$A + \bar{A} = 1 \longrightarrow$ Tautology

$A \cdot \bar{A} = 0 \longrightarrow$ Tautology

Expression is ~~tat~~ tautology iff its dual is tautology

## * SOP and POS

L-18

We have two way to represent function SOP and POS.

* Function
- → SOP (Sum of Products)
- → POS (Product of sum)

• SOP (disjunctive normal form)

$f(A,B) = A\bar{B} + \bar{A}B \Big\} \longrightarrow$ PDNF (Principal)

Standard SOP / Canonical SOP

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

$f(A,B,C,D) = AB + CD$

SOP ✓

SSOP X

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- **POS** (Conjunctive normal form)

$[f(A,B) = (A+B)\cdot(\bar{A}+\bar{B})] \rightarrow$ PCNF

SPOS
canonical POS

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

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

* **SSOP** → Standard Sum of Product

| A | B | ← minterms |
|---|---|---|
| 0 | 0 | $\bar{A}\bar{B}$ |
| 0 | 1 | $\bar{A}B$ |
| 1 | 0 | $A\bar{B}$ |
| 1 | 1 | $AB$ |

If each term in function is minterm/boolean term the we call it **SSOP**

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

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

→ $A\bar{B} + \bar{A}B$ → Not **SSOP**

Every var must be present.

## SSOP => SSOP

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

add missing variables

$$A\bar{B}\cdot[C+\bar{C}] + \bar{A}B[C+\bar{C}]$$

$$A\bar{B}C + A\bar{B}\bar{C} + \bar{A}BC + \bar{A}B\bar{C} \quad \text{Ans}$$

- $f(A,B,C) \Rightarrow AB + BC$

$$AB[C+\bar{C}] + (A+\bar{A})BC$$

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

$$ABC + AB\bar{C} + \bar{A}BC \quad \text{Ans}$$

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

$$AB(C+\bar{C})(D+\bar{D}) + (A+\bar{A})(B+\bar{B})\bar{C}D$$

$$\Downarrow$$

$$ABCD + ABC\bar{D} + AB\bar{C}D + AB\bar{C}D$$

$$ABCD + A\bar{B}CD + \bar{A}BCD + \bar{A}\bar{B}CD \quad \text{Ans}$$

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

$$\bar{A}BC + \bar{A}B\bar{C} + ABC + A\bar{B}C \quad \text{Ans}$$

SSOP $\Rightarrow$ New representation

| A | B | | |
|---|---|---|---|
| 0 | 0 | $\bar{A}\bar{B}$ | $\Rightarrow m_0$ |
| 0 | 1 | $\bar{A}B$ | $\Rightarrow m_1$ |
| 1 | 0 | $A\bar{B}$ | $\Rightarrow m_2$ |
| 1 | 1 | $AB$ | $\Rightarrow m_3$ |

$f(A,B) = m_0 + m_2$

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

$\Downarrow$

$f(A,B) = \cancel{\Sigma m(0,3)}$ $\Sigma m(3,0)$

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

$\Downarrow$

$f(A,B,C) = \Sigma m(5, 2, 3, 7)$

$f(A,B) = AB + BC$

$\Downarrow$

$f(A,B)$ $\Sigma m(7, 6, 3)$

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

$\Sigma m(7, 3, 6, 4)$

## * Product of sum

POS $\longrightarrow$ SPOS

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

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

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

$= \pi M(0, 1, 6, 7)$

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

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

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

$\pi M(4, 7, 3)$

| A | B | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | $\bar{A}\bar{B}$ | $m_0$ | $\overline{\bar{A}\bar{B}}$ | $\Rightarrow$ | $AB$ | $M_0$ |
| 0 | 1 | $\bar{A}B$ | $m_1$ | $\overline{\bar{A}B}$ | $\Rightarrow$ | $A\bar{B}$ | $M_1$ |
| 1 | 0 | $A\bar{B}$ | $m_2$ | $\overline{A\bar{B}}$ | $\Rightarrow$ | $\bar{A}B$ | $M_2$ |
| 1 | 1 | $AB$ | $m_3$ | $\overline{AB}$ | $\Rightarrow$ | $\bar{A}\bar{B}$ | $M_3$ |

$\downarrow$ minterms $\qquad\qquad$ $\downarrow$ maxterm

Standard pos → every term must be maxterm.

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

$\Rightarrow \cancel{\pi(\pi M(4,5,2,3)}$

$\Rightarrow \pi M(4,5,1)$ Ans

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

$\pi M(8,11,12,13,1,3,9)$

| A | B | f (A, B) |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

Minterm $\boxed{ON}$ SOP

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

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

$\Downarrow$

Maxterm ~~oo~~ $\boxed{OFF}$ POS