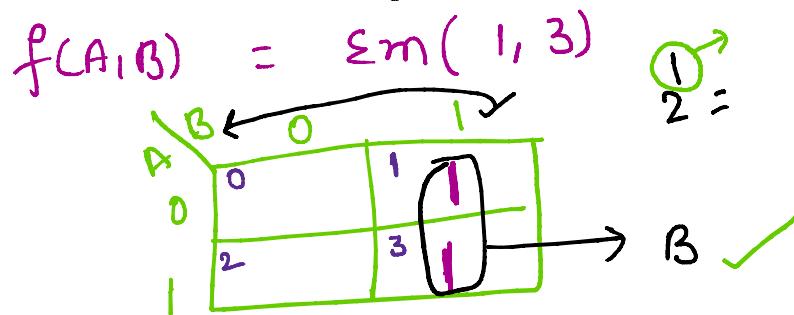


TWO Variable K-map

	B	0	1
A	0	$\bar{A}\bar{B}$	$\bar{A}B$
0	2	$A\bar{B}$	AB
1	3		

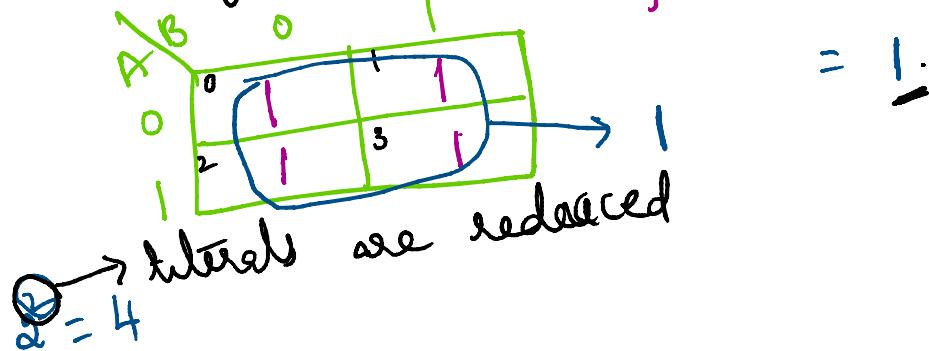
4 cells

- ① Grouping of two adjacent cells represent a term of single literal



- ② Grouping of four adjacent cells containing 1's → gives = 1

$$f(A, B) = \sum m(0, 1, 2, 3) = 1$$



3-Variable K-map

$$f(A, B, C)$$



2^3 possible combinations

A	B	C	
0	0	0	0
0	0	1	1
0	1	+	+

BC

A	B	C	m_0	m_1	m_2	m_3	m_4	m_5	m_6	m_7	m_8	m_9
0	0	0	0000	0011	0110	0101	1000	1011	1100	1111	1001	1010
0	1	0	ABC									
1	0	0	ABC									

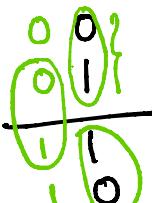
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0

Sequence X

BC
00
01
10
11

A	B	C	00	01	11	10
0	0	0	0	1	3	2
1	0	1	4	5	7	6

Gray Code



unit distance
code

① Each cell Contains 3 literals

A	B	C	00	01	
0	0	0	0	1	
0	1	0	2	3	
1	0	0	6	7	
1	1	0	4	5	

$$f(A, B, C) = \Sigma m(1, 2, 5, 6)$$

A	B	C	00	01	11	10
0	0	0	0	1	3	2
1	0	1	4	5	7	6

Variable reduced
① \Rightarrow 2 minterms

Grouping of '2' adjacent cells
Containing 1's represents
a term of two literals

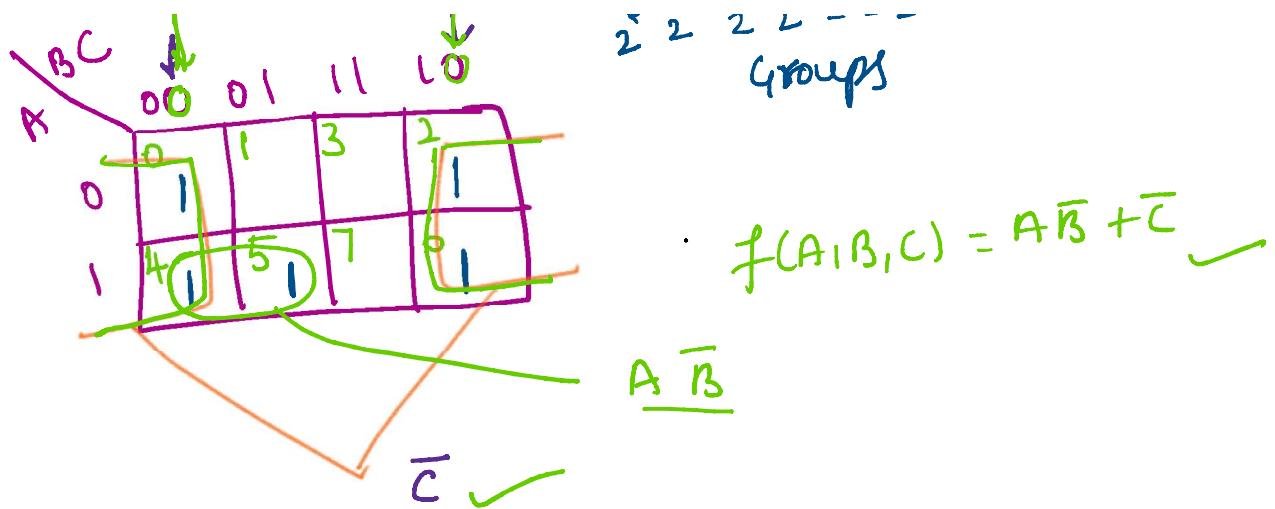
$$f(A, B, C) = \overline{B} \overline{C} + \overline{B} C$$

