Faculty of Engineering

CSE115: Digital Design

Lecture 12:
Don’t Care Conditions

Suggested Reading

- Sections 4.3.7-4.3.8

Don’t Care Conditions

In some applications, the Boolean function for certain combinations of the input variables is not specified. The corresponding minterms (maxterms) are called “don’t care minterms(maxterms)”.

In K-map , these are represented by ‘**x**’.

Since the output function for those minterms(maxterms) is not specified, those minterms(maxterms) could be combined with the adjacent 1 cells (0-cells) to get a more simplified sum-of-products (product-of-sums) expression.

Example 1

- Build a logic circuit that determines if **a decimal digit** is ≥ 5

1. The decimal digits (0,1,2,...,9) are represented by 4 bit BCD code.
2. The logic circuit should have **4 input** variables and **1 output**.
3. There are 16 different input combinations but only 10 of them are used.
4. The logic function should produce 0 if the number is < 5,
   and 1 if it is ≥ 5.

Example 1 (Contd.): Truth Table

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

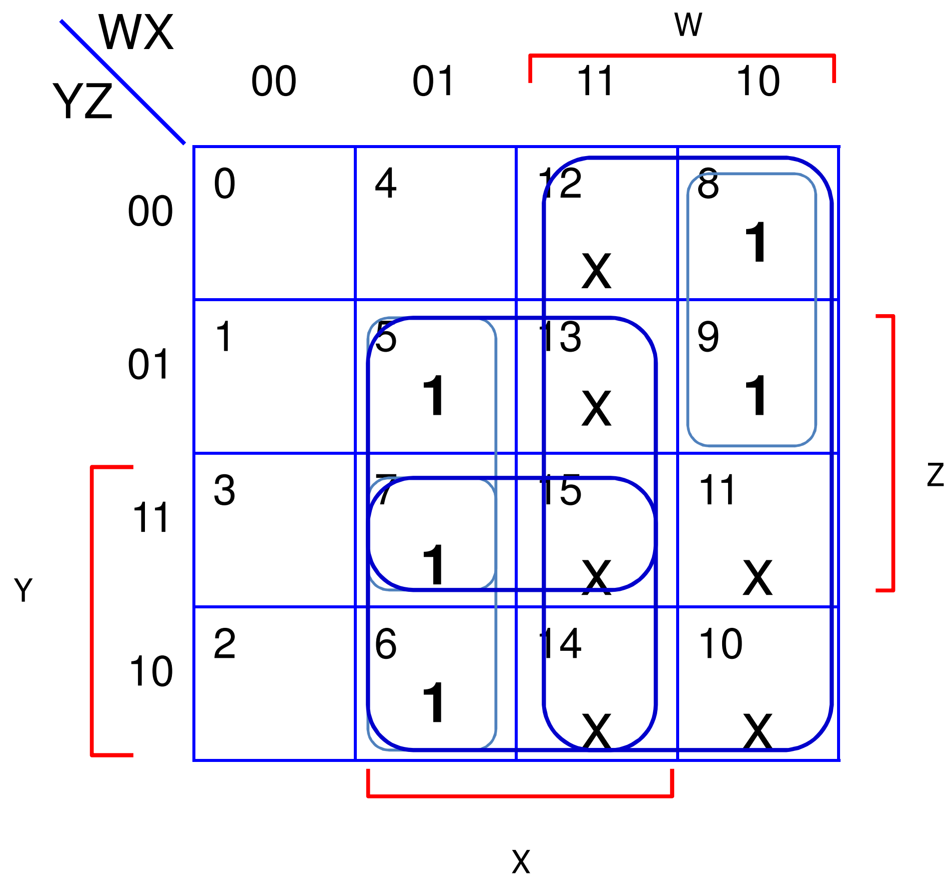
Example 1(Contd.)- K-Map

The Minimal Sum:

Combining the ‘1’ cells only, the minimal sum is:
F = WX’Y’+W’XZ+W’XY

Combining the don’t care minterms with the ‘1’ cells, the minimal sum is:

