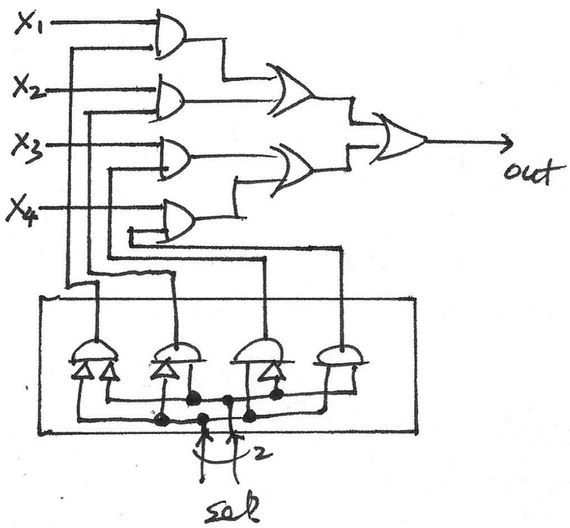
Assignment 1 key

#1 4×1 mux using only 3 gates (AND, OR, NOT).

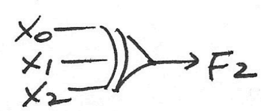


#2 Truth table

X_2	X_1	X_0	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
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	1	0	1

Rewrite F2

$F_2 = X_2 \oplus X_1 \oplus X_0$



$F_1 = \overline{X_2}\cdot X_1\cdot X_0 + X_2\cdot\overline{X_1}\cdot X_0 + X_2\cdot X_1\cdot\overline{X_0}$

$F_2 = \overline{X_2}\cdot\overline{X_1}\cdot X_0 + \overline{X_2}\cdot X_1\cdot\overline{X_0} + X_2\cdot\overline{X_1}\cdot\overline{X_0} + X_2\cdot X_1\cdot X_0$

$F_3 = \overline{X_2}\cdot\overline{X_1}\cdot\overline{X_0} + \overline{X_2}\cdot\overline{X_1}\cdot X_0 + \overline{X_2}\cdot X_1\cdot\overline{X_0} + \overline{X_2}\cdot X_1\cdot X_0$

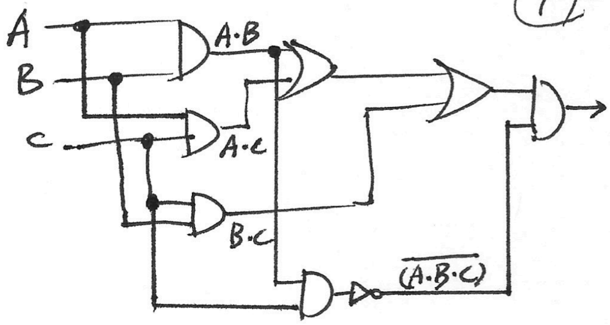
or, $F_3 = \overline{X_2}$

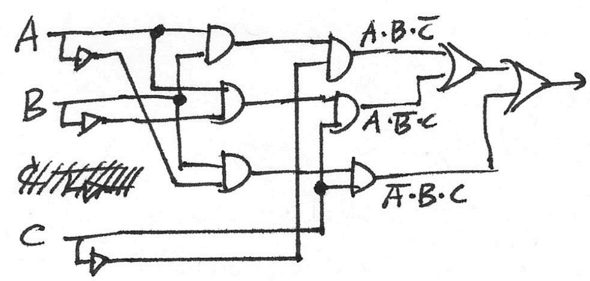
$F_4 = \cancel{X_2}:\ X_2\cdot\overline{X_1}\cdot\overline{X_0} + X_2\cdot\overline{X_1}\cdot X_0 + X_2\cdot X_1\cdot\overline{X_0} + X_2\cdot X_1\cdot X_0$

or, $F_4 = X_2$

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

7 + 8





#4
$$E=((A\cdot B)+(A\cdot C)+(B\cdot C))\cdot\overline{(A\cdot B\cdot C)}$$
$$=((A\cdot B)+(A\cdot C)+(B\cdot C))\cdot(\overline{A}+\overline{B}+\overline{C})$$ — by De Morgan's law

$$=((A\cdot B)\cdot(\overline{A}+\overline{B}+\overline{C}))+((A\cdot C)\cdot(\overline{A}+\overline{B}+\overline{C}))+((B\cdot C)\cdot(\overline{A}+\overline{B}+\overline{C}))$$ — by distributive la

$$=\left(\begin{array}{l}\underbrace{(A\cdot B\cdot\overline{A})}_{\phi}+\underbrace{(A\cdot B\cdot\overline{B})}_{\phi}+(A\cdot B\cdot\overline{C})\\+\underbrace{(A\cdot C\cdot\overline{A})}_{\phi}+(A\cdot C\cdot\overline{B})+\underbrace{(A\cdot C\cdot\overline{C})}_{\phi}\\+(B\cdot C\cdot\overline{A})+\underbrace{(B\cdot C\cdot\overline{B})}_{\phi}+\underbrace{(B\cdot C\cdot\overline{C})}_{\phi}\end{array}\right.$$

ref
$(X\cdot\overline{X})=\phi$
$(\phi+X)=X$

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

$\therefore$ $E=((A\cdot B)+(A\cdot C)+(B\cdot C))\cdot\overline{(A\cdot B\cdot C)}$
and $E=(A\cdot B\cdot\overline{C})+(A\cdot\overline{B}\cdot C)+(\overline{A}\cdot B\cdot C)$ are equivalent //.

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

start from $(A+B)\cdot\overline{(A\cdot B)}$
$$=(A+B)\cdot(\overline{A}+\overline{B})$$
$$=((A+B)\cdot\overline{A})+((A+B)\cdot\overline{B})$$
$$=(A\cdot\overline{A})+(B\cdot\overline{A})+(A\cdot\overline{B})+(B\cdot\overline{B})$$
$$=(B\cdot\overline{A})+(A\cdot\overline{B})=(A\cdot\overline{B})+(\overline{A}\cdot B)$$ //

#6

3-input XoR — True if # of Truths is odd.

X_1	X_2	X_3	XoR
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

Logic Eq:

$$XoR = (\overline{X_1}\cdot\overline{X_2}\cdot X_3) + (\overline{X_1}\cdot X_2\cdot\overline{X_3}) + (X_1\cdot\overline{X_2}\cdot\overline{X_3}) + (X_1\cdot X_2\cdot X_3)$$

— Using the idea of