CS240 Lab 3: Combinational and Arithmetic Logic

Pre-lab Assignment

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Question 1

Assume you have 3 inputs, **S**, **A1** and **A0**, and an output **Q**.

When **S** = 0, **Q** = **A0**
When **S** = 1, **Q** = **A1**

Give the truth table for **Q**:

S	A1	A0	Q
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Write the unsimplified sum-of-products boolean algebra expression for **Q**:

Q =

Write a simplified version of the expression above using only 4 operations (one of which is NOT):

Q =

Draw a circuit that produces **Q**:

S stands for "select." Knowing this, describe in English what this circuit does:

Question 2

Assume you have 2 inputs, **A1** and **A0**, and 4 outputs/functions, **Q0**, **Q1**, **Q2**, and **Q3**

- **Q0** is only true when **A1A0** = 00
- **Q1** is only true when **A1A0** = 01
- **Q2** is only true when **A1A0** = 10
- **Q3** is only true when **A1A0** = 11

Give the truth table:

A1	A0	Q3	Q2	Q1	Q0
0	0				
0	1				
1	0				
1	1				
0	0				
0	1				
1	0				
1	1				

Write a boolean algebra expression for each of **Q0**, **Q1**, **Q2**, and **Q3**:

Q0 =

Q1 =

Q2 =

Q3 =

Draw a circuit that produces each of the functions from a single set of inputs **A1** and **A0**:

Each input combination of **A1** and **A0** represents a 2-bit binary number. How is this related to the outputs?

Question 3

Complete the truth table for two functions, **Sum** and **CarryOut**, which represent the result when adding two individual bits **A** and **B**:

A	B	Sum	Carry Out
0	0		
0	1		
1	0		
1	1		

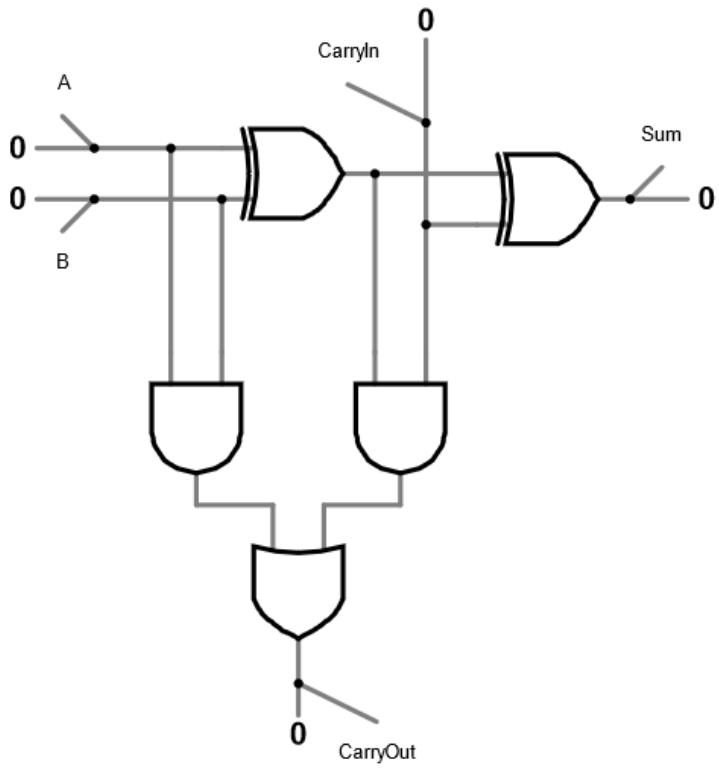
Draw a circuit which produces **Sum** and **CarryOut** from inputs **A** and **B** (this circuit is known as a half adder). You should use exactly one AND gate and one XOR (exclusive or) gate.

Give the truth table for a full adder (which incorporates a carry-in bit to the sum of **A** and **B**):

A	B	Carry In	Sum	Carry Out
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Question 4

A circuit for the full adder is:



Circle the two half adders on the diagram above.

Explain what each half adder is doing, in relation to adding the three bits **A**, **B**, and **CarryIn**:

Explain what the OR gate is doing to produce the **CarryOut**: