COM 530500 **Network Science Final Project**

DUE: Thursday, January 20, 2022

No late homework will be accepted.

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Problem 1. (40%) Consider the **ego-Facebook** [1] dataset. A node in this dataset represents a user on Facebook, and an edge between two nodes represents the relationship between two users.

(a) (10%) List some statistical information of this dataset, such as the number of nodes, number of edges, average clustering coefficient, diameter, average degree, maximum degree, etc.

(b) (10%) Visualize the dataset by plotting it.

(c) (10%) Plot the degree distribution with log-log scale.

(d) (10%) List the top 10 nodes ranked by the following centrality measures.

- Degree centrality
- Katz centrality
- Eigenvector centrality
- Betweenness centrality
- Closeness centrality

Solution: Type your answer here. ◇

Problem 2. (60%+bonus 10%) In this problem, we want to investigate the disease propagation by the independent cascade (IC) model in **ego-Facebook** [1] dataset. Assume the propagation probability is ϕ, and the set of seeds nodes S are randomly selected. Collect the set of infected nodes within the distance D of the seed nodes, and calculate the prevalence rate r_1 (which is defined by the ratio of the number of infected nodes to the total number of nodes). Set $\phi = 0.1, |S| = 5$, and D the diameter of the graph.

(a) (40%) Simulate the disease propagation by IC model after removing the top 0%, 10%, 20%, ..., 50% of nodes from the following centrality measures respectively, and calculate the corresponding prevalence rate r_1. Please plot the curves of r_1 vs. the percentage of nodes removed. (*Note: Please run the simulation 100 times and average the results.*)

- Degree centrality
- Katz centrality
- Eigenvector centrality

- Betweenness centrality
- Closeness centrality

(b) (bonus 10%) Could you find a centrality measure that achieves a better performance?

(c) (20%) Write a report to compare and discuss the results of different centrality measures.

Solution: Type your answer here. ◇

References

[1] J. Leskovec and J. J. Mcauley, "Learning to discover social circles in ego networks," in *Advances in neural information processing systems*, 2012, pp. 539–547.