Exercise Set 6

Exercise 6.1. Consider the spreading LP for \( d = 2 \):

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

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 5th, 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.