Assignment 9: Petri nets

ETH Zurich

1 Modelling Systems as Petri Nets

1.1 Background

The following tasks are about modelling concurrent systems as Petri nets. Some have been adapted from [1].

1.2 Task

1. Consider the following Petri net $N_1$ that models a traffic light:

   ![Petri net diagram]

   Extend $N_1$ such that it models two traffic lights and satisfies the following:
   
   - at most one traffic light is ever on a green light; and
   - the two traffic lights take turns in moving to a green light (i.e. it should not be possible that one traffic light is perpetually red whilst the other repeatedly cycles through red-green-yellow).

2. Consider the cookie vending machine Petri net we constructed in the lecture:
Extend the Petri net such that:

- at most one token can be in the coin slot place at any time; and
- at most one token can be in the signal place at any time.

3. Consider the Petri net we constructed for mutual exclusion:

For each process $i$ add a place noncritical$_i$ that holds a token if and only if that process $i$ is not in its critical region.

4. Model as an elementary Petri net a gambling machine that has the following characteristics:

- a player can insert a coin, which should reach a “cash box”;
- at this stage, the machine enters a state in which it pays out a coin from the (same) cash box an arbitrary number of times (including zero); and
- eventually, the machine stops giving out coins and becomes ready for another game.
2 Reachability Graphs and Unfoldings

2.1 Background

These tasks have been partly adapted from [2], and are about the two semantics we assigned to Petri nets in the lecture: first, the semantics based on interleaving; second, the semantics based on true concurrency.

2.2 Task

1. Consider the following Petri net $N_2$:

\[ t \]

\[
\begin{array}{ccccccc}
    a & \rightarrow & b & \rightarrow & c \\
    d & \rightarrow & e & \rightarrow & f & \rightarrow & g \\
    h & \rightarrow & i & \rightarrow & j & \rightarrow & k \\
\end{array}
\]

Construct the unfolding of $N_2$, and then use it to determine whether or not transition $t$ can occur. Explain your reasoning.

2. For the Petri net below, iteratively construct its unfolding until there are 9 transitions:

\[
\begin{array}{cccc}
    A1 & \rightarrow & B1 \\
    A2 & \rightarrow & A3 & \rightarrow & B2 \\
    A4 & \rightarrow & B3 \\
\end{array}
\]

3. Consider the Petri net below that models a producer-consumer scenario for a bounded buffer of capacity 1:
Construct a reachability graph for the Petri net, and prove that the buffer is never both full and empty.

References
