CIRCUITOS DIGITAIS

MULTIPLEXADORES

Prof. Marcelo Grandi Mandelli
mgmandelli@unb.br

Principais diferenças entre C.C. e C.S.

Circuitos Combinacionais

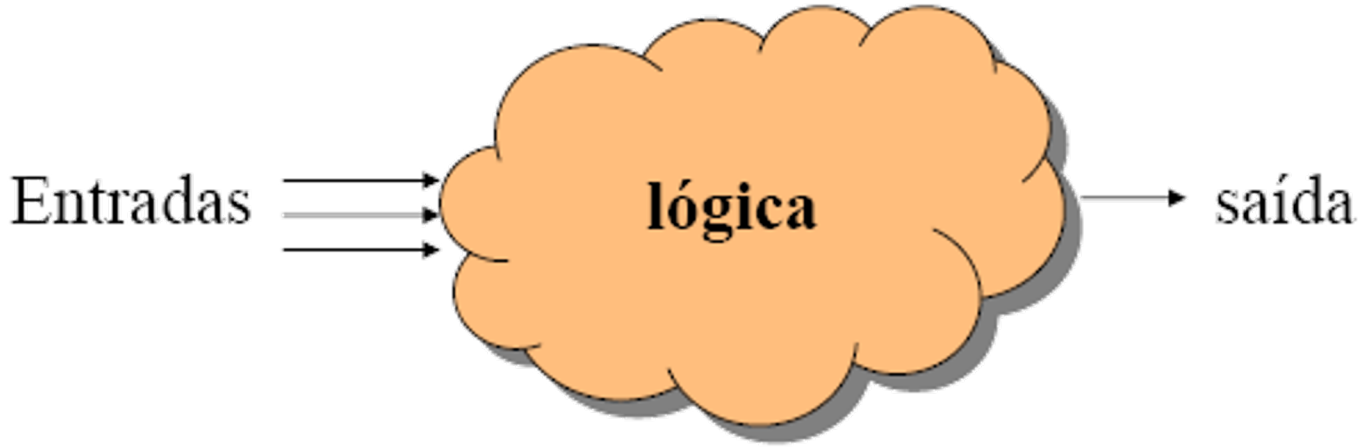
- A saída é formada por uma combinação de operações realizadas (unicamente) sobre as entradas.
- Ex.: Somadores, multiplexadores, codificadores, decodificadores, ULAs, etc.

Circuitos Sequenciais

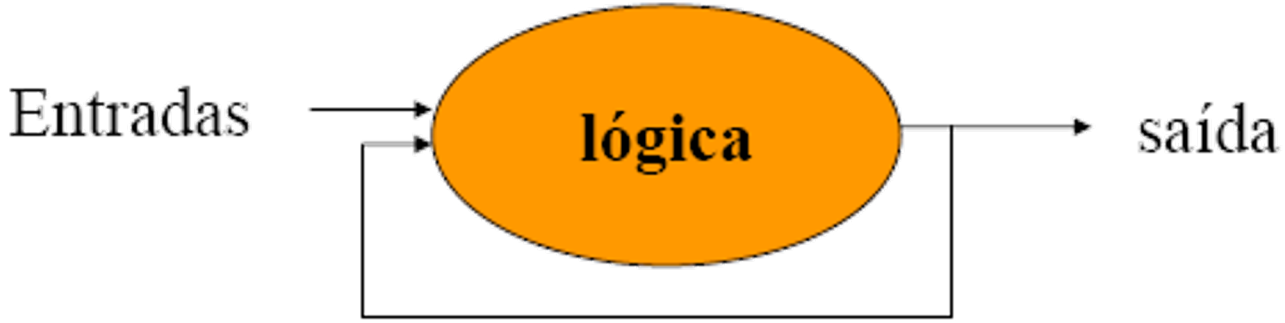
- São circuitos capazes de “lembrar” estados anteriores.
- Isso é possível pois esses circuitos permitem realimentação (a saída também serve de entrada)
- Caracteristicamente guiados pelo *clock (síncronos ou* assíncronos)
- Ex.: latches, flip-flops

Principais diferenças entre C.C. e C.S.

