Intro to Quantum Computing

LAB-1

Objectives:

* Getting Comfortable with binary numbers
  * Binary to decimal Conversion
  * Decimal to binary Conversion
  * Binary addition.

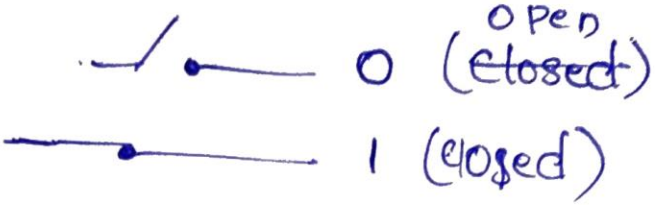
* Using logic gates to design Circuits
  * Review of logic Gate
  * Design of 1-bit adder*

* Thinking about algorithms and their Complexity
  * Linear Search algorithm.

* optional Content

Binary Numbers

Every Component in a Computer can be represented just as a Switch.



* Binary System with its two digits is a base-two System

Decimal number System

In decimal number System we can express any decimal number in units, tens, hundreds, thousands and so on. When we write a decimal number say, 5678.9 we know it can be represented as

$$5000 + 600 + 70 + 8 + 0.9 = 5678.9.$$

Positive and negative logic Systems

We have seen that, in binary logic, ~~two voltage represent if higher of two voltage~~, two voltage level represent the two binary digits, 1 and 0. If the higher of two voltage represents a 1 and the lower voltage represent a 0, the System is called a positive integer, on other hand if lower voltage represent a 1 and higher voltage represent a 0, we have a negative logic System.

Positive logic

High = 1
low = 0

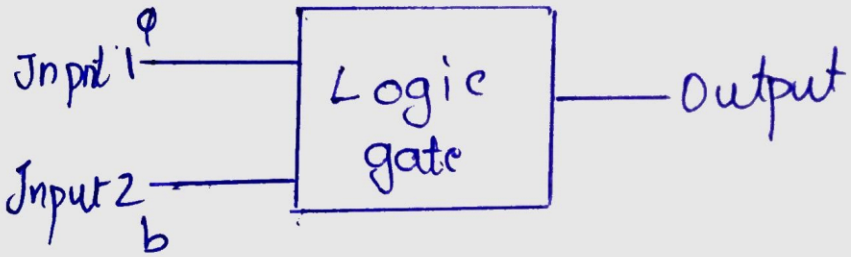
Negative logic

High = 0
Low = 1

Logic Gates

Logic gates are the basic building blocks of any digital System. It is an electronic circuit having one or more than one input and only one Output The relationship between the input and the Output is based on Curtain logic.

Building blocks of Computers



Truth table

a	b	O
0	0	1
0	1	0
1	0	0
1	1	1

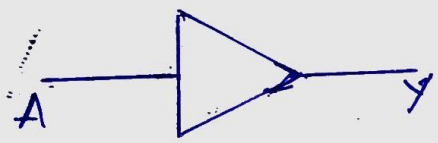
Types of Gate

~~No~~

NOT Gate

NOT gate is also known as inverter. it has one input A and one output Y

Logic diagram



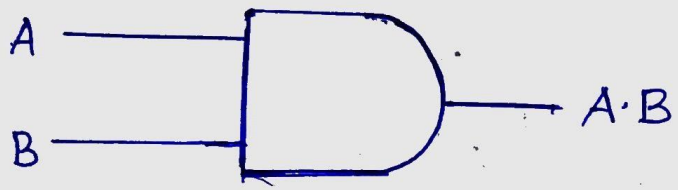
Truth table.

A	Y
0	1
1	0

AND Gate

AND gate has two or more than two inputs and only one Output. In AND gate Output is High or 1 only when each Input of it has in the High State

Means output is 1 if only all inputs are at level. If anyone input goes at 0 levels then output of AND gate becomes 0



Truth Table

A	B	A·B
0	0	0
0	1	0
1	0	0
1	1	1

The Universal gate

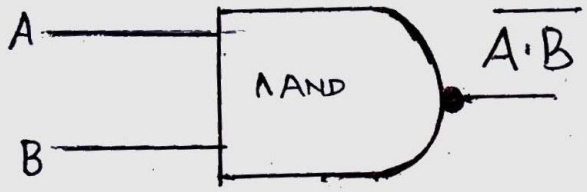
Universal gates are defined as which logic gates can be implemented any types of logic gates. There are two universal gates NAND and NOR. Both NAND and NOR gates can perform all three basic logic functions of AND, OR, NOT, AOI (AND/OR/INVERT(NOT)) Can be Converted to NAND logic or NOR logic

