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**Semidefinite Programming for Discrete Optimization
and Matrix Completion Problems**

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Abstract Semidefinite Programming (SDP) is currently one of the most active areas of research in optimization. SDP has attracted researchers from a wide variety of areas because of its theoretical and numerical elegance as well as its wide applicability. In this paper we present a survey of two major areas of application for SDP, namely discrete optimization and matrix completion problems.

In the first part of this paper we present a recipe for finding SDP relaxations based on adding redundant constraints and using Lagrangian relaxation. We illustrate this with several examples. We first show that many relaxations for the Max-Cut problem (MC) are equivalent to both the Lagrangian and the well-known SDP relaxation. We then apply the recipe to obtain new strengthened SDP relaxations for MC as well as known SDP relaxations for several other hard discrete optimization problems.

In the second part of this paper we discuss two completion problems, the positive semidefinite and the Euclidean distance matrix completion problem. We present some theoretical results on the existence of such completions and then proceed to the application of SDP to find approximate completions. We conclude this paper with a new application of SDP to find approximate matrix completions for large and sparse instances of Euclidean distance matrices.