- Circuitos combinacionais:



- Circuitos sequenciais:



Circuitos Combinacionais

- Tipos de circuitos combinacionais:
  - somadores
  - comparadores
  - decodificadores
  - codificadores
  - conversores de código
  - multiplexadores (seletores)
  - demultiplexadores
  - geradores/verificadores de paridade

Circuitos Combinacionais

- Tipos de circuitos combinacionais:
  - somadores
  - comparadores
  - decodificadores
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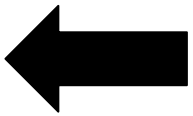
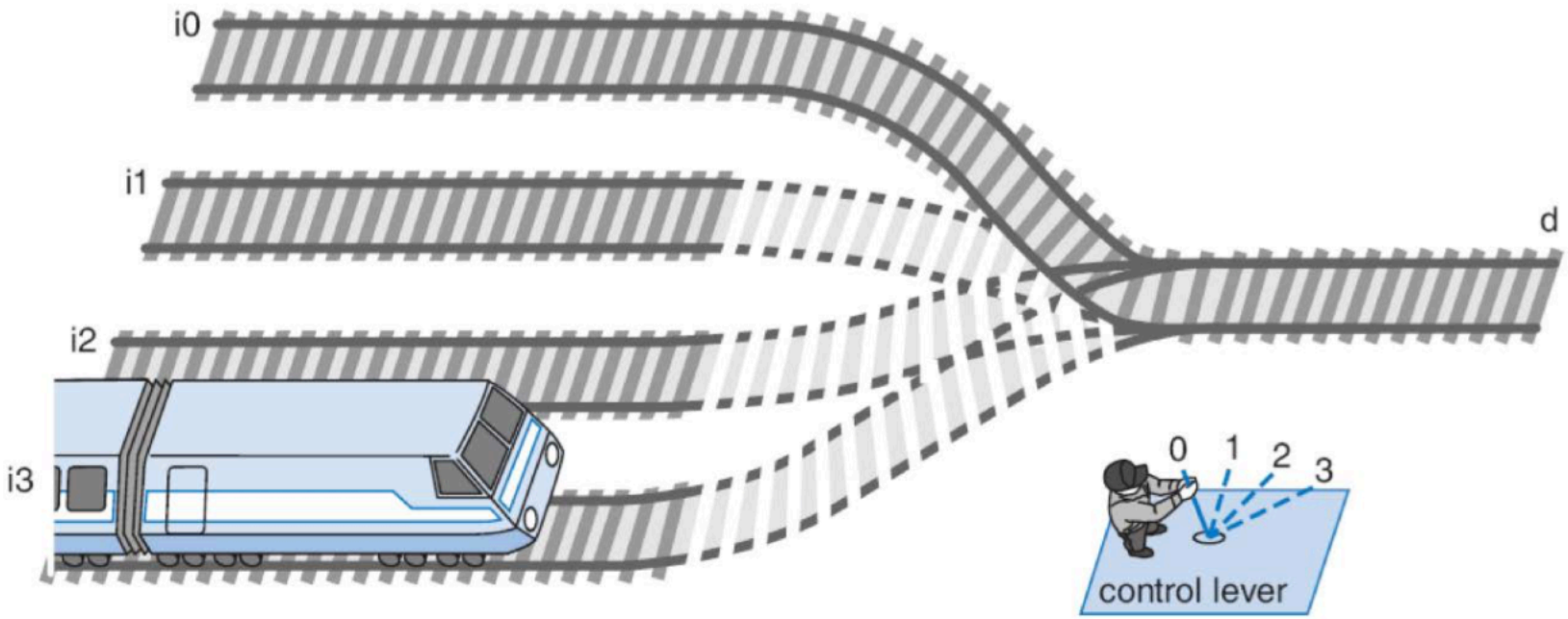
  - conversores de código
  - **multiplexadores (seletores)**  **AULA DE HOJE**
  - demultiplexadores
  - geradores/verificadores de paridade

