Game Theory for Wireless Networks

Course Description:

Future generation wireless networks will most likely consist of intelligent radio devices, capable to sense the environment and effectively adjust their transmission parameters according to the current local channel conditions and QoS specifications. These devices will opportunistically use the spectrum, while their local resource management choices (selecting the transmission rates, transmission powers, access method, route to final destination for a multihop network, etc.) will greatly influence the performance of all the other users in the network.
The interactions among users sharing a common resource can be formally modeled as games. The outcome of these games, and consequently the overall network performance, can be predicted using a game theoretic formulation.

In this course, we will present an introduction on game theory with an emphasis on applications for resource management in wireless networks. The first part of the course introduces the students to fundamentals of game theory, while the second part discusses applications to power control, access control, link adaptation, routing, and game theoretic solutions for cooperation in ad hoc networks.
An important component of this course will be the project, which will give the students the opportunity to apply their knowledge to design game theoretic solutions for specific resource allocation applications.

Prerequisites: None. Familiarity with wireless networks is recommended.

Textbook: D. Fudenberg and J. Tirole, "Game Theory", The MIT Press, Cambridge MA, 1992

Reference texts:
J. Zander et al, "Radio Resource Management for Wireless Networks", Artech House, April 2001.
D. Fudenberg and D.K. Levine, "The theory of Learning in Games (Economic Learning and Social Evolution)", The MIT Press, MA, 1998.
R. Gibbons, "Game Theory for Applied Economists", Princeton University Press, July 1992.
R. Meyerson, "Game Theory: Analysis of Conflict", Harvard University Press, Cambridge, MA, 1994.

Syllabus: Part I: Introduction to game theory: Games in strategic form and Nash equilibrium, Existence and properties of Nash equilibrium, Pareto efficiency, Correlated equilibrium, Extensive form games, Repeated games, Bayesian games and Bayesian equilibrium, Potential games, Super-Modular games, Learning in games: Fictitious play, and Regret minimization.
Part II: Applications for wireless networks: Routing, Dynamic channel allocation, Power control, Access control, Link adaptation, General game theoretic framework for cognitive radio networks and Game theoretic solutions for cooperation in ad hoc networks.

Grading:

Homework: 20%
Midterm 40 %
Project 40%