

Document for Lab 03

2.1 The example of writing logical equation from the truth table in the configuration of SOP and POS.

Sum of Product (SOP)

B	C	Min term
0	0	$m_0 = \bar{B} \bar{C}$
0	1	$m_1 = \bar{B} C$
1	0	$m_2 = B \bar{C}$
1	1	$m_3 = B C$

I/P		O/P
B	C	Y
0	0	0
0	1	0
1	0	1
1	1	1

Product of Sum (POS)

B	C	Max term
0	0	$M_0 = B + C$
0	1	$M_1 = B + \bar{C}$
1	0	$M_2 = \bar{B} + C$
1	1	$M_3 = \bar{B} + \bar{C}$

$$Y = BC + BC'$$

SOP

$$\begin{aligned} Y &= (B + C) \cdot (\bar{B} + \bar{C}) \\ &= (BB + BC' + BC + CC') \\ &= B + BC' + BC = B \end{aligned}$$

So, How could we write the output equations for SOP and POS from the truth table assigned in the 2.2?

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

SOP:
$$\begin{aligned} X &= \bar{A} \bar{B} \bar{C} + \bar{A} \bar{B} C + A \bar{B} C \\ &= \bar{B} C + A \bar{B} C = (\bar{B} + A \bar{B}) C \\ &= (A + \bar{B}) C \end{aligned}$$

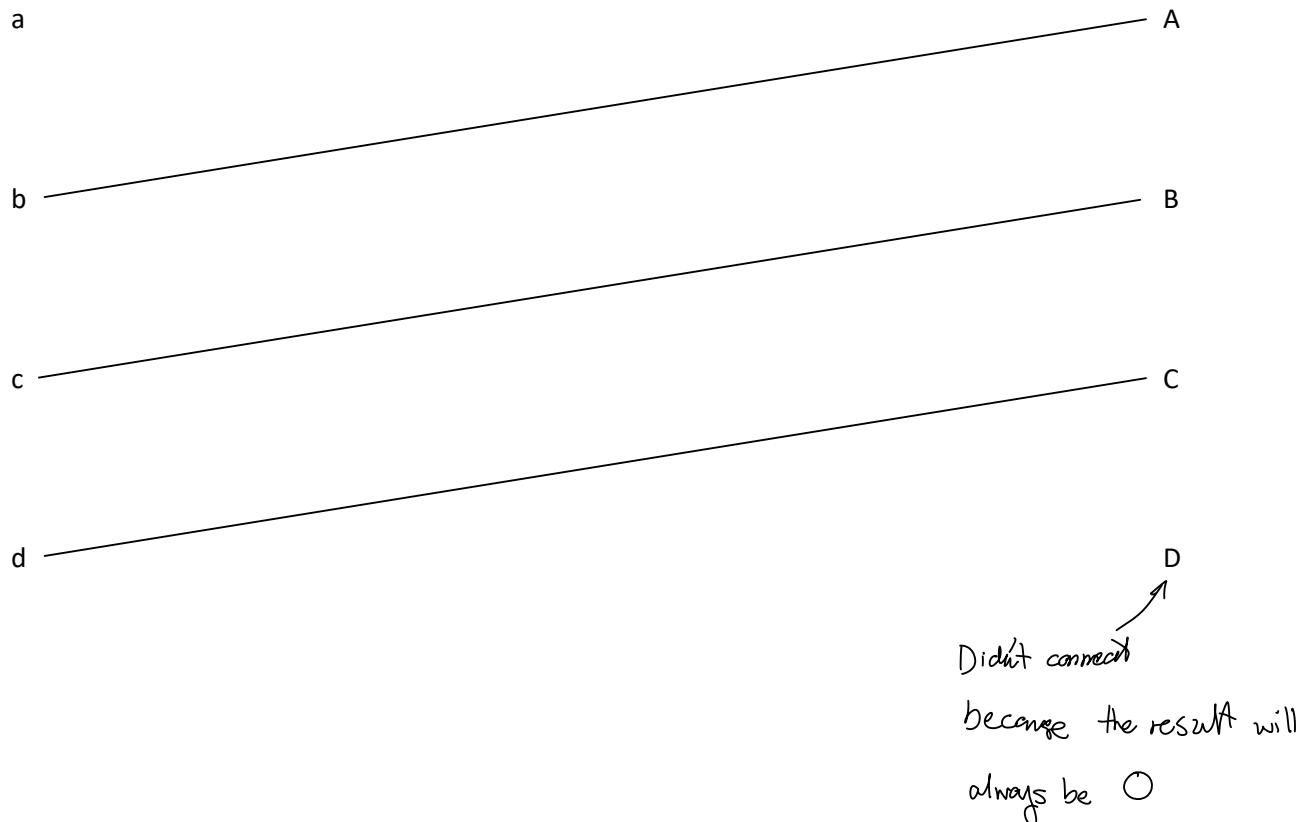
and POS:
$$X = (A + B + C)(A + \bar{B} + C)(A + \bar{B} + \bar{C})(\bar{A} + B + C)(\bar{A} + \bar{B} + C)$$

