Exercise Set 6

Exercise 6.1. Consider the *spreading LP* for $d = 2$:

$$\begin{aligned}
\min \quad & \sum_{e \in E(G)} w(e)\, l(e) & \\
\text{s.t.} \quad & \sum_{y \in X} l(\{x,y\}) \geq \frac{1}{4}\,(|X|-1)^{3/2} & x \in X \subseteq V(G) \\
& l(\{x,y\}) + l(\{y,z\}) \geq l(\{x,z\}) & x,y,z \in V(G) \\
& l(\{x,y\}) \geq 1 & x,y \in V(G),\ x \neq y \\
& l(\{x,x\}) = 0 & x \in V(G)
\end{aligned}$$

Show that the optimum of the spreading LP is a lower bound for the cost of any 2-dimensional arrangement.

(5 points)

Exercise 6.2. Given a chip area A and a set $\mathcal{C}$ of circuits. A *movebound* for $C \in \mathcal{C}$ is a subset $A_C \subseteq A$ in which C must be placed entirely. Assume that the height and width of every circuit is 1 and that A and each movebound A_C ($C \in \mathcal{C}$) are axis-parallel rectangles with integral coordinates.

Describe an algorithm with running time polynomial in $|\mathcal{C}|$ that decides whether there is a feasible placement meeting all movebound constraints.

(5 points)

Exercise 6.3. Consider the Standard Placement Problem on instances without blockages, where $h(C) \equiv 1 \equiv w(C)$ (unit size for $C \in \mathcal{C}$) as well as $w(N) \equiv 1$ (unit net weights for $N \in \mathcal{N}$).

Prove or disprove that this problem is NP-hard.

(5 points)

Exercise 6.4. Let N be a finite set of pins, and let S_p be a set of axis-parallel rectangles for each $p \in N$. We want to compute the *bounding box netlength* of N, i.e. an axis-parallel rectangle R with minimum perimeter s.t. for every $p \in N$ there is an $S \in S_p$ with $R \cap S \neq \emptyset$.

Show how to compute such a rectangle in $O(n^3)$ time where $n := \sum_{p \in N} |S_p|$.

(5 points)

Deadline: June 5^{th}, before the lecture. The websites for lecture and exercises can be found at:

`http://www.or.uni-bonn.de/lectures/ss18/chipss18.html`

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