IE539: Convex Optimization

Instructor: Woo Chang Kim
Industrial & Systems Engineering
Fall 2020

Course Objectives

This course will address a number of advanced topics in mathematical programming with particular emphasis on convex optimization problems. Topics will include

- Convex sets and convex functions
- Convex optimization problems, including linear, quadratic, semidefinite, and other special problems
- Applications of convex optimization in statistics and finance
- Duality and optimality conditions
- Algorithms for unconstrained and constrained convex optimization, including interior point methods
- Optimization for machine learning: problems, methods, applications, and challenges

Instructor

- Woo Chang Kim, ISysE Dept., #3107, E2-2, (T) 3129, wkim@kaist.ac.kr
- TAs: TBA
- Office hours: TBA

Time and Location

- Time: 1 to 2:15PM on Monday and Wednesday
- Location: Class will meet online via Zoom during the class hours.
- The instructor has two academic travels scheduled during the semester. If needed, make-up classes will be given.

Prerequisites

- Advanced calculus
- Linear algebra
- Mathematical analysis
- Basic knowledge in Matlab or Python

Textbook

- Convex optimization, S.Boyd & L.Vandenberghe, Cambridge University Press
- Visit http://www.stanford.edu/~boyd/cvxbook for detailed information about the book

References

- Nonlinear Programming: Theory and Algorithms by M. Bazaraa, H. Sherali, and C. Shetty
- Nonlinear Programming by D. Bertsekas
- Convex Analysis and Optimization by D. Bertsekas
- Introductory Lectures on Convex Optimization by Y. Nesterov
- Numerical Optimization by J. Nocedal and S. Wright
- Nonlinear Optimization by A. Ruszczynski

Logistics

- Grading: Homework assignments (50%), Final exam (50%)
- Attendance: -3% for each absence after first 3
- The announcements as well as the course materials will be posted to the KLMS website

Tentative Schedule

Week #	Lecture	Topics	Reading
1	1	Introduction	Chapter 1, Appendix A
	2	Convex sets I	Chapter 2
2	3	Convex sets II	
	4	Convex sets III	
3	5	Convex functions I	Chapter 3
	6	Convex functions II	
4	7	Convex functions III, Quasiconvex functions	
	8	Convex optimization problems I	Chapter 4
5	9	Convex optimization problems II	
	10	Convex optimization problems III	
6	11	Convex optimization problems: extensions	
	12	SDP and related problems, Optimization software	
7	13	Duality I	Chapter 5
	14	Duality II	
8		Reserved for review	
9	15	Duality III	
	16	Duality IV	
10	17	Duality V	
	18	Algorithms for unconstrained optimization I	Chapter 9
11	19	Algorithms for unconstrained optimization II	
	20	Algorithms for unconstrained optimization III	
12	21	Numerical linear algebra	Appendix C
	22	Algorithms for optimization with linear constraints	Chapter 10
13	23	Interior point methods I	Chapter 11
	24	Interior point methods II	
14	25	Optimization for machine learning I: problems	Papers (TBD)
	26	Optimization for machine learning II: methods	
15	27	Optimization for machine learning III: applications	
	28	Optimization for machine learning IV: challenges	
16		Final Exam	