A Low-rank Support Tensor Network

P. Benner[1,3], S. Dolgov[2], K. Kour[1], and M. Stoll[3]

[1]Max Planck Institute, Magdeburg, Germany
[2]Department of Mathematical Science, University of Bath, Bath, UK
[3]Faculty of Mathematics, Technical University, Chemnitz, Germany

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Abstract

An increasing amount of data collected are high-dimensional and efficient learning algorithms must utilize the tensorial structure as much as possible. The ever-present curse of dimensionality for high dimensional data and the loss of structure when vectorizing the data motivates the use of tailored low-rank tensor methods. We propose an algorithm of computing a Canonical Polyadic (CP) decomposition by avoiding the NP-hard issue of finding the best CP rank by computing first a Tensor Train (TT) decomposition and call it TT-CP factorization. Along with it, we define a nonlinear classification machine learning model. We build a full Gradient Descent Primal (GDP) optimization problem which takes initialized variables from the partial GDP model optimized via Support Tensor Machines (STM). In turn, the full GDP enhances a potential suboptimal CP decomposition computed in the first step. This leads to better classification accuracy and a reliable deterministic algorithm for comp! uting the nonlinear boundary, each step of which admits a reasonable explanation. Hence, the full GDP can thus be seen as both a tensor decomposition method tailored to the classification problem, and a classification method that exploits the low-rank model of the data. With numerical examples, we show that this approach benchmarked than other state-of-the-art techniques.