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Karnaught Maps (K-Maps)

$Y = A + BC$ three variables

max combos $\rightarrow 2^m = 2^3 = 8$

Possible combos $A = 1$ $A' = 0$

0	0	0	$A'B'C'$
0	0	1	$A'B'C$
0	1	0	$A'BC'$
0	1	1	$A'BC$
1	0	0	$AB'C'$
1	0	1	$AB'C$
1	1	0	ABC'
1	1	1	ABC

$\Rightarrow Y = \overset{\times}{A'B'C'} + \overset{\times}{A'B'C} + \overset{\times}{A'BC'} + A'\underline{BC} +$
$\underline{A}B'C' + \underline{A}B'C + \underline{A}BC' + \underline{A}\underline{BC}$

Thus final terms,

$$\underbrace{AB'C' + AB'C + ABC' + ABC}_{A} + \underbrace{A'BC}_{BC}$$

$A + BC$

Marking 1 for being present in the equation

	00 $B'C'$	01 $B'C$	11 BC	10 BC'
0 A'	$_{0}$	$_{1}$	1_{3}	$_{2}$
1 A	1_{4}	1_{5}	1_{7}	1_{6}

Only 1 bit change

For Eg.

$ABC' \Rightarrow 110$

$2^2\ 2^1\ 0$

Adding $\longrightarrow 4 + 2 = 6$

Bottom right represent binary.

8 - 4 - 2 - 1 - Code for binary

2^3 2^2 2^1 2^0

For min terms, Denotion (1 in kMap)

$Y = \sum_m (3, 4, 5, 6, 7)$

min terms

$\Rightarrow AB'C' + AB'C + ABC' + ABC + A'BC$

For Max terms, Denotion (0 in KMap)

$Y = \prod_M (3, 4, 5, 6, 7)$

max terms (capital)

Terminology reversed in Min and Max

$\sum_m \Rightarrow$ SOP

$\prod_M \Rightarrow$ POS

K-Map is used to Simplify the expression
$\therefore$ Reduces the expression

Simplifying via K-Map

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	B'C'	B'C	BC	BC'
A'	(0)	1 (1)	1 (3)	(2)
A	1 (4)	1 (5)	1 (7)	1 (6)

1) Pairing
→ 2 at a time
→ eliminates 1 variable

Eg.
$ABC + ABC' = AB$
(C eliminated)

Similarly
3) Octet
→ 8 at a time
→ eliminates 3 variables

2) Quad
→ 4 at a time
→ eliminates 2 variables

Eg.
$A'B'C + A'BC + AB'C + ABC$
$\Rightarrow C$ (AB elimited)

$\Rightarrow$ $\boxed{\text{Octant > Quad > Pair > Single Term}}$

- If all boxes are filled
  All min terms are present $\Rightarrow Y = 1$
- If none boxes are filled
  None min terms are present $\Rightarrow Y = 0$

Prime Implicant Essential (PI)

Implicants aren't subsets of any implicant

1	1	1	1
	1	1	

→ Essential Prime impelecant

NOT a Prime implicant

Prime implicant Essential

should have atleast one element which has not be covered yet.

Q) $F = \sum_m (0,1,3,5,7)$ ~~[POS]~~ [SOP]

	B'C'	B'C	BC	BC'
A'	1 (0)	1 (1)	1 (3)	(2)
A	(4)	1 (5)	1 (7)	(6)

1 Quad of 1, 3, 5, 7
1 Pair of 0, 1

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

$A'B'C' + A'B'C = A'B'$

∴ Simplified $\boxed{F = A'B' + C}$

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Q) $F = \prod_{M}(0,1,3,6,7)$ [POS]

	$B'C'$	$B'C$	BC	BC'
A'	0_{0}	0_{1}	0_{3}	$_{2}$
A	$_{4}$	$_{5}$	0_{7}	0_{6}

3 Pairs

Thus Simplified

$\Rightarrow (A'+B')(B+C)(A+B)$

Since its POS,

$0,1 \Rightarrow (A'+B'+C')(A'B+B'+C) \Rightarrow (A'+B')$

$3,7 \Rightarrow (A'+B+C)(A+B+C) \Rightarrow (B+C)$

$7,6 \Rightarrow (A+B+C)(A+B+C') \Rightarrow (A+B)$