6. Exercise Sheet: Petri-Nets

Submission: 28.07.2011
Discussion: 28.07.2011

**Submission Guidelines:** We will discuss the solutions to the exercise sheet on 28.07.2011. If you want to have comments on your solutions you can submit them after the lesson.

**Exercise 1 (Firing of Petri-nets)**
Prove or falsify:
Let $N = (P, T, E, V, m_0)$ be an eS-Net and $m, m'$ be markings of $N$ and $w \in L_N(m_0)$.

$$m \triangleright w \iff m' = m + \Delta w.$$  

**Exercise 2 (Petri-net modelling)**
Use an eS-Net to model the following handshaking protocol:

Processes $P_1$ and $P_2$ interchange messages. $P_1$ is the sender, $P_2$ the receiver. After having sent a message, the sender waits for $ACK$ sent by the receiver as acknowledgement. Having received the $ACK$, the sender may send a next message.

The receiver waits for messages. If a message arrives, the message is acknowledged by sending $ACK$ to the sender. Once the message is processed, the receiver waits for another message.

**Exercise 3 (Petri-net modelling)**
Use an eS-Net to model the following Reader-Writer synchronization protocol:

There are 4 processes which have access to a resource $P^*$. A process may either update or only read the resource. At any point of time at most one process is allowed to update the resource, however at most 4 processes are allowed to read the content of the resource concurrently.

**Exercise 4 (Petri-net modelling)**
Use an eS-Net to model the following Reader-Writer synchronization protocol:

There are 8 processes which have access to a resource $P^*$. A process may either update or only read the resource. At any point of time at most one process is allowed to update the resource, however at most 4 processes are allowed to read the content of the resource concurrently.
Exercise 5 (Petri-net properties)
Let the following eS-Net be given.

(a) Give the reachability and the coverability graph.
(b) Determine the T- and P-invariants.
(c) Interpret the invariants.
(d) Assume that in the initial marking of the eS-Net the left upper place is marked with 2 tokens, the right upper with 1 and all other places do not have tokens. Give the reachability and the coverability graph. Comment on the feasibility of these graphs for analysis in comparison to an invariant-based analysis.

Exercise 6 (Petri-net properties)
Let the following eS-Net be given.

(a) Give the reachability and the coverability graph.
(b) Determine the T- and P-invariants.
(c) Interpret the invariants.

Exercise 7 (Petri-net boundedness)
Prove or falsify the boundedness of the following eS-Net: