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BINARY POLYNOMIAL OPTIMIZATION THROUGH A HYPERGRAPH THEORETIC LENS

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ABSTRACT

We define the multilinear polytope as the convex hull of a set of binary points satisfying a collection of multilinear equations. This set corresponds to the convex hull of the feasible region of a linearized binary polynomial optimization problem. By introducing a hypergraph representation framework, we relate the complexity of the facial structure of the multilinear polytope to the acyclicity degree of the corresponding hypergraph. We then demonstrate how different degrees of acyclicity can be used to obtain compact formulations for the multilinear polytope in the original or in an extended space. This in turn enables us to identify several classes of polynomial-time solvable binary polynomial optimization problems and to construct strong linear programming relaxations for general mixed-integer polynomial optimization problems. This is joint work with Alberto Del Pia.

SPEAKER BIO

Aida Khajavirad is an Assistant Professor of Industrial and Systems Engineering at Lehigh University. Before joining Lehigh, she worked at Rutgers University, University of Texas at Austin and IBM TJ Watson Research Center. She received her PhD from Carnegie Mellon University in 2012. Aida's research goal is to advance the state-of-the-art in Mixed-Integer Nonlinear Optimization (MINLP) at theoretical, algorithmic, and software levels. Recently, she has become interested in developing optimization algorithms with performance guarantees for data science applications. Her work has been recognized by the 2017 Young Researchers Prize by INFORMS Optimization Society and 2023 INFORMS Computing Society (ICS) prize by INFORMS Computing Society. Aida's research has been funded by NSF, DOE, and AFOSR.

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