② Reduce the given function using K-map

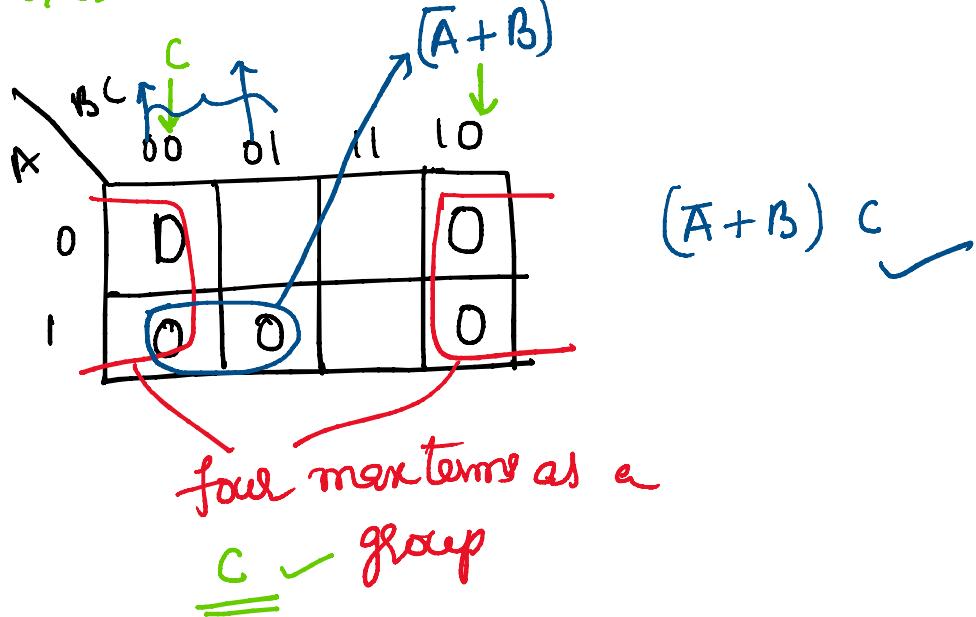
$$f(A, B, C) = \Sigma m(0, 2, 4, 5, 6)$$

A	B	C	00	01	11	10
0	0	0	0	1	1	1

$2^2 2^1 2^2 2^1$
Groups



$$\textcircled{2} \quad f(A, B, C) = \pi m(0, 2, 4, 5, 6)$$



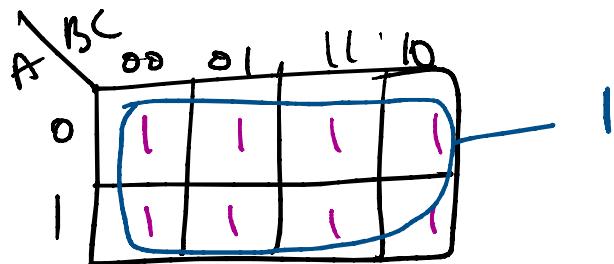
Grouping of four adjacent cells
containing 1's (0's in standard POS)

