01/03/2023

* 1's complement

Just inverse the complement

```
  100
+ 011
  ---
  111
```

* 2's complement

1's complement +1

```
  0100        100        1011   } 1's
+    1        01         0100
  ----          1   2's (1's+1)  1
  101         ---        ----
              100        101
```

MSB LSB

(1101100(1))

inverse

001001001 1

1001

Substracting using 1's complement

```
- 011   A   |   + 011
  100   B   |     001
            |     ---
  A-B       |     100      negative
  A+(-B)    |   - 011      1's complement
            |   - 3        of result
```

1st

$$\begin{array}{r} 1001 \\ 1100 \\ \hline \end{array} \qquad \begin{array}{r} 9 \\ -12 \\ \hline -3 \end{array}$$

$$\begin{array}{r} 1001 \\ +0011 \\ \hline 1100 \end{array}$$

inverse

0011 = 3

IF carry generated then we have to add that carry and its answer is positive.

2nd

$$\begin{array}{r} 1100 \\ -1001 \\ \hline \end{array} \qquad \begin{array}{r} 12 \\ 9 \end{array}$$

$$\begin{array}{r} 1100 \\ 0110 \\ \hline 0010 \end{array}$$

2's

$$\begin{array}{r} +1 \\ \hline 0011 \end{array} \rightarrow 3.$$

(i)

$$\begin{array}{r} -10001 \\ +11111 \\ \hline \end{array} \qquad \begin{array}{r} 17 \\ 31 \\ \hline 14 \end{array}$$

$$\begin{array}{r} 11111 \\ +01110 \\ \hline 01101 \\ +1 \\ \hline 1110 \end{array}$$

8 4 2 1

Substraction using 2's Complement.

11110 → 11110
11111 → 00001

11111
+ 00001

100000 → 32.

(2) 1010111 → 1010111
1110000 → 10000

11100
- 01110
0

11100
10010
01110

(3) 1100 → 1100
1001 → 0110
0011 → 0011

2nd Mar. 2023.

★ Multiplaction
Division
Logic gates :-

2nd Mar. 2022

* Multiplication

0 X 0 = 0
0 X 1 = 0
1 X 0 = 0
1 X 1 = 1

eg-1

```
  x   1 1        3
      1 1        3
  ---------
      1 1
 +  1 1 0
  ---------
    8 4 2 1
    1 0 0 1      9
```

eg-2

```
  x 1 0 0 1      9
        1 1      3
  -----------
    1 0 0 1
  1 0 0 1 0
  -----------
  1 1 0 1 1      27
```

eg-3

```
  x 1 0 1 0 1
      1 1 1 1
  -------------
```

eg-3

```
       11.11
        11.1
  ------------
     101.111
     11.11
    111.1
  ------------
    1101.001
```

eg-4

```
     11.1
      1.1
  ---------
    1 1.11
    1 1.1
  ---------
    101.01
```

eg 5

```
   11.011
    11.1
  --------
   11.1011
  111.011
  110.11
  --------
 1011.1101
```

eg 6

```
            11111001
    x       10010000
  ------------------------
        011111001000
    1111100100000000
  ------------------------
  1000110000001000 0
```

eg-6

```
          11111001
           1001000
  ------------------------
  11111001000000
      111110 1000
  ------------------------
  100011000 0 1000
```

* Division :-

1001 ÷ 11

```
        11
     ______
  11 | 1001
      -11
      ----
        11
        11
      ----
        00
```

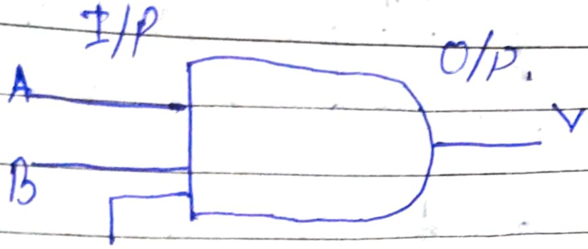
110 ÷ 11

```
              (2)
              10
          _______
  (3) → 11 | 110    → (6)
             11↓
           -----
             000
```

```
              1.1      2.5
        _______
  2 (10) | 101           5
           10
         -----
           0010
             10
           -----
             00
```

