Syllabus for MAE207
Game Theory for Engineers - Spring 2015

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This is the syllabus for MAE207 – Game Theory for Engineers, Spring 2015. The objective of this course is to get familiarized with the richness of scenarios that can be modeled with games, and the basic notions and mathematical tools employed to analyze them. The course focuses on noncooperative games, where individual players do not trust each other or form coalitions, but rather seek to maximize their own interest. Topics include static games, starting with two-player zero-sum games and eventually building up to n-player non-zero sum games, saddle points and Nash equilibria, dynamic games, both open and closed-loop policies, and Bayesian games.

Instructor

Jorge Cortés, `cortes at ucsd.edu`. Office at Jacobs Hall, room # 1608

Course Objectives

By the end of the course, you would/should have:

1. learned about a broad range of examples in engineering and economics involving strategic players
2. developed a basic understanding of the various ways in which games can be classified, and the impact this has on their analysis
3. learned and used tools for determining various notions of equilibria for static and dynamic games

Prerequisites

Knowledge of real analysis, linear algebra, and basic probability is assumed. Familiarity with simulation software of your choice (e.g., Matlab/Mathematica/Maple).

Text

We will use a variety of sources for reference. Our main reference will be:

- J. P. Hespanha. *An Introductory Course in Noncooperative Game Theory*. 2013. Unpublished notes. Freely available at http://www.ece.ucsb.edu/~hespanha/published/games.pdf

Additional recommended readings

Depending on the specific topic we are dealing with, we will complement the book above with the following material

[A1] T. Başar and G. J. Olsder. *Dynamic Noncooperative Game Theory*. SIAM, 2 edition, 1999

[A2] M. J. Osborne and A. Rubinstein. *A Course in Game Theory.* MIT Press, Cambridge, MA, 1994

[A3] D. Fudenberg and J. Tirole. *Game Theory.* MIT Press, Cambridge, MA, 1991

Course webpage

http://carmenere.ucsd.edu/jorge/teaching/mae207/s15/

The webpage contains this syllabus and the list of homework due. Please check it periodically for updates and other announcements related to the course.

Calendar

Introduction and examples

Modeling

- Elements of a game: players, objectives, information structure, actions and policies
- Notion of equilibria
- Classes of games: cooperative/non-cooperative, static/dynamic, zero/non-zero sum, open-/closed-loop, perfect/imperfect information, complete/incomplete information

Zero-sum games

- Zero-sum matrix games
- Mixed policies
- Minimax theorem
- Mixed saddle-point equilibrium policies
- Games in extensive form
- Stochastic policies for games in extensive form

Non-zero-sum games

- Two-player games
- Nash equilibria for bimatrix games
- N-player games
- Potential games

Dynamic games

- Dynamic games
- One-player discrete- and continuous-time dynamic games
- State-feedback zero-sum dynamic games

Bayesian games

- Games of incomplete information
- Bayesian Nash equilibrium
- Mechanism design

Homework

There will be a set of homework problems per week. Homework assignments are due weekly, on Thursdays (specific dates for your reference are included in the webpage). No late homework will be accepted.

Exams The midterm will be on **May 5**. Instead of a final exam, we will have a final project.

Final project

Each student should select a final project. A project can be any of the following:

- reading and understanding of a paper or book chapter from the literature on a topic not covered in class (e.g., correlated and conjectural equilibria, cooperative games, multi-agent learning, weakly acyclic games, Markov games, auctions);
- a research topic relevant to the student's own area of research that involves game-theoretic methods.

The selection of the project should be coordinated with the instructor. Project must be selected by **May 12**.

The project will be orally presented to the class in the final week. The criteria for evaluation are: (i) when presenting, clarity of the presentation, displayed understanding of the content, and handling of questions, (ii) when listening to a presentation, participation, quality, and pertinence of questions raised, and (iii) a written report describing the project and the lessons learned from the presentation and the Q&A. Written reports are due by **June 12**.

Grading policy

Homework: 30% Midterm: 30% Final project: 40%

ted

Your grades will be available via ted at http://ted.ucsd.edu

Room location and hours

Lectures take place at Center Hall (Map Building # 984), room 220, Tuesdays and Thursdays, from 11:00am to 12:20pm.

Office hours

Instructor: Mondays, from 3:30pm to 4:30pm, at EBUI, room 1603 (conference room). Please, send me an email describing the problem before coming to office hours. I will try to respond as quickly as possible. Additionally, I will share questions that are particularly good (and their answers) with the rest of the class by broadcasting my answer to the entire class.