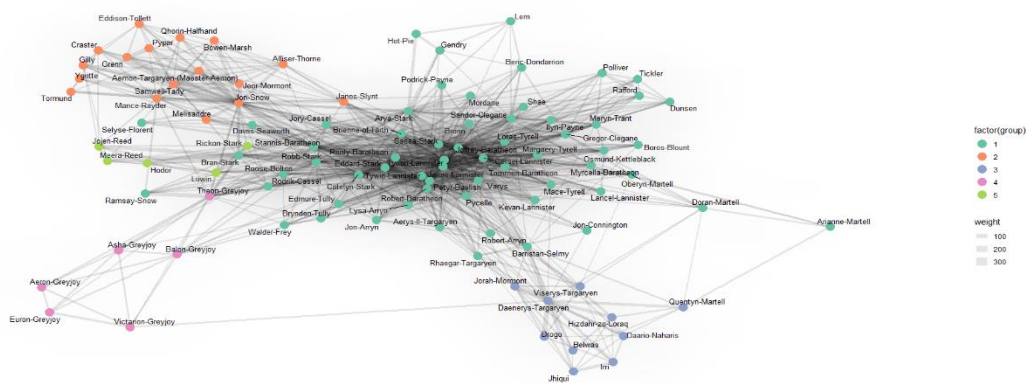

Figure 8: The Network of 100 most prominent characters across all 5 books

Interestingly, several of the groupings precisely follow the narrative: the men of the Night's Watch are grouped with the Wildlings, Stannis, Davos, Selyse, and Melisandre form another group, the Greyjoy and Bran's company in Winterfell before they headed for the North, Dany and her troop, and the Martells, and so on.

Our next plot, Figure 9, shows the most central characters across all books. We've used multiple metrics such as Node rank, centrality measures, edge betweenness in R, to identify the characters in the core of the saga, and the results were, well, interesting to say the least.
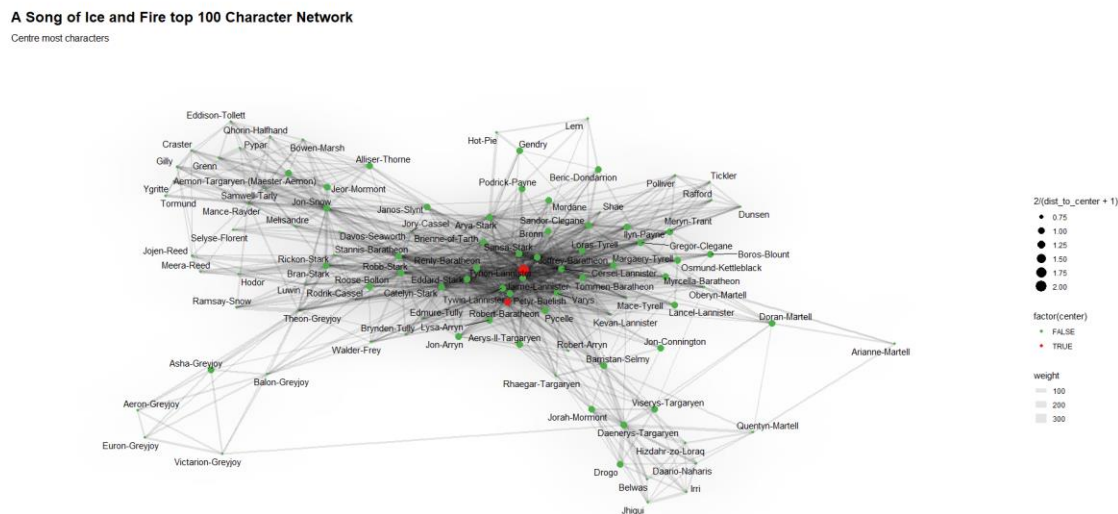

Figure 9: The plot for the most central characters across all 5 books

According to our finding the two center most characters who drive the narrative are:

- Tyrion Lannister's
- Robert Baratheon

While Tyrion Lannister doesn't really come as a surprise, we can't say the same for the latter. We honestly didn't expect Robert Baratheon to make this list considering his early death, but in a way, it actually makes a lot of sense. Robert and his rebellion against the Mad King - Aerys II Targaryen is the key trigger for much of what follows in the novels. As for Tyrion, we can say he was pretty much a given, being the favorite character of the author sure does come with perks!

By extending this analysis to each individual book, we were able to not only plot the key players in each book, but also their rise and fall, their movements across clusters, and the ripples they induce in the network.

In figure 10 we can see the key players (marked in red) in the first 2 Books.
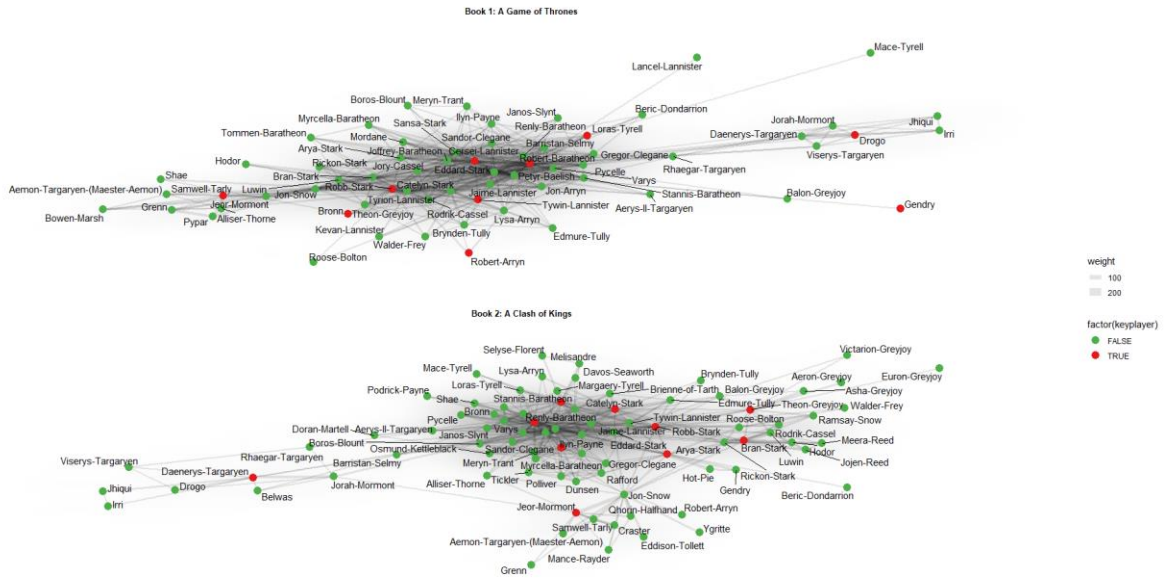
Book 1: A Game of Thrones

Figure 10: Key Players in Book 2 and Book 3, plotted in R

Similarly figure 11 represents the key players of Book 3 and Book 4, while figure 12 is the comparison between Book 4 and Book 5.
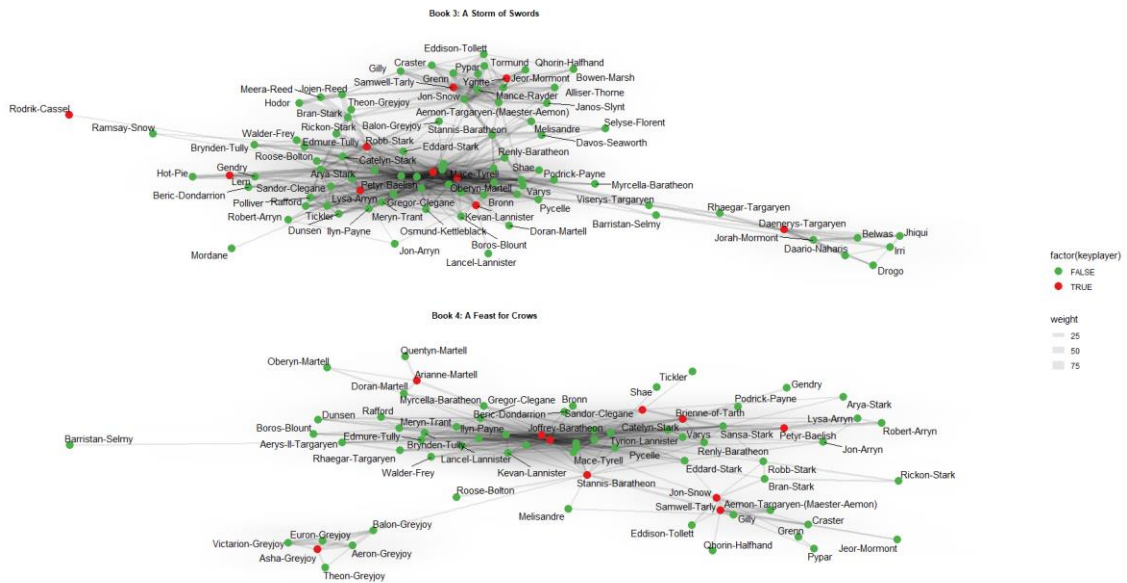
Book 3: A Storm of Swords

