

Section 1:

SECTION 1

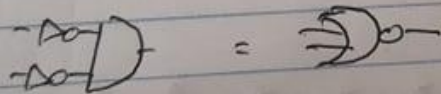
1.



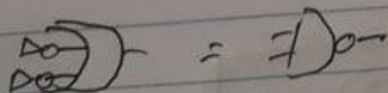
$$Q = (AB)C$$

A	B	C	Q
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

2. • An AND with inverted inputs is a NOR
 $\overline{A \cdot B} = \overline{A} + \overline{B}$



• An OR with inverted inputs is a NAND
 $\overline{\overline{A} + \overline{B}} = A \cdot B$



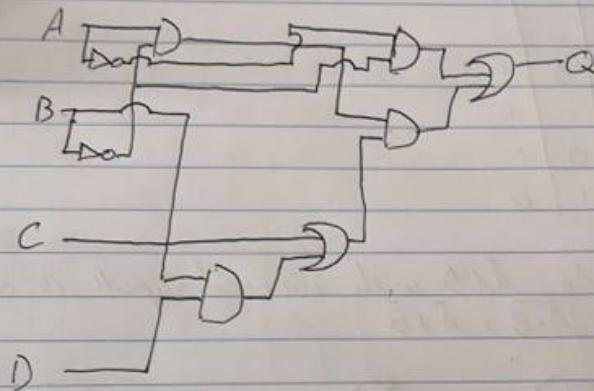
Section 2:

Normal:

Section 2

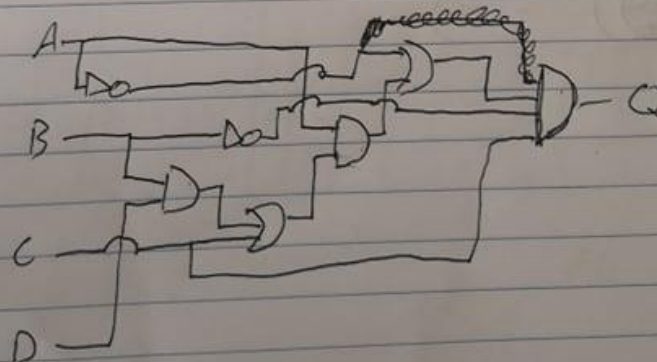
$$\begin{aligned} Q &= (A\bar{B}(C+BD) + \bar{A}\bar{B})C && \text{Common factor } B \\ &= (\bar{B}(AC) + (ABD)) + \bar{A})C && \text{Common factor } A \\ &= \bar{B}(A(C+BD)) + \bar{A})C \end{aligned}$$

Original:



$$\text{trans count} = 2 + 2 + 6 + 6 + 6 + 6 + 6 + 6 = 40$$

"Optimized":



$$\text{trans count} = 5 \times 6 + 2 \times 2 = 34$$

Alternative:

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

Truth Table

A	B	C	D	BD	C+BD	$A\bar{B}$	$A\bar{B}(C+BD)$	$\bar{A}\bar{B}$	Q
0	0	0	0	0	0	0	0	1	1
0	0	0	1	0	0	0	0	1	1
0	0	1	0	0	1	0	0	1	1
0	0	1	1	0	1	0	0	1	1
0	1	0	0	0	0	0	0	0	0
0	1	0	1	1	1	0	0	0	0
0	1	1	0	0	1	0	0	0	0
0	1	1	1	1	1	0	0	0	0
1	0	0	0	0	0	1	0	0	0
1	0	0	1	0	0	1	0	0	0
1	0	1	0	0	1	1	1	0	1
1	0	1	1	0	1	1	1	0	1
1	1	0	0	0	0	0	0	0	0
1	1	0	1	1	1	0	0	0	0
1	1	1	0	0	1	0	0	0	0
1	1	1	1	1	1	0	0	0	0

