

ISyE 4133 Advanced Optimization Syllabus

Course Objective: We will discuss optimization models and algorithms for machine learning. After taking this course, students are expected to have a good understanding about the foundation and recent progresses in the active field of optimization for machine learning.

Classes: 14 weeks, 3 hours per week (15:05pm-16:25pm T, Th, Instr Center 117)

Prerequisites: 1. Engineering Optimization (ISyE 3133), 2. Linear algebra (from Calculus II), Math 2602, and CS1316, or equivalents, 3. Basic statistics: ISyE 2028 - Basic Statistical Methods. These are real pre-requisites. Basic programming skills will also help you with the projects.

Grading policy: homework and quiz (30%), midterm (30%), project (40%).

Tentative schedule:

- Unit#1: Convex optimization
 - Generalized linear models
 - Support vector machine
 - Convex sets and convex functions
 - Convex programming duality
 - First-order methods
 - Second-order methods
 - Stochastic first-order methods
- Unit#2: Nonconvex optimization
 - Deep learning and other nonconvex models in machine learning
 - Optimality conditions for nonlinear programming
 - First-order methods and stochastic first-order methods for nonconvex optimization
 - Other optimization methods for nonconvex problems
- Unit#3: Low rank models and matrix optimization
 - Low rank models
 - Conditional gradient method