ESE 415 Optimization
Spring 2019
Instructor: Prof. Ulugbek S. Kamilov

Washington University in St. Louis

Lecture: Tue and Thu at 01:00-02:30 pm in Duncker 101
Tutorials: Fri at 01:00-03:00 pm in TBD

Instructor:
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Course Website: cigroup.wustl.edu/teaching/ese415-2019

Prerequisites: ESE 318 and Math 309 or equivalents. Familiarity with MATLAB.

Course Description:
Optimization is at the core of modern *machine learning*, *signal and image processing*, *digital communications*, *control and robotics*, *operations research*, and *financial engineering*. Some of the biggest challenges is those disciplines are formulated and solved as optimization problems. It is an essential topic that everyone in computational sciences and engineering must master. This course gives a rigorous introduction to the fundamentals of nonlinear optimization theory and algorithms. Topics include unconstrained and constrained optimization, convex optimization, computational optimization methods, optimality conditions, and duality theory. Algorithmic methods include the gradient and accelerated gradient methods, the Newton's method, the conjugate gradient method, projected gradient method, as well as penalty and barrier methods.

Syllabus:
- Introduction, motivation, and preliminaries
- Optimality conditions for unconstrained optimization
- Convex sets and functions
- Unconstrained minimization algorithms and applications
- Optimality conditions for constrained optimization
- Constrained minimization algorithms and applications
- Lagrangian duality and methods of multipliers
- Stochastic optimization (*if time permits*)

Grading Policy:
The course grade in ESE 415 will be based on a weighted average of the following components:
- Homework assignments (40%): Assignments will be handed out on Thu and will be due on another Thu before the class. Late submissions will be penalized 20% per day. You are encouraged to discuss on homework problems with your classmates, but you must write your own solutions. All assignments will be collected and graded via Gradescope (use code: M2P3R8).
- Midterm exam (30%): One in-class closed-book midterm will be held on Thu, 03/07. No external assistance is allowed in the midterm.
- Final exam (30%): The final is closed-book and will be held on Tue, 05/08. No external assistance is allowed in the final. A single crib sheet is allowed (front and back) for the final.

Optional textbooks:
The lecture notes for the class are available online. The following textbooks are an optional reading.

- "Mathematics of Nonlinear Programming" by A. L. Peressini
- "Linear and Nonlinear Programing" by D. G. Luenberger
  - Available online at http://mat.uab.cat/~alseda/MasterOpt/3l0trialtext.pdf
- "Convex Optimization" by S. Boyd and L. Vandenberghe
  - Available online at web.stanford.edu/~boyd/cvxbook
- "Nonlinear Programming" by D. P. Bertsekas

Technology:
In this course, we will be using iClicker technology. Each student must check out an iClicker from Olin Library in order to participate. Therefore, before the first lecture, please go to the Olin Library Help desk to check out an iClicker. All iClicker devices are available for checkout only for students registered in specific courses, so please be prepared to tell the circulation staff that you are registered for this course. Note that iClickers will not be used in grading, but as a tool for interaction during the lectures.

Disability:
If you have any disability that you feel may affect your performance, please inform the instructor.