



In the name of Allah, the Most Merciful, the Most Kind

Date: 25-10-2021

BCS 103 Digital Logic & Computer Architecture

Lecture 23 and 24

IN THE LAST LECTURE

We have discussed

• Karnaugh Map (3 variables)

TODAY

We will discuss about

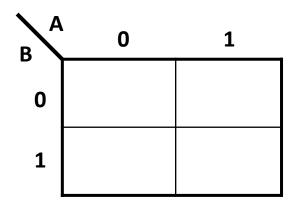
• Karnaugh Map (4 variables)

Review

2 variables Karnaugh map

Q: Simplify the following expressions

$$A'B' + AB + A'B$$



Review

3 variables Karnaugh map

Q: Simplify the following expressions

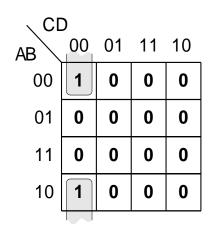
$$AC + AB + B'C'$$

AB	C 00	01	11	10
0				
1				

Karnaugh Maps

4 variables Karnaugh map

CD	В	00	01	11	10
00					
01					
11					
10					

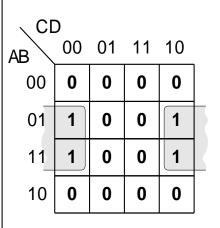


∖ C[)			
AB	00	01	11	10
00	0	0	0	0
01	0	1	0	0
11	0	1	0	0
10	0	0	0	0

CI				
AB	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	1	1	0
10	0	0	0	0

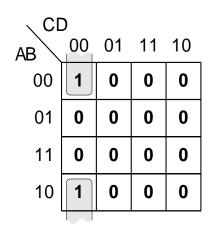
∖ C[)			
AB	00	01	11	10
00	0	0	0	0
01	1	0	0	1
11	0	0	0	0
10	0	0	0	0

∖ CD					
AB	00	01	11	10	
00	0	0	1	1	
01	0	0	1	1	
11	0	0	0	0	
10	0	0	0	0	



∖ CD					
AB	00	01	11	10	
00	0	0	1	1	
01	0	0	0	0	
11	0	0	0	0	
10	0	0	1	1	

CI AB	00	01	11	10	
00	1	0	0	1	
01	0	0	0	0	
11	0	0	0	0	
10	1	0	0	1	K



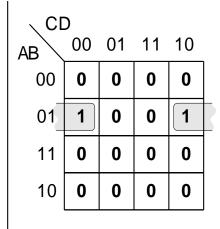
$$f = \sum (0,8) = \overline{B} \bullet \overline{C} \bullet \overline{D}$$

∖ C[)			
AB	00	01	11	10
00	0	0	0	0
01	0	1	0	0
11	0	1	0	0
10	0	0	0	0

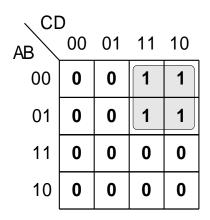
$$f = \sum (5,13) = B \bullet \overline{C} \bullet D$$

\ C[)			
AB	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	1	1	0
10	0	0	0	0

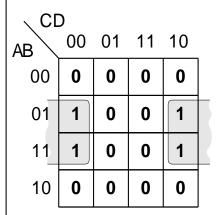
$$f = \sum (13,15) = A \bullet B \bullet D$$



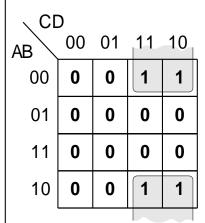
$$f = \sum (4,6) = \overline{A} \bullet B \bullet \overline{D}$$



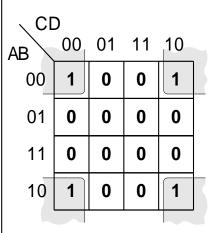
$$f = \sum (2,3,6,7) = \overline{A} \bullet C$$



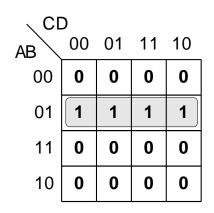
$$f = \sum (4,6,12,14) = B \bullet \overline{D}$$



$$f = \sum (2,3,10,11) = \overline{B} \bullet C$$



$$f = \sum (0,2,8,10) = \overline{B} \bullet \overline{D}$$

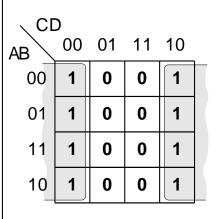


∖ C[)			
AB	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	1	0
10	0	0	1	0

∖ C[)			
AB	00	01	11	10
00	1	0	1	0
01	0	1	0	1
11	1	0	1	0
10	0	1	0	1

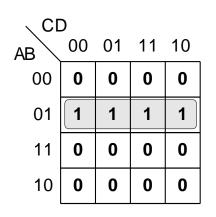
∖ CI)			
AB	00	01	11	10
00	0	1	0	1
01	1	0	1	0
11	0	1	0	1
10	1	0	1	0

