CP-ALS-QR report

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1 Introduction

The CANDECOMP/PARAFAC or canonical polyadic (CP) decomposition for multidimensional data, or tensors, is a popular tool for analyzing and interpreting latent patterns that may be present in multidimensional data. Basically CP decomposition of a tensor refers to its expression as a sum of r rank-one components and each of them is a vector outer product. One of the most popular methods used to compute a CP decomposition is the alternating least squares (CP-ALS) approach, which solves a series of linear least squares problems. Usually to solve these linear leaste squares problems, normal equations are used for CP-ALS. This approach may be sensitive for ill-conditioned inputs. Based on this idea, there are already a more stable approach which is solving the linear least sqaures problems using QR decomposition instead.

For my summer research project, I basically follows the QR apprach but assuming the input tensor is in Kruskal structure, that is, a tensor stored as factor matrices and corresponding weights. By exploiting this structure, we improve the computation efficiency by not forming Multi-TTM tensor. The problem left is when doing CP-ALS, QR-based methods is exponential in N, the number of modes.