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2.2 a) The circuit shall double the input value

Input	a	b	c	d	Output	A	B	C	D
0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	2	0	0	1	0
2	0	0	1	0	4	0	1	0	0
3	0	0	1	1	6	0	1	1	0
4	0	1	0	0	8	1	0	0	0
5	0	1	0	1	10	x	0	x	0
6	0	1	1	0	12	x	x	0	0
7	0	1	1	1	14	x	x	1	0
8	1	0	0	0	x	x	x	x	x
9	1	0	0	1	x	x	x	x	x
A	1	0	1	0	x	x	x	x	x
B	1	0	1	1	x	x	x	x	x
C	1	1	0	0	x	x	x	x	x
D	1	1	0	1	x	x	x	x	x
E	1	1	1	0	x	x	x	x	x
F	1	1	1	1	x	x	x	x	x

The circuit is:

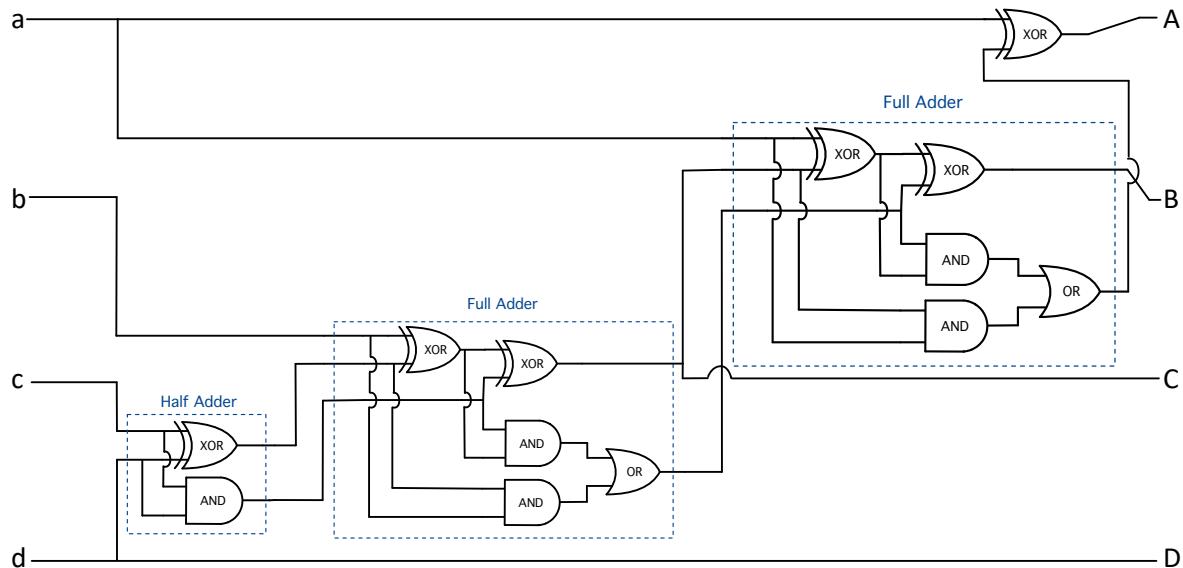


b) The circuit shall triple the input value

Input	a	b	c	d	Output	A	B	C	D
0	0	0	0	0 ✓	0	0	0	0	0
1	0	0	0	1	3	0	0	1	1
2	0	0	1	0 ✓	6	0	1	1	0
3	0	0	1	1 ✓	9	1	0	0	1
4	0	1	0	0	x	x	x	x	x
5	0	1	0	1	x	x	x	x	x
6	0	1	1	0	x	x	x	x	x
7	0	1	1	1	x	x	x	x	x
8	1	0	0	0	x	x	x	x	x
9	1	0	0	1	x	x	x	x	x
A	1	0	1	0	x	x	x	x	x
B	1	0	1	1	x	x	x	x	x
C	1	1	0	0	x	x	x	x	x
D	1	1	0	1	x	x	x	x	x
E	1	1	1	0	x	x	x	x	x
F	1	1	1	1	x	x	x	x	x

The circuit is:

CONCEPT: ADD DOUBLING WITH THE INITIAL NUMBER



2.3 Given the Boolean expression as $X = A'B' + B'C' + CD + A'D' + B'D$:

a) Construct a truth table for the given Boolean expression:

A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Hint: The term $A'B'$ would be concerned only $A = 0$ and $B = 0$, but don't care the logic of the other variables.

b) Simplify the given Boolean expression and draw the corresponding circuit to show that the results are consistent with the truth table found in a)

Simplify the Boolean expression:

$$X = \bar{A}\bar{B} + \bar{B}\bar{C} + CD + \bar{A}\bar{D} + \bar{B}D$$

$$= \overline{\bar{A}+\bar{B}} + \overline{\bar{B}+\bar{C}} + CD + \overline{\bar{A}+\bar{D}} + \overline{\bar{B}D}$$

draw the corresponding circuit:

