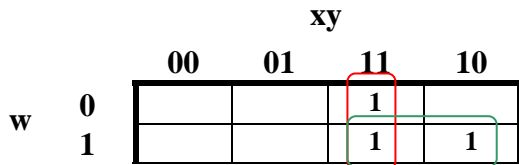


EE 2310 Homework #3 Solutions – Digital Logic Circuits: Using Karnaugh Maps for Logic Simplification

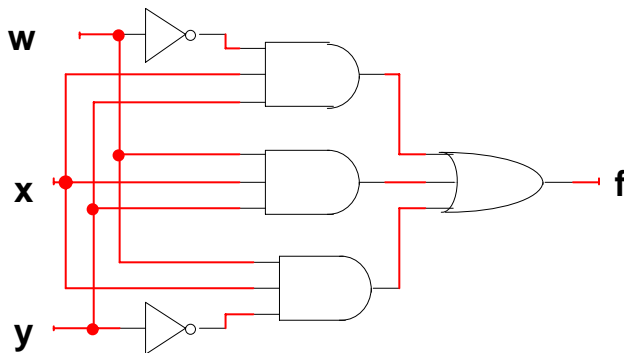
1. Given the truth table to the right, express its Boolean expression in SOP form. Draw the logic circuit that represents the Boolean expression. Then construct the Karnaugh Map, simplify the Boolean expression by determining the prime implicants, and draw the new, simplified circuit.

w	x	y	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

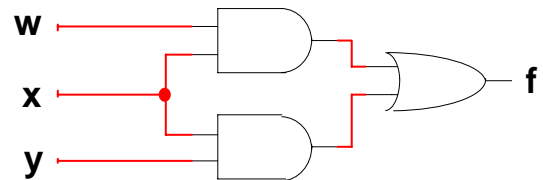


Original: $f = \bar{w}xy + wx\bar{y}$

Simplified: $f = wx + xy$



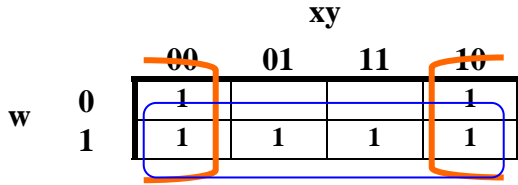
Original Circuit



Simplified Circuit

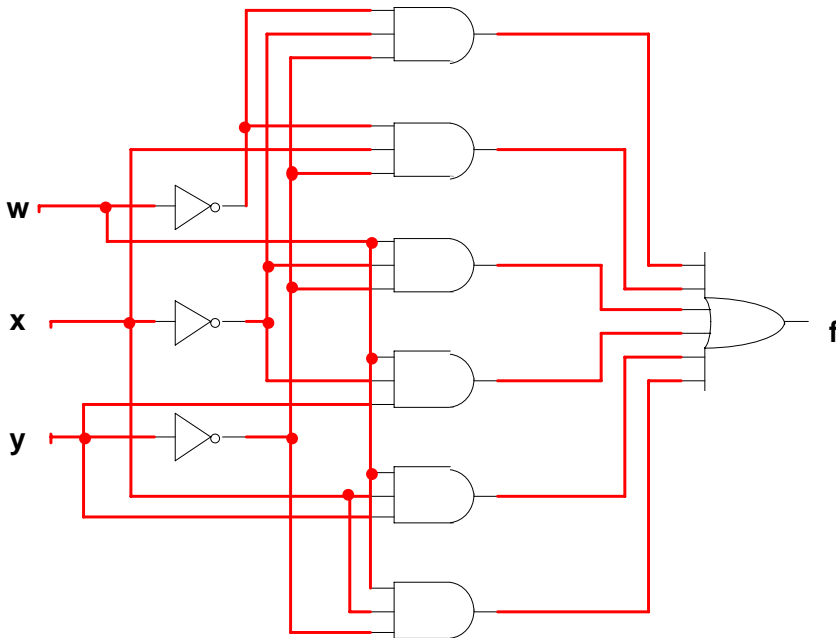
2. For the truth table to the right, write its Boolean expression in SOP form. Then draw the logic circuit that represents the Boolean expression. Construct the Karnaugh map, simplify the Boolean expression, and draw the new, simplified circuit.

w	x	y	f
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

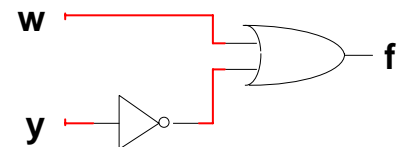


Original: $f = \overline{w} \overline{x} \overline{y} + \overline{w} \overline{x} y + \overline{w} x \overline{y} + \overline{w} x y + w \overline{x} \overline{y} + w \overline{x} y$

