

**Computer Science 240**  
**Combinational and Arithmetic Logic**  
Assignment for Lab 3

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**:

<b>S</b>	<b>A1</b>	<b>A0</b>	<b>Q</b>
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 a function for **Q**, and simplify to a minimum number of gates:

Draw a circuit that produces **Q**:

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

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:

<b>A1</b>	<b>A0</b>	<b>Q0</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>
0	0				
0	1				
1	0				
1	1				

Write a function 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 **A1A0** represents a decimal number. How is this related to the outputs?

3. Complete the truth table for two functions, **Sum** and **CarryOut**, which represent the result when adding two binary digits **A** and **B**:

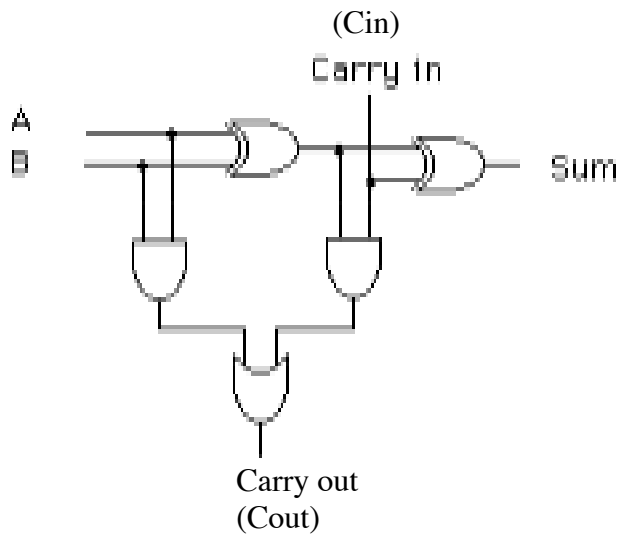
<b>A</b>	<b>B</b>	<b>CarryOut</b>	<b>Sum</b>
0	0		
0	1		
1	0		
1	1		

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**):

<b>A</b>	<b>B</b>	<b>CarryIn</b>	<b>CarryOut</b>	<b>Sum</b>
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

4. A circuit for the full adder is:



Circle the two half adders:

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

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