Maximum Likelihood Matrix Completion Under Sparse Factor Models: Error Guarantees and Efficient Algorithms

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This talk focuses on a general class of "matrix completion" tasks, where observations are obtained entry-wise and each is subject to some form of random noise or corruption. Our particular focus is on settings where the underlying matrix to be estimated adheres to a "sparse factor" model, in the sense that it may be expressed or well-approximated as the product of two matrices, one of which is sparse. We describe a general-purpose estimation error bound – obtained using tools from complexity-penalized maximum likelihood estimation – for problems of this form, and discuss the implications of our result in several different scenarios characterized by common noise models (additive Gaussian noise, additive Laplace noise, Poisson-distributed observations, and one-bit observations described by a probit model). We also describe a simple unified algorithmic framework, based on the alternating direction method of multipliers method, for obtaining estimates in problems of this form, and demonstrate the performance of our method in several stylized applications in imaging and collaborative filtering.