Assignment 12

Due by class time Tuesday, November 1

0. Read sections 5.1 and 5.2 of *Quantum Computing for Computer Scientists* (pages 138–151).

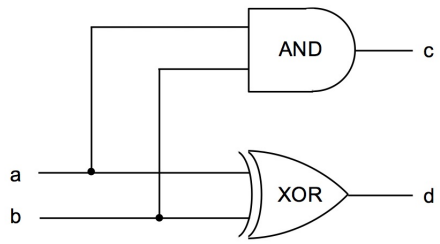
1. Suppose we have a 2-qubit register in state $\frac{1}{\sqrt{2}}|00\rangle - \frac{1}{\sqrt{6}}|01\rangle + \frac{i}{\sqrt{3}}|11\rangle$.

   (a) Write this state in the form of a column vector.

   (b) If we measure both qubits, what are the probabilities of obtaining as the outcome of the measurement 00, 01, 10, or 11, respectively? Fill in the table below accordingly:

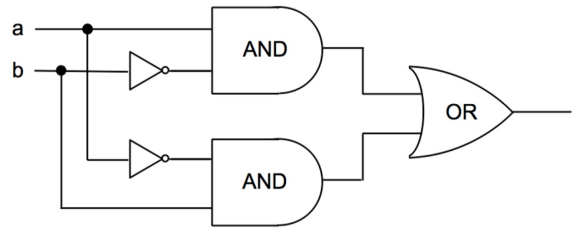
outcome	probability
00	
01	
10	
11	

2. Complete the truth table for the logic circuit below, showing the output values of c and d for each combination of input values a and b:



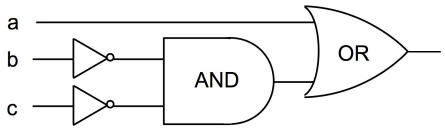
a	b	c	d
0	0		
0	1		
1	0		
1	1		

3. Complete the truth table for the logic circuit below, showing the values indicated in each column for each combination of input values a and b:



a	b	NOT a	NOT b	a AND (NOT b)	(NOT a) AND b	circuit output
0	0					
0	1					
1	0					
1	1					

4. Complete the truth table for the logic circuit below, showing the values indicated in each column for each combination of input values a, b, and c:



a	b	c	NOT b	NOT c	(NOT b) AND (NOT c)	circuit output
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

5. The truth table for NOR is given below. Show that NOR, like NAND, is a universal logic gate. Hint: show how to make NOT and AND (and thus NAND) gates using only NOR gates.

a	b	a NOR b
0	0	1
0	1	0
1	0	0
1	1	0