

Tutorial No. 2

Boolean algebra and logic Gates

Exercise 1:

Give the truth table for the following logic functions:

1°) $f(A, B) = A\bar{B} + AB + \bar{A}B$ 2°) $g(A, B, C, D) = \bar{A}BCD + A\bar{B}\bar{C}D + \bar{A}B\bar{C}D + ABCD$

Exercise 2:

Be the truth table of the logic function F:

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1

1	0	0	0	0
1	0	0	1	0
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

- Find the F logic function
- Use the theorems of Boolean algebra to simplify the function F(A,B,C,D).

Exercise 3:

Using the truth table

- 1) Check De Morgan's Law.
- 2) Check the function NotXOR $\bar{F} = \overline{A \oplus B} = \bar{A}B + A\bar{B}$. (the function XOR est $F = A \oplus B = \bar{A}B + A\bar{B}$).

Exercise 4:

For the following Karnaugh map(K-map), give the simplified functions:

xy \ zw	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	0	1	0	1
10	0	0	0	1

xy \ zw	00	01	11	10
00	1	0	0	1
01	1	1	1	0
11	0	0	1	0
10	1	0	1	1

Exercise 5 :

Consider the following functions:

$$F(x, y, z, w) = \bar{x}\bar{y}\bar{z}w + x\bar{z}\bar{w} + xy\bar{z}w + \bar{x}yzw + \bar{y}z\bar{w} + xy\bar{z}$$

$$G(x, y, z, w) = \bar{x}y\bar{z} + xyz + \bar{x}zw + x\bar{z}w$$

- 1) Simplify the logic functions F and G, using the theorems of Boolean algebra expression and Karnaugh's map method.
- 2) Draw the equivalent logic circuits for the function G.

Exercise 6:

Consider the following Boolean function: $F(x, y, z) = \bar{x}\bar{z} + x\bar{y} + \bar{y}\bar{z}$

- 1) Using the Karnaugh method (K-Map) to simplify the function $F(x,y,z)$.
- 2) If the same function $F(x,y,z)$ is to be simplified by means of the theorems and postulates of Boolean algebra, what theorems will be used?
- 3) Draw the equivalent logic circuits for the function F.

Additional Exercises

Exercise 1:

- 1- Proving that $x + xy = x$ using two methods.
- 2- Simplify the following logic functions:

$$f(x, y) = xy + x\bar{y}$$

$$f(x, y) = (x + y)(x + \bar{y})$$

$$f(x, y, z) = xz + xy\bar{z}$$

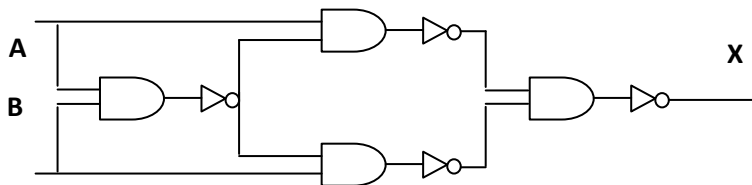
$$f(A, B) = \overline{(A + B)} (\bar{A} + \bar{B})$$

$$f(A, B) = A + \bar{A}B + A\bar{B}$$

- 3- Give the truth table of the function, $f(A, B) = A\bar{B} + \bar{B}C + \bar{A}C$

Exercise 2:

The following is an example of a logic circuit:



Give the expression for X.

Simplify the circuit for X.

Exercise 4:

Soit la fonction booléenne suivante :

$$F(x, y, z, w) = y\bar{z}\bar{w} + \bar{y}zw + \bar{x}\bar{y}z\bar{w} + \bar{x}yzw + \bar{x}yz\bar{w}$$

- 4) Simplifier la fonction $F(x, y, z, w)$, ensuite tracer le circuit équivalent.
- 5) Quel sont les termes (à 4 variables) qu'il faut ajouter à la fonction initial $F(x, y, z, w)$ (non simplifier), pour obtenir une fonction simplifier avec des termes à deux variables seulement.

Solutions

Exercice 1 :

$$F(A, B) = A\bar{B} + AB + \bar{A}B$$

A	B	$A\bar{B}$	AB	$\bar{A}B$	F
0	0	0	0	0	0
0	1	0	0	1	1
1	0	1	0	0	1
1	1	0	1	0	1

Exercice 2 :

$$F(A, B, C, D) = \bar{A}B\bar{C}\bar{D} + \bar{A}BC\bar{D} + A\bar{B}CD + ABCD + \bar{A}BCD$$

$$F(A, B, C, D) = \bar{A}B\bar{C}(\bar{D} + D) + ACD(\bar{B} + B) + \bar{A}BCD$$

$$F(A, B, C, D) = \bar{A}B\bar{C} + ACD + \bar{A}BCD \quad ((\bar{D} + D) = 1)$$

$$F(A, B, C, D) = \bar{A}B\bar{C} + CD(A + \bar{A}B) \quad ((A + \bar{A}B) = (A + B)) \text{ th de consensus}$$

$$F(A, B, C, D) = \bar{A}B\bar{C} + ACD + BCD$$

Exercice 3 :

2) La fonction XOR est $F = A \oplus B = \bar{A}B + A\bar{B}$

A	B	$F = A \oplus B$	$\bar{F} = \overline{A \oplus B}$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	0	1

$$F = \bar{A}B + A\bar{B} \text{ sqfd}$$

Exercice 4 :

	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	0	1	0	1
10	0	0	0	1

	00	01	11	10
00	1	0	0	1
01	1	1	1	0
11	0	0	1	0
10	1	0	1	1

$$F(x, y, z, w) = \bar{x}\bar{w} + xy\bar{z}w + z\bar{w}$$

$$F(x, y, z, w) = \bar{x}\bar{z}\bar{w} + \bar{x}yw + xzw + \bar{y}\bar{w}$$

Exercice 5 :

$$1) F(x, y, z, w) = \bar{x}\bar{y}\bar{z}w + x\bar{z}\bar{w} + xy\bar{z}w + \bar{x}yzw + \bar{y}z\bar{w} + xy\bar{z}$$

	00	01	11	10
00	0	1	0	1
01	0	0	1	0
11	1	1	0	0
10	1	0	0	1

$$F(x, y, z, w) = x\bar{z}\bar{w} + \bar{x}\bar{y}\bar{z}w + xy\bar{z} + \bar{x}yzw + \bar{y}z\bar{w}$$

2) $G(x, y, z, w) = \bar{x}y\bar{z} + xyz + \bar{x}zw + x\bar{z}w$ (fonction G est déjà simplifier au max)

xy \ zw	00	01	11	10
00	x	0	1	0
01	1	1	1	0
11	0	1	1	1
10	0	1	0	x

$$G(x, y, z, w) = \bar{x}y\bar{z} + xyz + \bar{x}zw + x\bar{z}w$$

Exercice 6 :