EBGN552 - Nonlinear Programming

Spring 2013

Lectures	Monday, Wednesday	9:30am - 10:45am	211 Engineering Hall
Instructor	A. M. Newman		
	Office:	319 Engineering Hall	
	Office Hours:	Monday	10:45am-11:15am
		Tuesday	8:00am-9:00am; 5:00pm-8:00pm
		Wednesday	10:45am-11:15am
	email:	newman@mines.edu	
Teaching	Timo Lohmann		
Assistant	Office:	126 Engineering Hall	
(TA)	Office Hour:	Monday	3:00pm-4:00pm

GENERAL INFORMATION

- **Textbooks:** *(recommended)*
  - ⋆ Optimization of Chemical Processes, Edgar, Himmelblau, Lasdon. (second edition)
  - ⋆ Optimization in Operations Research, Rardin.
  - ⋆ Nonlinear Programming: Theory and Algorithms, Bazaraa, Sherali, Shetty. (third edition)
  - ⋆ AMPL: A Modeling Language For Mathematical Programming, Fourer, Gay, Kernighan. (second edition)
- **Assignments:** There will be a weekly assignment due Wednesday (the following week). The TA will grade the homework, so direct homework grading questions to him. *Do not send email to the TA!!*
- **Project:** There will be a project involving formulating, solving and analyzing a challenging problem, writing code, and/or performing a literature review. The project group may consist of between one and four students. The project will be due during finals week.

- **Exams:** There will be a midterm and a final examination. Both are open book. You must wait 48 hours after the exam has been handed back to ask (me) any grading questions.
- **Grading:**
  - ⋆ Class Participation: 5%
  - ⋆ Homework Assignments: 20%
  - ⋆ Project: 25%
  - ⋆ Midterm: 20%
  - ⋆ Final: 30%

  Grading is done on a curve where 90% is sufficient but not necessarily necessary for an A-, 80% is sufficient but not necessarily necessary for a B-, etc.

COURSE OUTLINE

- ⋆ **I. Nonlinear Programming Formulations**
  - · Unconstrained problems
  - · Constrained problems
- ⋆ **II. Mathematical Structure of Nonlinear Programs**
  - · Review of linear programming
  - · Difficulty of finding solutions for nonlinear programs
  - · Well-behaved nonlinear programs (convex sets, convex functions, convex regions)
- ⋆ **III. Solution Techniques for Unconstrained Problems**
  - · Optimality conditions
  - · Rate of convergence
  - · Steepest Descent and Line search
  - · Newton's method
- ⋆ **IV. Solution Techniques for Constrained Problems**
  - · Karush-Kuhn-Tucker optimality conditions
  - · Lagrangian methods
  - · Penalty and Barrier methods
  - · Methods of feasible directions, e.g., reduced gradient
- ⋆ **(V. Mixed Integer Nonlinear Programming)**[1]

[1] Time permitting

- Formulation
- Solution techniques

⋆ **Computer Implementation**

- Model implementation will be emphasized throughout the course (using AMPL or GAMS as a modeling language – as in EBGN555, 556, and 557). However, as time permits, we will explore how to "fine-tune" state-of-the-art software (e.g., MINOS) to achieve the "best" results (in terms of solution quality or solution time) possible.

• RULES

⋆ Please do not send email regarding homework problems; come to office hours instead.

⋆ Statute of limitations for questions about grading is one week from the student's receipt of the graded work.

⋆ I do not want to see or hear your cell phone. Ever. This includes during office hours.

⋆ No rudeness of any kind towards anyone in the class will be tolerated.

⋆ Do not talk to your neighbor during class.

⋆ You may confer with others regarding the homework and project, but the work you hand in must be your own. Please ensure it is done neatly.

⋆ Attendance in class is required. Be on time.

⋆ Any alternate arrangements for exams must be submitted in writing at least one week in advance of the exam. Any additional arrangements regarding disabilities must be *formally* and *legally* documented and approved.

A minor infraction of the above rules will result in a warning. A major infraction will result in expulsion from the class.