

Técnicas Digitais para Computação

Minimização de Funções Booleanas Método de Quine-McCluskey

Aula 13b

Exemplo: Ordem ABCD

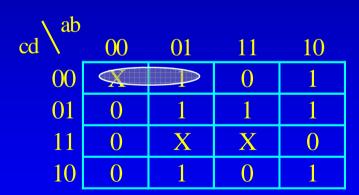
Note: Uso de *Don't Cares* na especificação da F.

Exemplo

cd\ab	00	01	11	10
00	X	1	0	1
01	0	1	1	1
11	0	X	X	0
10	0	1	0	1

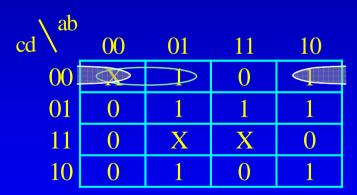
Co	lu	n .	a 0
00	0 0	(0)
01 10	0 0 0 0	(4)8)
01 01 10 10	0 1 1 0 0 1 1 0	(((1	5) 6) 9) 0)
01 11	1 1 0 1	(1	7)
11	11	(1	5)

Exemplo:



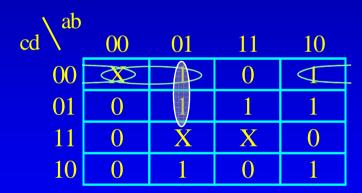
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 00 (4)	01 0 - (4, 5) 01 - 0 (4, 6)
10 0 0 (8)	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)	01 -1 (5, 7) -1 01 (5,13)
01 10 (6) 10 01 (9) 10 10 (1 0)	01 1- (6, 7)
	1-01 (9,13)
01 11 (7) 11 01 (1 3)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



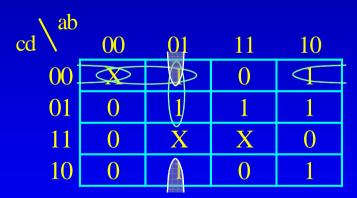
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 00 (4)	01 0 - (4, 5) 01 - 0 (4, 6)
10 0 0 (8)	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)	01 - 1 (5, 7) -1 01 (5,13)
01 10 (6) 10 01 (9) 10 10 (1 0)	01 1- (6, 7)
10 10 (1 0)	1-01 (9,13)
01 11 (7) 11 01 (1 3)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



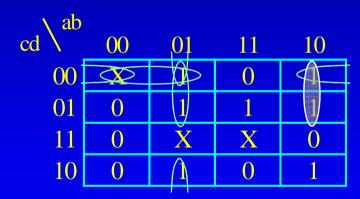
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 0 0 (4)	01 0 - (4, 5) 01 - 0 (4, 6)
10 0 0 (8)	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)	01 -1 (5, 7) -1 01 (5,13)
01 10 (6) 10 01 (9) 10 10 (1 0)	01 1- (6, 7)
	1-01 (9,13)
01 11 (7) 11 01 (1 3)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



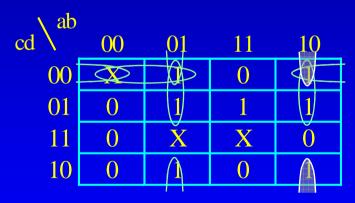
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 0 0 (4)	01 0 - (4, 5) 01 - 0 (4, 6)
10 00 (8)	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5) ×	01 -1 (5, 7) -1 01 (5,13)
10 1 0 (6) 10 0 1 (9) 10 1 0 (1 0)	01 1 - (6, 7)
01 11 (7)	1- 01 (9,13) -1 11 (7,15)
11 01 (1 3)	11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



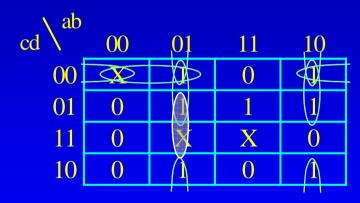
Co lun a 0	Co lun a 1
00 00 (0)	0-00(0,4) -000(0,8)
01 00 (4)🗙	01 0 - (4, 5) 01 - 0 (4, 6)
10 0 0 (8)	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)	01 - 1 (5, 7) -1 01 (5,13)
01 10 (6) 10 01 (9) 10 10 (1 0)	01 1- (6, 7)
	1-01 (9,13)
01 11 (7) 11 01 (1 3)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



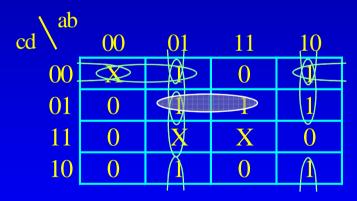
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 0 0 (4)🗙	01 0 - (4, 5) 01 - 0 (4, 6)
10 00 (8)	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)×	01 -1 (5, 7) -1 01 (5,13)
01 10 (6)X 10 01 (9)X 10 10 (1 0 X	01 1- (6, 7)
	1-01 (9,13)
01 11 (7) 11 01 (1 3)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