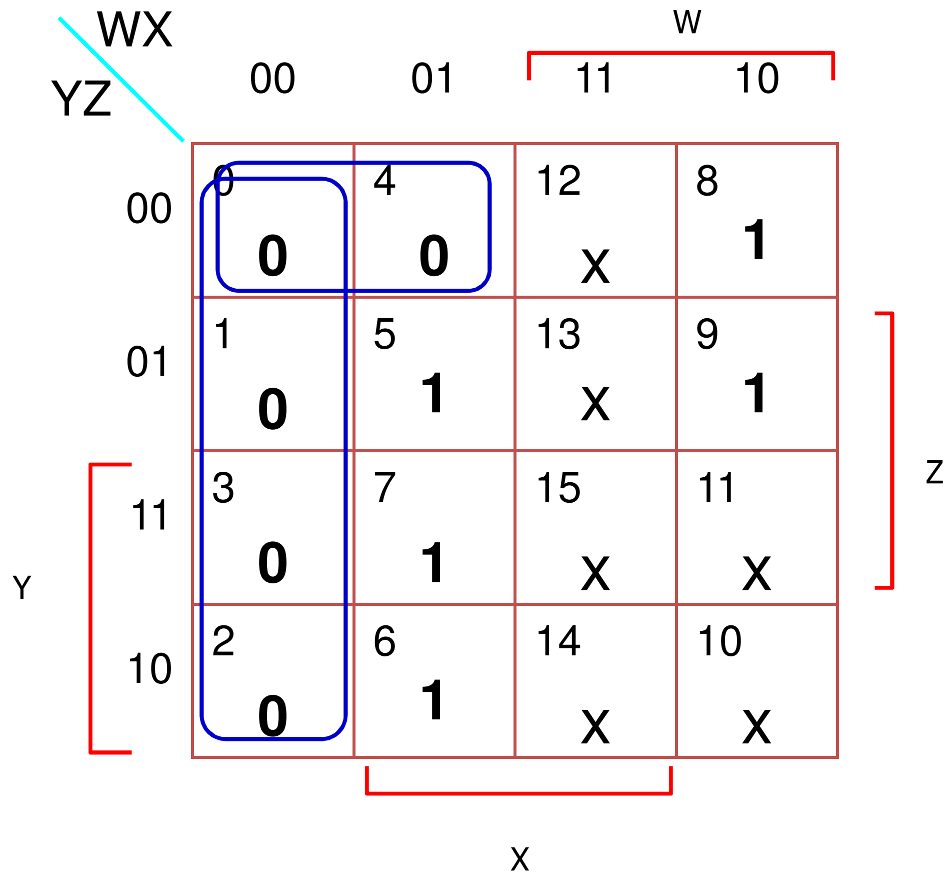
F = W+XZ+XY



Example 1 (Cont.): Minimal Product

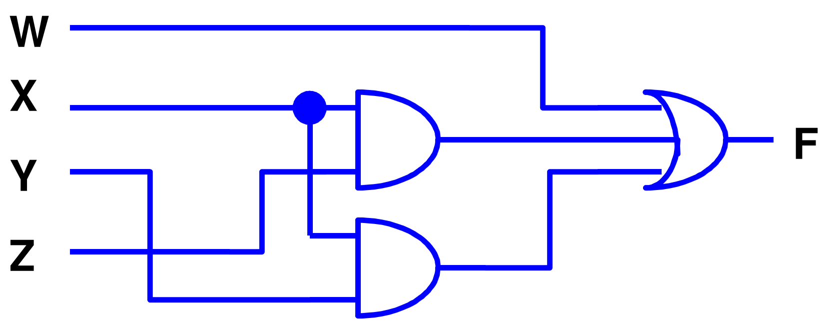
The Minimal Product:

F= (W+X).(W+Y+Z)