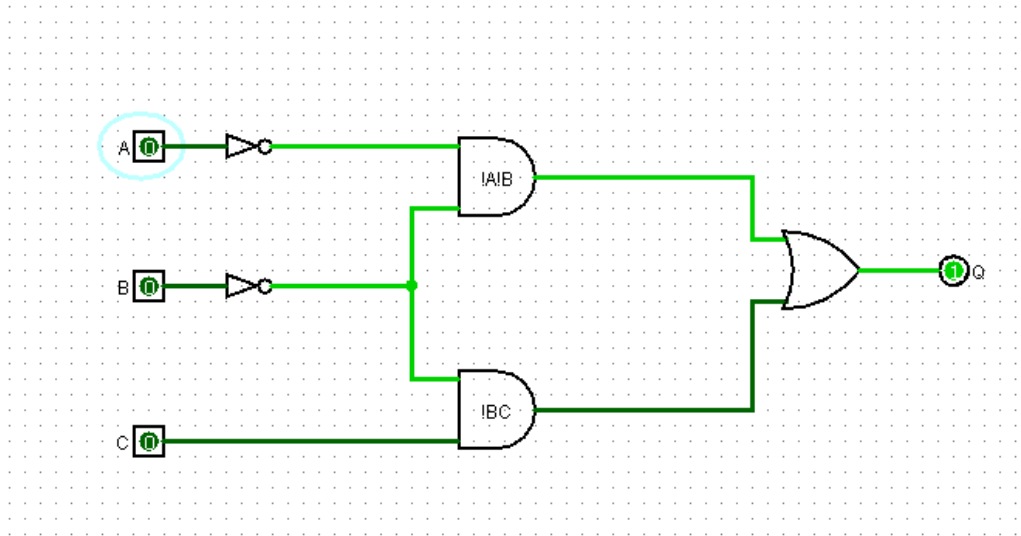
		AB			
		00	01	11	10
CD	00	1	0	0	0
	01	1	0	0	0
	11	1	0	0	1
	10	1	0	0	1

1st Loop: $\bar{A}\bar{B}$

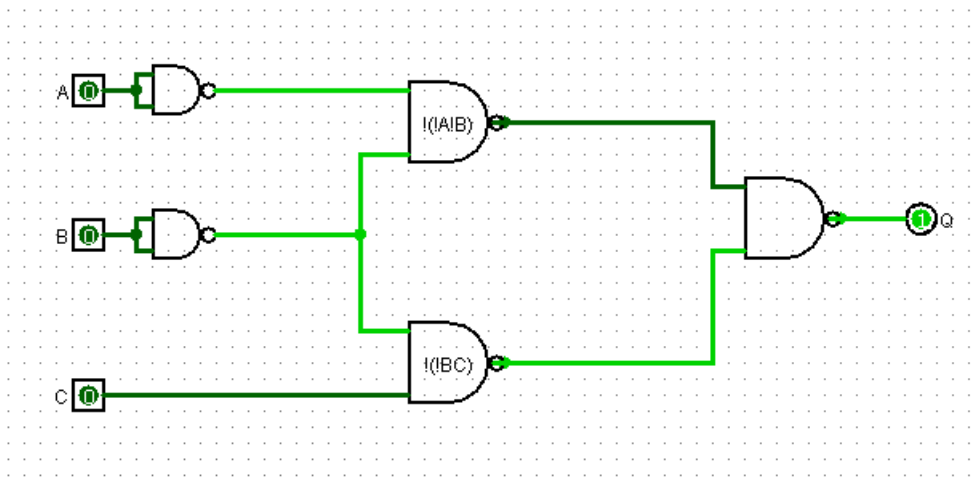
2nd Loop: $\bar{A}\bar{B}, A\bar{B}, C, D, C, \bar{D} = \bar{B}C$

So $Q = \bar{A}\bar{B} + \bar{B}C$

Optimized



NAND Only:



Trans count for optimized circuit: $3*7 + 2*2 = 25$

Trans count for NAND circuit: $5*5 = 25$

Section 3:

SECTION 3

1. Truth Table

A	B	C	Q
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

$1 \rightarrow \bar{A}\bar{B}C$
 $1 \rightarrow \bar{A}B\bar{C}$
 $1 \rightarrow \bar{A}BC$
 $1 \rightarrow A\bar{B}C$

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

3.

