



Faculty of Engineering

CSE115: Digital Design

Lecture 10:
Four Variable Karnaugh Map

Suggested Reading

- Sections 4.3

Four-Variable Karnaugh Map

WX \ YZ	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

Example 1

Row	W	X	Y	Z	F
0	0	0	0	0	1
1	0	0	0	1	0
2	0	0	1	0	1
3	0	0	1	1	0
4	0	1	0	0	0
5	0	1	0	1	1
6	0	1	1	0	0
7	0	1	1	1	1
8	1	0	0	0	1
9	1	0	0	1	0
10	1	0	1	0	1
11	1	0	1	1	0
12	1	1	0	0	0
13	1	1	0	1	1
14	1	1	1	0	0
15	1	1	1	1	1

F=

$W'X'Y'Z'$

+

$W'X'YZ'$

$W'XYZ'$

$W'XYZ$

$WX'Y'Z'$

$WX'YZ'$

$WXY'Z'$

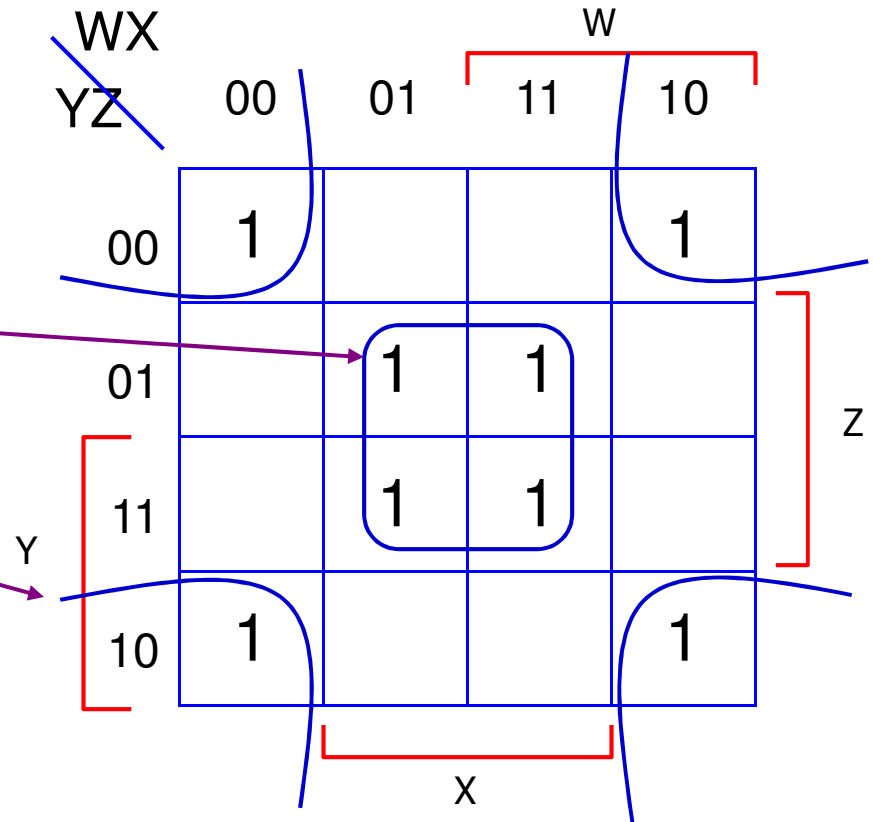
$WXYZ$

Example 1(Contd.)

Essential prime implicants:

The product term: **XZ**

The product term : **X'Z'**



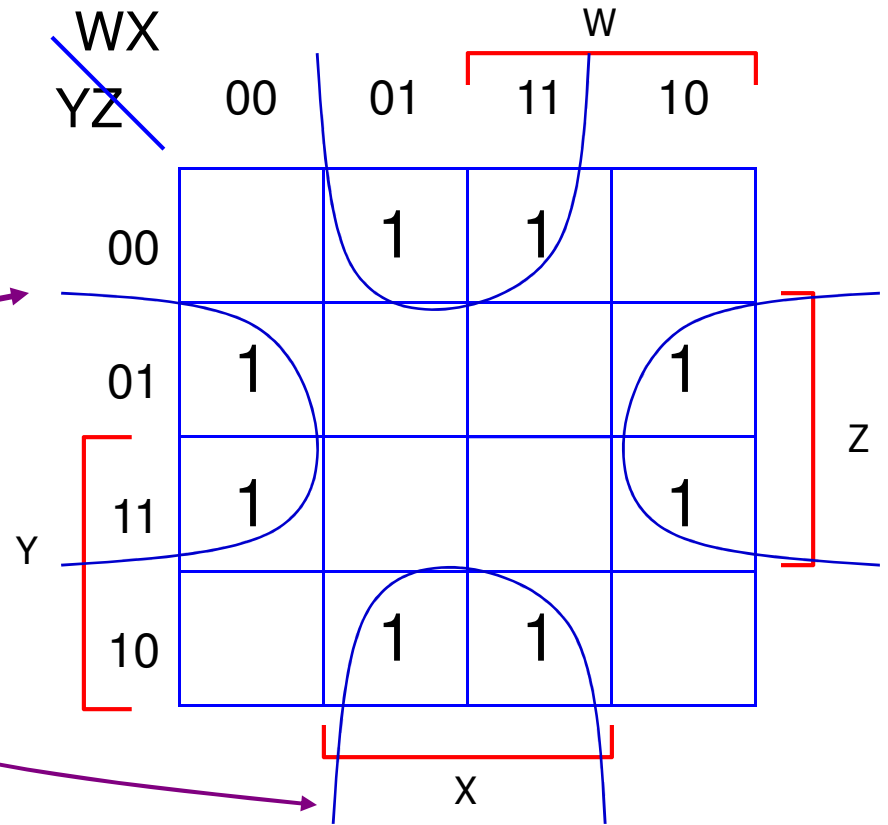
$$F = XZ + X'Z'$$

Example 2

Essential prime implicants:

The product term: $X'Z$

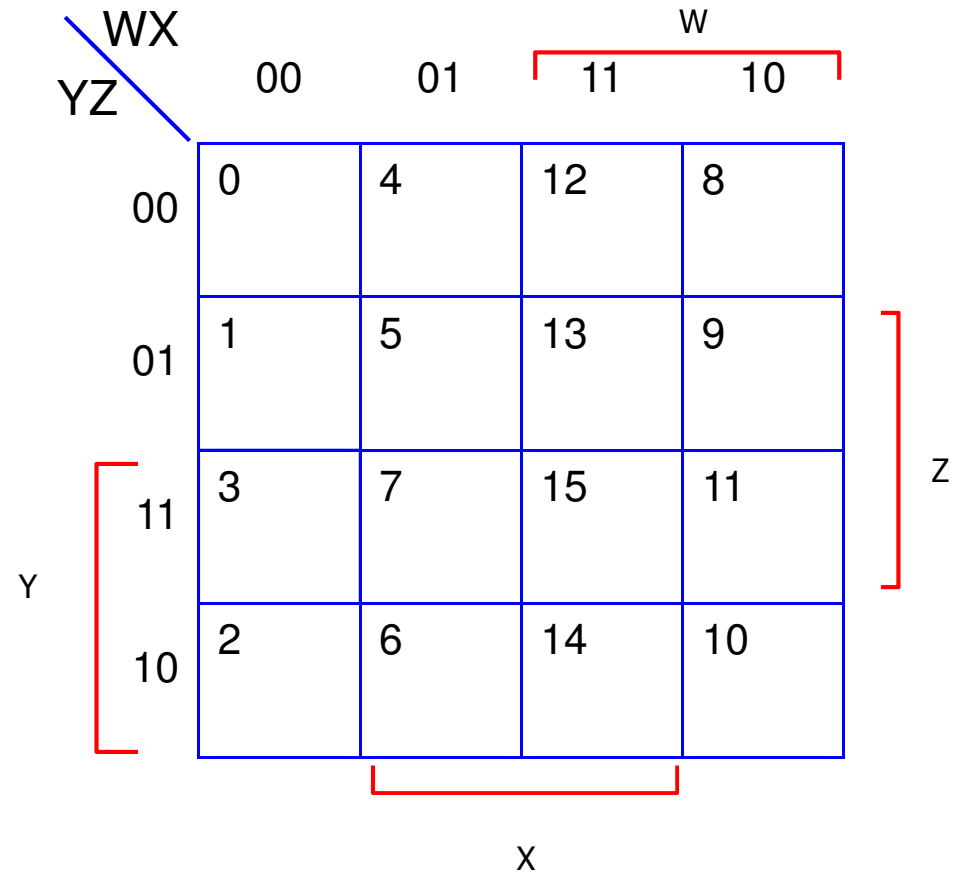
The product term : XZ'



