Lab2 – Logic for Adder

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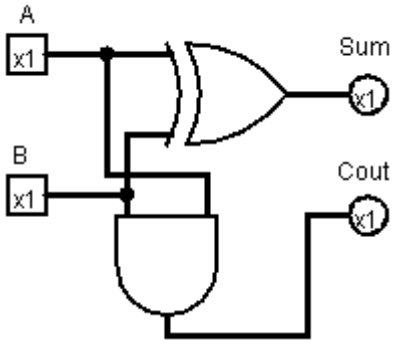
Part 1 - One Bit Half Adder

A	B	Sum	Cout
0	0	0	0
0	1	1	0
1	0	1	0
1	1	1	1

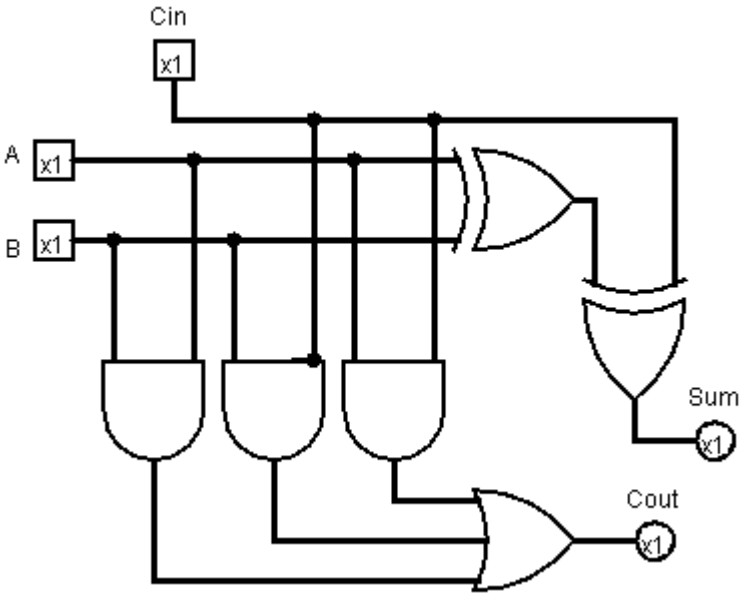


Sum = A V B

Cout = A ^ B

Part 2 - One Bit Full Adder

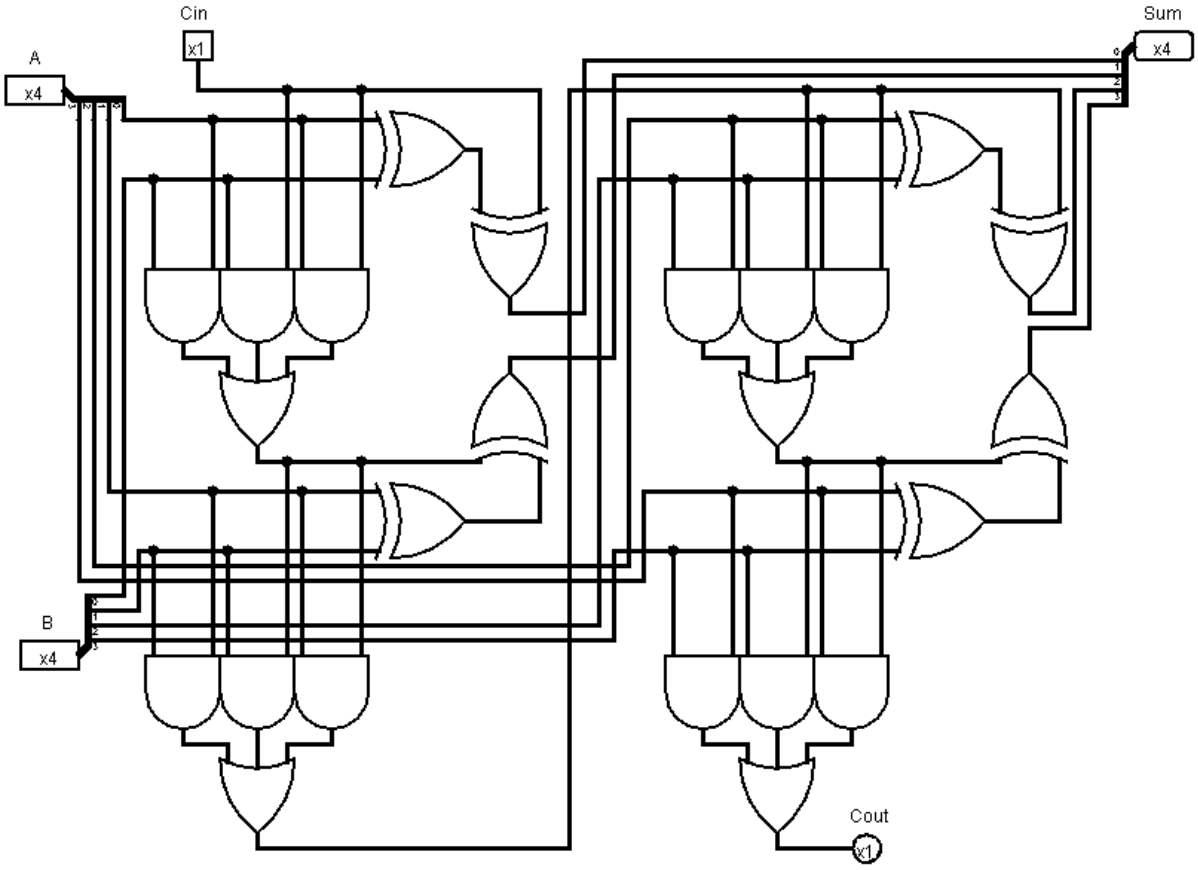
A	B	Cin	Sum	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1



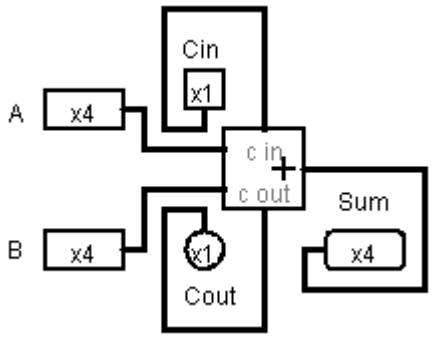
Sum = (A^B^C) V (A^~B^~C) V (~A^B^~C) V (~A^~B^C)

Cout = (A^B) V (A^C) V (B^C) V (A^B^C)

Part 3 - 4-bit Adder



Part 4 - Logisim 4-bit Adder



Questions about a 4-bit Adder

1. What is the range of unsigned numbers that you can represent in 4 bits?

   -8 to +7

2. Fill out the following table of sums, carry, and borrow that your 4-bit adder circuit will give. Assume unsigned representation of numbers in 4 bits.

Binary A input	Binary B Input	Binary sum	Decimal A input	Decimal B input	Decimal sum	Carry
0000	0111	0111	0	7	7	0
1100	0101	0001	12	5	17	1
0101	0101	1010	5	5	10	0
1111	1111	1110	15	15	30	1
0010	0110	1000	2	8	10	0

3. Assuming unsigned 4-bit representation of numbers, under what conditions does adding produce a result that is not meaningful with respect to normal addition and the constraint of only 4 bits to hold the sum?

4. What does the carry out pin signify?

5. Assuming unsigned 4-bit representation of numbers, what does your 4-bit adder actually produce if you try to add two numbers whose sum exceeds the 4-bit range of values? Give an arithmetic expression for the unsigned value of the sum bits in terms of x and y input values (use the modulus operation - mod; look for examples in your discrete math book).