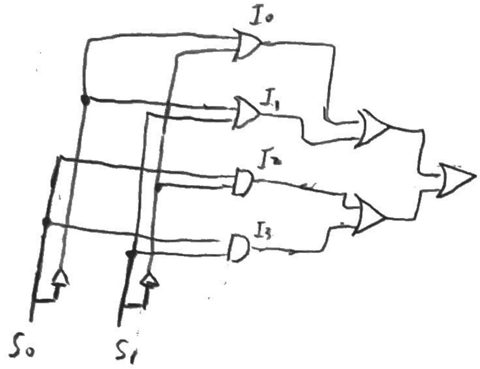
1.



S_0	S_1	y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

$y=(\bar{S_0}\bar{S_1}+I_0)+(\bar{S_0}S_1+I_1)+(S_0\bar{S_1}I_2)+(S_0S_1I_3)$

2.

X_0	X_1	X_2	F_1	F_2	F_3	F_4
0	0	0	0	0	1	0
0	0	1	0	1	1	0
0	1	0	0	1	1	0
1	0	0	0	1	0	1
0	1	1	1	0	1	0
1	0	1	1	0	0	1
1	1	0	1	0	0	1
1	1	1	0	1	0	1

$F_1=(\bar{X_0}X_1X_2)+(X_0\bar{X_1}X_2)+(X_0X_1\bar{X_2})$

$F_2=(\bar{X_0}\bar{X_1}X_2)+(\bar{X_0}X_1\bar{X_2})+(X_0\bar{X_1}\bar{X_2})+(X_0\cdot X_1X_2)$

$F_3=(\bar{X_0}\bar{X_1}\bar{X_2})+(\bar{X_0}\bar{X_1}X_2)+(\bar{X_0}X_1\bar{X_2})+(\bar{X_0}\cdot X_1\cdot X_2)$

$F_4=(X_0\bar{X_1}\bar{X_2})+(X_0\bar{X_1}X_2)+(X_0X_1\bar{X_2})+(X_0X_1X_2)$

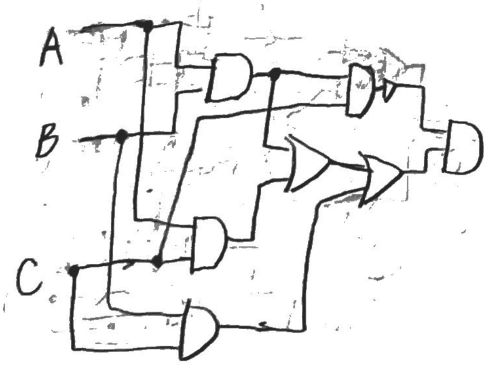
$F_2=X_0\oplus X_1\oplus X_2$

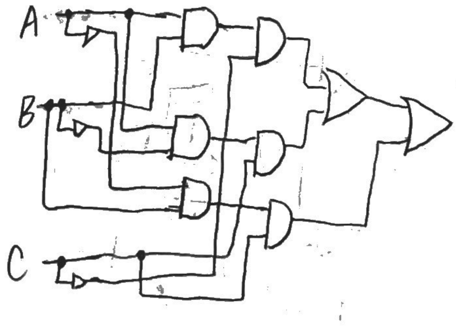
3. The equation that $E=((A\cdot B)+(A\cdot C)+(B\cdot C))\cdot\overline{(A\cdot B\cdot C)}$ is more efficient, because it only needs 7 gates while another one needs 8 gates.

$E=((A\cdot B)+(A\cdot C)+(B\cdot C))\cdot\overline{(A\cdot B\cdot C)}$

$(A\cdot B)+(A\cdot C)+(B\cdot C))\cdot(\bar{A}+\bar{B}+\bar{C})$

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





4.

$E = ((A \cdot B) + (A \cdot C) + (B \cdot C)) \cdot \overline{(A \cdot B \cdot C)}$

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

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

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

$\because A \cdot \bar{A} \cdot B,\ A \cdot B \cdot \bar{B},\ A \cdot \bar{A} \cdot C,\ A \cdot C \cdot \bar{C},\ B \cdot \bar{B} \cdot C,\ B \cdot C \cdot \bar{C}$

are always zero

$\therefore A \cdot \bar{A} \cdot B$、$A \cdot B \cdot \bar{B}$、$A \cdot \bar{A} \cdot C$、$A \cdot \bar{C} \cdot C$、$B \cdot \bar{B} \cdot C$、$B \cdot C \cdot \bar{C} \in \emptyset$

Thus $(A \cdot B \cdot \bar{A}) + (A \cdot B \cdot \bar{B}) + (A \cdot B \cdot \bar{C}) + (A \cdot \bar{A} \cdot C) + (A \cdot \bar{B} \cdot C) + (A \cdot C \cdot \bar{C}) + (\bar{A} \cdot B \cdot C) + (B \cdot \bar{B} \cdot C) + (B \cdot C \cdot \bar{C})$

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

Therefore $((A \cdot B) + (A \cdot C) + (B \cdot C)) \cdot \overline{(A \cdot B \cdot C)}$

5.

$XOR = (A+B) \cdot \overline{(A \cdot B)}$

$= (A+B) \cdot (\bar{A} + \bar{B})$

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

$\because A \cdot \bar{A},\ B \cdot \bar{B}$ are always false

$\therefore A \cdot \bar{A}$、$B \cdot \bar{B} \in \emptyset$

Thus $A \cdot \bar{A} + A \cdot \bar{B} + \bar{A} \cdot B + B \cdot \bar{B}$

$= (A \cdot \bar{B}) + (\bar{A} \cdot B)$

Therefore

$XOR = (A+B) \cdot \overline{(A \cdot B)} = (A \cdot \bar{B}) + (\bar{A} \cdot B)$

6.

A	B	C	xor
0	0	0	0
0	0	1	1
0	1	0	1
1	0	0	1
0	1	1	0
1	0	1	0
1	1	0	0
1	1	1	1

$$xor = \bar{A} \cdot \bar{B} \cdot C + \bar{A} \cdot B \cdot \bar{C} + A \cdot \bar{B} \cdot \bar{C} + A \cdot B \cdot C$$