ORF387: Networks

Fall 2022

Instructor:	Liza (Elizaveta) Rebrova
E-mail:	elre@princeton.edu
Webpage:	https://erebrova.github.io/ORF387.html
Class:	Tue and Thu, 11:00 am – 12:20 pm Friend 006
Office hours:	Tue 9:15-10:45 am Sherrerd 123

Course description

This course showcases how networks are widespread in society, technology, and nature, via a mix of theory and applications. It demonstrates the importance of understanding network effects when making decisions in an increasingly connected world. Topics include an introduction to graph theory, game theory, social networks, information networks, strategic interactions on networks, network models, network dynamics, information diffusion, and more.

Textbook: *David Easley and Jon Kleinberg, Networks, Crowds, and Markets* (available online, check class website for a link)

AIs: Jackie Lok, Aaradhya Pandey, Shambhavi Suryanarayanan, Rajiv Sambharya

- **Rajiv:**

    - **email** rajivs@princeton.edu
    - **office hours** 9-10:30 @TBA on Monday
    - **please CC' Rajiv to any class email**

- **Jackie:**

    - **email** jackie.lok@princeton.edu
    - **office hours** 3-4:30 @ Sherrerd 107 Wednesday
    - **precept** 7:30-8:20PM Monday

- **Shambhavi:**

    - **email** ss3472@princeton.edu
    - **office hours** 4-5:30 @ TBA Thursday

- **precept** 7:30-8:20PM Monday

- **Aaradhya:**

  - **email** ap9898@princeton.edu
  - **office hours** 10:30-noon @Sherrerd 107 Friday
  - **precept** 3:30-4:20PM Monday

For precept room assignments see https://registrar.princeton.edu/course-offerings/course-details?courseid=015450&term=1232

Grading

Your grade consists of four parts:

- **Homeworks:** 25% of the grade; 6 problem sets, due **9pm EST** on the days see in the schedule below (no extensions, one lowest score is dropped)

- **Project:** 25% of the grade, see *project description* file

- **Midterm:** 20% of the grade, take home on October 13th, no class on that day

- **Final exam:** 30% of the grade, take home

Any grading complaints and requests for re-grading must be submitted to the instructor or AI within one week of receiving your score. Grading complaints not initiated within this period of time will not be considered.

Homework schedule

1. Homework 1: Friday, September 9 - Friday, September 16

2. Homework 2: Tuesday, September 20 - Tuesday, September 27

3. Homework 3: Friday, September 30 - Friday, October 7

4. Homework 4: Friday, October 28 - Friday, November 4

5. Homework 5: Friday, November 11 - Friday, November 18

6. Homework 6: Friday, November 2 - Friday, December 9

Project milestones

1. Project proposal: due **9PM** on Wednesday, October 5

2. Project report: due **9PM** on Wednesday, November 9

3. Final report: due **noon** on Friday, December 16th, Dean's date

Final exam

A several-hour long time window from Friday, December 16 at 1pm until Thursday, December 22 at 9pm.

Homework and collaboration policy

- It is always due 9PM.

- No late homework will be accepted.

- Your lowest homework score will be dropped.

- You are encouraged to attempt solving problems by yourself first. The remaining problems can be discussed with the other students, at the office hours, searched in books and online, **but** in this case (a) you should include the names of your collaborators, books/resources on the first page of the write-up, and (b) do not copy solutions verbatim and always write your individual solution, not the same text as your collaborators have (to achieve that, it is enough to write up the final version of the problem on your own without consulting). You do not have to list office hours your attended, we leave it at your discretion: a good practice is to mention a particular office hour if it helped you significantly with some problem. None of these collaboration disclosures affect your grades! It is good and encouraged to collaborate and use external recourses for the homework.

- Please be considerate of the grader and write solutions neatly. AIs have the right to not grade unreadable solutions.

- All submissions are done on Gradescope.

Exams and collaboration policy

More detailed exam policies will be given in the last class prior to the respective exam. Both exams will be take home, likely timed to last several hours within 24 hour time period (midterm exam) or a week-long time period (final exam). No collaboration is allowed during the whole exam period.

Email policy

- Please use email mostly for emergencies and administrative or personal matters.

- For questions about the material and general interest questions, consider coming to office hours and posting to the course Ed Discussion page rather than emailing. We will refer you to the office hours and Ed for the open-ended email questions that were not previously discussed elsewhere.

- However, it makes sense to email with follow-up questions after the office hour discussion rather then wait. Please address and CC' whoever you initiated the conversation with before.

- **You should include "ORF 387", CC' me and the AIs to your emails**, unless the matter is sensitive and you would like to share it strictly personally.

Honor code

All work in this course must uphold the University's commitment to academic integrity. This includes the Honor Code (for written examinations, tests, and quizzes) and guidelines for the submission of original work on all other assignments.

Participation

This is an in-person class by current University guidelines, which can be reviewed here https://ua.princeton.edu/contents/academic-regulations/academic-year.

Tentative course schedule

Week	Date		Tentative topics
	T, Sep 6	1	Starting graph theory, connectivity, giant component
1	H, Sep 8	2	Strong and weak ties in networks
	T, Sep 13	3	Node centrality, graph partitionings
2	H, Sep 15	4	Other structural properties: friendship paradox, balance in signed networks
	T, Sep 20	5	Starting game theory, strategies
3	H, Sep 22	6	Equilibria, mixed strategies
	T, Sep 27	7	Applications to traffic control: Braess paradox
4	H, Sep 29	8	More on equilibria
	T, Oct 4	9	The stable matching problem
5	H, Oct 6	10	Valuations and optimal assignments, matching markets
	T, Oct 11	11	Review
6	H, Oct 13		**Midterm**
	T, Oct 18		Fall break
7	H, Oct 20		Fall break
	T, Oct 25	12	Ranking algorithms, PageRank
8	H, Oct 27	13	and their convergence analysis
	T, Nov 1	14	Information cascades, analysis with Bayes formula
9	H, Nov 3	15	Networks effects, applications to economics
	T, Nov 8	16	Cascading behavior in networks
10	H, Nov 10	17	Probabilistic graph models
	T, Nov 15	18	Probabilistic graph models, small world networks
11	H, Nov 17	19	Probabilistic graph models
	T, Nov 22		no class Friday schedule
12	H, Nov 24		no class Thanksgiving
	T, Nov 29	20	Epidemics modeling (SIR and SIS models)
13	H, Dec 1	21	Epidemics modeling (SIR and SIS models)
	T, Dec 6	22	Voter models
14	H, Dec 8	23	Review
	T, Dec 17		Final exam period starts
	H, Dec 23		Final exam period ends