represent a term of one literal ✓

2 → will be reduced
2 = 4 minterms

$$\cdot L(A, B, C) = \sum m(0, 1, 2, 3, 4, 5, 6, 7)$$

$$f(A, B, C) = \Sigma m(0, 1, 2, 3, 4, 5, 6, 7)$$



Grouping '8' adjacent cells

Containing 1's represent the function = 1

$$f(A, B, C) = \Pi M(0, 1, 2, 3, 4, 5, 6, 7)$$

$$\underline{f(A, B, C)} = 0$$

Grouping of '8' adjacent cells

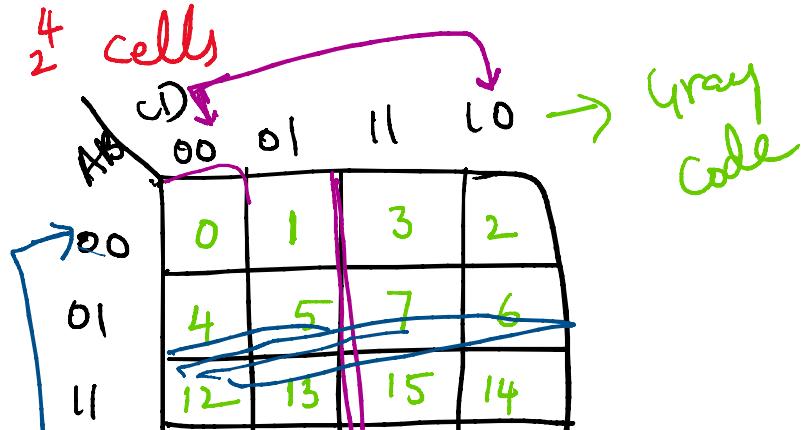
Containing 0's represents function = 0

$\begin{cases} 0 \\ 1 \end{cases}$ = minterm
with be reduced

= maxterm

4-Variable K-map \rightarrow 4 cells

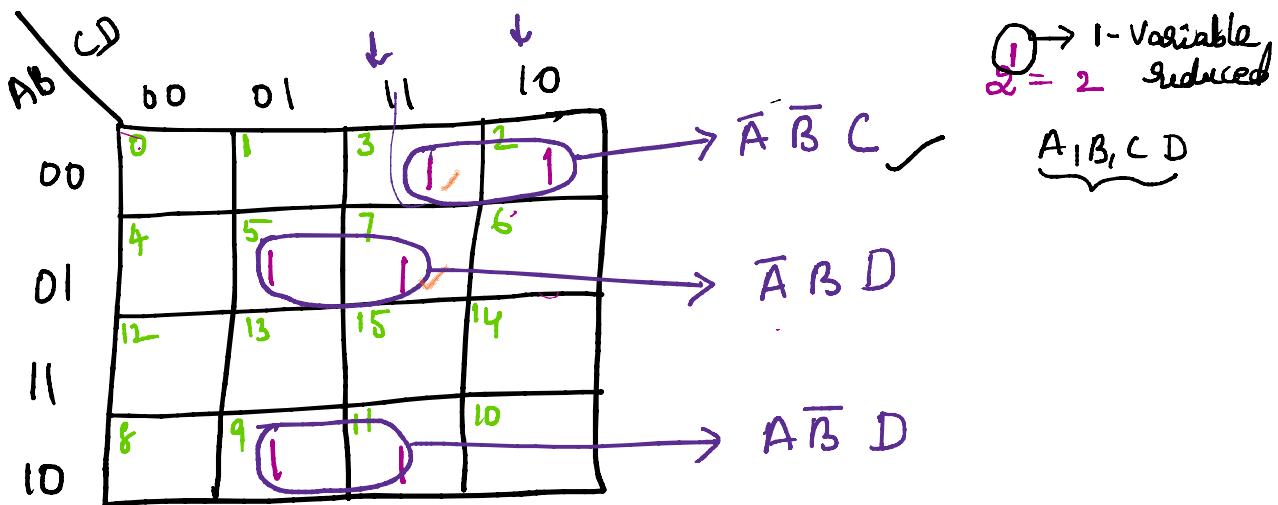
	CD	00	01	11	10
AB	0	1	3	2	6
BD	$\overline{AB}\overline{CD}$	$\overline{0001}$	0011	0010	
AD	0100	0101	0111	0110	
	12	13	15	14	



00	01000	0101	0111	...
11	12	13	15	14
10	1100	1101	1111	1110
01	8	9	11	10
00	1000	1001	1011	1010

↓ Gray Code

$$f(A, B, C, D) = \Sigma m(2, 3, 5, 7, 9, 11)$$



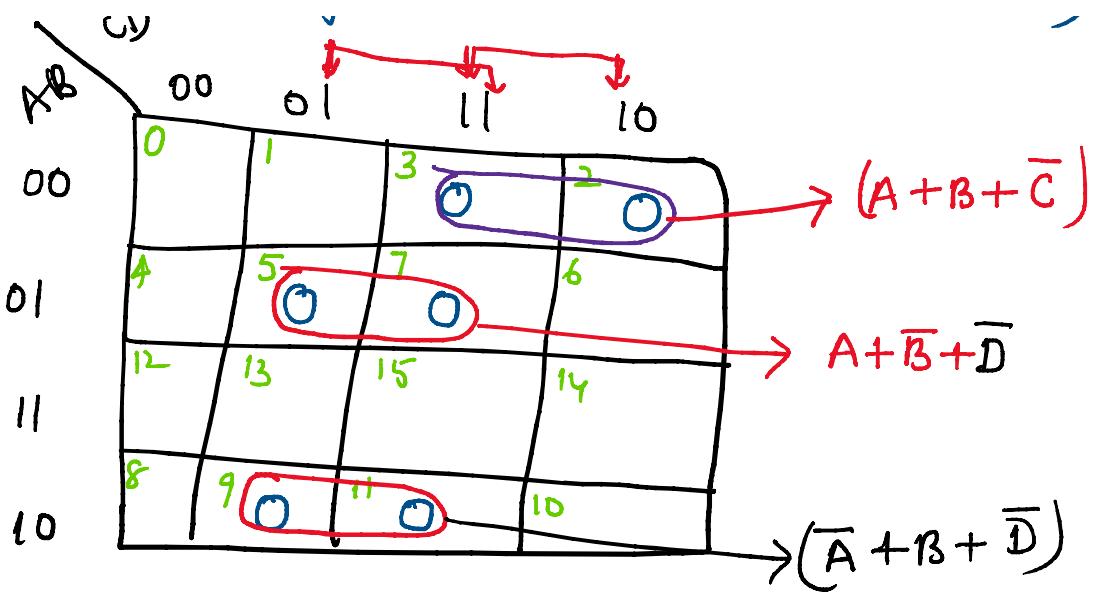
$$f(A, B, C, D) = \bar{A} \bar{B} C + \bar{A} B D + A \bar{B} D$$

$$f(A, B, C, D) = \Pi m(2, 3, 5, 7, 9, 11)$$

00	0000	0001	0011	10010
00	$A+B+C+D$	$A+B+C+\bar{D}$	$A+B+\bar{C}+\bar{D}$	$A+B+\bar{C}+D$
01	10100	50101	70111	60110
01	$A+\bar{B}+C+\bar{D}$	$A+\bar{B}+C+D$	$A+\bar{B}+\bar{C}+\bar{D}$	$A+\bar{B}+\bar{C}+D$
11	1100	1101	1111	11110
11	$\bar{A}+\bar{B}+C+\bar{D}$	$\bar{A}+\bar{B}+C+D$	$\bar{A}+\bar{B}+\bar{C}+\bar{D}$	$\bar{A}+\bar{B}+\bar{C}+D$
10	81000	91001	11011	101010
10	$\bar{A}+\bar{B}+C+\bar{D}$	$\bar{A}+\bar{B}+C+D$	$\bar{A}+\bar{B}+\bar{C}+\bar{D}$	$\bar{A}+\bar{B}+\bar{C}+D$

