

CPE100: Digital Logic Design I



K-Maps

Example 1

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

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

$$Y = \bar{A} \bar{B} C + B \bar{C} + A \bar{C}$$

Example 2

A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

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

$$Y = \bar{B}$$

Example 3

A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

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

$$Y = AD + \bar{A}\bar{B}\bar{D}$$

Example 4

- Minterm specification
- 4 variable (A,B,C,D) input
- $Y = \sum m(0,2,8,9,10,11)$
 - E.g.
 - $m8 = A\bar{B}\bar{C}\bar{D} = 1000$
 - $A = 1, B = 0, C = 0, D = 0$

		A B			
		00	01	11	10
C D	00	0 1	4	12	8 1
	01	1	5	13	9 1
	11	3	7	15	11 1
	10	2 1	6	14	10 1

$$Y = \bar{B}\bar{D} + A\bar{B}$$

Example 5

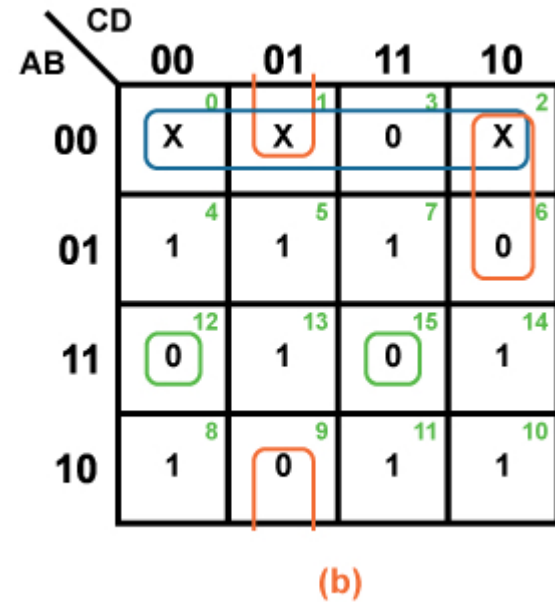
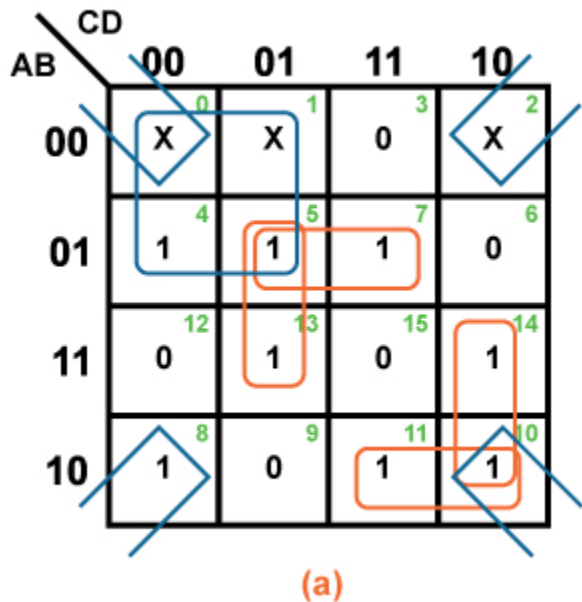
- 4 variable (A,B,C,D) input
- $Y = \sum m(1,3,6,9,11,12,13)$

		A B			
		00	01	11	10
C D	00	0	4	12 1	8
	01	1 1	5	13 1	9 1
	11	3 1	7	15	11 1
	10	2	6 1	14	10

$$Y = ABC\bar{C} + \bar{B}D + \bar{A}BC\bar{D}$$

Example 6

- 4 variable (A,B,C,D) input
- $Y = \sum m(4,5,7,8,10,11,13,14) + \sum d(0,1,2)$
 - d term indicates do not care
- Maxterm expression for POS form
- $Y = \prod M(3,6,9,12,15) + \sum d(0,1,2)$



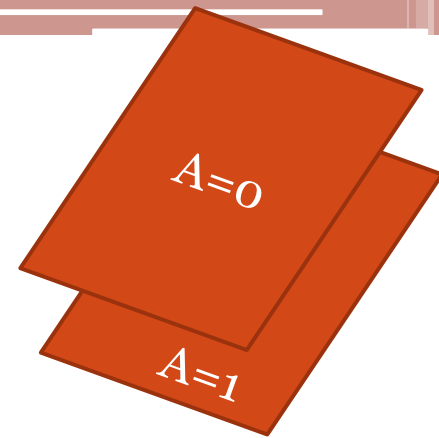
Note: AB and CD are switched in this K-map

Example 7

- Use a K-map to simplify the following equation
- $Y = ABC + BCD + AC + BC$
- Note this is a 4-input problem
- Use expansion to find canonical minterms or
- Create full truth table
- Ex:
 - $ABC \rightarrow 1110 \text{ and } 1111$
 - $AC \rightarrow 1010, 1011, 1110, \text{ and } 1111$
 - 1st and 3rd bits turned on

Example 8

- 5-input function (A,B,C,D,E)
 - Create two 4-input K-maps and “stack”



A = 0 BC

||
||
||

A = 1 BC

||
||
||

- Draw bubbles within 4x4 and in between stack
 - E.g. cell 5 and 21 $\rightarrow B'CD'E$

Example 8

- $Y = \sum m(0,1,2,3,8,9,16,17,20,21,24,25,28,29,30,31)$

A = 0 BC

DE	00	01	11	10
00	1	4	12	1
01	1	5	13	1
11	1	7	15	11
10	1	6	14	10

A = 1 BC

DE	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	19	23	1	27
10	18	22	1	26