EE 709 Mid-semester assignment

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1 The 74181 ALU

A data-sheet of the 74181 arithmetic logic unit (ALU) has been shared with you. This ALU implements 4-bit operations of many kinds. The input operands are A (that is A3 A2 A1 A0) and B (that is B3 B2 B1 B0), the output is F (that is F3 F2 F1 F0), and the operation itself is selected using the bits S3, S2, S1, S0, Cn, M.

The logic diagram of the implementation of the ALU is shown on page 5 of the data-sheet. Specifically, we are interested in the operations which are described in Table 2, and out of these, we are most interested in the operations add and multiply. These two operations are selected by the following bit combinations:

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-------------------------------------------------
S3 S2 S1 S0 Cn  M           Comment
-------------------------------------------------
0  0  0  1  0   0           F = A + B
0  1  1  0  1   0           F = A - B
1  0  1  1  1   0           F = A . B
                              (note: correction)
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Only the bottom four bits of the result of the operations are reported as F.

2 Assignment

1. For the implementation of the ALU illustrated on page 5 from the data-sheet, construct the implementation-ROBDD for each of the outputs

F3, F2, F1, F0 in terms of all the inputs to the ALU: the A inputs, the B inputs, the S inputs, Cn and M. (5 marks)

2. Check, using the ROBDD package, that the addition operation is correctly implemented.

   (a) Build reference BDDs (one for each output) of the addition operation (using a ripple carry adder, or using a truth-table if you like). These BDD's will be in terms of the A and B variables (2 marks).

   (b) Restrict the implementation-ROBDDs by choosing the S, Cn and M inputs to select the add operation and check whether the reference and implementation ROBDD's are the same (3 marks).

3. Repeat the verification outlined in the previous question for the subtract and AND operations (5 + 5).