SCE 0110 -
Elementos de Lógica Digital I

Implementação otimizada
de funções lógicas
(continuação)

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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

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

(a) Truth table

x_2 \ x_1	0	1
0	m_0	m_2
1	m_1	m_3

(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

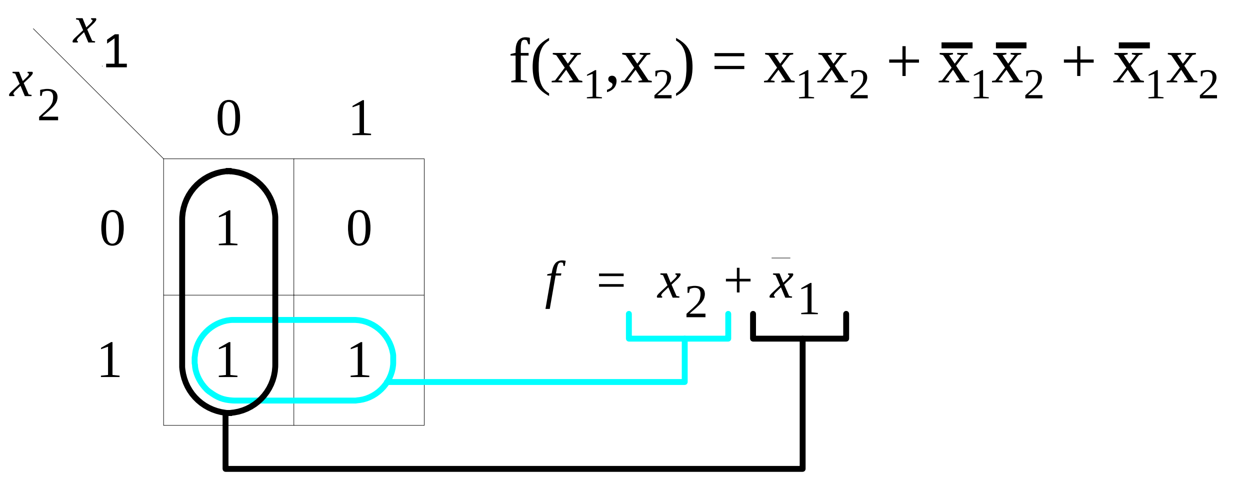


Figure 4.3. The function of Figure 2.15.

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

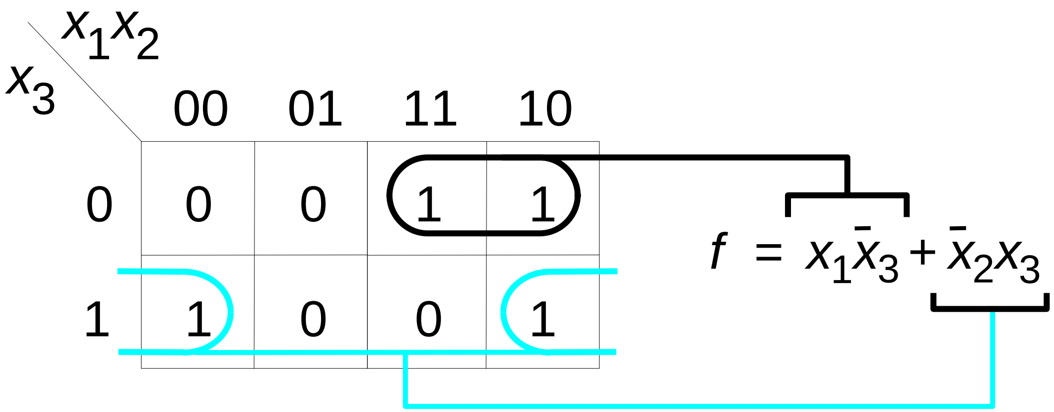
(a) Truth table

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

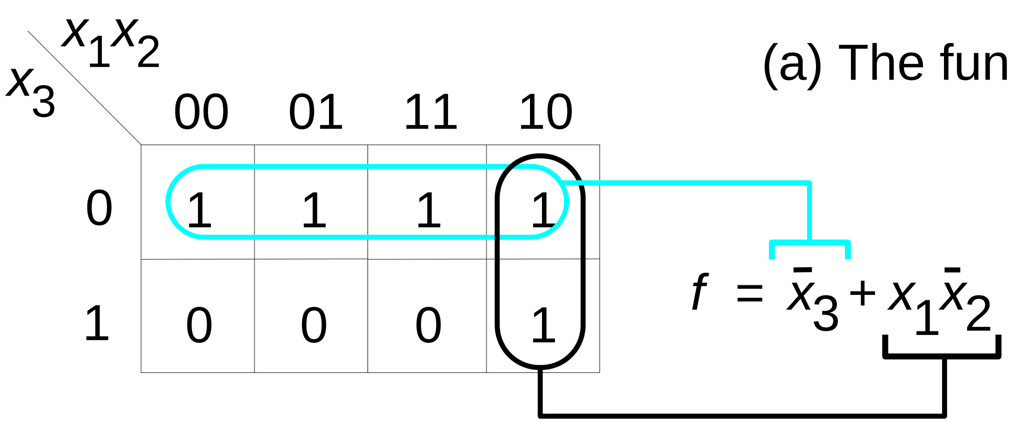
(b) Karnaugh map

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

x_3x_4 \ x_1x_2	00	01	11	10
00	m_0	m_4	m_{12}	m_8
01	m_1	m_5	m_{13}	m_9
11	m_3	m_7	m_{15}	m_{11}
10	m_2	m_6	m_{14}	m_{10}

Figure 4.6. A four-variable Karnaugh map.

