

Protokollsicherheit

Exercise Sheet 2

Exercise 2-1. (CCS Operational Semantics - Medium) Consider the following CCS process definitions, which specify a train and car crossway:

$$\begin{aligned}
 \text{Rail} &\stackrel{\text{def}}{=} \text{train.green.tcross.red.Rail} \\
 \text{Road} &\stackrel{\text{def}}{=} \text{car.up.ccross.down.Road} \\
 \text{Signal} &\stackrel{\text{def}}{=} \overline{\text{green.red.Signal}} + \overline{\text{up.down.Signal}} \\
 \text{Crossing} &\stackrel{\text{def}}{=} \nu(\text{green, red, up, down})(\text{Road|Rail|Signal})
 \end{aligned}$$

Write the labelled transition graph of the specification above. Demonstrate that it is not possible that the car is able to cross the track at the same time as the train is passing. That is, no accident occurs.

Exercise 2-2. (Bisimulation - Easy) Prove or disprove that the pair of processes P and Q in each item below are strong bisimilar:

- a) $P = a.b.0$ and $Q = a.b.0 + 0$
- b) $P = a.0|b.0$ and $Q = a.b.0 + b.a.0$
- c) $P = a.P + a.P + M$ and $Q = a.P + M$
- d) $P = a.b.0$ and $Q = a.0|b.0$
- e) $P = a.b.0$ and $Q = a.b.0 + a.0$

Exercise 2-3. (Bisimulation - Medium) Prove that for any process P and Q the following processes are strong bisimilar:

- a) $P + 0$ and P
- b) $P|0$ and P
- c) $P + Q$ and $Q + P$
- d) $P|Q$ and $Q|P$
- e) $P + P$ and P

Exercise 2-4. (Bisimulation - Medium) Consider the following specification of a two-way message buffer $\text{Buff}_1\langle a, a', b, b' \rangle$, which was discussed in the lecture:

$$\text{Buff}_1 \stackrel{def}{=} a.\bar{b}.\text{Buff}_1 + b'.\bar{a}'.\text{Buff}_1$$

Convince yourself that this specification corresponds indeed to a two-way buffer. This can be done by drawing its labelled transition graph. Now consider a second buffer obtained by joining the buffer $\text{Buff}_2 \stackrel{def}{=} \text{Buff}_1\langle b, b', c, c' \rangle$ together with Buff_1 as follows:

$$\text{Buff}_3 = \nu b.\nu b'.(\text{Buff}_1|\text{Buff}_2)$$

Do these processes behave the same way? That is, are the processes $\text{Buff}_1\langle a, a', c, c' \rangle$ and Buff_3 strong bisimilar?