EE 381V Game Theory

Instructor:	Prof. Evdokia Nikolova
Lecture Hours:	TTH 2:00-3:15 PM, EER 1.518
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Overview: Game Theory and Mechanism Design model mathematically the strategic interaction of multiple people (players, agents or users of a system). Algorithmic Game Theory and Algorithmic Mechanism Design merge computation with economic reasoning in order to better understand and improve the strategic interaction that occurs in the complex systems that surround us, as well as come up with better designs for such systems: the Internet, telecommunication and transportation networks, social networks, online markets, etc.

This advanced graduate class aims to prepare students to do research in the field via reading, presenting and discussing state-of-art research papers. Sample topics include: Strategic Form Games, Nash Equilibria and computation, Price of Anarchy, Learning, Congestion games; Mechanism Design: Auctions, Optimal Mechanisms, Revenue and Welfare Maximization, Sample Compexity; Network Effects and Games over Networks.

Prerequisites: Probability and Stochastic Processes (EE 381J or equivalent), Algorithms (EE 360C or equivalent), Optimization (EE 380N-11 or equivalent), mathematical maturity.

References:

- **[Osborne] "Introduction to Game Theory"** by Martin J. Osborne. Oxford University Press (2004)
- **[Krishna] "Auction Theory"** by Vijay Krishna. Academic Press, San Diego (2002). (Second edition, 2009)
- **[Hartline] "Mechanism Design and Approximation"** by Jason Hartline. http://jasonhartline.com/MDnA/
- **[Fudenberg-Tirole] "Game Theory"** by Drew Fudenberg and Jean Tirole. MIT Press (1991)
- **[AGT] "Algorithmic Game Theory"** by Eva Tardos, Noam Nisan, Tim Roughgarden, Vijay V. Vazirani, editors. Cambridge University Press (2007)
- **[MWG] "Microeconomic Theory"** by Andreu Mas-Colell, Michael D. Whinston, Jerry R. Green. Oxford University Press (1995)

Additional relevant material will be posted on Canvas.

Course Policy: Course material will be available on UT Canvas: https://utexas.instructure.com/

You may discuss papers with other students, but you are not allowed to copy from others. University disciplinary procedures will be invoked if any form of cheating is detected. Course and instructor evaluations will occur in the last week of lecture.

Grading:

30% Paper summaries and class participation

35% Research Paper presentation

35% Final Project (original research: theoretical or applied; or a survey of an area related to the course)

A short summary of the research paper (at most ½ page, with main ideas in bullet form) to be covered in each class will be due at the beginning of that class. You may jointly read and discuss the research papers with other students, but when writing your summary you are not allowed to copy from others. Copying without referencing will be treated as cheating. No late summaries will be accepted; to help with any extenuating circumstances where you are not able to turn in a summary on time, the lowest 4 summary scores will be dropped.

Students with Disabilities: The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the College of Engineering Director of Students with Disabilities at 471-4382.

Detailed Syllabus

Part 1: A brief introduction to Algorithmic Game Theory and Mechanism Design

1. Two-player games
2. Network congestion games, price of anarchy
3. Auctions

Part 2: Revenue Maximization in Mechanism Design

1. Simple vs Optimal Mechanisms
2. Prices and the winner's curse
3. Full extraction of the surplus in Bayesian and dominant strategy auctions
4. Optimal Auctions with Risk Averse Buyers
5. Revenue Maximization with an Uncertainty-Averse Buyer
6. A Duality-Based Unified Approach to Bayesian Mechanism Design
7. Optimal Mechanism Design with Risk-Loving Agents
8. Multi-parameter Mechanism Design and Sequential Posted Pricing
9. A Simple and Approximately Optimal Mechanism for an Additive Buyer
10. The sample complexity of Revenue Maximization
11. Mechanism Redesign

12. Clinching Auctions Beyond Hard Budget Constraint
13. Prior-free Approximation part 1
14. Prior-free Approximation part 2

Part 3: Price of Anarchy

15. Intrinsic Robustness of the Price of Anarchy
16. The Price of Anarchy in Auctions
17. Learning and Efficiency in Games with Dynamic Population
18. Network Pricing: How to Induce Optimal Flows Under Strategic Link Operators
19. Risk-averse selfish routing

Part 4: Matching and Beyond

20. The Efficient Allocation of Individuals to Positions
21. Algorithmic Bayesian Persuasion
22. Two-sided matching with one-sided preferences
23. Manipulation of Stable Matchings using Minimal Blacklists
24. Delegated Search approximates Efficient Search
25. Time-Inconsistent Planning: A Computational Problem in Behavioral Economics
26. On the Instability of Bitcoin Without the Block Reward