Book 4: A Feast for Crows

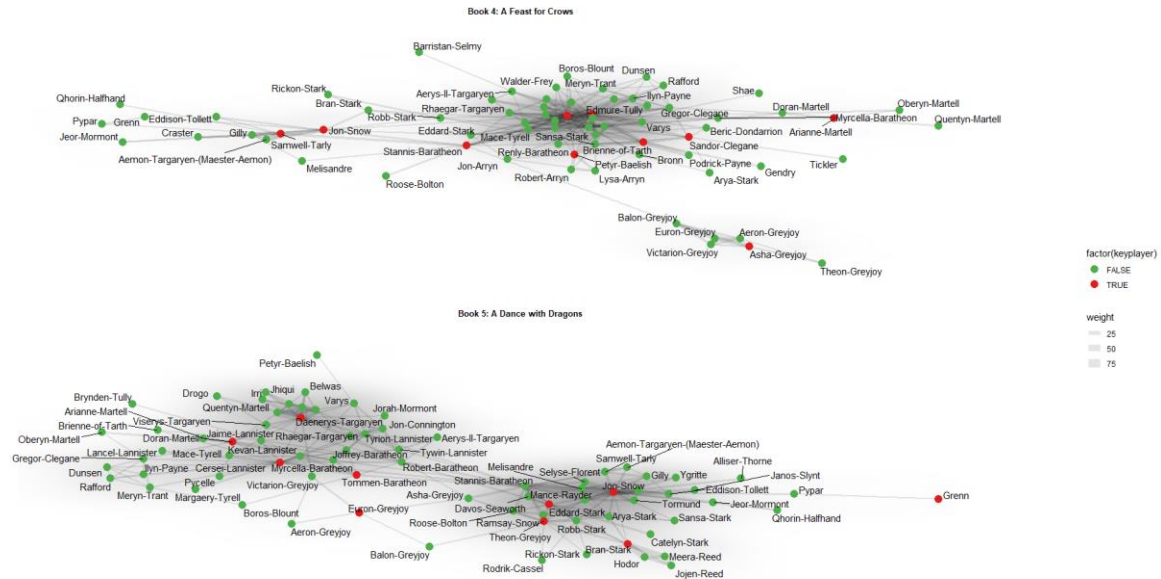*Figure 11: Key players in Book 3 and Book 4, plotted in R.*

Figure 12: Key players in Book 4 and Book 5, plotted in R.

The networks and key players in the five distinct books provide a few surprises as well as a lot that accurately mirrors the narrative. We can see some interesting movements in the network. Jon Snow and Daenerys Targaryan who started off in the edges of the first book not only became key players in the laters books but became central characters around whom the clusters are formed. Similarly, we can also see Robb Stark becoming a key player in Book 2 and reaching the center in Book 3 when he is at war against the Lanisters, and going back to his initial place, away from center in Book 4 when the narrative shifts.

These plots help us in visualizing the trajectory of the prominent characters we saw in our earlier analysis with the centrality measures, with respect to the narrative of the saga.

