Game Theory for Communication Networks

Course Description:

Modern communication networks support a variety of different applications with various QoS specifications. In this context, for both classic computer networks, as well as for wireless access networks, resource allocation becomes a key factor to guarantee the negotiated QoS, and to optimize the resource utilization. By sharing a common resource, the users' choices in selecting the transmission rates, transmission powers, access method, etc., greatly influence the performance of all the other users in the system.
These interactions can be formally modeled as games, and the outcome of these games, and consequently the overall network performance, can be predicted using a game theory formulation.

In this course, we will present an introduction on game theory with an emphasis on applications for communication networks. After the first part of the course will introduce the students to fundamentals of game theory, the second part of the course will focus on applications for communication networks. For classic computer networks we will discuss applications such as flow control and routing. In the context of wireless access networks, game theoretic approaches to power control, receiver optimization, access control, and link adaptation, will be presented. Using the game theoretic framework, we will characterize the convergence properties of each resource sharing game, such as the existence, uniqueness and efficiency of the Nash equilibrium. Also, for specific examples for both cellular and ad hoc networks, we will discuss how pricing strategies can improve the Nash equilibrium of a particular game.

Prerequisites: Familiarity with computer network analysis and wireless communications is recommended.

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

Reference texts:

R. Meyerson, “Game Theory: Analysis of Conflict”, Harvard University Press, Cambridge, MA, 1994.
M.J. Osborne and A. Rubinstein, “A course in game theory”, The MIT Press, Cambridge, MA, 1994.
R. Gibbons, “Game Theory for Applied Economists”
Research papers from a pre-assigned list.

Grading:

Quizzes: 20%
Midterm 40 %
Project 40%