

ORIE 4350 Introduction to Game Theory

Syllabus

Fall 2020



Course description

In many real-life settings, a group of agents or decision makers interacts by each agent choosing an action, and the actions chosen by every agent together determine the outcome of the interaction. Each agent has a preference over which outcome is realized, and different agent's preferences may not agree with one another. As examples, consider the following situations:

1. How should Amazon, Apple, and Google price their tablets to maximize their profit, given that the total demand depends on the prices charged by each firm?
2. How many million barrels of oil should each OPEC country produce, if the price of crude oil is determined by its total supply?
3. How should you bid in an eBay auction for a collectible (your favorite sesame street character toy), given there are other interested buyers?
4. How should you and your roommates agree to split the utilities bill each month, given the rooms are not identical, and all of you differ in your heating preferences?

Game theory involves the study of such *strategic* situations, and provides a systematic approach to describe/predict the actions of *rational* agents.

In this course, we will study the fundamental concepts of game theory, see what behaviors they imply in different settings, and look at few applications. We will focus primarily on *non-cooperative* game theory, where we assume the agents care only about their own self-interest (their profit, revenue, *utility*, well-being, happiness, etc.); all other considerations are secondary. In the end (if we have time), we will briefly cover *cooperative* game theory, where a group of agents come together to agree on a common course of action.

Learning outcomes

After taking this course, you should be able to achieve the following objectives:

1. For a wide range of multi-agent settings, recognize the strategic aspects in the interaction, and formulate these using the analytical framework discussed in class.
2. Analyze a variety of strategic settings using the concept of an equilibrium.
3. Describe the merits and drawbacks of the common rationality assumptions that underlie the various game theoretic equilibrium concepts.

Prerequisites

This course assumes familiarity with probability theory, including concepts such as expectations, conditional distributions, and Bayes' rule.

Some material in the course will also require knowledge of linear programming, duality and convexity at the level of ORIE 3300. If you have not taken this course or any equivalent course that covers these topics, please talk to me before **Sept 9, 2019** to get approval for taking this course.

Instructor

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office hours See Canvas website. One-on-one meetings can be set up at calendly.com/fms9

Teaching assistants

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Class websites

We will be using multiple website for this course. The main website that you need to remember is Canvas — all other websites are linked from Canvas.

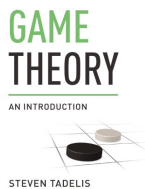
We will be using Canvas for announcements and lecture materials. You should be enrolled automatically into Canvas, but if not, please visit <https://canvas.cornell.edu> and search for ORIE 4350. All announcements for the class will be through Canvas, so it is your responsibility to ensure that you are enrolled and receiving the announcements. Please contact the instructor or the TAs if you have any issues.

Lectures, recitations and office hours will be held online via Zoom. There are Zoom links on the Canvas websites for all these.

Homework will be collected and graded via Gradescope. Regrade requests can also be submitted via Gradescope *within a week of the work being returned*, with a short explanation of the error. All of the work, not just the disputed question, may be regraded.

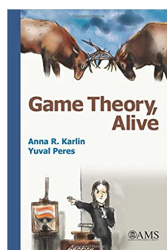
We will also use Piazza (<https://piazza.com/cornell/fall2020/orie4350>) for this class, where you should direct your questions related to homework, exams and the course content. There will be a link to the Piazza forum in Canvas.

Textbook

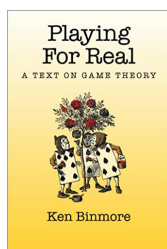


The textbook for this course is **Game Theory: An Introduction** by Steven Tadelis (Princeton University Press). We will follow this textbook pretty closely with the goal of covering (parts of) Chapters 3–12.

In addition, we will cover several topics based on the material from the following books:



Game Theory, Alive, by Anna Karlin and Yuval Peres,
<https://homes.cs.washington.edu/~karlin/GameTheoryBook.pdf>;



Playing for Real, by Ken Binmore, Oxford University Press,
<https://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780195300574.001.0001/acprof-9780195300574>.

Homework

Weekly homework will be due on Thursdays at 11.59pm (Eastern Time) on [gradescope.com](https://www.gradescope.com).

The goal of homework is to make you think about and work with the material in the course, thereby reinforcing the material. We are grading homework to give you feedback and help

you pinpoint which parts of the course you fully understand and which you have to review. The goal of the exam is to reinforce the material again, by giving you an incentive to review it.

In other words, the goal of the homework is not getting a perfect score, but it is meant as an exercise to sharpen your understanding and to find possible holes in your understanding. If you do not do your own homework, then this setup does not work. To encourage you to think about the exercises and find solutions yourself, I will experiment with the following: getting any score 90% or higher on a homework will be considered a perfect score. Original thoughts, going of an a (relevant) tangent, etc., can receive bonus points. (To be mundane: if a homework is out of x points and you score y points and b bonus points, then your percentage will be $\min\{100, 100\frac{y}{(.9)x}\} + b$.)

Some practical words about what I expect of you: You may discuss the homework with other current students of the class, but each student must write their solutions independently and individually. Showing each other written solutions is not acceptable.

Late homework is not accepted. Your lowest homework grade will be dropped.

Exams

We will have two midterms during the semester, which will be 24-hour takehome exams, open book and open notes. These are such that they will take less than 90 minutes of your time. You will be notified well in advance about their timings and the material of the midterm exams. The midterm exams will be posted on Canvas, and you will submit your work on Gradescope.

The final exam will also be a 24-hour takehome, open book and open notes, based on the material covered during the entire course. The final exam will be in December.

Note that because all exams are takehome exams, academic integrity is even more important than usual. Communicating with any person who is not me about the exam during the 24-hour exam period is considered to be a violation of Academic Integrity. Even a simple question like “Are you done with the exam already?” to a fellow student is *not* allowed. Not reporting requests of other students who ask for help is a violation also.

Please keep in mind what the ultimate goal is here: I want to foster an atmosphere where you can learn the material in this course, and sharpen your brain. Grades are not the ultimate goal, but only a tool for creating an environment where you learn in the best ways possible.

Covid-19

This semester is obviously different from other semesters. I will do my very best to make this course educational and interesting to you. I have chosen to teach this course fully online, because I want you all to be able to interrupt me and ask questions and make comments during lecture. I think teaching online is the best alternative to accommodate this. Please talk to me at any point during the semester if you think something in the course can be improved.

I am aware that this semester may prove difficult for a lot of us. Please remember that we are all on the same team here, and the goal is to foster an atmosphere conducive to learning. If you have any concerns about your learning, grades, or progress in the course, or if you get sick or if

you have other difficulties, feel free to talk to me or any of the TAs. Other resources at Cornell are also available (caringcommunity.cornell.edu).

In case you get sick, or there is some other emergency, please talk to me or send me email. We will try and figure the situation out together. Possible solutions include changing the course outcome to an incomplete, which gives you more time to finish this course.

Grading

Course grade will be based on homework sets, two tests, one final exam, and recitation exercises.

Homework	20%
Test 1	15-20%
Test 2	15-20%
Final Exam	30-40%
Recitation Exercises	10%
<hr/> Total	<hr/> 100%

Academic integrity

Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work. Complete code is available at <http://cuinfo.cornell.edu/Academic/AIC.html>.

Prohibition against buying and selling of course materials

Course materials, posted on Canvas/Piazza or otherwise, are intellectual property belonging to the author/instructor. Students are prohibited against buying or selling any course materials without the express permission of the instructor.