Simplification of Logic Functions Using SOP, POS

Lecture 4

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Introduction to Logic Simplification

Logic simplification is the process of reducing a complex logical expression to its simplest form without changing its output. The goals of simplification are:

- Reduce the number of gates and logic used in circuits.
- Save cost and power.
- Make the design easier to understand and maintain

SOP

SOP (sum of product)

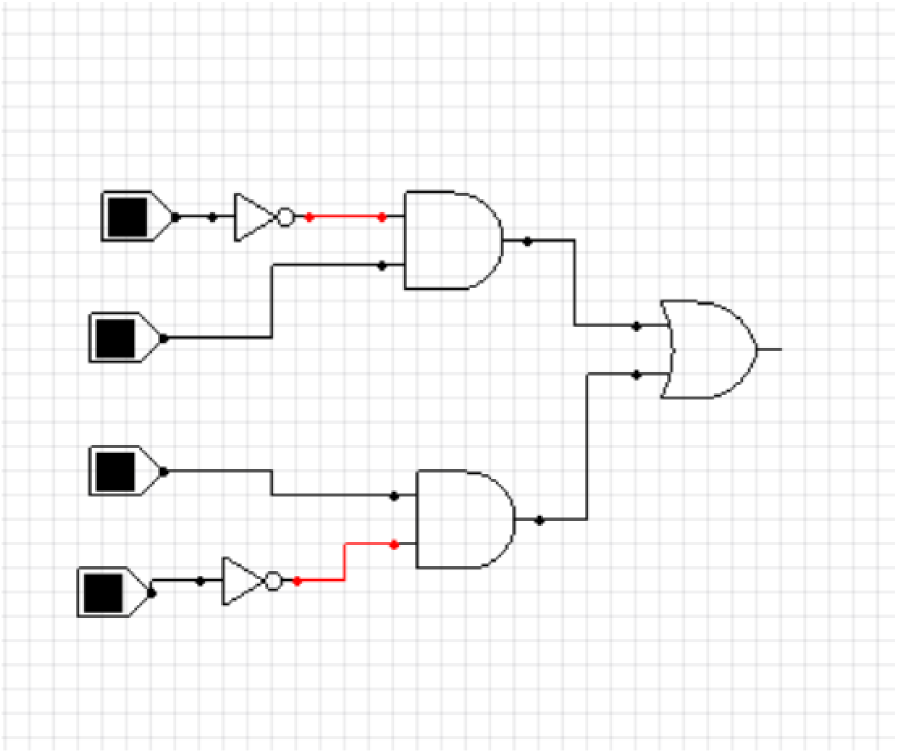
- Each term is a **product (AND) of variables or their complements**.
- Then all terms are summed together using OR.
- SOP is widely used because it is easy to convert into a logic circuit using **AND and OR gates**.

$Y = A'B + AB'$

- Each term like $A'B$ is a product.
- All terms are summed using + (OR)

SOP

$Y=A'B+AB'$



POS

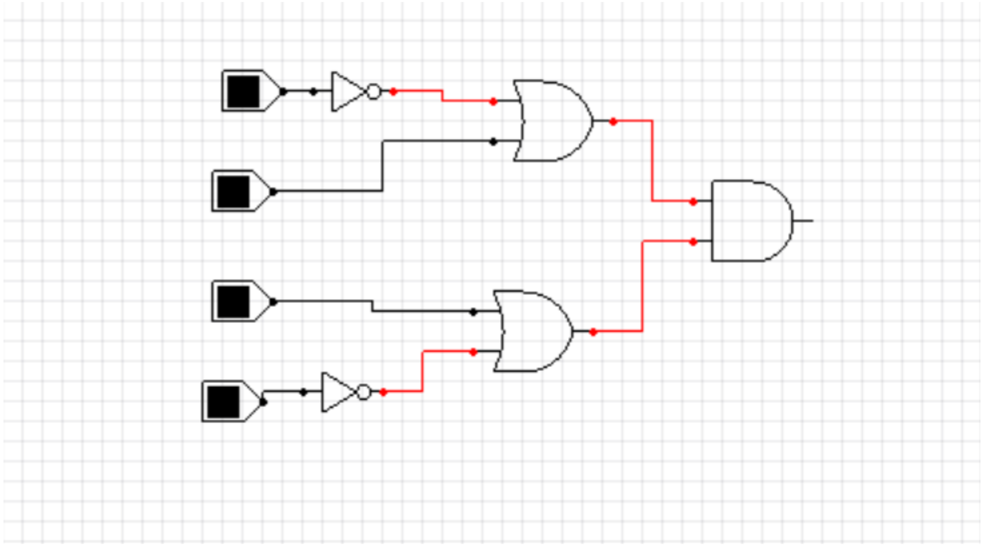
POS (product of sum)

- Each term is a **sum (OR) of variables or their complements**.
- Then all terms are multiplied together using AND.
- POS is sometimes used for designing circuits easily using **OR and AND gates**

- $Y = (A + B')(\mathrm{A} + B`)$
- Each term like $(A + B')$is a sum.
- All terms are multiplied together (AND).

POS

Y=(A`+B).(A+B`)



Canonical SOP

$F_{(A,B)} = \Sigma\ (1,3)$

Canonical SOP is the **sum of all minterms that give output 1**.

Each minterm is the **AND of all variables, complemented or not**.

Called canonical because it represents the function exactly, without simplificationIf

the function Y = (A, B) is equal to:

(A, B) = (0, 1), (1, 0)

The standard SOP formula is:

Y = A`B+AB`

Canonical POS

$F_{(A,B)} = \Pi\ (0,2)$

Canonical POS is the **product of all maxterms that give output 0**.

Each maxterm is the **OR of all variables, complemented or not, depending on value**.

Called canonical because it represents the function exactly before any simplification

the function Y = (A, B) is equal to:

(A, B) = (1, 1), (1, 0)

The standard POS formula is:

Y = (A`+B.(A`+B)

Example

From this table find:

1. SOP
2. POS
3. Canonical SOP
4. Canonical POS

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Example

To find SOP :

We look at the number of one in the result, write the number of variables, and then add negation to the input whose value is zero.

F = A\`B\`C+A\`BC+AB\`C\`+ABC\`

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Example

To find POS :

We look at the zero in the result, write down the number of variables, and then add the negative to the input whose value is one.

F =(A+B+C).(A+B`+C).(A`+B+C`).(A`+B`+C`)

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Example

Canonical SOP:

0 0 1   0 1 1   1 0 0   1 1 0

1   3   4   6

$F_{(A,B,C)} = \Sigma(1,3,4,6)$

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Example

Canonical POS

0 0 0   0 1 0   1 01   1 1 1

0   2   5   7

$F_{(A,B,C)} = \Pi(0,2,5,7)$

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0