* Logic gates

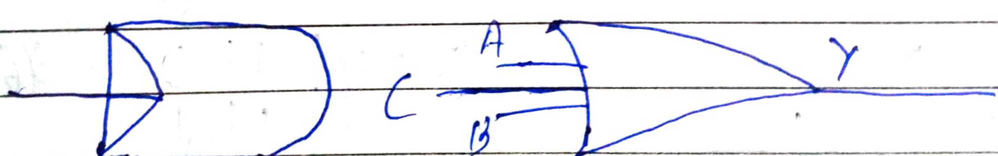
i) AND



$Y = A \cdot B \cdot C$

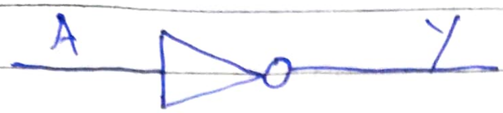
C	A	B	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0

ii) OR



C	A	B	Y
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

☆ NOT gate :-

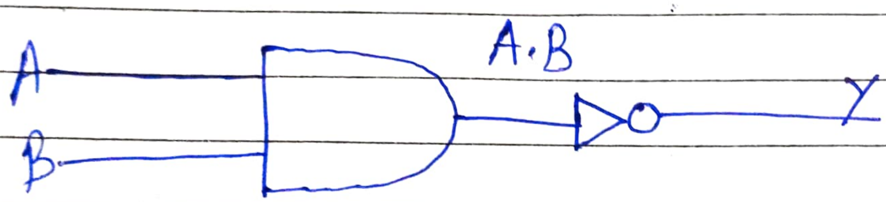


A	Y
0	1
1	0

03·Mar 2023

☆ NAND

· AND + NOT ≠ NOT + AND

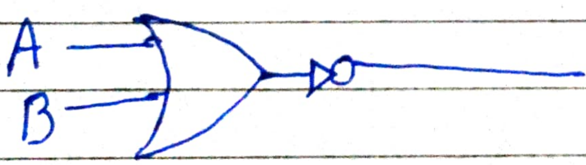


$\overline{A \cdot B}$

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

☆ NOR :-

OR + NOT

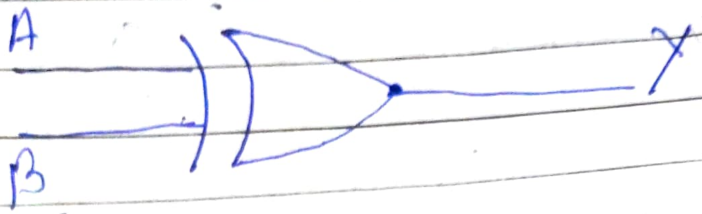


A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

EX OR

$A \oplus B$

$A\bar{B} + BA$



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

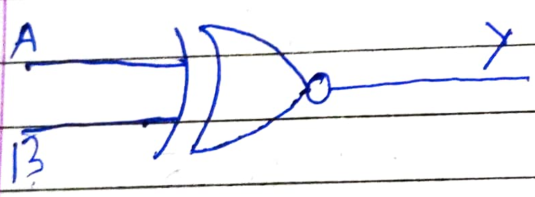
EXNOR

$\overline{A \oplus B}$

$= \bar{A}\bar{B} + AB$

=

X-OR + NOT



A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

Why we consider universal gate of NOR & NAND?

