



Lista de Exercícios 4 – Álgebra Booleana e Mapa de Karnaugh

1. Monte a tabela verdade para cada uma das funções booleanas abaixo:

a) $F(A, B, C) = ABC + \overline{AB}$

b) $F(A, B, C) = A + \overline{AC} + \overline{B}C$

c) $F(A, B, C) = (\overline{A} + B)(A + C)$

d) $F(A, B, C, D) = BD + \overline{AC} + \overline{ABD}$

e) $F(A, B, C, D) = (A + B)(B + \overline{C} + D)$

f) $F(A, B, C, D) = D + \overline{AD} + \overline{BCD}$

2. Determine a função booleana correspondente para cada tabela verdade abaixo utilizando uma soma-de-produtos padrão e também um produto-de-somas padrão:

a)

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

b)

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

c)

A	B	C	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	0
1	1	1	1

d)

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

e)

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

3. Obtenha a função booleana simplificada (em soma-de-produtos) de cada mapa de Karnaugh abaixo:

a)

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

b)

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

c)

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

d)

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

e)

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

f)

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

g)

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

h)

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

i)

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

j)

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

k)

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

l)

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

m)

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

n)

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

4. Simplifique as seguintes funções booleanas usando mapas de karnaugh. A função booleana simplificada deve ser uma soma-de-produtos.

a) $F(A, B, C) = A \overline{B}C + \overline{A}BC + \overline{A}\overline{B}C$

b) $F(A, B, C) = \sum m(1, 2, 6, 7)$

c) $F(A, B, C) = (A + \overline{B} + C)(\overline{A} + B + \overline{C})(A + \overline{B} + \overline{C})(A + B + \overline{C})$

d) $F(A, B, C) = \prod M(2, 4, 5, 7)$

e) $F(A, B, C) = \sum m(2, 5) + \sum d(0, 1, 4, 7)$

f) $F(A, B, C, D) = \sum m(0, 3, 5, 8, 13, 15)$

g) $F(A, B, C, D) = A \overline{B}CD + \overline{A}BCD + \overline{C}D$

h) $F(A, B, C, D) = (A + \overline{B} + C + D)(\overline{A} + B + \overline{C} + \overline{D})(A + B + C + \overline{D})(A + B + C + D)$

i) $F(A, B, C, D) = \sum m(1, 2, 5, 10, 11) + \sum d(0, 7, 8, 9)$

j) $F(A, B, C, D) = \sum m(1, 2, 4, 8, 11, 12, 15)$

GABARITO

1.

a)

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

b)

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

c)

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

d)

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	0
0	1	0	1	1
0	1	1	0	0
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	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

e)

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	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	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

f)

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

2.

a)

- soma-de-produtos:

$$F(A, B, C, D) = \overline{A} \overline{B} \overline{C} \overline{D} + \overline{A} \overline{B} \overline{C} D + \overline{A} \overline{B} C \overline{D} + \overline{A} \overline{B} C D + A \overline{B} \overline{C} \overline{D} + A \overline{B} \overline{C} D + A B C \overline{D}$$

- produto-de-somas:

$$F(A, B, C, D) = (A + B + \overline{C} + \overline{D})(A + \overline{B} + C + \overline{D})(A + \overline{B} + \overline{C} + D)(A + \overline{B} + \overline{C} + \overline{D})(\overline{A} + B + C + D)(\overline{A} + B + \overline{C} + D)(\overline{A} + \overline{B} + C + D)(\overline{A} + \overline{B} + \overline{C} + \overline{D})$$

b)

- soma-de-produtos:

$$F(A, B, C, D) = \overline{A} \overline{B} \overline{C} D + \overline{A} \overline{B} C \overline{D} + \overline{A} B \overline{C} D + \overline{A} B C \overline{D} + A \overline{B} C D + A B \overline{C} \overline{D} + A B \overline{C} D$$

- produto-de-somas:

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

c)

- soma-de-produtos:

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

- produto-de-somas:

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

d)

- soma-de-produtos:

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

- produto-de-somas:

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

e)

- soma-de-produtos:

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

- produto-de-somas:

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

3. Pode haver diferentes respostas corretas para esse exercício!

a)

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

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

b)

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

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

c)

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

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

d)

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

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

e)

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

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

f)

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

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

g)

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

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

h)

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

$$F(A, B, C, D) = \textcolor{red}{B}D + \textcolor{green}{\overline{B}}\overline{D} + \textcolor{blue}{A}\overline{C}D$$

i)

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

$$F(A, B, C, D) = \textcolor{red}{\overline{C}}D + \textcolor{green}{B}C\overline{D} + \textcolor{blue}{\overline{B}}\overline{C}$$

j)

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

$$F(A, B, C, D) = \textcolor{red}{B}\overline{C}\overline{D} + \textcolor{green}{A}B\overline{D} + \textcolor{blue}{\overline{B}}D$$

k)

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

$$F(A, B, C, D) = \textcolor{red}{B}D + \textcolor{green}{\overline{B}}\overline{D}$$

l)

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

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

m)

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

The Karnaugh map for function m) is shown. The variables are AB (rows) and CD (columns). The map contains the following values:

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

The prime implicants are circled in the image:

- Purple oval: (00,00), (00,01)
- Blue oval: (00,01), (01,01)
- Green oval: (01,01), (01,10)
- Red oval: (01,01), (01,11)

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

n)

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

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

4. Pode haver diferentes respostas corretas para esse exercício!

a)

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

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

b)

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

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

c)

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

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

d)

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

$$F(A, B, C) = ABC + \overline{A}\overline{B} + \overline{A}C$$

e)

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

$$F(A, B, C) = \overline{A}\overline{C} + \overline{B}$$

f)

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

$$F(A, B, C, D) = \overline{B}\overline{C}D + ABD + \overline{B}\overline{C}\overline{D} + \overline{A}\overline{B}CD$$

g)

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

$$F(A, B, C, D) = \overline{C}D + \overline{A}BD + A\overline{B}D$$

h)

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

$$F(A, B, C, D) = C\overline{D} + A\overline{C} + \overline{A}C + BD$$

i)

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

$$F(A, B, C, D) = \overline{A}\overline{C}D + A\overline{B} + \overline{B}\overline{D}$$

j)

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

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