CSC2108: Automated Verification
Assignment 2, part 2

Due: Wednesday, October 24, classtime.
Do not work on this part of the assignment in groups.

1. Let the following two expressions be given:

$$x_1 => (x_2 \ \wedge \ (x_3 \vee x_4)) \quad (exp_1)$$
$$(x_2 \vee \neg x_3) \ \wedge \ (x_1 \ \wedge \ x_4) \quad (exp_2)$$

Let the order of variables $x_1 < x_2 < x_3 < x_4$ be given.

(a) Build BDDs for the two expressions, referring to them as BDD_1 and BDD_2.

(b) Compute Apply('$\wedge$', BDD_1, BDD_2). You may compare your answers with computing $exp_1 \ \wedge \ exp_2$ and building a BDD from it (this is not part of the assignment – it is for your benefit only).

(c) Compute Apply($\vee$, BDD_1, BDD_2).

(d) Compute Quantify(x_1, BDD_1), i.e., compute $\exists x_1 \cdot exp_1$.

2. Prove the duality

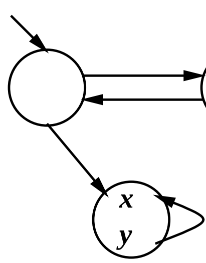
$$\mu Z.f(Z) = \neg \nu Z.\neg f(\neg Z)$$

3. Prove that $AF\varphi = \mu Z.\varphi \vee AXZ$, i.e., prove

(a) $\varphi \vee AXAF\varphi = AF\varphi$

(b) $\forall Y \cdot (Y = \varphi \vee AXY) \Rightarrow (Y \supseteq AF\varphi)$

4. Consider this model:



(a) Compute the transition relation R for this model.

(b) Symbolically, compute the value of $AGEFy$. Check that the computation is correct by executing the explicit-state model-checking algorithm.

(c) Symbolically, compute EGy.