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Q:- What is Truth Table?

Ans:- A table to show the truth values of a function f for all possible combinations of the truth ~~f~~ values of the independent variables which appear in the expression of f. Such a table is called the truth table for the function f.

Q:- Construct the truth table for a function $f(x,y)$ given by

$$f(x,y) = (x'+y)' + x'y'$$

Soln: f contains two ~~id~~ independent variables x and y and hence there are 4 possible ~~[illegible]~~ combination of 0 and 1 as the truth values of x and y. The truth table for f contains 3 columns and 4 rows.

x	y	f
0	0	1
0	1	0
1	0	1
1	1	0

Truth table

Note that $f(0,0)$

$= (0'+0)' + 0'.0'$

$= (1+0)' + 1.1$

$= (1)' + 1 = 0+1 = 1$

in a similar way we can find that

$f(0,1) = 0$, $f(1,0) = 1$ & $f(1,1) = 0$

Gates

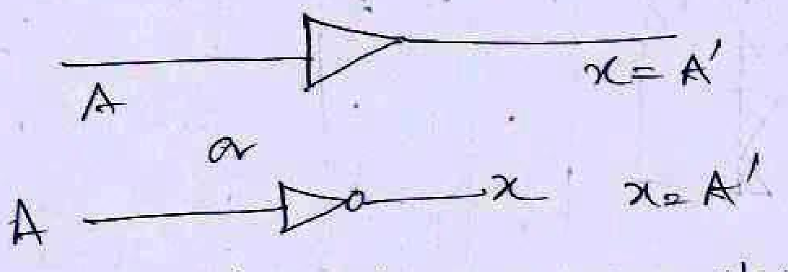
* Logical circuit elements are commonly called gates. A logic gate is defined as a circuit having two or more (but finite) input terminals but with only one output terminal, where the output signal is present when and only when the input signals assume some prescribe characteristics. Different logical gates can be implemented to satisfy various needs of the computer. e.g decision making, mixing and comparision of signals and several other types of execution and control.

NOT Gate / Inverter

This logical gate is said to realise the NOT [i.e. Complement (')] function

A	x
0	1
1	0

Truth Table



logical symbol of NOT Gate

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AND - gate: The logical AND-function corresponds to the basic operation of conjunction which asserts that the output will be present if and only if ~~or~~ only if all the inputs are simultaneously present. It consists of two or more but finite number of inputs with only one output.

The logical truth table for an AND-gate with two inputs A, B and output $X = A \cdot B$ is given by

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

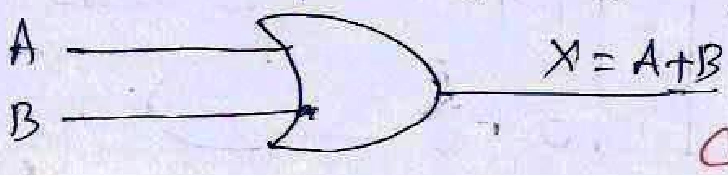
The logical symbol for an AND gate is .

OR - gate: The logical OR-function corresponds to the basic operation of disjunction and asserts that the output is present whenever one or more of the inputs are present. The output is absent if and only if all the inputs are absent simultaneously.

The logical truth table for an OR gate with two inputs A, B and output $X = A+B$ is given by

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

The logical symbol for an OR gate is



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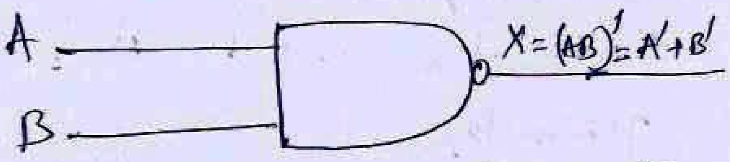
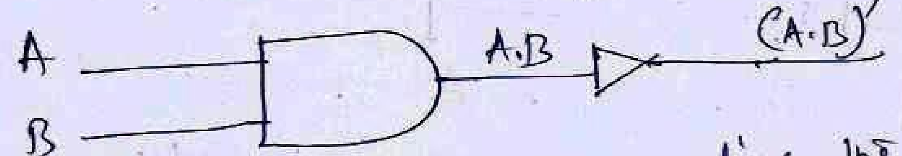
NAND gate: The NAND-operation is nothing but the complement of AND operation. The output is absent only when all the inputs are present simultaneously. The truth table (with two inputs) of a NAND-gate are ~~show~~ shown below:

A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

The logical symbol of a NAND-gate is given below



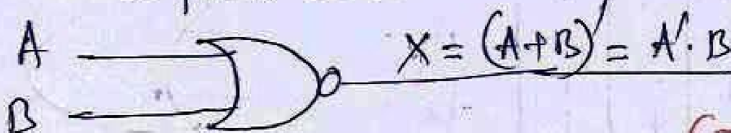
logically, it is equivalent to an AND gate followed by a NOT-gate. Thus the logical equivalent of a NAND-gate is as follows.



