Research Institute for Discrete Mathematics
Approximation Algorithms
Summer term 2012

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Exercise Set 8

Exercise 1:
Consider the MINIMUM MAKESPAN SCHEDULING problem with a constant number m of machines. Use the algorithm from Exercise 7.3 to obtain a PTAS for this problem.

(4 points)

Exercise 2:
Consider the MAXIMUM CLIQUE problem: Given a graph $G = (V, E)$, find a clique of maximum size in G. Show that (unless $P = NP$), there exists no absolute approximation algorithm for this problem.

(4 points)

Exercise 3:
Show that if there is an algorithm for BIN PACKING having a guarantee of $OPT(I)+\log^2(OPT(I))$, then there is a fully polynomial approximation scheme for this problem.

(4 points)

Exercise 4:
Prove: Unless $P = NP$, there does not exist an absolute approximation algorithm for the STEINER TREE problem.

(4 points)

Exercise 5:
Describe an algorithm for the STEINER TREE problem which runs in $O(n^3)$ for instances (G, c, R) with $|V(G) \setminus R| \leq s$ for some constant s.

(3 points)

Exercise 6:
Consider the following algorithm for the STEINER TREE problem with 3 terminals v_1, v_2 and v_3: Find the shortest path P between v_1 and v_2 and let a be the distance of v_3 to P. Then find a vertex z which minimizes $\sum_{i=1}^{3} dist(v_i, z)$ under the conditions $\mathrm{dist}(v_i, z) \leq \mathrm{dist}(v_1, v_2)$ for $i \in \{1, 2\}$ and $\mathrm{dist}(v_3, z) \leq a$. The algorithm finally returns the union of the shortest paths from z to the terminals.
Show that the algorithm can be implemented in $O(m + n \log n)$ and works correctly.

(3 points)

Please return the exercises until Tuesday, **June 5th, at 2:15 pm**.