Technische Universität München
Fakultät für Informatik
Lehrstuhl für Theoretische Informatik
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Winter Semester 2017/18
Problem Set 10
January 15, 2018

Online and Approximation Algorithms

Due January 22, 2018 at 10:00

Exercise 1 (Eulerian Cycle – 10 points)

Recall that a Eulerian cycle is a cycle in a graph that visits every edge exactly once. Show that a connected graph $G = (V, E)$, with possibly multiple edges between a pair of vertices, contains a Eulerian cycle if and only if every vertex $v \in V$ has even degree.

Exercise 2 (1,2-TSP – 10 points)

Let G be a complete undirected graph in which all edge lengths are either 1 or 2. Note that the edge lengths satisfy the triangle inequality.
Give a 4/3-approximation algorithm for TSP on this special class of graphs.
Hint: Start by finding a minimum 2-matching in G. A 2-matching is a subset S of edges such that every vertex is incident to exactly 2 edges of S. You can assume that a minimum 2-matching can be calculated in polynomial time.

Exercise 3 (Lower bound MST algorithm – 10 points)

In the lecture, it was shown the MST algorithm for the metric Traveling Salesman Problem achieves an approximation ratio of 2. Prove that this bound is tight.
Hint: Consider a graph where all edges have length 1 or 2.

Exercise 4 (Sorted List Scheduling – 10 points)

In the lecture it was shown that the Sorted List Scheduling algorithm achieves an approximation ratio of $\frac{4}{3}$ for the problem of makespan minimization. Show that this factor is tight for $m \to \infty$.