



Digital Logic

Lecture 6 – Part2

2nd Stage

Computer Science Department

Faculty of Science

Soran University

Topics covered

- K-Map Manipulation
 - Don't Cares

Karnaugh Map: Don't Cares



- Real circuits don't always need to have an output defined for every possible input.
 - For example, some calculator displays consist of 7-segment LEDs. These LEDs can display $2^7 - 1$ patterns, but only ten of them are useful.
- If a circuit is designed so that a particular set of inputs can never happen, we call this set of inputs a *don't care* condition.
- They are very helpful to us in Kmap circuit simplification.

Karnaugh Map: Don't Cares



Note 1 – If outputs are not defined for some combination of inputs, then those output values will be represented with **don't care symbol 'x'**. That means, we can consider them as either '0' or '1'.

Note 2 – If don't care terms also present, then place don't cares 'x' in the respective cells of K-map. Consider only the don't cares 'x' that are helpful for grouping maximum number of adjacent ones. In those cases, treat the don't care value as '1'.

Karnaugh Map: Don't Cares

Example 1

Simplify the function $F(A,B,C,D)$ whose K-map is shown at the right.

MSB → AB / CD ← LSB

	00	01	11	10
00	0	1	0	1
01	1	1	0	1
11	0	0	x	x
10	1	1	x	x

$AB \backslash CD$	00	01	11	10
00	0	1	0	1
01	1	1	0	1
11	0	0	x	x
10	1	1	x	x

$AB \backslash CD$	00	01	11	10
00	0	1	0	1
01	1	1	0	1
11	0	0	x	x
10	1	1	x	x

$$F = A'C'D + AB' + CD' + A'BC' \quad \text{Or} \quad F = A'C'D + AB' + CD' + A'BD'$$

Karnaugh Map: Don't Cares

Example 2

Simplify the function $F(A,B,C,D)$ whose K-map is shown at the right.

MSB → AB / CD ← LSB

	00	01	11	10
00	X	1	0	0
01	1	X	0	X
11	1	X	X	1
10	0	X	X	0

AB \ CD	00	01	11	10
00	X	1	0	0
01	1	X	0	X
11	1	X	X	1
10	0	X	X	0

$$F = A'C' + AB$$

Or

AB \ CD	00	01	11	10
00	X	1	0	0
01	1	X	0	X
11	1	X	X	1
10	0	X	X	0

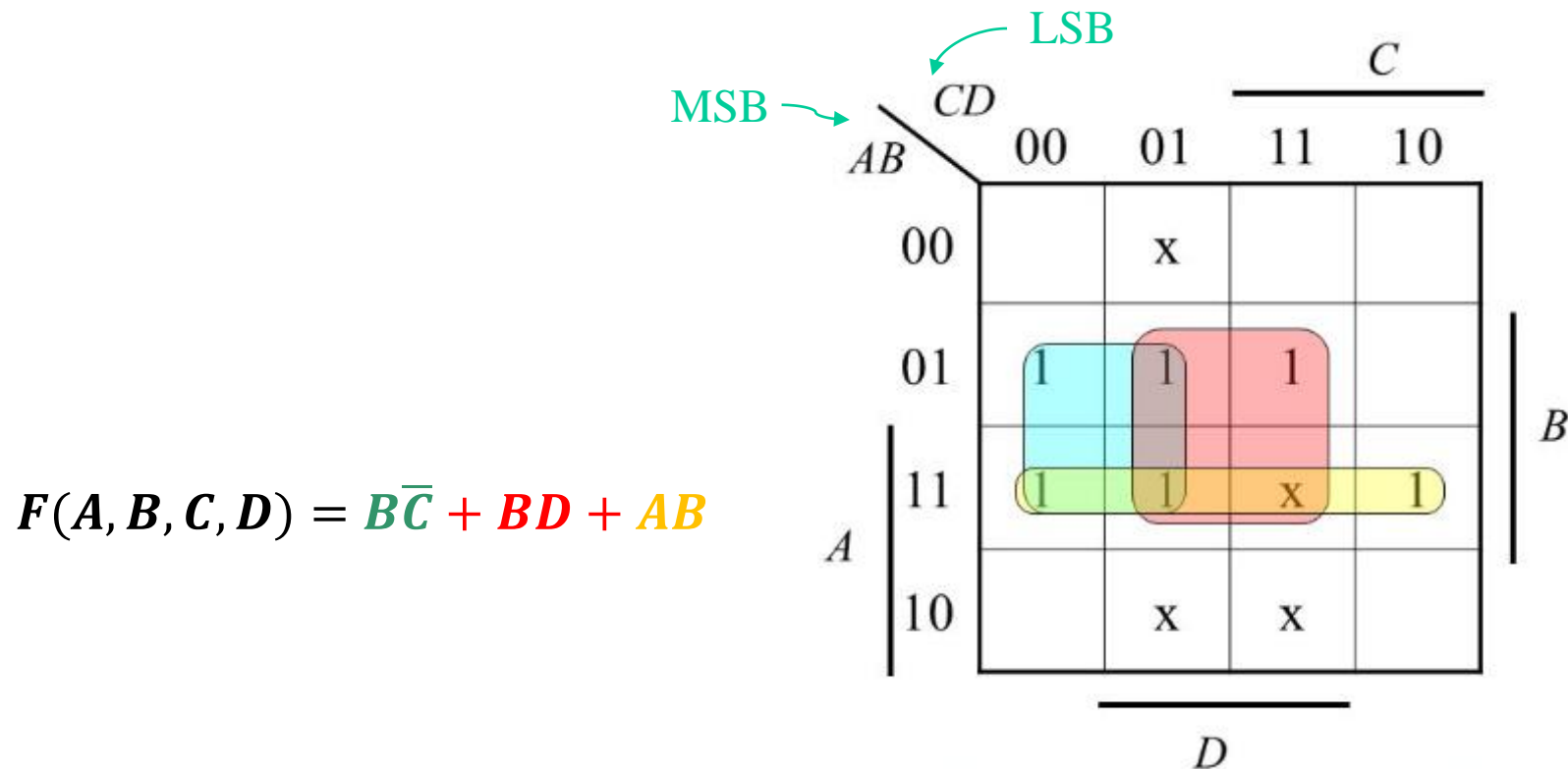
$$F = A'C' + BD'$$

Karnaugh Map: Don't Cares

Example 3

Simplify the following Boolean function, together with don't care condition d .

$$F(A, B, C, D) = \Sigma m(4, 5, 7, 12, 13, 14) + \Sigma d(1, 9, 11, 15)$$



Karnaugh Map: Don't Cares

Example 4



Try this:

Simplify the function $F(A,B,C,D)$ whose K-map is shown at the right, then draw the simplified logic diagram

MSB \rightarrow AB \swarrow CD \searrow LSB

	00	01	11	10
00	X	1	0	1
01	1	1	0	0
11	0	0	x	x
10	1	0	0	x

Karnaugh Map: Don't Cares

Example 5



Try this:

Simplify the function $F(A,B,C,D)$ whose Truth Table is shown at the right, then draw the simplified logic diagram

A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	x
0	1	1	0	x
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	x
1	1	1	0	0
1	1	1	1	1

Homework 7



Use Karnaugh Map to minimize $F(A,B,C,D) = \sum m(6,7,8,9,10,11) + d(0,1,2,3,14,15)$ to a minimum number of literals.

A) Using (*don't cares*).

B) Without (*don't cares*).

Deadline: November 25, 2022 @ 11:59 PM