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Inexact Column Generation for Causal Discovery

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Causal structure learning, the task of inferring causal relationships from data, is computationally challenging due to its combinatorial nature. State-of-the-art integer programming formulations suffer from exponential growth in the number of variables and constraints, while traditional column generation approaches struggle with the complexity of solving mixed-integer nonlinear programming pricing problems. In this talk, we propose an inexact column generation method that reformulates the pricing problem as a difference of submodular minimization problem. This approach significantly reduces the computational complexity of pricing subproblems while maintaining the quality of generated columns. Empirical results demonstrate that our method outperforms pure integer programming approaches, such as GOBNILP, in both solution quality and computational efficiency.

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