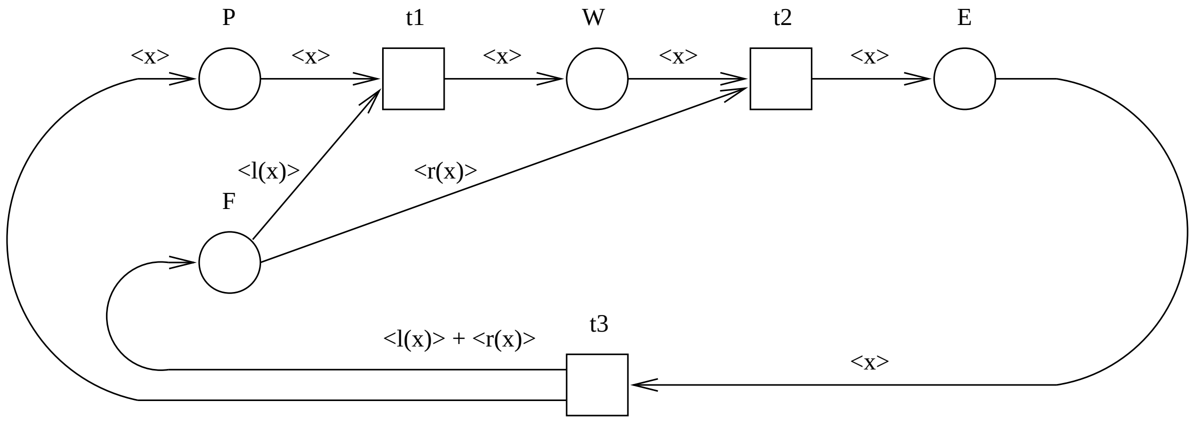
1. A solution to the 3 philosophers problem is given below:



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 $l(ph_i) = f_i$, $r(ph_i) = f_{(i \, mod \, 3)+1}$.

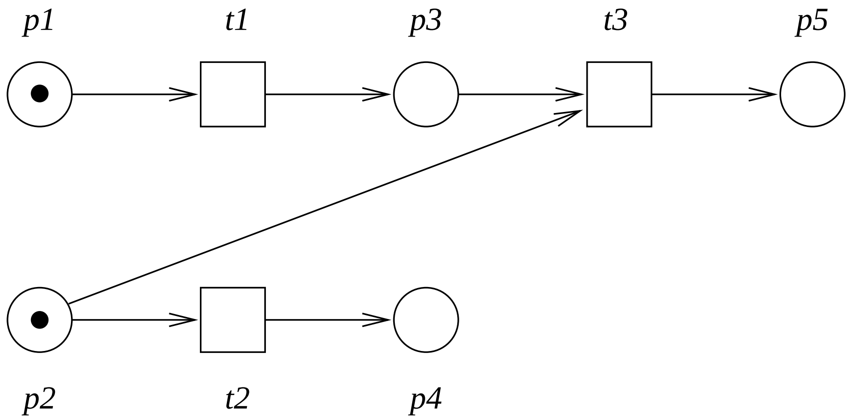
- Give the LTL formulae with which you can verify the properties in the list below. Do the model checking with Maria.
  - (a) Two neigbouring philosophers cannot eat at the same time.
  - (b) There exists a state where the philosopher ph_1 is dining.
  - (c) The philosopher ph_1 may starve.
  - (d) If 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 Maria 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.