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University of Southern California
Daniel Epstein Department of Industrial and Systems Engineering
ISE 520: Fall 2017
Numerical Optimization
MW: 3:30-4:50 pm, KAP-148

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Instructor: Professor Suvrajeet Sen
Email: s.sen@usc.edu
Office hours: M,W: 1:30pm – 2:30pm (Office: OHE 310P)

Teaching Assistant: Junyi Liu
Office hours: TBD

Preamble: This is a new offering of ISE 520. This is totally redone, and will not cover the material taught that was covered in the previous offerings of the course.   As the name suggests, it will focus on numerical methods, and will require some familiarity with computer programming. Students interested in fulfilling requirements for Financial Engineering, Data Science, or other non-ISE majors should take ISE 530 which will cover material that is more appropriate. EE students might consider this course in place of EE 553 which used to cover similar material in the past, although that course has not been offered in recent years.

Prerequisites: Multivariate Calculus, Linear Algebra, Computer Programming

Goals: Numerical optimization is the methodology which brings mathematical optimization theory, and numerical linear algebra under one umbrella so that the fruits of computing technology can be realized via robust and stable optimization algorithms. We will start with an understanding of optimization algorithms in a somewhat abstract manner, although, we will quickly transition into mini-projects for hands-on "learning" ranging from simple one-dimensional optimization to multi-dimensional constrained nonlinear optimization. The sequence of topics are chosen so that assigned projects can be completed during the semester.

Tentative lecture sequence:

Weeks	Dates	Topic	Source
1	8/21-8/23	Optimization Algorithms (Structure, Maps, Closedness)	Chapter 7, Bazaraa et al
2	8/28-8/30	Line Searches: "Exact" and Inexact Methods	Chapter 8, Bazaara et al
3	9/4-9/6	Steepest Descent, Newton's Method and Relatives	Chapter 8, Bazaara et al
4	9/11-9/13	Convergence Rate: Steepest Descent, Newton's Method	Chapter 3, Nocedal/Wright
5	9/18-	Conjugate Gradient	Chapter 5,

	9/20	Methods	Nocedal/Wright
6	9/25-9/27	Quasi-Newton Methods (QN)	Chapter 6, Nocedal/Wright
7	10/2	**Mid-term I**	Material for Weeks 1-5
7	10/4	Analysis of QN Methods	Chapter 6, Nocedal/Wright
8	10/9-10/11	Cholesky Updates and Limited Memory QN	Chapter 7, Nocedal/Wright
9	10/16-10/18	Constrained Optimization Basics	Chapter 12, Nocedal/Wright
10	10/23-10/25	Quadratic Programming	Chapter 16
11	10/30-11/1	Penalty Function Methods	Chapter 9, Bazaraa et al
12	11/6	**Mid-term II**	Material for Weeks 6-10
12	11/8	Successive Quadratic Programming	Chapter 18
13	11/13-11/15	Parameter Updates and Convergence of SQP	Chapter 18
14	11/20	Barrier Methods	Chapter 9, Bazaraa et al
15	11/27-11/30	Barrier and Interior Point Methods	Chapter 19, Nocedal/Wright

Textbook: Nocedal and Wright 2nd Edition, Springer Series and Bazaraa, Sherali and Shetty (electronic edition).

Mid-Terms (50%): Two mid-terms (equally weighted)
Programming Assignments (30%): Exact/Inexact Line Searches, DFP and BFGS Updates, Successive QP
Homework Assignments (20%): Four Assignments

Statement for Students with Disabilities

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. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/. Information on intellectual property at USC is available at: http://usc.edu/academe/acsen/issues/ipr/index.html.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.

Please activate your course in Blackboard with access to the course syllabus. Whether or not you use Blackboard regularly, these preparations will be crucial in an emergency. USC's Blackboard learning management system and support information is available at blackboard.usc.edu.