Switching Circuit & Logic Design

Lecture 10 : Karnaugh Map for four variables

Karnaugh Map For Three Variables

AB\CD	00	01	11	10
00	m_0	m_1	m_3	m_2
01	m_4	m_5	m_7	m_6
11	m_{12}	m_{13}	m_{15}	m_{14}
10	m_8	m_9	m_{11}	m_{10}

Max and minterms for four variables

Maxterm	Minterm	A	B	C	D
M0 = A+B+C+D	m0 = A’B’C’D’	0	0	0	0
M1 = A+B+C+D’	m1 = A’B’C’D	0	0	0	1
M2 = A+B+C’+D	m2 = A’B’CD’	0	0	1	0
M3 = A+B+C’+D’	m3 = A’B’CD	0	0	1	1
M4 = A+B’+C+D	m4 = A’BC’D’	0	1	0	0
M5 = A+B’+C+D’	m5 = A’BC’D	0	1	0	1
M6 = A+B’+C’+D	m6 = A’BCD’	0	1	1	0
M7 = A+B’+C’+D’	m7 = A’BCD	0	1	1	1
M8 = A’+B+C+D	m8 = AB’C’D’	1	0	0	0
M9 = A’+B+C+D’	m9 = AB’C’D	1	0	0	1
M10 = A’+B+C’+D	m10 = AB’CD’	1	0	1	0
M11 = A’+B+C’+D’	m11 = AB’CD	1	0	1	1
M12 = A’+B’+C+D	m12 = ABC’D’	1	1	0	0
M13 = A’+B’+C+D’	m13 = ABC’D	1	1	0	1
M14 = A’+B’+C’+D	m14 = ABCD’	1	1	1	0
M15 = A’+B’+C’+D’	m15 = ABCD	1	1	1	1

Practice

F = A’B’CD + AB’CD’ + A’BC’D + ABC’D’ + ABCD’

Practice

F = (A+B+C+D) (A’+B+C’+D’) (A’+B’+C’+D) (A+B’+C’+D’) (A’+B’+C+D)

Reduce

AB\CD	00	01	11	10
00				
01				
11				
10				

Reduce

$$F = \sum_m (2,3,6,7,8,10,11,13,14)$$

Reduce

$$F = \Pi_M (4,6,11,14,15)$$

Don’t Care

$$F = \Sigma_m (1,5,6,12,13,14) + d(2,4)$$

Five variable K-Map

A=0

BC\DE	00	01	11	10
00	◯			◯
01	◯	◯	◯	◯
11		◯	◯	
10	◯	◯	◯	◯

A=1

BC\DE	00	01	11	10
00	◯			◯
01	◯	◯	◯	◯
11		◯	◯	
10	◯	◯	◯	◯

Five variable K-Map

A=0

BC\DE	00	01	11	10
00			◯	◯
01	◯	◯		
11	◯	◯		
10			◯	◯

A=1

BC\DE	00	01	11	10
00			◯	◯
01	◯	◯		
11	◯	◯		
10			◯	◯

2, 4, 8, 16, 32

Five variable K-Map

A=0

BC\DE	00	01	11	10
00				
01				
11				
10				

A=1

BC\DE	00	01	11	10
00				
01				
11				
10				

$$F = \sum_m (0,1,2,4,7,8,12,14,15,16,17,18,20,24,28,30,31)$$

F = D’E’ + BCD + B’C’E’ + B’C’D’ + A’CDE

Don’t Care

$$F = \sum_m (6,9,13,18,19,25,27,29,31) + d(2,3,11,15,17,24,28)$$

A=0

BC\DE	00	01	11	10
00			x	x
01				1
11		1	x	
10		1	x	

A=1

BC\DE	00	01	11	10
00		x	1	1
01				
11	x	1	1	
10	x	1	1	

BE A’B’DE’ ABD B’C’D