**First draft**

Huge networks of different purposes exist all around us, starting from social media networks to product co-purchase networks, from peer-to-peer networks to email networks. In this research, our hypothesis is that network structures are affected by the behavior of the nodes of the networks to a certain extent. It is our assumption that networks of the same category (for example different p2p networks) will have a similar structure within an error interval, while networks of different categories (for example one social media network and one p2p network) will be distinctly different in terms of network structure. We also propose that networks in a broader sense, such as communication networks, have hierarchies within their structures, where we can observe the structures changing in a certain pattern or trend. Our intention is to establish whether network structures are behavior based or randomly structured with no particular order. Hence, we conduct visual analysis of multiple real-life networks to observe the network structures in terms of centrality values. Our datasets were constructed by calculating 13 centralities for each node of our 18 networks. As our datasets are high-dimensional and non-linear, we applied the non-linear dimensionality reduction technique t-SNE, on which we applied spherical k-means and Gaussian mixture models (GMM) separately to obtain clustering. We also observed the hierarchical relationship between networks such as email, collaboration and citation. Finally, to understand how each of the centrality values affects the different types of networks, and which play more significant roles in defining their structures, we conducted an ablation study consisting of 8 models and the original 13-dimensional model. To verify the results of our ablation study, we applied Principle Component Analysis (PCA) on the datasets and focused on the loading plots obtained. We also applied Sammons mapping for further clarification and better understanding of the results.

**Second draft**

As the internet becomes more accessible all around the world, the different networks around the internet such as p2p, email etc. are also growing in size. Therefore, analyzing large networks for the purpose of knowledge discovery to be able to learn different governing patterns that dictate these large networks is quite necessary. With that goal in mind, in this study we studied a plethora of large networks that varied from more active human driven networks such as email communications, social networks to more passive networks such as p2p. We employed unsupervised learning techniques to visualize the underlying structures of these networks by representing them as 2 dimensional manifolds. We hypothesize that network structures are more affected by the behavior of the nodes/users of the networks instead of having a predefined shape. It is our assumption that same type networks (p2p network) will have a similar structure within an error interval, while networks of different types (social network vs p2p network) will be distinctly different in terms of network structure. Based on our findings, we also propose a hierarchical categorization of networks in a broader sense, such as communication networks, have hierarchies within their structures, where we can observe the structures changing in a certain pattern or trend. This kind of behavior based unsupervised knowledge discovery methods can help us find further meaningful patterns in large random human networks which than can be used to identify and generalize different networks such as migration networks, criminal networks or terrorist networks.

**Keywords:** Unsupervised Learning, Network Visualization, Knowledge Discovery