Multiplexadores (MUX ou Seletores)

- Tem como função selecionar uma dentre as entradas, fazendo a entrada selecionada aparecer na saída



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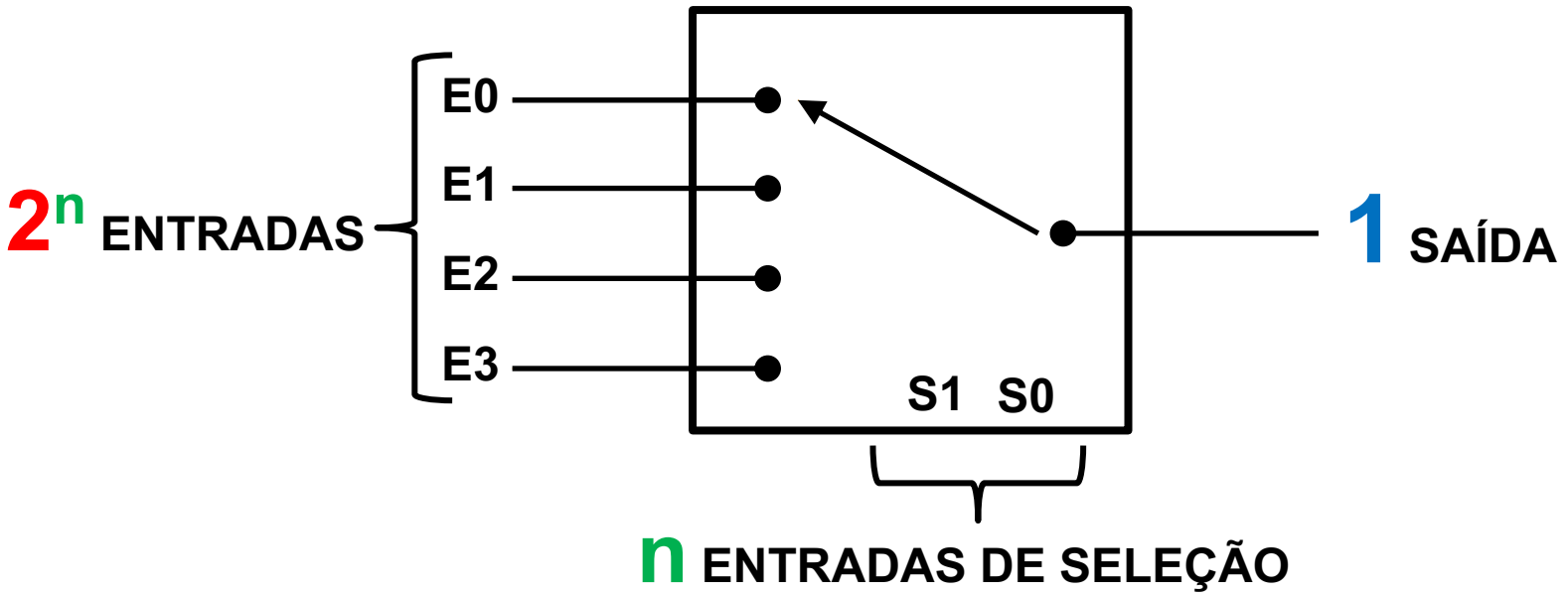
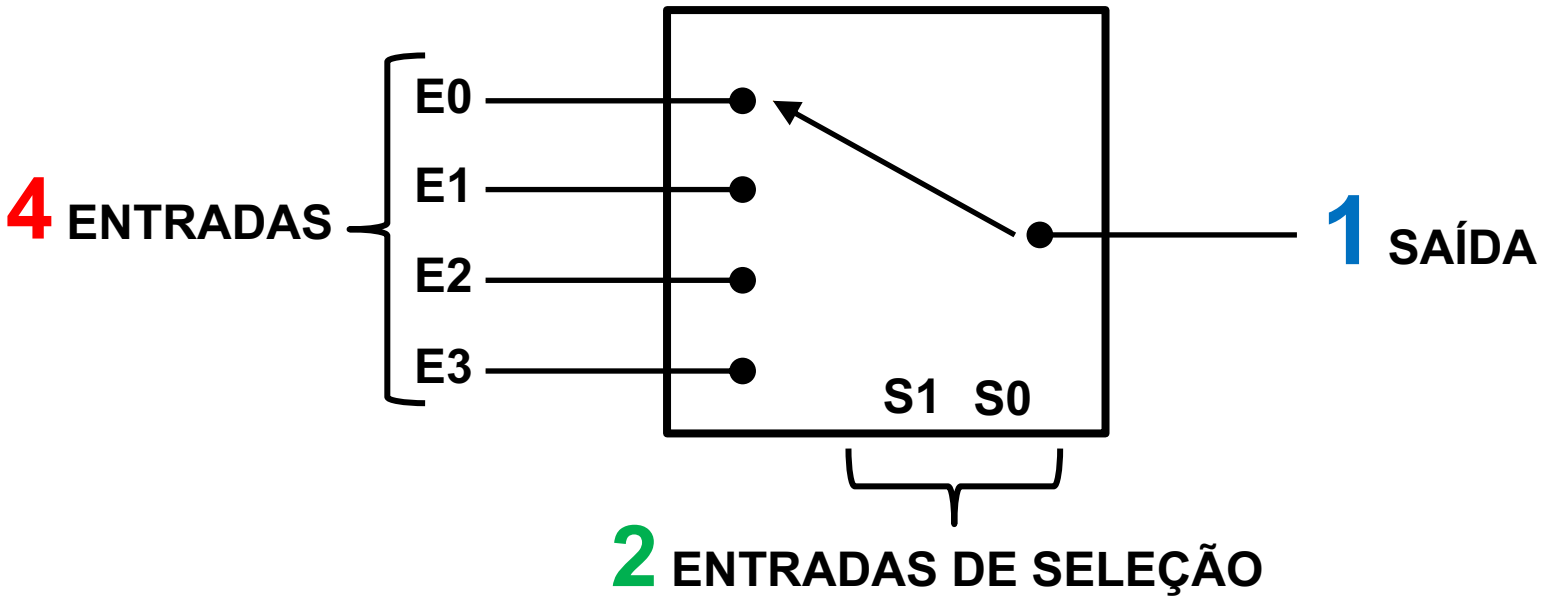


Multiplexadores (MUX ou Seletores)

- Exemplo: Multiplexador **4**:**1**



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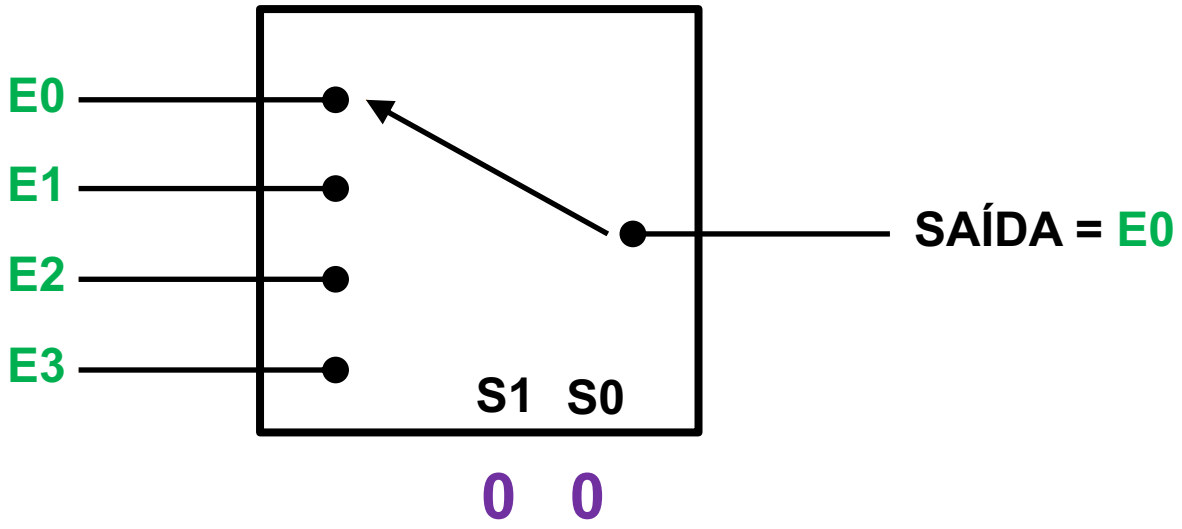

