Software Modeling and Verification
Lehrstuhl für Informatik 2
RWTH Aachen University

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Modeling Concurrent and Probabilistic Systems

Summer Term 09

– Series 10 –

Hand in until July 23 before the exercise class.

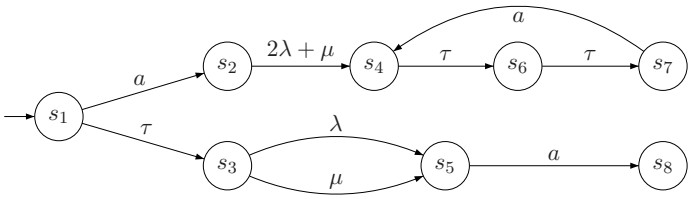
Exercise 1 (3 points)

Show that:

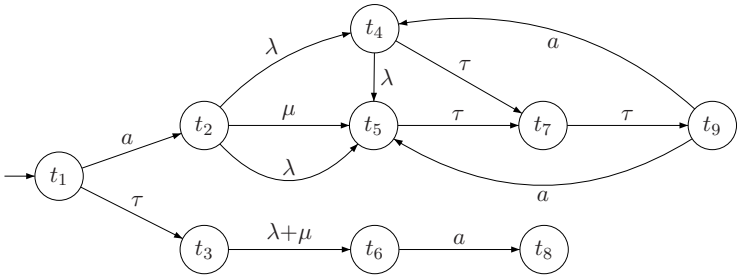
$$\Big((P \oplus_{\frac{1}{2}} Q) \oplus_{\frac{1}{3}} (R \oplus_{\frac{3}{4}} P)\Big) \oplus_{\frac{2}{3}} Q \;\sim_p\; (Q \oplus_{\frac{2}{3}} P) \oplus_{\frac{2}{3}} R.$$

Exercise 2 (4 points)

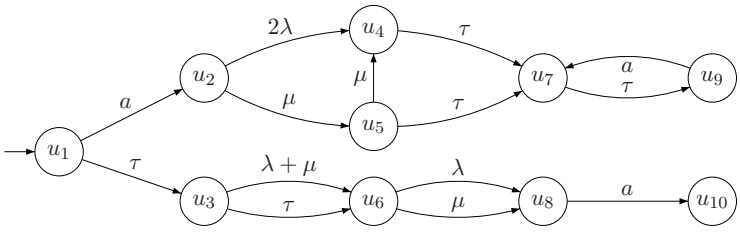
Given three IMCs E_1, E_2, E_3, where a, τ are actions, λ, μ are exponential rates.



IMC E_1



IMC E_2



IMC E_3

- Do we have $s_1 \sim_m t_1$?
- Do we have $t_1 \sim_m u_1$?
- Do we have $t_1 \approx_m u_1$?

Exercise 3 **(6 points)**

Given an M/M/2/1 queueing system as follows:

$$\begin{aligned} \mathit{Arr} &:= (\lambda).\alpha.\mathit{Arr} \\ \mathit{Buff} &:= \alpha.\delta.\mathit{Buff} \\ \mathit{Proc} &:= \delta.(\mu).\mathit{Proc} \\ \mathit{Sys} &:= \Big((\mathit{Proc} \parallel_{\varnothing} \mathit{Proc}) \parallel_{\{\delta\}} \mathit{Buff}\Big) \parallel_{\{\alpha\}} \mathit{Arr} \end{aligned}$$

- Construct the IMC of Sys.
- Show that $\mathit{Sys}[f]$ with $f(\alpha) = \tau$ and $f(\delta) = \tau$ is weak Markovian bisimilar to: