FMSP Lectures

Arnak Dalalyan
(ENSAE ParisTech)

Learning theory and sparsity

(1) Introduction into sparse recovery and compressed sensing.

November 25 (Wed) 14:55 ～ 18:00 Room 056

Abstract:

In this introductory lecture, we will present the general framework of high-dimensional statistical modeling and its applications in machine learning and signal processing. Basic methods of sparse recovery, such as the hard and the soft thresholding, will be introduced in the context of orthonormal dictionaries and their statistical accuracy will be discussed in detail. We will also show the relation of these methods with compressed sensing and convex programming based procedures.

(2) Lasso, Dantzig selector and their statistical properties.

December 2 (Wed) 14:55 ～ 18:00 Room 056

Abstract:

In this second lecture, we will focus on the problem of high dimensional linear regression under the sparsity assumption and discuss the three main statistical problems: denoising, prediction and model selection. We will prove that convex programming based predictors such as the lasso and the Dantzig selector are provably consistent as soon as the dictionary elements are normalized and an appropriate upper bound on the noise-level is available. We will also show that under additional assumptions on the dictionary elements, the aforementioned methods are rate-optimal and model-selection consistent.

(3) Sparsity and low rank matrix learning.

December 3 (Thu) 16:40～ 18:00 Room 123

Abstract:

In this third lecture, we will present extensions of the previously introduced sparse recovery techniques to the problems of machine learning and statistics in which a large matrix should be learned from data. The analogue of the sparsity, in this context, is the low-rankness of the matrix. We will show that such matrices can be effectively learned by minimizing the empirical risk penalized by the nuclear norm. The resulting problem is a problem of semi-definite programming and can be solved efficiently even when the dimension is large. Theoretical guarantees for this method will be established in the case of matrix completion with known sampling distribution.