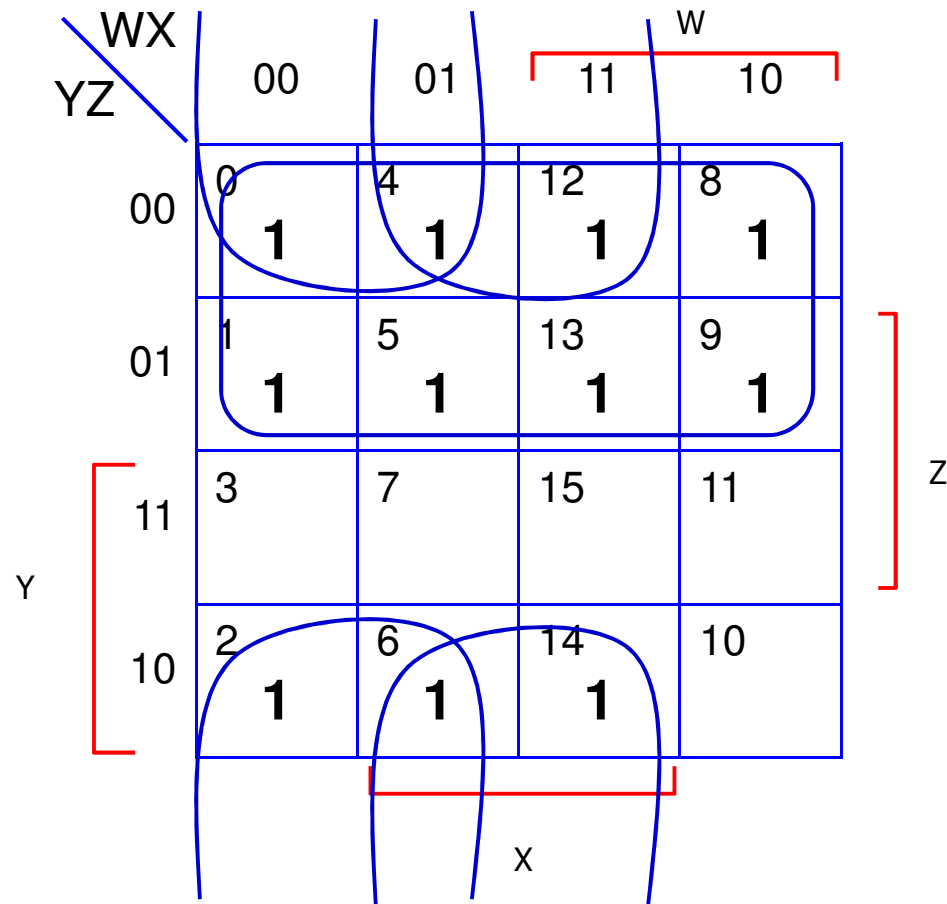
$$F = X'Z + XZ'$$

Exercise

Row	W	X	Y	Z	F
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	0
4	0	1	0	0	1
5	0	1	0	1	1
6	0	1	1	0	1
7	0	1	1	1	0
8	1	0	0	0	1
9	1	0	0	1	1
10	1	0	1	0	0
11	1	0	1	1	0
12	1	1	0	0	1
13	1	1	0	1	1
14	1	1	1	0	1
15	1	1	1	1	0



