Tensor Decompositions: A Mathematical Tool for Data Analysis

Abstract:

Tensors are multiway arrays, and tensor decompositions are powerful tools for data analysis and compression. In this talk, we demonstrate the wide-ranging utility of both the canonical polyadic (CP) and Tucker tensor decompositions with examples in neuroscience, chemical detection, and combustion science. The CP model is extremely useful for interpretation, as we show with an example in neuroscience. However, it can be difficult to fit to real data for a variety of reasons. We present a novel randomized method for fitting the CP decomposition to dense data that is more scalable and robust than the standard techniques. The Tucker model is useful for compression and can guarantee the accuracy of the approximation. We show that it can be used to compress massive data sets by orders of magnitude; this is done by determining the latent low-dimensional multilinear manifolds.

This talk features joint work with Woody Austin (University of Texas), Casey Battaglino (Georgia Tech), Grey Ballard (Wake Forrest), Alicia Klinvex (Sandia), Hemanth Kolla (Sandia), and Alex Williams (Stanford University).