Simplified: $f = w + \overline{y}$



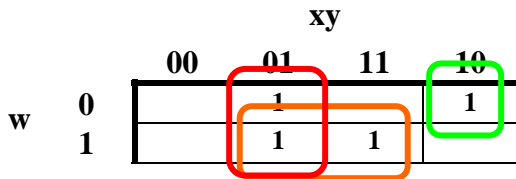
Original Circuit



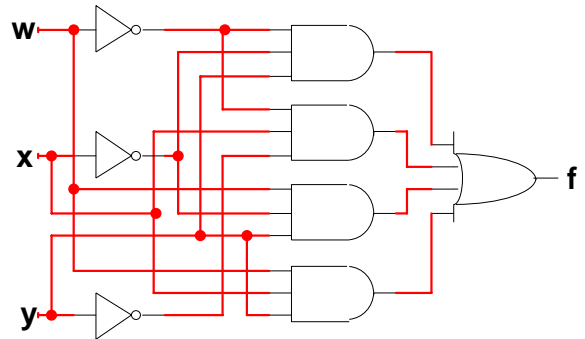
Simplified Circuit

3. For the truth table to the right, write its Boolean expression in SOP form. Then draw the logic circuit that represents the Boolean expression. Construct the Karnaugh map, simplify the Boolean expression, and draw the new, simplified circuit.

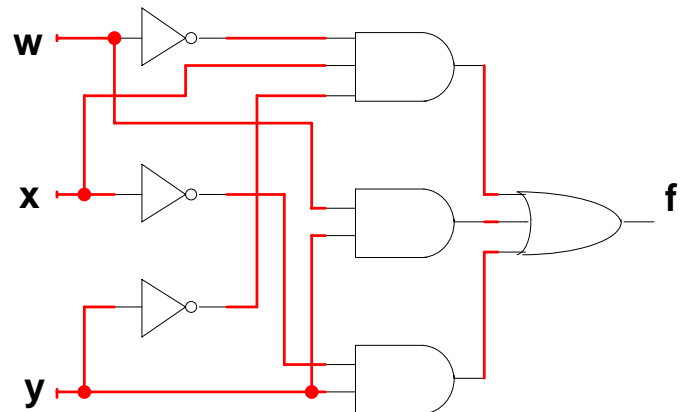
w	x	y	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



Original Expression:
 $f = \overline{w}xy + w\overline{x}y + wxy + wxy$



Original Circuit:



Simplified expression:
 $f = \overline{w}xy + w\overline{x}y + wx\overline{y}$

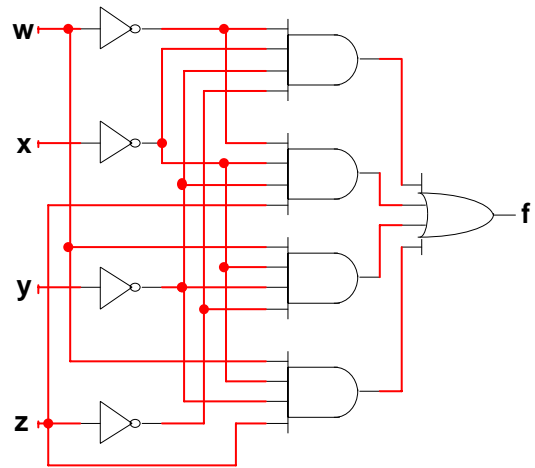
Simplified Circuit:

4. For the logic circuit at right, write its Boolean expression in SOP form. Then draw the Karnaugh map for the Boolean expression, simplify the expression, and draw the simplified circuit.

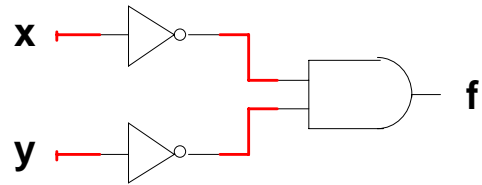
		yz			
		00	01	11	10
wx	00	1	1		
	01				
	11				
	10	1	1		

Original Expression:

$$f = \overline{w}x\overline{y}z + \overline{w}xy\overline{z} + w\overline{x}yz + wx\overline{y}z$$



