Chip Design
Summer term 2015

Prof. Dr. Jens Vygen
Markus Ahrens, M. Sc.

Exercise Set 4

Exercise 4.1:
Let $G = (V, E)$ be a connected graph, let $c : E \to \mathbb{R}_{\geq 0}$ be a cost function, let $T \subseteq V$ be a set of terminals, let $t \in T$ and let $j \geq 1$. We define

$$\mathcal{L}_j(v, I) = \max_{\{t\} \subseteq J \subseteq I \cup \{v\}, |J| \leq j+1} \operatorname{smt}(J)$$

for $v \in V$ and $\{t\} \subseteq I \subseteq T$. For $v \in V$ and $I \subseteq T \setminus \{t\}$ we set $\mathcal{L}_j(v, I) = 0$.
Prove: $\mathcal{L}_j$ is a feasible lower bound.

(4 points)

Exercise 4.2:
Let T be a finite set of points in the plane, let $S = S_1 \cup \cdots \cup S_m$ be a finite union of rectangular blockages and let $L > 0$. A rectilinear Steiner tree R for T is *reach-aware* if every connected component of the intersection of R and the interior of S has length at most L.
The *reach-aware Steiner tree problem* consists of finding a shortest reach-aware Steiner tree.
The Hanan grid induced by an instance $(T, S_1 \cup \cdots \cup S_m)$ of this problem is the Hanan grid induced by $T \cup \{l_i, r_i | i \in \{1, \ldots, m\}$ and l_i/r_i is the lower left / upper right corner of $S_i\}$.
Prove or disprove: There is always an optimal solution of the reach-aware Steiner tree problem that is a subgraph of the Hanan grid.

(3 points)

Exercise 4.3:
Let $T = \{(0, 0), (2, 0), (1.63, 2), (1, 3), (2, 3)\}$ be a set of terminals and let $s = (0, 0) \in T$ be the source. The source resistance is 1.75. The sink capacitance is 0.37 for $(1.63, 2)$ and 0 for all other sinks. The capacitance and resistance of a wire per unit length is 1.
Prove that there is no solution minimizing $\max_{t \in T \setminus \{s\}} \operatorname{Elmore}(s, t)$ that is a subgraph of the Hanan grid.

(3 points)

Deadline: Thursday, May 7th, before the lecture.

The websites for lecture and exercises are linked at

http://www.or.uni-bonn.de/lectures/ss15/ss15.html

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