Introduction to Model Checking 2015: Exercise 1.

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Exercise 1 *True or False?* *(2 points)*

1. *There are transition systems with finite number of states, but have* countably infinite *number of executions? Justify your answer.*
2. *There are transition systems with finite number of states, but have* uncountably infinite *number of executions? Justify your answer.*

Exercise 2 *(4 points)*
There are three light bulbs in a room and there are three toggle switches outside the room. Each switch operates exactly one light bulb. Initially all bulbs are switched off. Toggling a switch either turns on a bulb if it was off or turns it off if it was on.

1. *Define the behaviour of the three light bulbs and their switches as a transition system* $(S, Act, \rightarrow, s_0, AP, L)$. *(You can define the set of states and transition relation in a set builder notation, instead of drawing the entire transition system.)*
2. *How many states are reachable from the initial state?*
3. *Does every execution of your transition system defines a valid behaviour? Justify your answer.*

Exercise 3 *(4 points)*
A concurrent system comprises of competing processes $P_1, \ldots, P_n$ *(without shared memory) that access common resources within their critical sections. We assume that the resources may only be accessed exclusively and that* k *equivalent instances are available.*

Further, let $n, k \in \mathbb{N}$ *with* $2 \leq k \leq n$.
Process P_i *can be described by a transition system* $\mathcal{T}_i$ *(Figure .) with three states and the actions* $request, enter$ *and* $release$ *as indicated on the right.*

a) *Develop a transition system representation of an arbiter that communicates with the processes using actions* $request$ *and* $release$. *The arbiter should assure that there are no more than* k *processes within their critical section at the same time.*

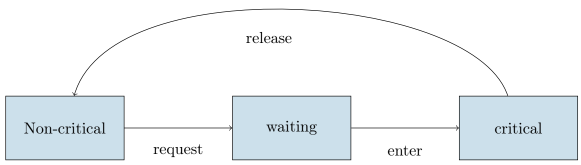

Figure 1: The process $\mathcal{T}_i$.

b) *Sketch the transition system of the parallel composition*

$$(\mathcal{T}_1 ||| \mathcal{T}_2 ||| \mathcal{T}_3) \parallel_{Syn} Arbiter$$

with $Syn = \{request, release\}$ *for* $k = 2$. *You need not consider the states* $wait_i$.