Networks Theory

Project 1

Objective

The student will explain the basic concepts of networks theory.

Instructions

1. Read completely this project assignment.
2. Choose a **social network dataset** you are personally interested in. Here are some pages where you can find interesting network datasets[1]:
    a. Network Datasets used in Network Science (Barabasi, 2018): http://networksciencebook.com/translations/en/resources/data.html
    b. Pajek Datasets: http://vlado.fmf.uni-lj.si/pub/networks/data/
    c. Network Data Repository from the University of California: http://networkdata.ics.uci.edu/index.html
    d. Standford Large Network Dataset Collection: http://snap.stanford.edu/data/
    e. Network Data (Mark Newman): http://www-personal.umich.edu/~mejn/netdata/
    f. Konect, Networks: http://konect.uni-koblenz.de/networks/
    g. Network Data from Arizona State University: http://socialcomputing.asu.edu/pages/datasets
    h. 70 Online Datasets: https://www.technologyreview.com/s/421886/the-70-online-databases-that-define-our-planet/
    Do not choose small networks, e. g. Karate Club Network.
3. Complete the following analysis:
    a. **Introduction.** Give a description of the chosen network, its importance and possible applications of the analysis. Indicate if the dataset was used in a paper and describe the general results. How can the network can be classified (Bipartite, Directed, Unidirected, Planar or any other reviewed in class) and why? Make a visualization of the network. Include any observation that you consider important based on the *T1. Graph Theory.*
    b. **Network Characteristics.** Measure: Size of the Network, Number of Links, Average Path Length, Clustering Coefficient. Additionally, include any

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[1] Social Network Analysis. Datasets: https://sites.google.com/a/umn.edu/social-network-analysis/resources/dataset

Distance Metrics you consider important: Average Distance, Diameter, Eccentricity, Radius, Periphery, Center based on the *T1. Graph Theory.*

c. **Centrality Measure.** Analyze the Network based on the Centrality Measures: Degree Centrality, Eigenvector Centrality, Katz Centrality, Page Rank, Betweenness Centrality, Closeness Centrality, Group Centrality. You don't need to calculate all of them, you need to choose the appropriate centrality measure for the chosen network and discuss about it. Include any observation that you consider important based on the *T2. Centrality Measures.*

d. **Degree Distribution and Models of Networks.** Make a plot of the degree distribution of the chosen network. Identify the most appropriate model for the chosen network:

   i. If the network can be model a Random Network, obtain the corresponding parameters (p). Make a comparison of with the corresponding expected values.

   ii. If the network is a Scale-Free Network, obtain its degree exponent γ. Include any observation that you consider important based on the *T3. Models of Networks.*

e. **Community Detection.** Apply a Community Analysis to the chosen network. Give a visualization of the communities. Include any observation that you consider important based on the *T4. Community Detection.*

f. **Conclusion.** Give a conclusion based on the analysis.

g. **Abstract.** Create an abstract based the analysis.

It is not sufficient to simply measure things, you need to discuss the insights you gained, always asking[2]:

- **What was your expectation?**
- **How do the results compare to your expectations?**
- **What did you learn from each quantity?**

Homework Submission
Submit your Homework as a unique PDF document. The document must include all sections:

- Abstract.
- Introduction.
- Network Characteristics.
- Centrality Measures.
- Models of Networks.
- Community Detection.

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[2] Network Science (Barabasi, 2018).

- Conclusion.
- References

Deadline

- Jun 21st, 2019 at 23:59 hrs.

Recommended Books

- Mark Newman (2018) Networks. The empirical study of Networks. UK: Oxford University Press.
- Reza Zafarani, Mohammad Ali Abbasi, Huan Liu (2014) Social Media Mining: An Introduction. UK.
- Barabási, Albert-László (2016) Network Science. USA.
- Menczer, Fortunato and Davis (2020) A First Course in Network Science.

Grading Scheme

Rubric

Results	Excellent	Good	Fair	Needs Improvement
Abstract	10	7.5	5	2.5
Introducción	15	11.25	7.5	3.75
Network Characteristics	15	11.25	7.5	3.75
Centrality Measures	15	11.25	7.5	3.75
Degree Distribution and Models of Networks	15	11.25	7.5	3.75
Community Detection	15	11.25	7.5	3.75
Conclusions	10	7.5	5	2.5
References	5	3.75	2.5	1.25