

# Networks and Processes

## Exercise Sheet 1

Discussion on – 6.11.2006, 15h45 (submissions of solutions are highly recommended, either before or after the exercise session)

1. Draw a P/T net for the following reader/writer system:

The system consists of a writer and a reader which communicate via shared memory. The memory is a first-in first-out (FIFO) queue, i.e. the data that has been written first will be read first. Moreover, the writer can only write data into one end of the memory and the reader can only read data from the other end of the memory. The memory has only two slots, so the writer cannot write three times without a read from the reader in between. The writer is either idle or in the state of requesting to write a data to the memory. The data can be written only if there is an available slot, otherwise the writer stays at the requesting state. The writer returns to the idle state after successfully writing to the memory. The reader is either idle or in the state of requesting to read a data from the memory. The reader can read only if there is some data in the memory, and the data will be removed immediately after the reading. The reader returns to the idle state after successfully reading from the memory.

2. Consider a P/T net  $N = \langle P, T, F, W, M_0 \rangle$ , where

- $P = \{p_1, p_2, p_3\}$ ,
- $T = \{t_1, t_2, t_3, t_4\}$ ,
- $F = \{ \langle p_1, t_1 \rangle, \langle p_1, t_2 \rangle, \langle t_2, p_1 \rangle, \langle p_2, t_2 \rangle, \langle t_2, p_3 \rangle, \langle p_2, t_3 \rangle, \langle t_3, p_3 \rangle, \langle p_3, t_4 \rangle, \langle t_4, p_2 \rangle \}$ ,
- $W = \{ \langle p_2, t_3 \rangle \mapsto 2 \} \cup \{ f \mapsto 1 \mid f \in F \setminus \{ \langle p_2, t_3 \rangle \} \} \cup \{ f \mapsto 0 \mid f \notin F \}$ ,
- $M_0 = \{ p_1 \mapsto 1, p_2 \mapsto 2, p_3 \mapsto 0 \}$ .

Answer the following questions:

- a) Draw the graphical representation of the net  $N$ .
- b) Compute the reachability graph of  $N$ .
- c) Does  $N$  have a deadlock? If yes, list all the deadlocks together with a sequence of transitions from the initial state leading to each of them.
- d) For each marking in the reachability graph, indicate every pair of enabled transitions that are concurrent or in conflict.
- e) Are there any two transitions of  $N$  that are independent? Justify your answer.

3. Draw a P/T net  $N$  which has the following properties:

- $N$  is 3-safe.
- $\langle 0, 2, 0 \rangle \xrightarrow{t_2}$
- $\langle 1, 1, 2 \rangle \in reach(N)$
- $\langle 4, 1, 0 \rangle \xrightarrow{t_1} \langle 2, 4, 1 \rangle$
- $t_2 \in \bullet p_3$
- $p_1 \in t_1^\bullet$