Indian Institute of Technology, Kanpur

Department of Computer Science and Engineering

New Course Proposal

Title: Topics in Game Theory and Collective Choice

Course No: CSXXX

Units: 3-0-0-0

Pre-requisites: This course will assume familiarity with formal mathematical reasoning, some probability theory, basic calculus, the basics of computational complexity, rational agent models, and will require you to write programs in Python (this is a soft constraint). A prior course on game theory or multi-agent systems will be a plus, but not necessary. If you are unsure, please contact the instructor.

Proposed by: Swaprava Nath

Estimated Enrollment: 50 or less

Departments which may be interested: CSE, EE, IME, ECO

Level of the course: PG (6xx level).

Short Description

This course deals with some selected topics in the intersection of Economics and Computation. The focus will be more on the applications of game theory in social decision making. For example, how online advertising slots are allocated among competing advertisers or how the mobile telephony spectrum is distributed among the competing service providers such that certain "good" and "fair" properties are satisfied. Problems of similar flavor exist in many more applications like crowdsourcing, internet routing, fair division of goods, matching of students to advisors, facility location, social networks and many more. To understand these applications and to improve them, technology needs to partner with economic principles that drive them. This course is aimed to develop those economic principles.

The course will primarily be focused on mechanism design (without and with money) -- which is the inverse problem of game theory. However, for the uninitiated, there will be a brief refresher of the game theoretic principles that is needed. The later part will see a bit of cooperative game theory and several application domains.
Course Plan (tentative coverage and sequence)

**Introduction to game theory:**

**Introduction to social choice theory:**

**Social choice function – relaxation:**
Axioms: weak pareto, monotonicity. Muller-Satterthwaite result. Special domains: ranking and positive results.

**Strategic considerations – mechanism design without money:**

**Special domains with positive results:**
Single peaked: Moulin’s characterization. Private good: Sprumont’s uniform rule.

**Non-strategic recent results in domains without money:**
Cardinal voting and distortion. Voting for single or k objects. Participatory budgeting. Cake-cutting. Rent division. (any 2 topics)

**Matching:**
One sided: object allocation, house allocation. Top trading cycle with fixed endowments and its properties.

**Mechanism design with money in quasi-linear form:**
**Further topics in mechanisms with money:**
Drawbacks of VCG mechanism. Axiom: ex-interim individual rationality with Bayesian incentive compatibility. Myerson-Satterthwaite result. AGV mechanism: ex-ante individual rationality.

**Cooperative games:**

**Theory to practice:**

**References**
No specific textbook, the book that will be closest to the content is by Yoav Shoham and Kevin Leyton-Brown: Multiagent Systems ([www.masfoundations.org](http://www.masfoundations.org)). Other relevant references and texts (if needed) will be posted on the course homepage from time to time. Some of the following books may be useful.

- Martin Osborne and Ariel Rubinstein: A course in game theory
- Martin Osborne: An Introduction to Game Theory
- Y. Narahari: Game Theory and Mechanism Design
- Tilman Borgers: An Introduction to the Theory of Mechanism Design
- Andreu Mas-Colell, Michael Whinston, and Jerry Green: Microeconomic Theory
- Debasis Mishra
  Game Theory course notes: [http://www.isid.ac.in/~dmishra/gm1doc/notes_2016.pdf](http://www.isid.ac.in/~dmishra/gm1doc/notes_2016.pdf)
  Mechanism Design course notes: [http://www.isid.ac.in/~dmishra/gmdoc/mdnotes.pdf](http://www.isid.ac.in/~dmishra/gmdoc/mdnotes.pdf)