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 $\sum_{i=1}^{3} \text{dist}(v_i, z)$ under the conditions $\text{dist}(v_i, z) \leq \text{dist}(v_1, v_2)$ for $i \in \{1, 2\}$ and $\text{dist}(v_3, z) \leq a$. 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.