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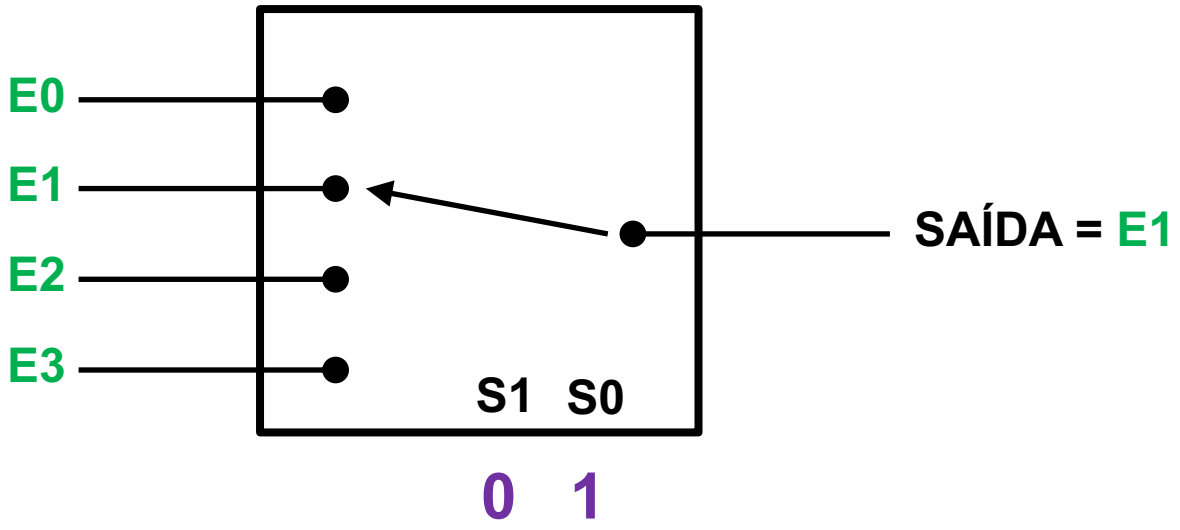

