EECS 868: Mathematical Optimization with Applications
Spring 2020

Course Description
A mathematical study of the minimization of functions. The course provides an introduction to the mathematical theory, implementation, and application of a variety of optimization techniques, with an emphasis on real-world applications. Optimization problem formulation. Unconstrained and constrained minimization, including conditions for optimality. Specific techniques for solving linear and nonlinear programming problems. Convergence of algorithms.

Course Meetings
MWF, 12-12:50pm, 2115 Learned Hall

Instructor
Dr. Suzanne Shontz
3016 Eaton Hall
Dept. of Electrical Engineering and Computer Science
Office Phone: (785) 864-8816
E-mail: shontz@ku.edu

Teaching Assistant
None

Office Hours:
MWF 2-3pm, or by appointment

Note: I have a second office in 203 Nichols Hall. At times you will be asked to come to Nichols Hall to meet with meet if you request to do so outside of office hours. Hence, it is recommended that you set-up meetings in advance via e-mail.

Text

Prerequisites
Math 590 or EECS 639, or consent of the instructor.

Course Requirements
Lecture attendance is required, although attendance will not be recorded. The course requirements for EECS 868 include class participation, four homework assignments, one project, one midterm exam, and a final exam. The homework assignments will require a combination of written exercises and programming. The exercises will involve the design and analysis of algorithms and will require mathematical proofs in some cases. The programming exercises will
be done in Matlab, a high-level language for numerical computation. Prior knowledge of Matlab is not a prerequisite for the course.

Homework assignments will be due approximately 10 days after they are assigned. Due dates for homework assignments will be announced in class. (The dates listed on the course calendar are simply a guide for me.) There will be a late penalty of 20% for homework handed in up to 24 hours late. No homework assignments will be accepted which are more than 24 hours late.

Students will design an individual project in the area of constrained optimization. There will be a late penalty of 20% for projects handed in up to 24 hours late. No projects will be accepted which are either (i) more than 24 hours late or (ii) is not submitted by 11:59pm the day before Stop Day.

There will be one take-home midterm exam scheduled for February 28-March 2, 2020 and one take-home final exam scheduled for May 6-14, 2020. Please reserve these dates on your calendar. Both exams will be open book and open notes; outside references may be consulted provided they are cited appropriately. The final exam will not be comprehensive in nature. A make-up midterm or final exam will be given to any student who is absent from an exam for a compelling reason and gets permission from the instructor.

The exams will cover topics drawn from the lectures and homework, and from the underlying algorithms and mathematics.

**Grading**

Homework will count for 30% of the final grade. The lowest scoring homework assignment will be dropped. One of the homework assignments may be skipped, in which case that is the one that will be dropped. The project will count for 20% of the final grade. The midterm exam will count for 20% of the final grade, and the final exam will count for the remaining 30% of the final grade.

Your final grade in the class will then be computed by using the weighted average given above and the following scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>[90%-100%]</td>
</tr>
<tr>
<td>A-</td>
<td>[88%-90%)</td>
</tr>
<tr>
<td>B+</td>
<td>[86%-88%)</td>
</tr>
<tr>
<td>B</td>
<td>[80%-86%)</td>
</tr>
<tr>
<td>B-</td>
<td>[78-80%)</td>
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</table>

The course will utilize +/- grading in Spring 2020 as indicated above. Depending on overall student performance in the course, I reserve the right to lower (but not raise) the above grade cutoffs. However, this is not something you should count on.
Class Schedule
The course calendar shows a week-by-week syllabus. The dates and order of topics are subject to change by the instructor. Any significant changes will be announced in class.

Course Website and E-mail
There is a course website available at the following URL:

E-mail will be used for announcements not given in class. Students are responsible for all announcements made either in class or via e-mail.

Computing Facilities
For programming questions on the homework assignments, students may use Matlab on the Linux or Windows machines in the computer laboratories in Eaton Hall.

Additional Course Policies
1. Students have one week from when an item was returned in class to request a regrade. In the event a regrade is requested, the entire homework assignment, project, or exam will be regraded.

2. If you have a mandated religious observance which conflicts with a scheduled midterm examination, please contact me privately at the beginning of the semester so that a make-up midterm examination can be scheduled at a mutually acceptable time. (The university policy which applies to religious observances in conflict with examinations does not apply to the final examination since instructors do not schedule final exams.)

Academic Integrity Policy
Cheating in the course will not be tolerated. Students are allowed to collaborate on the homework assignments to the extent of formulating ideas as a group. Each student is expected to write up the homework assignment by himself or herself. Students must not hand in homework that represents somebody else's ideas entirely. Students should do the Matlab coding on assignments by themselves—no program code should be shared. No collaboration of any kind is allowed on the project, midterm exam, or final exam.

Students are permitted to consult outside published material for the homework, project, and exams, although the homework and exams will be fully based on lecture notes, course handouts, and the textbook. If a student consults a source other than the lecture notes and textbooks, he or she must cite the source—failure to cite the source will be considered cheating.

If you are uncertain as to whether or not a particular behavior is considered cheating, you are highly encouraged to discuss it with the instructor before engaging in such behavior.

Anyone found cheating will receive a 0 on that work (homework assignment) or an F in the class (project, midterm exam, or final exam). A second incident will result in an F grade for the course. These penalties will be received by all parties involved, following a hearing with the instructor. In all cases, reports of academic misconduct will also be made to the dean’s office where further disciplinary action may be taken in accordance with School of Engineering and
University of Kansas guidelines. This may result in much more serious sanctions. It is your responsibility not to let anyone copy your homework assignment or exam; otherwise, you may have to pay the price for others' misconduct.

**Academic Achievement and Access**
Any student in this course who has a disability that may prevent him/her from fully demonstrating his/her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate the educational opportunity.

The Academic Achievement & Access Center (AAAC) coordinates accommodations and services for all KU students who are eligible. If you have a disability for which you wish to request accommodations and have not contacted the AAAC, please do so as soon as possible. Their office is located in 22 Strong Hall; their phone number is (785) 864-4064 (V/TTY). Information about their services can be found at [http://www.achievement.ku.edu/](http://www.achievement.ku.edu/). Please contact me privately in regard to your needs in this course.

**Concealed Carry Policy**
Individuals who choose to carry concealed handguns are solely responsible to do so in a safe and secure manner in strict conformity with state and federal laws and KU weapons policy. (See [http://concealedcarry.ku.edu/information](http://concealedcarry.ku.edu/information) and [http://policy.ku.edu/university-kansas-policy-weapons-including-firearms-effective-july-1-2017](http://policy.ku.edu/university-kansas-policy-weapons-including-firearms-effective-july-1-2017).)

Safety measures outlined in the KU weapons policy specify that a concealed handgun:
- Must be under the constant control of the carrier.
- Must be out of view, concealed either on the body of the carrier, or backpack, purse, or bag that remains under the carrier’s custody and control.
- Must be in a holster that covers the trigger area and secures any external hammer in an uncocked position.
- Must have the safety on, and have no round in the chamber.

*Suzanne M. Shontz, Associate Professor, Department of Electrical Engineering and Computer Science, University of Kansas, shontz@ku.edu*
## EECS 868: Mathematical Optimization with Applications
### Week-by-Week Syllabus

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan. 22-24: Introduction; Local and Global Minima.</td>
<td></td>
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<tr>
<td>3</td>
<td>Feb. 3-7: Trust Region Methods</td>
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<tr>
<td>4</td>
<td>Feb. 10-14: Conjugate Gradient Methods</td>
<td>HW1 due on Feb. 10. HW2 out on Feb. 14.</td>
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<tr>
<td>7</td>
<td>Mar. 2-6: Nonlinear Equations</td>
<td>Take-home exam due on Mar. 2 at 12:00pm.</td>
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<tr>
<td>BREAK</td>
<td>Mar. 9-13: Spring Break</td>
<td>No class this week due to Spring Break.</td>
</tr>
<tr>
<td>8</td>
<td>Mar. 16-20: Constrained Optimization and KKT Conditions</td>
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<tr>
<td>10</td>
<td>Mar. 30-Apr. 3: Applications of Linear Programming; Quadratic Programming</td>
<td>HW 3 due on Apr. 3.</td>
</tr>
<tr>
<td>11</td>
<td>Apr. 6-10: Quadratic Programming; Applications of Quadratic Programming</td>
<td>HW4 out on Apr. 6.</td>
</tr>
<tr>
<td>13</td>
<td>Apr. 20-24: Sequential Quadratic Programming</td>
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<tr>
<td>14</td>
<td>Apr. 27-May 1: Convex Optimization</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>May 4-6: Nonlinear Programming Applications</td>
<td>Project due on May 6. Final exam handed out on May 6 at 9:50am.</td>
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<tr>
<td>FINAL</td>
<td>Take-home final exam from May 6 (12:50pm) through May 14 (1pm)</td>
<td>Final Exam due at 1pm on May 14.</td>
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