A \ BC	00	01	11	10
1	0	1	0	0
0	0	1	1	1

1st Loop: $A, \bar{A}, \bar{B}, C \rightarrow \bar{B}C$

2nd Loop: $\bar{A}, \bar{B}, C, BC \rightarrow \bar{A}C$

3rd Loop: $\bar{A}, B, C, \bar{C} \rightarrow \bar{A}B$

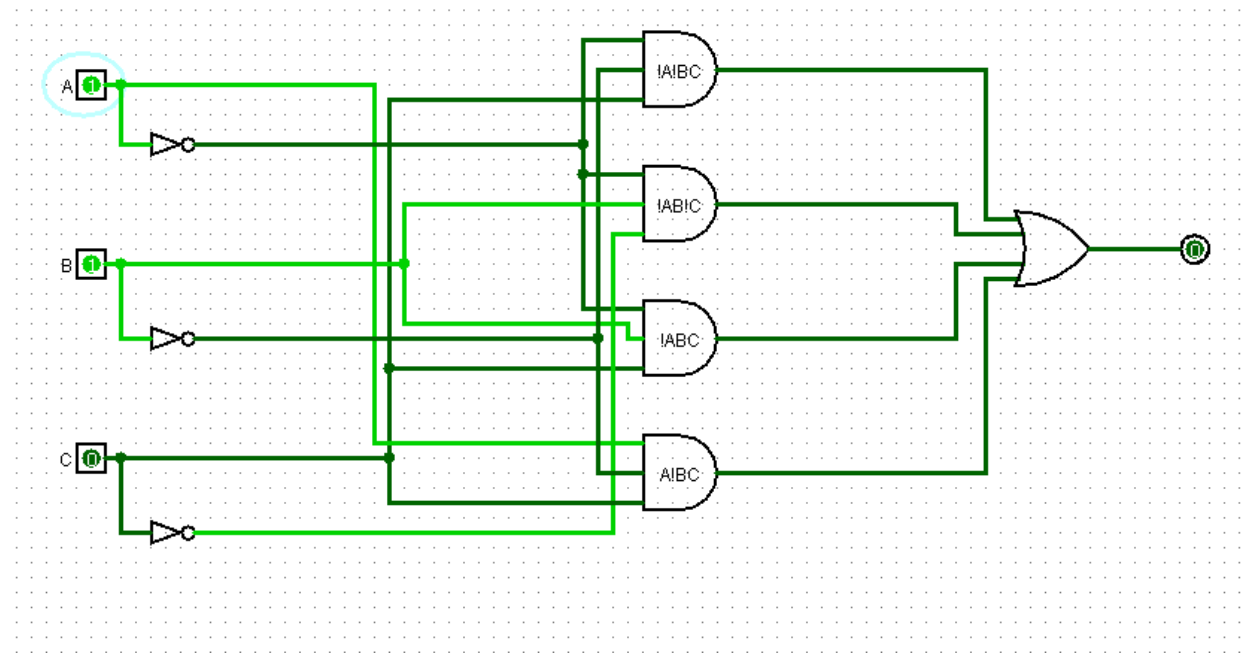
$$Q = \bar{B}C + \bar{A}C + \bar{A}B$$

Extra: trans count of un-optimized circuit: $11 \times 6 + 3 \times 8 = 162$

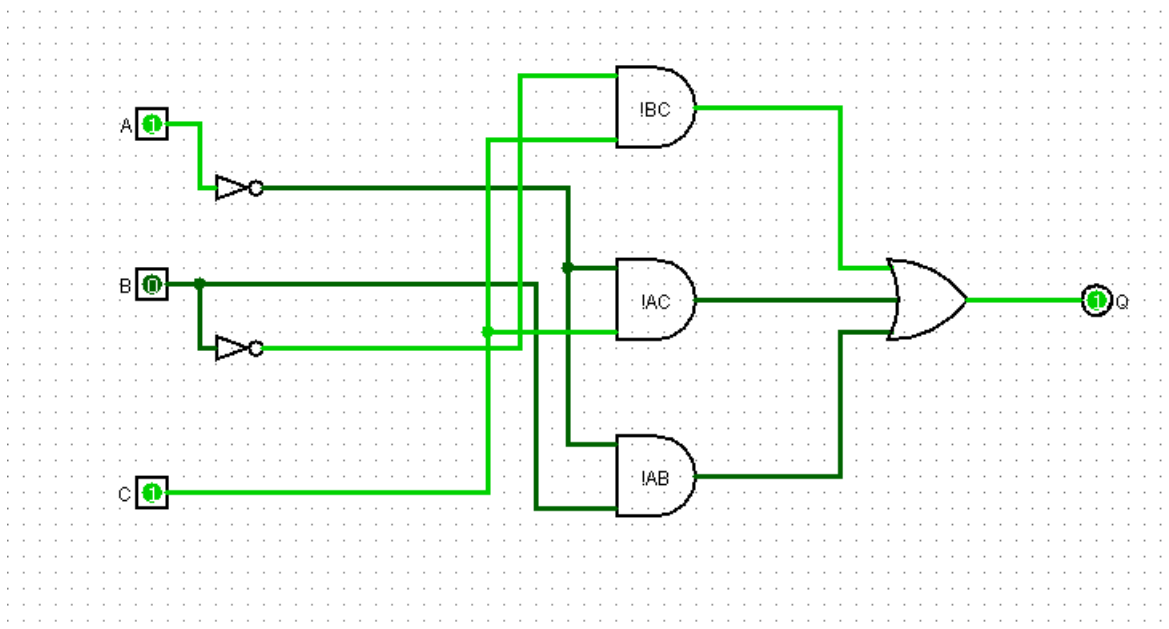
trans count of optimized circuit: $5 \times 6 + 2 \times 8 = 34$

trans count of NAND circuit: $8 \times 6 + 5 \times 7 + 2 = 49$

3.2- Non-Optimized



3.4- Optimized



3.5- NAND Only:

