Tutorial Exercises on BDD

CS 4271
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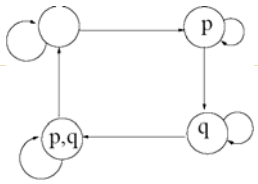
Ex. 1 (Simple)

A) Represent the transition relation of the following Kripke Structure as a boolean formula. The atomic propositions are p,q. You must specify the boolean variables appearing the formula and the meaning of each of these boolean variables.

B) Then construct the ROBDD – specify your variable ordering used.

Ex 1 (Simple)



Ex 2. (more involved)

Consider the boolean function corresponding to the even parity checker circuit. It is a boolean function which takes in n boolean inputs $x_1,\ldots,x_n$. The output is 1 if there is an even number of inputs with value 1. Otherwise the output is 0.

- Without constructing the BDD representation, argue that the size of the BDD representation of this function is independent of the input variable ordering.

Ex 2. (more involved)

- Construct the reduced ordered BDD representation of the boolean function corresponding to a 3-bit even parity checker.
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- What is the total number of nodes for the reduced ordered BDD representation of a n-bit even parity checker for any n? You should give a general formula in terms of n, and not just the number of BDD nodes for n=3,4,…

Ex. 3

- Following is a case-statement lifted from a SMV specification of a mutual-exclusion protocol we worked out earlier.
  - next(turn) := case{
  - (schedule = 0 & pc0 = l2) : 1;
  - (schedule = 1 & pc1 = m2) : 0;
  - 1 : turn;
  - };
- Describe the above as a boolean function (what will be the boolean inputs) and then as a ROBDD.

Ex. 4

Suppose we want to construct a Reduced Ordered Binary Decision Diagram (ROBDD) for the following boolean function *func which has four input variables x1, x2, x3, x4.*

- *func(x1, x2, x3, x4) = (x1 ⇒ (x2 ⇒ x3)) ∧ (¬x1 ⇒ (x2 ⇒ x4))*
- Choose a variable ordering which results in as small a ROBDD as possible. Clearly state and justify your choice of variable ordering without actually constructing the ROBDDs for each variable ordering.