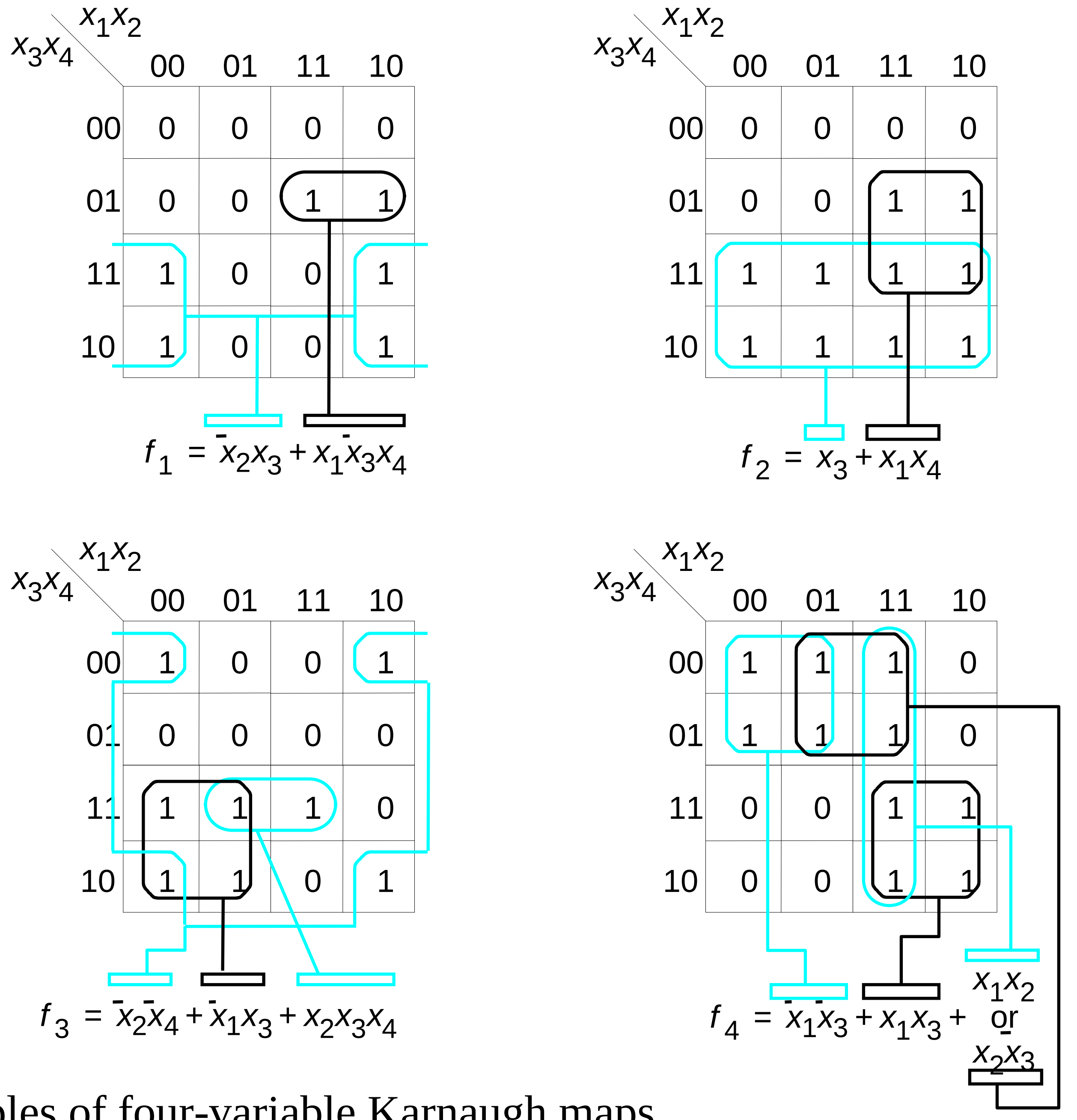


Figure 4.7. Examples of four-variable Karnaugh maps.

