Network Science

Spring 2021

Instructor:	Onur Varol, PhD	**Time:**	We, 14:40 – 16:20, Th, 1540 – 16:30
Email:	onur.varol@sabanciuniv.edu	**Place:**	Online on Zoom
Website:	http://onurvarol.com/teaching/SP21_NetSci		

Office Hours: After class, or by appointment.

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

- Menczer, Filippo, Santo Fortunato, and Clayton A. Davis. *A First Course in Network Science*. Cambridge University Press, 2020.
- Barabási, Albert-László. *Network science*. Cambridge university press, 2016.
  Online material for the book
- 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 analysis 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: Small worlds
Week 3: Hubs
Week 4: Network measures and metrics
Week 5: Network models I: Random networks
Week 6: Network models II: Preferential attachment
Week 7: Project proposal presentations
Week 8: Network analysis and visualization tools
Week 9: Percolation theory and network robustness
Week 10: Communities
Week 11: Dynamics on networks I: Opinion dynamics and information dissemination
Week 12: Dynamics on networks II: Epidemic spreading
Week 13: Temporal networks
Week 14: Final project presentations

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

Homeworks (4x10=40%): There will be four programming assignment on network analysis using Python and tools like Gephi for data visualization. Each student will work on assigments individually. Code for assignment, result files, and short report will be submitted.
Project (50%): 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 and report. 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 by others for our mini conference.
Attendance (10%)

Important Dates:

Homework 1	Week 3
Homework 2	Week 5
Project proposals	Week 7
Homework 3	Week 9
Homework 4	Week 11
Project presentations	Week 13&14

Class Policies and advices:

- Regular attendance is essential and expected.
- 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