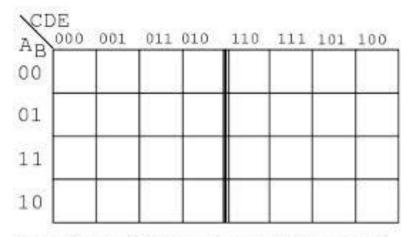
## **Tabulation Method**

The Quine-McCluskey Method

### K-map going big!



5- variable Karnaugh map (Gray code)

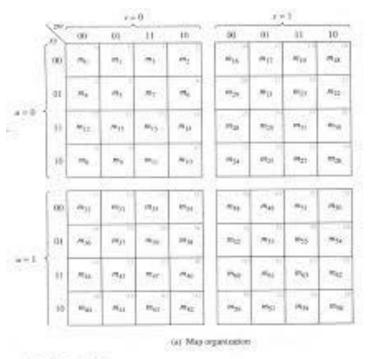


FIGURE 4.11 Six-variable map

6 variable k-map

- K-map works well upto 4 variable, but when number of variable is more than that trouble starts as it gets difficult to recognize patters leading to wrong selection
- Quine McCluskey method or the tabulation method is more systematic and works well for any number of variable

The starting point of the tabulation method is the list of minterms that specify the function. The first tabular operation is to find the prime implicants by using a matching process. This process compares each minterm with every other minterm. If two minterms differ in only one variable, that variable is removed and a term with one less literal is found. This process is repeated for every minterm until the exhaustive search is completed. The matching-process cycle is repeated for those new terms just found. Third and further cycles are continued until a single pass through a cycle yields no further elimination of literals. The remaining terms and all the terms that did not match during the process comprise the prime implicants. This tabulation method is illustrated by the following example.

# Part 1:Determination of the prime implicant

Forming the tabulation method

### Example

```
F(w,x,y,z) = \sum (1,4,6,7,8,9,10,11,15)
F={0001,0100,0110,0111,1000,1001,1010,1011,1111}
```

Step 1: group the minterms based on the no. of '1's in them

Group A: single '1': {0001,0100,1000}

Group B: two '1's: {0110,1001,1010}

Group C: three '1's: {0111,1011}

Group D:four '1's: {1111}

	Step 1
1	0001
4	0100
8	1000
6	0110
9	1001
10	1010
7	0111
11	1011
15	1111

• Step 2: Any 2 minterm that differ by 1 variable is combined and the different variable is removed. The minterms of a group is compared with minterms of immediate next group (this is because 2 term differing by more than 1 bit cannot match). If 2 matching minterms are found, a ' $\sqrt{}$ ' (tick) is place besides them

	Step 1	Step 2	
1	0001	(1,9)	_001
4	0100	(4,6)	01_0
8	1000	(8,9)	100_
		(8,10)	10_0
6	0110	(6,7)	011_
9	1001	(9,11)	10_1
10	1010	(10,11)	101_
7	0111	(7,15)	_111
11	1011	(11,15)	1_11
15	1111		

#### • Step 3:

Terms from step 2 has 3 options. '1' means variable is unprimed, '0' means variable is primed and '\_' means variable is not included in the term.

Now compare terms only if they have '\_' in the same position. Once two term match place a ' $\sqrt{}$ ' beside each

	Step 1	Step 2		2	Step 3		ep 3
1	0001		(1,9)	_001		(8,9,10,11)	10
4	0100	$\sqrt{}$	(4,6)	01_0		(8,9,10,11)	10
8	1000	$\sqrt{}$	(8,9)	100_	$\sqrt{}$		
			(8,10)	10_0	$\sqrt{}$		
6	0110		(6,7)	011_			
9	1001		(9,11)	10_1	$\sqrt{}$		
10	1010		(10,11)	101_	$\sqrt{}$		
7	0111		(7,15)	_111			
11	1011		(11,15)	1_11			
15	1111						

### Prime Implicant

• The remaining term (those without ' $\sqrt{}$ ') in Step 2 and the terms from Step 3 are called the prime implicants. These terms are candidates suitable for forming the simplified form of the expression

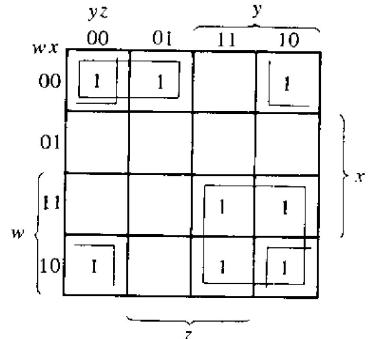
Here prime implicants are:

(1,9)	_001	X'Y'Z	
(4,6)	01_0	W'XZ'	
(6,7)	011_	W'XY	
(7,15)	_111	XYZ	
(11,15)	1_11	WYZ	
(8,9,10,11)	10	WX'	

 K-MAP using prime implicant shows that it can be further simplified to

$$F(w,x,y,z) = X'Y'Z+W'XZ'+XYZ+WX'$$

To achieve further simplification we need to find the essential prime implicant and remove the domination rows and dominated columns.



# Part 2: Selection of prime implicants- the setup

Optimizing the tabular method

given the question Create the large table 冲 4 6 17 8 9 10 X'Y'Z W'XZ' PLUMBETS WXY 11311 WYZ of stla WXI Spots.

So solution is F(W,X,Y,Z)= X'Y'Z+W'XZ'+WX'+XYZ

This matched the result from K-MAP!

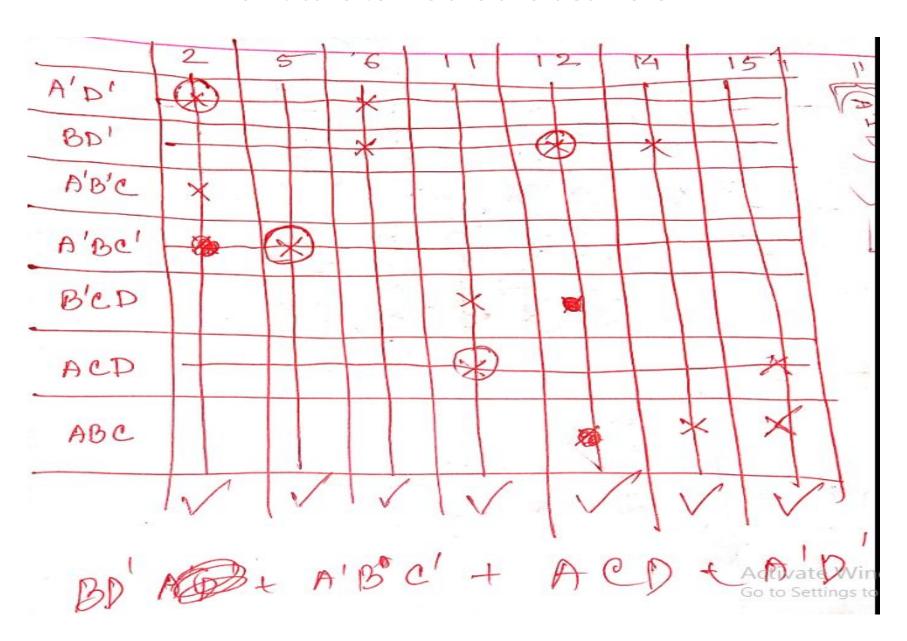
### Example 2

 $F(a,b,c,d)=\sum m(2,5,6,11,12,14,15)+\sum d(0,3,4)$ 

Note: avoid the don't care terms in the set-up(optimization) phase.

	Step 1	Step		2		Step 3	
0	0000	$\sqrt{}$	(0,2)	00-0	$\sqrt{}$	(0,2,4,6)	00
			(0,4)	0-00	$\sqrt{}$	(0,4,2.6)	00
2	0010	$\sqrt{}$	(2,3)	001-		(4,6,12,14)	-1-0
4	0100	$\sqrt{}$	(2,6)	0-10	$\sqrt{}$	(4,12,6,14)	-1-0
			(4,5)	010-			
			(4,6)	01-0	$\sqrt{}$		
			(4,12)	-100	$\sqrt{}$		
3	0011	$\sqrt{}$	(3,11)	-011			
5	0101	$\sqrt{}$	(6,14)	-110	$\sqrt{}$		
6	0110	$\sqrt{}$	(12,14)	11-0	$\sqrt{}$		
12	1100	$\sqrt{}$					
11	1011	$\sqrt{}$	(11,15)	1-11			
14	1110	$\sqrt{}$	(14,15)	111-			

#### Don't care terms are avoided here.



So solution is F(W,X,Y,Z)= BD'+A'BC'+ A'D'+ ACD

## Try it yourself

•  $F(w,x,y,z) = \sum (0,1,2,8,10,11,14,15)$ 

### Solution

(a)	(b)	(c)
w x y z	wx yz	wx yz
0 000 √	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$0, 8 - 0 \ 0 \ \sqrt{}$	10, 11, 14, 15 1 - 1 - 10, 14, 11, 15 1 - 1 -
8 1000 √	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	
10 1 0 1 0 🗸	10, 11 1 0 1 - 🗸	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	10, 14 1 - 1 - \( \square \)	
15 1 1 1 1 /	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	

### Prime implicant optimization

F=w'x'y'+x'z'+wy

	W'X'Y'	X'Z'	WY
0000	1	1	
0001	1		
0010		1	
1000		1	
1010		1	1
1011			1
1110			1
1111			1

All rows have single '1', so all are essential prime implicant hence no further optimization can be done. Answer is: F=w'x'y'+x'z'+wy