Chip Design
Summer term 2010

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Exercises 7

1) Given an undirected graph G, weights $w : E(G) \to \mathbb{R}_{\geq 0}$, $\mathcal{C} \subsetneq V(G)$ and $x : V(G) \setminus \mathcal{C} \to \{1, \ldots, k\}$ for $k \in \mathbb{N}$. We are looking for positions $x : \mathcal{C} \to \mathbb{R}$ such that

$$\sum_{\{v,w\} \in E(G)} w(\{v,w\}) \cdot |x(v) - x(w)| \tag{1}$$

is minimized.
Prove:

(a) There is always a placement x minimizing (1) with $x(v) \in \{1, \ldots, k\}$ for all $v \in \mathcal{C}$.

(b) A placement minimizing (1) can be found by solving $k-1$ minimum weight s-t-cut problems in digraphs with $O(|V(G)|)$ vertices and $O(|E(G)|)$ edges.

Hint: Consider the digraphs G_j ($j \in \{1, \ldots, k-1\}$) defined by

$$\begin{aligned} V(G_j) &:= \{s,t\} \cup \mathcal{C} \quad \text{and} \\ E(G_j) &:= \{\{s,v\} \mid \exists\, w \in V(G) \setminus \mathcal{C}, x(w) \leq j, \{v,w\} \in E(G)\} \cup \\ &\quad \{\{v,w\} \mid v,w \in \mathcal{C}, \{v,w\} \in E(G)\} \cup \\ &\quad \{\{v,t\} \mid \exists\, w \in V(G) \setminus \mathcal{C}, x(w) > j, \{v,w\} \in E(G)\}. \end{aligned}$$

(4 points)

2) Assume that there is an oracle which returns a feasible placement of minimum bounding box net length for any input net list $(\mathcal{C}', P', \gamma', \mathcal{N}')$ containing only two-terminal nets in $O(T(|\mathcal{N}'|, |\mathcal{C}'|))$ time for some $T : \mathbb{N}^2 \to \mathbb{N}$.
Show that such an oracle can be used to find a feasible placement minimizing the bounding box net length of a general net list $(\mathcal{C}, P, \gamma, \mathcal{N})$ in $O(T(|\mathcal{P}|, |\mathcal{C}|))$ time.

(4 points)

Deadline: June 8 before the lecture (12.15 pm).

Das nächste Treffen der Mentorengruppe des Forschungsinstituts für Diskrete Mathematik findet heute (1. Juni) um 18:00 Uhr im Konferenzraum (2.OG) des Arithmeums statt. Das Thema lautet 'Einführung in die Hypergraphen', alle interessierten Studenten sind herzlich eingeladen.