Exercise (Contd.)



$$F = Y' + W'Z' + XZ'$$

Example 3

The prime implicants:

$W'X'$

$W'Y'$

$W'Z$

XYZ

WXY

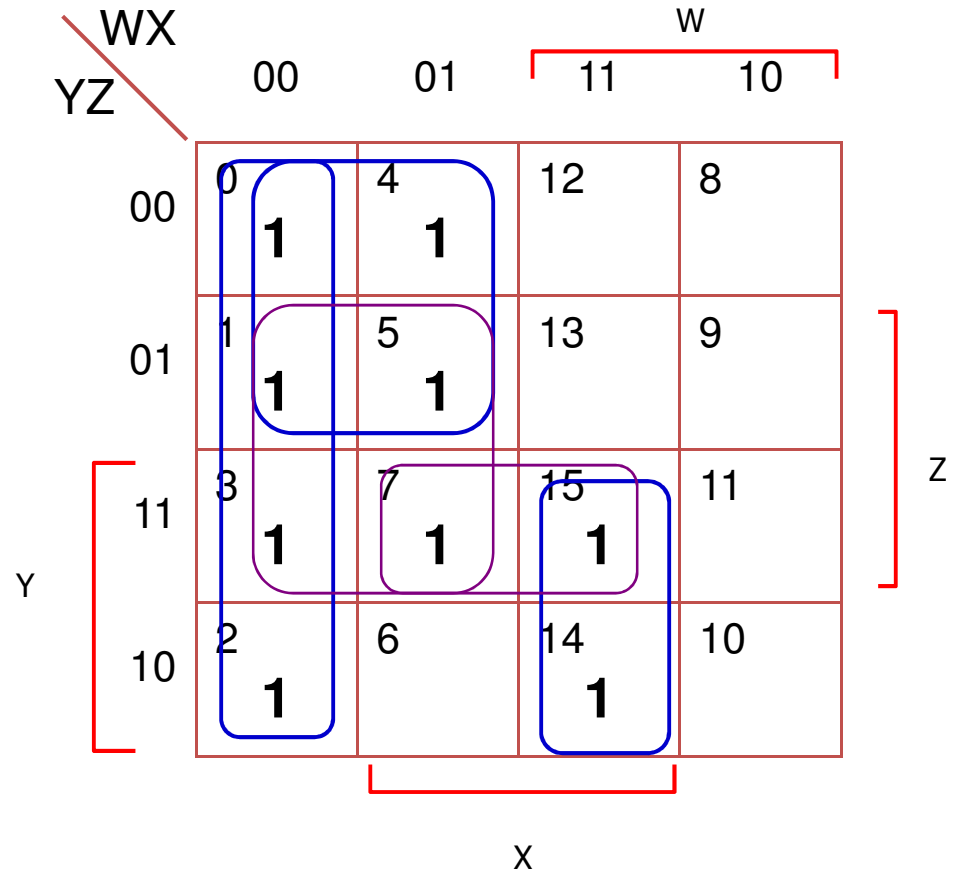
The essential prime implicants:

$W'X'$

$W'Y'$

WXY

Cell 7 is not covered by any of the essential prime implicants. Its covered by two non-essential prime implicants. We choose the one with the less number of variables which is $W'Z$



$$F = W'X' + W'Y' + WXY + W'Z$$

Exercise

- $F_{w,x,y,z} = \Sigma (0,1,2,3,4,6,7,8,9,12,14)$