

Problem 1.1

$$(230)_{10} \rightarrow \text{octal}$$

8	230
2	28, 6
	3, 4

$$(230)_{10} = (346)_8$$

✓

$$\begin{aligned} & 3 \times 64 + 4 \times 8 + 6 \\ & 192 + 32 + 6 \\ & = 230_{10} \end{aligned}$$

Prob 1.2

$$(19D)_{16} \rightarrow \text{decimal?}$$

$$\begin{aligned} (19D)_{16} &= (1 \times 16^2 + 9 \times 16 + 13)_{10} \\ &= (256 + 144 + 13)_{10} \\ &= \underline{\underline{(413)_{10}}} \end{aligned}$$

A
B
C
D = 13
E = 14
F = 15

16	413
16	25, 13=D
	1, 9

Prob 1.3

$$(10\ 0011)_{2s \text{ complement}}$$

Because MSB is 1, The number is -ve

$$\begin{aligned} (10\ 0011)_{2s} &= -(01\ 1100 + 1)_2 \\ &= -(01\ 1101)_2 \end{aligned}$$

$$= -(1D)_{16}$$

$$= -(29)_{16}$$

Prob 1.4

$$-23_{10} \rightarrow \text{2's complement}$$

How many bits?

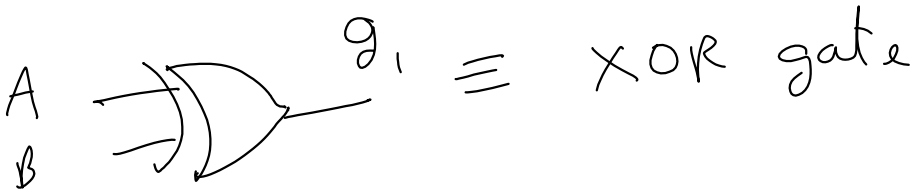
$$-23_{10} = -(17)_{16} = -(01\ 0111)_2$$

$$= (10\ 1000 + 1)_{25}$$

$$= (10\ 1001)_{25}$$

Two's complement

Problem 2



$$g_1 = \bar{A}B + A\bar{B}$$

$$g_2 = \bar{A}\bar{C} + AC$$

A	B	g_1
0	0	0
0	1	1
1	0	1
1	1	0

$$Y = g_1 \bar{g}_2 + \bar{g}_1 g_2$$

$$= (\bar{A}B + A\bar{B}) (\bar{A}\bar{C} + AC) + (\bar{A}B + A\bar{B}) (\bar{A}\bar{C} + AC)$$

$$Y = (\bar{A}B + A\bar{B}) \left(\underbrace{(A+C)(\bar{A}+\bar{C})}_{\text{XNOR}} + \underbrace{(A+\bar{B})(\bar{A}+B)}_{\text{XNOR}} \right) (\bar{A}\bar{C} + AC)$$

$$\underbrace{(A+C)(\bar{A}+\bar{C})}_{\text{XNOR}} = \underbrace{A\bar{A}}_0 + A\bar{C} + C\bar{A} + \underbrace{C\bar{C}}_0 = A\bar{C} + \bar{A}C$$

$$\underbrace{(A+\bar{B})(\bar{A}+B)}_{\text{XNOR}} = AB + \bar{A}\bar{B}$$

$$Y = (\bar{A}B + A\bar{B})(A\bar{C} + \bar{A}C) + (AB + \bar{A}\bar{B})(AC + \bar{A}\bar{C})$$

$$= \underbrace{\bar{A}B A\bar{C}}_0 + \bar{A}B \bar{A}C + A\bar{B} A\bar{C} + \underbrace{A\bar{B} \bar{A}C}_0 + AB AC + \underbrace{AB \bar{A}C}_0 + \underbrace{\bar{A}\bar{B} AC}_0 + \bar{A}\bar{B} \bar{A}\bar{C}$$