6. The Role of Strong and Weak Ties in the Network

"In terms of the links, one would also expect that the strong ties play a more important role in maintaining the network's integrity than the weak ones. Our analyses document the opposite effect in communication networks: The removal of the weak ties results in a phase transition-like network collapse, although the removal of strong ties has little impact on the network's overall integrity." (Structure and Tie Strengths in Mobile Communication Networks Author(s): J.-P. Onnela, J. Saramäki, J. Hyvönen, G. Szabó, D. Lazer, K. Kaski, J. Kertész and A. -L. Barabási)[9]

We know from the above study that contrary to conventional beliefs, it's weak and not the strong ties which hold the integrity of a network. But this only applies to real world networks. We were curious to see how our network reacts to removal of strong and weak edges, and does it follow the findings from the above paper?

We used Gephi to emulate the network of Book 1, 'A Game of Thrones', to study the impact of removing the strong and weak ties.

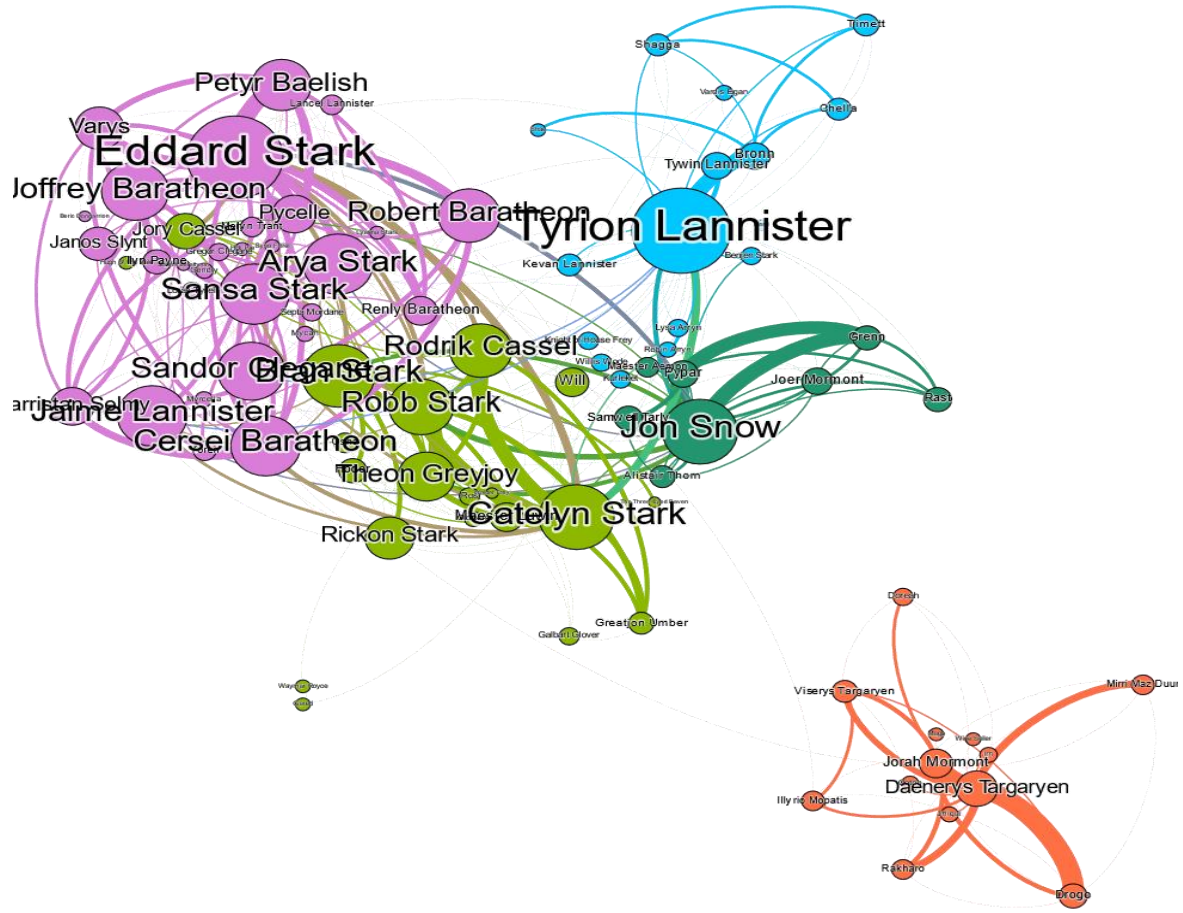For the first book, our network with both Weak and Strong ties intact is illustrated in figure 13.

