NSSA-102 Computer system Concepts (Fall 2023)
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Homework 2
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A. Fill-in the truth table for the below function. [1 pt]

$F(X,Y) = (X\bar{Y})\,Y \oplus X$

X	Y	F
0	0	0
0	1	0
1	0	1
1	1	1

$F(0,0) = (0\,1)\,0 \oplus 0 \Rightarrow 0 \oplus 0 = 0$

$F(0,1) = (0\,0)\,1 \oplus 0 \Rightarrow 0 \oplus 0 = 0$

$F(1,0) = (1\,1)\,0 \oplus 1 \Rightarrow 0 \oplus 1 = 1$

$F(1,1) = (1\,0)\,1 \oplus 1 \Rightarrow 0 \oplus 1 = 1$

B. Determine the SoM expression for the Boolean function F in below. Show your work.
$F(X,Y,Z) = (\,Z\,\bar{Y} + X\,)\,(\,X + \bar{Y}\,Z\,)$ [1pt]

X	Y	Z	F	
0	0	0	0	
0	0	1	1	m_1
0	1	0	0	
0	1	1	0	
1	0	0	1	m_4
1	0	1	1	m_5
1	1	0	1	m_6
1	1	1	1	m_7

$\therefore F = m_1 + m_4 + m_5 + m_6 + m_7$
$= (001) + (100) + (101) + (110) + (111)$
$= (\bar{X}\bar{Y}Z) + (X\bar{Y}\bar{Z}) + (X\bar{Y}Z) + (XY\bar{Z}) + (XYZ)$
$= (\bar{X}\bar{Y}Z) + (X\bar{Y}Z) + (X\bar{Y}\bar{Z}) + (XY\bar{Z}) + (XYZ)$
$= \bar{Y}Z + (X\bar{Y}\bar{Z}) + (XY\bar{Z}) + (XYZ)$
$= \bar{Y}(X\bar{Z} + Z) + XY\bar{Z} + (XYZ)$
$= \bar{Y}(X + Z) + XY\bar{Z} + (XYZ)$
$= \bar{Y}(X + Z) + XY(\bar{Z} + Z)$
$= \bar{Y}(X + Z) + XY \Rightarrow X\bar{Y} + \bar{Y}Z + XY = X(\bar{Y} + Y) + \bar{Y}Z = X + \bar{Y}Z$

Final Answer

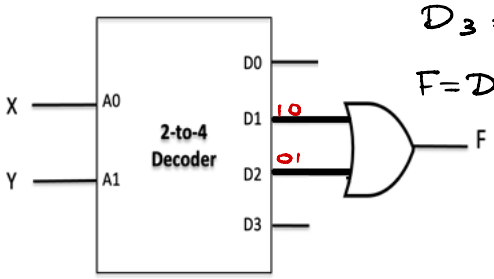
C. Determine the PoM expression for the Boolean function F in below. Show your work.
$F(A,B,C) = B \odot (\,A\,\bar{C}\,)$ [1 pt]

A	B	C	F	
0	0	0	1	
0	0	1	1	
0	1	0	0	M_2
0	1	1	0	M_3
1	0	0	0	M_4
1	0	1	1	
1	1	0	1	
1	1	1	0	M_7

$F = M_2 \cdot M_3 \cdot M_4 \cdot M_7$
$= (0+1+0)\cdot(0+1+1)\cdot(1+0+0)\cdot(1+1+1)$
$= (A+\bar{B}+C)\cdot(A+\bar{B}+\bar{C})\cdot(\bar{A}+B+C)\cdot(\bar{A}+\bar{B}+\bar{C})$

