

SCE 0110 - Elementos de Lógica Digital I

**Implementação otimizada
de funções lógicas
(continuação)**

Prof. Vanderlei Bonato

Sumário

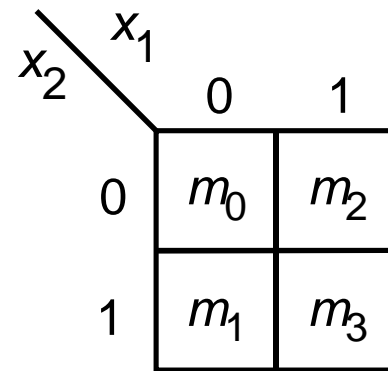
- Mapa de Karnaugh (Veitch-Karnaugh)
 - SOP (sum-of-products) e POS (product-of-sums)

- revisão da aula anterior -

- O Mapa de Karnaugh é uma alternativa à tabela verdade para representação de funções para representação de funções

x_1	x_2	
0	0	m_0
0	1	m_1
1	0	m_2
1	1	m_3

(a) Truth table



(b) Karnaugh map

Figure 4.2. Location of two-variable minterms.

- revisão da aula anterior -

- A representação por mapa de Karnaugh facilita o reconhecimento de minitermos que podem ser combinados usando a propriedade 14a da Álgebra Booleana
- O resultado é a função mínima

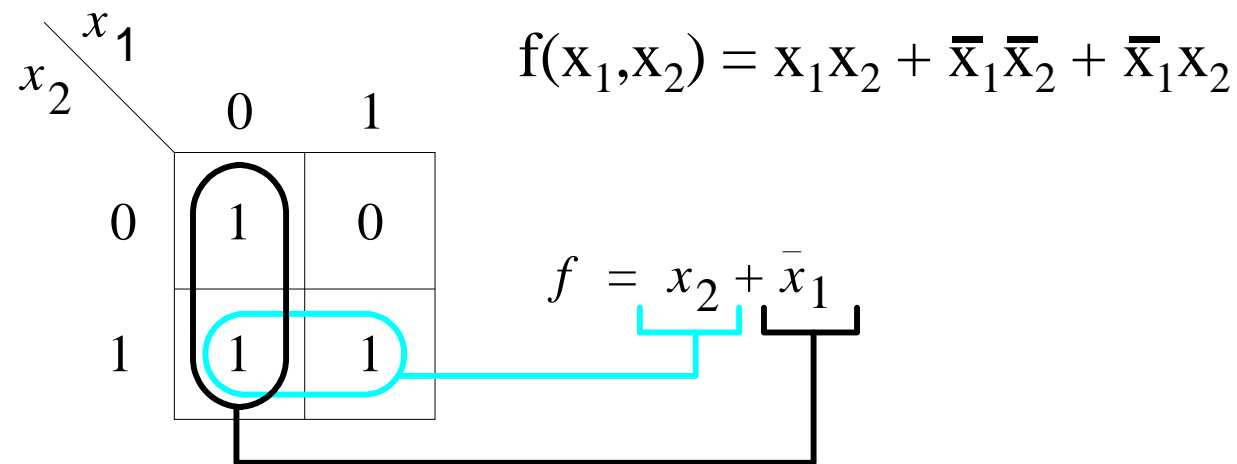


Figure 4.3. The function of Figure 2.15.

3 variáveis

x_1	x_2	x_3	
0	0	0	m_0
0	0	1	m_1
0	1	0	m_2
0	1	1	m_3
1	0	0	m_4
1	0	1	m_5
1	1	0	m_6
1	1	1	m_7