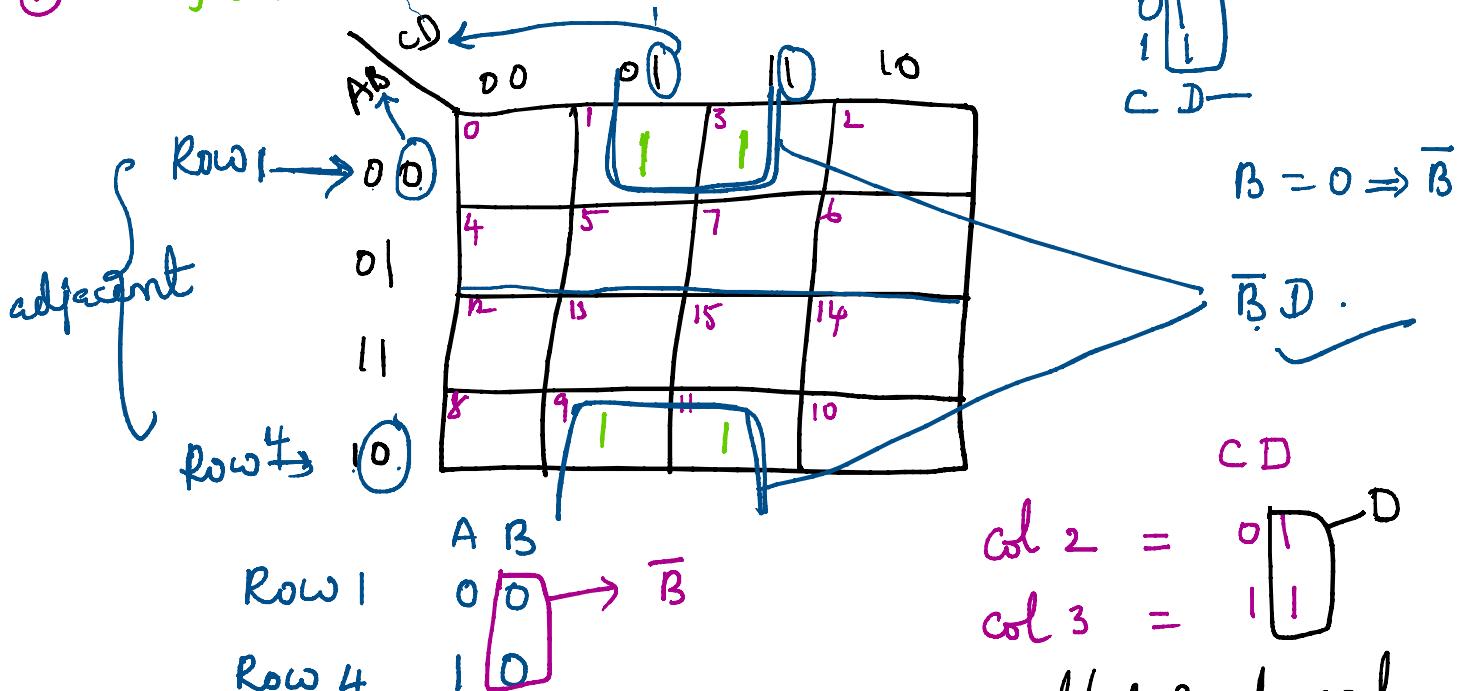
$$f(A, B, C, D) = \Pi m(2, 3, 5, 7, 9, 11)$$





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

① $f(A, B, C, D) = \Sigma m(1, 3, 9, 11)$

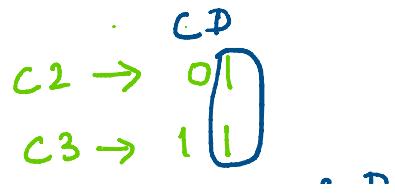


~~4 Variable K-map
4 minterms as group (2)
A, B, C, D = B̄D~~

variables reduced
means, my
boolean exp using
2 variables

4-Variable K-map

	C1	C2	C3	C4
--	----	----	----	----



of - Variable

	$\bar{A}B$	CD	$C1$	$C2$	$C3$	$C4$	
			00	01	11	10	
Row1	00			1	1		
Row2	01						
Row3	11						
Row4	10			1	1		