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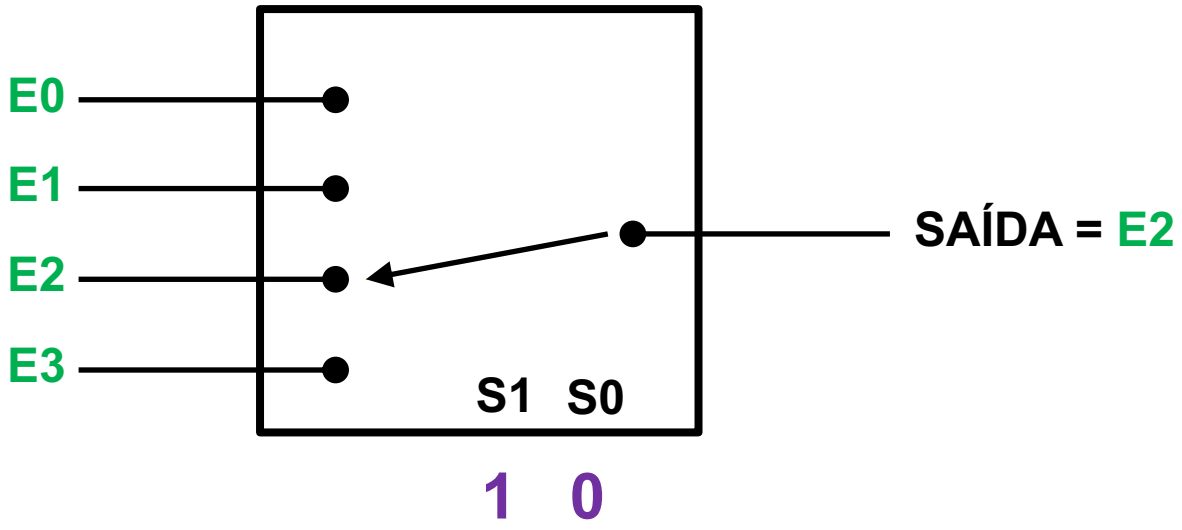

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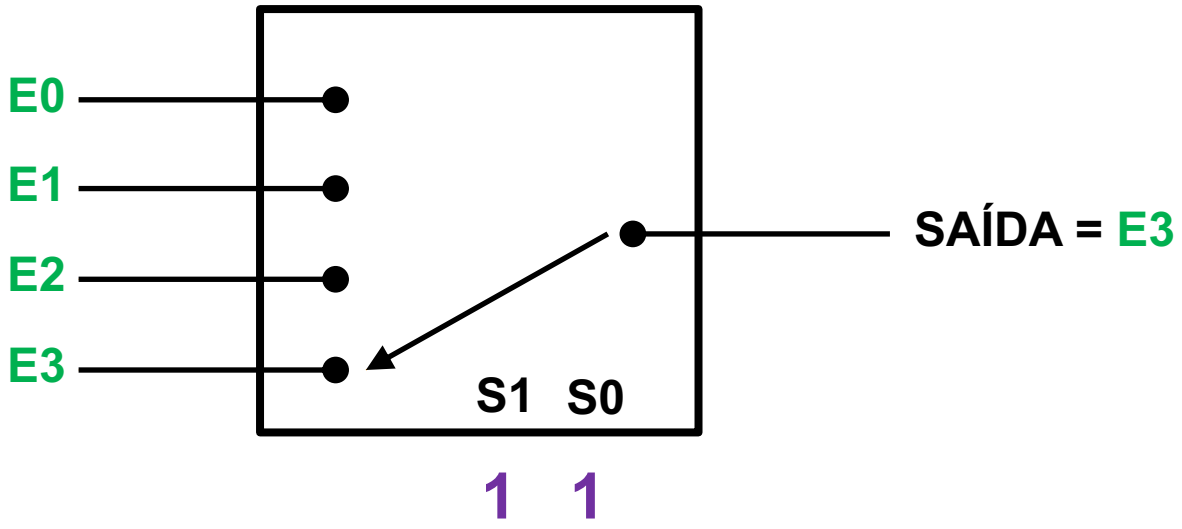
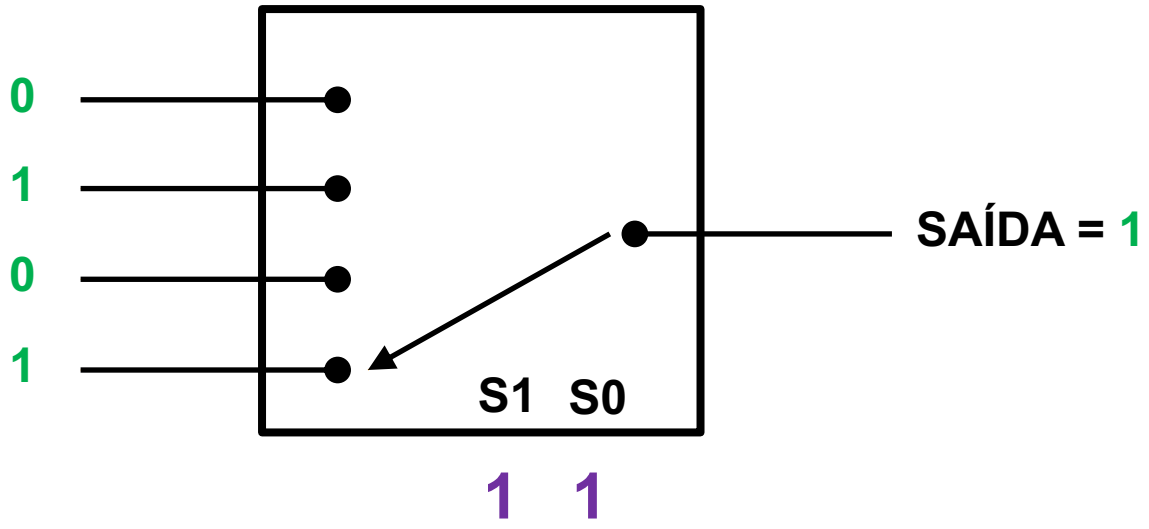