5 variáveis

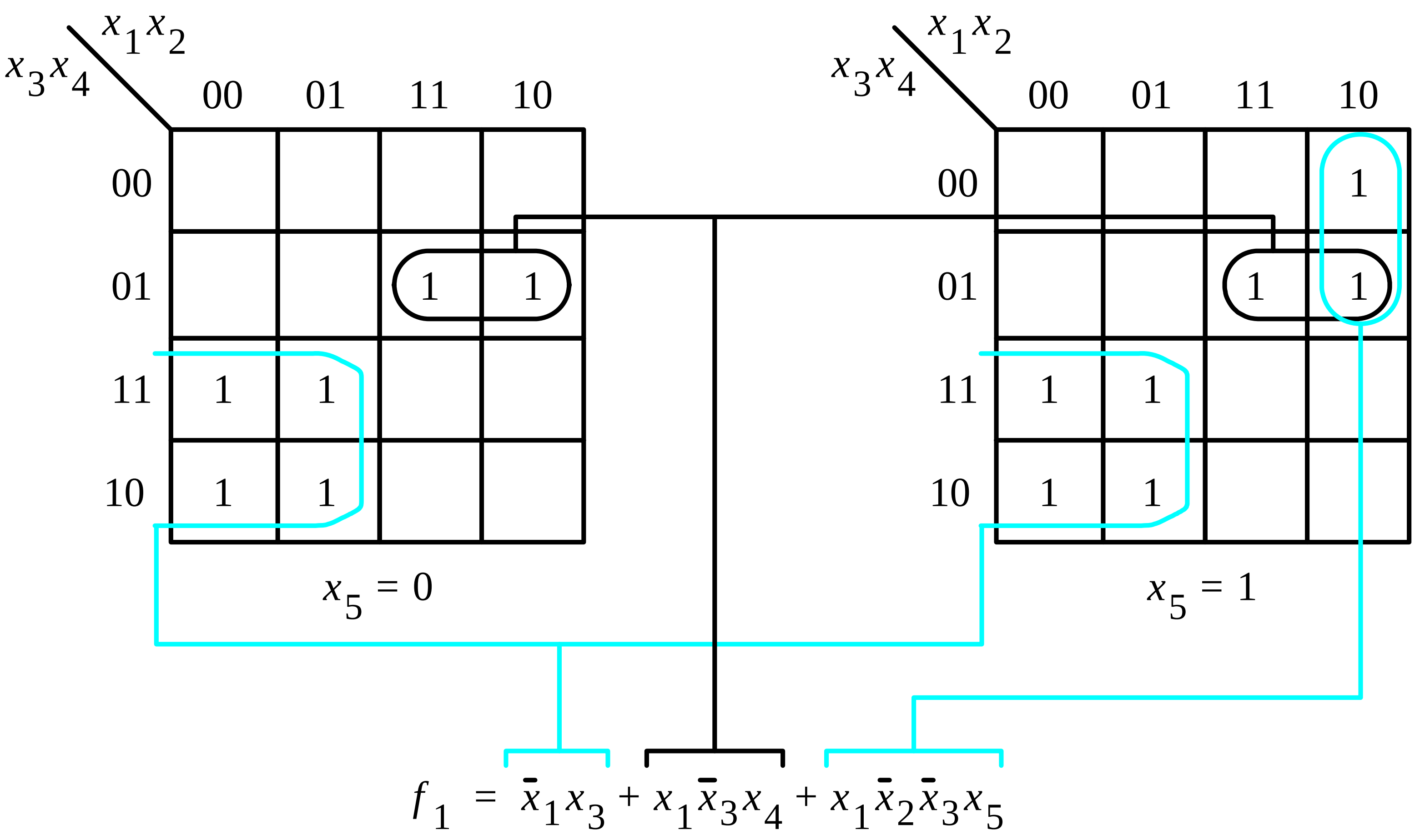


Figure 4.8. A five-variable Karnaugh map.

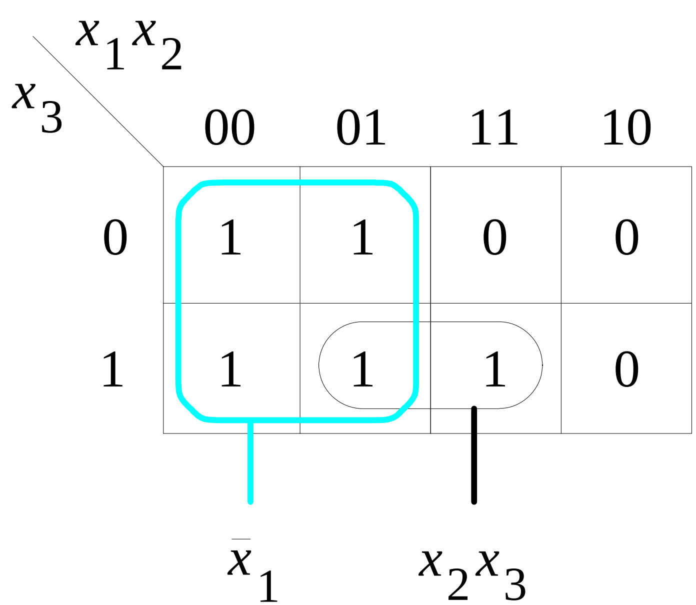


Figure 4.9. Three-variable function $f(x_1, x_2, x_3) = \Sigma\, m(0, 1, 2, 3, 7)$.

