MATP6600/ISYE6780 • Introduction to Optimization • Fall 2017
Time: 10:00-11:50am MR   Location: LOW3112

Instructor: Yangyang Xu
Email: xuy21@rpi.edu
Phone: 518-276-6902
Office: Amos Eaton 310
Office hours: MR 1:30pm – 3:00pm or By Appointment
Course page: https://xu-yangyang.github.io/MATP6600.html

Course Objective

This course is to introduce you optimization theory, methods, and applications. An emphasis will be placed on understanding theory and algorithms of nonlinear programming. After taking the course, you are expected to know

1. how to build up an optimization model for applications in areas such as machine and statistical learning, signal processing, engineering, and operations research

2. whether a given optimization problem is convex or not

3. how to characterize the optimality conditions of an optimization problem and obtain analytic solutions for small-sized problems

4. how to find a solution of an optimization model by applying certain optimization algorithm such as projected gradient descent, augmented Lagrangian method, and recently popular first-order type methods.

Prerequisites

You should be familiar with calculus and linear algebra and have basic knowledge on probability and real analysis.

Textbooks

- *Nonlinear Programming: theory and algorithms, 3rd edition* by Mokhtar S. Bazaraa, Hanif D. Sherali, and C. M. Shetty, 2006. (**required**)
- *Nonlinear Programming* by Dimitri Bertsekas (**recommended**)
- *Convex Analysis* by Rockafellar (**recommended**)
- *Convex Optimization* by Stephen Boyd and Lieven Vandenberghe (**recommended**)
- *Numerical Optimization* by Jorge Nocedal and Stephen Wright (**recommended**)

Topics to cover

1. Convex sets: definitions, Weierstrass' Theorem, Separation Theorem
2. Convex functions: definitions, subgradients, optimality conditions
3. Linear, convex qudratic, and conic optimization
4. Optimality conditions for constrained optimization: Fritz John and Karush-Kuhn-Tucker (KKT) conditions, constraint qualifications
5. Lagrangian duality and saddle point optimality conditions
6. Optimization algorithms: gradient descent, Newton's method, interior-point method, and recent first-order and operator splitting methods
7. Integer programming: examples, convex relaxations
8. Stochastic programming: modeling, examples, stochastic approximation methods

Homework and exams

- **Homework:** 6 in total, approximately once every two weeks. The homework will be posted on the course page https://xu-yangyang.github.io/MATP6600.html
- **Exam:** one mid-term exam and one final exam
- **Grades:** homework 30%, mid-term exam 30%, and final exam 40%. **No late homework will be accepted; no make-up exams**

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