$C_3 \rightarrow 1 \cup$
If $D=1$ means \underline{D}

four minterms
as a group

$$\underline{\bar{B} D}$$

By folding Row 1 & Row 4 are adjacent

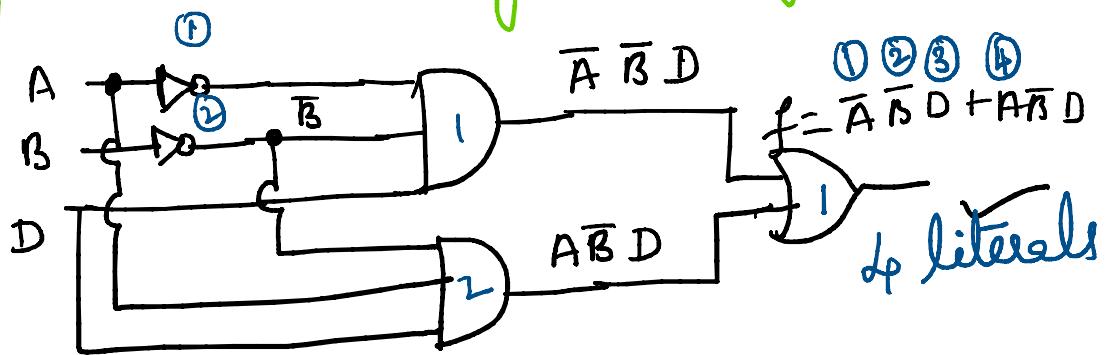
$$\begin{aligned} \text{Row1} &= \begin{array}{|c|c|} \hline A & B \\ \hline 0 & 0 \\ \hline \end{array} \quad \text{if } B=0 \text{ means } \bar{B} \\ \text{Row4} &= \begin{array}{|c|c|} \hline A & B \\ \hline 1 & 0 \\ \hline \end{array} \end{aligned}$$

	$\bar{A}B$	CD	00	01	11	10	D
			00	01	11	10	
				1	1		
							1
							0
							1
							0
							1
							0

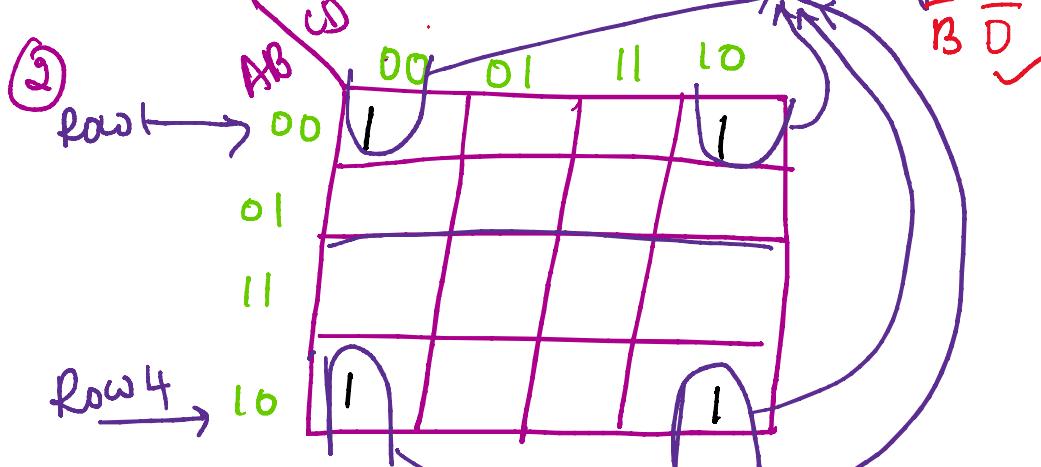
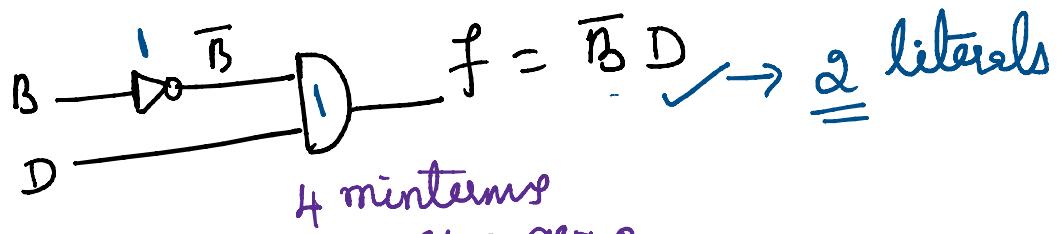
$$\begin{aligned} f(A, B, C, D) &= \overline{\bar{A} \bar{B} D + A \bar{B} D} \\ &= \bar{B} D (\underbrace{\bar{A} + A}_{1}) \quad \because A + \bar{A} = 1 \\ &= \bar{B} D \end{aligned}$$