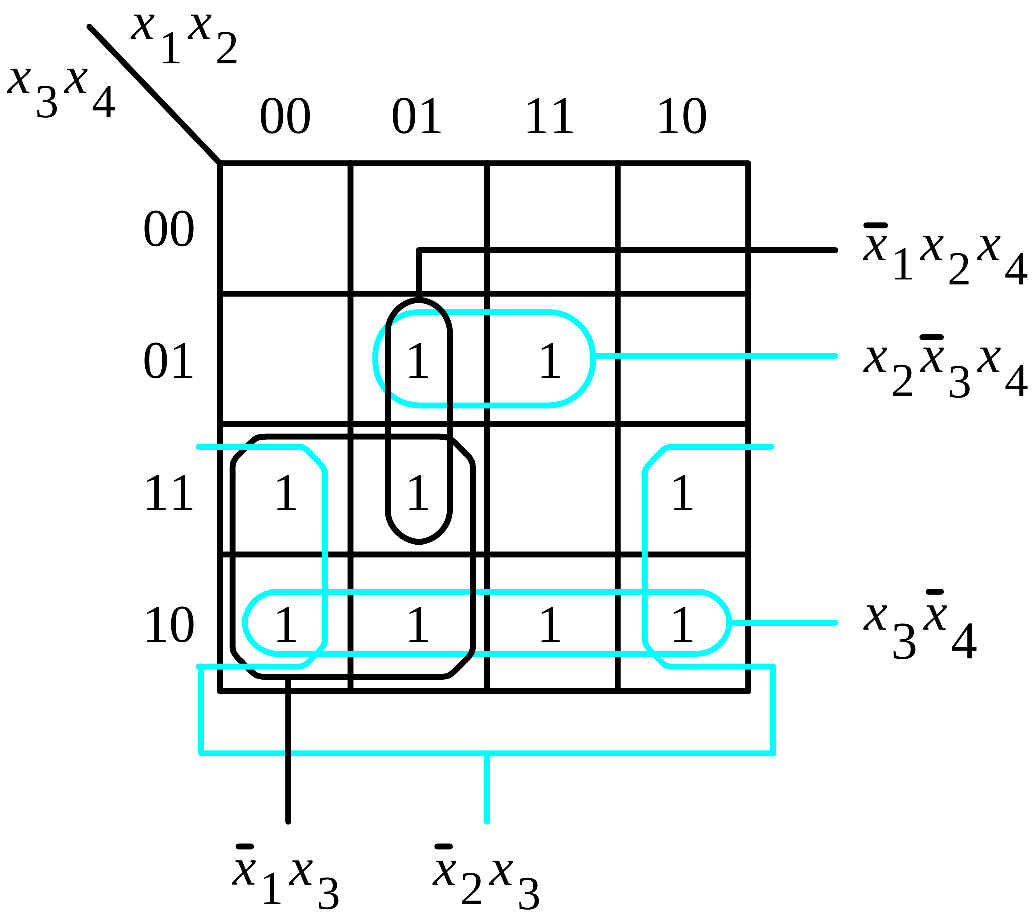


Figure 4.10. Four-variable function $f(x_1,\ldots,x_4) = \Sigma\, m(2, 3, 5, 6, 7, 10, 11, 13, 14)$.

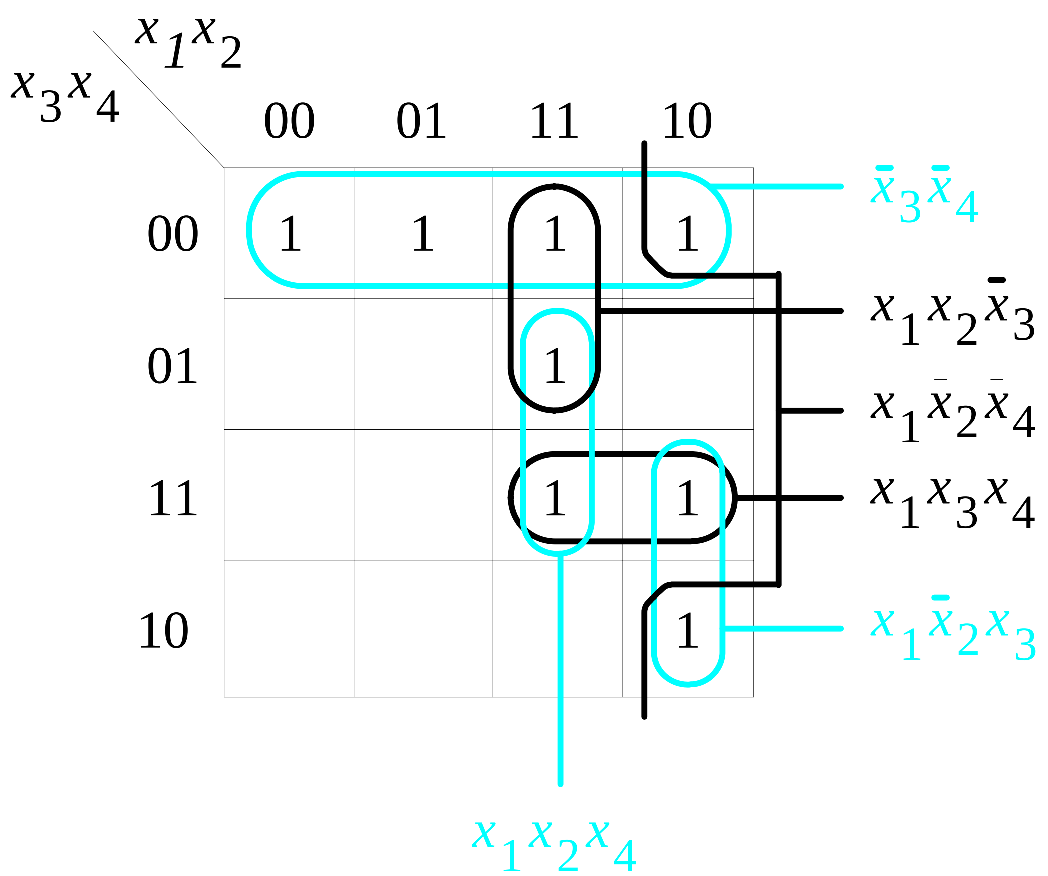


Figure 4.11. The function $f(x_1, \ldots, x_4) = \Sigma\, m(0, 4, 8, 10, 11, 12, 13, 15)$.

