EE 364A: Convex Optimization I
Summer 2013

Website

All course information is available at: ee364.stanford.edu.

Contact

- **Instructor:** Madeleine Udell, Packard 243, udell@stanford.edu.
- **Administrative Assistant:** Doug Chaffee, Packard 259, (650) 721-2892, dchaffee@ee.stanford.edu.
- **Teaching Assistants:**
  - Reza Takapoui, takapoui@stanford.edu.
  - Scott McKinney, scott.mckinney@stanford.edu.

Office Hours

Madeleine Udell's office hours: Mondays 5 – 6:15pm, Packard 243, and by appointment.

TA office hours: The TAs will offer informal working sessions, that will also serve as their office hours, during the week. Attendance is not required.

- Reza: Wednesdays 5–7pm, Packard 242.
- Scott: Thursdays 10am–12pm, lower level of Huang, near the entrance to ICME

Course Description

Concentrates on recognizing and solving convex optimization problems that arise in applications. Convex sets, functions, and optimization problems. Basics of convex analysis. Least-squares, linear and quadratic programs, semidefinite programming, minimax, extremal volume, and other problems. Optimality conditions, duality theory, theorems of alternative, and applications. Interior-point methods. Applications to signal processing, statistics and machine learning, control and mechanical engineering, digital and analog circuit design, and finance.

Course Objectives

- to give students the tools and training to recognize convex optimization problems that arise in applications
- to present the basic theory of such problems, concentrating on results that are useful in computation
- to give students a thorough understanding of how such problems are solved, and some experience in solving them
- to give students the background required to use the methods in their own research work or applications

Intended Audience

This course should benefit anyone who uses or will use scientific computing or optimization in engineering or related work (e.g., machine learning, finance). More specifically, people from the following departments and fields: Electrical Engineering (especially areas like signal and image processing, communications, control, EDA & CAD); Aero & Astro (control, navigation, design), Mechanical & Civil Engineering (especially robotics, control, structural analysis, optimization, design); Computer Science (especially machine learning, robotics, computer graphics,

algorithms & complexity, computational geometry); Operations Research (MS&E at Stanford); Scientific Computing and Computational Mathematics. The course may be useful to students and researchers in several other fields as well: Mathematics, Statistics, Finance, Economics.

Prerequisites

Good knowledge of linear algebra (as in EE263), and exposure to probability. Exposure to numerical computing, optimization, and application fields helpful but not required; the applications will be kept basic and simple.

You will use matlab and CVX to write simple scripts, so some basic familiarity with matlab will be required. Many good matlab tutorials are available online. The short course "CME192: Introduction to Matlab" is offered concurrently. This course is entirely optional, and will cover matlab in much greater depth than we require.

Lectures

Lectures are Tuesdays and Thursdays, 1:15-3:05pm, in Thornton 102. Thursdays will be interactive sessions in which students will discuss and present on homework problems. Students will also be required to watch some lectures online in order to make time for the more interactive class sessions on Thursdays.

Several sets of videos of previous lectures are available, but should not be considered a substitute for coming to class.

Textbook and Optional References

The textbook is *Convex Optimization*, available online, or in hard copy form at the Stanford Bookstore.

Several texts can serve as auxiliary or reference texts:

- Bertsekas, Nedic, and Ozdaglar, *Convex Analysis and Optimization*
- Ben-Tal and Nemirovski, *Lectures on Modern Convex Optimization: Analysis, Algorithms, and Engineering Applications*
- Nesterov, *Introductory Lectures on Convex Optimization: A Basic Course*
- Ruszczynski, *Nonlinear Optimization*
- Borwein & Lewis, *Convex Analysis and Nonlinear Optimization*

You won't need to consult them unless you want to.

Course Requirements and Grading

Requirements:

- *Weekly homework assignments*. Homework will normally be assigned each Friday. Students should be prepared to discuss and present on their solutions to the homework by the following Thursday, and should turn in their solutions the following Friday by 5pm in the box accross from Packard 243. **Late homework will not be accepted.** You are allowed, even encouraged, to work on the homework in small groups, but you must write up your own homework to hand in. Homework will be graded on a scale of 0–4.

- *Problem presentations*. On Thursday classes, a 50 minute lecture will be followed by an interactive session. After discussing the problems in small groups, students will be called on at random to present their solutions to homework problems. SCPD students should email the staff list to set up a day and time to

present, which can be accomplished either by attending class or via videoconference. Each student should expect to present about twice during the quarter.

- *Class participation*. Each student should turn in three responses to the material each week, each corresponding to an hour of lecture, or to one third of the reading listed for that week. These responses may take the form of questions, comments, summary of main points, or examples. Credit will be given for responses that are turned in and are relevant to the material covered,with binary grading (credit/no credit) for each response. Responses may be handed in physically in class, or submitted electronically on Piazza. All responses for a given week's material should be submitted by 5pm Friday. Attendance is not required. However, class participation in the problem sessions on Thursdays 2:10 - 3:05 does constitute part of the grade for in-person students. (SCPD students are exempted from this course requirement).

- *Final exam*. The format is a 24 hour take home, scheduled for the last week of classes, but we will accommodate your schedule if you can't take it at that time.

Grading: Homework 20%, problem presentations 10%, participation 20%, final 50%.

These weights are approximate; we reserve the right to change them later.

Quizzes

This class has **no** formal quizzes.

There are on-line quizzes on the lecture slides page. These are just for fun; they are not graded and your responses are not logged.