STOCHASTIC OPTIMIZATION FOR MACHINE LEARNING

Syllabus: SDSC 6015 / 2025-26 Semester A

1. Instructor.

- Lu Yu
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  Office: LAU 16-279
- Office hours: TBA.

2. Lectures.

- This course is scheduled for Thursday from 19:00 - 21:50 in room M3017, CMC Building.

3. Teaching Assistant.

- Xinnian Yang
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- Zhiyou Wu
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4. Course Information.
The course webpage on Canvas contains all course information, additional readings, assignments, announcements, office hours, etc.

5. Course Evaluation.

- Three assignments (30%): 10% each
- Option 1: Midterm exam (30%)
  Option 2: Course project (10%) + Midterm exam (20%)
- Final exam (40%)

6. Course Outline. This course covers several commonly used optimization algorithms in machine learning and related methodological concepts. Topics may include:

- Introduction
- Preliminaries of Stochastic Optimization
- Convex Function
- Convex Optimization Problems
- Gradient Descent
- Projected/Proximal Gradient Descent
- Subgradient Descent
- Mirror Descent
- Stochastic Gradient Descent (SGD)
- Momentum-based Methods
- Adaptive Learning Rates Methods
- Other Variants of SGD
- Coordinate Descent
- Newton Method, Quasi-Newton Method

- Zero-th Order Optimization
- Parallel and Distributed Optimization
- Nonconvex Optimization and its Applications in Machine Learning
- Robust and Adversarial Optimization
- Advanced Topics in Optimization for Machine Learning

7. Textbooks. There is no required course textbook. The following materials can be helpful.

- *Convex Optimization: Algorithms and Complexity*, by Sébastien Bubeck
- *Convex Optimization*, by Stephen Boyd and Lieven Vandenberghe
- *Introductory Lectures on Convex Optimization*, by Yurii Nesterov
- *First-Order and Stochastic Optimization Methods for Machine Learning*, by Guanghui Lan

8. Assignments.

- There will be 3 assignments in this course. The assignments will be released on Canvas.
- *Colloboration policy on the assignments.* Assignments must be your own individual work. After attempting the problems on an individual basis, you may discuss and work together on the homework assignments with up to two classmates. However, **you must write your own code and write up your own solutions individually and explicitly name any collaborators at the top of the homework**.

9. Exams. There will be an in-class midterm exam on October 9. Details will be announced in class and on Canvas. You can use an optional A4 cheat sheet (double-sided). Final exam date is TBD. You can use two optional A4 cheat sheets (double-sided).

10. Late policy. Ten percent of the value will be deducted for each late day (up to 3 days, then submission is blocked). No credit will be given for assignments submitted after 3 days.

11. Grading concerns. Any requests to have graded work re-evaluated must be made within one week of the date the grade is released. Re-evaluation may result in a decrease in the grade.

12. Missed Tests.

- If a test is missed for a valid reason, you must submit documentation to the course instructor.
- If a test is missed for a valid medical reason, submit your case along with supporting documentation via AIMS and let the course instructor know immediately.
- If the midterm test is missed for a valid reason then the final test will be worth 70% of your final grade. Other reasons for missing a test will require prior approval by your instructor. If prior approval is not received for non-medical reasons then you will receive a term test grade of zero.