Exercise 17

a) Draw the LTS for PA system $P = Q \parallel R$, with $Q = s.b.Q$, and $R = a.s.R + c.s.s.R$.

b) Show that action

$$(b.e.a.Q + b.b.e.a.Q) || (b.P + R) \xrightarrow{b} e.a.Q \parallel P$$

can be executed by subsequently applying the semantical rules of PA.

Exercise 18

Show the LTS for the correct version of Millner’s scheduler.

Exercise 19

Draw the LTS for the model of the railroad crossing presented in the lecture (slide 28). Find out whether accidents can happen in the model or not, and justify your answer.

Exercise 20

Let $\oplus$ denote an alternative PA-operator for non-deterministic choice. The semantics of $\oplus$ are defined as follows:

$R_1^{\oplus} : \quad \frac{P \xrightarrow{a} P'}{(P \oplus Q) \xrightarrow{a} (P' \oplus Q)}$

$R_2^{\oplus} : \quad \frac{Q \xrightarrow{a} Q'}{(P \oplus Q) \xrightarrow{a} (P \oplus Q')}$

Assume that $+$ is replaced by $\oplus$ in the model of the railroad crossing from Exercise 19. Under this assumption, find the shortest possible sequence of transitions which yields a state where an accident can happen. You do not have to draw all states but only those which are needed for the solution of this exercise.