SUM-OF-PRODUCTS FORM

LOGIC MINIMIZATION

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TOPIC OUTLINE

Sum-of-Products (SOP) Form

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When two or more **product terms** are summed by Boolean addition, the resulting expression is a **sum-of-products** (**SOP**).

example

$f = AB + ABC$

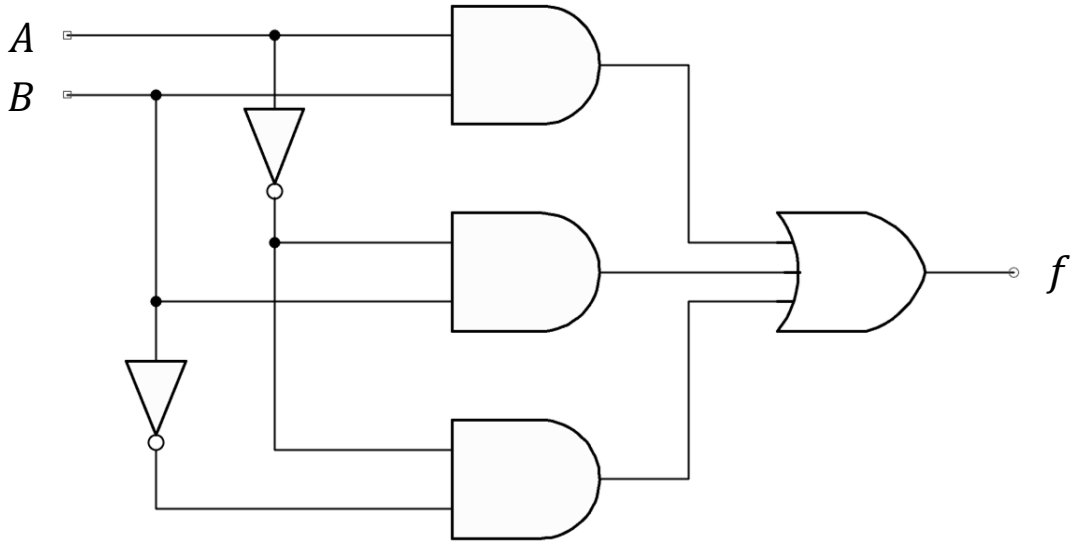
$f = A + \bar{A}\bar{B}C + BC\bar{D}$

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

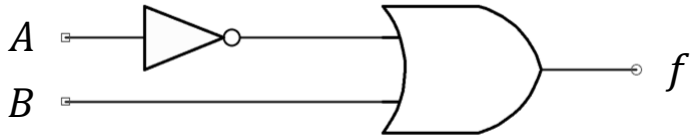
note

SOP expression can have the term $\bar{A}\bar{B}\bar{C}$ but not $\overline{ABC}$.

Canonical sum-of-products



Minimal-cost realization



EXERCISE

Convert the given Boolean expression to SOP form.

$f = AB + B(CD + EF)$

Solution

EXERCISE

Convert the given Boolean expression to SOP form.

$f = \overline{(\overline{A + B}) + C}$

Solution

STANDARD SOP FORM

A **standard SOP** form ensures that each product term is a **minterm**.

Minterm is a **product term** that evaluates to **1** for exactly one unique combination of input values.

Minterms for the three-variable table

Decimal	A	B	C	Minterm
0	0	0	0	$m_0 = \bar{A}\bar{B}\bar{C}$
1	0	0	1	$m_1 = \bar{A}\bar{B}C$
2	0	1	0	$m_2 = \bar{A}B\bar{C}$
3	0	1	1	$m_3 = \bar{A}BC$
4	1	0	0	$m_4 = A\bar{B}\bar{C}$
5	1	0	1	$m_5 = A\bar{B}C$
6	1	1	0	$m_6 = AB\bar{C}$
7	1	1	1	$m_7 = ABC$

EXERCISE

Convert the given Boolean expression to standard SOP form.

$$f = \overline{(\overline{A + B}) + C}$$

and then represent the result using a truth table format.

Solution

note

A nonstandard SOP expression is converted into standard form using Boolean algebra rule:

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

EXERCISE

Convert the given Boolean expression into standard SOP form.

$$f = ABC + AB(C + D)$$

and then represent the result using a truth table format.

Solution

EXERCISE

Convert the given Boolean expression into standard SOP form.

$$f = AB + B(C + D)$$

and then represent the result using a truth table format.

Solution

LABORATORY