

Foundations of Game Theory and Mechanism Design

ORIE 6350: Syllabus

Fall 2013

Course Information:

Foundations of Game Theory and Mechanism Design

Course Number: ORIE 6350

Room: Upson 205

Time: MWF 1:25-2:15pm

Course Website: <https://blackboard.cornell.edu/> (search for ORIE 6350)

Instructor:

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Office hours: M 5:00-6:00pm, T 2:00-3:00pm

Course Description:

Due to the recent growth of electronic commerce, there has been a tremendous increase in situations where multiple agents interact strategically with each other, according to some set of rules (“mechanism”). In these interactions, each agent seeks to optimize their payoffs, which in turn depend on how other agents behave. Examples include sponsored search auctions organized by Google, Bing, etc; online marketplaces like eBay, Amazon, etc. Game theory is the main tool to analyze such strategic interactions, and an important component in the design of mechanisms that further a broader goal like efficiency, welfare, profit maximization, etc.

In this course, we will focus on the foundations of non-cooperative game theory. We will look at games of complete and incomplete information in static and dynamic settings, and consider applications to mechanism design. The theoretical content of the course will be supplemented with examples from market design, oligopoly competition, resource allocation and other engineering contexts.

The broad course plan is as follows:

1. Introduction
2. Static games with complete information
 - (a) Definitions
 - (b) Nash equilibrium

- (c) Existence and application
- 3. Static games with incomplete information
 - (a) Definitions: types, beliefs
 - (b) Bayesian Nash equilibrium
 - (c) Purification theorem
 - (d) Auctions: first price, second price, etc.
- 4. Mechanism design in static settings
 - (a) Revelation principle
 - (b) Payoff equivalence
- 5. Dynamic games with complete information
 - (a) Extensive forms, game trees
 - (b) Subgame perfectness
 - (c) Repeated games
- 6. Stochastic games
 - (a) Markov perfect equilibrium
 - (b) Existence, application
- 7. Dynamic games with incomplete information
 - (a) Definitions, model
 - (b) Perfect Bayesian equilibrium
 - (c) Examples: signaling games
- 8. Large dynamic games
 - (a) Motivation
 - (b) Mean field equilibrium
 - (c) Existence and approximation
 - (d) Applications and open problems

Note: The course plan may change, to accommodate mutual interests.

Assignments:

There will be three assignments. You may collaborate on the problems (up to 3 students per group), but each student must write their solutions independently and individually. Submitting copied solutions will be considered a violation of the Cornell code of academic integrity.

Late homework submissions will not be accepted, except for at most one assignment and by at most 3 days.

Grading:

Three assignments (25%), a midterm (30%), and a class project with a final paper submission (35%). Depending on the class strength, students may be asked to scribe one or more lectures (10%).

Prerequisites:

Basic knowledge of operations research at level of ORIE 6300 and ORIE 6500 will be required. No prior knowledge of game theory will be assumed, but elementary concepts of static games will be covered quickly.

Announcements:

There will be no class on Oct 7 and on Oct 9, due to conference travel. We will schedule some extra lectures in order to make up for this, possibly at the end of the semester.

References:

There will be no required textbooks for this course, but some of the following books will be helpful as a reference.

- *Game Theory*, Fudenberg and Tirole. On reserve in Olin library.
- *A Course in Game Theory*, Osborne and Rubinstein. On reserve in Olin library.
- *Game Theory: Analysis of Conflict*, Myerson.
- *Microeconomic Theory*, Mas-Colell, Whinston and Green.
- *Putting Auction Theory to Work*, Milgrom.

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>.