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Summer term 2012
Problem Set 4
Due: Wednesday, 16th May 2012

Embedded Systems

Please indicate your **name**, **matr. number**, **email address**, and which **discussion session** you have been allocated to. We encourage you to collaborate in **groups** of up to **three** students. Only one submission per group is necessary.

Problems 1: Analyzing a Petri Net

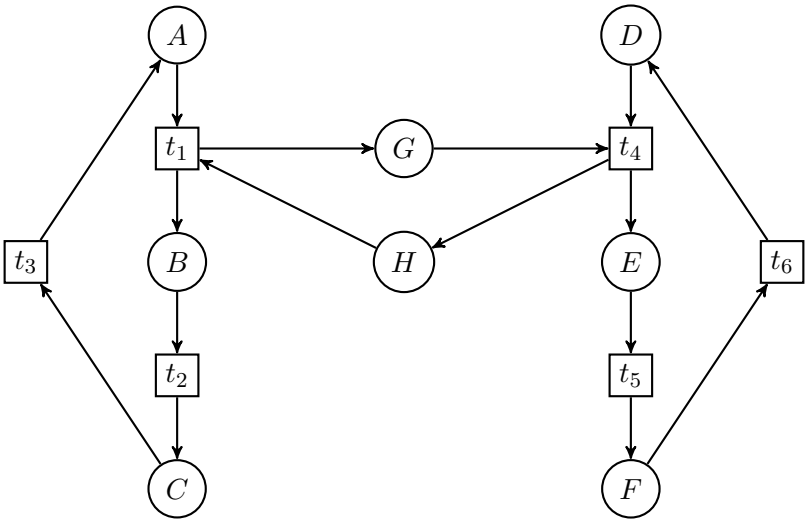


Figure 1: Petri net for Exercise 2 modeling a producer/consumer pattern.

Consider the Petri net in Figure 1 with places $A, \ldots, H$ and transitions $t_1, \ldots t_6$. Assume an initial marking M_0 with $M_0(A) = 1$, $M_0(H) = 3$, $M_0(D) = 1$, and $M_0(p) = 0$ for every other place p.

(a) Is there a dead marking for this Petri net?

(b) Is the Petri net deadlock-free?

(c) Is this Petri net live?

(d) Give the incidence matrix for the Petri net.

(e) Use the incidence matrix to deduce all place invariants.

(f) Is the net bounded? Justify your answer.

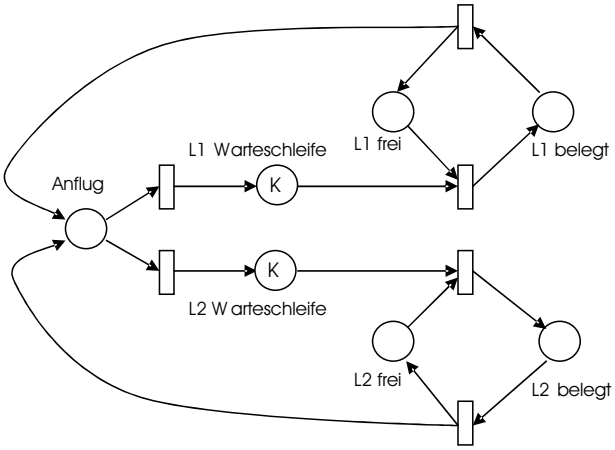


Figure 2: A Petri net modelling two landing strips.

Problem 2: Petri Net Properties

Is every live Petri net deadlock-free? Prove or disprove.

Problem 3: Modelling with Petri Nets

Consider the net in Fig. 2. It models the allocation of the landing strips of an airport. The airport has two strips exclusively reserved for landing airplanes. Each strip has a waiting list (Warteschleife) that should contain at most k airplanes. Furthermore, a strip can either be free (frei) or occupied (belegt). When an airplane approaches (Anflug) it selects a strip. It is possible to use both strips at the same time. Initially, there are n airplanes flying.

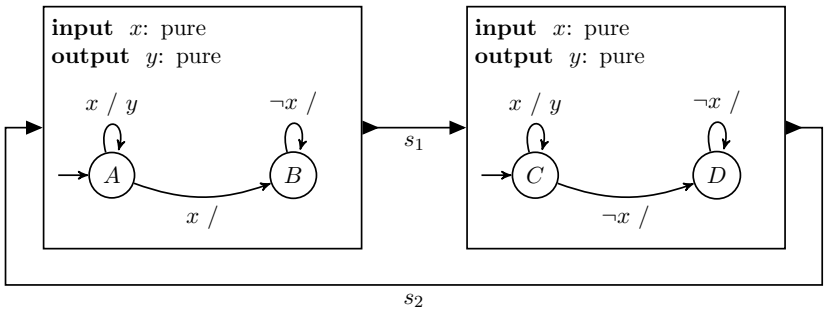
1. Complete the Petri net. Give the weights of the edges, the capacity of the places, and a meaningful initial marking. Do not rely on the default values for capacities (∞) and weights (1) but rather give all values explicitly.

2. Modify the net so that the maximal number of airplanes in one waiting list (Warteschleife) is coded not in the capacity of the places, but rather in the initial marking.

Problem 4: Synchronous Feedback

Consider the following synchronous models and determine whether they are well-formed. If so, give the language of possible sequences of values of the signals s_1 and s_2. If not, give a reachable state that has no or more than one fixed points. Note that nondeterminism in the states of one component, like in the left component of part (a), not necessarily harmful for well-formedness.

(a)



(b)