Implementation using Basic gates

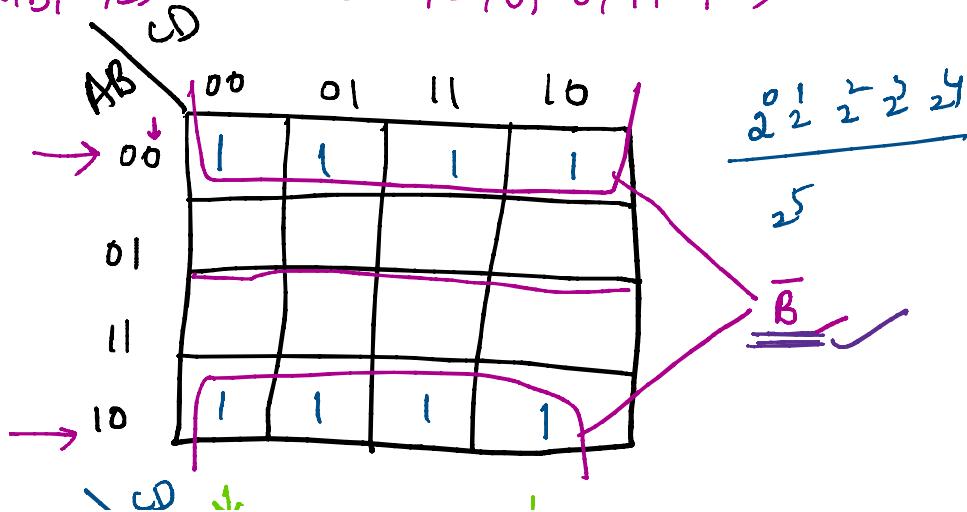
Implementation using Basic gates



$$f = \overline{B} D$$



$$f(A,B,C,D) = \Sigma m(0,1,2,3,8,9,10,11)$$

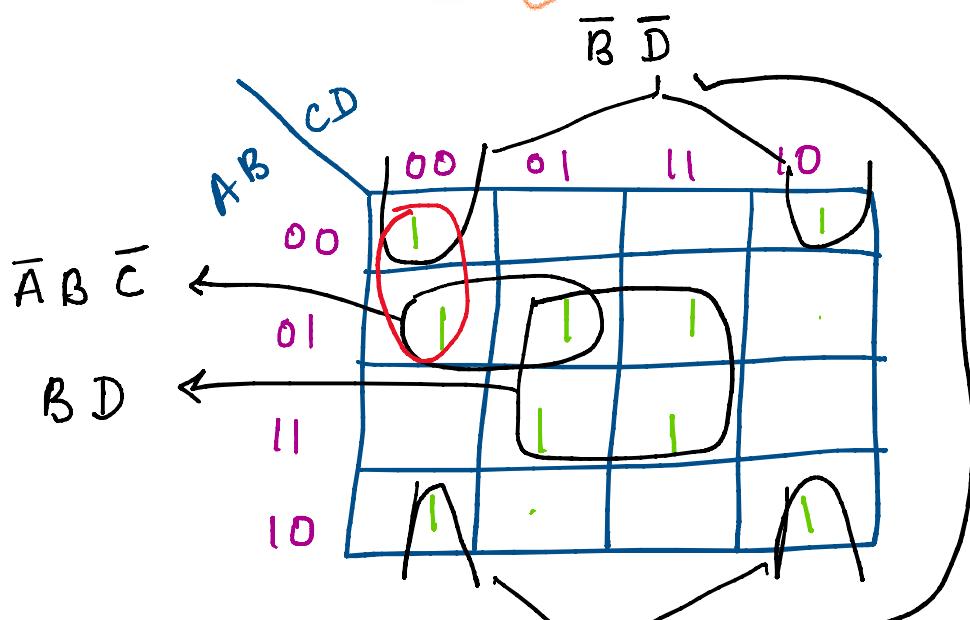




	CD	AB	00	01	11	10	11
	00	00	0	1	3	2	1
	01	01	4	5	7	6	1
