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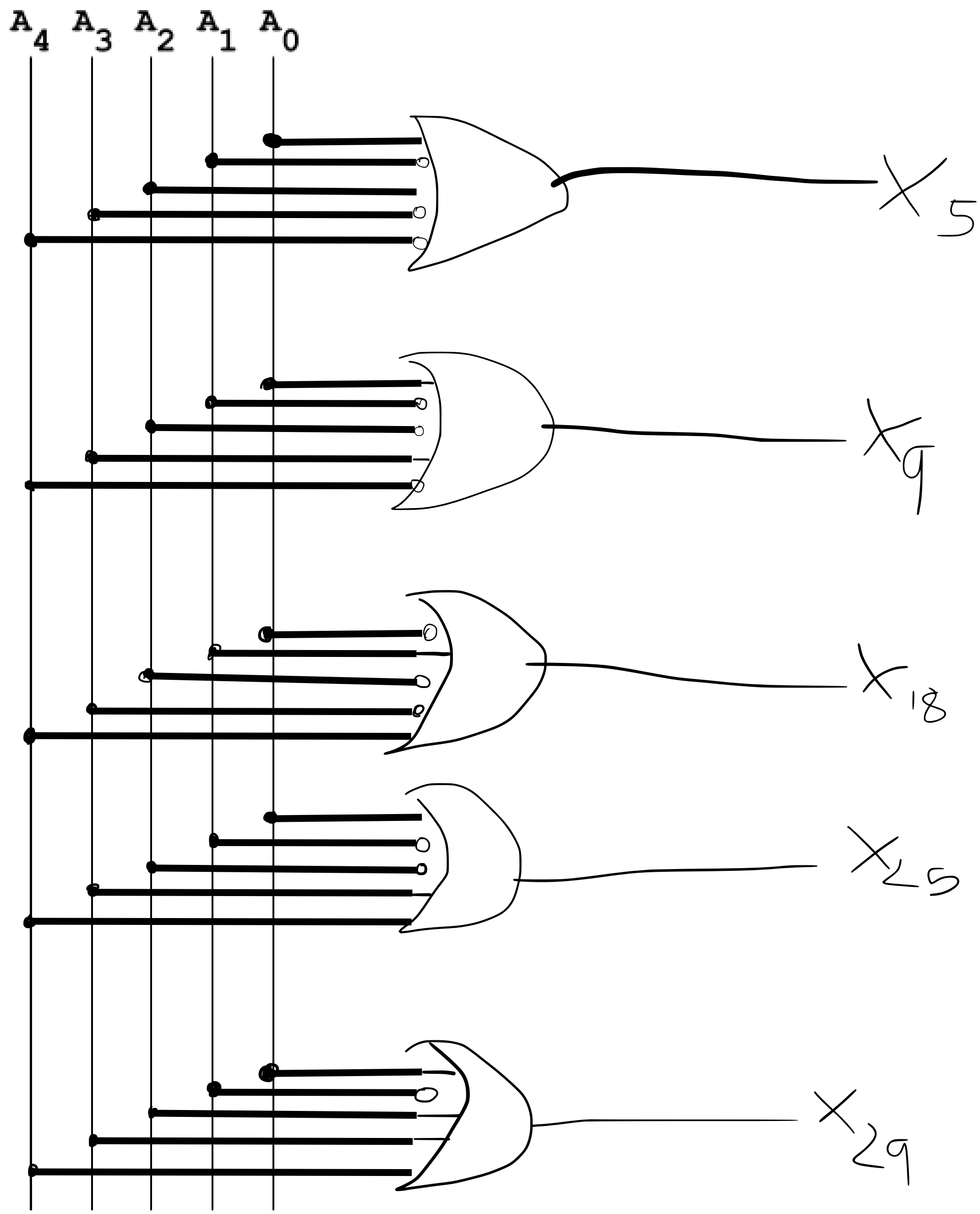
HW11: Standard combinational circuits, addition and subtraction (CS220-04)

1) Say we want to create a 5→32 decoder with inputs A_4--A_0. There would be 32 unique output circuits X_0--X_{31}. Using the input bus below, draw the complete circuits only for outputs X_5, X_9, X_{18}, X_{25}, and X_{29}. Don't forget to label each output.



