On Approximating Asymmetric TSP and Related Problems

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Licentiate Thesis
Stockholm, Sweden 2006
Abstract

In this thesis we study problems related to approximation of asymmetric TSP. First we give worst case examples for the famous algorithm due to Frieze, Gabiati and Maffioli for asymmetric TSP with triangle inequality. Some steps in the algorithm consist of arbitrary choices. To prove lower bounds, these choices need to be specified. We show a worst case performance with some deterministic assumptions on the algorithm and then prove an expected worst case performance for a randomised version of the algorithm. The algorithm by Frieze et al. produces a spanning cactus and makes a TSP tour by shortcuts. We have proven that determining if there is a spanning cactus in a general asymmetric graph is an \( \text{NP} \)-complete problem and that finding a minimum spanning cactus in a complete, directed graph with triangle inequality is equivalent to finding the TSP tour and the problems are equally hard to approximate. We also give three other results; we show a connection between asymmetric TSP and TSP in a bipartite graph, we show that it is \( \text{NP} \)-hard to find a cycle cover in a bipartite graph without cycles of length six or less and finally we present some results for a new problem with ordered points on the circle.

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