⊙ NAND

NOT

$Y = \overline{A \cdot A}$

$Y = \overline{A}$

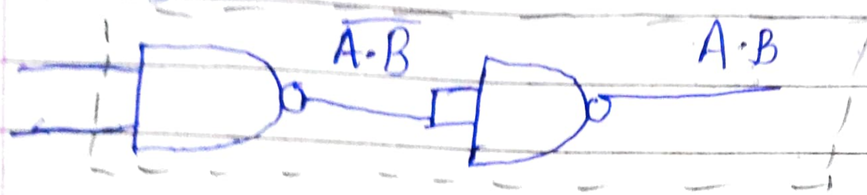
$A \cdot A = A$

$A \cdot 0 = 0$

$A \cdot 1 = A$

$A \overline{A} = 0$

AND



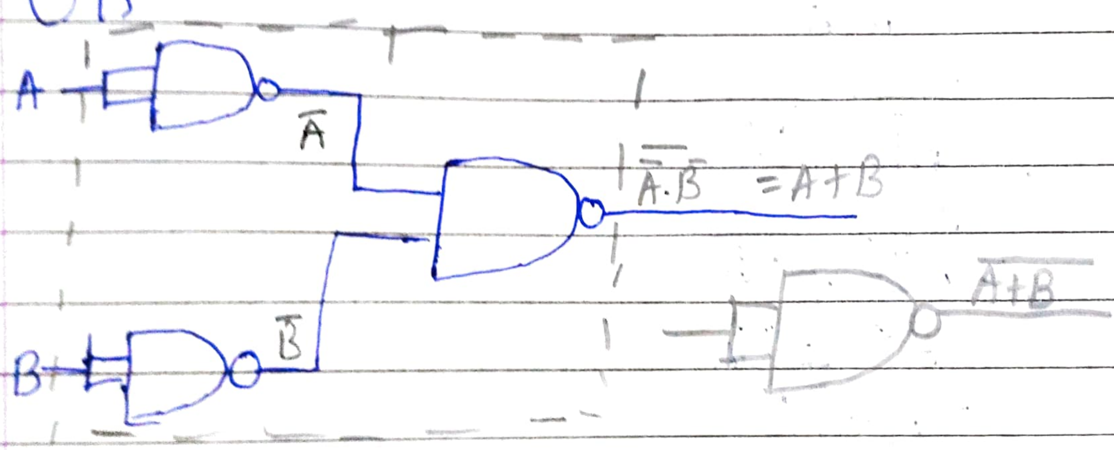
$A + 0 = A$

$A + A = A$

$A + 1 = 1$

$A + \overline{A} = 1$

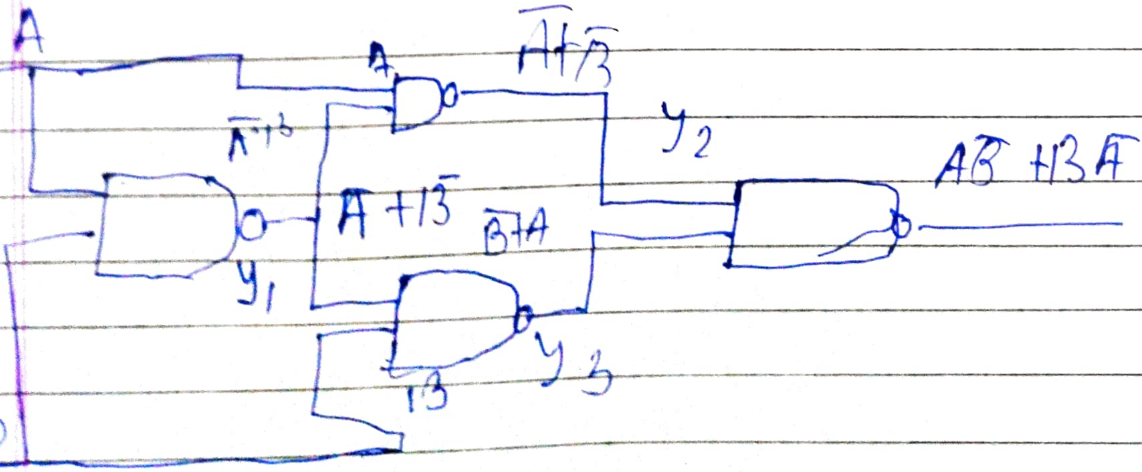
OR



$\overline{A \cdot B} = \overline{A} + \overline{B}$

$\overline{A + B} = \overline{A} \cdot \overline{B}$

$\overline{\overline{A}} = A$



* Why we consider universal gate of NOR & NAND?

