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Analysis of Sparse Cutting-plane for Sparse IPs with applications to Stochastic IPs

In this talk, we present an analysis of the strength of sparse cutting-planes for mixed integer linear programs (MILP) with sparse formulations. We examine three kinds of problems: packing problems, covering problems, and more general MILPs with the only assumption that the objective function is non-negative. For each of these problems: (i) We first present a method to describe the sparsity structure of the constraint matrix. This method is different for the different types of problems. (ii) We present a method to describe a hierarchy of cutting-planes from very sparse to completely dense. (iii) Assume that we decide on support of cutting-planes and the strongest inequalities on these supports are added. Call the optimal objective function value of the linear programming relaxation together with these cuts as zcut. We present bounds on the ratio of zcut and the optimal objective function value of the MILP that depends only on the sparsity structure of the constraint matrix and the support of sparse cuts selected, that is, these bounds are completely data independent. There results also shed light on the strength of scenario-specific cuts for two stage stochastic MILPs. This is joint work with Marco Molinaro and Qianyi Wang.