2020 NETWORKS ONLINE COURSE SYLLABUS

COURSE OVERVIEW

Network Science and Engineering is a new discipline that investigates the and function of large complex networks, from social to technological networks. Applications of complex networks can be found in modeling of epidemics in social graphs to the formation of opinions in online networks. In this course, we will provide students with the tools to model and analyze the behavior of complex processes taking place over complex networks. As part of this program, students will learn some of the basic mathematical and computational tools, methods, and algorithms to deal with massive networks, as well as practical applications of this new science.

The typical day will be divided into live lectures and two different office hours (to accommodate various time zones). As a companion of each lecture, the student will have to work on practice exercises aiming to solidify the content covered in class. Also, as an integral part of this course, students will work on a project involving the design of effective strategies to contain the spread of a disease in a contact social network.

The course will also have some guest speakers who will expose you to different aspects of network science and engineering.

Here are more details about each component, as well as requirements for the course

LIVE LECTURE

New content will be delivered via a live lecture every day

Monday – Friday: 9:00AM – 12:00 PM EDT (two lectures with a break in between)

All lectures will be done via Zoom (or some equivalent software) and the recordings will be posted immediately after the lecture.

TOPICS

Mathematics of networks

☐ **Networks and their representation**

☐ **The adjacency matrix**

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☐ Weighted and directed networks

☐ Hypergraphs. Bipartite networks, trees and planar networks

☐ Degree, paths, components

☐ Independent paths, connectivity, and cut sets

Measures and metrics

☐ Degree centrality, eigenvector centrality, katz centrality, PageRank

☐ Hubs and authorities, closeness centrality, betweenness centrality

☐ Transitivity, reciprocity, similarity, assortative Mixing

The large-scale structure of networks

☐ Components

☐ Shortest paths and the small-world effect

☐ Degree distributions. Power laws and scale-free networks

☐ Distributions of other centrality measures

Random graphs

☐ Random graphs

☐ Random graphs with general degree distributions

☐ Models of network formation

OFFICE HOURS

8:00 AM – 9:00 AM EDT (Asian/ eastern hemisphere countries)

12:00 PM – 1:00 PM EDT (N. & S. American/ western hemisphere countries)

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please note that you are welcome to attend whichever session works best for your personal schedule, regardless of your location

COURSE HARDWARE & SOFTWARE REQUIREMENTS

Students are required to have their own computer or laptop with access to a microphone and a webcam (this is built-in on most modern machines). You must also have strong/ reliable internet service. Any course-specific software will be provided free of charge and installation instructions will be given prior to the start of the course (or on the first day of class).