Exercise Set 9

Exercise 9.1. Consider the special case of the METRIC TSP where the vertices are points in the euclidean plane and the edge weights c are given by the euclidean distance. Prove that even for this special case Christofides' algorithm achieves no better approximation ratio than $\frac{3}{2}$.

(4 points)

Exercise 9.2. Let G be a complete undirected graph in which all edge lengths are either 1 or 2. Give a $\frac{4}{3}$-approximation algorithm for the TSP in this special case.

Hint: You may use that a minimum weight 2-matching, i.e. a minimum weight subgraph of G in which every vertex has degree 2, can be computed in polynomial time.

(5 points)

Exercise 9.3. Let $V \subset \mathbb{R}^2$ be an instance of the EUCLIDEAN TSP and let T be a tour for V. Prove that for any line segment l of length s not containing any point of V, there is a tour for V whose length exeeds the length of T by at most $3s$ and which crosses l at most twice.

(5 points)

Exercise 9.4. Consider the following variant of the METRIC TSP: Given an instance of the METRIC TSP, we look for a Hamiltonian path of minimum weight (with arbitrary start- and endpoint). Give a $\frac{3}{2}$-approximation algorithm for this problem.

(6 points)

Deadline: Thursday, June 28th, before the lecture. The websites for lecture and exercises can be found at:

> http://www.or.uni-bonn.de/lectures/ss18/appr_ss18_ex.html

In case of any questions feel free to contact me at traub@or.uni-bonn.de.