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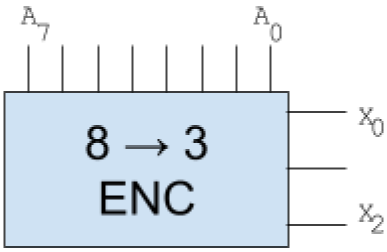
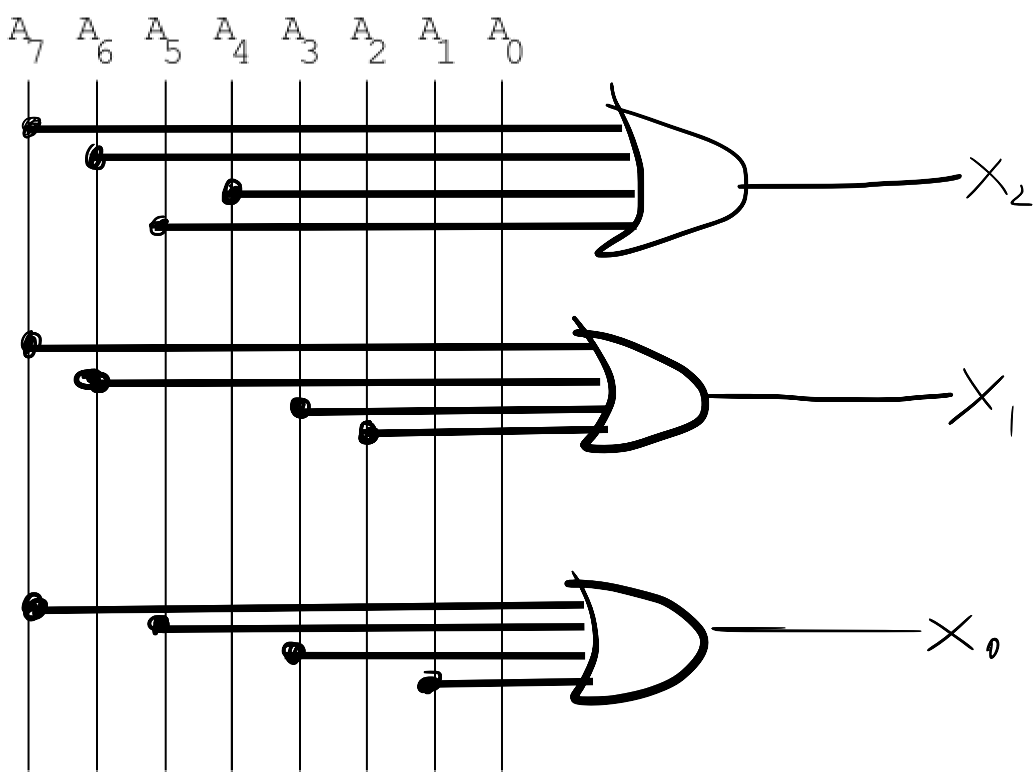
2) Say we want to develop circuits for an encoder like the one on the right. (a) Complete the truth table provided below for each of the output circuits. (b) Use the given input bus to draw the complete circuits for each of the outputs.



