

University of New Brunswick

Computer Science

CS3853: Computer Architecture and Organization

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Due Date: July 26, 2024 — 11:59 PM

ASSIGNMENT 2

Submission instructions:

- Submit a pdf file to the Desire2Learn dropbox

Problem 1. Find the respective expressions for following Boolean functions using Karnaugh maps:

- $F(A,B,C) = \sum m(0, 1, 2, 3, 4, 6)$

Solution: 3 points

f	b,c			
	00	01	11	10
a 0	1	1	1	1
1	1	0	0	1

$$F = \bar{A} + \bar{C}$$

- $F(A,B,C) = \sum m(0, 4, 6, 7)$

Solution: 3 points

f	b,c			
	00	01	11	10
a 0	1	0	0	0
1	1	0	1	1

$$F = \bar{B}\bar{C} + AB$$

- $F(A, B, C, D) = \sum m(0, 1, 2, 5, 6, 7, 8, 10, 13, 15)$
Solution: 3 points

y_0	AB				
	00	01	11	10	
CD	00	1	0	0	1
	01	1	1	1	0
	11	0	1	1	0
	10	1	1	0	1

$$F = \overline{ABC} + \overline{ACD} + \overline{ACD} + \overline{ABC} + \overline{BD} + BD$$

- $F(w_1, w_2, w_3, w_4) = \prod m(0, 2, 3, 8, 9, 11, 15) + \sum d(4,5,6)$
Solution: 3 points

f	w_3, w_4			
	00	01	11	10
w_1, w_2 00	0	1	0	0
01	0	0	1	0
11	1	1	0	1
10	0	0	0	1

$$F(w_1, w_2, w_3, w_4) = (w_1 + \overline{w_2} + w_3)(w_1 + w_4)(\overline{w_1} + \overline{w_3} + \overline{w_4})(w_2 + \overline{w_3} + \overline{w_4})(\overline{w_1} + w_2 + w_3)$$

Problem 2. Find the respective expressions for following Boolean functions using the Quine-McCluskey tabular algorithm:

- $F(A, B, C) = \sum m(0, 1, 2, 3, 4, 6)$

Solution: 8 points

Variable = a,b,c

1. min terms and their binary representations

Group A1 0 000 →

1 001 →

Group A2 2 010 →

4 100 →

Group A3 3 011 →

6 110 →

2. merging of min term

0,1 00- →

Group B1 0,2 0-0 →

(A1,A2) 0,4 -00 →

1,3 0-1 →

Group B2 2,3 01- →

(A2,A3) 2,6 -10 →

4,6 1-0 →

3. merging of min term pairs

Group C1 0,1,2,3 0-- ✓

(B1,B2) 0,2,4,6 --0 ✓

1. Prime implicant chart (ignore the don't cares)

Pis\Minterms	0	1	2	3	4	6	a,b,c
0,1,2,3	X	X	X	X			0--
0,2,4,6	X		X		X	X	--0

$$F = \overline{AC}$$

- $F(A,B,C,D,E) = \sum m(0,1,2, 3, 4, 6,12,14,15,16,17,18,20,24,28,30,31)$
Solution: 12 points

