Introduction

DSAI5104: Optimization for Machine Learning

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Subject Lecturer

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Teaching Assistants

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Syllabus

Mathematical Background
Numerical linear algebra, calculus

First-order Methods
Gradient descent and accelerated variants, projected and proximal gradient descent, stochastic gradient descent, stochastic coordinate descent

Second-order Methods
Newton's method, quasi-Newton methods, Semismooth Newton method

Dimensionality Reduction Methods
Principle component analysis, multidimensional scaling, ISOMAP, t-SNE

Duality Theory
Karush-Kuhn-Tucker conditions, Fenchel duality theory, Alternating Direction Method of Multipliers (ADMM).

Introduction

Assessment Method

Assigment	30%
Examination	70%

Rubrics (to be confirmed)

A+, A, A−	80 marks or above
B+, B, B−	65 marks or above
C+, C, C−	50 marks or above
D+, D	40 marks or above
F	Below 40 marks

Reference Books

Nocedal and Wright,
Numerical Optimization (2nd edition), Springer, 2006.

Boyd and Vandenberghe,
Convex Optimization, Cambridge University Press, 2004.

Luenberger and Ye,
Linear and Nonlinear Programming (4th edition), Springer 2016.

Ghojogh, Crowley, Karray, and Ghodsi, *Elements of Dimensionality Reduction and Manifold Learning*, Springer, 2023.

Hart and Recht,
Patterns, Predictions, and Actions: A story about machine learning,
https://mlstory.org

Bottou, Curtis, and Nocedal, *Optimization Methods for Large-Scale Machine Learning*, SIAM Review, 60 (2018), 223 311.