(a)

A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	X_2	X_1	X_0
1								1	1	1
	1							1	1	0
		1						1	0	1
			1					1	0	0
				1				0	1	1
					1			0	1	0
						1		0	0	1
							1	0	0	0

(b)



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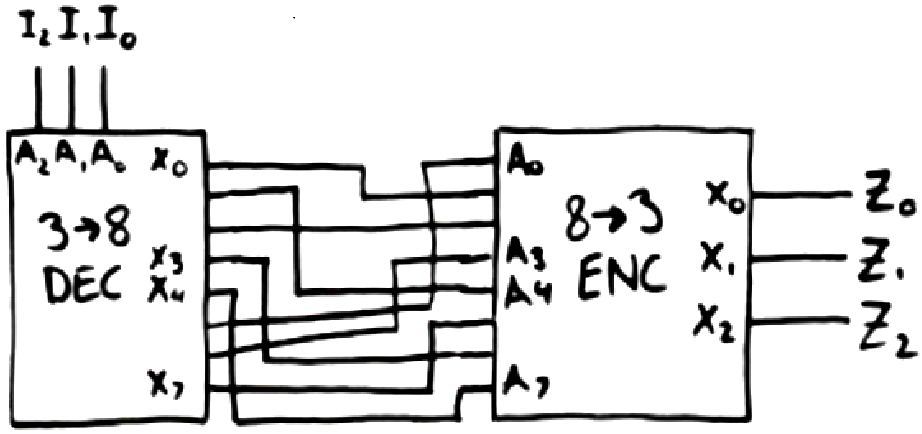
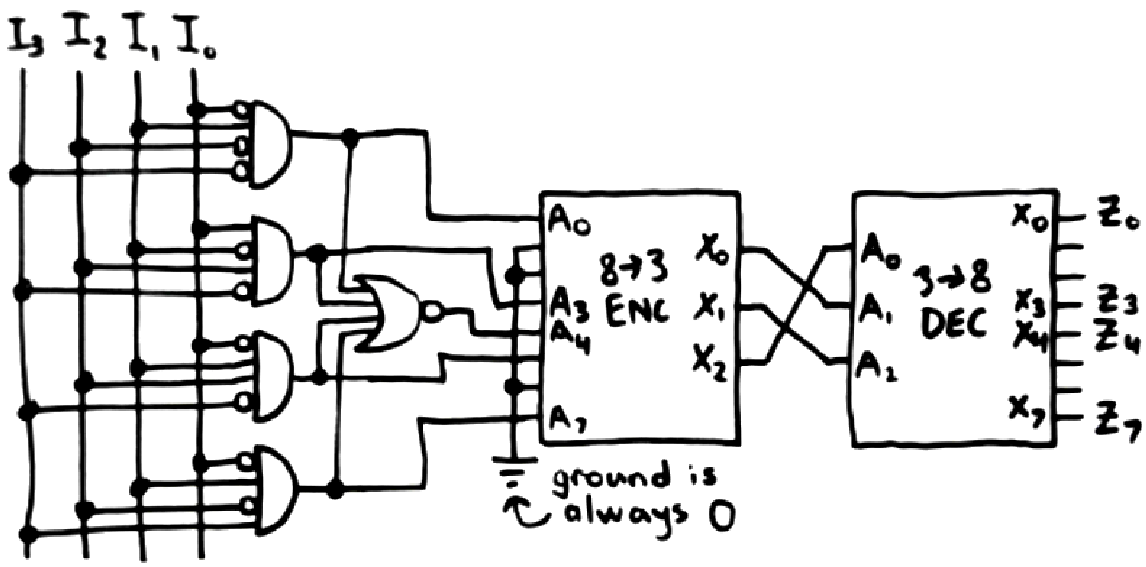
3) Given the circuit below, where 'A's are inputs and 'X's are outputs of the decoders and encoders, determine the 3 bit output Z of the overall circuit for each of the given 3 bit input values for the overall circuit.



(a) `I = 001` 100 (b) `I = 010` 010 (c) `I = 100` 111 (d) `I = 110` 011 (e) `I = 111` 101

4) Given the circuit below, where 'A's are inputs and 'X's are outputs of the decoders and encoders, determine which pin (eg, Z_3) will output 1 for given 4 bit input values.



