<u>BOOLEAN</u> <u>ALGEBRA</u>

AND

<u>LOGICAL</u>

<u>CURCUITS</u>

USUAL ALGEBRA

$$c = a + b$$

$\infty \quad \infty \quad \infty$

BOOLEAN ALGEBRA

$$c = a + b$$

0,1   0,1   0,1

1 Logic	0 Logic
True	False
Open	Closed
High	Low
Yes	No
Open Switch	Closed Switch

Numerical representation of voltage changes, is the most commonly usage of the boolean algebra.
Such as

$0 \longrightarrow 0 - 2.5\ V$

$1 \longrightarrow 2.51 - 5\ V$

BASIC BOOLEAN ALGEBRA OPERATIONS & GATES

AND OR NOT

AND OPERATOR and GATE

$X = A \cdot B$ $X = AB$

X, A and B are Boolean variables. Their values can be only 1 or 0.

If both A and B is 1 the result is 1, in all other cases result is 0.

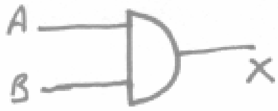
All possible results of a Boolen equation are showed on the truth table.

A	B	X = A.B
0	0	0
0	1	0
1	0	0
1	1	1

it looks like multiplication operation in usual algebra

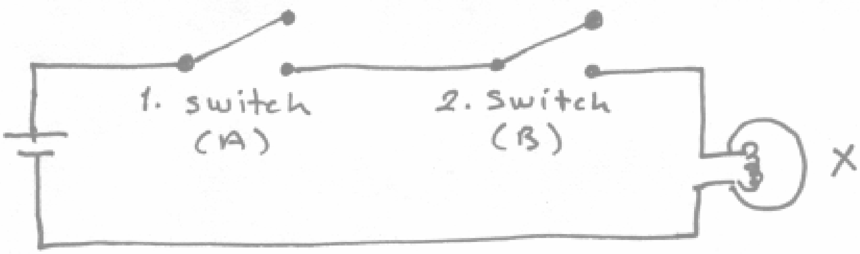
Truth Table of $X = A \cdot B$

AND Gate



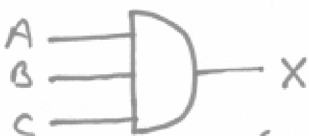
$X = A \cdot B$

AND operation looks like



$X = ABC$

A	B	C	X = ABC
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1



$(X = ABC)$

If there are N variables in a boolean equation, there are 2^N possible result.

$N = 3 \qquad 2^3 \longrightarrow 8$

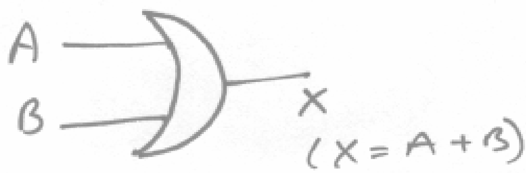
OR OPERATOR and GATE

$$X = A + B$$

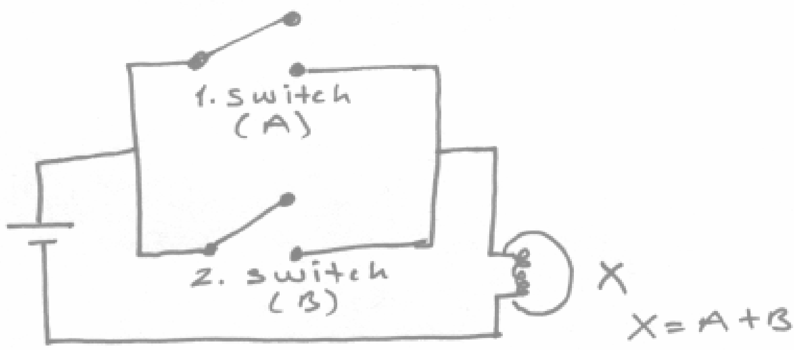
Truth Table of $X = A+B$

A	B	X = A + B
0	0	0
0	1	1
1	0	1
1	1	1

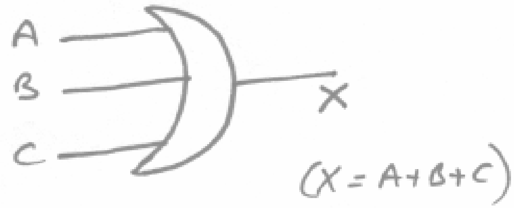
like addition in usual algebra



OR Gate



A	B	C	X = A + B + C
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1



NOT Operator & GATE

NOT OPERATOR REVERSE A BOOLEAN VALUE.

IF IT IS 1 WITH NOT OPERATOR IT BECOMES 0. OR IF 0 IT IS 1.

$$X = \bar{A}$$

A	$X=\bar{A}$
0	1
1	0

NOT GATE HAS ALWAYS ONE INPUT, AND OUTPUT IS REVERSE OF IT.

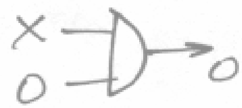
RULES OF BOOLEAN ALGEBRA

A Boolean Algebra equation/function is made up AND, OR and NOT. There can be any number of boolean variables.

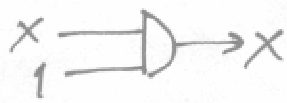
When a lot of variables are used, there are some simplification rules to get small but equivalant equations instead of long equations.

a) Rules for Single Variable

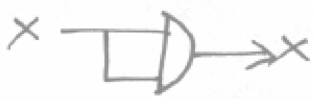
1) $X.0=0$



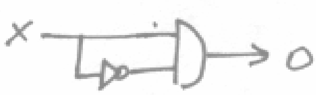
2) $X.1=X$



3) $X.X=X$

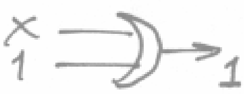


4) $X.\bar{X}=0$

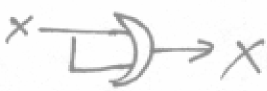


5) $X+0=X$

6) $X+1=1$

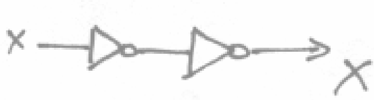


7) $X+X=X$



8) $X+\bar{X}=1$

9) $\bar{\bar{X}}=X$



They can be tested with giving 0 and 1. Also, these rules can be used for more than variables. Example:
$A\bar{B}\cdot(\overline{A\bar{B}})$ $\quad X=A\bar{B} \rightarrow X.\bar{X} \rightarrow 0$ (4.Rule)