

Game Theory

TR, 12:00pm–1:15pm, Holmes 389

Course Information

Game theory provides the most natural framework to study the strategic interactions between self-interested decision makers. Due to the emergence of distributed complex systems made up of many autonomous agents (such as the Internet), there has been a resurgence of interest in game theory within the engineering and the computer science communities. This course will introduce the students to the fundamentals of noncooperative game theory as well as the computational tools provided by noncooperative game theory. Emphasis will be on the engineering applications such as control, communications, transportation systems, and resource allocation problems. The course is intended for mathematically inclined students with some background on probability theory.

Instructor:	Gürdal Arslan, Holmes 440, Phone: 956–3432, E-mail: gurdal@hawaii.edu
Office Hours:	Open
Recommended Texts:	Dynamic Noncooperative Game Theory by Başar and Olsder Game Theory by Fudenberg and Tirole,
Webpage:	www2.hawaii.edu/~gurdal/EE693H.htm Site of announcements, handouts, homeworks, etc.
Grading:	Homework 30%; Mid-term 35%; Project 35%.
Policies:	No credit will be given to late homeworks. Exams must be taken at the announced times.

(Tentative) Topics

- Introduction (1 Lecture)
 - Examples and various solution concepts
- Zero-Sum Finite Games in Normal Form (2 Lecture)
 - Security strategies
 - Lower and upper values
 - Saddle-point equilibrium
 - Mixed strategies
 - Minmax theorem
 - Computation of saddle-point equilibria by graphical solution and LP approaches
 - Dominated strategies
 - Iterative elimination of dominated strategies

- Normal Form Games (6 Lecture)
 - Pure and mixed strategies
 - Dominated strategies and solution by iterated dominance
 - Nash equilibrium
 - Pure equilibrium, Strict equilibrium
 - Examples of pure equilibrium (Cournot's model of oligopoly, CDMA uplink power control)
 - Existence of mixed equilibria in finite normal games (Best response correspondence, Kakutani's fixed point theorem)
 - Existence of pure equilibrium in infinite games with continuous payoffs (Quasi-concavity of player payoffs in its own decisions)
 - Sufficient conditions for the uniqueness of pure equilibrium in infinite games with continuous payoffs (Diagonal strict concavity condition)
 - Existence of mixed equilibrium in infinite games with continuous payoffs
 - Discontinuous games
 - Computation of Nash equilibria in finite normal-form games (algebraic approach, optimization approach)
 - Correlated equilibrium, coarse correlated equilibrium, correlated equilibrium with information partitions
- Well-known Classes of Non-Zero-Sum Games (7 Lecture)
 - Generalized ordinal potential games and existence of pure equilibria
 - Finite improvement property
 - Characterization of potential games
 - Weighted potential games
 - Congestion games
 - Inefficiency of Nash equilibria in congestion games, Tolls minimizing the total congestion, Braess' paradox
 - Price of anarchy and price of stability in congestion games
 - Infinite potential games
 - Efficiency loss in resource allocation games
 - (Weakly) acyclic games
 - Consensus problem
 - Supermodular games
- Learning in games (8 Lecture)
 - Cournot's adjustment process
 - Fictitious play, Asymptotic behavior, Convergence of beliefs in certain classes of games, Shapley's example, Lack of payoff consistency,
 - Stochastic fictitious play, Payoff consistency, Perturbed equilibria, Convergence of intended behavior via stochastic approximation theory
 - Computation, memory, and observation requirements of fictitious play
 - Regret based dynamics, Utility based fictitious play
 - Finite memory variants of fictitious play, Adaptive play, Elements of Markov processes, Perturbed Markov processes, Stochastic stability
- Repeated Games
- Auctions; Mechanism design; Incentive design
- Games with incomplete/imperfect information;
- Extensive form games
- Dynamic games; Markov games