To indicate that you solved an exercise and that you can present it in the exercise group, tick it off in our MOODLE course until 9am on the day of the exercise. Unmarking and marking exercises at the begin of the exercise class is not possible.

Exercise 17
Let $P = b.c.P$ and $Q = a.b.Q$. Show that action

$$((b.Q + b.a.Q) \mid (b.P + b.c.P)) + (a.Q \mid b.P) \xrightarrow{b} a.Q \mid P$$

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

Exercise 18
Let $P, Q$ and $R$ be PA systems with $P = a.t.P, Q = b.t.Q$ and $R = t.R$.

1. Draw the LTS for $P \mid Q \mid R$.
2. Draw the LTS for $(P \mid Q) \setminus \Theta \mid R$, where $\Theta = \{t\}$.

Exercise 19
Draw the LTS for the model of the railroad crossing presented in the lecture (slide 28, without hiding). As a help, on the next page you can find the shape of the expected LTS including the first steps. Fill out the nodes and transition labels of the system. Further, 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:

$R^1_\oplus: \frac{P \xrightarrow{a} P'}{(P \oplus Q) \xrightarrow{a} (P' \oplus Q)}$

$R^2_\oplus: \frac{Q \xrightarrow{a} Q'}{(P \oplus Q) \xrightarrow{a} (P \oplus Q')}$

Assume that $+$ is replaced by $\oplus$ in the model of the railroad crossing presented in the lecture (slide 28). 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.