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

$$= (\bar{A}+A)BC + (A+\bar{A})\bar{B}\bar{C}$$

$$= BC + \bar{B}\bar{C} = \text{XNOR gate b/w } B \text{ and } C$$

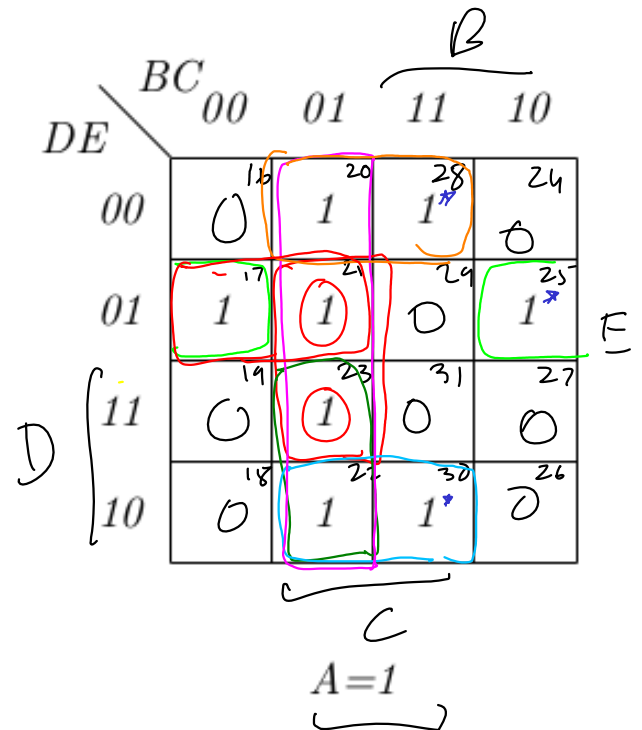
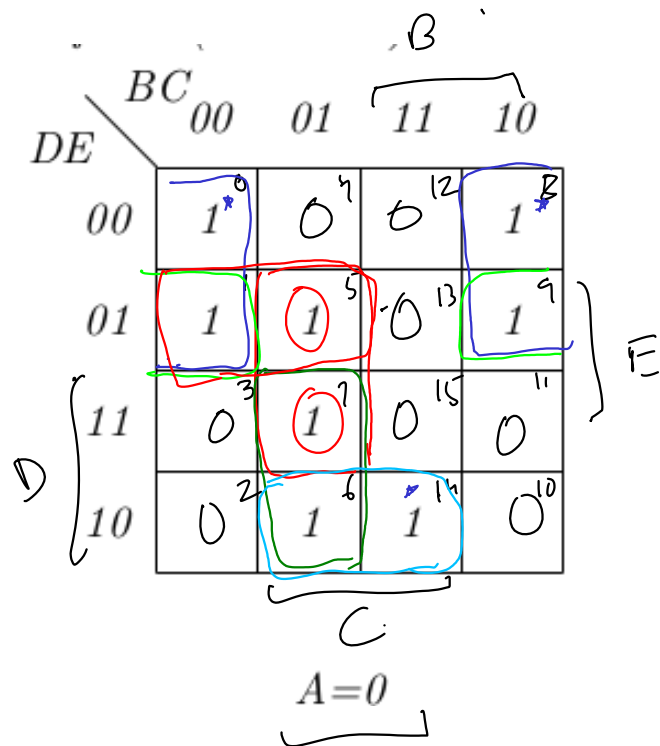
$$= \bar{B}\bar{C} + BC = \text{XNOR gate}$$

