

ECE 2300
Digital Logic Design

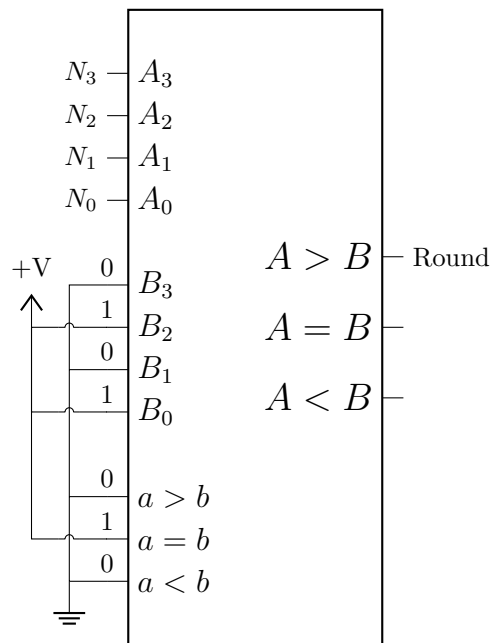
Homework 6

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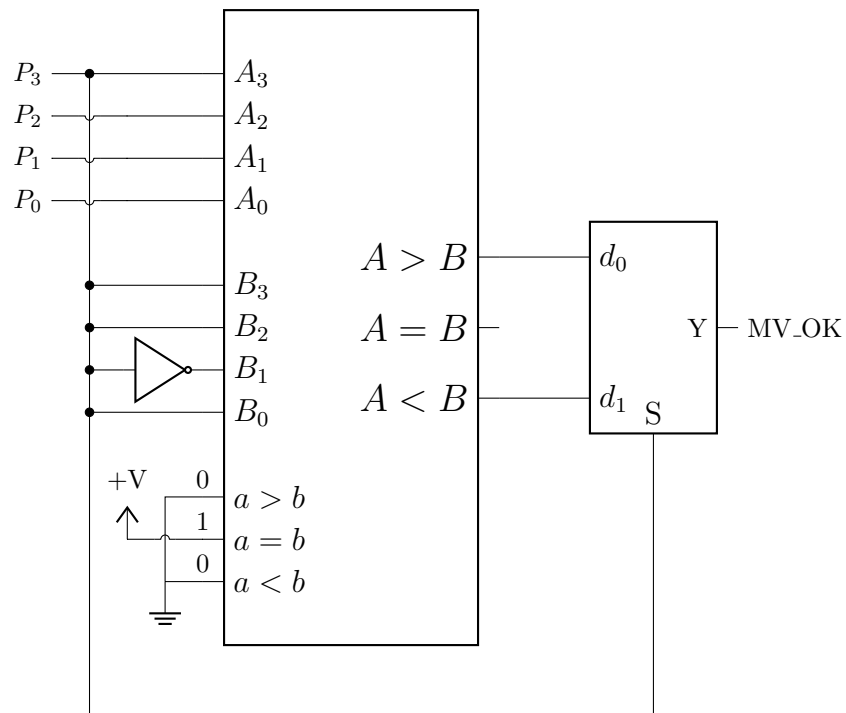
- Using a magnitude comparator, generate a logic one “Round” signal (to round a number up by one) if the base 12 input, $N = N_3, N_2, N_1, N_0$, is six or higher. Let N connect to the comparator’s A input.

$$\text{Round} = N > 5 = (N_3 N_2 N_1 N_0)_2 > (0101)_2$$

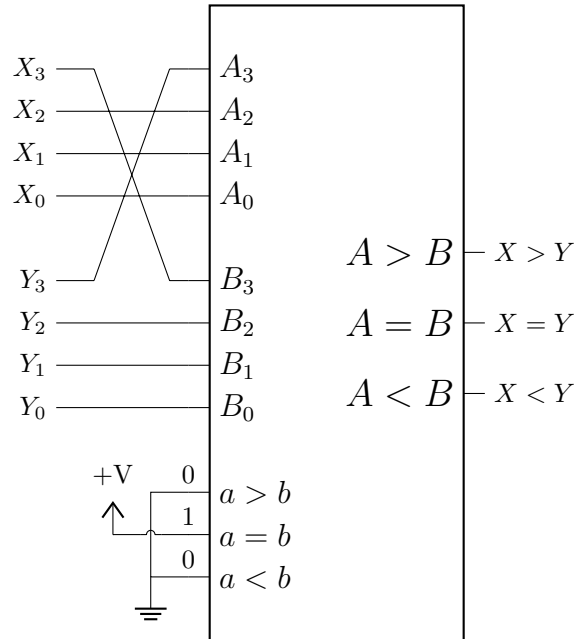


- 2 A simple mechanism moves between positions $P = (0000)_2$ and $P = (1111)_2$. Using a magnitude comparator, generate an enable signal, MV_OK, that is one if the position, P, is 12 or lower or if it is three or higher.

