1999 Paper 8 Question 13

Specification and Verification II

Describe briefly how propositional boolean formulae can be represented as Binary Decision Diagrams (BDDs). [6 marks]

What is the significance of variable ordering? [2 marks]

Describe how the BDDs representing existentially and universally quantified boolean formulae are constructed. [2 marks]

Draw the BDDs of both $\neg(x = y) \Rightarrow z$ and $\forall z.\ \neg(x = y) \Rightarrow z$. [4 marks]

Let $E_1(x, y)$ and $E_2(x, y)$ be boolean formulae containing the variables x and y. Let the relation $\mathcal{R}$ be defined by:

$$\mathcal{R}((x, y), (x', y')) \ = \ (x' = E_1(x, y) \ \wedge \ y' = y) \ \vee \ (x' = x \ \wedge \ \ y' = E_2(x, y))$$

Assuming you have already computed the BDD of $P(a, b)$, explain how the BDD of $\exists a\ b.\ P(a, b) \ \wedge \ \mathcal{R}((a, b), (x, y))$ can be computed without having to compute the BDD of $\mathcal{R}((a, b), (x, y))$. Explain the significance of this. [6 marks]