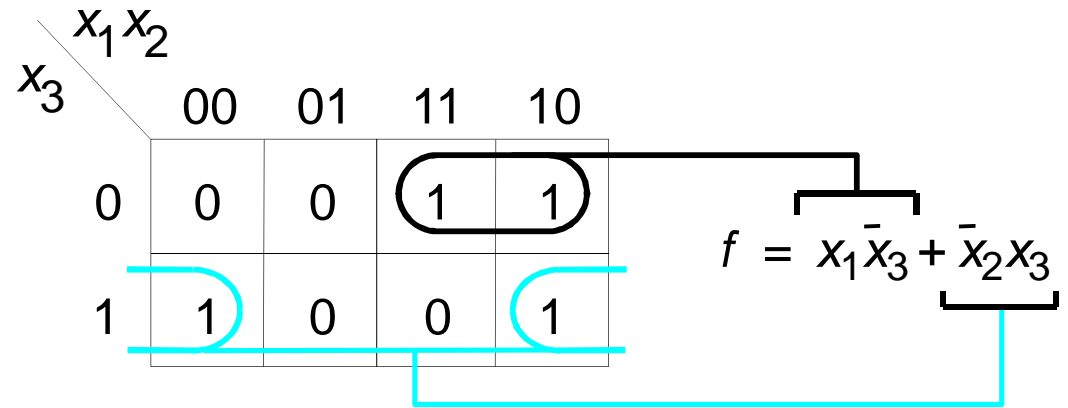
(a) Truth table

		$x_1 x_2$			
		00	01	11	10
x_3	0	m_0	m_2	m_6	m_4
	1	m_1	m_3	m_7	m_5

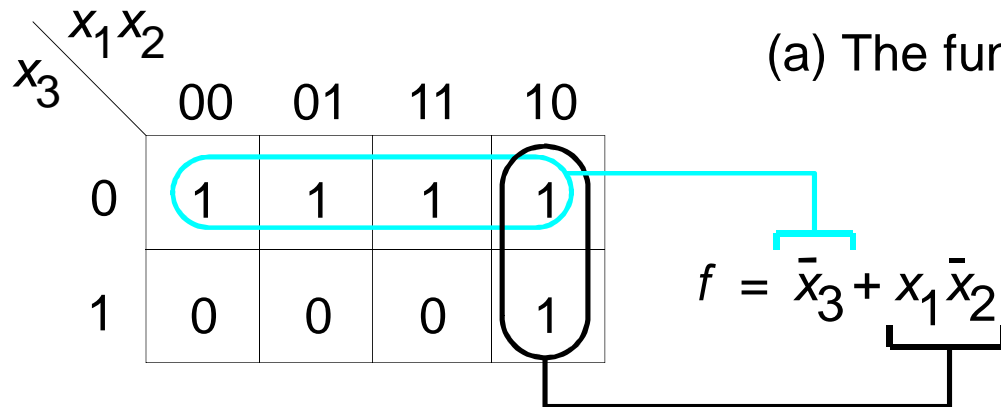
(b) Karnaugh map

Figure 4.4. Location of three-variable minterms.

- Basta cobrir todas as células, mas por que não unir a última coluna também?
- Variação de um bit por vez



(a) The function of Figure 2.18



(b) The function of Figure 4.1

Figure 4.5. Examples of three-variable Karnaugh maps.

4 variáveis

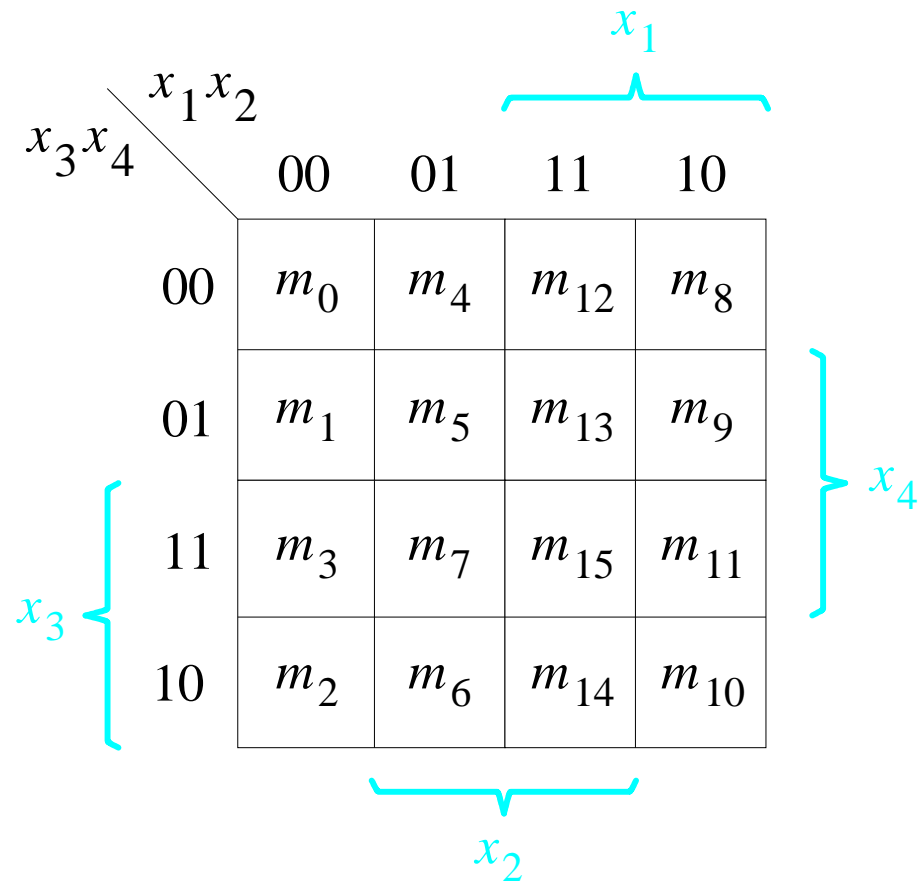


Figure 4.6. A four-variable Karnaugh map.

