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## 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](#))

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#### 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](#))

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#### 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](#))

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## 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](#))

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## Lecture 5

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

[04/03/2024] [[slides](#)] [[slides on NetworkX](#)]

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## 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](#))

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## Lecture 7

- More on centralities; exercises

[12/03/2024] [[slides](#)]

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## 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](#))

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## 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](#))

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## 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](#))

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## 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](#))

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## 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>.