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Exercise Set 10

Exercise 10.1. Provide an instance of the SIMPLE GLOBAL ROUTING PROBLEM which admits a fractional solution, but no feasible integral solution. Your instance has to satisfy $w(N, e) \leq u(e)$ for each net N and edge e.

(5 points)

Exercise 10.2. Show that the VERTEX-DISJOINT PATHS PROBLEM is NP-complete even if G is a subgraph of a track graph G_T with two routing planes. Recall that in this case G_T is a graph $G_T = (V, E)$ for some $n_x, n_y \in \mathbb{N}$ with $V = \{1, \ldots, n_x\} \times \{1, \ldots, n_y\} \times \{1, 2\}$ and $E = \{\{(x, y, z), (x', y', z')\} : |x - x'|z + |y - y'|(3 - z) + |z - z'| = 1\}$.

(5 points)

Exercise 10.3. Consider the ESCAPE ROUTING PROBLEM: We are given a complete 2-dimensional grid graph $G = (V, E)$ (i.e. $V = \{0, \ldots, k-1\} \times \{0, \ldots, k-1\}$ and $E = \{\{v, w\} \mid v, w \in V, \|v - w\| = 1\}$) and a set $P = \{p_1, \ldots, p_m\} \subseteq V$. The task is to compute vertex-disjoint paths $\{q_1, \ldots, q_m\}$ s.t. each q_i connects p_i with a point on the border $B = \{(x, y) \in V \mid \{x, y\} \cap \{0, k-1\} \neq \emptyset\}$.

Find a polynomial-time algorithm for the ESCAPE ROUTING PROBLEM or prove that the problem is NP-hard.

(5 points)

Exercise 10.4. Formulate the SIMPLE GLOBAL ROUTING PROBLEM as an integer linear program with a polynomial number of variables and constraints.

(5 points)

Deadline: June 20, before the lecture. The websites for lecture and exercises can be found at:

`http://www.or.uni-bonn.de/lectures/ss23/chipss23_ex.html`

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