Concurrency Theory (WS 2010/11)	Out: Wed, Nov 17 Due: Mon, Nov 22

Exercise Sheet 4

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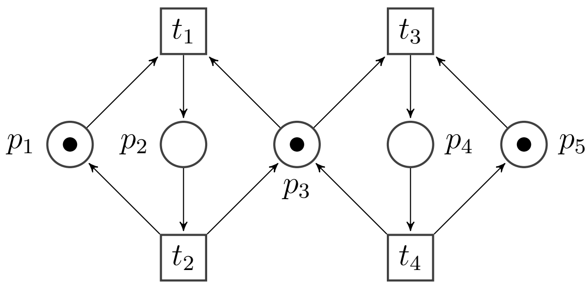
Problem 1: Simple Mutual Exclusion

Consider the Petri net $N = (S, T, W, M_0)$ depicted below and let $\mathbb{C}$ be its connectivity matrix.



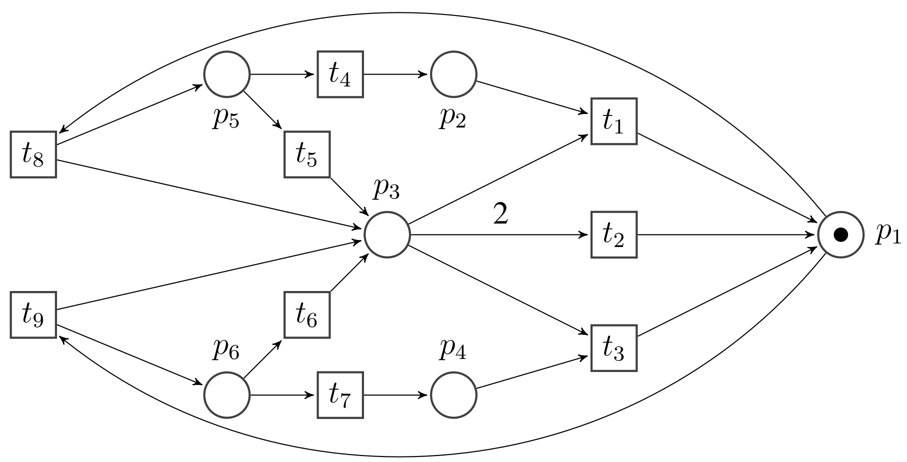
Use linear algebraic techniques in order to:

(a) determine the S-invariants of the Petri net N;

(b) prove that for all $M \in R(N)$: $M(p_2) + M(p_4) \leq 1$ (p_2 and p_4 are mutually exclusive) is implied by any invariant out of a *maximal subset* of the S-invariants you found.

Problem 2: A Deadlock-Free Petri Net

Consider the Petri net $N = (S, T, W, M_0)$ depicted below and let $\mathbb{C}$ be its connectivity matrix.



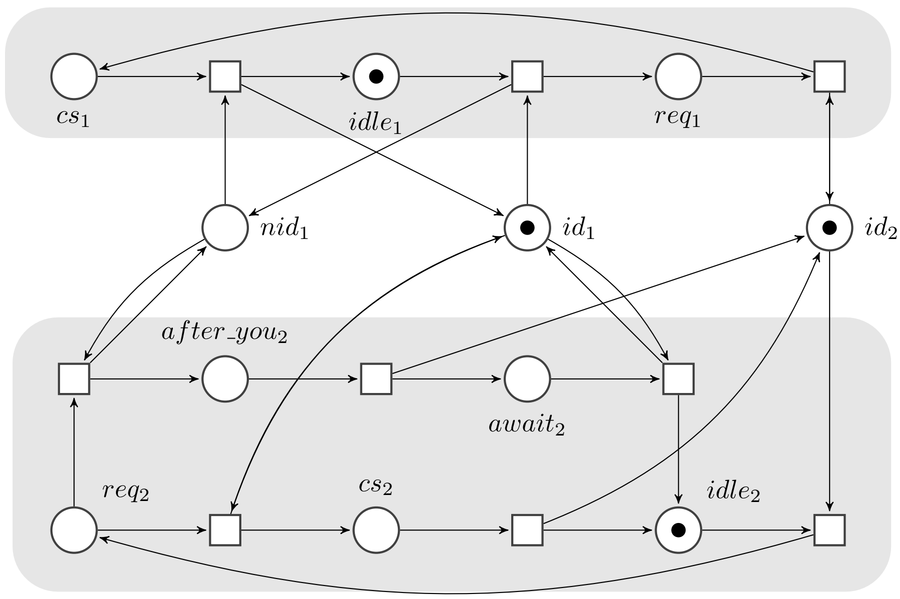
(a) describe the set $D \subseteq \mathbb{N}^{|S|}$ of markings which represent deadlocks of N and determine whether $\mathbb{C}\mathbf{x} = M - M_0$ is solvable in $\mathbb{N}^{|T|}$ for some $M \in D$;

(b) determine the S-invariants and the traps of the Petri net N;

(c) prove that $D \cap R(N) = \emptyset$ by showing that the system of linear inequalities describing D together with N's traps and S-invariants is inconsistent; are **all/any** traps really needed?

Problem 3: Lamport's Mutual Exclusion Algorithm

Consider the Petri net below, describing Lamport's 1-bit mutual exclusion algorithm.



(a) set up the colinear property one would want the mutex to satisfy and determine the connectivity and trap matrices of the given Petri net;

(b) prove that the *basic verification system* is feasible;

(c) prove that the *enhanced verification system* is infeasible.

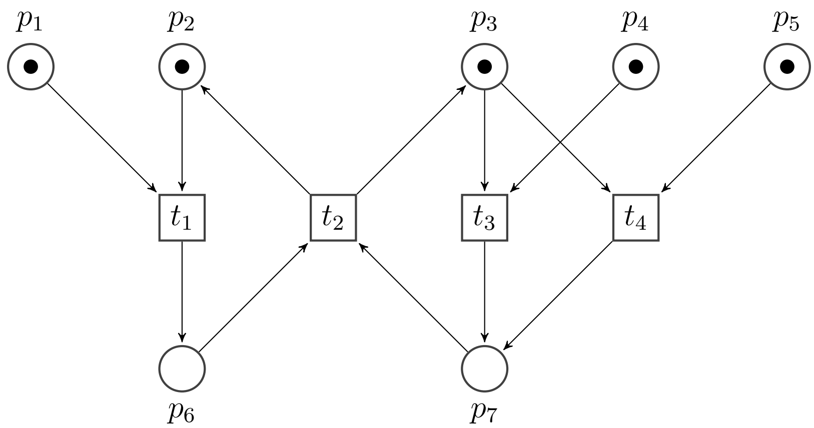
How do you interpret the fact that *bvs* is feasable and *evs* infeasible?

Problem 4: Unfoldings, Configurations and Cuts

Consider the Petri net depicted below.

(a) unfold the given Petri net and outline one of its prefixes;

(b) describe/list all the configurations and cuts of your unfolding.



Why is your unfolding finite?