	11	12	13	15	14	1	1
	10	8	9	11	10	1	1

$$f(A, B, C, D) = \Sigma m(0, 2, 4, 6, 8, 10, 12, 14)$$

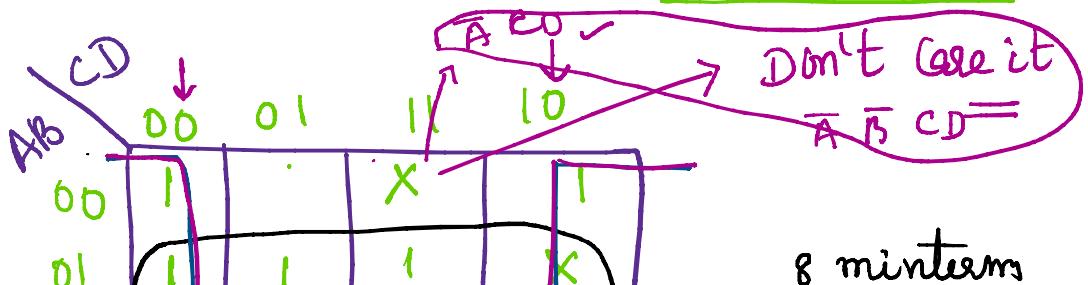
$$= \overline{D}$$

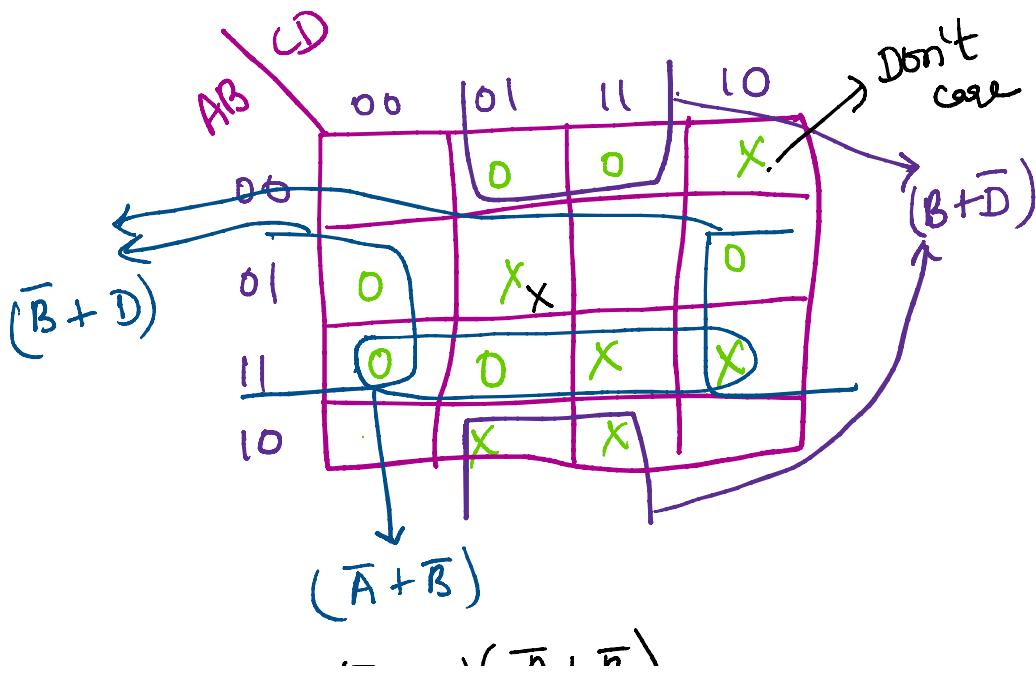
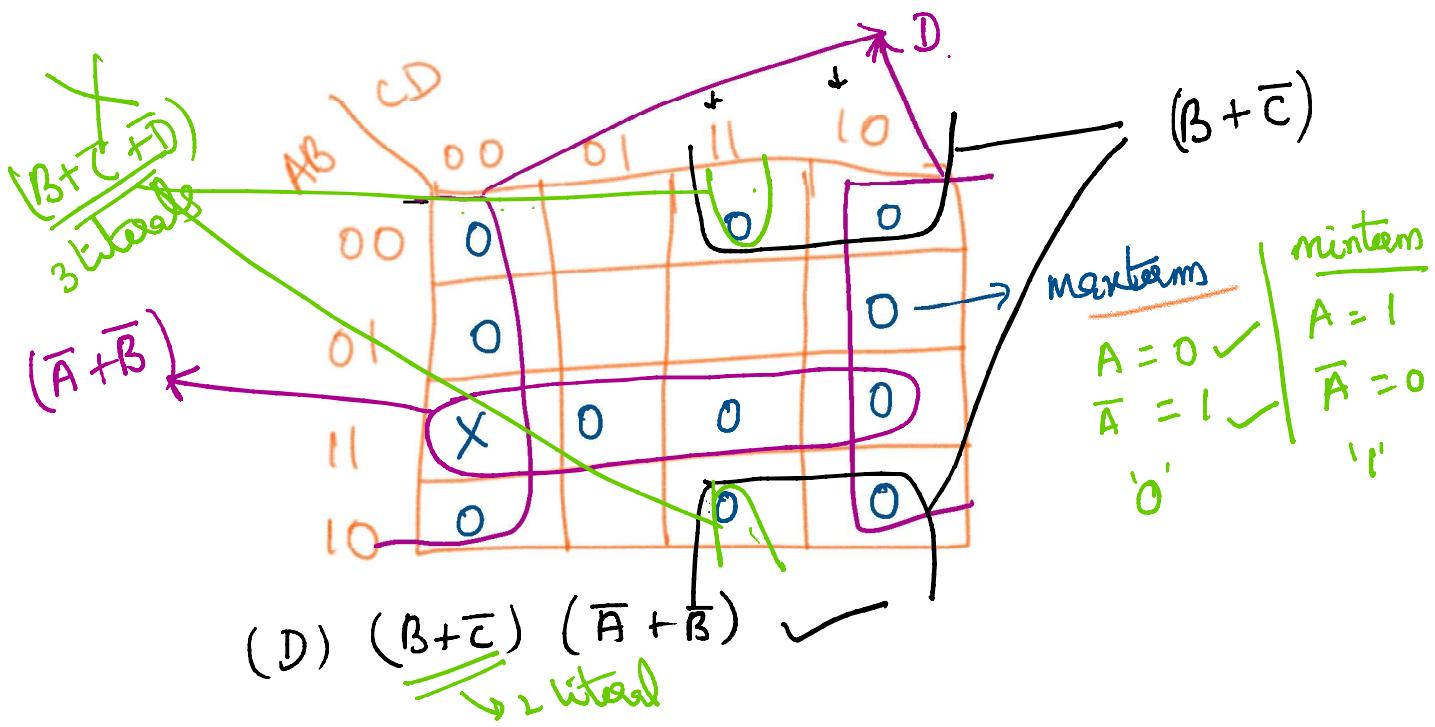
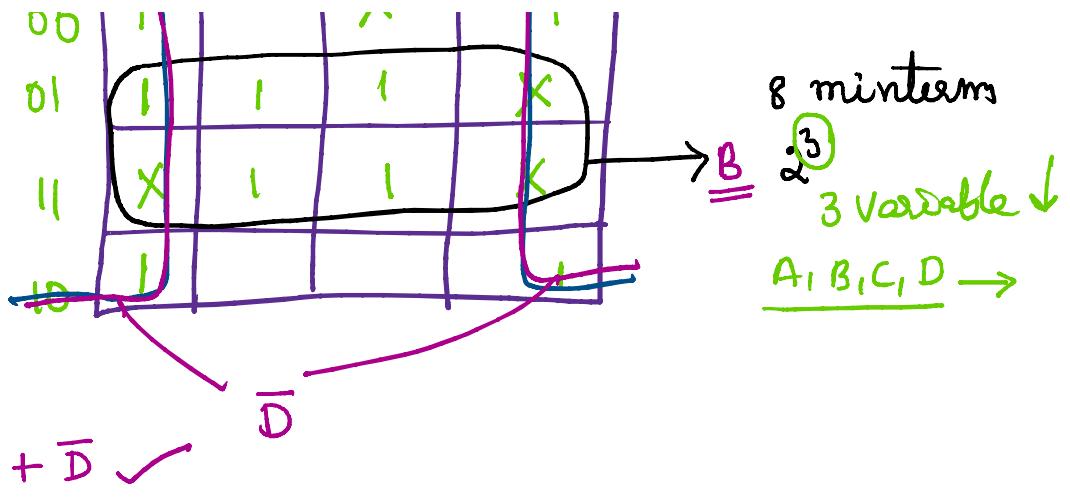


