Networks: Games, Contagion, and Control
IEOR 8100
Spring 2018
Department of Industrial Engineering and Operations Research, Columbia University,
Time: TBD, TBD
Where: 1127 Seeley W. Mudd Building

Instructor: Dr. Agostino Capponi, Office Hours: Monday, Mudd 535G, TBD
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Teaching Assistant: TBD, Email: TBD
Office Hours: TBD

Email Communication with Instructor and Teaching Assistants: When emailing the instructor or TAs, please make the subject of the email the following – "IEOR 8100, *YOUR LAST NAME*, *ISSUE*". This will be beneficial for tracking email communications. Please include the issue in the subject.
Additionally, your email should follow good business letter writing principles. You can find more about business letter writing from the Columbia Writing Center at http://www.college.columbia.edu/core/uwp/writing-center.
The email should have a salutation, appropriate grammar, correct spelling and capitalization, a clear description of the question or issue, and your full name.

Prerequisite: Mathematical maturity is expected. Exposure to game theory and optimization is desirable, at the level of IEOR E4407: Game Theoretic Models of Operations, or IEORE6613: Optimization I.
Knowledge of some programming language, such as Mathematica, Matlab or R will be useful.

Teaching facilities: I will use the Microsoft Surface Pro to explain to the class.

Textbook: Lecture notes will be provided and post on the course website. Those notes contain all of the information and material you need for the course. When using external material and research papers, I will make them available to the class. Two good textbook resources are:

- *Networks, Crowds, and Markets: Reasoning About a Highly Connected World* (*Cambridge University Press*), by David Easley and John Kleinberg.
- *Social and Economic Networks (Princeton University Press),* by Mathew Jackson

Lectures: There will be regular lectures covering the class material, alternated with guest lectures featuring prominent academics working in the area of networks as well as practitioners employing network modeling in their daily jobs. The Nobel Laureate, Prof. Joseph Stiglitz has kindly agreed to deliver one or two lectures. Senior researchers from the US Department of Treasury's Office of Financial Research and the Federal Reserve, will also lecture on models of financial networks and market liquidity.

Homework Assignments: There will be homework assignments that will test you on class material. Students are encouraged to collaborate with each other, but each student must complete and submit his/her homework individually. Copying homework solutions from other students will not be tolerated and considered as cheating. Make sure all pages of the assignments are stapled together. Late assignments will not be accepted. Homework solutions will be usually posted the day after the homework is due.

Exams: There will be no exam. Students will be asked to select a project based on the material taught in the class. I will make available a list of tentative projects. Students are free to propose their own projects, but these are all subject to approval of the instructor.

Weights
Homework: 40%
Final Project: 60%

Attendance Policy: Attendance of each lecture is mandatory.

Grading: The final grade will be based on the total number of points earned during the semester. If you earn 89% of the available (weighted points) you are guaranteed at least an A-, 79% guarantees at least a B-, 69% guarantees at least a C-, etc… However, the final scores might be adjusted at the discretion of the course instructor.

Course Description:
Networks are ubiquitous in our modern society. Economic and social networks have been used extensively to model a variety of situations, in which individual decision-makers are affected by the choices of their peers in the network. For instance, the choices of individuals regarding which products to buy or whom to vote for are usually influenced by their friends and colleagues. The decision of an individual or a firm on whether or not to adopt a new technology (new software, messaging service, etc.) depends on who among their social or professional network are adopting that technology as well. Banks in financial networks may coordinate private or subsidized bailouts and rescue insolvent banks so as to stop financial contagion. The decision of an individual to become a criminal depends heavily on the behavior of others in his/her social network: more connections to criminals yield a higher profitability in the crime business and thus a higher chance of engaging in criminal activities. This course will introduce the main mathematical models for the study of these networks. It will discuss game theoretical and dynamic optimization techniques, which can be used to analyze a wide variety of these networks, including their resilience to shocks, the amplification effects resulting from their topological structure, and how the strategic behavior of network agents shapes the performance of the network.