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9/1/21

CSCI 113 Assignment 1

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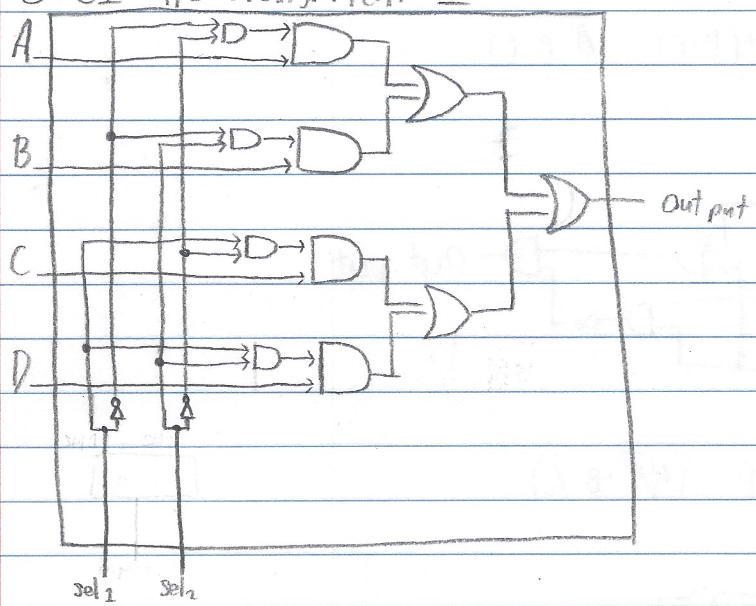


2.

X_0	X_1	X_2	F1	F2	F3	F4
0	0	0	0	0	1	0
0	0	1	0	1	1	0
0	1	0	0	1	1	0
0	1	1	1	0	1	0
1	0	0	0	1	0	1
1	0	1	1	0	0	1
1	1	0	1	0	0	1
1	1	1	0	0	0	1

F1: $(\overline{X_0} \cdot X_1 \cdot X_2) + (X_0 \cdot \overline{X_1} \cdot X_2) + (X_0 \cdot X_1 \cdot \overline{X_2})$

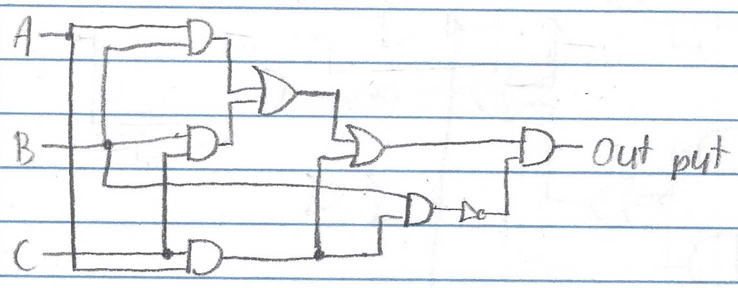
F2: $(\overline{X_0} \cdot \overline{X_1} \cdot X_2) + (\overline{X_0} \cdot X_1 \cdot \overline{X_2}) + (X_0 \cdot \overline{X_1} \cdot \overline{X_2})$

F3: $(\overline{X_0} \cdot \overline{X_1} \cdot \overline{X_2}) + (\overline{X_0} \cdot \overline{X_1} \cdot X_2) + (\overline{X_0} \cdot X_1 \cdot \overline{X_2}) + (\overline{X_0} \cdot X_1 \cdot X_2)$

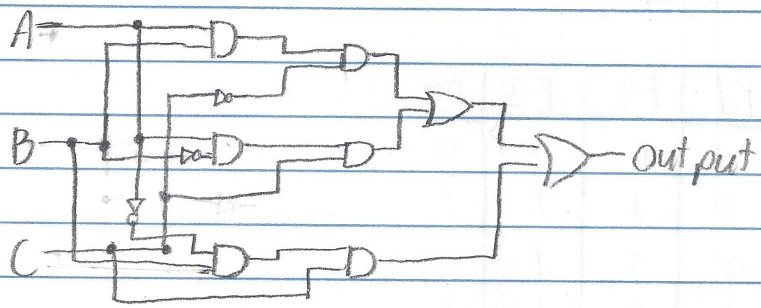
F4: $(X_0 \cdot \overline{X_1} \cdot \overline{X_2}) + (X_0 \cdot \overline{X_1} \cdot X_2) + (X_0 \cdot X_1 \cdot \overline{X_2}) + (X_0 \cdot X_1 \cdot X_2)$

XOR F2: $X_0 \oplus X_1 \oplus X_2$

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



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



The first equation is more efficient in terms of 2-input gates because it needs 7 gates while the second equation needs 8 gates.

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

$\rightarrow ((A\cdot B)+(A\cdot C)+(B\cdot C))\cdot(\overline{A}+\overline{B}+\overline{C})$ DeMorgan's Law

$\equiv (((A\cdot B)\cdot(\overline{A}+\overline{B}+\overline{C}))+((A\cdot C)(\overline{A}+\overline{B}+\overline{C}))+((B\cdot C)\cdot(\overline{A}+\overline{B}+\overline{C})))$ Distribution laws

$\equiv (((A\cdot B\cdot \overline{A})+(A\cdot B\cdot \overline{B})+(A\cdot B\cdot \overline{C}))+((A\cdot C\cdot \overline{A})+(A\cdot C\cdot \overline{B})+(A\cdot C\cdot \overline{C}))$
$+((B\cdot C\cdot \overline{A})+(B\cdot C\cdot \overline{B})+(B\cdot C\cdot \overline{C})))$ Distribution law

$\equiv ((0+0+(A\cdot B\cdot \overline{C}))+((0+(A\cdot C\cdot \overline{B})+0)+((B\cdot C\cdot \overline{A})+0+0))$ Negation laws

$\equiv (A\cdot B\cdot \overline{C})+(A\cdot C\cdot \overline{B})+(B\cdot C\cdot \overline{A})$ Identity laws

$\equiv (A\cdot B\cdot \overline{C})+(A\cdot \overline{B}\cdot C)+(\overline{A}\cdot B\cdot C)$ Commutative laws

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

$\rightarrow ((A\cdot\overline{B})+\overline{A})\cdot(A\cdot\overline{B})+B)$ Distribution laws

$\equiv ((A+\overline{A})\cdot(\overline{B}+\overline{A}))\cdot((A+B)\cdot(\overline{A}+B))$ Distribution laws

$\equiv (1\cdot(\overline{B}+\overline{A}))\cdot((A+B)\cdot 1)$ Negation laws

$\equiv (\overline{B}+\overline{A})+(A+B)$ Identity laws

$\equiv (A+B)\cdot(\overline{B}+\overline{A})$ Commutative Laws

$\equiv (A+B)\cdot(\overline{A}+\overline{B})$ Commutative Laws

$\equiv (A+B)\cdot(\overline{A\cdot B})$

6. $XOR = A \oplus B \oplus C$

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

A	B	C	output
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1