NOR-gate: NOR-gate realises the NOR-operation which is nothing but the complement of OR-operation. The output is present only when all when all the inputs are ~~absent~~ absent. The truth table for a 2-input NOR-gate is given below

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

The logical symbol of a NOR-gate is ~~en~~ given below



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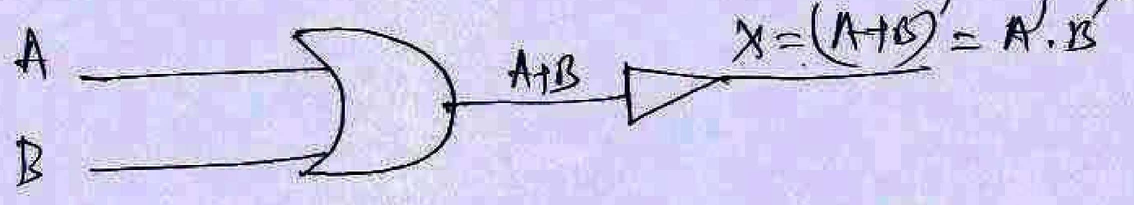
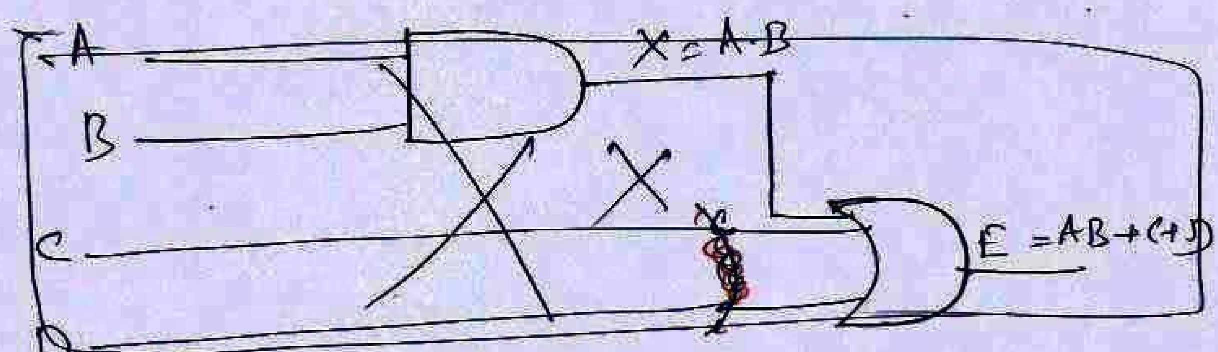
NOR-gate (Continued)

A NOR-gate is logically equivalent to an OR-gate followed by a NOT-gate

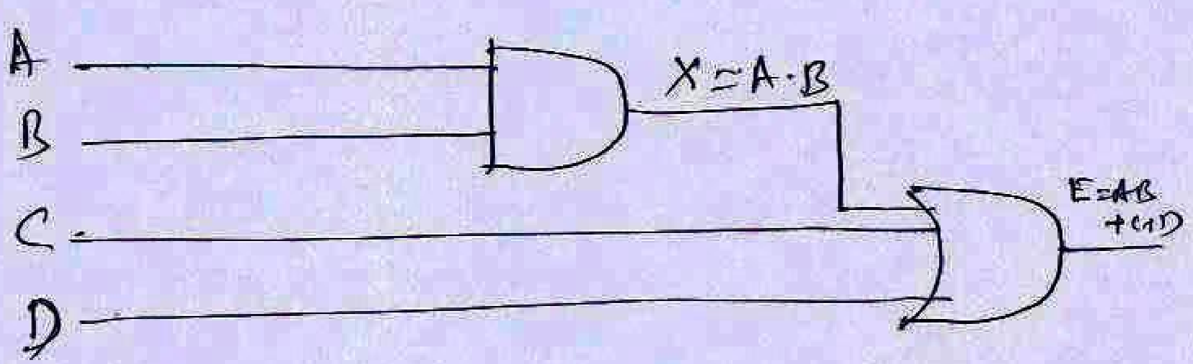


Example Q: Obtain the logical diagram for the following functions

(i) $AB + (C+D) = E$



Ans:



Differentiate between Boolean Algebra with the Algebra of Real Numbers

<u>Ans</u>: Although the algebra of sets with two-binary operations union and intersection is a Boolean algebra, the algebra of real numbers however, cannot be recognised as a Boolean-~~Alglo~~ Algebra. Some of the important differences

(i) The commutative and associative laws of addition (+) and ~~maan~~ multiplication (.) are true in both the algebras. but the distributive law of + over . is not true in ordinary algebra i.e in ~~order~~ Ordinary algebra $a+b.c \neq (a+b).(a+c)$ for any three real numbers a, b and c. The distributive law of $\cdot$ over +, however holds for both the algebras.

ii) In the ~~alg~~ algebra of real numbers, the idempotent laws or Absorption Laws, which are true for any Boolean Algebra.

iii) The numbers 0 & 1 may be considered as the identity elements for addition and multiplication respectively in the algebra of real numbers but the complement element does not arise in ~~Qga~~ ordinary algebra Contd...

iv) There exist no De Morgan's Laws or the Laws of ~~Anal~~ Double Complementation in ordinary algebra.
Also The principle of Duality does not hold in the algebra of real numbers.

v) In view of the Idempotent laws, Boolean algebra is linear in character since $x + x = x$ and $x.x = x$ for any x in a Boolean algebra. But, in the algebra of real numbers, for any x we have $x + x = 2x$ or $x.x = x^2$ etc.
Thus in a Boolean algebra, we don't ~~have~~ have any element like $2x$, $3x$, x^2, $2x^2$ etc.

vi) The cancellation laws
(namely $a.b = a.c$ implies $b = c$ for $a \neq 0$ and $a + b = a + c$ implies $b = c$) hold in the algebra of real numbers but not in ~~real numbers~~. Boolean algebra.

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