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* Self dual, Neutral and orthogonal function L-19

- SSOP to SPOS

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

$f(A,B) = \Sigma m(1,2)$

↓ in SPOS

$f(A,B) = \pi M(0,3)$

- SPOS to SSOP

$f(A,B) = \pi M(0,3)$

↓ in SSOP

$f(A,B) = \Sigma m(1,2)$

$(A+B)\cdot(\bar{A}+\bar{B}) \Rightarrow A\bar{B} + \bar{A}B$

SOP → POS

↑ Minimization by laws

↓

SSOP → SPOS

Q $f(A,B,C) = \bar{A}B + \bar{B}C)$

SSOP → ~~$\Sigma m(2,3,6,7)$~~ $\Sigma m(2,3,1,5)$

✓The Good Point

SSOP → (2, 3, 6, 7) (2, 3, 1, 5)

SPOS → (0, 1, 4, 5) . (0, 4, 6, 7)

$(A+B+C)(\bar{A}+B+C)(\bar{A}+\bar{B}+C) \cdot (\bar{A}+\bar{B}+\bar{C})$

POS → $(B+C) \cdot (\bar{A}+\bar{B})$

* POS → SOP

$f(A, B, C) = (A+\bar{B}) \cdot (B+\bar{C})$

$= \Pi M(2, 3, 1, 5)$

SOP = $\Sigma m(0, 4, 6, 7)$

↓ SSOP

$\bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + AB\bar{C} + ABC$

$\bar{B}\bar{C} + AB$ → SOP

* Functions

→ Neutral
No. of minterm = No. of maxterm

→ not neutral
No equal

A	B	f1	f2	f3	f4	f5	f6
0	0	1	1	1	0	0	0
0	1	1	0	0	1	1	0
1	0	0	1	0	1	0	1
1	1	0	1	1	0	1	1

$4C_2 = 6$

Q If we have 'n' var then total No. of neutral function possible?

$n \longrightarrow 2^n$ => minterms

$\frac{2^n}{2} = 2^{n-1}$ => $2^nC_2\ n-1$

Q XOR on 2 variable is Neutral?

XOR → odd no. of literal true
So, yes it is netural

XOR → 2^{n-1}

Q XNOR on 2 variable is neutral?
yes, Statement is correct

Q XNOR on n variable is neutral?
yes

Q
NOT → Neutral ✓
OR → $2^n - 1$ ✗
AND → 1 ✗
NAND → $2^n - 1$ ✗
NOR → 1 ✗
XOR → 2^{n-1} ✓
XNOR → 2^{n-1} ✓

NOT, XOR, XNOR ⟹ Neutral

* Functions
→ Self dual
function & its dual are same

→ not self dual
not same

• $f(A,B) = \bar{A}B + A\bar{B}$

$\bar{A}B(\bar{A}+B)\cdot(A+\bar{B})$

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

not same / Not self dual

- $f(A,B) = \bar{A}B + AB$

  $\downarrow B$

  $(\bar{A}+B)\cdot(A+B)$

  B

  Same / Self dual

- $f(A,B) = A\bar{B} + AB$

  $\downarrow A$

  $(A+\bar{B})\cdot(A+B)$

  $\downarrow A$

  Same / self dual

* 2 Condition for self dual
  → Neutral
  → no mutually exclusive term

  $A\bar{B}$, $\bar{A}B$ $\quad$ $\bar{A}BC$ $\quad$ $A\bar{B}\bar{C}$

  both are mutal exclusive term because we cannot take "Common"

- 3 variable

(0,7)	$\bar{A}\bar{B}\bar{C}$	ABC
(1,6)	$\bar{A}\bar{B}C$	$AB\bar{C}$
(2,5)	$\bar{A}B\bar{C}$	$A\bar{B}\bar{C}$
(3,4)	$\bar{A}BC$	$A\bar{B}\bar{C}$

mutual exclusive terms

(0,7) → 0 → 7 (6, 1, 2, 3)
(1,6) → 1 → 6 (0, 6, 5, 4)
(2,5) → 2 → 5 (7, 2, 1, 3)
(3,4) → 3 → 4
⋮

$2 \times 2 \times 2 \times 2 = 2^4 = 16$ ⇒ Self dual function on 3 variables

- 2 variable

(0, 3) → 0 → 3
(1, 2) → 1 → 2

$2 \times 2 = 4 = 2^2$

- 4 variables

(0, 15) 2^8
(1, 14)
(2, 13)
(3, 12)
(4, 11)
(5, 10)
(6, 9)
(7, 8)

No. of self dual functions on 'n' variables

minterms ⇒ 2^n
Pairs ⇒ 2^{n-1}

f^n $2^{2^{n-1}}$ Ans

$f(A,B,C) = \bar{A}BC + A\bar{B}C + \bar{A}\bar{B}\bar{C} + ABC$

(0, 7) ✓
(1, 6) ✗
(2, 5) ✓
(3, 4) ✓

not self dual

$f(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}BC + A\bar{B}C + AB\bar{C}$

(0, 7) ✓
(1, 6) ✓
(2, 5) ✓
(3, 4) ✓

Self dual

* function

↳ orthogonal
dual = Compliment

↳ non orthogonal
dual ≠ Compliment

Q XOR fn is orthogonal?

$A \oplus B = A\bar{B} + \bar{A}B \rightarrow (A+\bar{B}) \cdot (\bar{A}+B)$

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

orthogonal

$A\bar{B} + \bar{A}B \quad - \bar{A}\bar{B} + AB$