Figure 13: The Complete network graph for Book 1 with all ties intact.

Though it's faint, we can still observe quite a few weak links. One noteworthy weak link is the one between Illyrio Mopatis and Jorah Mormont from the Daenery/Essos faction (Orange cluster) to King's Landing (Purple cluster). We've chosen to concentrate on this weak link since it has the most impact on the events that are yet to occur.

6.1 Removal of weak Ties

We then tried removing the weakest links in the network to see how the network adapts, figure 14 depicts the resulting network after removing the weaker ties from the complete graph of Book 1.
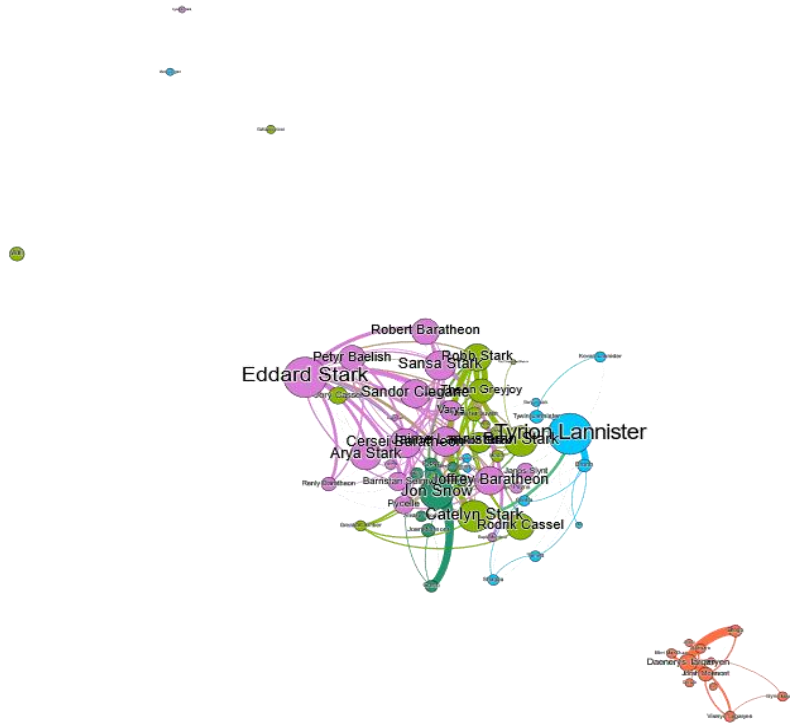

Figure 14: The network graph of Book 1, after removal of Weak Ties.

We can observe that the network seems to have collapsed a little, further removing the weaker ties results in even more collapse. This aligns pretty well with the study done in the O'nnela paper.

Another striking difference we can see in the second plot is lonesome nodes and the seeming isolation of Daenerys and the Essos cluster (Orange). With the weak links gone they have effectively become isolated from the central network, which helps us to conclude that the weak ties that Jorah Mormont and Illyrio had with King's Landing is essentially what brought Daenery into power and made her a central figure in the saga, without those ties, who knows, maybe we never would've had, a game of 'Thrones'.

6.2 Removal of Strong Ties

We saw what happened to the network after removal of the weak ties, but what of the strong ties? What role do they play in the network of Book 1 of the saga 'A song of Ice and Fire'.

