Optimal estimation of Gaussian mixtures via denoised method of moments

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Abstract:
The Method of Moments is one of the most widely used methods in statistics for parameter estimation, obtained by solving the system of equations that match the population and estimated moments. However, in practice and especially for the important case of mixture models, one frequently needs to contend with the difficulties of non-existence or non-uniqueness of statistically meaningful solutions, as well as the high computational cost of solving large polynomial systems. Moreover, theoretical analysis of method of moments are mainly confined to asymptotic normality style of results established under strong assumptions.

In this talk I will present some recent results for estimating Gaussians location mixtures with known or unknown variance. To overcome the aforementioned theoretic and algorithmic hurdles, a crucial step is to denoise the moment estimates by projecting to the truncated moment space before executing the method of moments. Not only does this regularization ensures existence and uniqueness of solutions, it also yields fast solvers by means of Gauss quadrature. Furthermore, by proving new moment comparison theorems in Wasserstein distance via polynomial interpolation and majorization, we establish the statistical guarantees and optimality of the proposed procedure. These results can also be viewed as provable algorithms for Generalized Method of Moments which involves non-convex optimization and lacks theoretical guarantees.

This is a joint work with Yihong Wu (Yale).

Bio:
Pengkun Yang is from the Department of Electrical and Computer Engineering at University of Illinois at Urbana-Champaign. He is a fifth-year graduate student advised by Professor Yihong Wu and planning to graduate in the summer. His research interests include statistical inference, learning, optimization and systems. He received a B.E. degree from the Department of Electronic Engineering at Tsinghua University in 2013, and a M.S. degree from the Department of Electrical and Computer Engineering at University of Illinois at Urbana-Champaign. He is a recipient of Jack Keil Wolf ISIT Student Paper Award at the 2015 IEEE International Symposium on Information Theory.