MATH 467, Fall 2015
(39685R,39686R-Discussion)

Theory and Computational Methods for Optimization

Instructors

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Course Description

Optimization is one of the most important categories of mathematical problems that applied mathematicians, scientists and engineering frequently encounter in their work. The development of a large body of mathematical theories was motivated by the optimization problems. While the mathematical theories help to establish the existence of a solution to an optimization problem and, in some cases provide characterization of the solution, the computational techniques are developed to actually find the optimal solution for an application. In this course, we present an introduction to the basic theories of optimization starting from the characterization of optimal solutions for unconstrained and constrained optimization problems using tools of multiple variable calculus and linear algebra. We also provide an introduction to the most frequently used numerical techniques for local and global optimization problems. The following is a tentative list of topics that will be covered in the class:

- Unconstrained optimization and quasi-Newton method
- Least square problems
- Introduction to linear programming and simplex method
- Constrained optimization and convex optimization

Several computation projects which require students to use Matlab to implement specific numerical optimization techniques and to solve interesting application problems will be assigned during the semester. These projects allow students to gain hands-on experience in solving practical optimization problems.

Textbook and Reference

E. K.P. Chong and S.H. Zak, *An Introduction to Optimization*, 4th Ed., Wiley Inter-Science, 2013
S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004

Grading Policy

Homework: 30%, Project: 10%, Midterm Exam: 30%, Final Exam: 30%.
Final Exam: Wednesday, December 16, 11:00AM-1:00PM

Monday, August 24 Introduction and Review	*Wednesday, August 26* Introduction and Review	*Friday, August 28* Set constrained and unconstrained optimization
Monday, August 31 Set constrained and unconstrained optimization	*Wednesday, September 2* One-dimensional search	*Friday, September 4* One-dimensional search
Monday, September 7 Labor Day	*Wednesday, September 9* Gradient method	*Friday, September 11* Gradient method
Monday, September 14 Newton's method	*Wednesday, September 16* Newton's methods	*Friday, September 18* Newton's methods
Monday, September 21 Conjugate gradient method	*Wednesday, September 23* Conjugate gradient method	*Friday, September 25* Conjugate gradient method
Monday, September 28 Conjugate gradient method	*Wednesday, September 30* Quasi-Newton Method	*Friday, October 2* Quasi-Newton Method
Monday, October 5 Linear programming	*Wednesday, October 7* Linear programming	*Friday, October 9* Linear programming
Monday, October 12 Linear programming	*Wednesday, October 14* Linear programming	*Friday, October 16* Midterm Exam
Monday, October 19 Linear programming	*Wednesday, October 21* Simplex Method	*Friday, October 23* Simplex Method
Monday, October 26 Simplex Method	*Wednesday, October 28* Simplex Method	*Friday, October 30* Simplex Method
Monday, November 2 Duality	*Wednesday, November 4* Duality	*Friday, November 6* Duality
Monday, November 9 Constrained optimization	*Wednesday, November 11* Constrained optimization	*Friday, November 13* Constrained optimization
Monday, November 16 Constrained optimization	*Wednesday, November 18* Constrained optimization	*Friday, November 20* Constrained optimization
Monday, November 23 Constrained optimization	*Wednesday, November 25* Thanksgiving	*Friday, November 27* Thanksgiving
Monday, November 30 Convex optimization	*Wednesday, December 2* Convex optimization	*Friday, December 4* Convex optimization