We have proved

$$Y = \overline{B}\overline{C} + B\overline{C}$$

Problem 3 5-var k map

A B C D E



$$PI = \{ \underbrace{\overline{A}\overline{C}\overline{D}}_{\Sigma m(0,18,9)}, \overline{B}CE, \overline{B}CD, CDE, \underbrace{\overline{C}\overline{D}E}_{\Sigma m(1,9,17,25)}, \underbrace{A\overline{B}C}_{\Sigma m(20,21,23,22)}, \underbrace{AC\overline{D}\overline{E}}_{\Sigma m(20,28)}, \underbrace{\overline{B}\overline{D}E}_{\Sigma m(1,5,17,21)} \}$$

$$\overline{C}\overline{D}E, A\overline{B}C, AC\overline{D}\overline{E}, \overline{B}\overline{D}E$$

$$\overline{B}\overline{D}E, \Sigma m(1,5,17,21)$$

$$EPI = \{ \bar{A}\bar{C}\bar{D}, C\bar{D}\bar{E}, \bar{C}\bar{D}E, \\ A\bar{C}\bar{D}E \}$$

Remaining minterms are $m(5, 7, 27, 23)$

Adding $\bar{B}CE$ will complete the cover with the EPIs

$$f(A, B, C, D, E) = \bar{A}\bar{C}\bar{D} + C\bar{D}\bar{E} + \bar{C}\bar{D}E \\ + A\bar{C}\bar{D}E + \bar{B}CE$$

minimum SOP expression for F

Problem 4

$$g_1 = \overline{A \cdot B} \Rightarrow \bar{g}_1 = \bar{A} \cdot \bar{B}$$

$$g_2 = \overline{A \cdot C \cdot D} \Rightarrow \bar{g}_2 = \bar{A} \cdot \bar{C} \cdot \bar{D}$$

$$g_3 = E + F + G \Rightarrow \bar{g}_3 = \bar{E} \cdot \bar{F} \cdot \bar{G}$$

$$Y = \overline{g_1 \cdot g_2 \cdot g_3}$$

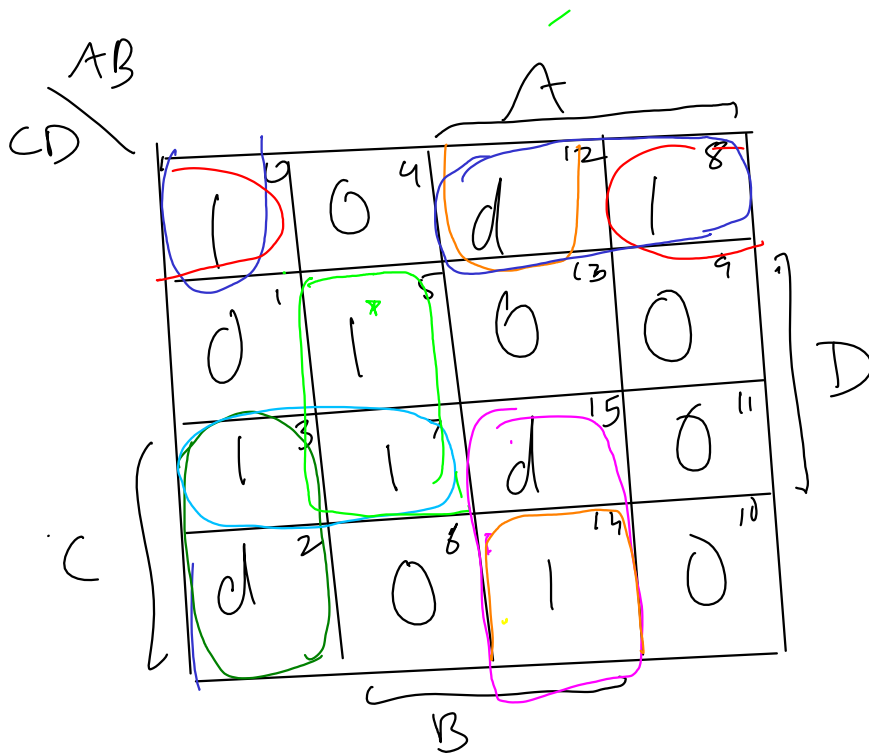
$$= \bar{g}_1 + \bar{g}_2 + \bar{g}_3$$

$$= \bar{A} \cdot \bar{B} + \bar{A} \cdot \bar{C} \cdot \bar{D} + \bar{E} \cdot \bar{F} \cdot \bar{G}$$

