Sparse Optimization: Algorithmic Design Using Combinatorial Techniques

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Abstract:

Sparse optimization is a crucial research area focused on finding solutions with a minimal number of non-zero components, which enhances both interpretability and computational efficiency across various applications. This article delves into the algorithmic design of sparse optimization techniques using combinatorial methods as a framework. We investigate how formal power series and algebraic combinatorics can be utilized to create efficient algorithms for problems related to sparse representation. By applying generating functions, we uncover combinatorial insights that aid in enumerating sparse solutions and understanding their properties. Through case studies and algorithmic frameworks, we demonstrate the effectiveness of integrating combinatorial techniques into sparse optimization, highlighting improved performance in both theoretical and practical contexts. This work seeks to connect combinatorial theory with optimization practice, illustrating the potential of combinatorial methods to enhance sparse optimization strategies.