

Algorithmic Game Theory - Syllabus (tentative)

Week 1 - Non-cooperative Game Theory 1: Normal Form Games, 2-player zero-sum games, Basic Solution Concepts, Dominant Strategies, Iterated Elimination of Dominated Strategies, Optimal Strategies, Computing Optimal Strategies, The Minimax Theorem.

Reading Material:

- *Multi-agent systems* by Shoham and Leyton-Brown, Sections 3.1, 3.2, 3.4.1 and 3.4.3.
- *Game Theory, Part II: Two-Person Zero-Sum Games* by Ferguson, Sections 1 and 2.
- *CS261: A Second Course in Algorithms Lecture #10: The Minimax Theorem and Algorithms for Linear Programming* by Roughgarden, Section 1.
- *Lecture Slides in Optimization* by Peter Bro Miltersen, Lecture 5 and 6, Slides 1-9.

Week 2 - Non-cooperative Game Theory 2: Normal Form Games, pure and mixed Nash equilibria, Extensive Form Games, Conversion to normal form, Sub-game perfect equilibrium, Extensive Form Games of Imperfect Information, Behavioral Strategies, Perfect and Imperfect Recall.

Reading Material:

- *Multi-agent systems* by Shoham and Leyton-Brown, Sections 3.3.2, 3.3.3, 5.1, 5.2.1, 5.2.2.
- *Game Theory, Part III: Two-Person General-Sum Games* by Ferguson, Sections 1 and 2.
- *Extensive Form Games (Lecture Notes)* by Jonathan Levin, Sections 1-4.

Week 3 - Congestion Games: Congestion Games, Non-atomic Congestion Games, Selfish Routing, Price of Anarchy.

Reading Material:

- *Multi-agent systems* by Shoham and Leyton-Brown, Section 6.4.

Week 4 - Social Choice: Social Choice Functions. Strategyproofness. The Gibbard-Satterthwaite Theorem. Single-peaked Preferences. Median Voter Schemes. Moulin's Characterization.

Reading Material:

- *Algorithmic Game Theory* by Nisan, Roughgarden, Tardos and Vazirani. 9.1, 9.2, 10.1, 10.2.

Week 5 - Mechanism Design with Money: Second Price Auction. Strategyproof mechanisms with money. The VCG Mechanism. Weak Monotonicity. Roberts' Theorem.

Reading Material:

- *Multi-agent systems* by Shoham and Leyton-Brown. 10.4.1, 10.4.2, 10.4.3, 10.4.5, 10.5.1
- *Algorithmic Game Theory* by Nisan, Roughgarden, Tardos and Vazirani. 9.3, 9.5

Week 6 - Optimal Mechanism Design: Second Price Auction with Reserve Price. Bayesian Mechanism Design. Myerson's Revenue-Maximizing Auction. Virtual valuations.

Reading Material:

- *Algorithmic Game Theory* by Nisan, Roughgarden, Tardos and Vazirani. 13.1, 13.2
- *Multi-agent systems* by Shoham and Leyton-Brown. 11.1.8

Week 7 - Coalitional Game Theory: Coalitional Games, Classes of Coalitional Games, Properties of Payoffs, The Shapley Value, The Core, The ϵ -Core, The Least Core, The Nucleolus.

Reading Material:

- *Multi-agent systems* by Shoham and Leyton-Brown. 12.1, 12.2

Week 8 - Student Presentation: Some scientific paper related to the concepts we have covered over the course of the tutorial.