∖ CD					
AB	00	01	11	10	
00	0	1	1	0	
01	0	1	1	0	
11	0	1	1	0	
10	0	1	1	0	



∖ CD					
00	01	11	10		
0	0	0	0		
1	1	1	1		
1	1	1	1		
0	0	0	0		
	00 0 1 1	00 010 01 11 1	00 01 11 0 0 0 1 1 1 1 1 1		

CI AB		01	11	10
00	1	1	1	1
01	0	0	0	0
11	0	0	0	0
10	1	1	1	1
,				



$$f = \sum (4, 5, 6, 7) = \overline{A} \bullet B$$

∖ C[)			
AB	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	1	0
10	0	0	1	0

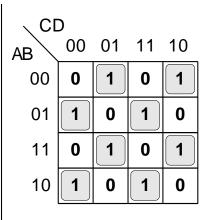
$$f = \sum (3,7,11,15) = C \bullet D$$

∖ C[)			
AB	00	01	11	10
00	1	0	1	0
01	0	1	0	1
11	1	0	1	0
10	0	1	0	1

$$f = \sum (0, 3, 5, 6, 9, 10, 12, 15)$$

$$f = A \otimes B \otimes C \otimes D$$

、 CD



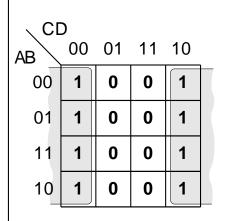
$$f = \sum (1, 2, 4, 7, 8, 11, 13, 14)$$

$$f = A \oplus B \oplus C \oplus D$$

\ C[)			
AB	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	0	1	1	0
10	0	1	1	0

$$f = \sum (1,3,5,7,9,11,13,15)$$

f = D



$$f = \sum (0,2,4,6,8,10,12,14)$$

 $f = \overline{D}$

AB	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	1	1	1	1
10	0	0	0	0

$$f = \sum (4,5,6,7,12,13,14,15)$$

CD					
AB	00	01	11	10	
00	1	1	1	1	
01	0	0	0	0	
11	0	0	0	0	
10	1	1	1	1	
•					

$$f = \sum_{\mathbf{F}} (0,1,2,3,8,9,10,11)$$

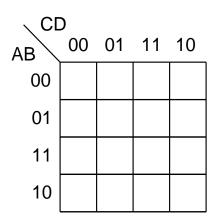
f = $\overline{\mathbf{R}}$

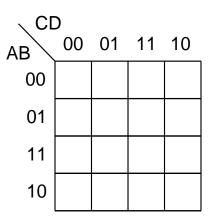
√ CD				
AB	00	01	11	10
00	1	1		1
01	1	1		1
11	1	1		1
10	1	1		

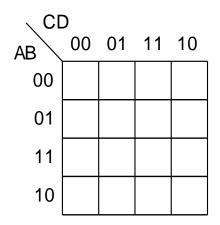
∖ CD					
AB	00	01	11	10	
00	1	1		1	
01				1	
11					
10	1	1		1	

√ CD					
AB	00	01	11	10	
00					
01	1	1	1		
11	1	1		1	
10	1				

∖ CD						
AB	00	01	11	10		
00		1	1			
01	1	1	1	1		
11	1		1	1		
10			1			

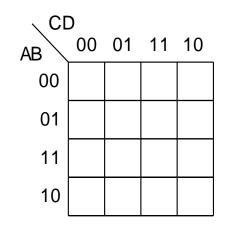


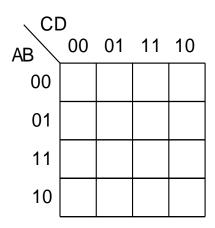


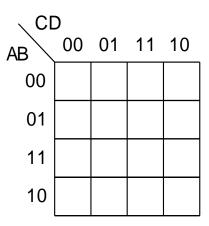


CI AB	01	11	10
00			
01			
11			
10			

∖ CD						
AB	00	01	11	10		
00						
01						
11						
10						







Exercise

- 4.7 Using a Karnaugh map, simplify the following functions and implement them with basic gates.
 - (a) $F(A, B, C, D) = \Sigma(0, 2, 3, 6, 7, 8, 10, 11, 12, 15)$
 - (b) $F(A, B, C, D) = \Sigma(0, 2, 3, 5, 7, 8, 13) + d(1, 6, 12)$
 - (c) F (A, B, C, D) = Σ (1, 7, 9, 10, 12, 13, 14, 15) + d (4, 5, 8) *
 - (d) $F(A, B, C, D) = \pi(0, 8, 10, 11, 14) + d(6)$
 - (e) F (A, B, C, D) = π (2, 8, 11, 15) + d (3, 12, 14) *
 - (f) $F(W, X, Y, Z) = \pi(0, 2, 6, 11, 13, 15) + d(1, 9, 10, 14) *$
- 4.8 Prepare a Karnaugh map for the following functions.
 - (a) F = ABC + A'BC + B'C'
 - (b) F = A + B + C'
 - (c) Y = AB + B'CD
- 4.9 Using the Karnaugh map method, simplify the following functions, obtain their sum of the products form, and product of the sums form. Realize them with basic gates.
 - (a) $F(W, X, Y, Z) = \Sigma(1, 3, 4, 5, 6, 7, 9, 12, 13)$
 - (b) $F(W, X, Y, Z) = \Sigma(1, 5, 6, 7, 11, 12, 13, 15)$
 - * Questions with don't care conditions

Thanks