D. Nowotka | Winter Term 2008/09

Networks and Processes

Exercise Sheet 3

Discussion on – 4.12.2008, 15h45 (submissions of solutions are highly recommended, either before or after the exercise session)

1. Consider a traffic light controller at a pedestrian crossing, which consists of a traffic light for cars, a traffic light for pedestrians, and a button. The car traffic light repeatedly shows green, yellow, red, red-yellow (at the same time), while the pedestrian traffic light repeatedly shows green and red.

   Initially, the car traffic light is green and the pedestrian traffic light is red. The traffic lights alternate as expected in real life. In particular, when a pedestrian presses the button, the car traffic light should eventually turn red, and the pedestrian traffic light should eventually turn green. Also, the button stays on until the pedestrian light turns green.

   a) Design a P/T net with capacities that has at least six places: Five places for the five traffic light colors and a place for the button. A token in a place means that the corresponding light is on.

   b) Use the complement construction to the net in (a) to construct the net without capacities.

2. Recall the dining philosophers problem[1]:

   > Five philosophers, numbered from 0 to 4 are living in a house where the table is laid for them, each philosopher having his own place at the table. Their only problem – besides those of philosophy – is that the dish served is a very difficult kind of spaghetti, that has to be eaten with two forks. There are two forks next to each plate, so that presents no difficulty: as a consequence, however, no two neighbours may be eating simultaneously.
   >
   > ... we could think the following solution for the philosopher's life adequeate
   >
   > *cycle begin* think;
   > P(left hand fork); P(right hand fork);
   > eat;
   > V(left hand fork); V(right hand fork);
   > *end.*

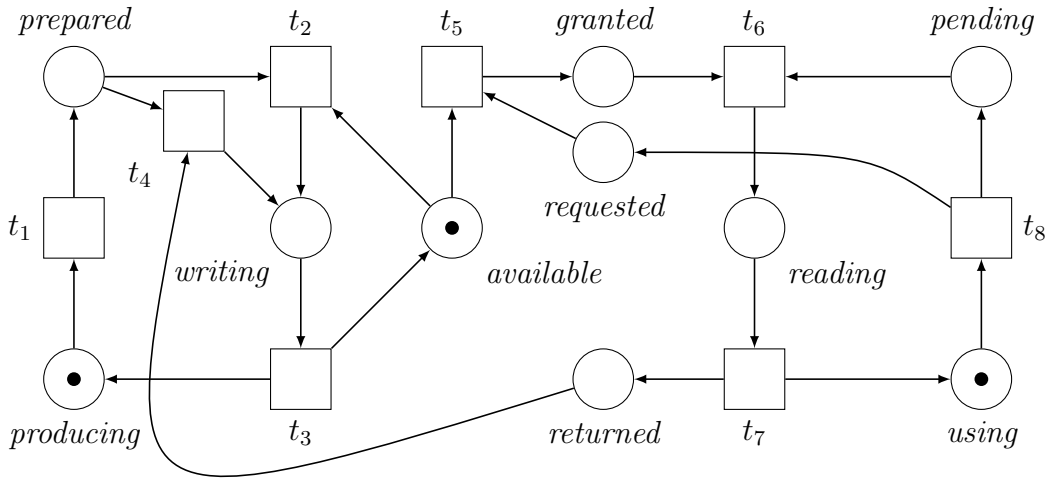
[1] E. W. Dijkstra. Hierarchical ordering of sequential processes. *Acta Informatica*, 1:115–138, 1971.

please turn overleaf ↻

We could think of P and V as a *taking* and *releasing* operation, respectively. If a P-operation cannot be done (i.e. another philosopher is holding the fork), he waits until another philosopher performs a V-operation on the same fork.

Model the dining philosophers problem with a high-level net that has exactly four places: a place for forks, three places for three philosophers' states, i.e. thinking, wating (for right hand forks), and eating.

3. The following P/T net models a system of a writer and a reader. The writer is either *producing*, *prepared*, or *writing*. The reader is either *using*, *pending*, or *reading*.



a) Give the incidence matrix C of the net.

b) Find the natural solutions of the system of linear equations

$$C^T x = \mathbf{0}.$$

c) Derive from (b) the minimal P-invariants.

d) Can we conclude from the P-invariants that the writer and the reader are never writing and reading at the same time? Justify your answer.

e) Find a trap that exactly one place initially contains a token.