(a) `I = 0010` Z_1 (b) `I = 0101` Z_5 (c) `I = 0110` Z_6 (d) `I = 0111` Z_7 (e) `I = 1010` Z_2

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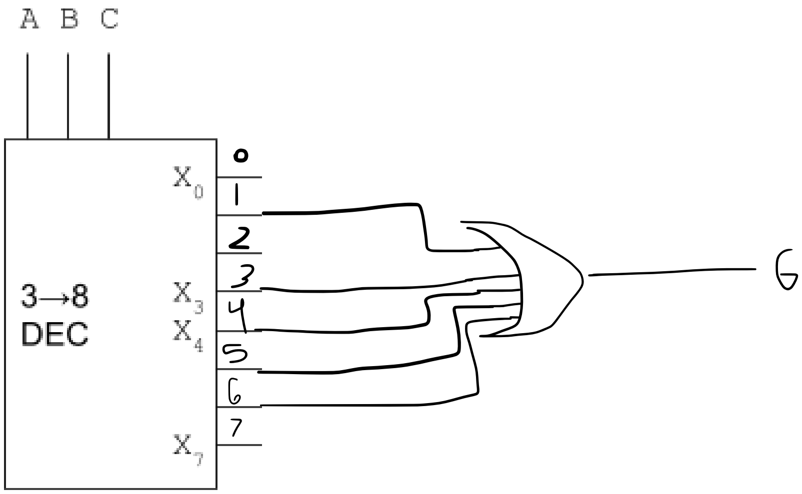
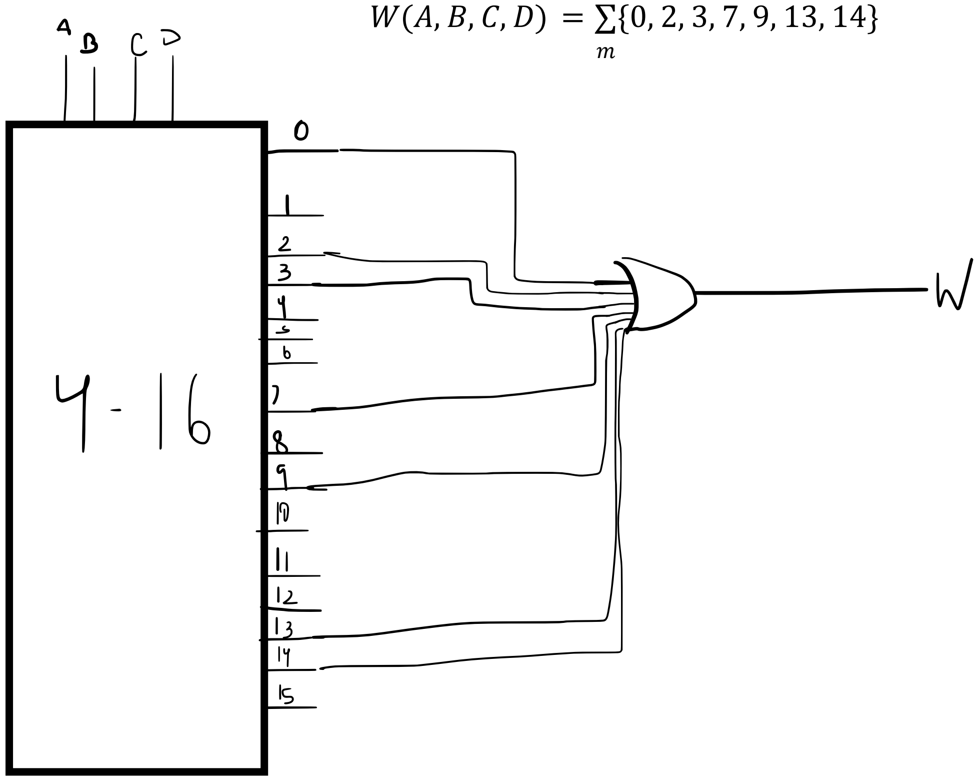
5) Given the expression below, draw the equivalent circuit based on the use of a decoder.

