Prerequisites: Undergraduate analysis and linear algebra at the level of Math 104/110

Required textbooks:

Recommended book:

Instructor: Alper Atamtürk (email: atamturk@berkeley.edu)
Lectures: Tue Thr 12:30–2 PM (3106 Etcheverry)
Office hrs: Wed 4-6 PM (4175 Etcheverry)
Teaching assistant: Nguyen Truong (email: truongln@gmail.com)
Discussion hrs: Sec 101: Fri 3-4 PM (3106 Etcheverry)
Office hrs: Mon 9–11 AM (1116 Etcheverry)

Course web page: Maintained at http://bspace.berkeley.edu/
Final exam: FRIDAY, DECEMBER 18, 2009 12:30–3:30 PM

Course description
This a graduate level introductory course on optimization. The course will cover fundamental concepts in optimization theory, generic algorithmic approaches, as well as modeling optimization problems and their numerical solution. In particular, the topics will include elements of convex analysis, linear programming, sensitivity analysis, Lagrangian duality, local optimality conditions for unconstrained and constrained nonlinear problems, and introduction to discrete optimization. Optimization algorithms, including the simplex method and its variants, steepest descent method, Newton’s method, and branch-and-bound method will be introduced.

Students will be assigned theoretical as well as computational exercises. There will be a midterm exam and a final exam.

Grading
- Problem Sets: 30%
- Midterm Exam: 30% [October 22, 2009, 12:30–2:00 PM]
- Final Exam: 40% [December 18, 2009, 12:30–3:30 PM]
Outline

1. Elements of convex analysis
   - Basic terminology
   - Convex sets and convex functions (NLP: Ch2, Ch3)
   - Projection, separating hyperplanes, Farkas’ lemma (LP: Sec 4.6, 4.7)
   - Polyhedral sets (LP: Ch 2)

2. Linear programming
   - Introduction to linear programming (LP: Ch 1)
   - Duality, certificates of optimality and unboundedness (LP: Ch 4)
   - Simplex method and its variants (LP: Ch 3)
   - Sensitivity analysis and parametric programming (LP: Ch 5)

3. Nonlinear programming
   - Unconstrained optimization (NLP: Ch 1)
     - Local optimality conditions (NLP: Sec 4.1)
     - Steepest descent method (NLP: Sec 8.6)
     - Newton’s method and its variants (NLP: Sec 8.6)
   - Constrained optimization (NLP: Ch 3,4)
     - Local optimality conditions for equality constrained problems
     - Karush-Kuhn-Tucker conditions & constraint qualification (NLP: Ch 4,5)
     - Lagrangian duality and saddle point optimality conditions (NLP: Ch 6)

4. Discrete optimization
   - Computational complexity (LP: Secs 8.1, 11.8)
   - Modeling techniques (LP: Ch 10)
   - Network problems and total unimodularity (LP: Ch 7)
   - Relaxation and search (LP: 11)
   - Dynamic programming (LP: 11)
   - The art and joy of optimization: applications (LP: Ch 12)

This syllabus may be modified as time and interests dictate.