Prof. Dr. Stephan Held
Niklas Schlomberg, M. Sc.

Exercise Set 5

Exercise 5.1. Provide a polynomial time algorithm for the STANDARD PLACEMENT PROBLEM restricted to instances with only one circuit.

(5 points)

Exercise 5.2. 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 5.3. Prove that unless P = NP, there is no polynomial time n^α approximation algorithm for the QUADRATIC ASSIGNMENT PROBLEM for any $\alpha < 1$ even if $w \equiv 1$, $c \equiv 0$, $d : U \times U \to \{0, 1\}$ is metric and G is a tree.

Hint: Transformation of 4-Partition, where G is chosen as a collection of stars (one for each item) whose centers are connected to (an additional) common root vertex. U can be chosen as $|U| = |V(G)|$.

(5 points)

Exercise 5.4. 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)

Deadline: May 14th, before the lecture. The websites for lecture and exercises can be found at:

`http://www.or.uni-bonn.de/lectures/ss24/chipss24_ex.html`

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