⊙ NAND

NOT

$Y = \overline{A \cdot A}$

$Y = \overline{A}$

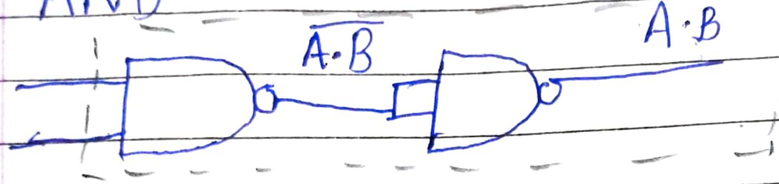
$A \cdot A = A$

$A \cdot 0 = 0$

$A \cdot 1 = A$

$A \cdot \overline{A} = 0$

AND



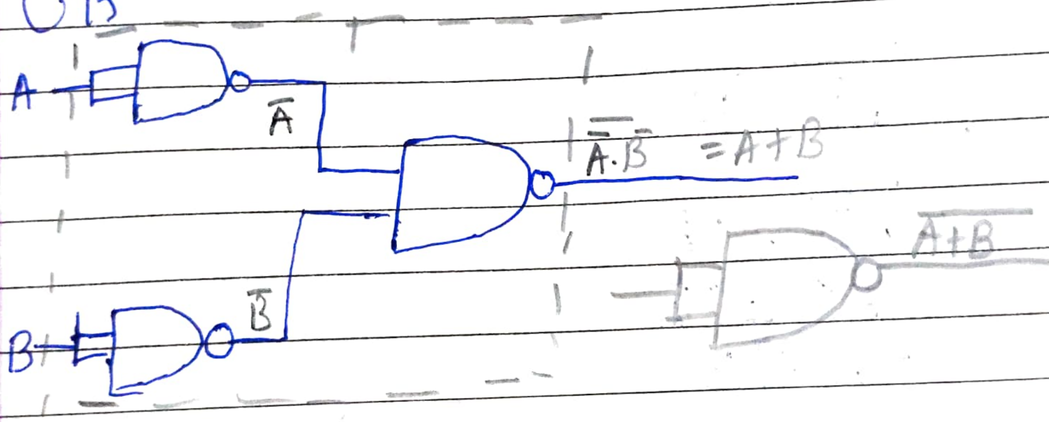
$A + 0 = A$

$A + A = A$

$A + 1 = 1$

$A + \overline{A} = 1$

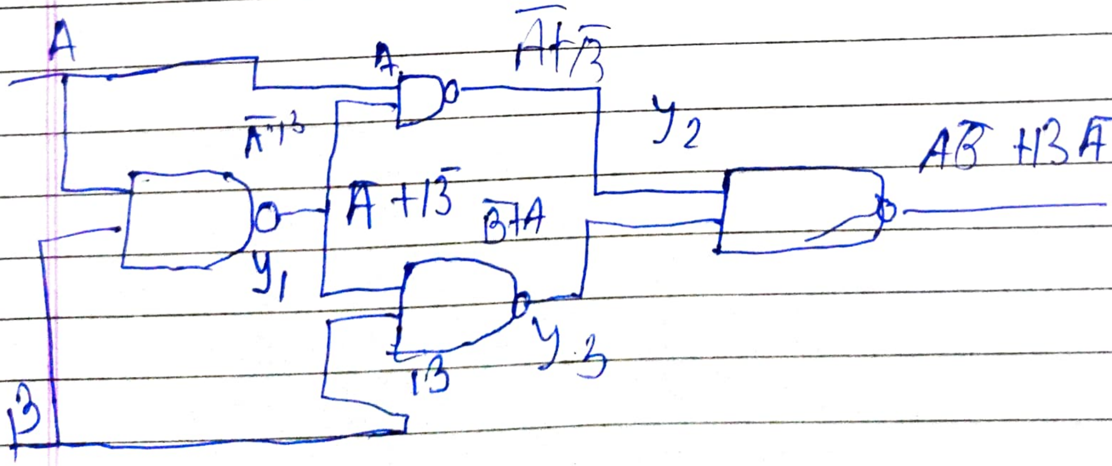
OR



$\overline{A \cdot B} = \overline{A} + \overline{B}$

$\overline{A + B} = \overline{A} \cdot \overline{B}$

$\overline{\overline{A}} = A$



$$Y_1 = \overline{\bar{A} \cdot B} = A + \bar{B}$$

$$Y_2 = \overline{A \cdot (\bar{A} + \bar{B})}$$

$$= \overline{0 + A\bar{B}}$$

$$= \overline{A\bar{B}}$$

$$= \bar{A} + B$$

$$Y_3 = \overline{B \cdot (\bar{A} + \bar{B})}$$

$$= \overline{B\bar{A}}$$

$$= \overline{B\bar{A}}$$

$$Y = \overline{\overline{A\bar{B}} \cdot \overline{B\bar{A}}}$$

$$= \overline{\overline{A\bar{B}}} + \overline{\overline{B\bar{A}}}$$

$$= A\bar{B} + B\bar{A}$$

$$= A \oplus B$$