$$G(A, B, C) = \sum_m \{1, 3, 4, 5, 6\}$$



6) Given the expression below, draw the equivalent circuit based on the use of a decoder.

$$W(A, B, C, D) = \sum_m \{0, 2, 3, 7, 9, 13, 14\}$$



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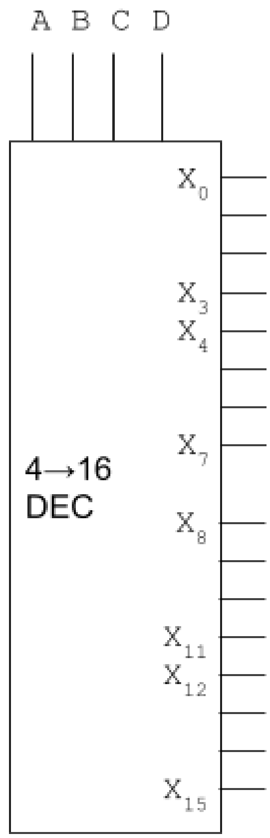
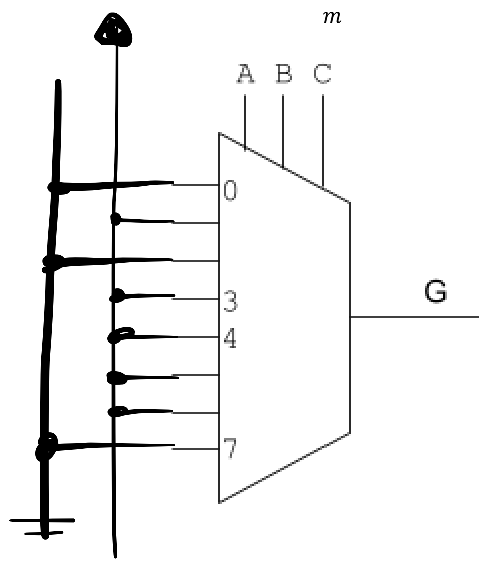


7) Given the expression below, draw the equivalent circuit based on the use of a multiplexor.

$$G(A, B, C) = \sum_m \{1, 3, 4, 5, 6\}$$



8) Given the expression below, draw the equivalent circuit based on the use of a multiplexor.

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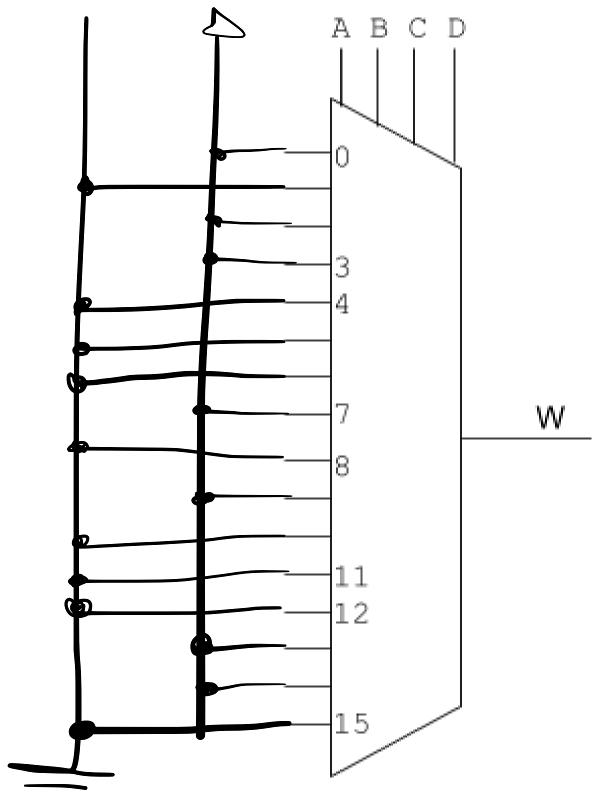
$$W(A,B,C,D) = \sum_m \{0, 2, 3, 7, 9, 13, 14\}$$