Figure 15 illustrates the network graph after we remove the strong ties from the complete network graph of Book 1.
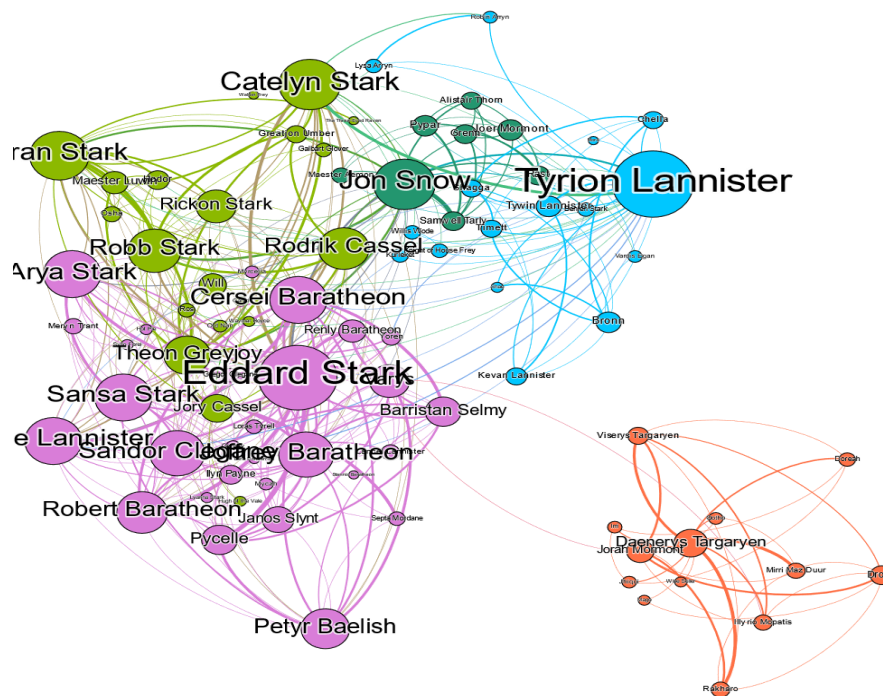

Figure 15: The network graph of Book 1, after removal of Strong Ties.

At first glance there doesn't seem to be much difference between this and the original network, however on closer examination we can observe that the local communities have spread a little.

The intensity of this dispersion-like effect of the local communities keeps increasing as we remove a few more ties. From this effect we can infer that while the strong ties aren't as crucial as the weak ones in transferring information or maintaining the structural integrity of the network, they still, however, are essential in maintaining the local communities.

"Weak ties appear to be crucial for maintaining the network's structural integrity, but strong ties play an important role in maintaining local communities." [9]

We're able to conclude that our findings for the network of Book 1 "A game of Thrones" aligns very well with the study done in the above paper, as such, our network might imitate real world networks much more closely that what we initially anticipated.

7. Friend and Foes - A Structural Balance Analysis

The analysis of weak and strong ties helped us understand how our network imitates the real-world ones, however we wanted to dive deeper into the network and wanted to know what holds the network together. For a tale filled with conflicts and infighting, we wanted to uncover the strained balance

between the different factions. We chose the 10 most prominent characters from our previous analysis, them being:

- Tyrion Lannister
- Jon Snow
- Robert Baratheon
- Cersei Lannister
- Daenerys Targaryen
- Joffrey Lannister
- Stannis Baratheon
- Arya Stark
- Jamie Lannister
- Sansa Stark

We took a sub-graph of these ten characters and plotted the nature of ties between them. Since we didn't have the data for the nature of their ties, we used the wiki for Game of thrones (https://gameofthrones.fandom.com/wiki/Game_of_Thrones_Wiki) to determine the nature of relation between two characters.

Below in figure 16, we've illustrated the nature of ties between the 10 selected characters, green being for positive(friend) and red for a negative relation(foe). We have to note that the subgraph is not a complete one since few characters have neither a positive or negative tie with others, Daenerys-Arya, Daenerys-Sansa to name a few.
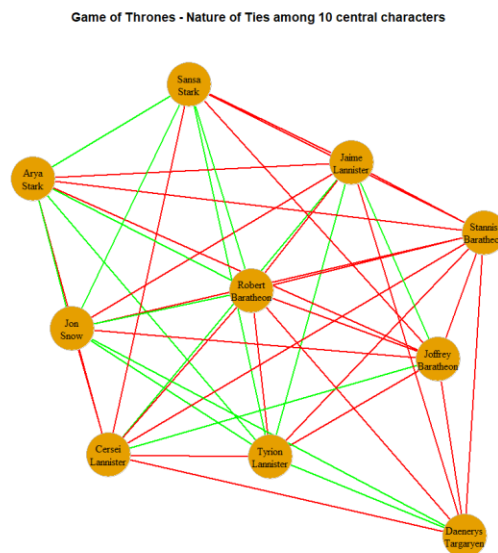

Figure 16: The sub-graph of 10 most prominent characters, and their nature of Ties.

