Contents

Syllabus

Network Science Module

Lecture 1

- Overview of the course; introduction to networks

[20/02/2024] [**slides**]

reading material: Sec. 0.1-0.6 (Menczer, Fortunato, and Davis 2020) Sec. 1.1, 1.2 (Easley and Kleinberg 2010)

Lecture 2

- Graph theory: basic definitions; density and sparsity; subnetworks; degree; directed networks; weighted networks; multilayer and temporal networks; network representations; drawing networks; paths and distances; connectedness and components; small world phenomena, clustering coefficient.

[23/02/2024] [**slides**]

reading material: Chapter 1-2 (Menczer, Fortunato, and Davis 2020) Sec. 2.1, 2.2, 2.3 (Easley and Kleinberg 2010)

Lecture 3

- Strong and weak ties; triadic closure; the strength of weak ties; tie strength and network structure in large-scale data; tie strength, social Media, and passive Engagement; closure, structural holes, and social capital.

[27/02/2024] [**slides**]

reading material: Sec. 3.1-3.5 (Easley and Kleinberg 2010)

Lecture 4

- Homophily; assortativity; mechanisms underlying homophily: selection and social influence; affiliation; tracking link formation in online data; a spatial model of segregation;

[01/03/2024] [**slides**]

reading material: Sec. 2.1 (Menczer, Fortunato, and Davis 2020) Sec. 4.1-4.5 (Easley and Kleinberg 2010)

Lecture 5

- Exercises; basics on network analysis with Python; introduction to NetworkX

[04/03/2024] [**slides**] [**slides on NetworkX**]

Lecture 6

- Hubs; centralities; degree centrality; eigenvector centrality; closeness centrality; betweenness centrality; friendship paradox; robustness; core decomposition

[08/03/2024] [**slides**]

reading material: Chapter 3 (Menczer, Fortunato, and Davis 2020)

Lecture 7

- More on centralities; exercises

[12/03/2024] [**slides**]

Lecture 8-9

- Network models; random network; small-world networks; the configuration model; preferential attachment

[15-19/03/2024] [**slides**]

reading material: Chapter 5 (Menczer, Fortunato, and Davis 2020)

Lecture 10

- Popularity as a network phenomenon; power laws; rich-get-richer models; unpredictability of rich-get-richer effects; the long tail

[22/03/2024] [**slides**]

reading material: Chapter 18 (18.1 - 18.7) (Easley and Kleinberg 2010)

Lecture 11

- Introduction to communities; community variables; community definitions; partitions; network partitioning algorithms; data clustering; dendrograms

[**26/03/2024**] [**slides**]

reading material: Chapter 6 (Menczer, Fortunato, and Davis 2020)

Lecture 12

- Girvan-Newman; modularity; modularity optimization; Newman's greedy algorithm; Louvain's algorithm; modularity's limits; label propagation; stochastic block modeling

[**05/04/2024**] [**slides**]

reading material: Chapter 6 (Menczer, Fortunato, and Davis 2020)

Lecture 13

- method evaluation; artificial benchmarks; real benchmarks; partition similarity; exercises

[**09/04/2024**] [**slides**]

reading material: Chapter 6 (Menczer, Fortunato, and Davis 2020)

References

Easley, D., and J. Kleinberg. 2010. *Networks, Crowds, and Markets: Reasoning about a Highly Connected World.* Cambridge University Press. https://books.google.it/books?id=atfCl2agdi8C.

Menczer, F., S. Fortunato, and C. A. Davis. 2020. *A First Course in Network Science.* Cambridge University Press. https://books.google.it/books?id=q1abxgEACAAJ.