Prof. Dr. Stephan Held
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Exercise Set 12

Exercise 12.1. Given a power consumption $P_l > 0$ for each buffer $l \in L$, extend the algorithm by van Ginneken from the lecture to obtain a PTAS for the problem of finding an assignment of buffers such that all required arrival times are met and the total power is minimized.

(a) First assume that for all $l \in L$, both P_l and $\frac{1}{P_l}$ are polynomially bounded in the input size.

(b) Then solve the general case using binary search.

(3+2 points)

Exercise 12.2. Let $\alpha > 1$ and $1 \leq \beta < 1+2/(\alpha-1)$. Construct a connected, planar graph G with $w : E(G) \to \mathbb{R}_+$ and $r \in V(G)$ that contains no spanning tree T with the following properties:

(a) For each $v \in V(G)$: $\text{dist}_{w,T}(r, v) \leq \alpha \cdot \text{dist}_{w,G}(r, v)$.
(b) For a minimum-spanning tree M: $\sum_{e \in E(T)} w(e) \leq \beta \cdot \sum_{e \in E(M)} w(e)$.

(5 points)

Exercise 12.3. A posynomial function $f : \mathbb{R}^n_{>0} \to \mathbb{R}$ is of the form

$$f(x) = \sum_{k=1}^{K} c_k \prod_{i=1}^{n} x_i^{a_{ik}}$$

for $K \in \mathbb{N}, c_k > 0$ and $a_{ik} \in \mathbb{R}$.

(a) Give an example for a non-convex posynomial function.

(b) Let f be a posynomial function with lower and upper bounds $l, u \in \mathbb{R}^n_{>0}$, $l \leq u$ on the variables. Show that each local minimum of f on the box $[l, u]$ is also a global minimum of f on $[l, u]$.

Hint: Use a logarithmic variable transformation to derive an equivalent convex problem.

(2 + 3 points)

Exam submission infos: This is a bonus sheet. For exam submission you will therefore only need a total of 142 points, as 284 points is the total number of (non-bonus-)points from programming and theory exercise sheets. The points that you reach on this sheet still will still be added to your total point sum and can therefore still enable you to reach the necessary amount of points for exam submission.

Deadline: July 15th, before the lecture. The websites for lecture and exercises can be found at:

`https://www.or.uni-bonn.de/lectures/ss25/chipss25_ex.html`

In case of any questions feel free to contact me at heinz@dm.uni-bonn.de.