We can observe that the 10 selected characters are more mutual enemies than friends, and this doesn't really come as a surprise considering the different factions they represent and the ongoing conflict between the kingdoms.

The below table, numbered 3, displays the count of different natured triangles in the above network, '+++' stands for a triangle with 3 positive(green) edges, '++-' for 2 positive with 1 negative, and so on.

Count of Triangles

+ + +	+ + -	+ - -	- - -	Total
9	10	62	24	105

Structural Balance Score: 0.67619

Table 3: Number of positive/negative edged triangles between selected 10 characters

While we've already established the fact that there are more negative (red) ties than positive, one interesting inference we can draw from the above table is the impact of the count of triangles with 2 negative and 1 positive edges (+--). We know that this kind of structure is a balanced one, so even though most of the characters are mutually enemies, they are still forming strategic alliances with others to plant themselves in a judicious position for the power struggle. This is causing the structure to have an impressive balance score of nearly 68% despite all those negative ties.

This again is reminiscent of real-world networks, where countries used the exact logic to form strategic alliances during world war I and II.

Combining both study of ties, the essence of Strong and Weak ones, and the balance created by Positive and Negative one, we can conclude that the social network of the saga of "A song of Ice and Fire" is mimicking real-life networks. It's not every day we come across a fiction which imitates real life so well, we believe this blend of being so real, yet having the groundworks of fantasy may be one of the key factors behind the widespread success of this series. While we haven't proved this theory yet, we still strongly believe it to be the case, and are planning to analyze a few other successful novels such as J.R.R. Tolkien's 'The Lord of The Rings' and J.K. Rowling's 'Harry Potter' to reinforce our claims.

8. **Longest Plotline and Hidden Players - Cliques Analysis**

In the paper 'CLIQUE COMMUNITIES IN SOCIAL NETWORKS' (by Luís Cavique, Armando B. Mendes and Jorge M.A. Santos)[12], the author states that "At the most general level, a clique is a subset of a network in which the actors are more closely and intensely tied to one another than they are to other members of the network. The smallest cliques are composed of two actors: the dyad. But dyads can be "extended" to become more and more inclusive -- forming strong or closely connected regions in graphs. A number of approaches to finding groups in graphs can be developed by extending the close-coupling of dyads to larger structures." He further adds "Formally, a clique is the maximum number of

actors who have all possible ties present among themselves. A 'Maximal complete subgraph' is such a grouping, expanded to include as many actors as possible."

We intend to extend this concert to our dataset, for this we used R to identify the largest cliques in every book, our results are summarized in table 4. The largest cliques give us an idea of the players who are closely knit or interact with each other more frequently than any other characters. Also, we made sure to remove any large cliques which didn't have any key players in it, this helps us focus on cliques that drive the plotline in every book.

Book Number	Largest - Clique											Characters
Book1	Robert-Baratheon	Eddard-Stark	Sansa-Stark	Joffrey-Baratheon	Cersei-Lannister	Petyr-Baelish	Catelyn-Stark	Tyrion-Lannister	Jaime-Lannister	Varys		10
Book2	Joffrey-Baratheon	Cersei-Lannister	Tyrion-Lannister	Sansa-Stark	Jaime-Lannister	Renly-Baratheon	Stannis-Baratheon	Catelyn-Stark	Robb-Stark	Robert-Baratheon		10
Book3	Joffrey-Baratheon	Tickler	Arya-Stark	Cersei-Lannister	Dunsen	Gregor-Clegane	Ilyn-Payne	Meryn-Trant	Polliver	Rafford	Sandor-Clegane	11
Book4	Cersei-Lannister	Jaime-Lannister	Tyrion-Lannister	Tommen-Baratheon	Tywin-Lannister	Mace-Tyrell						6
Book5	Cersei-Lannister	Rafford	Dunsen	Gregor-Clegane	Ilyn-Payne	Meryn-Trant						6

Table 4: Identifying the Largest Cliques in each Book

Our finding aligns very well with the overall narrative of the books, straight up we can observe that the first three books have a much longer 'largest clique' than book 4 or 5, this makes perfect sense since the events in books 4 and 5 occur chronologically at the same time but are separated geographically. This limits the character pool in both books and results in much smaller cliques.