D. Given the below circuit, write a **simplified** expression of F ? [1 pt]

$F(X,Y) =$ X ⊕ Y



$D_0 = \bar{X}\bar{Y}$; $D_1 = \bar{X}Y$; $D_2 = X\bar{Y}$

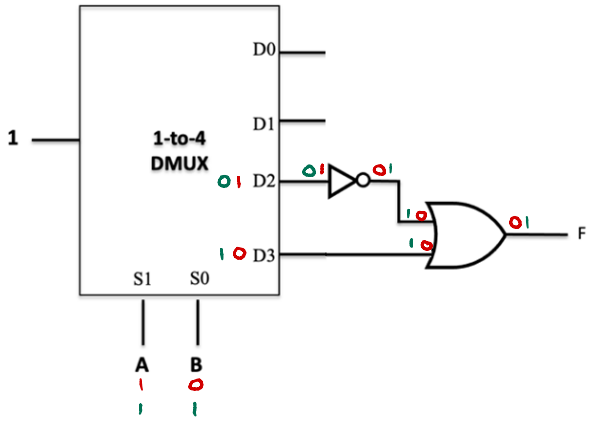
$D_3 = XY$

$F = D_1 + D_2 = \bar{X}Y + X\bar{Y}$

$= X \oplus Y$

X	Y	D_0	D_1	D_2	D_3
0	0	0	X	X	X
0	1	X	0	X	X
1	0	X	X	0	X
1	1	X	X	X	0

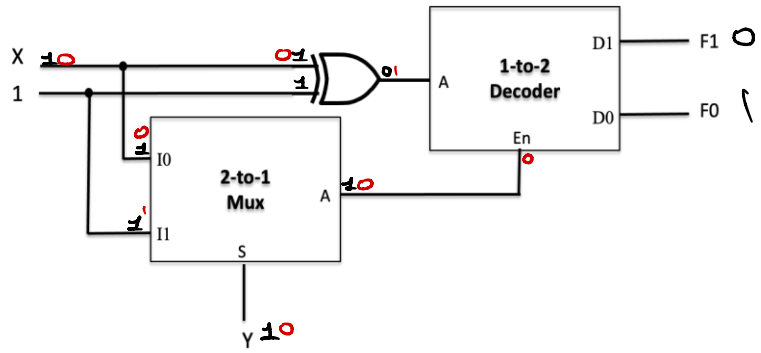
E. Fill-in the truth table for the below circuit. [1 pt]



S_1 S_0

A	B	F
0	0	X
0	1	X
1	0	0
1	1	1

F. Fill-in the truth table for the below circuit. [2 pts]



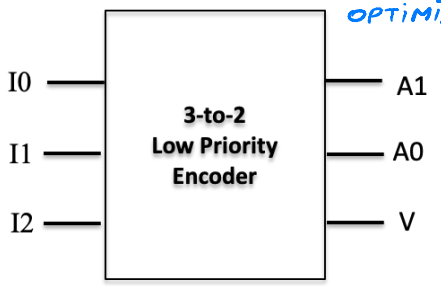
X	Y	F1	F0
0	0	X	X
0	1	1	0
1	0	0	1
1	1	0	1

G. Write down the equations of A1 and A0 in the below encoder circuit. [1 pt]

$A1 = I_1 + I_2 / I_2 \cdot \overline{I_1} \cdot \overline{I_0}$

$A0 = I_0 + (I_1 \overline{I_2}) / \overline{I_1} \cdot \overline{I_0}$

OPTIMISED NOT OPTIMISED



$A_0 = I_1 \cdot \overline{I_0}$ NOT OPTIMISED

$A_1 = I_2 \cdot \overline{I_1} \cdot \overline{I_0}$

$A_0 = I_0$ OR (I_1 AND $\overline{I_2}$)

$A_1 = I_1$ OR I_2 OPTIMISED

I_2	I_1	I_0	A_1	A_0	V
0	0	0	X	X	0
X	X	1	0	0	1
X	1	0	0	1	1
1	0	0	1	0	1

H. If N = 10101 in binary, then what is N in decimal, assuming we have signed-magnitude representation? [0.5 pts]

N = -5

I. If N = 11100 in binary, then what is N in decimal, assuming we have signed 2s complement representation? [0.5 pts]

N = -4

J. If N = +88 in decimal, then what is N in binary, assuming we have 8-bit signed 2s complement representation? [0.5 pts]

N = 01011000 -> 1s':- 00100111

K. If N = -88 in decimal, then what is N in binary, assuming we have 8-bit signed-magnitude representation? [0.5 pts]

N = 11011000