LAB 2 – ECE 3300L

Fall 2024 / Dr. Van Blerkom

For this lab, we will implement a simple calculator. The calculator will have three operations – addition, subtraction, and multiplication. We will use two 4-bit inputs, A and B, and assume 2's complement inputs for addition / subtraction. For multiplication, we will assume unsigned 4-bit inputs (i.e. you don't need to handle multiplication by negative values).

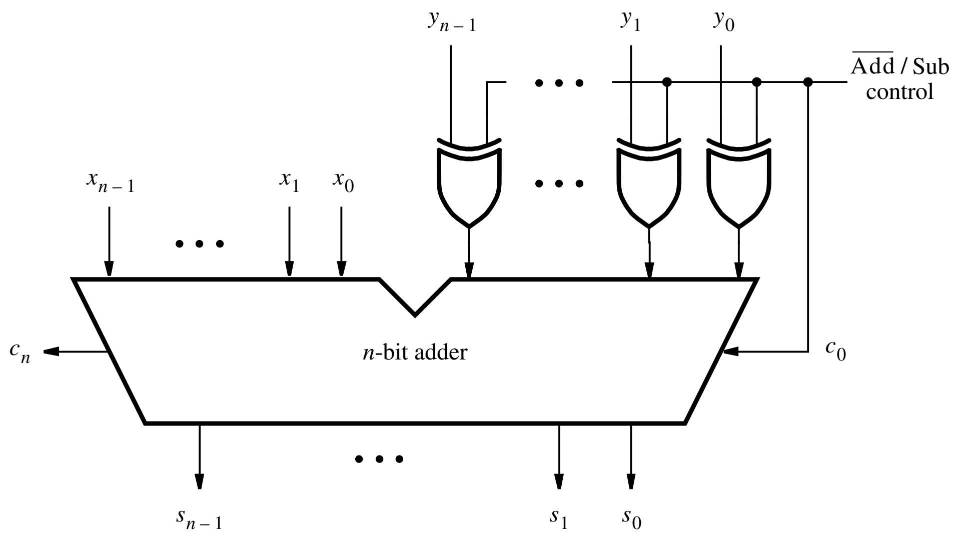
You will assign 4 switches to input A, 4 switches to input B, and 2 switches to determine the calculator operation, as follows:

OP_1	OP_0	Operation
0	0	Addition: A + B
0	1	Subtraction: A – B
1	X	Multiplication: A * B

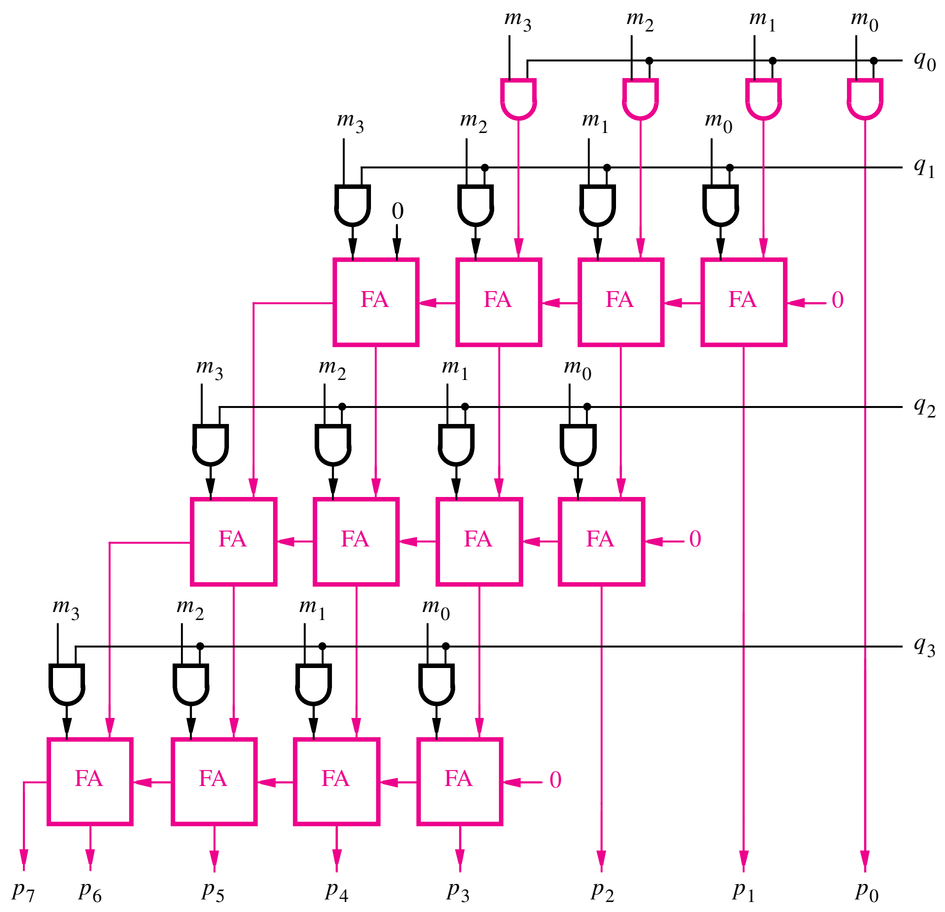
Because the multiplier will produce 8-bit values, you will show the output of the calculator on 10 LEDs: When the multiplier is selected, the 8-bit value will be shown on the 8 LEDs, and the top 2 LEDs will be off. When the adder/subtractor is selected, the 4-bit output will be shown on the bottom 4 LEDs. The carry_out and overflow signals from the addition/subtraction will be shown on the top 2 LEDs.

To build this calculator, you will need to implement an adder/subtractor, a multiplier, and a multiplexor to route the correct outputs to the LEDs, depending on the state of the operation switches.

Make the adder/subtractor following the block diagram below, where the state of OP_0 is used as the Add/Sub control. You can build the n-bit adder using any of the adder Verilog implementations described in the textbook. Make sure to also include the logic to generate the overflow signal: Overflow = C_n XOR C_{n-1}



Make the multiplier following the diagram below:



You should use three of your 4-bit adder modules from the adder/subtractor design for your multiplier implementation.

Finally, create a multiplexor that takes the 4 bit adder/subtractor output and the carry and overflow bits; and the 8 bit multiplier output, and sends the correct value to the outputs, depending on the state of OP_1.

Starter code is provided in the GitHub repository.