Parallel Singular Value Decomposition for Large Matrices by Multiple Random Sketches

Weichung Wang

National Taiwan University

Abstract

The singular value decomposition (SVD) of large-scale matrices is a key tool in data analytics and scientific computing. The rapid growth in the size of matrices further increases the need for developing efficient SVD algorithms. Randomized SVD based on one-time sketching has been studied, and its potential has been demonstrated for computing a low-rank SVD. We present a Monte Carlo type integrated SVD algorithm based on multiple random sketches in this talk. The proposed integration algorithm takes multiple random sketches and then integrates the results obtained from the multiple sketched subspaces. So that the integrated SVD can achieve higher accuracy and lower stochastic variations. The main component of the integration is an optimization problem and an average scheme over a matrix Stiefel manifold. In addition to the theoretical and statistical analyses, we also consider practical algorithms that are suitable for parallel computers. The proposed algorithms can be implemented on the latest multi-core CPU, many-core GPU, and MPI-based cluster. Numerical results suggest that the proposed integrated SVD algorithms are promising. This is a joint work with Ting-Li Chen and Su-Yun Huang at the Institute of Statistical Science, Academia Sinica, Dawei D. Chang, Hung Chen, Chienyao Lin, and Mu Yang at Institute of Applied Mathematical Sciences, National Taiwan University.