Prof. Dr. Ir. Dr. h.c. Joost-Pieter Katoen
apl. Prof. Dr. Thomas Noll
Philipp Berger Sebastian Junges

Concurrency Theory WS 2017/2018
— Series 1 —

Hand in until October 20th before the exercise class.

Exercise 1 (2 Points)

Consider the following process definition:

$$B = a.\overline{a}.B \;+\; b.\overline{b}.B$$

Draw LTS(B) and write down all necessary derivation trees for drawing LTS(B).

Exercise 2 (4 Points)

In this exercise, we extend CCS by a new syntactical element. Intuitively, the *sequential composition* $P;Q$ of two processes P and Q means that first P is executed until no further rule is applicable and then Q is executed.

(a) Extend the semantics of CCS (Definition 2.4) by rules for sequential composition.

(b) Consider the following two process definitions:

$$\begin{aligned} C &= (\overline{a}.Q \;||\; P[a.\text{nil} \;/\; \text{nil}]) \;\setminus\; \{a\}, \\ C' &= P;Q, \end{aligned}$$

where P and Q are arbitrary processes, a does not occur in P and Q, and $P[a.\text{nil} \;/\; \text{nil}]$ denotes the syntactic replacement of every occurrence of nil by a.nil. Prove or disprove: $LTS(C)$ and $LTS(C')$ are isomorphic.[1]

[1] Two LTS are isomorphic if and only if they are identical up to the names of states and actions.

Exercise 3 (4 Points)

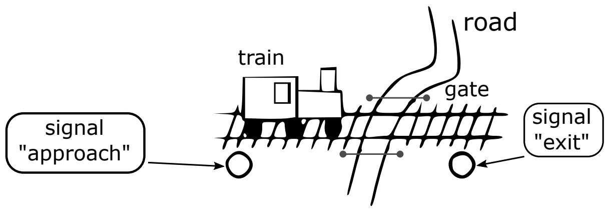

Figure 1: Railroad crossing

Model a railroad crossing with the three components train, gate and controller, like the one shown in Figure 1, in CCS. Please take the following considerations into account:

- The (relevant) state of the train is based on its location: Is the train *far away*, is it *approaching* the road, or is it actually *crossing* the road. Assume that the train runs indefinitely long.
- The gate can be *up* or *down*.
- The gate and the train do not communicate directly. The controller should make sure that the gate is *down* whenever the train is *crossing* the road.

Think about possible states that the systems can be in, on which actions systems should synchronize and what pitfalls simple designs might hold. Be aware that the considerations above are not complete.