

Data Structures and Algorithms in Python

Assignment 18 – Digital Logic Circuits

Digital logic circuits form the backbone of all modern digital systems, from your cell phone to the world's most powerful supercomputer. At their core, digital logic circuits process binary data, performing operations based on the principles of Boolean algebra.

Understanding digital logic is crucial for anyone interested in understanding the principles underlying electronics, computer engineering, or computer science.

In this assignment, we will explore digital logic circuits through both theory and hands-on activities. You'll be introduced to the basic components of digital logic, logic gates, and learn how to combine them to perform specific functions. Additionally, you will gain an understanding of truth tables, which are essential for analyzing and designing logic circuits. The highlight of this assignment is building a two-bit adder, a fundamental component in digital arithmetic.

LOGIC GATES



AND



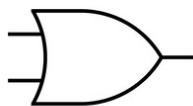
NAND



XOR



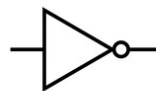
XNOR



OR



NOR

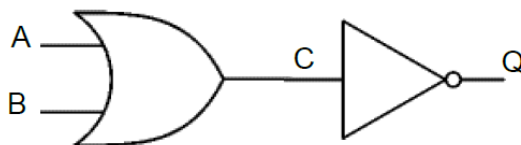


NOT

1. A Logic circuit has two inputs being **X** and **Y** fill in all the possible combinations.

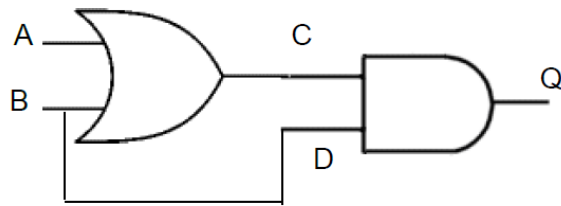
X	Y

2. The figure below shows a logic circuit and its incomplete truth table. Complete the below truth table.



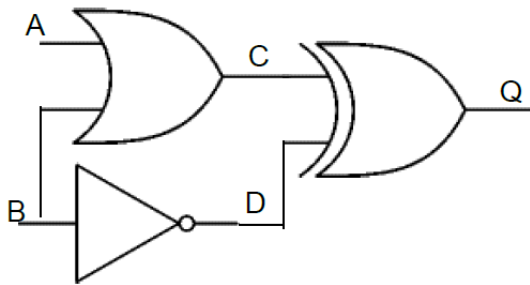
A	B	C	Q
0	0		
0	1		
1	0		
1	1		

3. The figure below shows a logic circuit and its incomplete truth table. Complete its truth table.



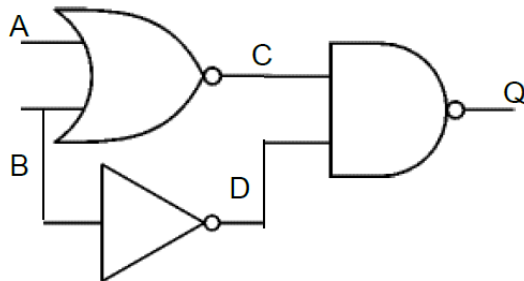
A	B	C	D	Q
0	0			
0	1			
1	0			
1	1			

4. The figure below shows a logic circuit and its incomplete truth table. Complete the below truth table.



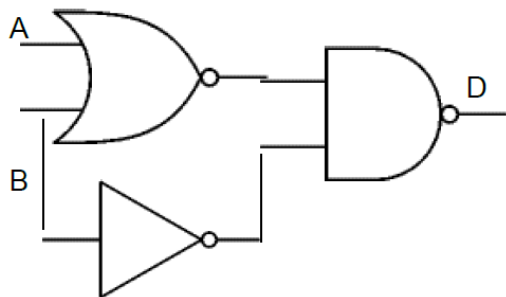
A	B	C	D	Q
0				
0				
1				
1				

5. The figure below shows a logic circuit and its incomplete truth table. Complete the below truth table.



A	B	C	D	Q
	0			
	1			
	0			
	1			

6. For the logic circuit below complete the truth table.

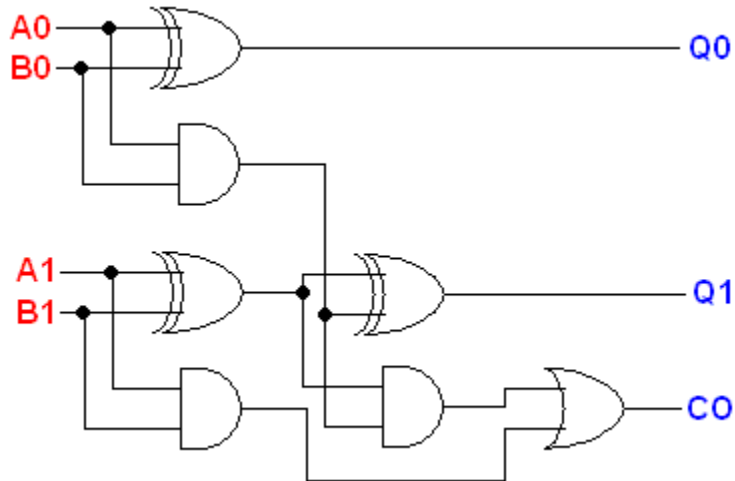


A	B			D
0	0			
0	1			
1	0			
1	1			

The Two-Bit Adder

The final part of this assignment is a practical component that will be completed in class. You will build a two-bit adder using logic gates. A two-bit adder is a circuit that adds together two, 2-bit numbers. The first number, A, can be represented using two bits A1 and A0. The second number, B, is similarly represented. The output consists of the sum of A and B, represented as two bits Q1 and Q0, and one *carry* bit. The truth table and circuit diagram for a two-bit adder are as follows:

Inputs				Outputs		
A1	A0	B1	B0	c0	Q1	Q0
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	0	1	1
0	1	1	1	1	0	0
1	0	0	0	0	1	0
1	0	0	1	0	1	1
1	0	1	0	1	0	0
1	0	1	1	1	0	1
1	1	0	0	0	1	1
1	1	0	1	1	0	0
1	1	1	0	1	0	1
1	1	1	1	1	1	0



We will use *breadboards* and Dual Inline Package Integrated Circuits (DIP ICs) to construct and test the two-bit adder in class. The functionality of your circuit will be factored into your grade for this assignment.