ESC 702 Advanced Optimization
Spring 2019
Cleveland State University

General Information

Meeting time and place :	T-Th 4:00-5:50 PM in WH 205
Instructor:	Dr. Eric Schearer, e.schearer@csuohio.edu, FH 104
Office Hours:	M/W 3:30-4:30 in WH122 (Center for Human Machine Systems)

Course Description

This is an advanced course in optimization. Optimization is the practice of finding inputs to an objective function that either minimize or maximize the function's output. The course covers methods for solving unconstrained and constrained problems with linear, quadratic, and generally nonlinear objective functions and constraints.

Course Objectives

Upon completion of the course students will be able to

- Understand various linear and nonlinear optimization techniques and their rates of convergence
- Select an appropriate optimization technique to solve a specific problem
- Write a program in Matlab to solve unconstrained and constrained problems with nonlinear objectives and constraints
- Use various functions in the Matlab optimization toolbox to solve optimization problems
- Propose and solve an optimization problem relevent to each student's research and give oral and written reports on the solution.

Prerequisites

multivariable calculus
linear algebra
computer programming in Matlab

Textbook

The textbook is Nocedal and Wright, *Numerical Optimization*, 2nd Ed., Springer, 2006. If you go to `http://scholar.csuohio.edu/record=b2572431` you can access the book online and download individual chapters for free.

Matlab

We will use Matlab frequently in this course. Matlab is available in the computer labs in Fenn Hall. CSU students can also install a stand-alone version of Matlab on their own computers for free. Go to `http://www.csuohio.edu/research/matlab-installation-instructions` for installation instructions.

Grading

Homework	6 assignments, 100 points each
Project Introduction	50 points
Project Presentation	150 points
Project Report	200 points
Total	1000 points

A	[93 – 100%]
A-	[90 – 93%)
B+	[88 – 90%)
B	[82 – 88%)
B-	[80 – 82%)
C	[70 – 80%)
F	<70%

Homework

All homework will be submitted via Blackboard. This includes assignments where you prepare handwritten solutions. In the case of handwritten solutions you should scan or take a picture of your handwritten solution and upload the electronic file to Blackboard. Turn in your homework before class starts on the day it is due. Otherwise it is late. You have three cumulative free days of late homework for the entire duration of the semester. If you turn in your homework after class starts on the due date, that counts as one day of lateness, and you only have two remaining days of free lateness for the rest of the semester. If you turn it in more than 24 hours after the start of class on the due date, you have used up two days of free lateness for the semester. Weekend days and university holidays do not count towards your total. Once you have used up all three free days you will get zero points for any subsequent late homework assignment. Reasonable exceptions for circumstances outside your control (e.g., long-term illness, family emergencies) will be considered. Unreasonable

exceptions (e.g., too much work in other classes, you slept in, couldn't find a parking space) will not be considered.

Unless I explicitly state that an assignment should be done in groups you should attempt each homework problem on your own before asking the advice of your classmates. At that point you are free to discuss solution strategies with classmates. Please do not offer an entire solution to a classmate. Give general suggestions to help your classmates to solve problems on their own.

Project

Propose, formulate, and solve an optimization problem relevant to your research using one of the methods you learned in class. You will write a paper and give a presentation on your project. At the end of March you will turn in an introduction to your paper that gives background, explains why solving your problem is important, and explains how you will go about solving the problem. By the end of April you will have solved the problem and written a five-page paper including a title, abstract, introduction, methods, results, and discussion. Two of your classmates will give you critical feedback on your paper. On the last day of class you will give a ten-minute presentation on your project. During finals week you will turn in a final paper that incorporates the feedback from your classmates and feedback during the presentation.

Blackboard

All homework assignments, grades, and official course announcements will be posted to Blackboard. I will try to remind you of upcoming events in class, but please check Blackboard at least on a weekly basis.

I will open a discussion thread for each homework allowing you to post questions regarding the homework. My answers or the answers of a classmate will be available for everyone's benefit. I will not respond to emails with questions about homework.

Academic Integrity

Integrity is very important. Do your own work and give credit to people who helped you. If you received any help or ideas on a homework problem, note where you got help from (e.g., the name of a classmate or website) and what ideas leading to the solution were not your own in the comments box with your submission on Blackboard. You will not receive any less credit if you receive help on a homework problem as long as you state where the help came from. You are welcome to discuss ideas for solving problems with your classmates, but your homework submissions must be your own work. Do not turn in computer code that resembles some one else's code.

Here is a non-exhaustive list of things that are not allowed in this course on homework assignments

- Turning in some one else's homework solution or computer code as your own.

- Giving an electronic or paper copy of a solution or computer code that partially or completely solves a homework problem to a classmate.
- Receiving from a classmate or anyone else an electronic or paper copy of a solution or computer code that partially or completely solves a homework problem or project.
- Giving another student access to view your solution or code for the purpose of copying the solution or code.
- Receiving access to view another student's solution or code for the purpose of copying the solution or code.
- Using computer code downloaded from the internet that partially or completely solves a homework problem.

If you do any of the things above on a homework assignement you will receive a grade of zero for that assignment, and I will write a letter of reprimand to be placed in your student record. If you do any of the things above more than once on your homework assignments you will recceive a grade of F for the course, and I will write a letter of reprimand to be placed in your student record.

Students with Disabilities

I am available to discuss appropriate academic accommodations that you may require as a student with a disability. I encourage you to make requests for academic accommodations to me during the first week of class. Please work with the Office of Disability Services for determination of reasonable academic accommodations. For more information visit `http://www.csuohio.edu/disability/for-students`.

Electronic Devices

You should turn off any handheld electronic device during class unless it is for taking notes. You cannot use any electronic device an exam unless I explicitly state that you can use a device.

Tentative Schedule

Day	Date	Topic	Chapter	Due	Events
Tues	1/15	Introduction	1		
Thurs	1/17	Fundmentals of Unconstrained Optimization	2		
Tues	1/22	Line Search Methods	3		
Thurs	1/24	Line Search Methods	3		
Tues	1/29	Line Search Methods	3		interactive
Thurs	1/31	Trust Region Methods	4	HW1	
Tues	2/5	Trust Region Methods	4		
Thurs	2/7	Trust Region Methods	4		interactive
Tues	2/12	Conjugate Gradient Methods	5		
Thurs	2/14	Quasi-Newton Methods	6		
Tues	2/19	CG and QN Methods	5&6	HW2	interactive
Thurs	2/21	Derivative-Free Optimization	9		
Tues	2/26	Least-Squares Problems	10		
Thurs	2/28	DFO and Least-Squares Problems	9&10		interactive
Tues	3/5	Introduction to Constrained Optimization	12	HW3	
Thurs	3/7	Introduction to Constrained Optimization	15		
Tues	3/12	Spring Break			no class
Thurs	3/14	Spring Break			no class
Tues	3/19	Quadratic Programming	16		
Thurs	3/21	Quadratic Programming	16	HW4	
Tues	3/26	Quadratic Programming	16		interactive
Thurs	3/28	Penalty Methods	17	project intro	
Tues	4/2	Augmented Lagrange Methods	17		
Thurs	4/4	Augmented Lagrange and Penalty Methods	17		interactive
Tues	4/9	Sequential Quadratic Programming	18		
Thurs	4/11	Sequential Quadratic Programming	18	HW5	
Tues	4/16	Sequential Quadratic Programming	18		interactive
Thurs	4/18	Interior Point Methods	19		
Tues	4/23	Interior Point Methods	19	project paper draft	
Thurs	4/25	Evolutionary Optimization		project peer review	
Tues	4/30	Evolutionary Optimization		HW6	
Thurs	5/2	Project Presentations			
Tues	5/7			project report	