ALGORITHMIC GAME THEORY

PROF. PALASH DEY
Department Of Computer Science And Engineering
IIT Kharagpur

PRE-REQUISITES : Knowledge of algorithms

INTENDED AUDIENCE : Under-graduate And Post-graduates

INDUSTRY SUPPORT : All Software Companies Especially Google, Microsoft, Etc.

COURSE OUTLINE :

Game theory is the formal study of interaction between "self-interested" (or "goal-oriented") "systems" (or "agents" or "decision makers" or "players"), and strategic scenarios that arise in such settings. It began life in Economics in the 1940's with the work of von Neumann and Morgenstern, but has since been applied to an extraordinary range of subjects, including political science, evolutionary biology and 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 and 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 and computing have received extensive attention. These include electronic auctions, and 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.

ABOUT INSTRUCTOR :

Prof. Palash Dey is an Assistant Professor in the Department of Computer Science and Engineering at Indian Institute of Technology, Kharagpur since 2018. Before joining IIT Kharagpur, he was a post-doctoral INSPIRE faculty in TIFR, Mumbai for one year. He finished his Ph.D. and M.E. from the Department of Computer Science and Automation at Indian Institute of Science, Bangalore in 2017 and 2013 respectively. Prior to that, he finished his B.E. from the Department of Computer Science and Engineering at Jadavpur University in 2010. His primary field of research is algorithmic game theory. He is broadly interested in theoretical computer science.

COURSE PLAN :

Week 1: Introduction to game theory: Non-cooperative game theory, Zero sum and general sum games
Week 2: Minmax strategies, Nash equilibrium
Week 3: Yao’s Lemma, Special Classes Games
Week 4: Potential Games, Local Search
Week 5: Complexity Classes: FNP, TFNP, PPAD
Week 6: Correlated Equilibrium, Coarse Correlated Equilibrium, Multiplicative Weight
Week 7: No Regret Dynamics, No Swap Regret
Week 8: Selfish Routing, Selfish Load Balancing
Week 9: Bayesian Games, Extensive Form Games, Mechanism Design
Week 10: Gibbard Satterwaite Theorem, Quasi-Linear Environment
Week 11: VCG Mechanism, Knapsack Mechanism
Week 12: Stable Matching, House Allocation