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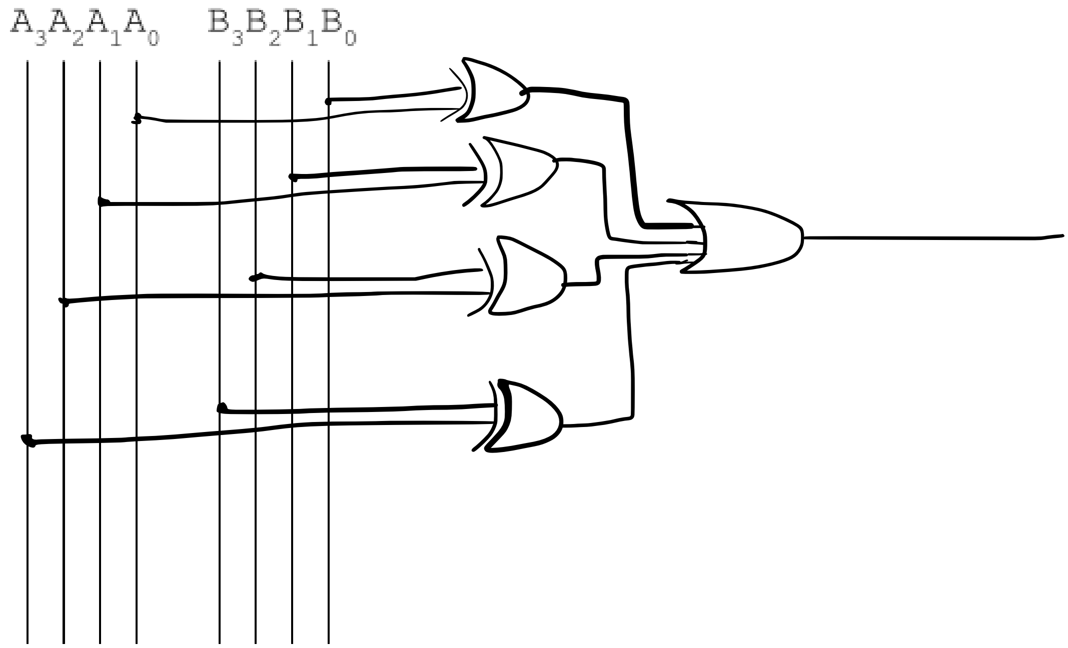
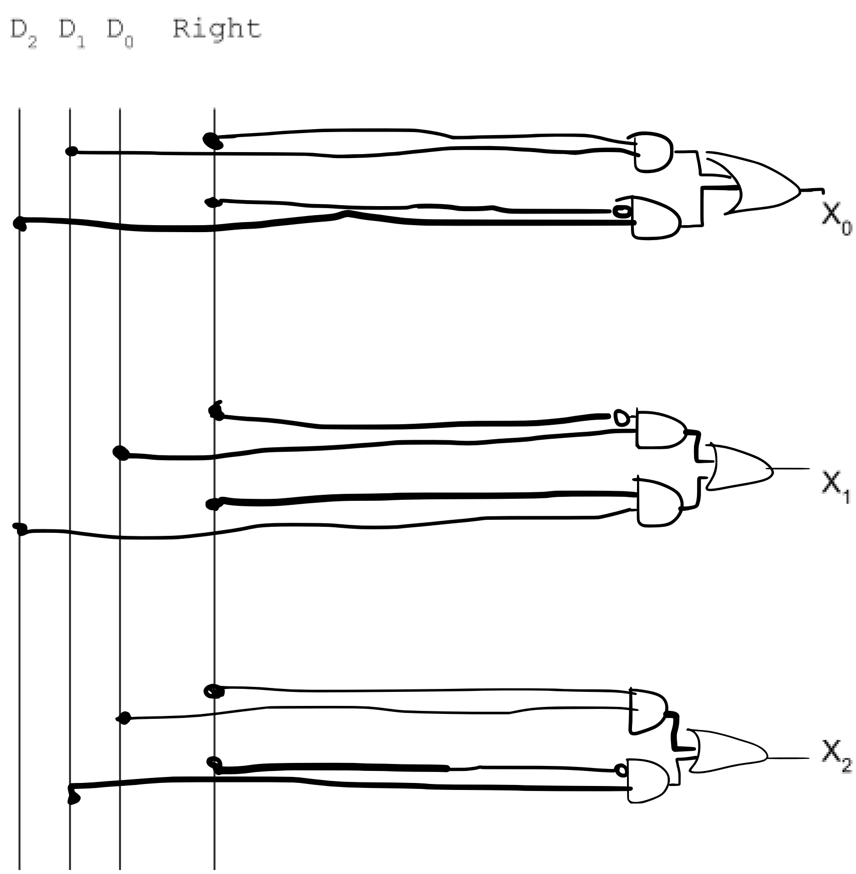
9) Complete the "equivalence" circuit below so that it compares two 4-bit numbers, A and B, and outputs a 1 if A and B are identical (each pair of bits in A and B are the same.. A_i==B_i).



