SHANGHAI JIAOTONG UNIVERSITY
X071571: OPTIMIZATION METHODS
2018 COURSE OUTLINE

1. Basic Informations

Instructors.

Lecturer : Victor Mouquin *mouquinv@sjtu.edu.cn*
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Space-time coordinates.

Space : RM 213, Chen Ruiqiu Building, Min Hang Campus
Time : Fridays 8:55 - 11:40, Week 1-16

Website. `http://math.sjtu.edu.cn/faculty/victorm/X071571.html`

2. Goals

After taking this class, you will have a solid understanding of

- Convex Analysis. Convex sets and their properties, projections onto convex sets, separation of convex sets by hyperplanes, convex hull of sets, etc. Convex functions of severable variables. Continuity of convex functions, first and second order criterion of convexity.
- Convex or non-convex optimization problems in normal forms, various kind of standard optimization problems such as linear programs, least squares, etc. Recognize or formulate problems as convex optimization problems.
- Duality in optimization. KKT Conditions, how to use duality to obtain lower bounds for potentially non-convex problems.
- Unconstrained optimization. Algorithms to solve such problems, such as gradient or steepest descend methods, (quasi-)Newton methods, conjugate gradient algorithms, etc.
- Constrained optimization. Algorithms such as the interior point methods, the barrier methods, primal-dual methods, etc.

3. Prerequisites

Multivariable Calculus, Linear Algebra. Basic coding skills in languages such as Python or Matlab would be helpful (although I guess not absolutely necessary for success in this course). Some homework problems will require numerical implementations, and some course projects can have a programming component.

4. Texbooks

(1) Fundamentals of convex analysis, J.-B. Hiriart-Urruty, C. Lemarechal. Springer
(2) Numerical Optimization, Jorge Nocedal and Stephen Wright, 2nd Edition, Springer
(3) Convex Optimization, Stephen Boyd and Lieven Vandenberghe, Cambridge University Press
(4) Vandenberghe Lecture notes, `http://www.seas.ucla.edu/~vandenbe/ee236b/ee236b.html`

5. Evaluation

- **Homework:** There will be 4 Problem Sets during the semester. They will involve a blend of theoretical problems (i.e proof based) and practical ones (i.e numerical implementations). Your are expected to hand in a short report with details of your solutions or code.
- **Class Project:** You will be expected to complete a class project, in groups of 2-3 students. This will involve giving a presentation in front of the class (during the last 2 weeks of the semester) and writing up a short report with your explanation/code/implementation.

  The subject of this project will be a discussion on a research paper related to optimization methods. I will give you a list of such possible subjects. Of course, it is also acceptable to come up with your own topic, provided you let me know in advance, so that I can approve it.
- **Final Exam:** There will be a closed book, written final exam.

6. Final Mark

Late handling. A Problem Set or project report handed back after the deadline will be deducted 10% of its mark. Problem Sets or project reports handed back more than three days after the deadline will be refused, and thus will be given a 0 mark.

Discussing problems with other students is absolutely fine (and even encouraged!) but Problem Sets reports must be individual. In particular, it is **not acceptable** to have two different reports completely identical. In other words, you can collaborate and discuss with others, but should write up your solutions independently.

Final grade.

$$30\% \cdot (\text{Problem Sets Mark}) + 30\% \cdot (\text{Class Project Mark}) + 40\% \cdot (\text{Final Exam}).$$