Syllabus

Overview

Popularized by movies such as "A Beautiful Mind," game theory is the mathematical modeling of strategic interaction among rational (and irrational) agents. Beyond what we call `games' in common language, such as chess, poker, soccer, etc., it includes the modeling of conflict among nations, political campaigns, competition among firms, and trading behavior in markets such as the NYSE. How could you begin to model keyword auctions, and peer to peer file-sharing networks, without accounting for the incentives of the people using them? The course will provide the basics: representing games and strategies, the extensive form (which computer scientists call game trees), Bayesian games (modeling things like auctions), repeated and stochastic games, and more. We'll include a variety of examples including classic games and a few applications.

Requirements/Prerequisites

You must be comfortable with mathematical thinking and rigorous arguments. Relatively little specific math is required; you should be familiar with basic probability theory (for example, you should know what a conditional probability is), and some very light calculus would be helpful.

Course Structure

The course consists of the following materials:

Videos. The lectures are delivered via videos, which are broken into small chunks, usually between five and fifteen minutes each. There will be about an hour and a half of video content per week. You may watch the lecture videos at your convenience. Lower-resolution videos are also available for those with slow internet connections.
Slides. We have made available pdf files of all the lecture slides.
Quizzes. There will be *non-graded* short "quiz" questions that will follow some of the videos to help you gauge your understanding.
Online Lab Exercises. After some of the videos, we will ask you to go online to a specific url (that will be provided to you at that point) to play some games. These are entirely optional, and designed to illustrate some of the concepts from the course.
Problem Sets. There will also be *graded* weekly problem sets that you will also answer online, but may work through offline; those must be completed within two weeks of the time that they are posted in order to be graded for full credit. If you miss a problem set deadline, you may complete it before the end of the course for half credit. You may discuss problems from the problem sets with other students in an online forum, without providing explicit answers.
Final Exam. There will be an online final exam that you will have to complete within two weeks of its posting. Once you begin the exam, you will have four hours to complete it.
Screen-side Chats. Each week on Thursday (Pacific time, Friday in some parts of the world) we will hold a brief online chat where we answer some questions and discuss other topics.

Suggested Readings

The following background readings provide more detailed coverage of the course material:

Essentials of Game Theory, by Kevin Leyton-Brown and Yoav Shoham; Morgan and Claypool Publishers, 2008. This book has the same structure as the course, and covers most of the same material. It is free if you access the link from a school that subscribes to the Morgan & Claypool Synthesis Lectures, and otherwise costs $5 to download. You can also get it as a printed book from (e.g.) amazon.com, or as an ebook for Kindle or Google devices.
A Brief Introduction to the Basics of Game Theory, by Matthew O. Jackson. These notes offer a quick introduction to the basics of game theory; they are available as a free PDF download.

Grading

You will receive direct feedback on all questions you answer. Your grade in the course will be based solely on the problem sets (70 percent of your grade) and the final exam (30 percent of your grade). Students with a total grade of over 70 percent will receive an online Certificate of Completion. Students with a grade exceeding 90 percent will receive the added designation "with Distinction".

You are free to follow the course without completing the problem sets or final, but then will not receive a certificate of completion.

Questions

If you have any questions, please *do not* contact the professors directly, as with over one hundred thousand of students it is infeasible for us to respond. The course includes on-line Q&A forums where students can post and respond to questions. This will go live in parallel with the first lectures. Students rank questions and answers, so that the most important questions and the best answers bubble to the top. TAs and the professors will periodically monitor these forums, so that important questions not answered by other students will be addressed.

Course Topics

Release Dates		Due Dates	
1/6 (midnight PST)	**Week 1: Introduction** Introduction, overview, uses of game theory, some applications and examples, and formal definitions of: the normal form, payoffs, strategies, pure strategy Nash equilibrium, dominant strategies.. **PSet 1 Release**	1/13 (midnight PST)	**PSet 1 Suggested Deadline**
1/13 (midnight PST)	**Week 2: Mixed-Strategy Nash Equilibrium** pure and mixed strategy Nash equilibria. **PSet 2 Release**	1/20 (midnight PST)	**PSet 1 Full Credit Deadline PSet 2 Suggested Deadline**

1/20 (midnight PST)	**Week 3: Alternate Solution Concepts** Iterative removal of strictly dominated strategies, minimax strategies and the minimax theorem for zero-sum game, correlated equilibria. **PSet 3 Release**	1/27 (midnight PST)	**PSet 2 Full Credit Deadline PSet 3 Suggested Deadline**
1/27 (midnight PST)	**Week 4: Extensive-Form Games** Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium, introduction to imperfect-information games, mixed versus behavioral strategies. **PSet 4 Release**	2/3 (midnight PST)	**PSet 3 Full Credit Deadline PSet 4 Suggested Deadline**
2/3 (midnight PST)	**Week 5: Repeated Games** Repeated prisoners dilemma, finite and infinite repeated games, limited-average versus future-discounted reward, folk theorems, stochastic games and learning. **PSet 5 Release**	2/10 (midnight PST)	**PSet 4 Full Credit Deadline PSet 5 Suggested Deadline**
2/10 (midnight PST)	**Week 6: Bayesian Games** General definitions, ex ante/interim Bayesian Nash equilibrium. **PSet 6 Release**	2/17 (midnight PST)	**PSet 5 Full Credit Deadline PSet 6 Suggested Deadline**
2/17 (midnight PST)	**Week 7: Coalitional Games** Transferable utility cooperative games, Shapley value, Core, applications. **PSet 7 Release**	2/24 (midnight PST)	**PSet 6 Full Credit Deadline PSet 7 Suggested Deadline**
2/24 (midnight PST)	**Week 8: Final Exam Available**	3/3 (midnight PST)	**PSet 7 Full Credit Deadline**
	Week 9: Final Exam Due	3/10 (midnight PST)	**Final Exam Deadline Partial Credit Deadline for all PSets**