NETWORK SCIENCE

CS 48002/58002

Spring 2022

Instructor: Onur Varol, PhD	**Email**: onur.varol@sabanciuniv.edu
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Time and location - Thursdays 15:40 – 17:30, University Center G030 - Fridays 17:40 – 18:30, **Online on Zoom**	
Office hours: After class or by appointment	**Website**: SUCourse platform will be used to share course material and information.

Main references: This is a restricted list of various interesting and useful books that will be touched during the course. You may need to consult them occasionally.

- Menczer, Filippo, Santo Fortunato, and Clayton A. Davis. A First Course in Network Science. Cambridge University Press, 2020.
- Barabasi, Albert-Laszlo. Network science. Cambridge University Press, 2016. Online materials available here
- Newman, Mark. Networks. Oxford university press, 2018.

Course summary: Network science is a framework to analyze the complex systems of technological, biological, and cultural networks. This course will present the fundamentals of networks, mathematical toolsets to study and characterize networked data, and develop skills for network thinking. Special network topics such as network models, communities, and dynamics on networks will be presented.

Objectives and learning outcomes: This course is primarily designed for graduate students and undergraduates with a strong interest in data analytics to use network theory and network science applications in computational social science problems. Students are expected to create a novel project on network science concepts and deliver a paper as their project report. A student who successfully fulfills the course requirements will be able to demonstrate:

- To identify, construct, and analyze networks using appropriate network models and algorithms.
- To learn mathematical concepts to characterize networks and analytically study properties of data.
- To obtain hands-on experience with network analysis and visualization tools.
- To learn modeling dynamical processes on the networks such as information diffusion and epidemic spreading
- To learn applications of network on various field and interdisciplinary research by reading supplementary reading materials.

Prerequisites: An undergraduate level understanding of probability, statistics, and linear algebra is assumed. To be able to deliver homework assignments and class project, programming with Python is required.

Tentative Course Outline:

Week 1		Introductions to networks and network thinking
Week 2		Network properties and small-world networks
Week 3		Power laws and scale-free networks
Week 4	Homework #1 due	Measures for centrality and assortativity
Week 5		Network visualizations and analysis
Week 6		Project proposal presentations
Week 7		Generative network models
Week 8		Community detection
Week 9	Homework #2 due	Percolation and robustness
Week 10		Spreading phenomena - Information diffusion
Week 11		Spreading phenomena - Epidemic models
Week 12	Homework #3 due	Special topics: Temporal networks
Week 13		Special topics: Representation learning on graphs
Week 14		Final project presentations

Grading Policy: These percentages are tentative and subject to change.

- **Homework** (3x15=45%): There will be 3 assignments on network analysis with analytical part and programming practices using Python and tools like Gephi for data visualization. Each student will work on assignments individually. Code for assignment, result files, and short report will be submitted.
- **In-class quizzes** (2x5=10%): There will be 5 short quizzes on subjects covered in the class.
- **Project** (45%): A group of students will propose a topic and dataset to carry out network analysis using techniques covered in the class. They will have two presentations for the project proposal (15%) and final report (25%). At the end of the project, project results will be submitted as a paper, and the code and data used to generate project results. Students will also review papers (5%) of other teams for our mini conference.

Class Policies and advice:

- Regular attendance is essential and class participation is expected in paper discussions.
- Late assignments. There will be 10% late penalty for up to 3 days and 20% penalty for assignments submitted in the next 10 days.
- Students have the responsibility of backing up all their data and code. At the end of the semester, they are expected to prepare public release of their code and data with a proper documentation.

Academic honesty: All students must follow the university guidelines of academic integrity. https://www.sabanciuniv.edu/en/academic-integrity-statement