Prob 5

$$Y(A, B, C, D) = \sum m(0, 3, 5, 7, 8, 14) + \sum d(2, 12, 15)$$

5.1



$$PI = \{ \bar{A}\bar{B}\bar{D}, \bar{B}\bar{C}\bar{D}, \bar{A}\bar{B}C, \bar{A}CD, \bar{A}BD, \sum m(0, 2), \sum m(0, 8), \sum m(2, 3), \sum m(3, 7), \sum m(5, 7) \}$$

$$ABC, AB\bar{D}, A\bar{C}\bar{D} \}$$

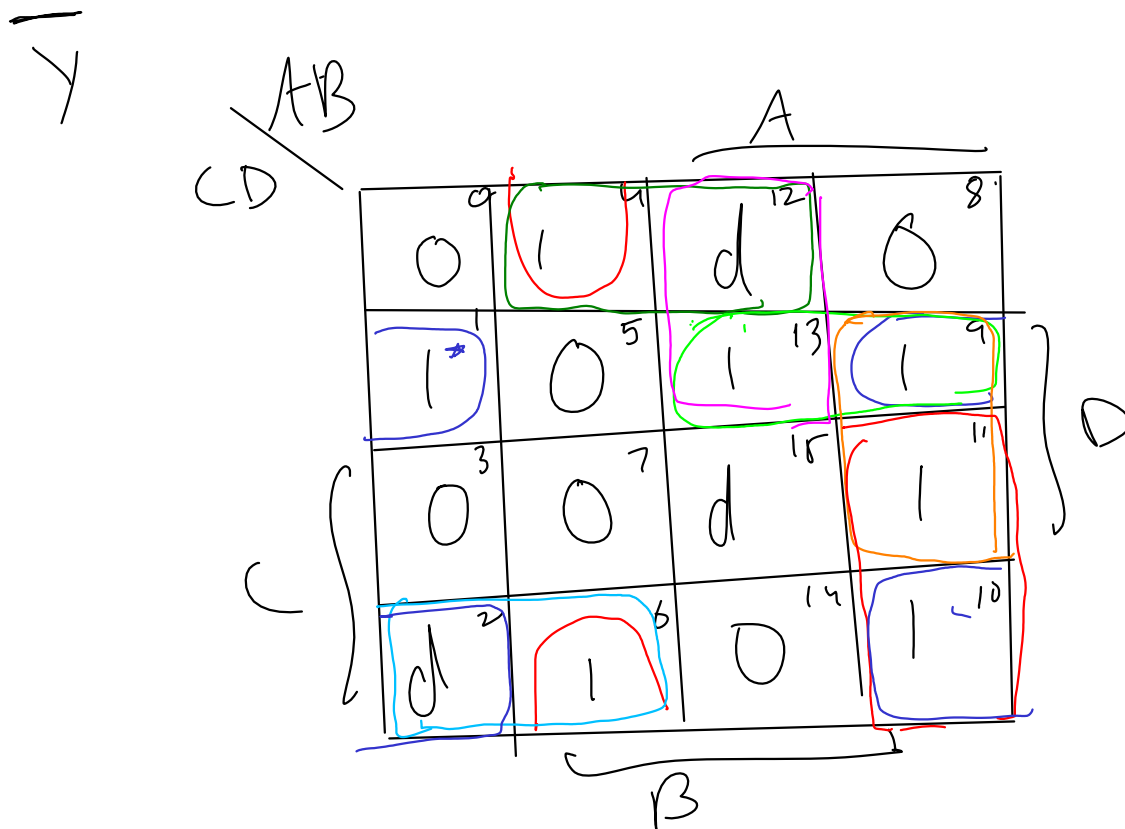
$$EPI = \{ \bar{A}BD \}$$

$$EPI \text{ round 2} = \{ \bar{A}\bar{B}C \}$$

$$\text{Addnl PI cover} = \{ \bar{B}\bar{C}\bar{D}, ABC \}$$

$$Y(A, B, C, D) = \bar{A} B D + \bar{A} \bar{B} C + \bar{B} \bar{C} \bar{D} + ABC$$

