



TEXAS A&M UNIVERSITY

Research Institute for Foundations of Interdisciplinary Data Science

TRIPODS DISTINGUISHED LECTURE Tensor Moments of Gaussian Mixture Models: Theory and Applications

TAMIDS



Gaussian mixture models (GMM) are fundamental tools in statistical and data sciences. We study the moments of multivariate Gaussians and GMMs. The dth moment of an n-dimensional random variable is a symmetric d-way tensor of size n^d , so working with moments is assumed to be prohibitively expensive for d > 2 and larger values of n. In this work, we develop theory and numerical methods for implicit computations with moment tensors of GMMs, reducing the computational and storage costs to $O(n^2)$ for general covariance matrices and O(n) for diagonal ones. We derive concise analytic expressions for the moments in terms of symmetrized tensor products, relying on the correspondence between symmetric tensors and homogeneous polynomials. The primary application of this theory is estimating GMM parameters from a set of observations, which can be formulated as a moment-matching optimization problem. If there is a known and common covariance matrix, then it is possible to debias the data observations, in which case and the problem of estimating the unknown means reduces to symmetric tensor decomposition. Numerical results illustrate the numerical efficiency of these approaches. This is joint work with Joe Kileel and João M. Pereira, Dept. of Mathematics, University of Texas.

Tamara G. Kolda, Ph.D. Mathematical Consultant, MathSci.ai

Distinguished Visiting Professor Northwestern University

Date: Monday, January 31, 2022 Time: 1:50 – 2:50 p.m. US Central Time Zoom Meeting ID: 998 4499 3279 Passcode: 724615 Faculty host: Yu Ding, TAMIDS

Biography

Dr. Tamara Kolda is an independent mathematical consultant under the auspices of her company MathSci.ai based in California. She is also a Distinguished Visiting Professor in the Department of Industrial Engineering & Management Science at Northwestern University in Evanston, Illinois. From 1999-2021, she was a researcher at Sandia National Laboratories in Livermore, California. She specializes in mathematical algorithms and computational methods for tensor decompositions, tensor eigenvalues, graph algorithms, randomized algorithms, machine learning, network science, numerical optimization, and distributed and parallel computing. She is the founding editor-in-chief for the SIAM Journal on Mathematics of Data Science (SIMODS) and Chair of the Illustrating the Impact of the Mathematical Sciences study for the National Academies. She is a member of the National Academy of Engineering (NAE), Fellow of the Society for Industrial and Applied Mathematics (SIAM), and Fellow of the Association for Computing Machinery (ACM).

You can also click this link to join the seminar https://tamu.zoom.us/j/99844993279?pwd=TkJodWFVRURyMmkwakI4SWZGeVJTQT09





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For more information about TAMIDS tutorial series, please contact Ms. Jennifer South at jsouth@tamu.edu