SOP & POS

• Sum-of-Products (SOP) Expression: a product term or a logical sum (OR) of several product terms.

Examples: x, x+yz', xy'+x'yz, AB+A'B'

• Product-of-Sums (POS) Expression: a sum term or a logical product (AND) of several sum terms.

Examples: x, x(y+z'), (x+y')(x'+y+z), (A+B)(A'+B')

• Every boolean expression can either be expressed as sum-of-products or product-of-sums expression.

Examples:

SOP: x'y + xy' + xyz

POS: (x + y')(x' + y)(x' + z')

MIN & MAX TERM

- Minterms are sum terms.
- For Boolean functions, the minterms of a function are the terms for which the result is 1.
- Boolean functions can be expressed as sum of-Minterms
- Maxterms are Product terms.
- For Boolean functions, the maxterms of a function are the terms for which the result is 0.
- Boolean functions can be expressed as Products-of-Maxterms.

	Α	В	C	F
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0

Min Terms: 0,1,4,5 [000,001,100,101]

 $F = \sum (0,1,4,5)$

Max Terms: 2,3,6,7 [010,011,110,111]

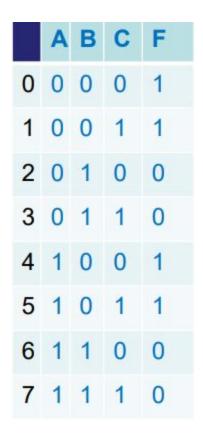
 $F = \Box(2,3,6,7)$

MIN-SOP and MAX-POS

	Minterms			Maxterms	
X	y	term	notation	term	notation
0	0	x'y'	m0	x+y	M0
0	1	x'y	m1	x+y'	M1
1	0	xy'	m2	x'+y	M2
1	1	xy	m3	x'+y'	M3

Each minterm is the complement of the corresponding maxterm:

Example: m2 = xy' m2' = (xy')' = x' + (y')' = x'+y = M2



Min Terms: 0,1,4,5 [000,001,100,101] $F=\sum(0,1,4,5)$ F=A'B'C'+A'B'C+AB'C'+AB'C(A'+B'+C') Max Terms : 2,3,6,7 [010,011,110,111] $F=\Box(2,3,6,7)$ F=(A+B'+C)(A+B'+C')(A'+B'+C)

Conversion between MIN & MAX

 $F2 = \sum (m1, m4, m5, m6, m7)$

X	y	Z	F2	F2'
0	0	0	0	1
0	0	1	1	0
0	1	0	0	1
0	1	1	0	1
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

The complement function of F2 is:

$$F2' = \sum (m0, m2, m3) = m0 + m2 + m3$$

F2 =
$$(m0 + m2 + m3)'$$

= $m0' \cdot m2' \cdot m3'$
= $M0 \cdot M2 \cdot M3$
= $\square(M0,M2,M3)$

Every Boolean function can be expressed as either Sum-of-Minterms or Product-of-Maxterms.

Simplified Function to SOP & POS

How to Convert into SOP:

Check if each term contains all variable, if not then AND (x+x') if x is the missing term

Simplified Function, F=A+B'C

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F=A+B'C

=A(B+B')(C+C')+B'C(A+A')

=(AB+AB')(C+C')+B'C(A+A')

=AB(C+C')+AB'(C+C')+B'C(A+A')

=ABC+ABC'+AB'C+AB'C'+AB'C+A'B'C

=ABC+ABC'+AB'C+AB'C'+A'B'C

=\sum(1,4,5,6,7)
```

How to Convert into POS:

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1. Often distributive law (x+yz)=(x+y)(x+z)) is used
2. If then terms, like x, are missing, OR xx'
3. Each POS is missing a term so OR missing terms
Again applying distributive law
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Simplified Function, F=A+B'C

F=A+B'C

= (A+B')(A+C)

=(A+B'+CC')(A+BB'+C)

=\{(A+B')+C\}\{(A+B')+C'\}\{(A+C)+B\}\{(A+C)+B'\}

=(A+B'+C)(A+B'+C')(A+B+C)(A+B'+C)

=(A+B'+C)(A+B'+C')(A+B+C)

=(2,3,0)

=(0,2,3)
```