Limits of Linear and Semidefinite Relaxations for Combinatorial Problems

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Linear and semidefinite programming are versatile tools for continuous optimization that have also found applications in combinatorial contexts. Spectacular success was achieved in the 1990's when, by means of appropriate semidefinite programming relaxations, new polynomial-time approximation algorithm with non-trivial approximation guarantees were found for graph partition problems. However, for certain other problems, such as the problem of computing the size of the minimum vertex cover in a graph, little is known on the actual power of semidefinite programming methods. In this talk I will give an overview of this question and propose a new approach to proving inconditional negative results on the power of semidefinite programming for combinatorial problems. The main idea is to view the question more globally, and not by looking at one problem at a time, as a question of proving inexpressibility results in certain logics. We give some partial results in this direction.