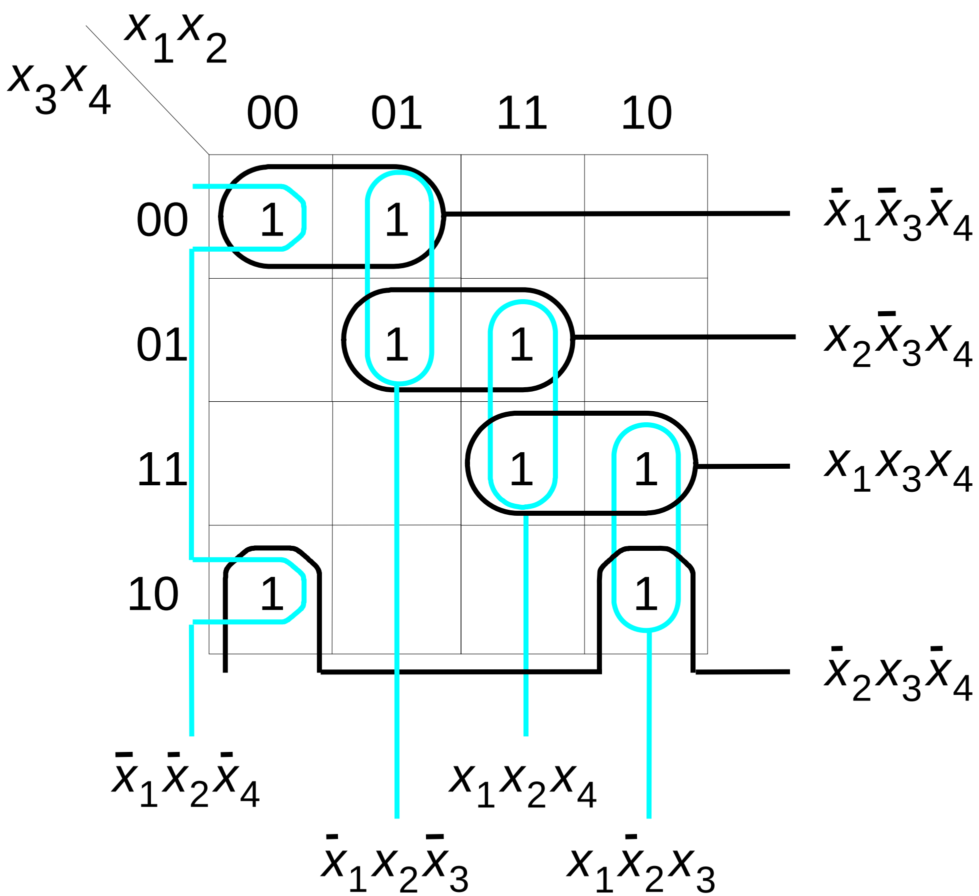


Figure 4.12. The function $f(x_1, \ldots, x_4) = \Sigma\, m(0, 2, 4, 5, 10, 11, 13, 15)$.

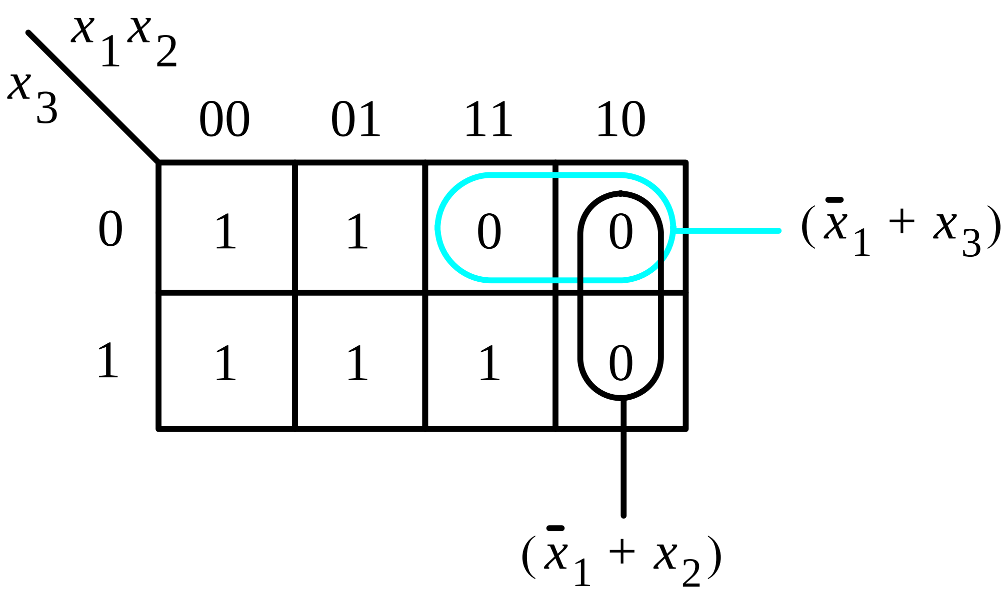


Figure 4.13. POS minimization of $f(x_1, x_2, x_3) = \Pi M(4, 5, 6)$.

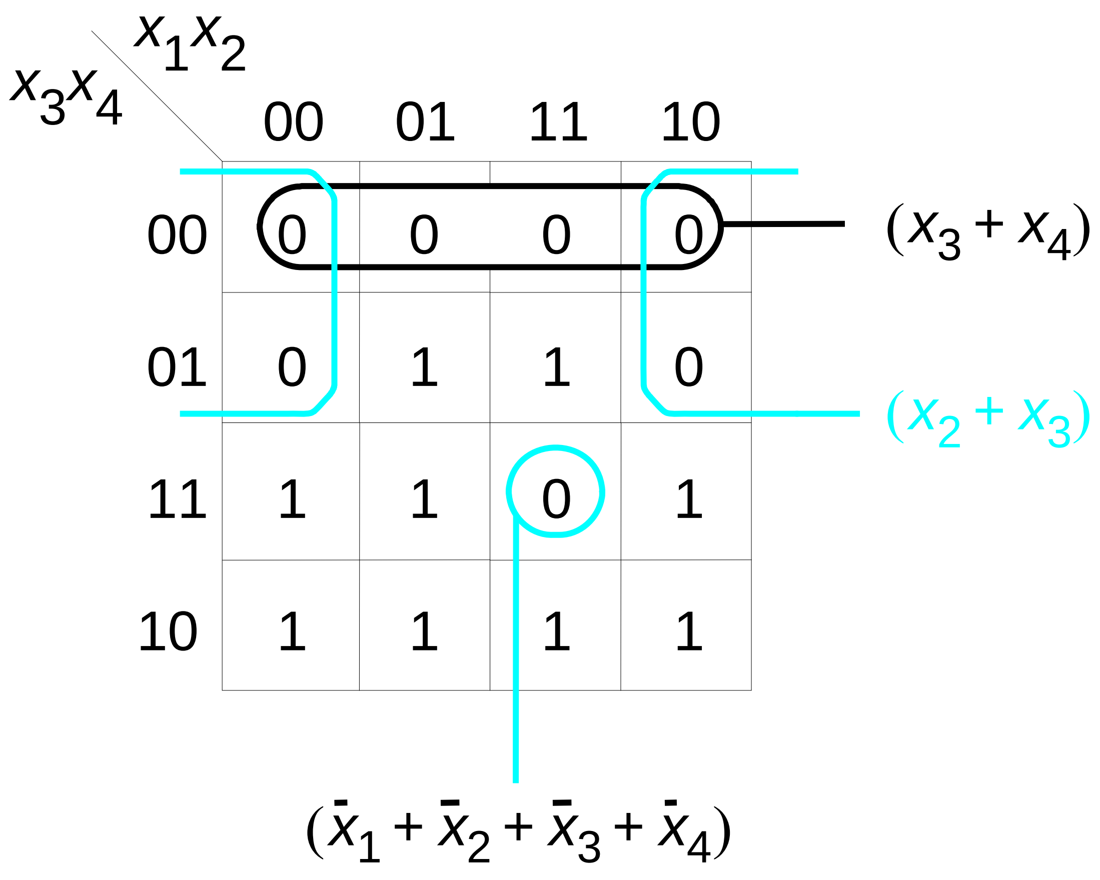


Figure 4.14. POS minimization of $f(x_1,\ldots,x_4) = \Pi M(0, 1, 4, 8, 9, 12, 15)$.

