Tik-79.231 Parallel and distributed digital systems

Tutorial 4
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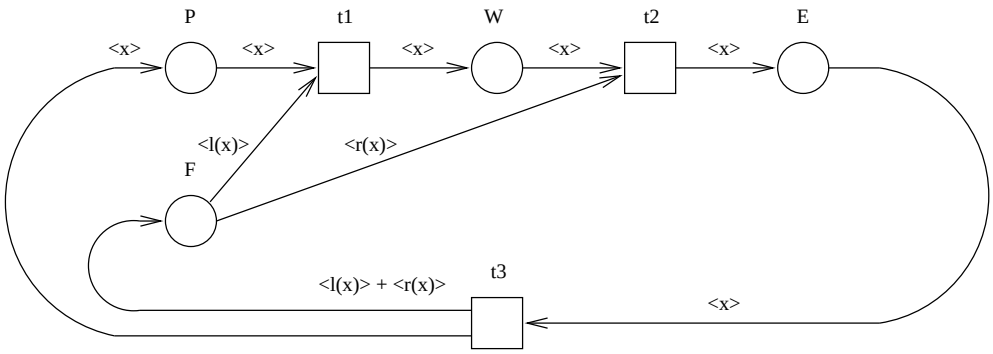
1. A solution to the 3 philosophers problem is given below:



where the initial marking: $P \mapsto \{\langle ph_1 \rangle + \langle ph_2 \rangle + \langle ph_3 \rangle\}$, $F \mapsto \{\langle f_1 \rangle + \langle f_2 \rangle + \langle f_3 \rangle\}$ and $l(ph_i) = f_i$, $r(ph_i) = f_{(i \mod 3)+1}$.

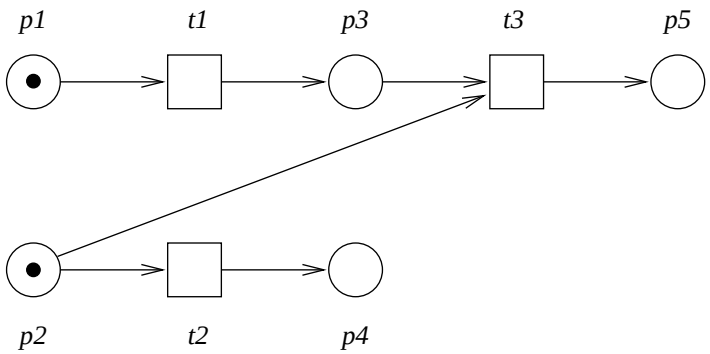
- Give the LTL formulae with which you can verify the properties in the list below. Do the model checking with PROD.
  (a) Two neigbouring philosophers cannot eat at the same time.
  (b) There exists a state where the philosopher ph_1 is dining.
  (c) The philosopher ph_1 may starve.
  (d) If the philosopher ph_1 us dining, the forks f_1 and f_2 are not free.
  (e) If the forks f_1 and f_2 are not free, the philosopher ph_1 is dining.

2. Solve the following problem with modulo 22 arithmetics:

   Traverse all numbers $0 \leq i \leq 21$ by doing 22 additions in modulo 22 arithmetics. The numbers in the additions are restricted in such a way that only some numbers are allowed, and even then only a restricted number of times. The numbers allowed are: 18 three times, 17 five times, 14 four times, 8 three times, 6 three times, and 5 four times. Start the additions from 0.

   (a) Design a Pr/T net to solve the problem.
   (b) Write a PROD description of the net.
   (c) Use a tester to find one of the solutions.
   (d) From a computational point of view, was this a sensible approach to solving the problem?

3. Demonstration whose items (b) and (c) are beyond the scope of the course. Let us examine the following P/T net:



(a) Perform reachability analysis on the net.

(b) Construct a Büchi automaton corresponding the reachability graph when the atomic propositions are $= \{p5\}$.

(c) Do the model checking of the LTL formula $\Box\neg p5$ using the synchronous product of the formula and graph automata.