Technische Universität München
I7
Prof. J. Esparza / Dr. M. Blondin

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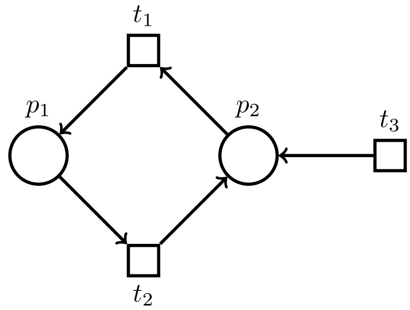
Petri nets — Homework 3

Due 23.05.2018

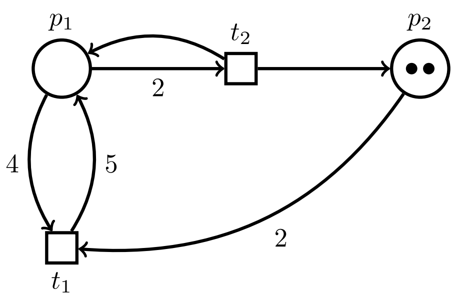
Exercise 3.1

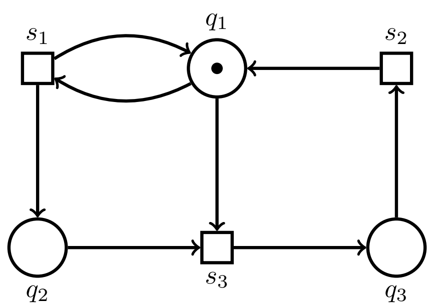
The algorithm Coverability-Graph does not specify how the coverability graph should be traversed during its construction. Show that different traversal strategies can lead to different coverability graphs. More precisely, exhibit a marking M and two different coverability graphs for $(\mathcal{N}, M)$, where $\mathcal{N}$ is the following net:



Exercise 3.2

Let $\mathcal{N}$ and $\mathcal{N}'$ be respectively the left and right Petri nets below.





Use the backward algorithm to answer the following questions.

(a) Describe the set of initial markings from which $\{p_2, p_2\}$ is coverable in $\mathcal{N}$. Illustrate this set.

(b) Determine whether $\{q_1, q_3\}$ is coverable from $\{q_1\}$ in $\mathcal{N}'$.

(c) Determine whether $\{q_1, q_2\}$ is coverable from $\{q_1\}$ in $\mathcal{N}'$.

Exercise 3.3

A net with reset, doubling and transfer arcs is a tuple (P, T, F, R, D, Tr) where (P, T, F) is a net,

$$R \subseteq P \times T,\ D \subseteq T \times P,\ Tr \subseteq (P \times T) \cup (T \times P),$$

and F, R, D and Tr are pairwise disjoint. Let $M \in \mathbb{N}^P$ and $t \in T$. We say that t is enabled at M if $M(p) > 0$ for every $(p, t) \in F$. Firing t at M has the following effect:

- every arc $(p, t) \in F$ consumes a token from p;
- every arc $(t, p) \in F$ produces a token in p;
- every arc $(p, t) \in R$ empties p;
- every arc $(t, p) \in D$ doubles the amount of tokens in p;
- every arc $(p, t) \in Tr$ empties p;
- every arc $(t, p) \in Tr$ adds $\sum_{(q,t)\in Tr} M(q)$ tokens to p.

Show that the backward algorithm works for this extended class of nets by showing that it is monotonic, i.e. show that for every markings $X, X', Y \in \mathbb{N}^P$, if $X \to Y$ and $X' \geq X$, then $X' \to Y'$ for some $Y' \geq Y$.

Exercise 3.4

(a) Show that nets with inhibitor arcs are not monotonic.

(b) Give a net with reset arcs $\mathcal{N}$ and a marking M such that $(\mathcal{N}, M)$ is bounded, but such that there exists a sequence $M \xrightarrow{\sigma} M' \xrightarrow{\sigma'} M''$ with $M'' \geq M'$ and $M'' \neq M'$.