

Title of the course:
Algorithmic Game Theory

Credit requirement:(L-T-P: 3-0-0, Credit: 3)

Please select the committee for Approval: PGPEC

Name of the Dept: CSE

Please Specify the Level of the Subject: PG level

Whether the subject will be offered as compulsory or elective: Elective

Prerequisite(s) for the subject, if any
(Please give the subject numbers and names): Algorithms-I (CS21003),
Algorithms-II (CS31005)

Course Objective

Game theory is the formal study of interaction between "self-interested" (or "goal-oriented") "systems" (or "agents" or "decision makers" or "players"), & strategic scenarios that arise in such settings. It began life in Economics in the 1940's with the work of von Neumann & Morgenstern, but has since been applied to an extraordinary range of subjects, including political science, evolutionary biology & even to inspection regimes for arms control.

Game theory has for years also played an important, if less recognized, role in several branches of computer science. Applications within computer science include the use of games in automated verification & model checking to model computing systems in an unknown and possibly adverse environment. In AI games are applied to the analysis of multi-agent systems. Recently, with the advent of the internet and e-commerce, many game theoretic questions in the interplay between economics & computing have received extensive attention. These include electronic auctions, & more generally mechanism design questions (inverse game theory) related to finding incentive structures for cooperation between independent entities on the internet.

Wherever game theory plays a quantitative role, algorithmic and computational questions related to "solving" games are also of central importance. This course discusses algorithmic aspects of game-theoretic models, with a focus on recent algorithmic and mathematical developments.

Study Materials

In this course, we will use the following textbooks. We will also use online study materials

Books:

1. Game Theory by Michael Maschler, Eilon Solan, and Shmuel Zamir

2. Algorithmic Game Theory by Noam Nisan, Tim Roughgarden, Eva Tardos, and Vijay V. Vazirani
3. Microeconomic Theory by Andreu Mas-Colell, Michael D. Whinston, and Jerry R. Green
4. A Course in Game Theory by Martin J. Osborne, Ariel Rubinstein.
5. Game Theory and Mechanism Design by Y. Narahari

Syllabus:

Game Theory:

Quick introduction to game theory: Non-cooperative game theory, Zero sum and general sum games, Minmax strategies, Nash equilibrium, correlated equilibrium: 3 hours

Algorithms for Two-Player Games: Lemke-Howson: 2 hours

Hardness of Computing Nash, PPAD completeness: 3 hours

Potential Games and PNE; Hierarchy of Equilibria: 2 hours

Best-Case and Strong Nash Equilibria: 2 hours

No-Regret Algorithms and Coarse Correlated Equilibria: 2 hours

No-Swap-Regret and Correlated Equilibria: 2 hours

Introduction to Co-operative game theory, correlated equilibrium: 2 hours

Selfish routing, price of anarchy: 3 hours

Mechanism Design:

Quick introduction to mechanism design, Myerson's Lemma: 3 hours

What is algorithmic mechanism design: 2 hours

Revenue maximizing auctions, Sponsored search auction: 3 hours

Knapsack Auctions, Revelation Principle: 2 hours

Combinatorial Auctions, Spectrum Auctions: 2 hours

VCG mechanism: 2 hours

Stable matching: 2 hours

Computational Social Choice: 2 hours

Names of the faculty members of the Department/Centers/School who have the necessary

expertise and will be the willing to teach the subject (Minimum two faculty members should

be willing to teach the subject)

Palash Dey, Niloy Ganguly

Do the contents of the subject have an overlap with any other subject offered in the Institute?

a) Game Theory and Applications (IM60068): 20%

b) Reasons for offering the new subject in spite of the overlap

We will focus mostly on algorithmic aspects of game theory with applications in Computer Science whereas the other course is aimed at covering the basics of game theory.

DO WE NEED TO GIVE THE SYLLABUS OF THE COURSES OR JUST COMMENT IS ENOUGH?

Related Subjects offer by the Institute
IM60068 Game Theory and Applications

IM60068 Game Theory and Applications

Syllabus :

1) Introduction 2) Non-cooperative games 3) Co-operative games 4) Mechanism Design 5) Applications