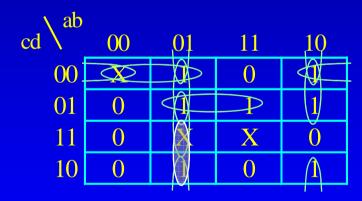
Co lun a 0	Co lun a1
00 00 (0)×	0-00(0,4) -000(0,8)
01 00 (4)	01 0 - (4, 5) 01 - 0 (4, 6)
1000(8 🙀	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5 🗶	01 -1 (5, 7) -1 01 (5,13)
01 10 (6 × 10 01 (9 × 10 10 (1 0 ×	01 1 - (6, 7)
01 11 7 🗸	1- 01 (9,13) -1 11 (7,15)
11 01 (1 3)	11 -1 (1 3,15)

Exemplo



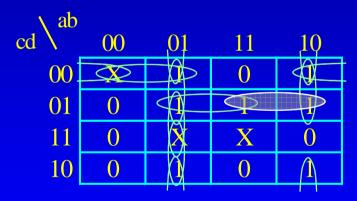
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 00 (4)	01 0 - (4, 5) 01 - 0 (4, 6)
10 00 (8)🔀	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)× 01 10 (6)×	01 -1 (5, 7) -1 01 (5,13)
10 01 (9 × 10 10 (1 0 ×	01 1 - (6, 7)
	1-01 (9,13)
01 11 (7)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



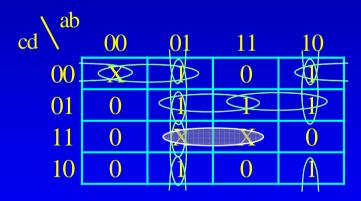
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 00 (4)🗙	01 0 - (4, 5) 01 - 0 (4, 6)
1000(8)🗙	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)🗙	01 - 1 (5, 7) -1 01 (5,13)
01 10 (6)X 10 01 (9)X 10 10 (1 0)X	01 1- (6, 7)
	1-01 (9,13)
01 11 (7)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



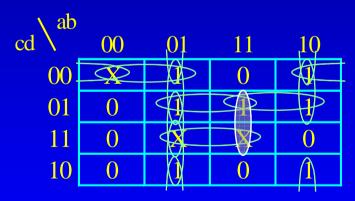
Co lun a 0	Co lun a1
00 00 (0)	0-00(0,4) -000(0,8)
01 0 0 (4)	01 0 - (4, 5) 01 - 0 (4, 6)
10 0 0 (8 🔀	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)×	01 -1 (5, 7) -1 01 (5,13)
01 10 (6) 10 01 (9 X 10 10 (1 0 X	01 1- (6, 7)
	1-01 (9,13)
01 11 (7) 11 01 (1 3)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5)	

Exemplo



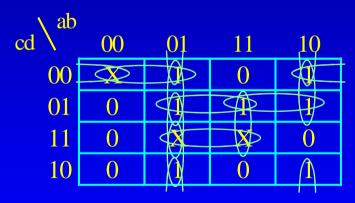
Co lun a 0	Co lun a1
00 00 (0)×	0- 00 (0, 4) -0 00 (0, 8)
01 00 (4)🗙	01 0 - (4, 5) 01 - 0 (4, 6)
10 00 (8)🔀	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (5)	01 -1 (5,7) -1 01 (5,13)
01 10 (6)X 10 01 (9)X 10 10 (1 0)X	01 1- (6, 7)
	1-01 (9,13)
01 11 (7)	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1 5 🔀	

Exemplo



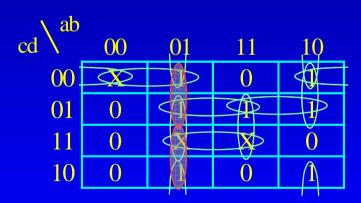
Co lun	a 0	Co lun	a 1
00 00 (0)×	0- 0 0 (-0 0 0 (0,4)
01 00 (4)×	01 0 - (01 - 0 (
10 00 (8 💢	10 0 - (10 - 0 (
01 01 (01 - 1 (-1 01 (
01 10 (10 01 (10 10 (1	9 🙀	01 1- (6,7)
		1-01 (9,13)
01 11 (7) ×	-1 11 (11 -1 (1	
11 11 (1	5 🔭		

Exemplo



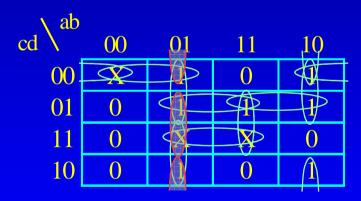
Co lun	a 0	Co lun a1
00 00 (0)×	0- 00 (0, 4) -0 00 (0, 8)
01 00 (4)×	01 0 - (4, 5) 01 - 0 (4, 6)
10 00 (8 🔀	10 0 - (8, 9) 10 - 0 (8,10)
01 01 (01 10 (5)×	01 -1 (5, 7) -1 01 (5,13)
10 01 (9 🙀	01 1 - (6, 7)
		1-01 (9,13)
01 11 (11 01 (1	7)× 3)×	-1 11 (7,15) 11 -1 (1 3,15)
11 11 (1	5)×	

