IEEM 510400

Stochastic Optimization

Semester: Spring 2017

Number of credit hours: 3

Instructor: Professor Kuo-Hao Chang (birdhow@gmail.com)
Room 713R. Phone (03) 5742337

Lecture Time: Friday 2:20-5:10 pm

Office Hours: W 4-6 pm or by appointment

Prerequisites: IEEM510300 (Stochastic Processes) or equivalent probability course. Basic programming skills are also required.

Textbook:

(1) *Introduction to Stochastic Search and Optimization (Estimation, Simulation and Control)* by James C. Spall, John Wiley, 2003.
(2) *Stochastic Programming (Mathematics and Its applications)* by András Prékopa, Kluwer Academic Publishers, 2010.
(3) *Lectures on Stochastic Programming (Modeling and Theory)* by Alexander Shapiro, Darinka Dentcheva and Andrzej Ruszczynski, SIAM-Society for Industrial and Applied Mathematics, 2009.

Overview: The aim of stochastic optimization is to find optimal decisions in problems which involve uncertain data. This field is currently developing rapidly with contributions from many disciplines including operations research, mathematics, and probability. Many successful applications have been found, ranging from agriculture, financial planning, manufacturing to computer networks. This is a research class. An extensive up-to-date paper study and discussion is required.

Student Learning Objectives:

- To develop an understanding of the types of problems for which a stochastic optimization approach is useful
- To understand the fundamental role of the process by which information becomes available in stochastic optimization problems
- To develop insight in structural characteristics of problems that are important for understanding and computation
- To become familiar with a variety of stochastic optimization algorithms and the issues involved in their implementation
- To understand the limitations of these algorithms, and to become familiar with some approximation methods for dealing with large-scale problems.

Course Topics

Stochastic Search and Optimization: an overview (One week)
Direct Methods for Stochastic Search (One week)

Stochastic Approximation (Three weeks)
Gradient Estimation (Two weeks)
Annealing-Type Algorithms (One week)
Evolutionary Computation (Two weeks)
Statistical Methods for Optimization in Discrete Problems (Two weeks)
Simulation-based Optimization (Two weeks)
Other topics

Grading Elements, Weighting and Scale:

Grade Element	**Weighting**
Project and Presentation	40%
Paper Assignment and Presentation	30%
Final exam	30%

Class participation:
From the 3rd week, we will study and discuss one or two paper each week (depending on how many students register in this class). One student (presenter) will make a presentation for the selected topic (the presentation time is about an hour). The presenter and other students should prepare at least five questions, along with their own answers, for discussion. The grade will be given based on questions and answers that students offer in class.

Project and Presentation:
Students will tackle a number of cases throughout the semester and write technical reports. Some programming work will be need. The reports will be collected and graded.

Paper Assignment and Presentation:
Each student will make a presentation for the paper they choose. The papers will be provided by the instructor. The presentation time, including discussion, is about one hour.

Final exam:
The final exam is comprehensive, covering all material discussed in class.