Chip Design
Summer term 2010

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Exercises 13

1) Prove Kraft's inequality:
Let S be a nonempty finite set, $r \notin S$, and $h_s \in \mathbb{N}$ for $s \in S$. There exists a topology A for root r and sinks S with $|E(A_{[r,s]})| - 1 \leq h_s$ for all $s \in S$ if and only if

$$\sum_{s \in S} 2^{-h_s} \leq 1.$$

(4 points)

2) Given a source r, a finite set S of sinks, positions $p : S \dot{\cup} \{r\} \to \mathbb{R}^2$ and a topology T for root r and sinks S.
Formulate an $O(|S|)$-time algorithm that computes positions $p : V(T) \setminus (S \dot{\cup} \{r\}) \to \mathbb{R}^2$ minimizing the total length

$$\sum_{(v,w) \in E(T)} ||p(w) - p(v)||_1.$$

(4 points)

3) Let A be an arborescence that results from a topology by subdividing edges. Let L be a buffer library and $k \in \mathbb{N}$, $k \geq 2$. Due to capacitance constraints, every subtree of A with k or more vertices must contain at least one buffer.
Give a tight upper bound, depending on k, $|L|$ and $|V(A)|$, on the number of non-dominated solution candidates in the dynamic programming buffering algorithm.

(4 points)

4) Show that the algorithm presented in the lectures for solving the RECTILINEAR SINK CLUSTERING PROBLEM can be implemented to run in $O(|D| \log |D|)$ time.
You can assume without proof that a shortest rectilinear spanning tree on n terminals can be computed in $O(n \log n)$ time.

(4 points)

Deadline: July 20 before the lecture (12.15 pm).