10) Complete the **rotation** circuit below to rotate a 3-bit value 1 bit to the right if the "Right" input is 1 (left otherwise). Note: this is not a merged shifter-rotator.



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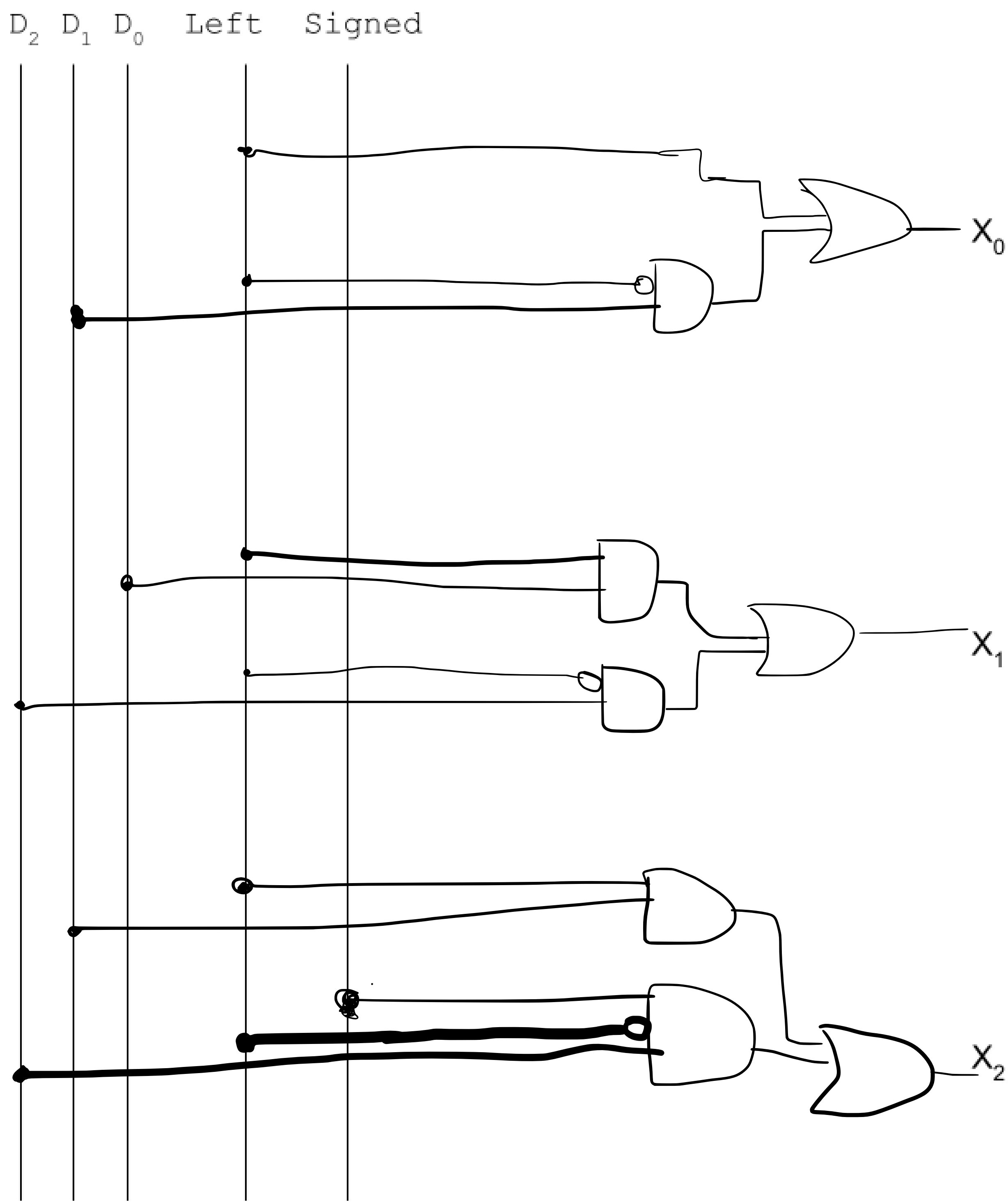
11) Complete the **shifting** circuit below to shift a 3-bit value 1 bit to the left if the "Left" input is 1 (right otherwise). The circuit should sign extend if the "Signed" input is 1 (shift in zeros otherwise). Note: this is not a merged shifter-rotator.



