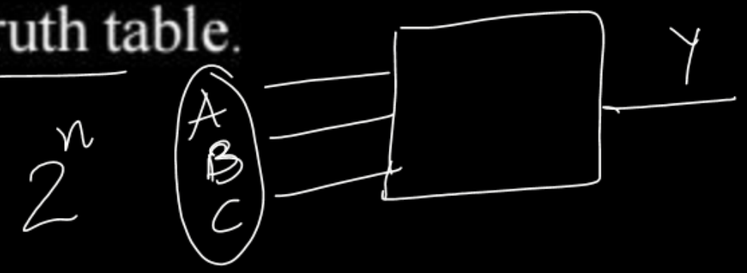
UNIT 1 : LOGIC SIMPLIFICATION AND COMBINATIONAL LOGIC DESIGN

Today's Target

- Truth Table Formation
- Canonical and Standard Forms
- Truth table representing minterm and maxterm
- Express the Boolean function as standard sum of minterms.
- Express the Boolean function as standard sum of maxterms.
- DPP

Truth Table Formation

- A truth table represents a table having all combinations of inputs and their corresponding result.
- It is possible to convert the switching equation into a truth table.
- For example, F(A,B,C) = A + BC
- The output will be high (1) if A = 1 or BC = 1 or both are 1
- The number of rows in the truth table is 2^n where n is the number of input variables
- Here there are $2^3 = 8$ possible input combination of inputs.



GW
GATEWAY CLASSES

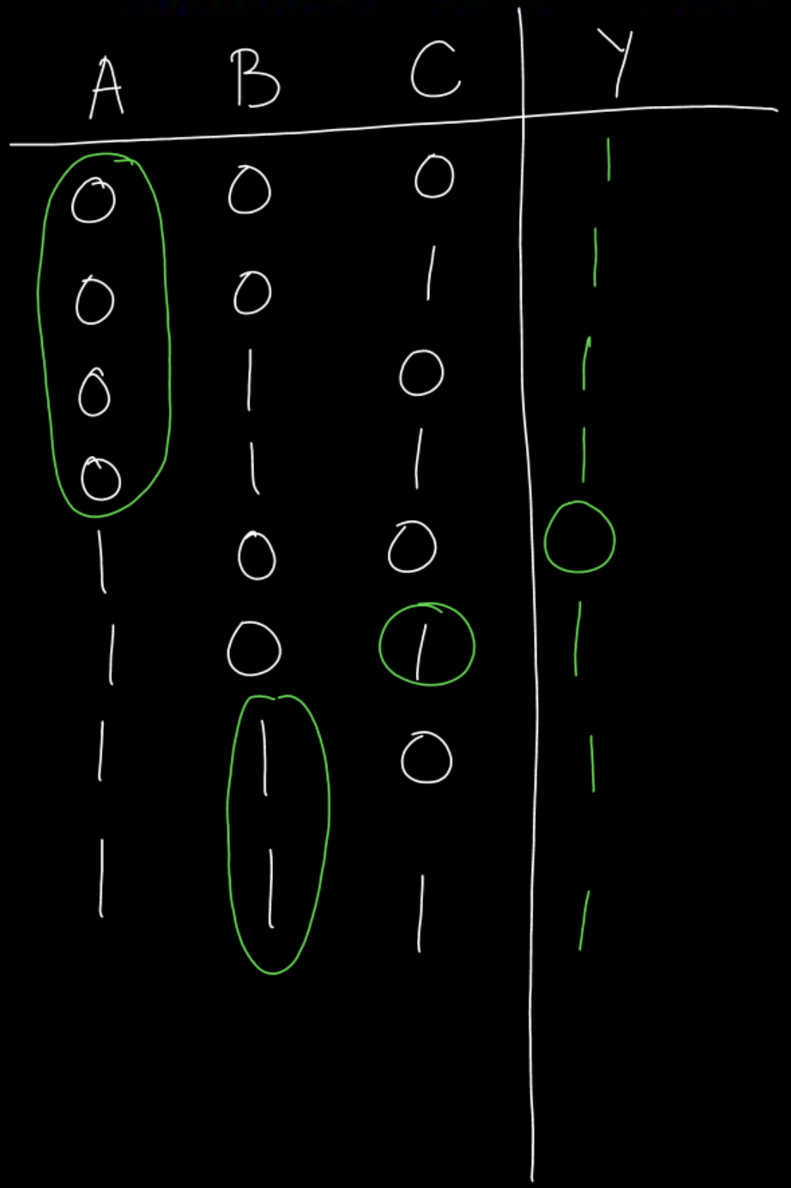
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(A+BC) INPUTS			OUTPUT
A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Maxterms

