## Solutions for Exercise Class 1

## 1. Solution for Petri.2

(a) The simplest Petri Net becomes:



It is seen that it is necessary to introduce an anonymous transition that ensures that the two sequential processes are synchronized in each round. (This synchronization may also be expressed in other, less obvious, ways.)

- (b) From the above net it is seen that (A, D), (B, D), (C, D) can be executed concurrently. (Since there exists behaviours of the net in which the corresponding transitions may fire simultanuously.)
- (c) For the first round, we get the following six possible interleavings:

A, B, D	A, C, D
A, D, B	A, D, C
D, A, B	D, A, C

**2.** A place with a single token is added, and a loop from/to this place is added to each of the transitions *A*, *B*, *C*, and *D*.

## 3. Solution for Petri.1

The jetties A and C are represented by places marked with the current number of boats. The jetty B is represented by two places, since boats are to continue towards A or C. All jetties have a place modelling the capacity of the jetty. Inbetween the jetties, there are places representing boats on their way on the sea. Here, the five boats have been placed arbitrarily at the jetties:



- 4. Advantages of formal models are clearly that they are precise and unambigious. Furthermore, graphical models like Petri Nets may even be very intuitive. A disadvantage is that formal models requires the reader to know the modelling language well. Furthermore, the relationship with the real-world phenomenon being modelled may be less obvious.
- 5. A fork over a place-node reflects a *choice*. A fork over a transition-node reflects *process creation*.

6.



Possible firings:  $M_0 \xrightarrow{\{t_1\}} (1, 1, 1), M_0 \xrightarrow{\{t_2\}} (1, 1, 1), M_0 \xrightarrow{\{t_1, t_2\}} (0, 2, 1), M_0 \xrightarrow{\{t_1, t_1\}} (0, 2, 1)$ Note that  $t_1$  may fire together with itself, but  $t_2$  may not!