MATH 467, Fall 2019
(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: 15%, Project: 10%, Quiz: 20%, Midterm Exam: 25%, Final Exam: 30%.
Final Exam: Wednesday, December 18, 11 a.m.-1 p.m.

Monday, August 26 Introduction and Review	*Wednesday, August 28* Introduction and Review	*Friday, August 30* Set constrained and unconstrained optimization
Monday, September 2 Labor Day	*Wednesday,* September *4* Set constrained and unconstrained optimization	*Friday, September 6* One-dimensional search
Monday, September 9 One-dimensional search	*Wednesday, September 11* Gradient method	*Friday, September 13* Gradient method
Monday, September 16 Newton's method	*Wednesday, September 18* Newton's methods	*Friday, September 20* Newton's methods
Monday, September 23 Conjugate gradient method	*Wednesday, September 25* Conjugate gradient method	*Friday, September 27* Conjugate gradient method
Monday, September 30 Conjugate gradient method	*Wednesday, October 2* Quasi-Newton Method	*Friday, September 4* Quasi-Newton Method
Monday, October 7 Linear programming	*Wednesday, October 9* Linear programming	*Friday, October 11* Linear programming
Monday, October 14 Linear programming	*Wednesday, October 16* Midterm Exam	*Friday, October 18* Fall Recess
Monday, October 21 Linear programming	*Wednesday, October 23* Simplex Method	*Friday, October 25* Simplex Method
Monday, October 28 Simplex Method	*Wednesday, October 30* Simplex Method	*Friday, November 1* Simplex Method
Monday, November 4 Duality	*Wednesday, November 6* Duality	*Friday, November 8* Duality
Monday, November 11 Constrained optimization	*Wednesday, November 13* Constrained optimization	*Friday, November 15* Constrained optimization
Monday, November 18 Constrained optimization	*Wednesday, November 20* Constrained optimization	*Friday, November 22* Constrained optimization
Monday, November 25 Constrained optimization	*Wednesday, November 27* Thanksgiving	*Friday, November 30* Thanksgiving
Monday, December 2 Convex optimization	*Wednesday, December 4* Convex optimization	*Friday, December 6* Convex optimization

This is a tentative schedule. The contents of lectures may change significantly.