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Exercise Set 9

Exercise 9.1. Consider the PLACEMENT LEGALIZATION PROBLEM (see lecture notes for the formal definition) with $y_{\max} - y_{\min} = 1$. We are given an infeasible placement $\tilde{x} : \mathcal{C} \to \mathbb{R}$. Show that there are feasible instances for which there is no optimum solution which is consistent with $\tilde{x}$, i.e. such that $x(C) < x(C') \Rightarrow \tilde{x}(C) \leq \tilde{x}(C')$.

(3 points)

Exercise 9.2. Consider following specialized legalization problem. A feasible placement consists of integral placement coordinates $x, y : \mathcal{C} \to \mathbb{Z}^2$ (such that all circuits are located within the chip image), and all circuits have unit height and width. In addition, there is an (infeasible) input placement $\tilde{x}, \tilde{y} : \mathcal{C} \to \mathbb{R}^2$.

- Find a polynomial-time algorithm that finds a legal placement minimizing the linear or quadratic movement.
- Find a linear time algorithm that finds a legal placement minimizing the quadratic movement if the instance consists of a single row. Assume that the input is sorted.

(2+2 points)

Exercise 9.3. Consider the following variant of the SINGLE ROW PLACEMENT WITH FIXED ORDERING problem, in which we minimize the bounding box net length:

Input: A set $\mathcal{C} = \{C_1, \ldots, C_n\}$ of circuits, widths $w(C_i) \in \mathbb{R}_+$, an interval $[0, w(\Box)]$, s.t. $\sum_{i=1}^{n} w(C_i) \leq w(\Box)$. A netlist $(\mathcal{C}, P, \gamma, \mathcal{N})$ where the offset of a pin $p \in P$ satisfies $x(p) \in [0, w(\gamma(p))]$. Weights $\alpha : \mathcal{N} \to \mathbb{R}_+$.

Task: Find a feasible placement given by a function $x : \mathcal{C} \to \mathbb{R}$ s.t. $0 \leq x(C_1)$, $x(C_i) + w(C_i) \leq x(C_{i+1})$ for $i = 1, \ldots, n-1$ and $x(C_n) + w(C_n) \leq w(\Box)$, that minimizes

$$\sum_{N \in \mathcal{N}} \alpha(N) \cdot \mathrm{BB}(N).$$

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Here, $\mathrm{BB}(N)$ denotes the bounding box net length.

Show that there exist $f_i : [0, w(\Box)] \to \mathbb{R}$, $i = 1, \ldots, n$, piecewise linear, continuous and convex, such that we can solve this problem by means of the SINGLE ROW ALGORITHM.

(5 points)

Deadline: June 13, 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.