

Optimization methods for machine learning

IE 495 — Fall 2012

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Evaluation

Homework: 50%
Final Project: 30%
Class participation 20%

Scope of the course

Syllabus: This course introduces a range of machine learning models and optimization tools that are used to apply these models in practice. For the students with some ML background this course will introduce what lies behind the optimization tools often used as a black box as well as an understanding of the trade-offs of numerical accuracy and theoretical and empirical complexity. For the students with some optimization background this course will introduce a variety of applications arising in machine learning and statistics as well as novel optimization methods targeting these applications.

The main topics covered are: Machine learning paradigm, empirical risk minimization, structural risk minimization, learning guarantees, introduction of VC-dimension.

Machine learning models: logistic regression, support vector machines, sparse regression, low dimensional embedding, low rank matrix factorization, sparse PCA, multiple kernel learning.

Convex optimization models: linear optimization, convex quadratic optimization, second order cone optimization, semidefinite optimization, convex composite optimization

Methods for convex optimization: gradient descent, Newton method, interior point methods, active set, prox methods, accelerated gradient methods, coordinate descent, cutting planes, stochastic gradient.

Programming language

Matlab will be the best tool to use for the homeworks and the final project in the course, but if you have other preferences, you are welcome to use other suitable environments.

Homework

Homeworks will be given roughly every two weeks.

Case Studies

The final projects will be given to groups of 2-3 students. Students are encouraged to propose their own project. It will most likely involve an implementation and a computational study of some ML model for some particular data or a new an optimization approach to an ML model.

Attendance

I strongly encourage you to attend all lectures and to actively participate. The material is much harder to learn on your own.

Accommodations for Students with Disabilities

If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center C212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

Note: this syllabus is subject to change.