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MADALGO seminars by Aaron Archer, AT&T Shannon Research Laboratory

Improved Approximation Algorithms for the Prize-Collecting Steiner Tree Problem

Abstract:

Given a graph (*V*,*E*) with a cost on each edge and a penalty (a.k.a. prize) on each node, the prize-collecting Steiner tree (*PCST*) problem asks for the tree that minimizes the sum of the edge costs in the tree and the penalties of the nodes not spanned by it. In addition to being a useful theoretical tool for helping to solve other optimization problems, *PCST* has been applied fruitfully by AT&T to the optimization of real-world telecommunications networks.

This problem is NP-hard, so research has focused on approximation algorithms. The most recent improvement was the famous 2-approximation algorithm of Goemans and Williamson, which first appeared in 1992. The natural linear programming relaxation of *PCST* has an integrality gap of 2, which has been a barrier to further improvements for this problem.

We present a 1.9672-approximation algorithm for *PCST*, using a new technique for improving prize-collecting algorithms that allows us to circumvent the integrality gap barrier. We have also applied the same technique to obtain improved approximation algorithms for the prize-collecting path and traveling salesman problems.

Joint work with Mohammad Hossein Bateni (Princeton), Mohammad Taghi Hajiaghayi (AT&T), and Howard Karloff (AT&T).