minimum SOP expression for Y



$$PI = \left\{ \begin{array}{ll} \bar{B} \bar{C} D & \sum m(1, 9) \\ \bar{A} B \bar{D} & \sum m(4, 6) \end{array} \right\}, \quad \begin{array}{ll} B \bar{C} \bar{D} & \sum m(4, 12) \\ \bar{A} C \bar{D} & \sum m(6, 2) \end{array}$$

$$\begin{array}{ll} A \bar{C} D & \sum m(9, 13) \\ AB \bar{C} & \sum m(12, 13) \end{array}, \quad \begin{array}{ll} A \bar{B} D & \sum m(9, 11) \\ A \bar{B} C & \sum m(11, 10) \end{array}$$

$$EPI = \left\{ \begin{array}{l} \bar{B} \bar{C} \bar{D} \\ \sum m(10, 2) \end{array} \right\}$$

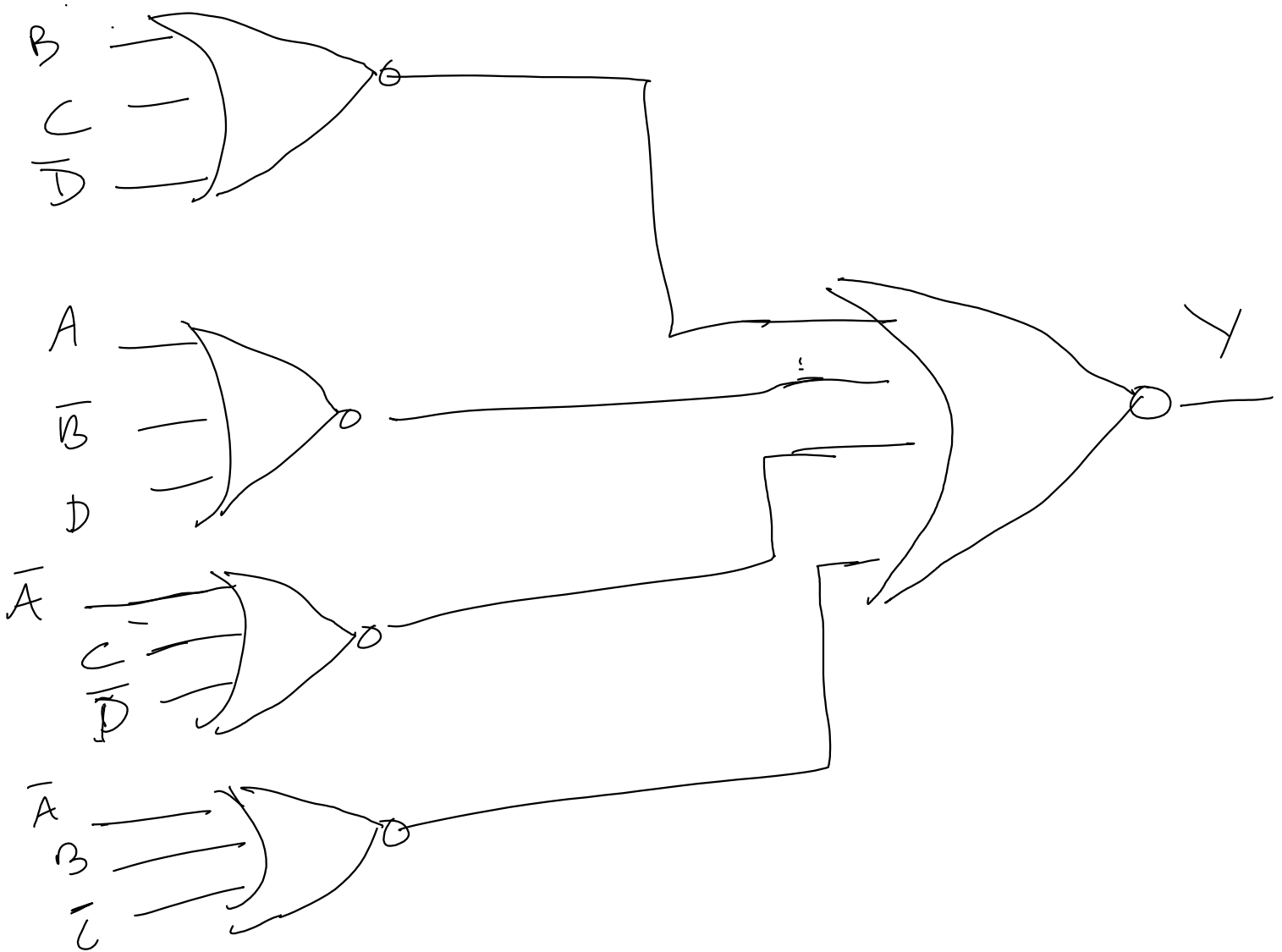
$$\text{Addnl } PIs = \left\{ \begin{array}{l} \bar{A} B \bar{D} \\ A \bar{B} C \end{array} \right\} \text{ for cover}$$

