

# INFO 4220 NETWORKS II: MARKET DESIGN

## (CS 4852 / ECON 3825 / INFO 6220)

Cornell University – Spring 2024

Prof. Cristobal Cheyre Forestier

Information Science – Gates Hall 210

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### Grading basis:

3 Credits, Letter Grade Only.

### Pre-requisites:

INFO 2040, CS 2800 or equivalent. Knowledge of basic probability and statistics expected.

### Lectures:

Tuesday, Thursday: 9.40 – 10.55AM (28 sessions).

Hollister Hall B14.

### Office Hours:

Prof. Cheyre: Monday 11.00am – 12.00pm, or by appointment. Gates Hall 210.

### Course Staff:

*Graduate TAs:* Cristiana Firullo (cf528), Jose Guridi (jg2222), and Fengyang Lin (fl354).

*Undergraduate TAs:* Allen Chen (ac2324), Tuan Anh Dang (td296), Maximilian Dittgen (myd4), Gaveal Fan (jf675), Claire Jiang (cj337), Helena Jiang (hj398), Lauren Kam (lk543), Sneha Kumar (sk2677), Hannah Lee (hel33), Arnaav Sareen (aks247), Peixuan Tong (pt295), Catherine Wang (cw797).

*Undergraduate Consultants:* Isabella Zhi (yz952).

### Course Description:

Networks II builds on its prerequisite course and continues to examine how each of the computing, economic, sociological and natural worlds are connected and how the structure of these connections affects these worlds. In this course, we will construct mathematical models for and analyze networked settings, allowing us to both make predictions about behavior in such systems, as well as reason about how to design such systems to exhibit some desirable behavior. Throughout, we will draw on real-world examples such as social networks, peer-to-peer filesharing, Internet markets, and crowdsourcing, that illustrate these phenomena.

### Course Objectives:

In the last 10 years we have seen a shift in the makeover of the world's most valuable companies. Most of the most valuable firms are now technology firms that operate as platforms in multi-sided markets. During this period, economists have improved their understanding of how markets operate and have developed a number of techniques to design markets that incentivize certain outcomes. In this course we

will use different modelling techniques to understand how markets operate and how we can design them to influence agents' behavior and produce the outcomes we need. We will also explore what defines network economies, multi-sided markets, and platforms. At the end of the course the students will be able to:

- Define metrics to evaluate the performance of markets and prioritize a set of desired characteristics.
- Evaluate the performance of existing market mechanisms and identify the factors driving the outcomes.
- Design market mechanisms that produce desired outcomes.
- Apply microeconomic theory and game theory to analyze markets and network industries.

### How to Contact Us:

For questions about the course, homework, tests, etc. please use Ed Discussions.

If you have a problem with the grading of a homework or test, please write a re-grade request using the form available in CANVAS. All re-grade requests must be submitted **within one week** of receiving the grade. Please explain your issue clearly and in a professional way.

For requests regarding missed work, or other special accommodation requests, please read below.

If you have a personal issue you would like to discuss (and that you prefer not to share in Ed Discussions), please contact Prof. Cheyre. Please start your subject with [INFO 4220] to maximize your options of a quick response.

### Accommodations for Students with Disabilities

Your access in this course is important to me. I automatically receive all approved accommodations from Student Disability Services (SDS) and will work with the course staff to arrange your approved academic accommodations. If you want to discuss your letter or needs with me, please reach out with enough time for us to make the necessary arrangements. If you need immediate accommodation, please speak with me after class or send an email message to me and/or SDS at [sds\\_cu@cornell.edu](mailto:sds_cu@cornell.edu). If the need arises for additional accommodations during the semester, please contact SDS.

SDS is located on level 5 of Cornell Health, 110 Ho Plaza, 607-254-4545, [sds.cornell.edu](http://sds.cornell.edu)

### Textbook and Other Material:

This course follows the textbook "Market Design: Auctions and Matching" by Guillaume Haeringer. For each lecture, I have listed the relevant chapter from the book. If you are struggling with the material, I strongly suggest you read the relevant chapters and reach out to the course staff in office hours.

Additionally, for each lecture I list a set of recommended readings. These are mostly the journal articles that introduce the concepts we are studying. Some of them contain technically difficult sections. You do not need to understand all the math in the articles to benefit from reading them.

