University of Southern California
Daniel J. Epstein Department of Industrial and Systems Engineering
ISE 520: Optimization: Theory and Algorithms – Fall 2006
Course Syllabus

Instructor: Fernando Ordóñez
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Office Hours: 11:15 -12:15 Monday-Wednesdays

General:
The course meets Mondays and Wednesdays, 2:00 - 3:15 at KAP-165. Handouts will be posted at the Blackboard website (http://totale.usc.edu)

Course Text:
Stephen Boyd and Lieven Vandenberghe *Convex Optimization*, Cambridge University Press, 2004.

Course Objectives:
The course is a graduate-level subject in the theory, applications, and algorithms of convex optimization. Topic covered include convexity, conditions for optimality, and nonlinear programming algorithms for unconstrained and constrained problems. Several applications of convex optimization will be discussed.

The objective is to provide students with a working knowledge of convex optimization. That is to develop the skills and background needed to recognize, formulate and solve convex optimization problems.

Prerequisites:
MATH 225, Linear Algebra and Linear Differential Equations or
EE 441, Applied Linear Algebra for Engineering or Departmental approval

Grading:
The course will have almost weekly problem sets, which will consist of problems from the text and computational exercises. Computational exercises will be carried out using the NEOS Server for Optimization (http://www-neos.mcs.anl.gov/) and/or MATLAB. The homeworks will be graded on a random subset of the problems, but solutions to all problems will be posted in the course's web-page. The course will also have midterms and a final exam. The grading for the class will be determined using the following weights, homework: 30%, midterm average 30%, and final: 40%.

Academic integrity: "The Department of Industrial and Systems Engineering adheres to the University's policies and procedures governing academic integrity as described in SCampus. Students are expected to be aware of and to observe the academic integrity

standards described in SCampus, and to expect those standards to be enforced in this course."

"Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776."

Tentative Course Outline:

1. Introduction (1 lectures)
- Optimization problems, Least-squares and linear programming, Convex Optimization, Equivalent optimization problems

2. Convex Sets and Functions (4 lectures)
- Convex sets and functions, Operations that preserve convexity, Separating and supporting hyperplanes, Cones and Generalized inequalities, Conjugate function

3. Convex Optimization Problems (3 lectures)
- Convex optimization, Linear and quadratic programming, Geometric programming, Generalized inequality constraints, Vector optimization.

4. Duality (4 lectures)
- Lagrange dual, Optimality conditions, Perturbation and sensitivity analysis, Theorems of alternatives

5. Applications (5 lectures)
- Approximation and fitting, Statistical estimation, Chebyshev and Chernoff bounds, Geometric problems, Classification

6. Unconstrained and Equality Constrained Minimization (5 lectures)
- Descent methods, Gradient and steepest descent methods, Newton's method, Self-concordance, Newton's method with equality constraints, Infeasible start Newton method

7. Interior point methods (3 lectures)
- Logarithmic barrier function and central path, Barrier method, Feasibility and phase I methods, Complexity, Primal-dual methods.

8. Non-smooth, non-convex optimization (2 lectures)
- Subgradients, convex lowerbounds, branch and bound.

Tentative Assignment Schedule:

Class	Date	Assignment	Reading
1	Aug 21		1.1- 1.6
2	Aug 23		2.1 - 2.6
3	Aug 28		
4	Aug 30	PS #1 due	3.1 - 3.4, 3.6
5	Sep 6		
6	Sep 11	PS #2 due	4.1 - 4.7
7	Sep 13		
8	Sep 18	PS #3 due	
9	Sep 20		5.1 - 5.8
10	Sep 25	PS #4 due	
11	Sep 27		
12	Oct 2	PS #5 due	
13	Oct 4		Ch. 6, 7, 8
14	Oct 9	**Midterm 1**	
15	Oct 11		
16	Oct 16		
17	Oct 18		
18	Oct 23	PS #6 due	
19	Oct 25		9.1 - 9.7
20	Oct 30	PS #7 due	
21	Nov 1		
22	Nov 6	PS #8 due	10.1 - 10.4
23	Nov 8		
24	Nov 13	PS #9 due	11.1 - 11.5
25	Nov 15		
26	Nov 20	PS #10 due	
27	Nov 22		
28	Nov 27	PS #11 due	
29	Nov 29		
30	Dec 8	**Final Exam**	2:00-4:00 p.m.