$$\overline{B} \overline{D} + B D + \overline{A} \overline{B} \overline{C}$$

$$\overline{B} \overline{D} + B D + \overline{A} \overline{C} \overline{D}$$

Don't Care = X



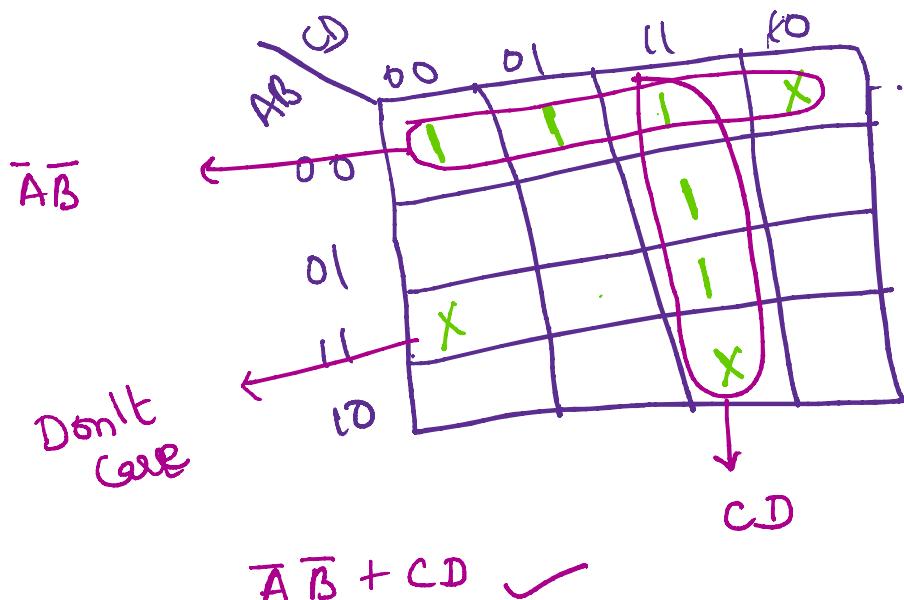


$$(\bar{A} + B)$$

$$(B + \bar{D})(\bar{B} + D)(\bar{A} + \bar{B})$$

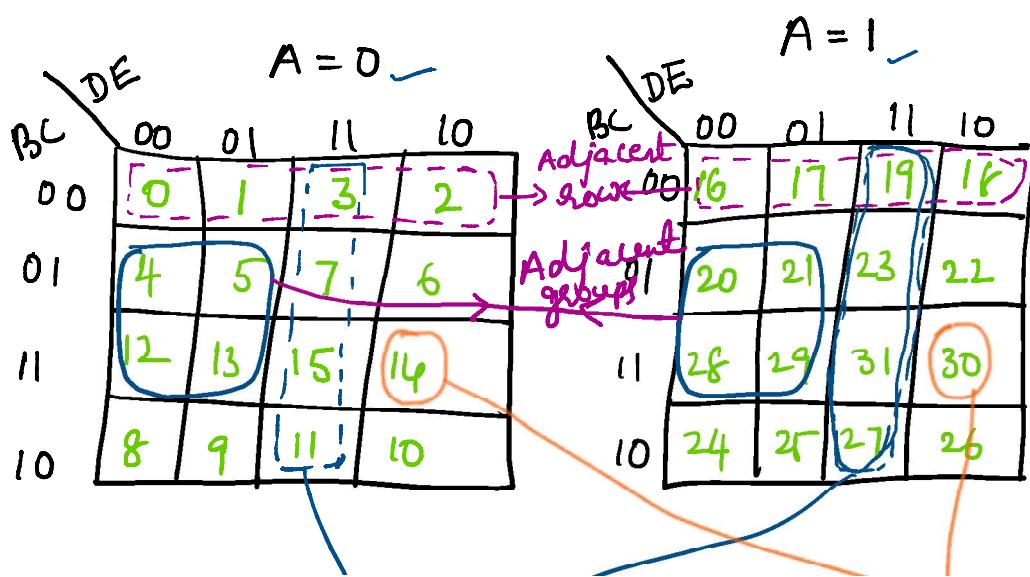
① Find the reduced form of SOP for the following function

$$f(A, B, C, D) = \Sigma m(0, 1, 3, 7, 15) + \Sigma d(2, 11, 12)$$



5-Variable K-map

$$2^5 \text{ cells} = 32 \text{ cells}$$



A B C D E
0 0 0 0 0 → 0

Adjacent columns

Adjacent cells

1 1 1 1 → 15

1 0 0 0 0 → 16

1 0 0 0 1 → 17

1 1 1 1 1 → 31

5-Variable k-map

$$f(A, B, C, D, E) = \Sigma(0, 2, 3, 4, 6, 7, 9, 11, \underline{16}, \\ 18, 19, 20, 22, 23, 25, 27)$$