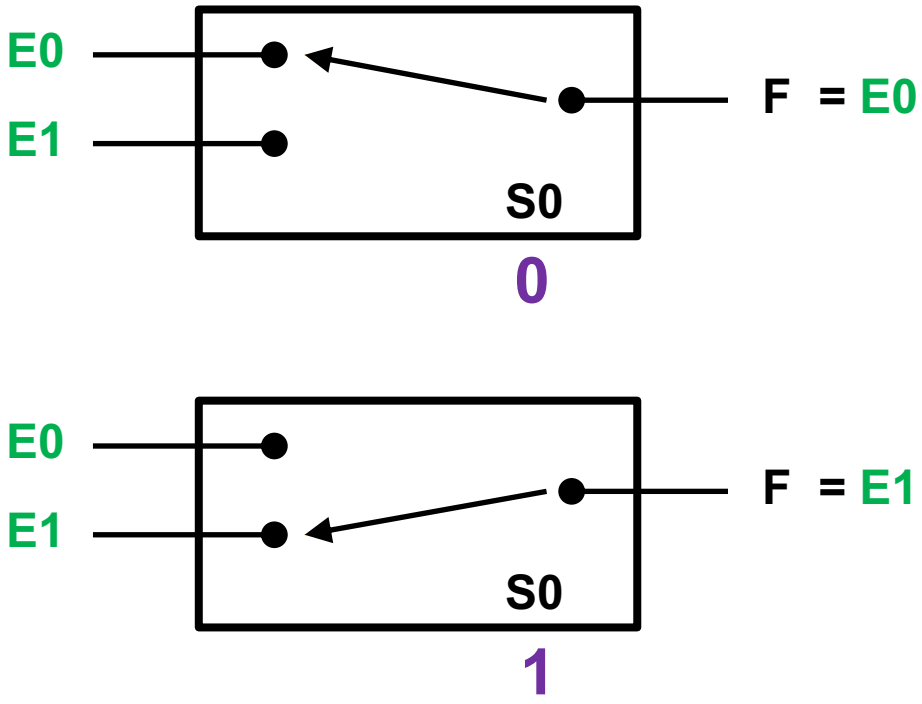
Multiplexadores (MUX ou Seletores)

- Exemplo: Multiplexador **4**:**1**



Multiplexadores (MUX ou Seletores)

