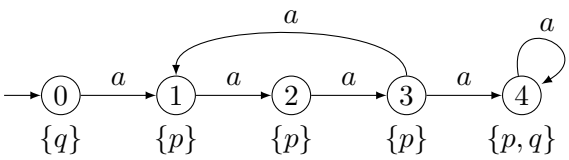
Homework Assignment #2

Note

This assignment is due 9AM Wednesday, May 27, 2009. Please write or type your answers on A4 (or similar size) paper. Drop your homework by the due time in Yih-Kuen Tsay's mail box on the first floor of Management College Building II. You may discuss the problems with others, but copying answers is strictly forbidden.

Problems

1. (20 points) Consider an extended Kripke structure M as shown below:



   Show the iterative valuations and the final result for the following fixpoints in μ-calculus:

   (a) $\mu Q.(q \vee (p \wedge \langle a \rangle Q))$

   (b) $\mu Q_1.(\nu Q_2.(p \wedge \langle a \rangle Q_2) \vee (q \wedge \langle a \rangle Q_1))$

2. (30 points) Prove the following equivalences between propositional μ-calculus formulae (interpreted over finite transition systems). (Note: in each equivalence, formulae f and g satisfy the usual monotonicity requirement.)

   (a) (20 points) $\neg \mu Q.f(Q) \equiv \nu Q.\neg f(\neg Q)$

   (b) (10 points) $\nu Q.f \vee (Q \wedge g) \equiv \nu Q.f \vee g$ (Note: f and g may contain Q.)

3. (20 points) Define a Büchi automaton (by drawing its transition diagram) for each of the following temporal properties.

   (a) p holds initially (at 0-th position) and at every third position.

   (b) Whenever p holds, q must hold eventually at a strictly later position.

4. (10 points) Apply the simple on-the-fly translation algorithm to construct a generalized Büchi automaton from the LTL formula $(p \wedge q)\, \mathcal{U}\, (p \vee q)$. Please try to illustrate how the algorithm works by showing a few partially constructed automata during the translation.

5. (20 points)

(a) Check the satisfiability of $(a \vee b \vee c) \wedge (a \vee \bar{b} \vee \bar{d}) \wedge (b \vee \bar{d}) \wedge (b \vee d) \wedge (\bar{a} \vee \bar{d})$ by the DP algorithm.

(b) Check again with the DPLL algorithm.