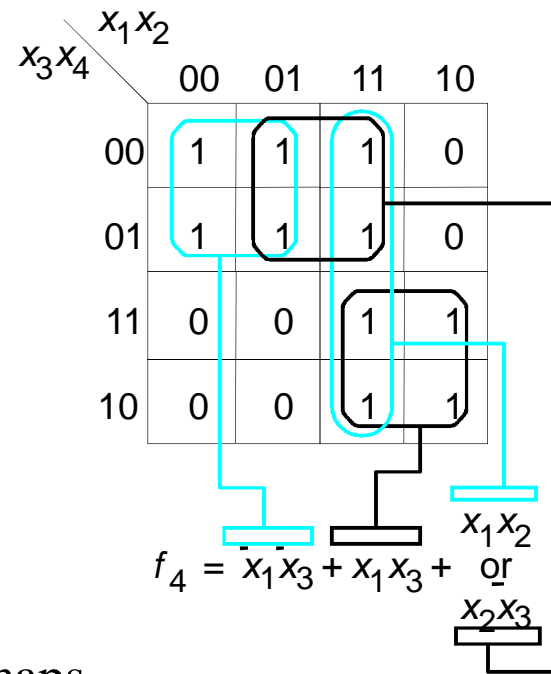
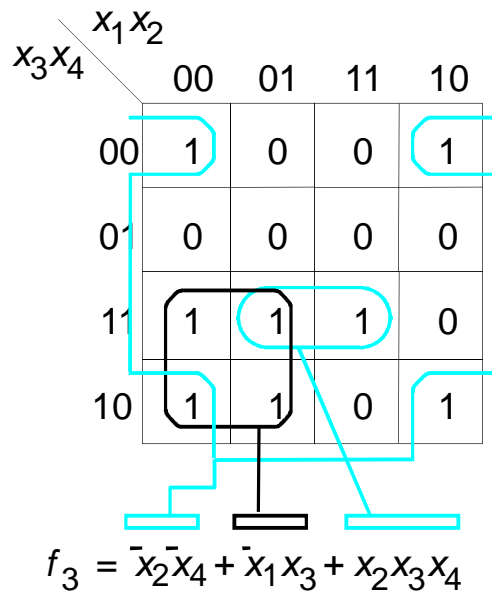
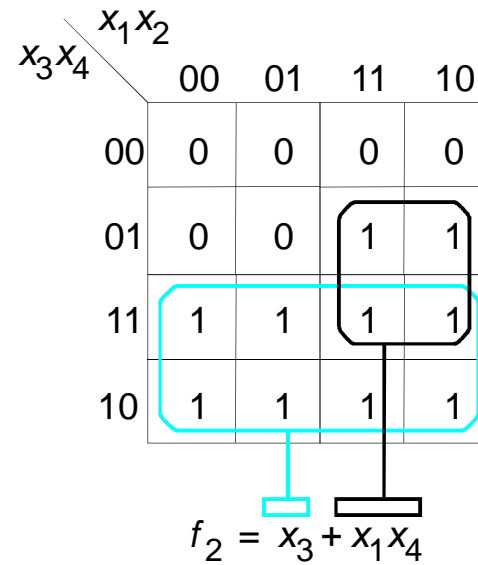
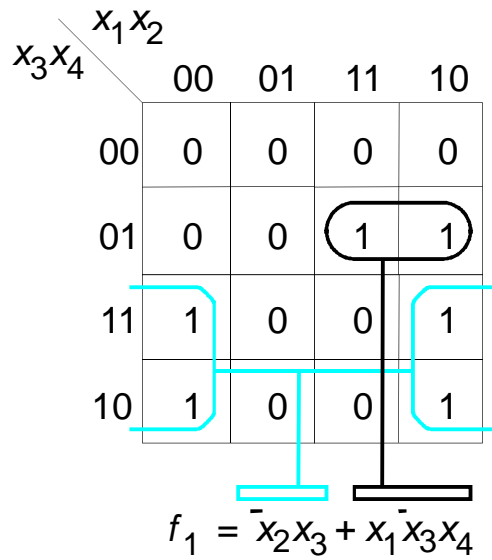


Figure 4.7. Examples of four-variable Karnaugh maps.

