Research Institute for Discrete Mathematics
Approximation Algorithms
Summer term 2010

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Exercise Set 8

Exercise 1:
Consider an optimization problem $\mathcal{P}$ and the corresponding decision problem $\mathcal{P}'$. Show that if $\mathcal{P}'$ can be decided in polynomial time, then $\mathcal{P}$ can also be solved in polynomial time. You can assume that the optimum value of $\mathcal{P}$ is always an integer.

(3 points)

Exercise 2:
Describe an algorithm for the Steiner Tree Problem which runs in $O(n^3)$ for instances (V, E, c, K) with $|V \setminus K| \leq s$ for some constant s.

(4 points)

Exercise 3:
Consider the Rectilinear Steiner Tree Problem: The terminal set is a finite set $K \subset \mathbb{R}^2$, Steiner points can be created anywhere in the plane, and all line segments have to be either vertical or horizontal. Show that there is an algorithm which finds a shortest rectilinear Steiner tree in finite time.

(4 points)

Exercise 4:
The "vertex version" of the contraction lemma (which will be discussed in thursday's lecture) is wrong. To show this, define a complete graph whose edge lengths fulfill the triangle inequality and vertex sets A, B, and C such that

$$0 < mst(A) - mst(A \cup C) < mst(A \cup B) - mst(A \cup B \cup C).$$

Here $mst(X)$ for a vertex set X denotes the length of a minimum spanning tree in the graph induced by X.

(4 points)

Special topic:
The institute's group of mentors would like to invite all interested students to attend the talk "Diskrete Mathematik jenseits der Uni". The speaker Johannes Zühlke from the Fraunhofer-Institut für Algorithmen und wissenschaftliches Rechnen talks about his current work and how his studies at our institute still has influence on his work. The talk will take place on Tuesday, June 22nd, at 6:00 pm in the Gerhard-Konow-Hörsaal (Arithmeum).

Please return the exercises until Tuesday, **June 22th, at 2:15 pm**.