P_3	Threshold				Relationship
0	0	0	1	0	P valid if greater than threshold
1	1	1	0	1	P valid if less than threshold
	P_3	P_3	$\overline{P_3}$	P_3	



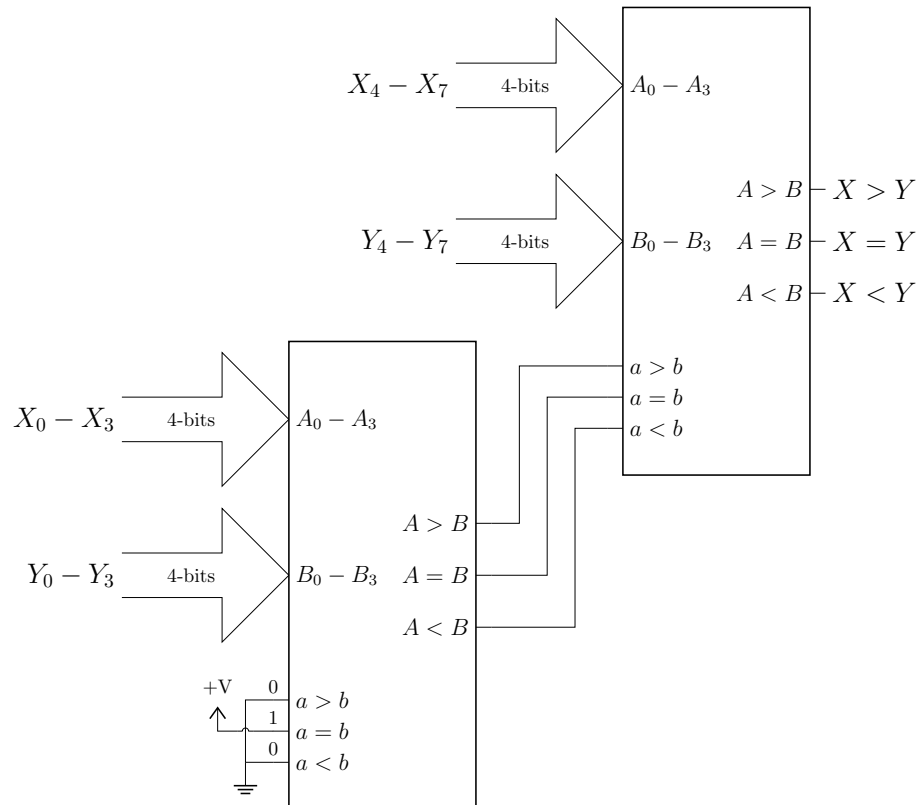
- 3.a Design a magnitude comparator to compare two 4-bit two's complement numbers, X and Y.



- 3.b Complete the following chart giving the outputs for the corresponding inputs (the leftmost X and Y bits are the MSBs). Indicate whether the output is correct (i.e. “OK”) and give the true relationship of the signed inputs.

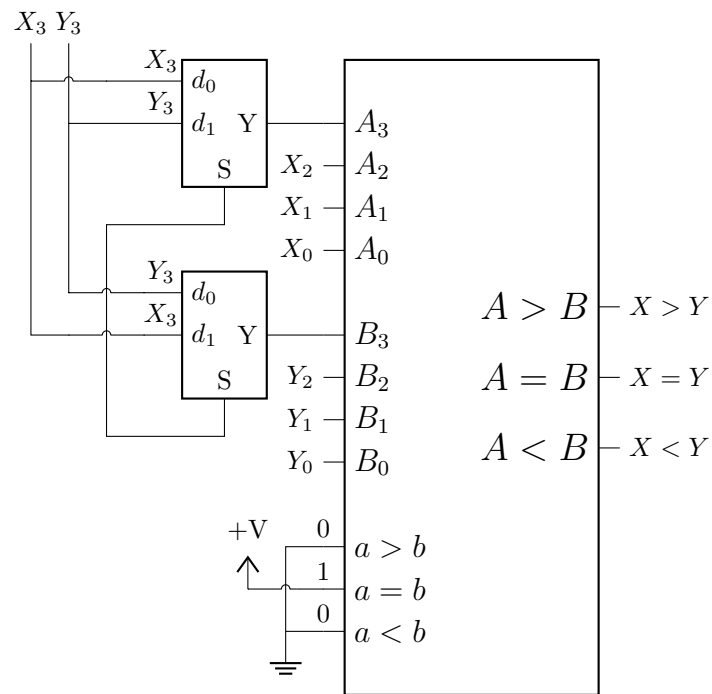
X (in) signed	Y (in) signed	A unsigned	B unsigned	X > Y	X = Y	X < Y	OK (Signed Result)
1 1 0 0	0 1 0 1	0 1 0 0	1 1 0 1	0	0	1	OK (-4 < +5)
1 0 1 0	1 0 0 1	1 0 1 0	1 0 0 1	1	0	0	OK (-6 > -7)
1 0 0 0	0 1 0 1	0 0 0 0	1 1 0 1	0	0	1	OK (-8 < +5)
1 1 0 1	1 1 0 1	1 1 0 1	1 1 0 1	0	1	0	OK (-3 = -3)
0 0 1 1	1 1 0 1	1 0 1 1	0 1 0 1	1	0	0	OK (+3 > -3)
1 1 0 1	1 1 0 0	1 1 0 1	1 1 0 0	1	0	0	OK (-3 > -4)
0 1 1 1	0 1 0 1	0 1 1 1	0 1 0 1	1	0	0	OK (+7 > +5)
0 0 1 1	0 1 0 0	0 0 1 1	0 1 0 0	0	0	1	OK (+3 < +4)

- 4 Using magnitude comparators, create a circuit to compare two 8-bit unsigned numbers, X and Y. Let X connect to the comparator A inputs.