<u>(0)</u> 00000 ✓	(0,1) 0000- ✓	(0,1,2,3) 000--
(1) 00001 ✓	(0,2) 000-0 ✓	(0,1,16,17) -000-
(2) 00010 ✓	(0,4) 00-00 ✓	(0,2,4,6) 00--0
(4) 00100 ✓	<u>(0,16)</u> -0000 ✓	(0,2,16,18) -00-0
<u>(16)</u> 10000 ✓	(1,3) 000-1 ✓	<u>(0,4,16,20)</u> -0-00
(3) 00011 ✓	(1,17) -0001 ✓	(4,6,12,14) 0-1-0
(6) 00110 ✓	(2,3) 0001- ✓	(4,12,20,28) --100
(12) 01100 ✓	(2,6) 00-10 ✓	<u>(16,20,24,28)</u> 1--00
(17) 10001 ✓	(2,18) -0010 ✓	<u>(12,14,28,30)</u> -11-0
(18) 10010 ✓	(4,6) 001-0 ✓	(14,15,30,31) -111-
(20) 10100 ✓	(4,12) 0-100 ✓	
<u>(24)</u> 11000 ✓	(4,20) -0100 ✓	
(14) 01110 ✓	(16,17) 1000- ✓	
<u>(28)</u> 11100 ✓	(16,18) 100-0 ✓	
(15) 01111 ✓	(16,20) 10-00 ✓	
<u>(30)</u> 11110 ✓	<u>(16,24)</u> 1-000 ✓	
(31) 11111 ✓	(6,14) 0-110 ✓	
	(12,14) 011-0 ✓	
	(12,28) -1100 ✓	
	(20,28) 1-100 ✓	
	<u>(24,28)</u> 11-00 ✓	
	(14,15) 0111- ✓	
	(14,30) -1110 ✓	
	<u>(28,30)</u> 111-0 ✓	
	(15,31) -1111 ✓	
	(30,31) 1111- ✓	

	0	1	2	3	4	6	12	14	15	16	17	18	20	24	28	30	31	
(0,1,2,3)	x	x	x	x														
(0,1,16,17)	x	x								x	x							
(0,2,4,6)	x		x		x	x												
(0,2,16,18)	x		x							x		x						
(0,4,16,20)	x				x					x			x					
(4,6,12,14)					x	x	x	x										
(4,12,20,28)					x		x						x			x		
(16,20,24,28)										x			x	x		x		
(12,14,28,30)							x	x								x	x	
(14,15,30,31)									x	x							x	x

$$F = \overline{ABC} + \overline{BCD} + \overline{ACE} + BCD + ADE$$

- $F(A,B,C,D,E) = \sum m(3,5,6,9,10,11,13,19,21,22,23,25,26,27,29)$

Solution: 12 points

<u>(3)</u> 00011 ✓	(3,11) 0-011 ✓	<u>(3,11,19,27)</u> --011
(5) 00101 ✓	(3,19) -0011 ✓	(5,13,21,29) --101
(6) 00110 ✓	(5,13) 0-101 ✓	(9,11,25,27) -10-1
(9) 01001 ✓	(5,21) -0101 ✓	(9,13,25,29) -1-01
<u>(10)</u> 01010 ✓	(6,22) -0110	<u>(10,11,26,27)</u> -101-
(11) 01011 ✓	(9,11) 010-1 ✓	
(13) 01101 ✓	(9,13) 01-01 ✓	
(19) 10011 ✓	(9,25) -1001 ✓	
(21) 10101 ✓	(10,11) 0101- ✓	
(22) 10110 ✓	<u>(10,26)</u> -1010 ✓	
(25) 11001 ✓	(11,27) -1011 ✓	
<u>(26)</u> 11010 ✓	(13,29) -1101 ✓	
(23) 10111 ✓	(19,23) 10-11	
(27) 11011 ✓	(19,27) 1-011 ✓	
<u>(29)</u> 11101 ✓	(21,23) 101-1	
	(21,29) 1-101 ✓	
	(22,23) 1011-	
	(25,27) 110-1 ✓	
	(25,29) 11-01 ✓	
	<u>(26,27)</u> 1101- ✓	

	3	5	6	9	10	11	13	19	21	22	23	25	26	27	29
(3,11,19,27)	x					x		x							x
(5,13,21,29)		x					x		x						x
(9,11,25,27)				x		x						x		x	
(9,13,25,29)				x			x					x			x
(10,11,26,27)					x	x							x	x	
(6,22)			x								x				
(19,23)								x			x				
(21,23)									x		x				
(22,23)										x	x				

$$F = \overline{C}DE + C\overline{D}E + B\overline{C}E + B\overline{C}D + \overline{B}CDE + ABDE$$