

DIG CIRC HW3

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$$y=F(x_1,x_2,x_3,x_4)=\cup_1 (0,1,2,4,7,10,13)+\cup_{\emptyset} (5,8,14)$$

$x_1x_2 \backslash x_3x_4$	00	01	11	10
00	1 ₀	1 ₁	0 ₃	1 ₂
01	1 ₄	∅ ₅	1 ₇	0 ₆
11	0 ₁₂	1 ₁₃	0 ₁₅	∅ ₁₄
10	∅ ₈	0 ₉	0 ₁₁	1 ₁₀

$x_1x_2 \backslash x_3x_4$	00	01	11	10
00	1 ₀	1 ₁	0 ₃	1 ₂
01	1 ₄	∅ ₅	1 ₇	0 ₆
11	0 ₁₂	1 ₁₃	0 ₁₅	∅ ₁₄
10	∅ ₈	0 ₉	0 ₁₁	1 ₁₀

$$\text{Prime implicants} = \overline{x_1}x_2x_4 + x_2\overline{x_3}x_4 + x_1x_3\overline{x_4} + \overline{x_1}x_3 + \overline{x_2}x_4$$

$$\text{Essential ones} = \overline{x_1}x_3, \overline{x_2}x_4, \overline{x_1}x_2x_4, x_2\overline{x_3}x_4$$

$$E = \overline{x_2}x_4 \quad D = \overline{x_1}x_3 \quad C = x_1x_3\overline{x_4} \quad B = x_2\overline{x_3}x_4 \quad A = \overline{x_1}x_2x_4$$

Cost and covered points table

	0	1	2	4	7	10	13	Cost
A					X			7
B							X	7
C						X		7
D	X	X		X				6
E	X		X			X		6

Since 1, 2, 4, 13 essential points we need to choose E, A and B, D.

	1	4	Cost
D	X	X	6

Finally, we take D.

Total cost is $E = 6, A = 7, B = 7, D = 6 \rightarrow 26$

$$F = \overline{x_2 x_4} + \overline{x_1} x_2 x_4 + x_2 \overline{x_3} x_4 + \overline{x_1 x_3}$$

Using Tabular (Quine-McCluskey) Method

	X ₁	X ₂	X ₃	X ₄
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
4	0	1	0	0
7	0	1	1	1
10	1	0	1	0
13	1	1	0	1
5	0	1	0	1
8	1	0	0	0
14	1	1	1	0

	X ₁	X ₂	X ₃	X ₄	1's amount	
0	0	0	0	0	0	✓
1	0	0	0	1	1	✓
2	0	0	1	0		✓
4	0	1	0	0		✓
8	1	0	0	0		✓
5	0	1	0	1	2	✓
10	1	0	1	0		✓
7	0	1	1	1	3	✓
14	1	1	1	0		✓
13	1	1	0	1		✓

Compare each group with below group.

	X ₁	X ₂	X ₃	X ₄	
0,1	0	0	0	-	✓
0,2	0	0	-	0	✓
0,4	0	-	0	0	✓
0,8	-	0	0	0	✓
1,5	0	-	0	1	✓
2,10	-	0	1	0	✓
4,5	0	1	0	-	✓
8,10	1	0	-	0	✓
5,7	0	1	-	1	*
5,13	-	1	0	1	*
10,14	1	-	1	0	*

Next step:

	X ₁	X ₂	X ₃	X ₄	
0,1,4,5	0	-	0	-	*
0,2,8,10	-	0	-	0	*
0,4,1,5	0	-	0	-	
0,8,2,10	-	0	-	0	

Finally, we have prime implicants from (*) terms since they can't be simplified more.

$$\overline{x_1}x_2x_4 + x_2\overline{x_3}x_4 + x_1x_3\overline{x_4} + \overline{x_1}x_3 + \overline{x_2}x_4 \quad \text{tabular}$$

$$\overline{x_1}x_2x_4 + x_2\overline{x_3}x_4 + x_1x_3\overline{x_4} + \overline{x_1}x_3 + \overline{x_2}x_4 \quad \text{karnaugh}$$

5)

a) In order to cover max 1 generating points with less prime implicant it's better to cover with 4 units if possible.

b) We take don't care values as 1 when we drawing rectangles to cover max amount of 1 with less prime implicant. Then we take as 0 when simplifying because we don't need to cover them.

Let's look at below example Karnaugh map. We a don't care value at 8. Since we can't include 8 to rectangles it has no use.

x_3x_4 $x_1x_2 \backslash$	00	01	11	10
00	1_0	1_1	0_3	1_2
01	0_4	0_5	0_6	1_7
11	ϕ_8	0_9	0_{11}	0_{10}
10	0_{12}	0_{13}	0_{15}	0_{14}