Take-home Examination Part 1: Modeling and analysis of concurrent systems 1 (MACS1), 2014/2015.

To be handed in before Monday October 20, 10.00h (STRICT deadline!).

- This examination should be made individually. Any form of collaboration with others is considered fraud.
- The work should be handed in in the postbox of Rom Langerak, in INF 3047. No electronic submission.
- Indicate address, student number and study.
- Each question is worth 10 points, except question 8, which is worth 30 points. Mark: total divided by 10.

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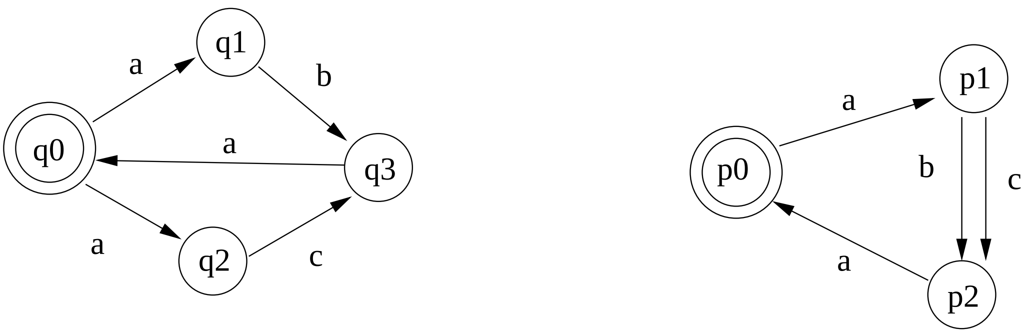
1. Show that the automata below accept the same language (by solving the appropriate equations).



2. Consider the processes

$$P_1 \stackrel{def}{=} a.R + a.Q,\ R \stackrel{def}{=} b.P_1 + a.Q,\ Q \stackrel{def}{=} a.Q + b.P_1$$

and

$$P_2 \stackrel{def}{=} a.S,\ S \stackrel{def}{=} a.S + b.T,\ T \stackrel{def}{=} a.S$$

Prove that P_1 and P_2 are bisimilar (by proving that there is a bisimulation relation).

3. Specify a bitstack with capacity 3. Draw the transition system.

4. Give the standard form of

$$(\mathbf{new}a((a.Q + b.S)|\overline{a}.0))|(\mathbf{new}b(\overline{b}.S + \overline{a}.R))|\mathbf{new}c(c.R)$$

and prove that it is structurally equivalent.

5. Draw the complete transition system of scheduler L_1 of example 4.15 of Milner's book. Is this process weak bisimulation equivalent with the process *Lotspec*?

6. Prove using Theorem 6.15 from Milner's book:

   (a) $\tau.a.P + a.P + M \approx \tau.a.\tau.P + M$

   (b) $\tau.(P + a.(B + \tau.C)) \approx \tau.(P + a.(B + \tau.C)) + a.C$

7. Consider the following equation:

$$X \approx \tau.X + a.P$$

Prove that if Q_1 is a solution, then also $\tau.Q_1 + \tau.Q_2$, with Q_2 any process, is a solution.

8. Exercises 7.5, 7.6, 7.7, 7.8, and 7.10 from Milner's book.