$$\overline{Y}(A, B, C, D) = \overline{B}\overline{C}D + \overline{A}B\overline{D} + A\overline{C}D + A\overline{B}C$$

$$Y(A, B, C, D) = (B + C + \overline{D})(A + \overline{B} + D)(\overline{A} + C + \overline{D})(\overline{A} + B + \overline{C})$$

minimum POS expression for Y

5.2 Sketch NOR-NOR



Prob 5.3 write Y in POS canonical form

$$Y(A, B, C, D) = \sum m(0, 3, 5, 7, 8, 14) \\ + \sum d(2, 12, 15)$$

$$= \prod M(1, 4, 6, 9, 10, 11, 13)$$

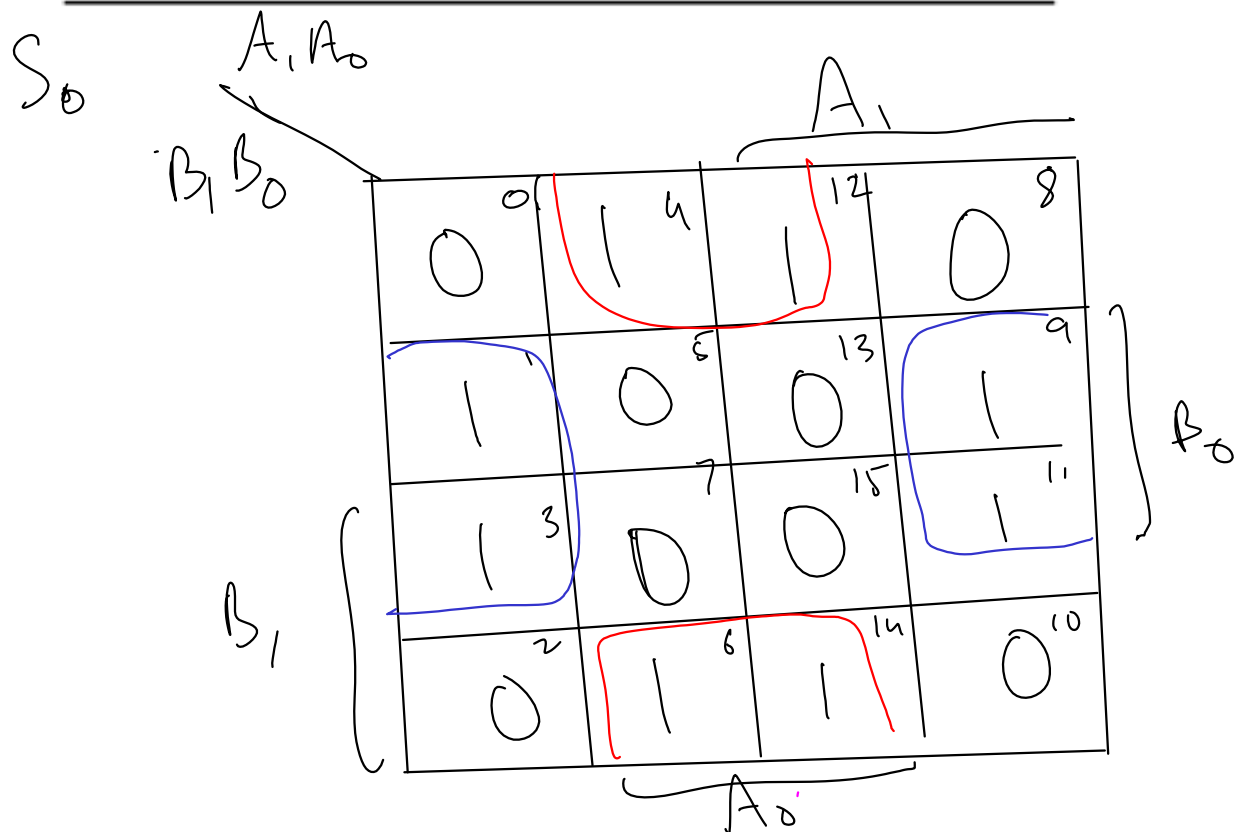
$$= (\overline{A}\overline{B}\overline{C}D)_{m_1} \cdot (\overline{A}B\overline{C}\overline{D})_{m_4} \cdot (\overline{A}B\overline{C}D)_{m_6} \cdot (A\overline{B}\overline{C}D)_{m_9} \\ \cdot (\overline{A}\overline{B}C\overline{D})_{m_{10}} (\overline{A}\overline{B}CD)_{m_{11}} (\overline{A}B\overline{C}\overline{D})_{m_{13}}$$