5 variáveis

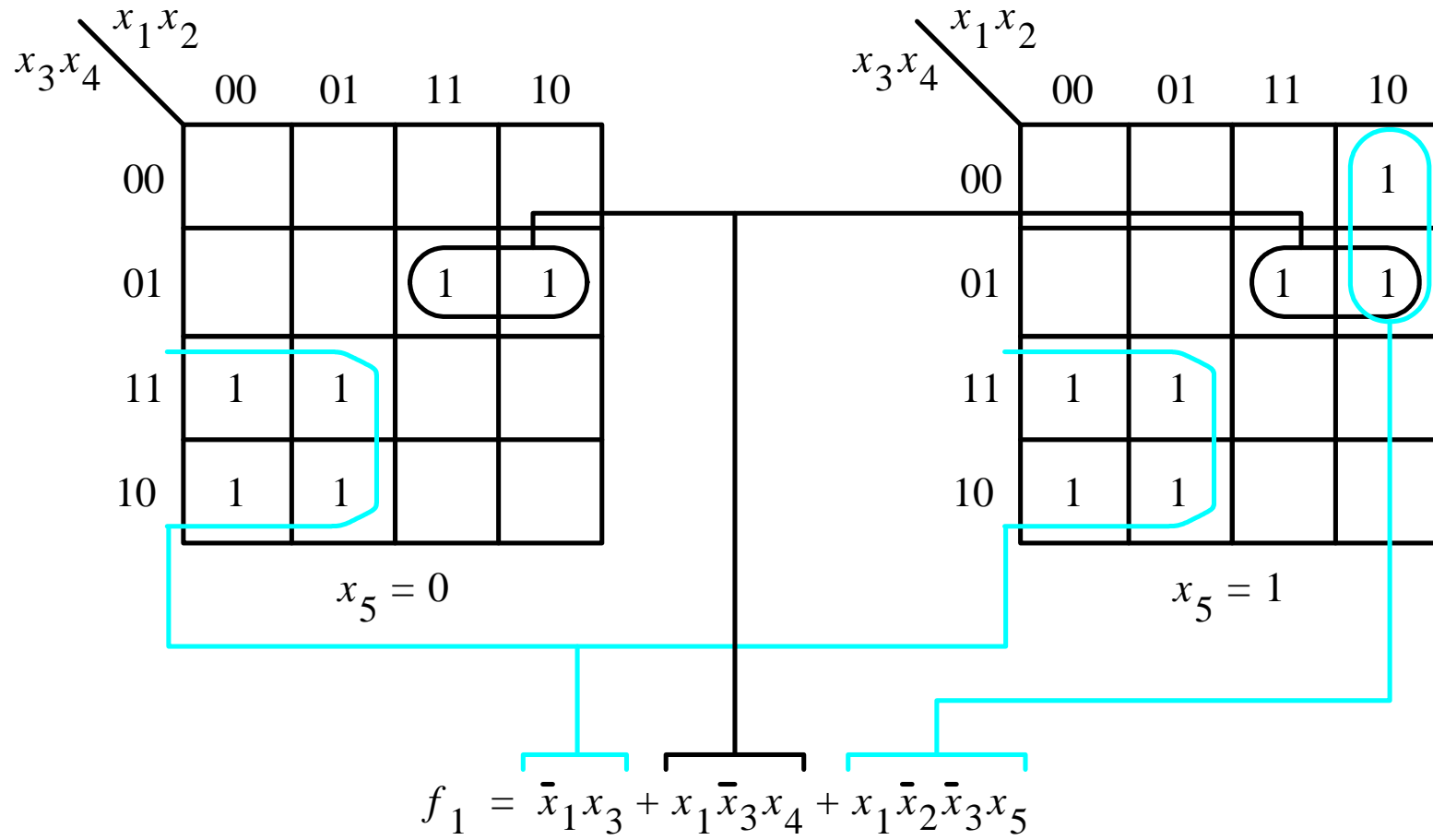


Figure 4.8. A five-variable Karnaugh map.

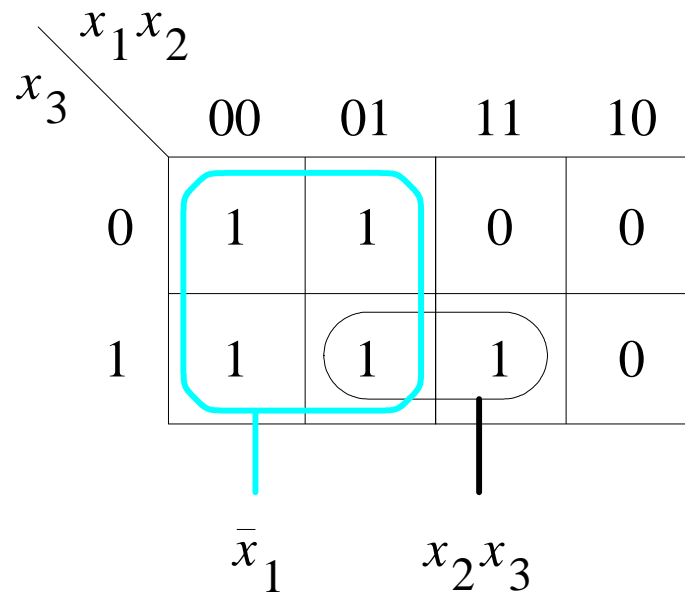


Figure 4.9. Three-variable function $f(x_1, x_2, x_3) = \Sigma m(0, 1, 2, 3, 7)$.

