THE UNIVERSITY OF
CHICAGO

Departments of Computer Science, Mathematics, Statistics, and the Computation Institute

SCIENTIFIC AND STATISTICAL COMPUTING SEMINAR

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Rank-Revealing Decompositions for Matrices with Multiple Symmetries

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Eckhart 133, 5734 S. University Avenue

ABSTRACT

Suppose an order-6 tensor $\mathcal{A}$ has the property that the value of $\mathcal{A}(i_1, i_2, i_3, j_1, j_2, j_3)$ does not change if the i-indices are permuted, or if the j-indices are permuted, or if the i-indices as a group are swapped with the j-indices as a group. Such a tensor has multiple symmetries and if it is smartly unfolded into a matrix A, then A itself has interesting structure above and beyond ordinary symmetry. In the case of the given example, there are permutation matrices Γ_1 and Γ_2 (both involving Kronecker products and perfect shuffles) such that both $\Gamma_1 A \Gamma_1^T$ and $\Gamma_2 A \Gamma_2^T$ equal A. We show how to compute a structure-preserving, low-rank approximation to A using LDL^T with diagonal pivoting together with a very cheap block diagonalization that is performed at the start. The full exploitation of structure has ramifications for efficiency and applications.

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