

Positive & logic System Vs Negative logic System

↳ In +ve logic system higher voltage means "logic 1" and lower voltage means "logic 0".

Difference is 5V

0V → logic 0 +5V → logic 1

+2.5V to +7.5V
↓ ↓
logic 0 logic 1

2) -2.5V to -4.5V
↓ ↓
logic 1 logic 0

↳ In -ve logic system higher voltage means "logic 0" and lower voltage means "logic 1".

For ex 0V → logic 1 +2.5V → logic 1
 +5V → logic 0 +7.5V → logic 0

	High	Low
negative logic	0	1
the logic	1	0

↳ Duality is not Complement, it changes its System (+ve to -ve logic system)

Duality

Dual of a function is denoted as f^d

↳ if there is a fun ($f(a,b,c) = z, a, b, c, \dots, 1, 1, 1$)

$$f(a, b, c) = 2, 1, 0, +1 - \gamma$$

↳ Variable is same but ops changes

$$a+b \rightarrow a \cdot b$$

$$a + 0 = a \rightarrow a \cdot 1 = a \text{ (both are same)}$$

↳ we take dual of an expression to convert

→ If any expression is true, in original form then the duality will also be true.

a	b	a+b
L	L	L
L	H	H
H	L	H
H	H	H

+ve	-ve
L=0	L =1
H=1	H=0

a	b	+ve logic a+b system (a+b)
0	0	0
0	1	1
1	0	1
1	1	1

a	b	-ve logic <u>a.b</u>
1	1	1
1	0	0
0	1	0
0	0	0

+ve logic
a+b -ve logic a.b

(a+b) $\xrightarrow{\text{duality}}$ (a.b)

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a	b	a.b
L	L	L
L	H	L
H	L	L
H	H	H

+ve logic system

a	b	a.b
0	0	0
0	1	0
1	0	0
1	1	1

-ve logic System

a	b	a+b
1	1	1
1	0	1
0	1	1
0	0	0

$(a \cdot b)$ \longrightarrow $(\bar{a} + \bar{b})$
 +ve logic system \qquad -ve logic system

+ve (OR) \longrightarrow -ve (AND)
 +ve (AND) \longrightarrow -ve (OR)

$$a + ab = a \text{ (True)}$$

$$a \cdot (a + b) = a \text{ (True)}$$

$f \neq f^c$ (They can never be same)

$\boxed{f = f^d} \longrightarrow \text{self dual}$

$$\bar{\bar{a}} = a$$

$$a + 1 = 1$$

$$a + \bar{1} = \bar{a}$$

$$a + 0 = a$$

Properties of duality

↳ property of an expression and its duality will be same.

OR $\xleftrightarrow{\text{dual}}$ AND

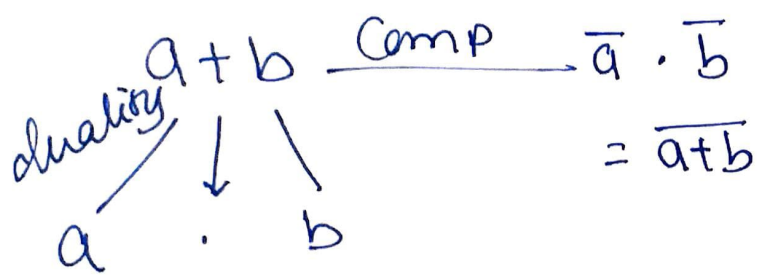
NOR $\xleftrightarrow{\text{dual}}$ NAND

EX-OR $\xleftrightarrow{\text{dual}}$ EX-NOR

OR $\xleftrightarrow{\text{comp}}$ NOR

AND $\xleftrightarrow{\text{comp}}$ NAND

EX-OR $\xleftrightarrow{\text{comp}}$ EX-NOR



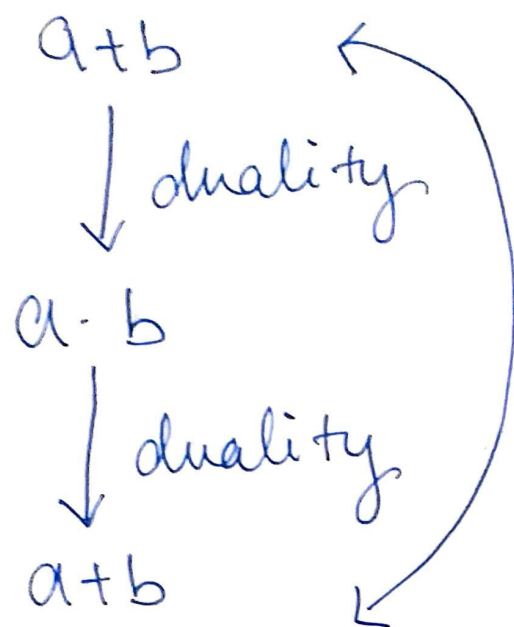
Self dual function

A function is said to be self-dual, if func and its dual both are same

$$f = f^d$$

Ex:- $(f^c)^c \rightarrow (\text{Complement})^{\text{Complement}}$
= Same no.

$$(f^d)^d = f$$



i) $f = f^d$ (self dual)

Ex:

$$f(a, b) = \Sigma(0, 2) = \bar{a}\bar{b} + a\bar{b}$$

$$\bar{a}\bar{b} + a\bar{b}$$

$$\bar{b}[\bar{a} + a]$$

$$= \bar{b}$$

$$\downarrow \text{duality}$$

$$\underline{\bar{b}}$$

$$= (\bar{a} + \bar{b})(a + \bar{b})$$

$$= \bar{a} \cdot \bar{a}^0 + \bar{a}\bar{b} + \bar{b}a + \bar{b} \cdot \bar{b}$$

$$= \bar{a}\bar{b} + a\bar{b} + \bar{b}$$

$$= \bar{b}[\bar{a} + 1 + a]$$

$$= \bar{b}[1 + \bar{a}] = \bar{b}$$

	\bar{a}	a	
\bar{b}	1	1	= \bar{b}
b			

$$f(a, b, c) = a\bar{b} + a\bar{b} + ab$$