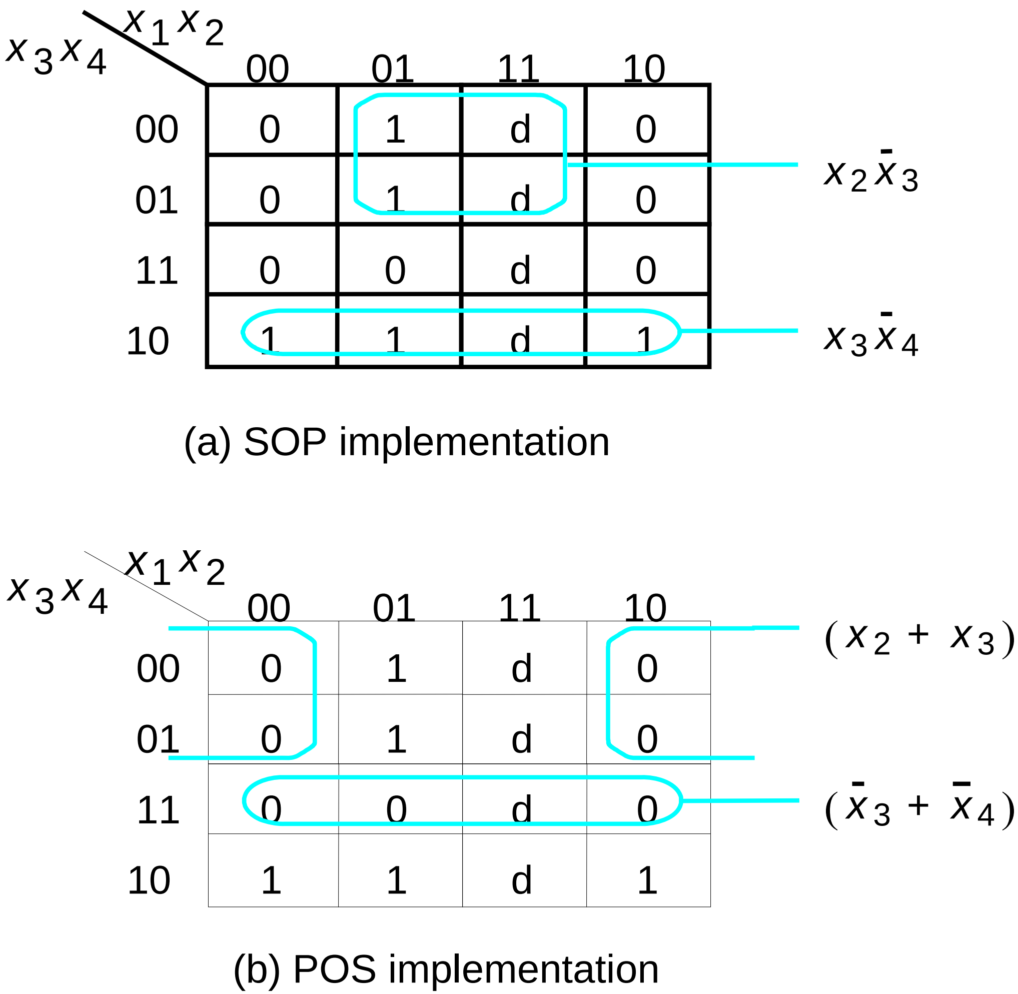
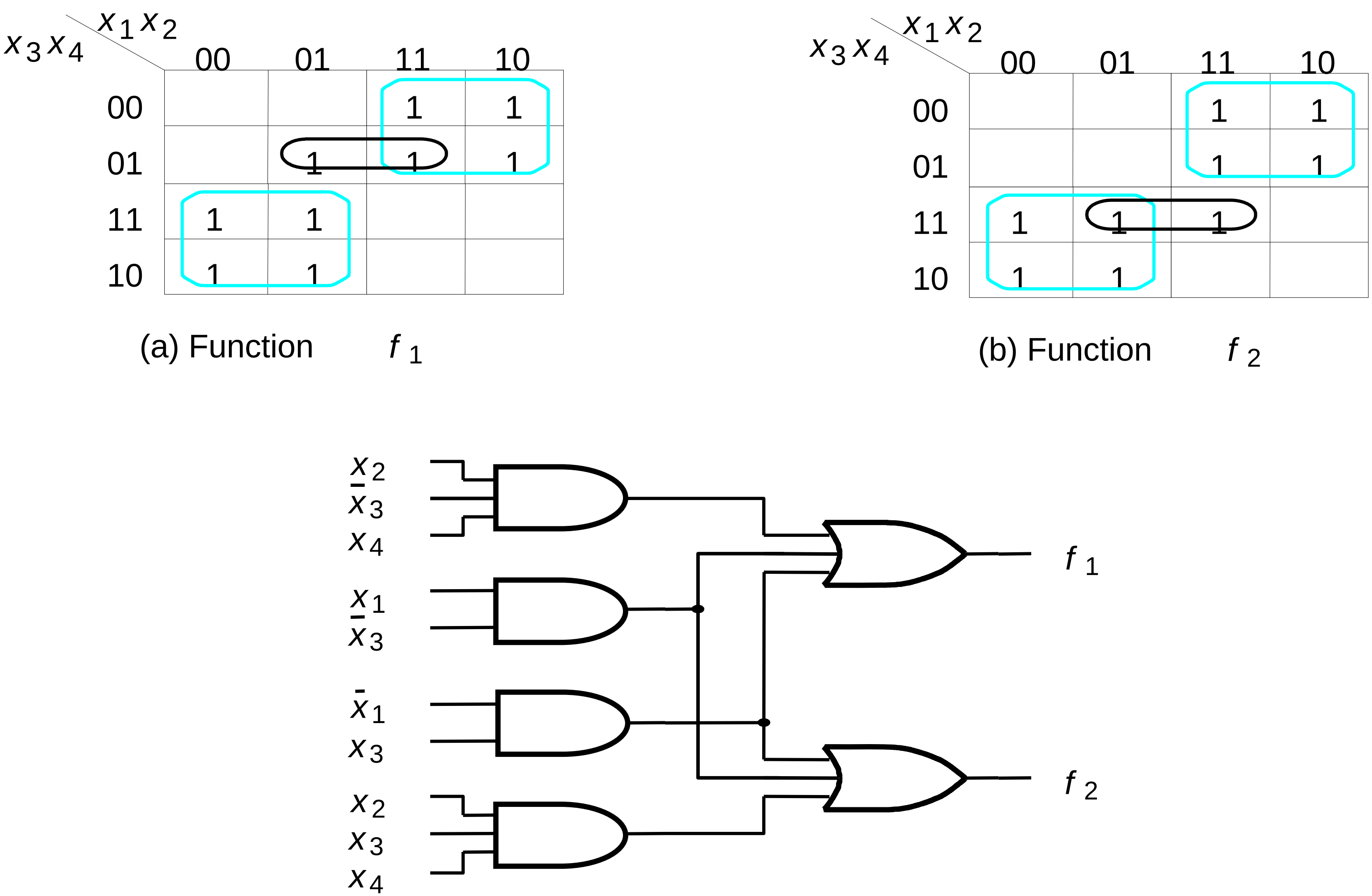