Minterms

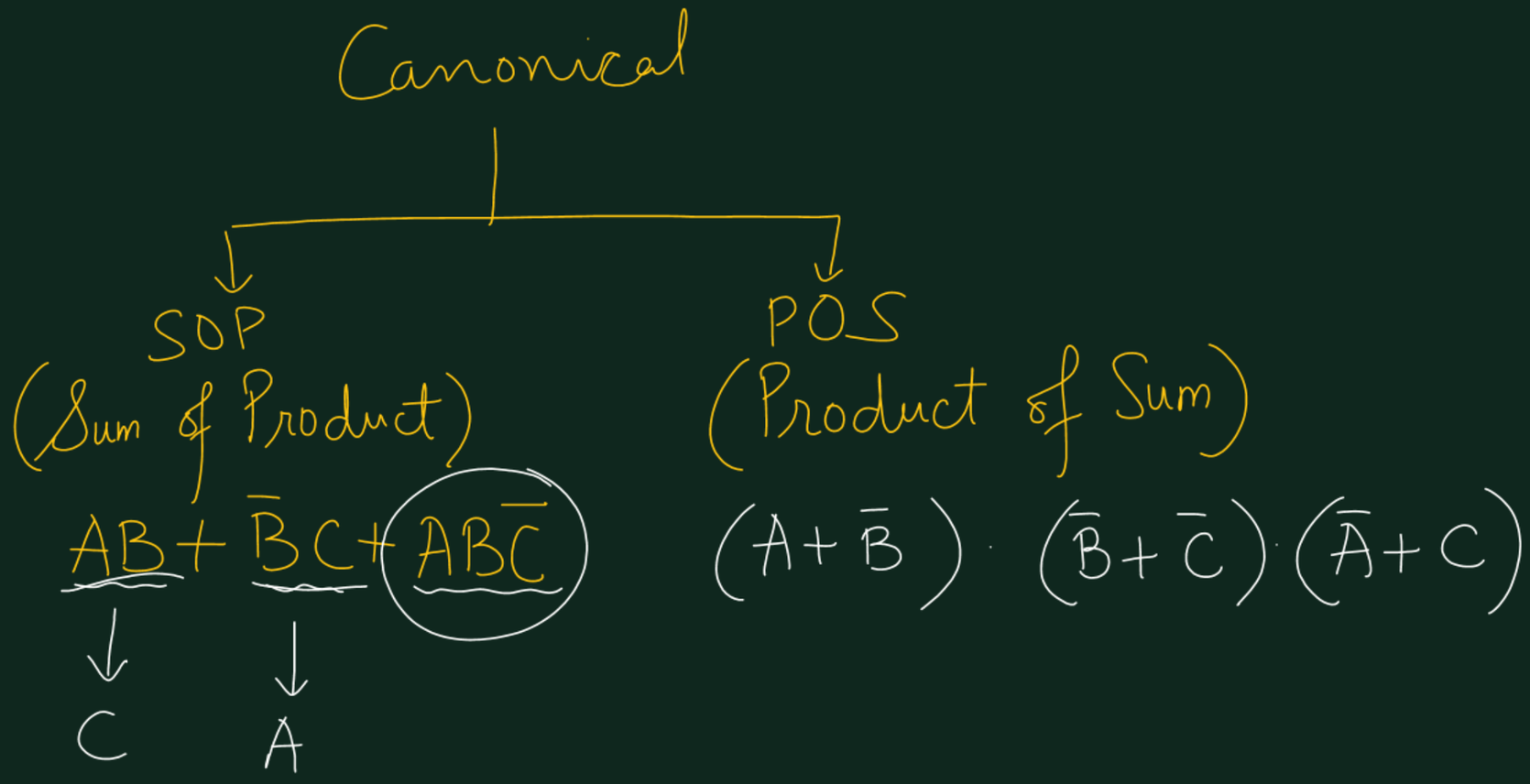
Generate Truth Table for : Y = (A' + B) + C



