Numerical Analysis and Scientific Computing Seminar

Fast Algorithms for Nonnegative Matrix Factorizations and Applications

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Abstract: Nonnegative Matrix Factorization (NMF) has attracted much attention during the past decade as a dimension reduction method in machine learning and data mining. NMF is considered for high dimensional data where each element has a nonnegative value, and it provides a lower rank approximation formed by factors whose elements are also nonnegative. Numerous success stories were reported in application areas including text clustering, computer vision, and chemometrics. In this talk, we review several NMF algorithms available in literature and present our fast algorithms for NMF and their convergence properties. Our algorithms are based on alternating nonnegative least squares (ANLS) and active-set-type methods for non-negativity constrained least squares problem. They can naturally be extended to obtain highly efficient nonnegative tensor factorization (NTF) in the form of the PARAFAC (PARAllel FACtor) model, sparse NMF and NTF with L1 norm regularization. Extensive comparisons of algorithms using various data sets show that the proposed new algorithms outperform existing ones in computational speed. In addition, we introduce fast NMF algorithms with Bregman divergences, adaptive NMF algorithms for changing reduced ranks and data sets, symmetric NMF, and their performances in clustering and video analysis.

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