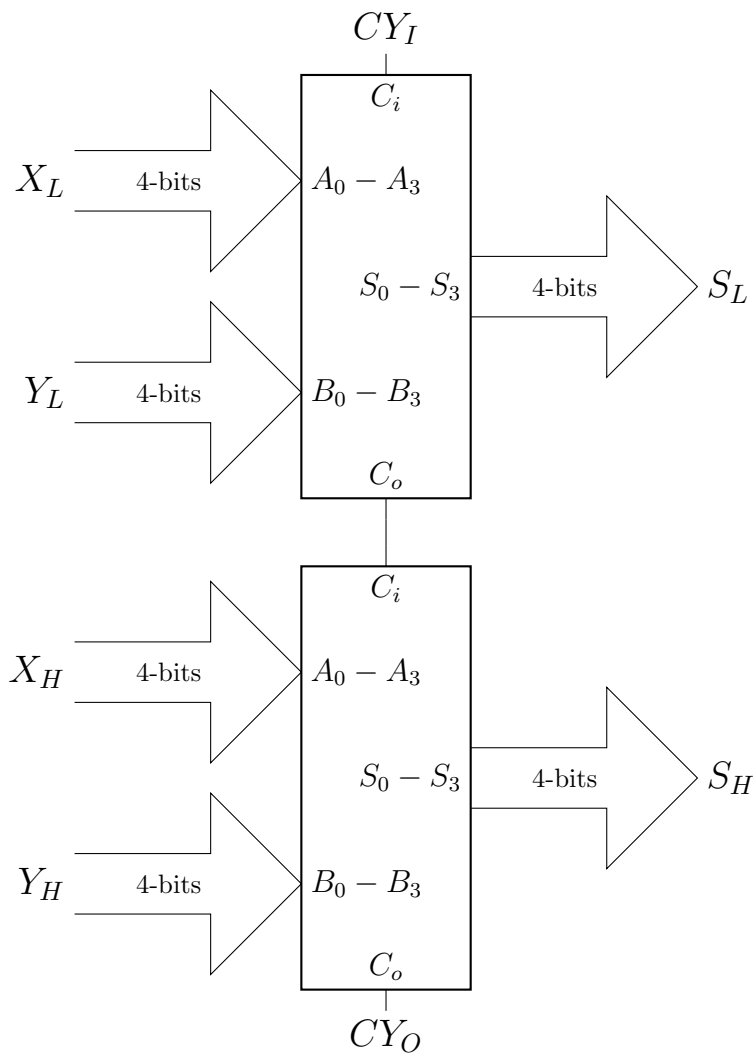


- 5 Using two 2:1 muxes and a magnitude comparator, design a circuit to compare 4-bit inputs X and Y as unsigned numbers when S=0 or as two's complement numbers when S=1.

S	A_3	B_3
0	X_3	Y_3
1	Y_3	X_3

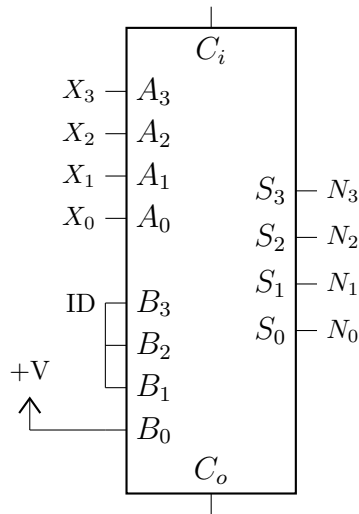


- 6 Draw a circuit to add two 8-bit unsigned binary numbers, X and Y. Include a carry-in, CY_I , and carry-out, CY_O . Let X connect to the adder A inputs and Y to the adder B inputs. The sum is S. Hint: Use fat arrows for each nybble with subscript “L” or “H” for the low and high nybbles respectively.



- 7 Using an adder, draw a circuit to increment or decrement an unsigned 4-bit number, $X = \{X_3X_2X_1X_0\}$. Let X connect to the adder A inputs and let the result be $N = \{N_3N_2N_1N_0\}$. Ignore the carry-out. Let ID be the increment or decrement signal (0 = increment, 1 = decrement). Hint: Do not use the carry-in input.

	ID	B	B_3	B_2	B_1	B_0
Increment	0	1	0	0	0	1
Decrement	1	-1	1	1	1	1



- 8 Using an adder, draw a circuit to subtract Y from X where X connects to the A input. The format is two's complement. Let the result be $N = \{N_3N_2N_1N_0\}$. Ignore the carry-out. Hint: This is only a subtractor so complements can be done with inverters.

