Network Analytics

3 credits

Spring 2020

Prof. Negar Kiyavash
ODY 1 02 (Odyssea), +41 21 693 02 59
Negar.kiyavash@epfl.ch
https://people.epfl.ch/negar.kiyavash?lang=en

Teaching Assistant
Jalal Etesami
ODY 3 15 (Odyssea), +41 21 693 14 09
seyed.etesami@epfl.ch

Course website: https://edu.epfl.ch/coursebook/en/network-analytics-MGT-416
Course moodle: https://moodle.epfl.ch/course/view.php?id=15501

Office hours:

To be determined

COURSE OVERVIEW

Students will learn the core concepts and techniques of network analysis with emphasis on causal inference. Theory and application will be balanced, with students working directly with network data throughout the course.

DIDACTIC APPROACH AND CLASS ATTENDANCE

The course will be offered lecture-style by the instructor on white (or blackboard) for two hours each week. TA or the Professor will also solve problems for the class during the last hour of the class. Attendance is not enforced but highly encouraged.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Identify situations in which a problem/data can be thought of as a network.
- Analyze data appropriately using a variety of network analytic techniques.
- Interpret the results of applying network analytics.
- Propose action based on sound interpretation of network analytics.

MATERIALS

Course notes.

FORM OF EXAMINATION & GRADING

- Regular individual assignments: 30%
- Mid-term exam: 30%
- Final group project: 40%

DETAILED COURSE OUTLINE

This course will cover a broad range of approaches pertaining to network causal analysis for analyzing real world network data ranging from financial to social and biological networks. The assignments, mid-term and final project will require students to have a theoretical understanding of the concepts as well as to be able to analyze and interpret real network data.
Specific topics include, but are not limited to, the following:

- Introduction: What is causal inference?
- Review of Useful Probability concepts
    - Random variable, predictors, divergences
- Introduction to Applications
    - Computational neuroscience
    - Financial markets
    - Social networks
- Pearl Causality
    - Causal Bayesian Networks (CBNs)
    - Learning CBNS: Faithfulness and identifiably
    - Algorithms
- Potential Outcome Model
    - Counterfactuals and identification problems
    - Graphical causal models
- Randomized Experiments
    - Identification of causes in randomized experiments
    - Effect modification
- Causality in Times Series

- Granger causality
- More general linear predictors
- Beyond linear models and Granger causality
- Directed information graphs
- Efficient algorithms

- Concrete Applications
  - Computational neuroscience
  - Financial markets
  - Social networks