AMSC 607/ CMSC 764 TTh 11-12:15, CSI 2120
Advanced Numerical Optimization, Fall, 2010
http://www.cs.umd.edu/users/oleary/a607

Prof. Dianne P. O'Leary: Room 3271 A.V. Williams Building,
oleary@cs.umd.edu

Office Hours: Tuesday 1:00-2:30, Friday 8:30-10, and by appointment, in AVW 3271. Please restrict telephone inquiries to office hour times, except in "emergencies." E-mail is welcome anytime!

Prerequisites: A course in linear algebra and a course in numerical analysis. (A previous course in optimization is NOT expected.)

Purpose: An algorithmic approach to numerical optimization, constrained and unconstrained. Emphasis on practical methods with enough theory to make them work.

Texts: No required texts. Any of the following books would be a good primary reference. We will make use of on-line resources for more advanced material.

- Numerical Optimization by Jorge Nocedal and Stephen J. Wright, Springer, 2006.
- Linear and Nonlinear Optimization by Igor Griva, Stephen G. Nash, and Ariela Sofer, SIAM Press, 2009.
- Linear and Nonlinear Programming by Stephen G. Nash and Ariela Sofer, McGraw-Hill 1996. This book is an out-of-print older edition of the book above. Inexpensive copies are available used.
- We will make use of on-line resources for more advanced material, although A Mathematical View of Interior-Point Methods in Convex Optimization" by James Renegar, SIAM Press, 2001 is an excellent reference for this material.

Grading: Grading will be on a *curve*, except that you will be guaranteed an A- if your average is 90% or better, a B- if your average is 80% or better, etc. Keep all of your work in case there is any question about recording of grades.

Homework	**approx. 200 points**
Project	**100 or 200 points**
Final Exam (open book/notes)	**100 points**

You can choose to do a 200 point project, or choose to do a 100 point project and take the final exam on Monday, December 13, 8-10am. *For Computer Science Majors who want to count this as an MS comp or PhD qualifying course: You need to take the final exam.*

Homework: Approximately 1 week will be allowed for each assignment. Some homework will include programming assignments using the software package MATLAB. To pass this course, you must make an honest effort at each homework. Partial credit will be given for partially-working programs. There will be a 15% penalty for assignments turned in up to 2 days late, 30% penalty for assignments turned in 2-4 days late, etc.

The project will involve an investigation of one aspect of constrained optimization. More information will be given in mid-October. It is due at 11am on Tuesday, December 14.

Regrades: If you think a mistake has been made in grading your work, submit it for regrading within two weeks of the date on which the work was returned to the class. After that, the grade will be considered final.

News: Assignments, course notes, answers to homeworks, and announcements will be posted on the course's homepage. You are responsible for checking this site before each class.

Accommodations: If you require academic accommodations due to a religious obligation or a disability, you must provide documentation by the end of the 2nd week of the semester.

Academic Integrity: Class accounts are to be used only for class assignments. All files within the accounts are subject to inspection, and the cam-

pus code of computer conduct must be followed. All work that you submit in this course must be your own; group efforts will be be considered academic dishonesty. See http://www.studenthonorcouncil.umd.edu/code.html for definitions and sanctions. You may discuss homework and the project in a general way, but you may not consult any one else's written work, program drafts, computer files, etc. Any marked similarity in form or notation between submissions with different authors will be regarded as evidence of academic dishonesty – so protect your work. You are free to use reference material to help you with assignments, but you must cite any reference you use. Such citation will not lower your grade, although extensive quotation might.

CourseEvalUM: Please complete your evaluation for this course near the end of the semester at http://www.courseevalum.umd.edu.

COURSE OUTLINE

Objective: Understand and use state-of-the-art algorithms for optimization. (Note that this is a moving target.)

Prerequisites: A course in linear algebra and a course in numerical analysis. A previous course in optimization is not assumed.

1. **Introduction** (approx. 2 weeks)

   sources of optimization problems
   feasibility, optimality, convexity
   representation of linear constraints

2. **Unconstrained Optimization** (approx. 4 weeks)

   A survey of the characterization of solutions to minimization problems, algorithms for problems of various smoothness, and global optimization.

   optimality conditions, descent methods
   Newton's method and steepest descent
   automating differentiation
   variations on Newton's method

3. **Constrained Optimization** (approx. 8 weeks)

   A survey of feasible set methods, projection methods, and interior point methods for linear and nonlinear constraints.

   optimality conditions
   duality
   feasible point methods
   penalty and barrier methods
   interior point methods