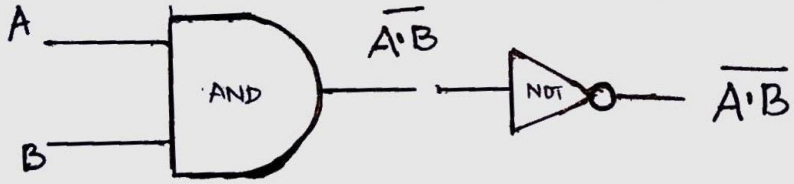
NAND Gate

NAND gate is a combination of AND gate and NOT gate. if the output of AND gate is inverted then it is called NAND gate.

Truth table

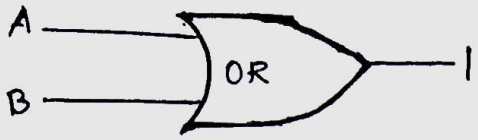
A	B	A · B
0	0	1
0	1	1
1	0	1
1	1	0





OR Gate

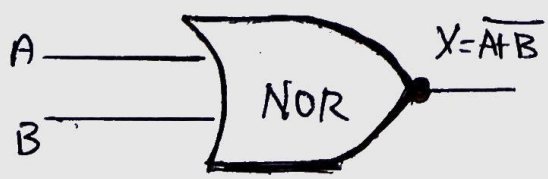
OR gate has also two or more than two input but only one output. The output is High or 1 if even any one of input is 1. The output is 0 or Low if all input is in low state or 0..



A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

NOR Gate

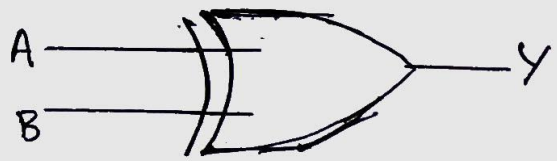
When the output of OR gate is NOTed or inverted then it is called the NOR gate. NOR means NOT OR. NOR gate is the Combination of an OR gate and a NOT gate. The output is 1 or High when both input is 0 or Low. Other wise, the Output is 0. The boolean expression for the NOR gate is ~~expressed~~ expression



A	B	$\overline{A+B}$
0	1	1
0	1	0
1	0	0
1	1	1

XOR Gate

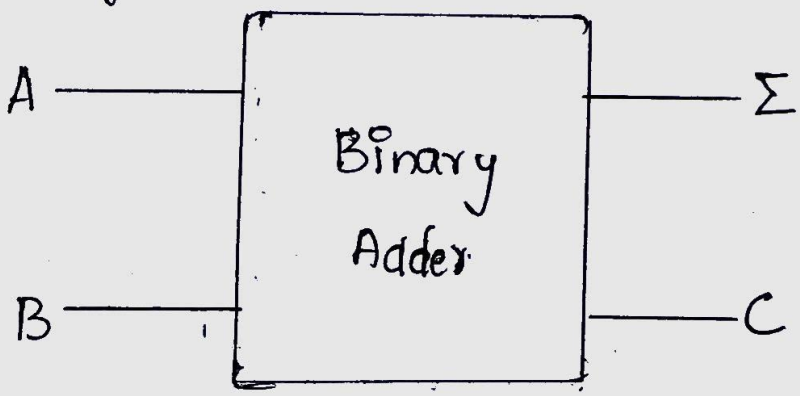
A XOR gate is a gate that gives a true (1 or High) output when the number of true inputs is odd. An XOR gate is also called exclusive OR gate or EXOR. In two input XOR gate, the Output is high or true when two inputs are different



A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

Exploratory problem

Design a logic Circuit to compute the Sum of two 1-bit bits Have bit(s) to Output the 1-bit result and Carryout bit (c)



A	B	SUM	CARRY
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Design a logic Circuit to Compute the Sum of two 1-bit bits Have one bit (S) to output the 1-bit result and Carry out bit (C) for the Carry of the Sum

Ans