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Complete the two truth tables below for (12) a half adder and (13) a full adder.

13)

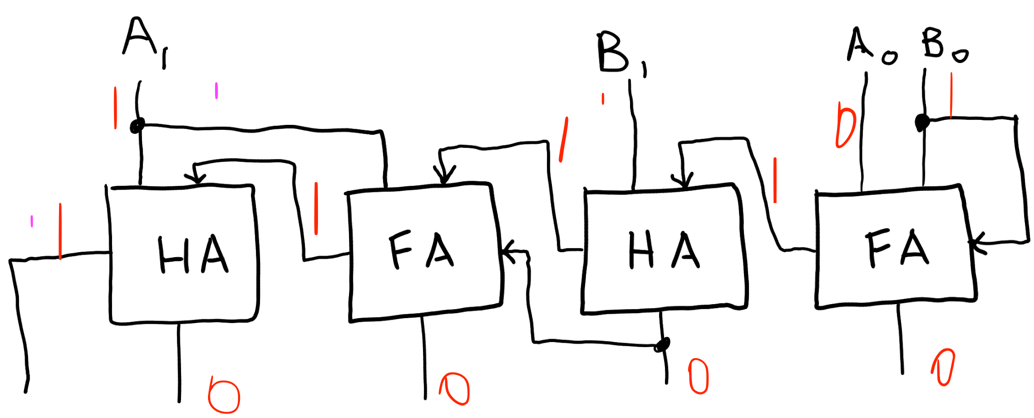
C_I	A	B	C_o	Sum
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

12)

A	B	C_o	Sum
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Text

14--17) Given the unusual circuit below constructed of full and half adders, determine the 5 bit output of the circuit for each of the given 2 bit values for A and B.



14) A = 10 B = 11

10000

16) A = 01 B = 10

00111

15) A = 11 B = 10

10011

17) A = 10 B = 01

10010

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18) Given the 2 bit adder-subtractor circuit below... (a) label the red control line either "Subtract" or "Add" based on the way it is connected and whether the circuit adds or subtracts when a 1 is put on the control line. (b) Complete the rest of the circuit diagram by connecting the B inputs to the full adders through the multiplexers.