FIM Nachdiplomvorlesung

Martin Wainwright (UC Berkeley)

Statistics meets Optimization: Randomization and approximation for high-dimensional problems

September 22 - December 15, 2015
Tuesdays, 10.15 - 12.00h
HG G 43, ETH Zürich, Rämistrasse 101

Abstract

In the modern era of high-dimensional data, the interface between mathematical statistics and optimization has become an increasingly vibrant area of research. In this course, we provide some vignettes into this interface, including the following topics:

(A) Dimensionality reduction via random projection. The naive idea of projecting high-dimensional data to a randomly chosen low-dimensional space is remarkably effective. We discuss the classical Johnson-Lindenstrauss lemma, as well as various modern variants that provide computationally-efficient embeddings with strong guarantees.

(B) When is it possible to quickly obtain approximate solutions of large-scale convex programs? In practice, methods based on randomized projection can work very well, and arguments based on convex analysis and concentration of measure provide a rigorous underpinning to these observations.

(C) Optimization problems with some form of nonconvexity arise frequently in statistical settings - for instance, in problems with latent variables, combinatorial constraints, or rank constraints. Nonconvex programs are known to be intractable in a complexity-theoretic sense, but the random ensembles arising in statistics are not adversarially constructed. Under what conditions is it possible to make rigorous guarantees about the behavior of simple iterative algorithms for such problems? We develop some general theory for addressing these questions, exploiting tools from both optimization theory and empirical process theory.

www.fim.math.ethz.ch/lectures

D MATH   FIM Forschungsinstitut für Mathematik   ETH zürich