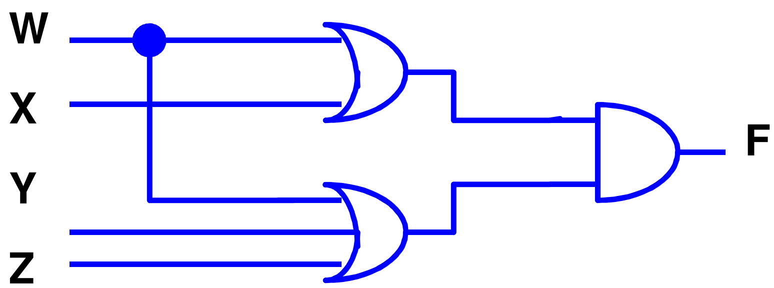


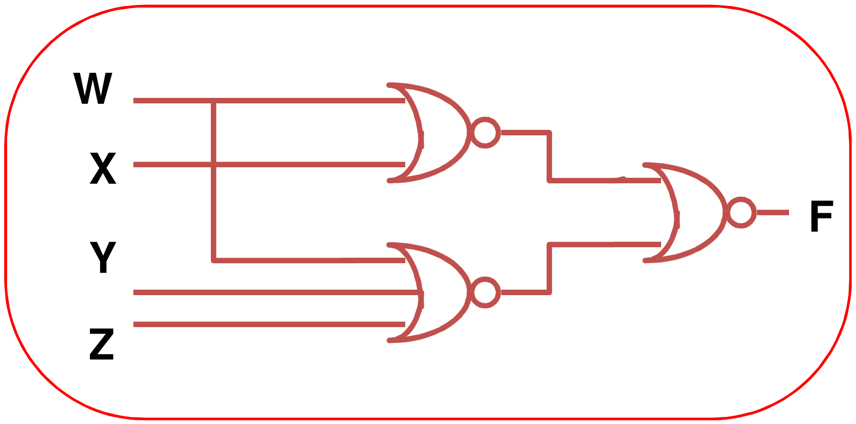
Example 1 (Contd.): Implementation

The minimal sum implementation: **F = W+XZ+XY**



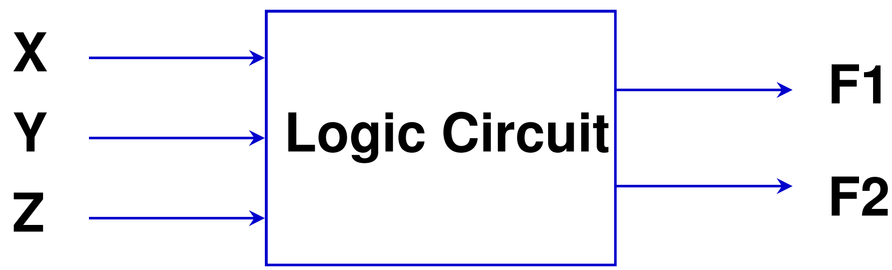
The minimal product implementation: **F= (W+X).(W+Y+Z)**





Multiple-Output Minimization

Most digital applications require multiple outputs derived from the same input variables.

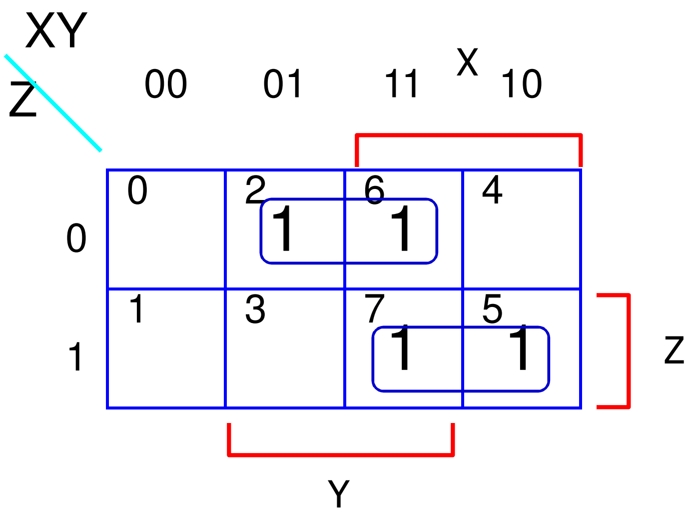


1. Each output function could be minimized using K-map and realized independently.
2. The output functions could share one or more product terms (prime implicant) which reduces the total number of gates.

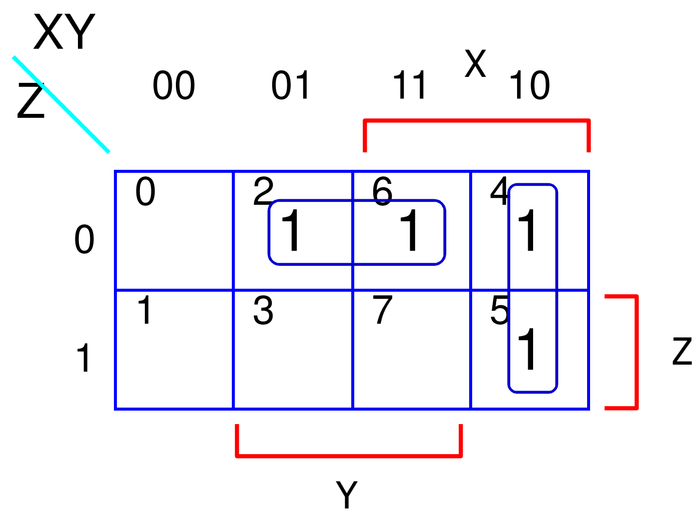
Example 2

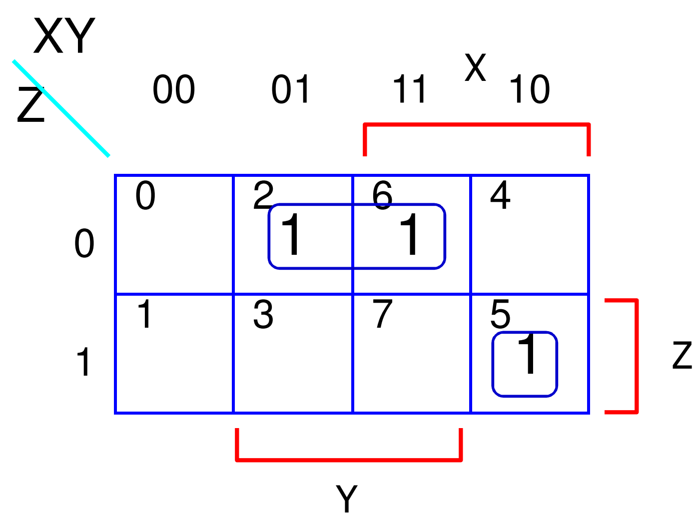
F1 = XZ + YZ'
F2 = XY' + YZ'

F1



F2





To find the common terms multiply the two functions (F1.F2)

The common terms are: **YZ', XY'Z**

Example 2 (Contd.) – Logic Diagram

Independent realization
Minimal realization

F1= XZ+YZ'

F2= XY'+YZ'