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 exceeds 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.