$$= (A+B+C+\overline{D})_{M_1} (A+\overline{B}+C+D)_{M_4} (A+\overline{B}+\overline{C}+D)_{M_6} (\overline{A}+B+C+\overline{D})_{M_9} \\ \cdot (\overline{A}+B+\overline{C}+D)_{M_{10}} (\overline{A}+\overline{B}+\overline{C}+\overline{D})_{M_{11}} (\overline{A}+\overline{B}+C+\overline{D})_{M_{13}}$$

Problem 6

$$\begin{array}{r} A_1 A_0 \\ B_1 B_0 \\ \hline 10 \\ 11 \\ \hline 101 \end{array} \quad C=1$$

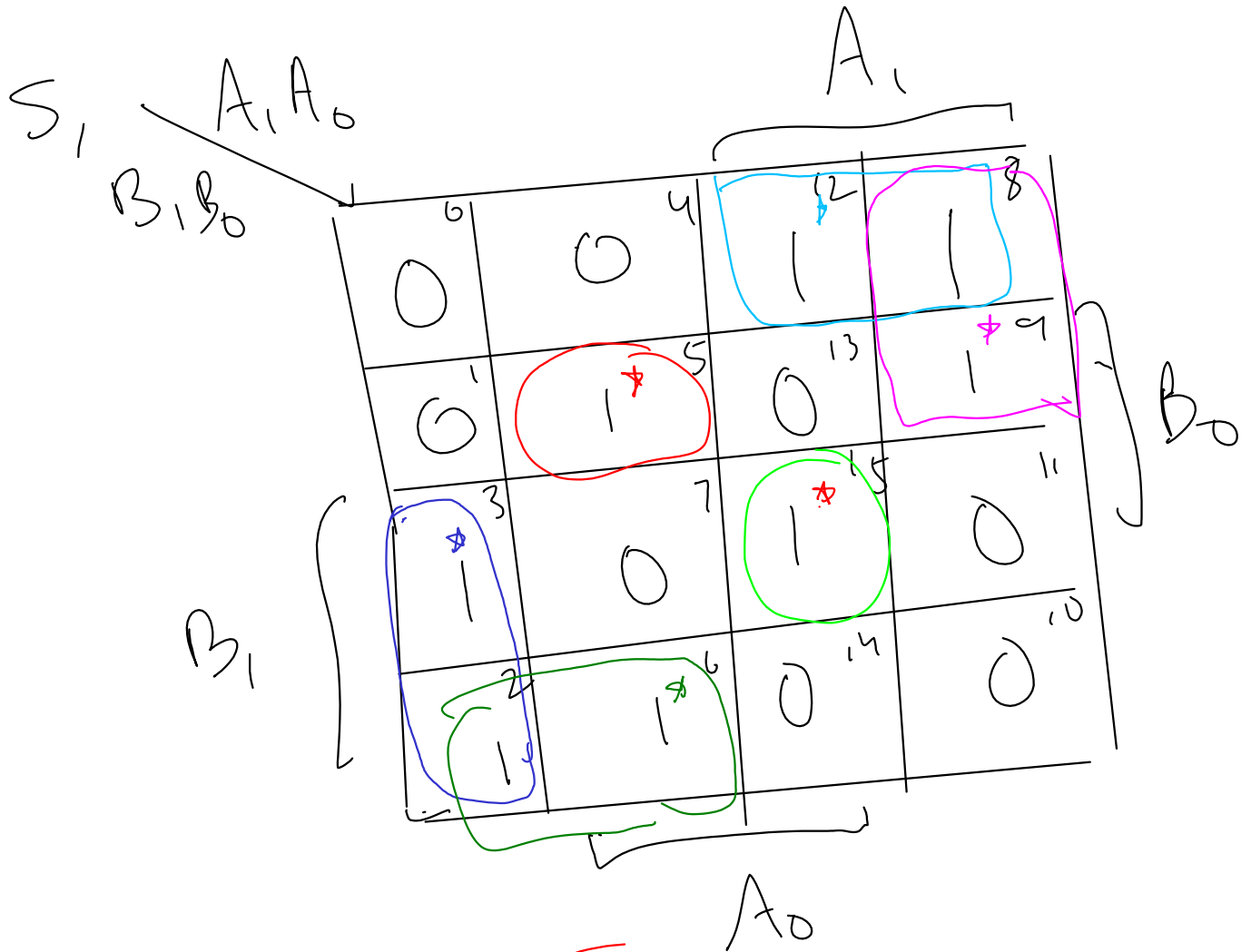
A_1	A_0	B_1	B_0	C_1	S_1	S_0
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	0	1	1
0	1	1	1	0	0	0
1	0	0	0	0	1	0
1	0	0	1	0	1	1