Original circuit

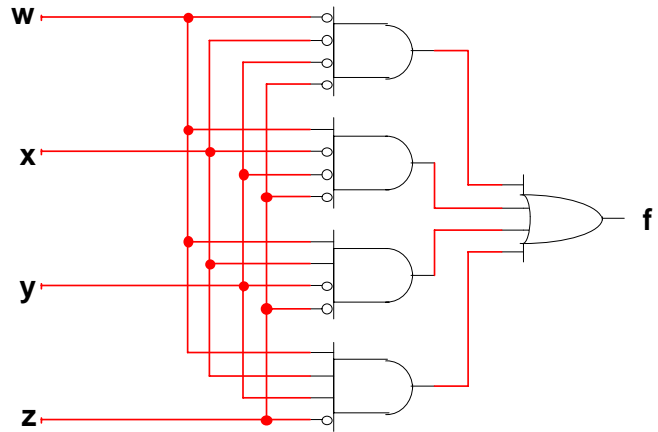
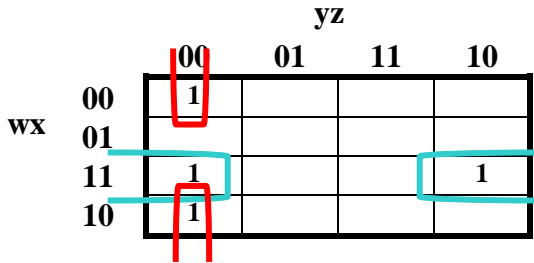


Simplified circuit

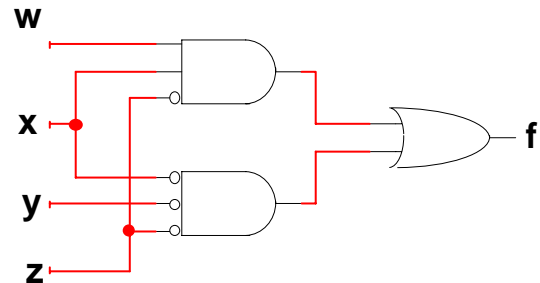
Simplified expression:

$$f = \overline{x} \overline{y}$$

5. For the logic circuit at right, write its Boolean expression in SOP form. Then draw the Karnaugh map for the Boolean expression, simplify the expression, and draw the simplest possible circuit.



$$f = \overline{w}x yz + w\overline{x} yz + wx\overline{y}z + wxyz$$

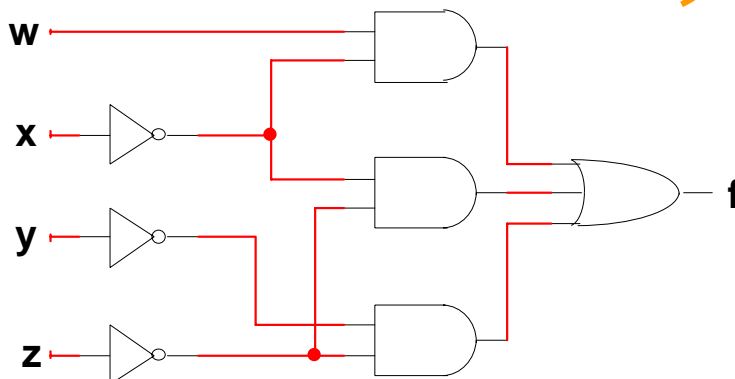
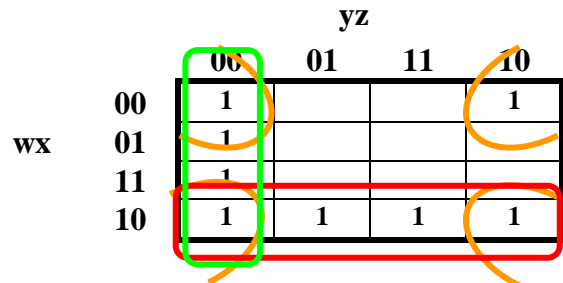


The simplified expression is: $f = \overline{x}yz + wxz$. The simplified circuit is shown above.

6. For the Karnaugh map at right, write its simplified expression, and draw the simplest possible circuit.

The simplified expression is:

$$f = \overline{w}x + xz + yz$$



7. For the Karnaugh map at right, write its Boolean expression in unsimplified SOP form. Then write the simplified expression, and draw the simplified circuit (only).

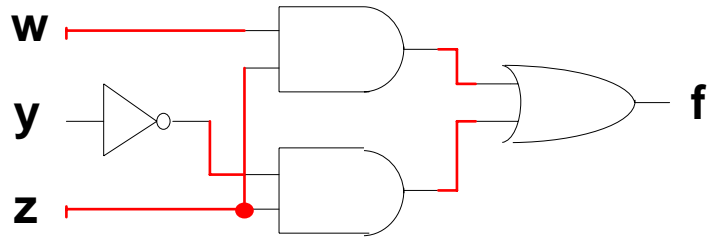
		yz			
		00	01	11	10
wx	00		1		
	01		1		
	11		1	1	
	10		1	1	

Unsimplified expression:

$$f = \overline{w} \overline{x} \overline{y} z + \overline{w} \overline{x} y \overline{z} + w x \overline{y} z + w x y \overline{z} + w \overline{x} \overline{y} z + w \overline{x} y \overline{z}$$

Simplified expression:

$$f = w z + \overline{y} z$$



Simplified circuit