A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

CANONICAL AND STANDARD FORMS

- **Canonical Form –**
- In Boolean algebra,Boolean function can be expressed as Canonical Disjunctive Normal Form known as **minterm**
- Some are expressed as Canonical Conjunctive Normal Form known as **maxterm** .
- In Minterm, we look for the functions where the output results in "1" & perform **Sum of minterm** = **SOP**
- In Maxterm we look for function where the output results in "0" & perform **Product of Maxterm** = **POS**
- Boolean functions expressed as a sum of minterms or product of maxterms are said to be in canonical form.


Canonical
SOP
(Sum of Product)
POS
(Product of Sum)
AB + B̄C + ABC̄
(A + B̄) · (B̄ + C̄) · (Ā + C)
C
A

Standard Form

- In standard form Boolean function will contain all the variables in either true form or complemented form while in canonical number of variables depends on the output of SOP or POS.

- AB +BC = Canonical SOP
- ABC' + ABC + A'BC = Standard SOP
- (A+B) (B+C) = Canonical POS
- (A+B+C')(A+B+C)(A'+B+C) = Standard POS

Truth table representing minterm and maxterm

X	Y	Z	Minterms	Maxterms
0	0	0	$m_0 = \bar{x}\bar{y}\bar{z}$	$M_0 = (x + y + z)$
0	0	1	$m_1 = \bar{x}\bar{y}z$	$M_1 = (x + y + \bar{z})$
0	1	0	$m_2 = \bar{x}y\bar{z}$	$M_2 = (x + \bar{y} + z)$
0	1	1	$m_3 = \bar{x}yz$	$M_3 = (x + \bar{y} + \bar{z})$
1	0	0	$m_4 = x\bar{y}\bar{z}$	$M_4 = (\bar{x} + y + z)$
1	0	1	$m_5 = x\bar{y}z$	$M_5 = (\bar{x} + y + \bar{z})$
1	1	0	$m_6 = xy\bar{z}$	$M_6 = (\bar{x} + \bar{y} + z)$
1	1	1	$m_7 = xyz$	$M_7 = (\bar{x} + \bar{y} + \bar{z})$

Example – Express the Boolean function $F = A + B'C$ as standard sum of minterms.

$$F = A + \bar{B}C$$

$$= A \cdot 1 \cdot 1 + 1 \cdot \bar{B}C$$

$B + \bar{B}$

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

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

$A + A = A$

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

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

$$= \Sigma m(7, 6, 5, 4, 1)$$

Express the Boolean function F = xy + x'z as a product of maxterms

$F = xy + \bar{x}z$

$= (xy + \bar{x})(xy + z)$

$= (x + \bar{x})(y + \bar{x})(x + z)(y + z)$

$= (\bar{x} + y)(x + z)(y + z)$

$= (\bar{x} + y + 0)(x + 0 + z)(0 + y + z)$

$= (\bar{x} + y + z\bar{z})(x + y\bar{y} + z)(x\bar{x} + y + z)$

$= (\bar{x} + y + z)(\bar{x} + y + \bar{z})(x + y + z)(x + \bar{y} + z)(x + y + z)(\bar{x} + y + z)$

$= (\bar{x} + y + z)(\bar{x} + y + \bar{z})(x + y + z)(x + \bar{y} + z)$

$= \Pi M(4, 5, 0, 2)$

$A + BC = (A + B)(A + C)$

$A \cdot A = A$

Example –Convert F(A, B, C) = ∑m(1,4,5,6,7) to POS FORM

$$F(A,B,C) = \sum m(1,4,5,6,7)$$

$$= \pi M(0,2,3)$$

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

0 0 1

1 0 0

1 0 1

1 1 0

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

DPP

a) Generate truth table for F= xy + x'z

b) Generate truth table for Y= (a+c') (b+c)

b) Convert Boolean expression in standard form F=y'+xz'+xyz

c) Express the Boolean function F = (A+B')(B+C) as a product of maxterms

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Thank You

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