1	0	1	0	1	0	0
1	0	1	1	1	0	1
1	1	0	0	0	1	1
1	1	0	1	1	0	0
1	1	1	0	1	0	1
1	1	1	1	1	1	0



$$PI_S = \{ A_0 \bar{B}_0, \bar{A}_0 B_0 \}$$

$$= EPI_S$$

$$S_0 = A_0 \bar{B}_0 + \bar{A}_0 B_0$$



$$\begin{aligned}
 S_1 = & \bar{A}_1 \bar{A}_0 \bar{B}_1 + \bar{A}_1 A_0 \bar{B}_1 B_0 \\
 & + \bar{A}_1 B_1 \bar{B}_0 + A_1 \bar{B}_1 \bar{B}_0 + \\
 & + A_1 A_0 B_1 B_0 + A_1 \bar{A}_0 \bar{B}_1
 \end{aligned}$$

C_1 $\overline{B_1} B_0$ $A_1 A_0$

	0^0	0^4	0^{12}	0^8
	0^1	0^5	1^{13}	0^9
B_1	0^3	1^{*7}	1^{15}	1^{11}
	0^2	0^6	1^{14}	1^{*10}
	A_0		B_0	

$$C_1 = A_1 B_1 + A_1 A_0 B_0 + A_0 B_1 B_0$$