Exemplo



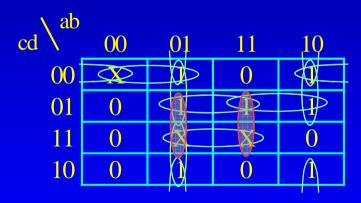
Co lun a	0	Co lun a 1	Co lun a 2
Co luii a	· U	Co full a 1	Co lun a 2
00 00 (0)🗶	0-00(0,4) -000(0,8)	
01 00 (4) × 8) ×	10 0 - (4, 5) × 01 - 0 (4, 6) × 10 0 - (8, 9) 10 - 0 (8,10)	01 (4, 5, 6, 7)
10 01 (6)	01 -1 (5,7) -1 01 (5,13) 01 1- (6,7) × 1- 01 (9,13)	-1 -1 (5, 7, 13,15)
01 11 (11 01 (1			
11 11 (1	5 💢		

Exemplo



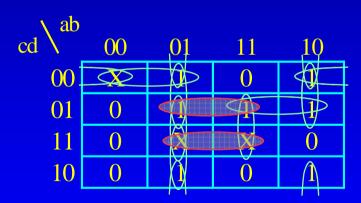
Co lun	a 0	Co lun a 1	Co lun a 2
00 00 (0)🗶	0-00(0,4) -000(0,8)	
01 00 (10 00 (4) X 8) X	01 0 - (4,5) × 01 - 0 (4,6) × 10 0 - (8,9) 10 - 0 (8,10)	01 (4 , 5, 6, 7)
01 01 (01 10 (10 01 (10 10 (1	5) X	01 - 1 (5, 7) × -1 01 (5,13) 01 1 - (6, 7) × 1- 01 (9,13)	-1 -1 (5, 7, 13,15)
01 11 (11 01 (1	7) × 3) ×		
11 11 (1	5 💢		

Exemplo



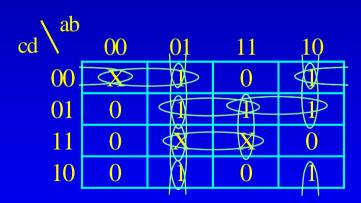
Co lun	a 0	Co lun a1	Co lun a 2
00 00 (0)🗶	0-00(0,4) -000(0,8)	
01 0 0 (10 0 0 (4) X 8) X	01 0 - (4, 5) × 01 - 0 (4, 6) × 10 0 - (8, 9) 10 - 0 (8,10)	01 (4, 5, 6, 7)
01 01 (01 10 (10 01 (10 10 (1	9 🗙	01 -1 (5, 7) × -1 01 (5,13) 01 1- (6, 7) × 1- 01 (9,13)	-1 -1 (5, 7, 13,15)
01 11 (11 01 (1 11 11 (1		11 -1 (1 3,15)	

Exemplo



Co lun a 0	Co lun a 1	Co lun a 2
Co lun u o	Co lun u l	Co run u 2
00 00 (0)	0- 00 (0, 4) -0 00 (0, 8)	
01 00 (4)	01 0 - (4, 5) × 01 - 0 (4, 6) × 10 0 - (8, 9)	01 (4, 5, 6, 7)
10 00 (8)	10 0 - (8, 9) 10 - 0 (8,10)	
01 10 / 6	01 -1 (5,7) × -1 01 (5,13) ×	
10 01 (9)	01 1- (6, 7) 🗙	-1 -1 (5, 7, 13,15)
10 10 (1 0)	1-01 (9,13)	
01 11 (7)× 11 01 (1 3)×	-1	
11 11 (1 5)		

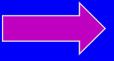
Exemplo



Co lu	ın	a 0		C	0	lun	a	1		Co lun a 2
00 00	(0)	×	0- 0 -0 0	0	(0 , 0 ,	4) 8)		
01 0 0 10 0 0	(4) 8)	$\boldsymbol{\lambda}$	01 0 01 -	_ 0	(4,4,	5) 6)	×	01 (
		,				(
01 01 01 10 10 01	(5)	×	01 - -1 0	1 1	(5 , 5 ,	7) 13)	×	
10 01 10 10 10	((1	9)	X X X						×	-1 -1 (5 , 7, 13,15)
				10	1		у,	± 5)		
01 11 11 01	((1	7) 3)	X	-1 1 11 -	1 1	(1	7,	15) 15)	X	
11 11	(1	5)	X							

Tabela de Cobertura ($m_y = 1$ apenas, nas colunas)

Tabela de Cobertura	4	5	6	8	9	10	13
(0, 4) 0-00	Х						
(0, 8) -000				X			
(8,9)100-				X	X		
(8,10) 10-0				X		X	
(9,13) 1-01					X		X
(4, 5, 6, 7) 01	X	X	X				
(5, 7,13,15) -1-1		X					X



Implicantes primos essenciais

Ferramenta de Minimização KARMA

- Acesse applet e executável no endereço:
 - www.inf.ufrgs.br/nangate
 - **尽** Selecione o link <Tools>
 - **Execute o software KARMA 2.0**
 - Como Applet ou
 - Instalando o executável
 - Pratique exemplos de minimização, utilizando especificação de funções com "Don't Cares".