Concurrency Exercises 2: FSP and modelling concurrency

Topic 2.2: FSP Modelling Concurrency

**Important:** Again answers to all exercises are to be found on the course website, BUT you should try the exercises BEFORE looking at solutions.

1. Draw (at least part of) the LTS for combining two people’s days, i.e. combining two ‘DAY3’ LTS diagrams, with no interaction between the two people (use actions upA, upB etc). How can you represent actions performed in ‘abstract parallel’?

2. Now consider how to model both people having to drink either tea or coffee together, i.e. they must synchronize on their tea or coffee actions.

3. If you are using concurrency in your 3rd Year Project, attempt to give abstract specifications for the concurrent components in FSP.

4. Show that $S_1$ and $S_2$ describe the same behaviour:

   \[
   P = (a \rightarrow b \rightarrow P),
   Q = (c \rightarrow b \rightarrow Q),
   ||S_1 = (P || Q).
   \]

   \[
   S_2 = (a \rightarrow c \rightarrow b \rightarrow S_2 \mid c \rightarrow a \rightarrow b \rightarrow S_2).
   \]

5. $\text{ELEMENT} = (\text{up} \rightarrow \text{down} \rightarrow \text{ELEMENT})$ accepts an $\text{up}$ action and then a $\text{down}$ action. Using parallel composition and the $\text{ELEMENT}$ process describe a model that can accept up to four $\text{up}$ actions before a $\text{down}$ action.

6. Extend the client server system $\text{CLIENT\_SERVER}$ (see the course textbook) so that more than one client can use the server.

7. Modify the model in the previous exercise so that the call may terminate with a timeout action rather than a response from the server. What happens to the server in this situation?

8. A roller-coaster system only permits its car to depart when it is full. Passengers arriving at the departure platform are registered with the roller-coaster controller by a turnstile. The controller signals the car to depart when there are enough passengers on the platform to fill the car to its maximum capacity of $M$ passengers. The
car goes around the roller-coaster track and then waits for another $M$ passengers. A maximum of $M$ passengers may occupy the platform. Ignore the synchronisation details concerning passengers embarking from the platform and the car departure. The roller-coaster consists of three processes: \textsc{Turnstile}, \textsc{Control} and \textsc{Car}. \textsc{Turnstile} and \textsc{Control} interact by the shared action \textit{passenger} indicating an arrival and \textsc{Control} and \textsc{Car} interact by the shared action \textit{depart} signalling car departure. Provide $FSP$ descriptions for each process and the overall composition.

9. A museum allows visitors to enter through the east entrance and leave through its west exit. Arrivals and departures are signaled to the museum controller by the turnstiles at the entrance and exit. At opening time, the museum director signals the controller that the museum is open and then the controller permits both arrivals and departures. At closing time, the director signals that the museum is closed, at which point only departures are permitted by the controller. Given that it consists of the four processes \textsc{East}, \textsc{West}, \textsc{Control} and \textsc{Director}, provide an $FSP$ description for each of the processes and the overall composition.