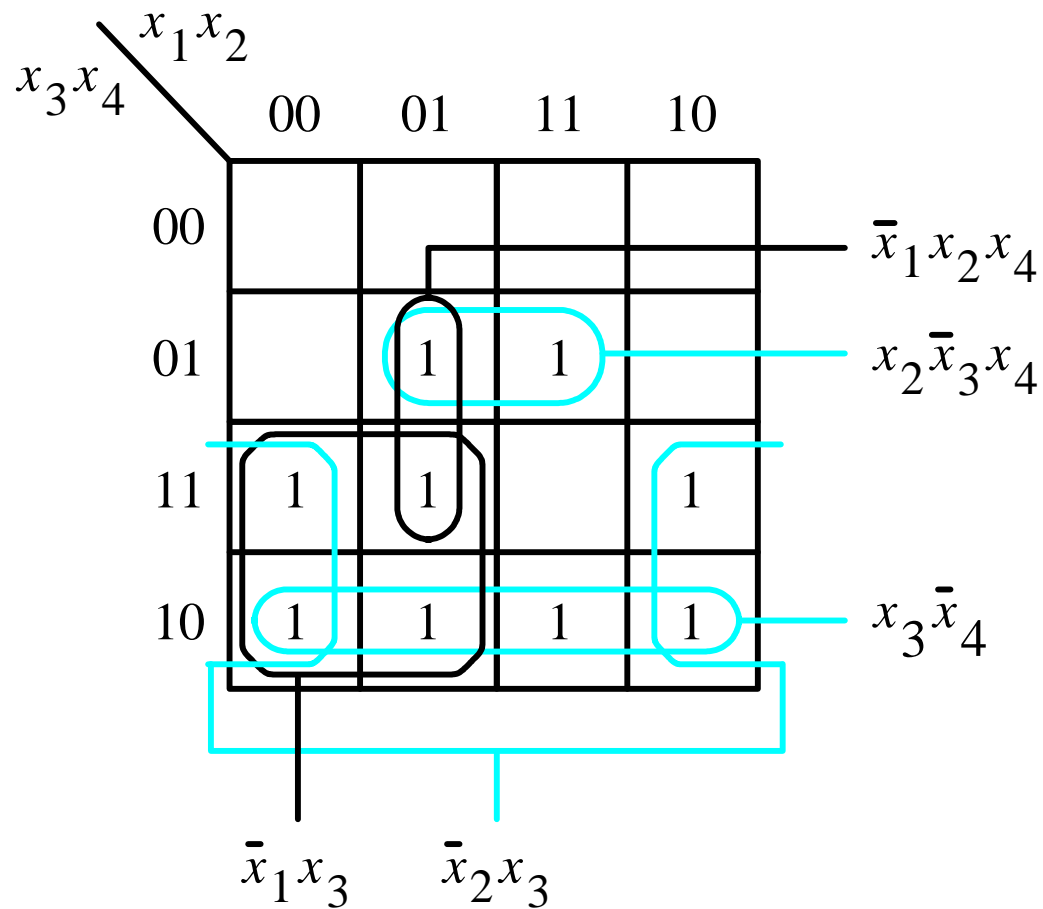


Figure 4.10. Four-variable function $f(x_1, \dots, x_4) = \Sigma m(2, 3, 5, 6, 7, 10, 11, 13, 14)$.

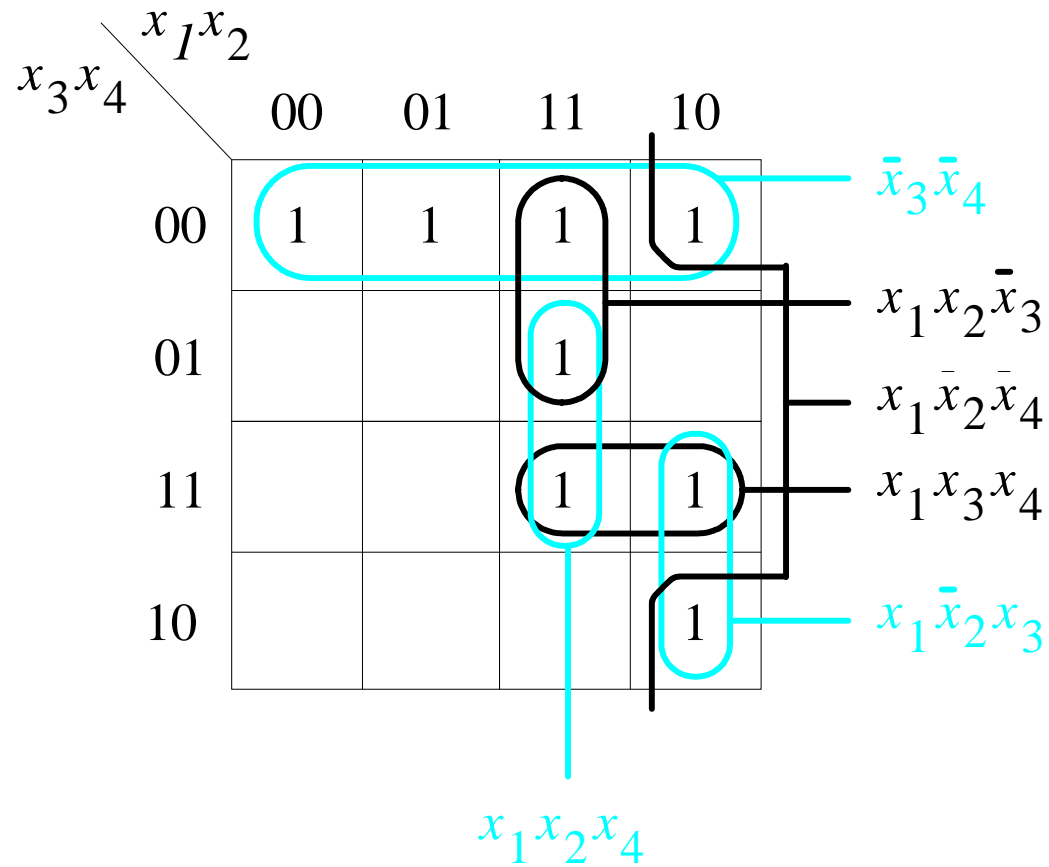


Figure 4.11. The function $f(x_1, \dots, x_4) = \Sigma m(0, 4, 8, 10, 11, 12, 13, 15)$.