### Use of Online Services and Resources and/or Posting of Course Material

Using online services and resources other than the course's CANVAS sites and Ed Discussion forum is strictly forbidden. Posting, or selling, any material related to the course is not permitted under any circumstance. Such unauthorized behavior constitutes academic misconduct.

## Use of Generative AI

I do not think that generative AI (e.g. ChatGPT or CoPilot) will be of much help to solve the problem sets for this course (I may be wrong). Besides, I recommend you do them yourself and use the opportunity to engage and understand the material, as in exams you will not have access to generative AI. Using generative AI is not banned, but if you use it you must abide by the following rules:

- You must disclose that you used generative AI (or the help of generative AI) for your submission and identify which systems you used.
- You must provide as an appendix the prompts you used, and the output provided by the systems. Please comment on how the prompt helped you, and what you used of it.

I reserve the right to change this policy if during the semester it becomes evident that is not appropriate for the learning objectives of the course, or for any other reason.

Note that I did use generative AI when drafting this policy. I asked MS CoPilot to “create a policy about the use of generative AI for a college course”. I did not like the output, which wasn’t bad but seemed geared towards courses that require a lot of writing and included a lot of unnecessary things in the context of this course. I ended up not using any of it.

## Assignments/Grading:

### Problem Sets (30%)

There will be 5 problem sets throughout the semester. You must turn them in by 11.59PM EST on the due date using GradeScope.

### In Class Prelim 1 (20%)

### In Class Prelim 2 (20%)

### Final exam (30%)

Students enrolled in INFO6220 will have to complete an additional take-home exam activity to fulfill the graduate-level course requirement. The additional take-home exam activity will be worth 35% of the final exam grade, while the common final exam will be worth 65% of the final exam grade.

### Class Participation Bonus (up to +5%)

During the lectures we will be doing several activities, including polls and games. To encourage participation and engagement, I will provide, in every lecture, a bonus to those that participate and obtain a total score in the top 33%. For example: If there are 20 lectures with activities in the semester, each lecture you earn a bonus you will obtain a 0.25% bonus. This means that throughout the semester you can obtain up to a 5% bonus through participation in the activities. The exact number of lectures with activities, and the bonus awarded per day will be adjusted depending on what happens in the semester (i.e. the number of lectures with activities) in order to make it possible to earn up to a 5% bonus through class participation.

## Grading Scale:

Letter grades will be assigned to scores according to the following table. Note the table below indicates the minimum scores necessary for each letter grade. The distribution of grades *may* be adjusted so that

at least 30% of the class obtains a grade in the A range, and 35% obtains a letter in the B range (i.e. the cutoff scores can be lowered so at least 30% of the class gets and A, but the will not be raised if more than 30% of the class is getting an A).

98-100	A+		70-74	C
94-98	A		65-70	C-
90-94	A-		60-65	D+
86-90	B+		55-60	D
82-85	B		50-55	D-
78-82	B-		0-50	F
74-78	C+			

### Re-grade requests

If you have a problem with the grading of a homework or test, please write a re-grade request using the form available in CANVAS. All re-grade requests must be submitted **within 1 week** of receiving the grade. Please explain your issue clearly and in a professional way. No requests will be considered after 1 week.

### Missed work

To account for personal problems that may prevent you from turning in a problem set in time, or affect your performance, I will drop the worst problem set grade and calculate the score considering only the 4 best problem sets.

Additionally, everyone gets 2 slip-days for turning in a problem set up to 1 day late. **You must indicate when turning in your problem set if you are using one of the slip-days.** Note you can only use them in one day increments (i.e. you cannot use 6 hours of one and save the remaining 18 hours for later. You either use a day or not. You can use 2 slip-days in one problem set).

No explanation is needed to drop the worst PS (which I will do automatically for everyone) or to use the slip-days (although you must specify if you are using a slip-day when turning in a late assignment).

With respect to exams, I will follow the recommendations of Cornell's faculty handbook (<https://blogs.cornell.edu/deanoffaculty/files/2015/12/Chapter5-1lrdm5s.pdf>). The handbook suggests that faculty consider special accommodations in four types of situations. However, whether to provide accommodations is ultimately an individual decision of the faculty member. I will handle these situations in the following way:

- Illness, or family/personal emergency: Contact the advising dean for your college. The advising dean will then contact me directly and I will decide based on the case.
- Employment interviews: Provide me with evidence of the interview, and that you cannot change the date.
- Religious observance: I tried to avoid all conflicts. If you have one, please contact me within the first 3 weeks of class.
- Athletics/Extra-curricular activities: Give me your permission slip at least 2 weeks before the exam.

