Concurrency theory
Exercise sheet 4

TU Braunschweig

Sebastian Muskalla, Prakash Saivasan

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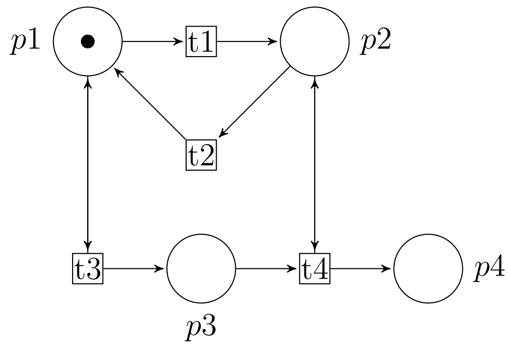
Out: November 09 Due: November 14

Submit your solutions until Tuesday, November 14, during the lecture. You may submit in groups up to three persons.

Exercise 1: Coverability and place boundedness

Consider the following Petri net



a) Construct the coverability graph $\texttt{Cov}(N)$ using the algorithm seen in the lecture.

b) Is $\texttt{Cov}(N)$ unique?

c) Do you need to label the edges of $\texttt{Cov}(N)$ to solve the coverability instance?

Exercise 2: Upward-closed sets

For a finite alphabet Σ and $w_1, w_2 \in \Sigma^*$, let $w_1 \leqslant w_2$ if and only if w_1 is a subword of w_2 [i.e. w_1 can be obtained by deleting zero or more letters in w_2]. For any $\mathcal{L} \subseteq \Sigma^*$, the upward-closure of $\mathcal{L}$ is defined as $\mathcal{L}\uparrow = \{w \mid \exists w' \in \mathcal{L} : w' \leqslant w\}$ and the downward closure $\mathcal{L}\downarrow$ is defined as $\mathcal{L}\downarrow = \{w \mid \exists w' \in \mathcal{L} : w \leqslant w'\}$

a) Show that for any language $\mathcal{L} \subseteq \Sigma^*$, the languages $\mathcal{L}\uparrow$ and $\mathcal{L}\downarrow$ are regular. (Assume that the set of finite sequences over a finite alphabet, ordered by the subword relation, is well-quasi-ordered)

b) Let $(A, \leqslant)$ be a wqo and $M_1, M_2 \subseteq A$ finite. Show that it is decidable if $M_1\uparrow = M_2\uparrow$.