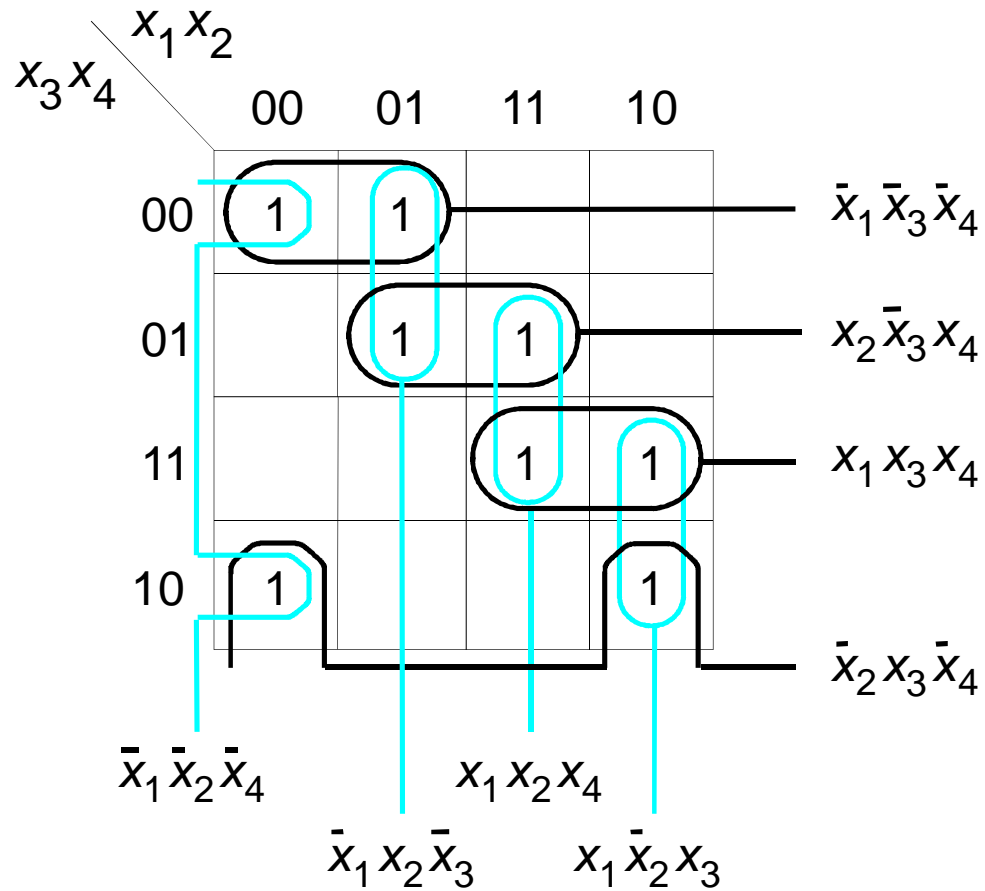


Figure 4.12. The function $f(x_1, \dots, x_4) = \Sigma m(0, 2, 4, 5, 10, 11, 13, 15)$.

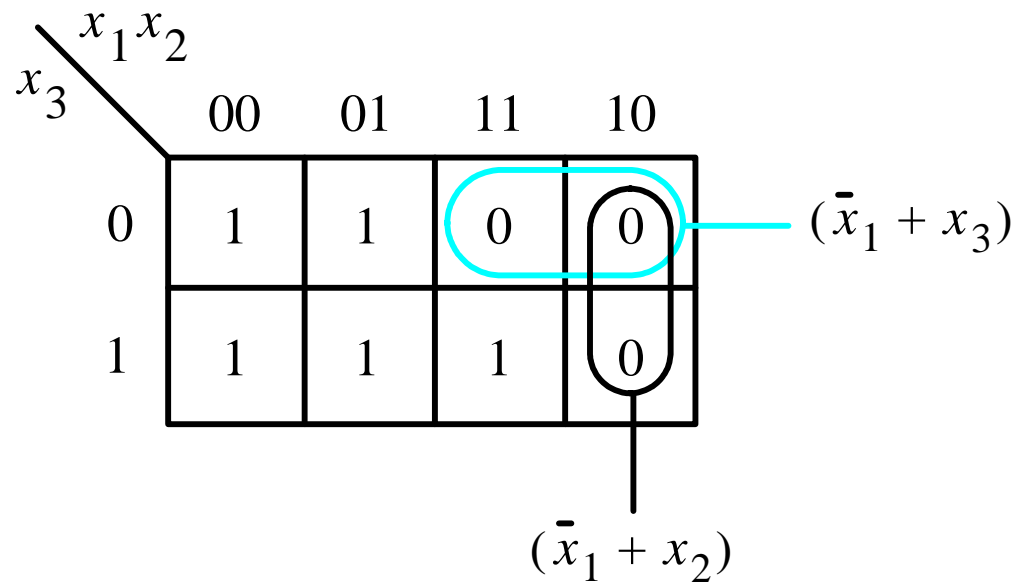


Figure 4.13. POS minimization of $f(x_1, x_2, x_3) = \Pi M(4, 5, 6)$.

