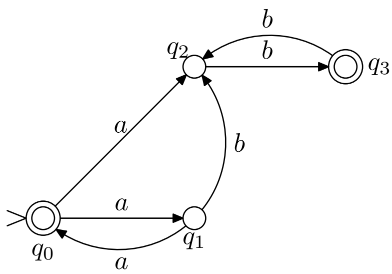
T-79.186 **Spring 2003**
Reactive Systems
Home Exercise 3
Deadline 11.2-2003 8:45

Return your answer by email (Postscript or PDF) to Timo Latvala at Timo.Latvala@hut.fi, or on paper to the lecture. All rounds will be 6 points maximum.

Please remember to include your name and student number to your answer.

For this home exercise use the automata definitions used in the Lecture slides.

1.) Consider the following finite state automaton $\mathcal{A}_1$:



a) Create a deterministic automaton $\mathcal{A}_2$ such that $\mathcal{L}(\mathcal{A}_2) = \mathcal{L}(\mathcal{A}_1)$.

b) Create an automaton $\mathcal{A}_3$, which accepts the complement of the language accepted by $\mathcal{A}_1$.

c) Given atomic propositions *TRY0* and *CR0*, create an automaton $\mathcal{S}_1$, which accepts all sequences of valuations (finite strings over over the alphabet 2^{AP}) such that: if *CR0* holds at some index, then *TRY0* has held at some earlier index.

2.) Express the following properties in LTL. (Define first the atomic propositions you use and their meanings.)

a) If message "m1" is sent infinitely many times by the sender, then message "m1" is received infinitely many times by the receiver.

b) Only finitely many messages are lost by the data channel "d1".

c) Always when process "p1" is in the critical section, it will go to non-critical section in a finite amount of time steps.

d) If a message "m2" is received by the receiver, the the message "m2" was sent before (or at the same time moment) by the sender.

e) If an addition operation is fed to a pipelined ALU unit, then the result of the ALU is ready four time moments later. (Use X to denote one time unit.)

3.) For each item below, using the semantic definition of CTL^* give a Kripke structure which satisfies the CTL^* formula in question. (Recall the requirement that each state should have at least one successor.)

a) Give a Kripke structure M_a, such that $M_a, s^0 \models EF(p \wedge (EFq \wedge AX\neg q))$.

b) Give a Kripke structure M_b, such that $M_b, s^0 \models ((EXEG(p)) \wedge (EX(AF(\neg p))))$.

c) Give a Kripke structure M_c, such that $M_c, s^0 \models \neg AGF(p)$.

d) Give a Kripke structure M_d, such that $M_d, s^0 \models A(GF(p) \Rightarrow GF(q))$.