Math 617/717: Optimization: with application to machine learning
Spring 2024
Department of Mathematical Sciences, UWM

Lecture Time
10:00 AM - 11:15 AM, Monday and Wednesday, EMS Building, Room E208

Instructor:
Professor Dexuan Xie
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Office Hours: 2:30 PM -3:30 PM, Monday and Wednesday

Reference Books
- *Numerical Optimization*, by Jorge Nocedal and Stephen J. Wright, 2nd Edition, Springer, 2006, ISBN-10: 0-387-30303-0
- *Optimization for Machine Learning*, Edited by Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, The MIT Press, 2011, ISBN-13: 978-0262537766

Prerequisite
Grade of C or better in either Math 321 or 602, or graduate students.

   Note: Math 617 for graduate students and advanced undergraduate students while Math 717 for graduate students in a doctoral program. Students who do not meet prerequisites can consult the instructor for enrollment permission.

Course Overview
   The lectures are given based on Instructor's teaching notes. They will cover the following topics:
   _ Unconstrained nonlinear optimization: *Steepest descent method, line search methods, conjugate gradient methods, modified Newton's methods, quasi-Newton methods.*
   _ Least-squares problems: *Singular value decomposition for linear least-squares problems, Gauss-Newton methods for nonlinear least-squares problems*
   _ Constrained nonlinear optimization: *Lagrange multipliers, Kuhn-Tucker conditions, sequential quadratic programming methods, and penalty and augmented Lagrange methods.*
   _ Stochastic gradient descent methods for a supervised learning problem: *Automatic differentiation for computing gradients, convergence analysis, and*

implementation issues (such as initial iterate selection, learning rate issues, and normalization techniques).

Grading

- Four homework assignments: 80% (20 % per homework)
- Participation and discussion: 20 %.

Grading scale: A (90-100), A- (85-89), B+ (80-84), B (75-79), C (65-74), D (55-64), F (below 55).

Important Dates

- January 22: First day of classes.
- February 18: Last day to drop without "W" on academic record.
- March 17-24: Spring Break.
- April 7: Last day to drop.
- May 8: Last day of classes.

Homework Assignments and Discussions

Homework is assigned in class. You must show answers in detail. The due dates are announced one week earlier in class. You will present some of your homework answers in class to gain the scores of participation and discussion.

Additional Information

- Texting and photo-taking are not permitted during class time. Cell phones and smart watches should be turned off.
- Room changes and cancellations are valid only if posted outside the classroom door on Math Department letterhead and sent via email.
- Students with disabilities or who qualify for accommodations (VISA) should contact me early in the semester to discuss the assistance they may need.

Statement of Academic Misconduct

The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonestly. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors.