Institute for Applied Mathematics, Bonn University

Oberseminar Stochastik

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A non-backtracking method for long matrix and tensor completion

Matrix completion is the task of filling in the missing entries of a partially observed matrix; one example is the movie-ratings matrix, as appears in the Netflix problem. We consider the problem of low-rank rectangular matrix completion in the regime where the matrix of size $n \times m$ is “long", i.e., the aspect ratio m/n diverges to infinity. Such matrices are of particular interest in the study of tensor completion, where they arise from the unfolding of a low-rank tensor. In the case where each entry is observed with probability $\frac{d}{\sqrt{mn}}$, we propose a new spectral algorithm for recovering the singular values and left singular vectors of the original matrix based on a variant of the standard non-backtracking operator of a suitably defined bipartite weighted random graph, which we call a non-backtracking wedge operator. When d is above a Kesten-Stigum-type sampling threshold, our algorithm recovers a correlated version of the singular value decomposition of the original matrix with quantifiable error bounds. This is the first result in the regime of bounded d for weak recovery and the first for weak consistency when $d \to \infty$ arbitrarily slowly without any polylog factors. As an application, for low-rank orthogonal order-k tensor completion, we efficiently achieve weak recovery with sample size $O(n^{k/2})$.