

Karnaugh maps

Solutions to Student Exercises

Exercise 1:

1. AND gate:

Inputs		Output
B	A	Q
0	0	0
0	1	0
1	0	0
1	1	1

		A	
		0	1
B	0	0	0
	1	0	1

2. NOR gate:

Inputs		Output
B	A	Q
0	0	1
0	1	0
1	0	0
1	1	0

		A	
		0	1
B	0	1	0
	1	0	0

3. ExOR gate

Inputs		Output
B	A	Q
0	0	0
0	1	1
1	0	1
1	1	0

		A	
		0	1
B	0	0	1
	1	1	0

4. NAND gate

Inputs		Output
B	A	Q
0	0	1
0	1	1
1	0	1
1	1	0

		A	
		0	1
B	0	1	1
	1	1	0

5. ExNOR gate

Inputs		Output
B	A	Q
0	0	1
0	1	0
1	0	0
1	1	1

		A	
		0	1
B	0	1	0
	1	0	1

Exercise 2:

Inputs		Output
B	A	Q
0	0	1
0	1	0
1	0	1
1	1	1

		A	
		0	1
B	0	1	0
	1	1	1

Simplest Boolean expression = $\bar{A} + B$

Check via Boolean gives

$$\bar{A}\bar{B} + \bar{A}B + AB$$

$$\bar{A}\bar{B} + B \cdot (\bar{A} + A)$$

$$\bar{A}\bar{B} + B$$

$$\bar{A} + B$$

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Exercise 3.

Inputs			Output
C	B	A	Q
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

		BA			
		00	01	11	10
C	0	0	1	1	0
	1	1	1	1	0

Simplest Boolean expression = $A + \bar{B}C$

Example 2 :

		BA			
		00	01	11	10
DC	00	0	0	1	0
	01	1	1	0	1
	11	1	1	0	1
	10	0	0	1	0

Boolean expression is : $\bar{B}C + A\bar{B}\bar{C} + \bar{A}C$

Exercise 4:

1. $\overline{A}\overline{B}C + \overline{A}B\overline{C} + AB + B\overline{C}$

		BA			
C		00	01	11	10
	0	0	0	1	1
	1	1	0	1	1

Simplest Boolean expression = $B + \overline{A}C$

2. $\overline{A}\overline{B}\overline{C} + A\overline{B}\overline{C} + A\overline{B}C + \overline{A}C$

		BA			
C		00	01	11	10
	0	1	1	1	1
	1	0	1	0	0

Simplest Boolean expression = $\overline{C} + A\overline{B}$

3. $A\overline{B}\overline{C} + \overline{A}\overline{B}C + A\overline{B}C$

		BA			
C		00	01	11	10
	0	0	1	0	0
	1	1	1	0	0

Simplest Boolean expression = $A\overline{B} + \overline{B}C$ or $\overline{B}(A + C)$