SIE 545: Fundamentals of Optimization

Fall 2014

Course Description: This is a graduate level introductory course on optimization, with an emphasis on the classical mathematical concepts, theory and techniques for linear, nonlinear and discrete optimization problems. The course will cover fundamental concepts in optimization, modeling nonlinear/linear problems, basic results in convex analysis, and optimality conditions for constrained and unconstrained problems, duality theory, and some algorithms.

Prerequisites: SIE 340 – Deterministic Operations Research, or equivalent. Knowledge of elementary calculus and matrix algebra.

Time and Location: TuTh 11:00am-12:15pm, ENGR 301

Instructor: Dr. Neng Fan
Office: ENGR 312
Office Hours: TuTh 12:15pm-1:30pm
Email: nfan@email.arizona.edu (preferred)
Tel: 520-621-6557

Course Website: We'll be using D2L (https://d2l.arizona.edu/). All class materials, including homework assignments, lecture notes, supplementary readings, etc. will be distributed from D2L. I will also be sending emails to the whole class throughout the semester using the classlist in D2L. You must check the announcements in D2L and your email at least twice a week.

Textbook: M.S. Bazaraa, H.D. Sherali, and C.M. Shetty, *Nonlinear Programming: Theory and Algorithms*, 3rd edition, Wiley & Sons Inc, New Jersey, 2006.

Reference: D. Bertsimas and J. N. Tsitsiklis, *Introduction to Linear Optimization*, Athena Scientic, Belmont, Massachusetts, 1997.

Course Objectives: The goal of this course is for students to: (1) improve their ability to formulate real-world problems as optimization problems by some modeling and reformulation tricks, and recognize when problems they consider are nonlinear programming problems; (2) review and extend knowledge and understanding of the mathematical foundations of optimization; (3) develop an understanding of optimization conditions for both unconstrained and constrained nonlinear programming problems; (4) study and understand when and how to apply optimality conditions for solving particular problems; (5) study and apply some basic computational algorithms for nonlinear programs.

Course Outline (subject to change):

1. Mathematical modeling (5 lectures)

2. Convex analysis:
   Convex sets (3 lectures)
   Convex functions and generalizations (4 lectures)

3. Optimality conditions and duality:
   Optimality conditions for unconstrained and constrained problems (6 lectures)
   Lagrangian duality and saddle point optimality conditions (4 lectures)

4. Algorithms (3 lectures)

Course Requirements:

- Lectures: Students are expected to attend and participate in all lectures. Lecture materials will be posted in D2L, and you can print and take to class to make notes. Some questions left in lectures will require you study by yourself.
- Reading: Reading materials from textbook or supplementary posted in D2L will be mentioned in the end of lecture notes. Students are responsible for completing these readings.
- Homework assignments: There will be 8 problem sets due approximately every two weeks. The due date will be given in class and shown in dropbox of D2L. Late homework will not be accepted, and all homework submissions should be electronically through D2L as a PDF-file produced by LaTex.
- Exams: There will be two midterm exams and one final exam. Two midterm exams are in-class with 75-minute limit for each. The final exam has 2-hour limit. The schedule of exams is as follows.
- Grading scheme:
  Homework: 8 sets (20%)
  Exams:
  Midterm exam 1: (25%) 11:00am-12:15pm, October 2, 2014
  Midterm exam 2: (25%) 11:00am-12:15pm, November 13, 2014
  Final exam: (30%) 1:00pm-3:00pm, December 16, 2014

Academic integrity policy: Students are welcome to discuss class related materials, homework assignments with your classmates. However, Students must write solutions individually and cite references, including discussions with classmates.

You are encouraged to make recommendations to improve the class and my teaching skills.