MATH6490 • Topics in Optimization • Spring 2018

Time: 12:00-1:50pm TF Location: DARRIN 236

Instructor: Yangyang Xu
Email: xuy21@rpi.edu
Phone: 518-276-6902
Office: Amos Eaton 310
Office hours: TF 10:30am – 11:30am or By Appointment
Course page: https://xu-yangyang.github.io/MATH6490.html

Course Objective

This course is to introduce recent advancement of optimization methods in big data analysis. The focus will be given to optimization algorithms for very large-scale problems that arise from machine learning, statistics, signal and image processing, and data mining. Convergence and complexity analysis will also be covered. Topics include first-order methods, operator splitting, block coordinate update, stochastic approximation, and parallel computing.

Prerequisites

MATP6600/ISYE6780 or MATP6610 or MATH6800

Textbooks

- *Optimization for Machine Learning* by Suvrit Sra, Sebastian Nowozin, Stephen Wright. (**recommended**)
- *Convex Analysis* by Rockafellar (**recommended**)
- *Introductory Lectures on Convex Programming* by Yuri Nesterov (**recommended**)
- *Convex Optimization* by Stephen Boyd and Lieven Vandenberghe (**recommended**)
- *Numerical Optimization* by Jorge Nocedal and Stephen Wright (**recommended**)

Topics to cover

1. Measure of algorithm reliability and efficiency: convergence in different senses, convergence speed, iteration complexity
2. Gradient descent, proximal gradient, accelerated proximal gradient

3. Block coordinate update method: coordinate descent, randomized coordinate descent, greedy coordinate update
4. Augmented Lagrangian method, linearized augmented Lagrangian method, alternating direction method of multipliers
5. Operator splitting: forward-backward splitting, Peaceman-Rachford splitting, Douglas-Rachford splitting
6. Stochastic gradient method, variance-reduction, accelerated stochastic gradient

Grading policy

- **Homework:** there will be programming assignments, approximately one assignment for each class of methods.
- **Project:** a final project that will be assigned early the semester
- **Grades:** homework 50%, and project 50%

Academic Integrity

Intellectual integrity and credibility are the foundation of all academic work. A violation of Academic Integrity policy is, by definition, considered a flagrant offense to the educational process. It is taken seriously by students, faculty, and Rensselaer and will be addressed in an effective manner.

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