E1 254 January 3:1

Game Theory

Instructor

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Teaching Assistant

PhD Students
Email: PhD students

Department: CSA (Computer Science and Automation)

Course Time: Monday, Wednesday, Friday 9.30 to 11 AM

Lecture venue: CSA 117

Detailed Course Page: http://lcm.csa.iisc.ernet.in/gametheory/index.html

Announcements

Brief description of the course

In the past decade, game theory and mechanism design have emerged as an important tool for solving numerous problems in computer science and Internet economics problems. Examples of these problems include design of decentralized algorithms involving selfish agents, design of sponsored search auctions on the web, design of procurement markets in electronic commerce, design of robust communication protocols, design of resource allocation mechanisms in computational grids, analysis of social networks, etc. An emerging discipline, algorithmic game theory, which is concerned with design and analysis of game theoretic algorithms, is now an active research area.

The course is in three parts: (1) Noncooperative Game Theory (2) Mechanism Design and (3) Cooperative Game Theory.

The course can be taken by Master's students and early PhD students. Third year and fourth year undergrduate

students can also take the course.

Prerequisites

There are no formal prerequisites. However, familiarity with probability, linear algebra, linear programming, calculus, and algorithms are desirable.

Syllabus

Introduction: rationality, intelligence, common knowledge, von Neumann - Morgenstern utilities;

Noncooperative Game Theory: strategic form games, dominant strategy equilibria, pure strategy nash equilibrium, mixed strategy Nash equilibrium, existence of Nash equilibrium, computation of Nash equilibrium, matrix games, minimax theorem, extensive form games, subgame perfect equilibrium, games with incomplete information, Bayesian games.

Mechanism Design: Social choice functions and properties, incentive compatibility, revelation theorem, Gibbard-Satterthwaite Theorem, Arrow's impossibility theorem, Vickrey-Clarke-Groves mechanisms, dAGVA mechanisms, Revenue equivalence theorem, optimal auctions.

Cooperative Game Theory: Correlated equilibrium, two person bargaining problem, coalitional games, The core, The Shapley value, other solution concepts in cooperative game theory.

References:

Roger B. Myerson, Game Theory: Analysis of Conflict, Harvard University Press, September 1997.

Martin J. Osborne, An Introduction to Game Theory, Oxford University Press, 2003.

Y. Narahari. Game Theory and Mechanism Design. IISc Press and the World Scientific, 2014.

Course outcomes

The objective of this course is to provide a foundation of game theory to help students apply game theory to problem solving in a rigorous way.

At the end of this course, the students can expect to be able to model real-world situations using game theory, analyze the situations using game theoretic concepts, and design correct and robust solutions (mechanisms, algorithms, protocols) that would work for rational and intelligent agents.

The students will have an opportunity to obtain an exposure to and a serious appreciation of the seminal contributions of celebrities such as von Neumann, John Nash, Lloyd Shapley, Robert Aumann, William Vickrey, Leonid Hurwicz, Eric Maskin, and Roger Myerson.

After completing the course, the students will be able to make forays into topical areas such as algorithmic game theory, algorithmic mechanism design, computational social choice, auctions and market design, electronic commerce, Internet monetization, social network research, and mechanism design for multiagent systems.

Students would be able to pursue inter-disciplinary topics such as cyberphysical systems, intelligent transportation, service science, green supply chains, and human computation systems (such as crowdsourcing networks) by formulating and solving topical problems using the conceptual foundations covered in the course.

Grading policy

The grading policy is an absolute one, based on the total marks secured by the student. The range for different

grades is decided based on natural clusters that get formed in the set of overall marks secured by all the students.

The marks are determined by the performance of the students in three monthly tests (30%), one substantial miniproject (20%), several problem sets (10%), participation in online discussion forum (10%), and the final examination (30%)

Assignments

Assignments and Problem sets are available on the course website:

http://lcm.csa.iisc.ernet.in/gametheory/prog_assign.html

http://lcm.csa.iisc.ernet.in/gametheory/problemsets.html

Resources

The instructor has written a book: Game Theory and Mechanism Design (2014), published by the IISc Press and the World Scientific.

Notes for all the classes are available on the course website. These notes are culled out from the above textbook.

The textbook has the following website:
http://lcm.csa.iisc.ernet.in/hari/book.html