Homework Assignment #4

Note

This assignment is due 2:20PM Thursday, May 3, 2012. Please write or type your answers on A4 (or similar size) paper. Late submission will be penalized by 20% for each working day overdue. You may discuss the problems with others, but copying answers is strictly forbidden.

Problems

1. (60 points) The following is a NuSMV model for two asynchronous processes that use a semaphore to achieve mutual exclusion.

```
MODULE main
VAR
  semaphore : boolean;
  proc1     : process user(semaphore);
  proc2     : process user(semaphore);
ASSIGN
  init(semaphore) := 0;


MODULE user(semaphore)
VAR
  state : {idle, entering, critical, exiting};
ASSIGN
  init(state) := idle;
  next(state) :=
    case
      state = idle                 : {idle, entering};
      state = entering & !semaphore : critical;
      state = critical             : {critical, exiting};
      state = exiting              : idle;
      1                            : state;
    esac;
  next(semaphore) :=
    case
      state = entering : 1;
      state = exiting  : 0;
      1                : semaphore;
```

```
esac;
```

(a) Write all the necessary boolean formulae that specify the main module as a Kripke structure; you may define shorter substitute names for the variables to save space.

(b) Please draw BDD diagrams (as small as possible) for the formulae in 1a.

2. (40 points) Consider an extended Kripke structure M as shown below:
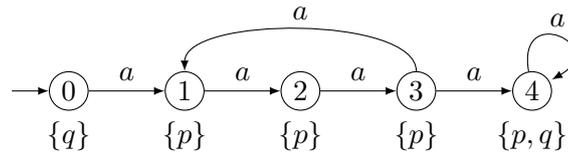
Show the iterative valuations and the final result for the following fixpoints in μ-calculus:

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

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