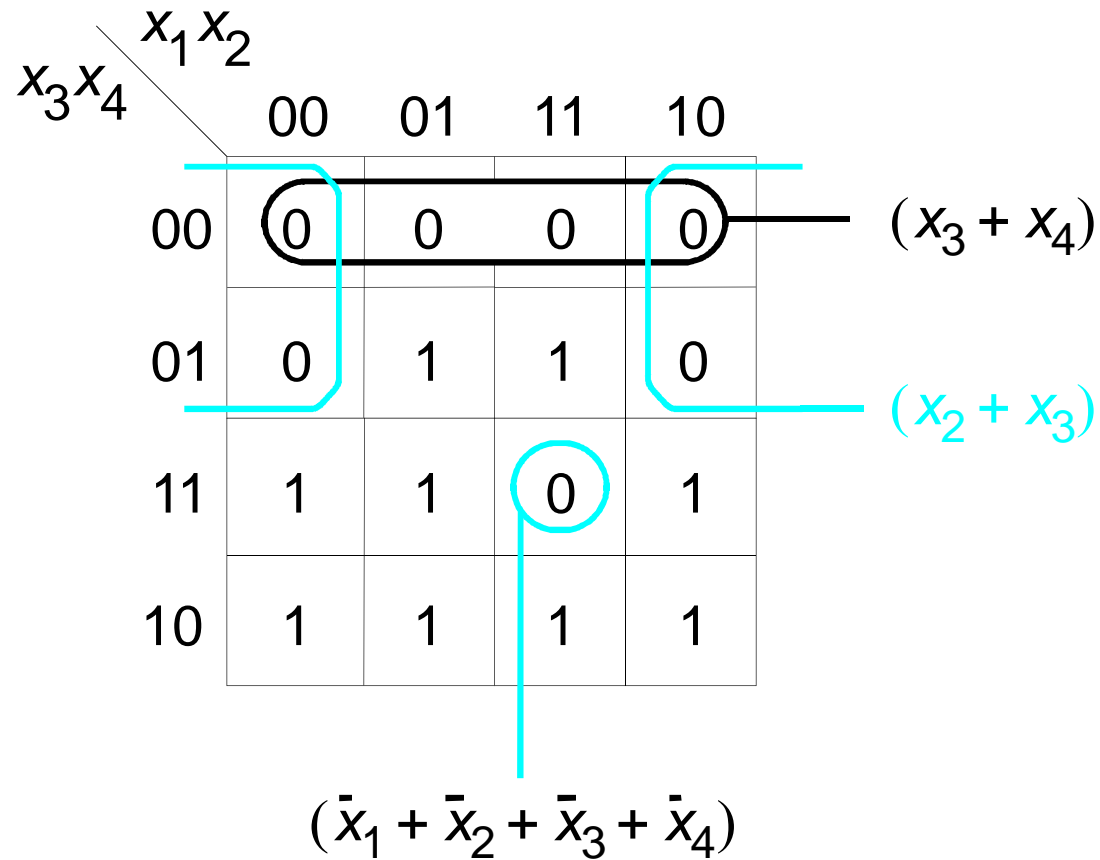


Figure 4.14. POS minimization of $f(x_1, \dots, x_4) = \Pi M(0, 1, 4, 8, 9, 12, 15)$.

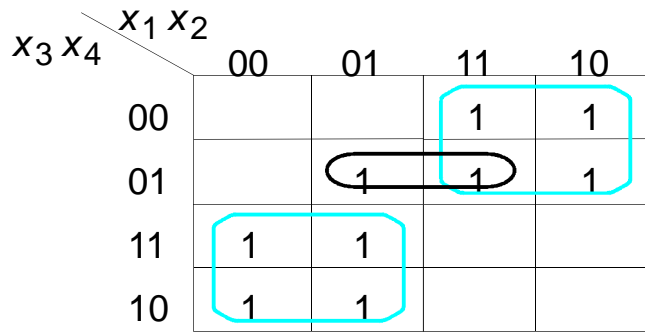
	$x_1 x_2$	00	01	11	10	
$x_3 x_4$	00	0	1	d	0	$x_2 \bar{x}_3$
	01	0	1	d	0	
	11	0	0	d	0	$x_3 \bar{x}_4$
	10	1	1	d	1	

(a) SOP implementation

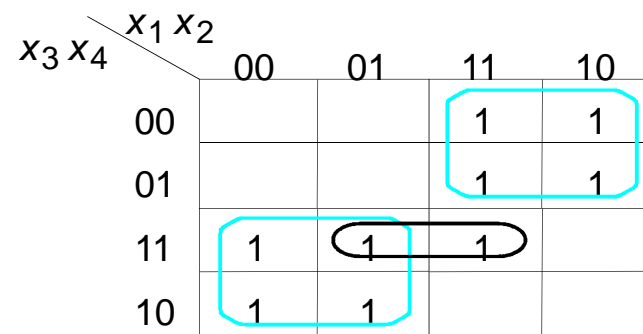
	$x_1 x_2$	00	01	11	10	
$x_3 x_4$	00	0	1	d	0	$(x_2 + x_3)$
	01	0	1	d	0	
	11	0	0	d	0	$(\bar{x}_3 + \bar{x}_4)$
	10	1	1	d	1	

