

# ELE/COS 381 – Networks: Friends, Money, and Bytes

Fall Semester, 2017

## Instructor

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Office Hours: Monday and Wednesday, 1:30-2:50pm in B313, or by appointment.

## Teaching Assistants

Akshay Krishna, PhD Student  
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Ji Qi, PhD Student  
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Office Hours: Friday, 2:00-5:00pm in C319G

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Alex Tarr, PhD Student  
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Office Hours: Thursday, 1:00-3:00pm in EQuad F310 J

## Course Information

Meeting times: Monday and Wednesday, 3:00-4:20 pm  
Prerequisites: Linear algebra, single-variable calculus, and MATLAB/Python coding  
Website: [www.powerofnetworks.org](http://www.powerofnetworks.org)

## Course Description

This course is oriented around the social (“friends”), economic (“money”), and technical (“bytes”) networks that we encounter in our daily lives. We investigate questions such as: Why is WiFi faster at home than at a hotspot? How does Netflix recommend movies for me to watch? Why doesn’t the Internet collapse under congestion? How does Google rank webpages? Why does each Gigabyte of mobile data cost \$15? To formulate and answer these questions, we use

techniques from matrix algebra, calculus, graph theory, optimization, and machine learning, and in doing so we introduce the fundamental concepts of the networking industry.

### Required Textbooks

- *Networked Life: 20 Questions and Answers*, By Chiang
- *The Power of Networks: Six Principles that Connect our Lives*, By Brinton and Chiang

### Course Topics and Tentative Schedule

The course will be divided into six units, each consisting of roughly three lectures. The following is a tentative schedule of topics and due dates.

L	Date	Unit	Topics Covered	TAs	Due	Reading
1	9/13	<b>Introduction and Overview</b>		All		20Q Preface PoN Preface
2	9/18	<b>Sharing in Networks</b>	Cellular Power Control	AK, AT		20Q Ch. 1 PoN Ch. 1
3	9/20		WiFi Random Access	JQ, JS		20Q Ch. 18 PoN Ch. 2
4	9/25		Mobile Data Pricing	AK, AT		20Q Ch. 11 PoN Ch. 3
5	9/27	<b>Ranking in Networks</b>	Ad Space Auctions	JQ, JS	<b>HW #1</b>	20Q Ch. 2 PoN Ch. 4
6	10/2		Search Engines	AT, JS		20Q Ch. 3 PoN Ch. 5
7	10/4		Voting Systems	JQ, JS		20Q Ch. 6
8	10/9	<b>Exam #1</b>		AK, AT	<b>HW #2</b>	
9	10/11	<b>Data in Networks</b>	Combining Product Ratings	JQ, JS	<b>Project Topics</b>	20Q Ch. 5 PoN Ch. 6
10	10/16		Recommendation Systems	AK, AT		20Q Ch. 4 PoN Ch. 7

11	10/18		Social Learning Networks	JQ, JS		Lecture packet PoN Ch. 8
12	10/23	<b>Reaching through Networks</b>	Information Cascades	AK, AT	<b>HW #3</b>	20Q Ch. 7 PoN Ch. 9
13	10/25		Social Influence Models	JQ, JS		20Q Ch. 8 PoN Ch. 10
Fall Break No class 10/30, 11/1				Fall Break No class 10/30, 11/1		
14	11/6		Small World Phenomenon	AK, AT		20Q Ch. 9 PoN Ch. 14
15	11/8	<b>Exam #2</b>		JQ, JS	<b>HW #4</b>	
16	11/13	<b>Networks of Networks</b>	Packet Routing	AK, AT		20Q Ch. 13 PoN Ch. 11&12
17	11/15		Congestion Control	JQ, JS		20Q Ch. 14 PoN Ch. 13
18	11/20		Video Streaming	AT, JS	<b>Interim Project Report</b>	20Q Ch. 17
Thanksgiving No class 11/22			Thanksgiving No class 11/22			
19	11/27	<b>Scaling up Networks</b>	Scale-Free Networks	AK, AT	<b>HW #5</b>	20Q Ch. 10
20	11/29		Peer-to-Peer Networks	JQ, JS		20Q Ch. 15
21	12/4		Cloud Datacenter Networks	AK, AT		20Q Ch. 16
20	12/6	<b>Exam #3</b>		JQ, JS	<b>HW #6</b>	

21	12/11	<b>Project Presentations</b>	AK, AT		
22	12/13		JQ, JS		
23	TBD	<b>Final Exam</b>		<b>Final Project Report</b>	

### **Evaluation**

This class will have five types of evaluations:

1. *Exams (30%)*

There will be three exams (aside from the final exam) throughout the semester, administered in class. Each exam will cover two of the six units.

2. *Homeworks (20%)*

There will be six homeworks, one per unit due after the last lecture in the unit. These will consist of a few problems that are generally more challenging than the examples covered in class, requiring a combination of mathematical formulations and computer simulations.

Homework must be turned in to the student's TA before the start of class on the date listed.

3. *Final (20%)*

A comprehensive final examination will be given at the end of the semester. The questions on the final will be of similar difficulty those in the other exams.

4. *Project (20%)*

Throughout the semester, students will work in groups to complete a term project. Each group will be given the freedom to decide who they will work with and the topic of their project, but the project must be approved by the instructor and TAs and must build upon one or more of the lectures. Groups should typically consist of 2-3 students, with possible exceptions granted on a case-by-case basis. The scope and length of the final report should be proportional to the group size, while the quality is expected to be independent of it.

The project will have three deliverables throughout the semester: an interim report (due around Thanksgiving), a presentation (in the last two lectures), and a final report (due around the final exam).

5. *Attentiveness and Blog (10%)*

Students are required to attend and participate in lectures. An attendance sheet will be passed out each lecture. As part of participation, students will be required to blog weekly on the course website ([www.powerofnetworks.org](http://www.powerofnetworks.org)) about a relevant networking topic.