I will consider accommodations for time conflicts with exams only if you have a direct conflict, or more than 2 exams in 24 hours.

### Academic Integrity:

Academic integrity is expected of all students of Cornell University at all times, whether in the presence or absence of members of the faculty. Violations of the code of academic integrity will be prosecuted through the Academic Integrity Hearing Board. For more information, see the following page on academic integrity: <https://cuinfo.cornell.edu/aic.cfm>.

## Calendar:

The calendar is subject to change.

Date	Topic	Additional Notes	Book Chapter	Suggested Readings
23-Jan	Introduction + Markets			
25-Jan	Markets + Game Theory		Appendix A	
30-Jan	Game Theory + Market Design			
1-Feb	Basic Matching Model	PS1 Out (Due 2/7)	Chapter 9	David Gale and Lloyd Shapley (1962), College Admissions and the Stability of Marriage Alvin Roth (2008), What Have We Learned from Market Design?
6-Feb	National Medical Residence Program		Chapter 10	Alvin Roth and Elliott Peranson (1999), The Re-Design of the Matching Market for American Physicians: Some Engineering Aspects of Economic Design
8-Feb	National Medical Residence Program 2			
13-Feb	Assignment Problems		Chapter 11	A. Abdulkadiroğlu & T. Sönmez (1998), "House Allocation with Existing Tenants," Journal of Economic Theory, Vo. 88, pp. 233-260.
15-Feb	Assignment Problems 2	PS2 Out (Due 2/21)		
20-Feb	Prelim 1 Review			
22-Feb	Prelim 1 In Class			
<b>27-Feb</b>	<b>FEBRUARY BREAK</b>			
29-Feb	Probabilistic Assignments		Chapter 12	
5-Mar	School Choice 1		Chapter 13	Atila Abdulkadiroğlu, Parag Pathak and Alvin Roth (2005), The New York City High School Match Atila Abdulkadiroğlu, Parag Pathak, Alvin Roth and Tayfun Sonmez (2005), The Boston Public School Match

7-Mar	School Choice 2		Chapter 14	
12-Mar	Course Allocation		Chapter 15	Tayfun Sönmez and M. Utku Ünver (2010), Course Bidding at Business Schools
14-Mar	Course Allocation 2	PS3 Out (Due 3/20)		
19-Mar	Kidney Exchange 1		Chapter 16	NSF (2005) Kidney Exchange: A Life-Saving Application of Matching Theory Alvin Roth, Tayfun Sonmez and Utku Ünver (2005), A Kidney Exchange Clearinghouse in New England
21-Mar	Kidney Exchange 2			
26-Mar	Prelim 2 Review			
28-Mar	Prelim 2 in Class			
<b>2-Apr</b>	<b>SPRING BREAK</b>			
<b>4-Apr</b>	<b>SPRING BREAK</b>			
9-Apr	Game Theory - Extensive Form Games		Appendix A	
11-Apr	Basic Auctions		Chapter 2	National Academy of Sciences Beyond Discovery Report (2003), The Bidding Game
16-Apr	Basic Auctions 2			
18-Apr	Online Auctions and VCG	PS4 Out (Due 4/24)	Chapter 3 - 4	Richard Thaler (1988), Anomalies: The Winner's Curse
23-Apr	Keyword Auctions		Chapter 5	Jonathan Levin and Paul Milgrom (2010), Online Advertising: Heterogeneity and Conflation in Market Design
25-Apr	Spectrum Auctions		Chapter 6	
30-Apr	Auctions in Financial Markets + Trading		Chapter 7 - 8	Paul Klemperer (2002), What Really Matters in Auction Design
2-May	Auctions in Financial Markets + Trading 2	PS5 Out (Due 5/7)		
7-May	Final Review			

## Summary of Deadlines:

Problem Set 1: 2/7

Problem Set 2: 2/21

Prelim 1: 2/22 In Class

Problem Set 3: 3/20

Prelim 2: 3/28 In Class

Problem Set 4: 4/24

Problem Set 5: 5/7

Final Exam: TBD by Registrar in early/mid March. Check: <https://registrar.cornell.edu/exams/spring-final-exam-schedule>