(b) POS implementation

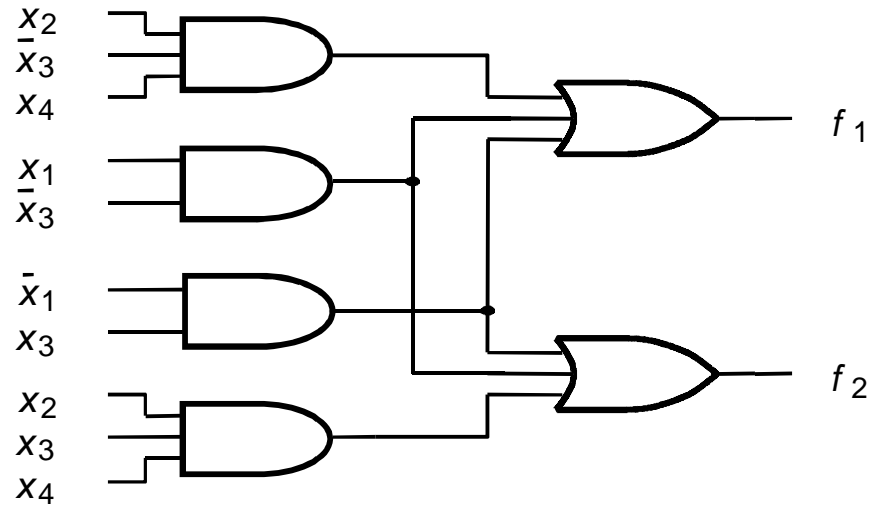
Figure 4.15. Two implementations of the function $f(x_1, \dots, x_4) = \Sigma m(2, 4, 5, 6, 10) + D(12, 13, 14, 15)$.



(a) Function f_1

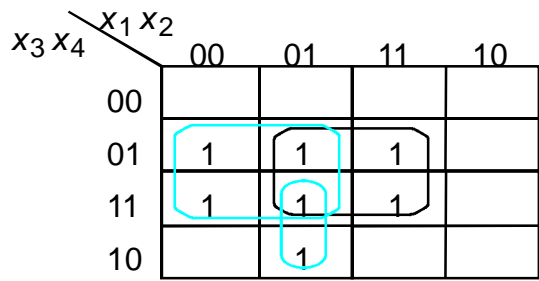


(b) Function f_2

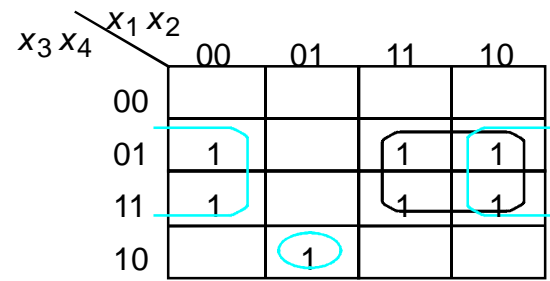


(c) Combined circuit for f_1 and f_2

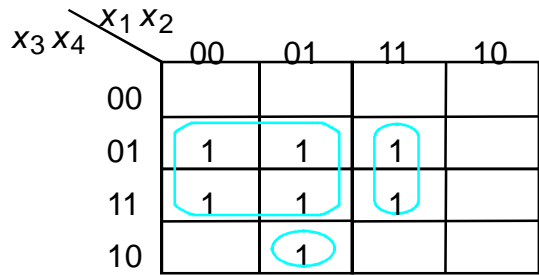
Figure 4.16. An example of multiple-output synthesis.



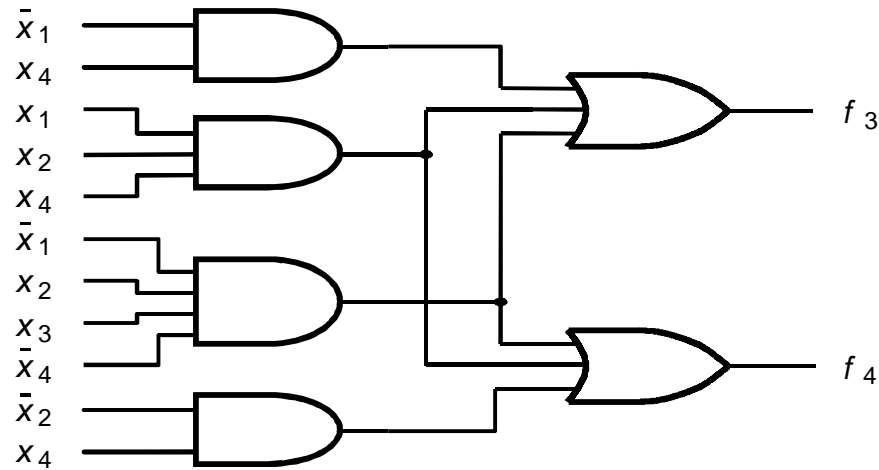
(a) Optimal realization of f_3



(b) Optimal realization of f_4



(c) Optimal realization of f_3 and f_4 together



(d) Combined circuit for f_3 and f_4

Figure 4.17. An example of multiple-output synthesis.

- Resolver os exercícios 4.1 e 4.2 (Livro Brown (2005))
- Analisar o mapa de Karnaugh para as portas lógicas XOR e XNOR (pgs. 194 e 195 - Livro Idoeta (1986))