CMPE 276, Fall 2002
Homework 3: Model Checking
Due: November 14, 2002

Problem 1 [25 points]

On the model of Algorithm 4.2 (page 17) of the CAV book (by Henzinger and Alur, see link on web page), write an algorithm that performs the existential quantification of a variable. The algorithm takes a BDD B and an index i, and returns a BDD C with $r(C) = \exists x_i.r(B)$.

Problem 2 [25 points]

Recall that if B is a propositional formula (represented as a BDD) defining a set of states, then Post(B) is the BDD denoting the set of successors of B. In formulas, if $C = \text{Post}(B)$ then

$$C' = \exists \mathcal{V}.(B \wedge \mathcal{T})$$

where $\mathcal{V}$ is the set of all variables, and $\mathcal{T}$ is the transition relation.

- **Part 1 [10 points].** Write an algorithm that, given BDDs A, B, C, D, checks whether there is a path that goes from A to D by visiting a state of B or C. Note that visiting a state of both B and C, while going from A to D, is fine.
- **Part 2 [15 points].** Write an algorithm that, given BDDs A, B, C, D, checks whether there is a path that goes from A to D by visiting a state of either B or C, *but not both.* In other words, we want to know whether from A we can reach D by visiting one, and only one, of B and C.

1 Problem 3 [25 points]

Do Exercise 4.10 (page 9) of the CAV book (and comment on the time complexities).

2 Problem 4 [25 points]

Do Exercise 4.16 (page 13) of the CAV book.

3 Problem 5 [25 points]

Extra credit problem. Do Exercise 4.13 (page 12) of the CAV book. Give a proof of the size bounds for the BDDs.