But the noteworthy takeaway from this analysis is the presence of non-key players who drive the plot from the shadows. We've already established the most prominent characters from our previous analysis, and the fact that the largest cliques are in a way driving the plot of each book. The presence of characters like Petyr Baelish and Varys in the largest clique, who aren't even in the top 25 central characters based on our earlier analysis shows that the key-players and centrality measures aren't a monolith. It indicates the presence of hidden players, characters that drive the plot while staying out of the spotlight. Both Varys and Petyr Baelish 'Littlefinger' have spies all over the continent and are always on top of the information chain, they may not directly hold much power but they're privy to information and their frequent interaction with the central figures end up shaping the event that occur in books.

This again mimics the real world, where information or knowledge is analogous to power. As Sora Park states in his paper 'Digital Capital - Information is Power' (2017), "The core element that drives the society is information. Information is the key to how society adds value and redistributes power. In a connected world, information gains power through retention and distribution." She further states, "This new way of existing and sharing creates gaps between those who can use information as a resource and those who cannot." [13]

9. Future Research and study

We had to limit our study due to time constraints, but we've planned to dive deeper and expand our research to analyze the following concepts, when we get the time.

- Visualizing the "Small World Effect" in our network, since we believe our network is a good example to illustrate this effect, with the wide range of characters and how they converge together towards a single coordinate in their power struggle.

- Analyzing "Embeddedness Theory '' and "Homophily concept" in the network of 'A Song of Ice and Fire.' There seems to be a lot of potential to visualize this effect since we've observed a lot of small and large communities forming during our analysis which adheres to these principles.

- Finally, we want to compare our network of 'A Song of Ice and Fire' with other renowned novels such as J.R.R. Tolkien's 'The Lord of The Rings' and J.K. Rowling's 'Harry Potter', to test out claims and to observe how having multiple fractal protagonists and heroes affect the course of the story when compared to a network centered around a single character.

10. Conclusion:

To understand the character arc and determine the various fractal protagonists, looking at the 2 CCDs (Figure 7) we observe some interesting patterns in how the centralities change over time.

Jon and Daenerys have both gone through a "hero's journey." They begin below the diagonal and advance steadily upwards and to the right from their adversity point. Cersei and Jamie's journeys have been more tragic: a meteoric ascent in Book 1, followed by an equally precipitous collapse from Book 5. Sansa's tale, on the other hand, is about her using her Status to grow her Importance.

When we observe the centrality measures and how a few characters journey through the books, we can make an informed observation as the protagonists of the story. Tyrion, although resembles a hero, fits the image of a protagonist more appropriately. Both Arya and Sansa also take the journey of the protagonist in their own rights as they suffer adversaries and are faced with tough choices throughout the book which is evident through their CCDs.

We can follow other character's positions over time to see what kind of journey they are on.

The latter half of our report focuses on the ties between the multitude of characters, and how their interactions resemble real world networks. We saw that the weak and strong ties in our network behave just like in the real world, the weak ties hold the integrity of the structure, and the strong ones maintain the local communities. The nature of ties helped us understand how a fragile balance is achieved in this strained network. "An enemy of my enemy is my friend", this is the stance most of the factions in the series take and progress by establishing strategic alliances.

Lastly, we observed how few characters hold information as a bargaining chip and help progress the plots all the while staying away from the spotlight. This is something we see happen a bit too common in the real world as well.

We believe that the well intricate story, the hero's journey of our fractal protagonists that captivates the reader's hearts, and the sparsely yet effectively sprinkled fantasy elements all tied up in a perfect blend, all the while having the nature of real-world network might be the key factor behind the series' massive success. As stated in our future research, soon we're planning to do another study comparing our network with other renowned works of fiction to prove our theory.

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