

**Computer Science 240**  
Assignment for Lab 3

Due: Wednesday, before lab

Review Lecture 4/5 and Lab 3 notes to complete the following exercises.

1. Give the logic symbols for an AND, OR, NOT, NAND, NOR and XOR (exclusive-OR) gates.

How many transistors are needed to implement each of the above gates?

2. Here is a boolean expression for a function F:

$$F = A'B' + A'B$$

Design a code detector for F using basic logic gates (AND, OR, NOT gates) and draw your design below. Do **not** simplify the circuit (in other words, use two NOT gates, two AND gates, and one OR gate)! :

Give the truth table for F:

<u>A</u>	<u>B</u>	<u>F</u>
0	0	
0	1	
1	0	
1	1	

Complete the truth table for:

$$Q = A' + A'B + A'B'$$

<u>A</u>	<u>B</u>	<u>Q</u>
0	0	
0	1	
1	0	
1	1	

Is Q equivalent to F from problem 1? Why or why not?

3. Which type of basic logic gates are defined as **universal**, and what does that mean?
4. Implement each of the basic gates in your circuit from problem 1 with NAND gates, and re-draw the circuit below (you should only need 5 NAND gates)

5. Now, use the identities of Boolean Algebra to simplify the function  $F = A'B' + A'B$  (show your work). You should be able to implement  $F$  with a single gate!

Draw your circuit:

6. What basic gate is the basis for a comparator? Why?

7. Describe the difference between a multiplexer and a decoder: