Math 409-509 (Spring 2011) - Optimization
Syllabus

Instructor
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Lecture Hours and Location
Monday, Wednesday at 12:30 at SCI B09

Discussion Sections
To be announced

Course Webpage
http://home.ku.edu.tr/∼emengi/teaching/math409/math409.html

Textbooks
The first book below can be obtained from the Xerox room in the student center. The second book will be made available at the reserve desk in the library.

- Numerical Optimization, Philip E. Gill and Margaret H. Wright (Main textbook)
- Numerical Optimization 2nd Edition, Jorge Nocedal and Stephen J. Wright

Grading
Your overall score will be determined based on your performance in the homeworks, midterms and the final using the scheme below.

$$\text{Total Score} = \%30(\text{Homework Score}) + \%30(\text{Midterm}) + \%40(\text{Final})$$

Please keep in mind that there will be a curve in the end.

Prerequisites
The prerequisite is a course on multivariable calculus (for instance Math 203). Linear algebra will play a crucial role, but is not a prerequisite. The course will be as self-contained as possible. In particular basic linear algebra background will be described.

It is important that you are comfortable with multivariable calculus. We will be differentiating and integrating vector valued functions depending on multivariables. The chain rule may get quite complicated. Taylor polynomials will be reviewed and employed frequently.

Experience with performing numerical computations (for instance in Matlab) would help, but is not required.

Midterms
The midterm will be held during the regular lecture at SCI B09 on April 25th, Monday. All topics covered in class until April 20th, Wednesday are included in the midterm. The midterm will be a closed book exam. You can use one-page of double-sided notes.

Final
The location and date of the final will be announced later towards the end of the semester. The final will be a closed-book exam. You can use one-page of double-sided notes.

Homeworks
You will be assigned five or six homeworks. Your homework score will be determined by taking the average of these homeworks. You will typically be given two weeks to complete each homework.

Half of the homework questions will be conceptual. The remaining half will be computational and require performing computations in Matlab.

Description
Two main ingredients of an optimization problem are

- an objective function which we want to minimize or maximize,
- a set of constraints which determines the set of allowable points over which the objective function must be minimized or maximized.

The first part of this course will focus on unconstrained optimization problems in the absence of constraints. Constrained optimization problems will be considered in the second part. For both cases we will derive the optimality conditions (*i.e.* conditions that distinguish an optimal point from an ordinary point), introduce numerical algorithms to locate points satisfying the optimality conditions and analyze the convergence properties of the numerical algorithms. More precisely the following topics will be covered in this specific order.

- Optimality Conditions for Unconstrained Optimization and their Derivation
- Solution of Nonlinear systems (Zero Finding) - Newton's Method
- Line Search Methods for Unconstrained Optimization
- Optimality Condition for Constrained Optimization and their Derivation
- Penalty and Barrier Function Methods for Constrained Optimization
- Linear and Quadratic Programming (as much as time permits)