Lower Rank Approximation of Matrices Based on Fast and Robust Alternating Regression

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Abstract

In this paper, we introduce fast and robust methods for lower rank approximation of matrices. These methods are based on robust alternating regression. Alternating regression, also called criss-cross regression, was used for lower rank approximation of matrices by Gabriel and Zamir (1979) based on least squares estimator, which is not robust for outliers in the matrices. Instead of using least squares estimator, we use robust estimators. Among all the robust estimators, we focus on the Huber-type M estimators and the L1 estimator. Since these estimators are the computationally fastest estimators with their most advanced algorithms. We emphasis on the computing speed, since alternating regression needs extensive computation for relatively large matrices, which are quite common in the applications of computer vision and macroarray analysis. To make our algorithm robust to matrices with high percentage of outliers, we combine M estimators and the L1 estimator with the LTS estimator, which is robust to leverage points, through a sequential test during the initial iterations of the alternating regression. For M estimators, we also give some suggestions to avoid dead cycles in alternating regression based on the descenders.

References

K.R. Gabriel and S. Zamir (1979). Lower Rank Approximation of Matrices by Least Squares with any Choice of Weights, *Technometrics 21*, 489-498.