Model Checking – Exercise sheet 7

Exercise 7.1: Some BDD's

Let $a_0 a_1 a_2 \ldots a_n$, $b_0 b_1 \ldots b_n$ and $c_0 c_1 \ldots c_{n+1}$ three integers written in binary least significant digit first.

- Give an order over the variables and a BDD such that $a + b = c$

- Give an order over the variables and a BDD such that $c = 3b$

Exercise 7.2: Simulation and Bisimulation

- Let K_1 and K_2 two Kripke structures, assume $K_1 \subseteq K_2$ (i.e. for any state q of K_1, q is also a state in K_2, and for any transition (q_1, q_2) in K_1, (q_1, q_2) is also a transition in K_2. Does one structure simulate the other ? Are they bisimilar ?

- Are the two following Kripke structures bisimilar:
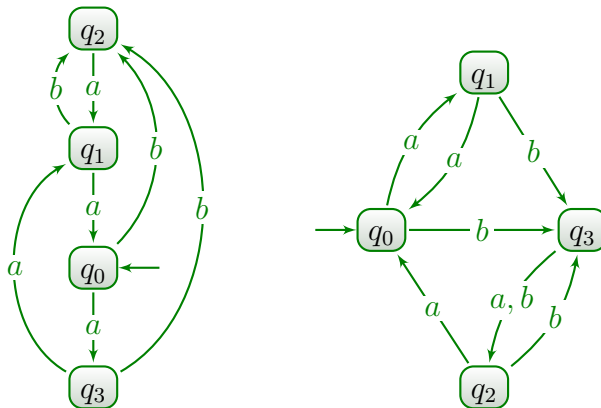
- TODO: find two Kripke structures, with labels on nodes and not on transitions such that the first one (untrivially) simulates the second one.

Exercise 7.3: Abstraction

We will study in this exercise some simple C programs over two integer variables
X and Y. We are interested in the sign of those variables, we therefore define two
predicates p and q which holds when the value of X (resp. Y) is postive.

```
1   X = X + X
2   Y = Y - X
3   Y = Y - X
4   Y = Y + X
5   Y = Y + Y
6   X = X - X
```

For this program, we not only have the predicates p and q but also the control
point (i.e. line number).

- Assume we have: i `X = X + Y`
  What are the successors of $(i, \{p, q\})$? What are the successors of $(i, \{q\})$?

- Build the transition system from $(1, \{p, q\})$ using this step by step construction.

- What happens in practice ?

```
1   while (X != Y)
2       if (X < Y)
3           Y = Y - X;
4       else
5           X = X - Y;
6   return X;
```

- Build the transition system for that program from $(0, \{p, q\})$

- Build the transition system when introducing another predicate r which holds
  when $X < Y$