Figure 4.15. Two implementations of the function $f(x_1, \ldots, x_4) = \Sigma\, m(2, 4, 5, 6, 10) + D(12, 13, 14, 15)$.

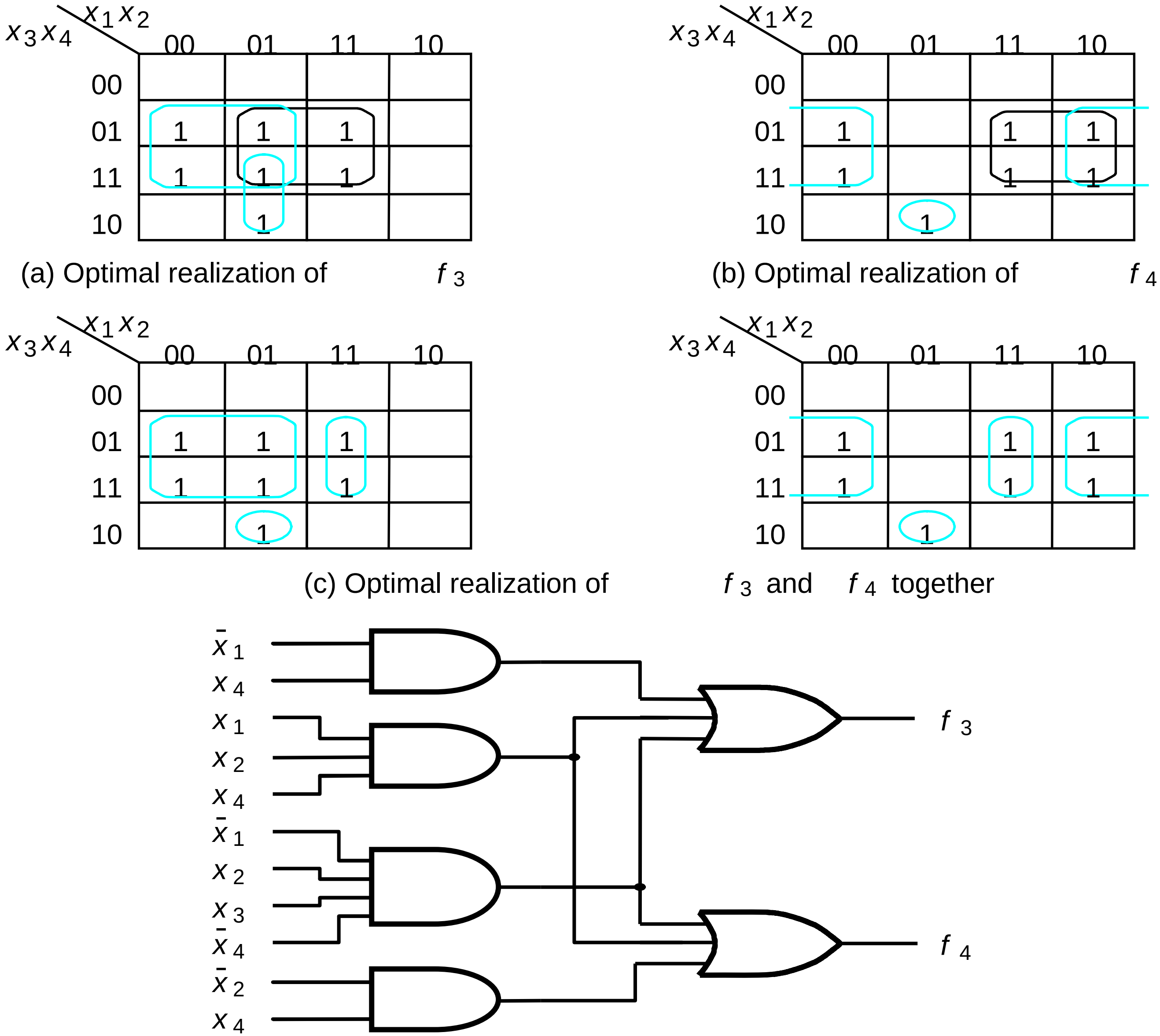


(a) Function f_1

(b) Function f_2

(c) Combined circuit for f_1 and f_2

Figure 4.16. An example of multiple-output synthesis.



(d) Combined circuit for f_3 and f_4

Figure 4.17. An example of multiple-output synthesis.