- **MUX 2:1**



S0	F
0	E0
1	E1

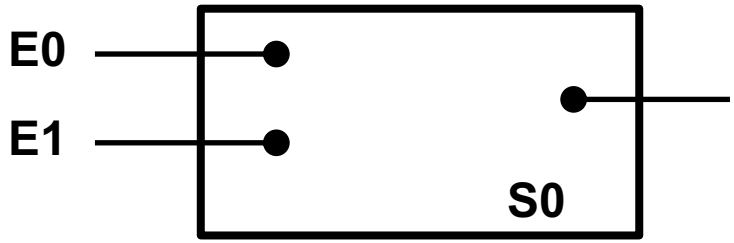
S0	E0	E1	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Multiplexadores (MUX ou Seletores)

- **MUX 2:1**

S0	E0	E1	F
0	0	0	0
0	0	1	0
0	1	0	**1**
0	1	1	**1**
1	0	0	0
1	0	1	**1**
1	1	0	0
1	1	1	**1**

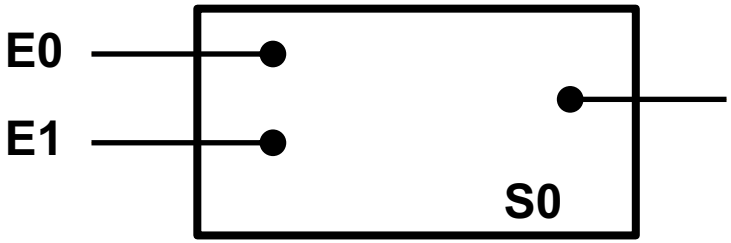
S0 \ E0 E1	00	01	11	10
0	0	0	1	1
1	0	1	1	0



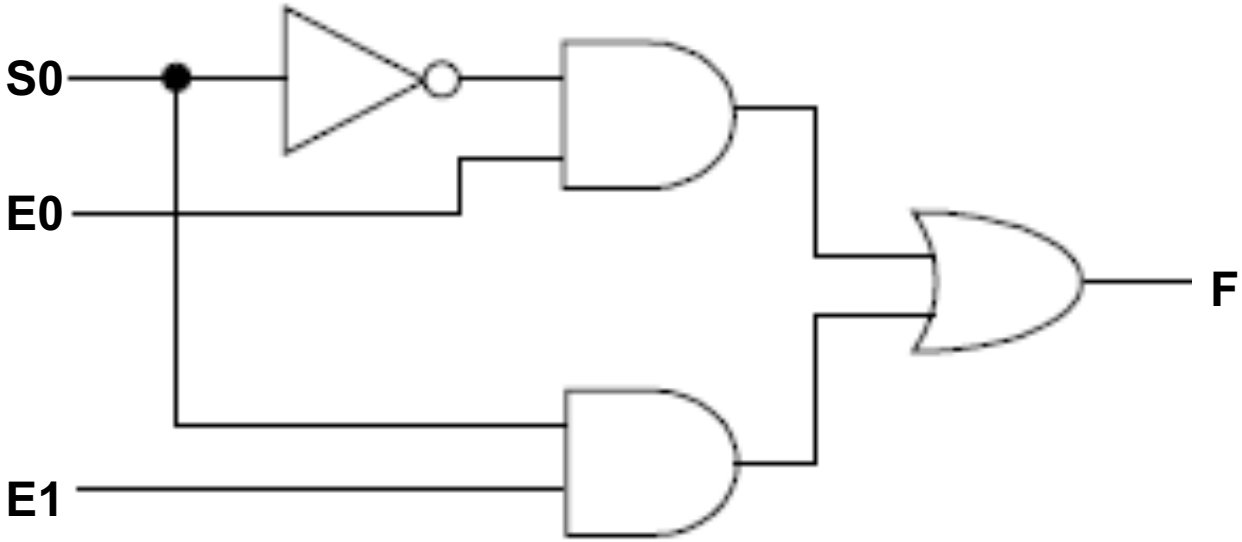
$$F = \overline{S0}E0 + S0E1$$

Multiplexadores (MUX ou Seletores)

- **MUX 2:1**

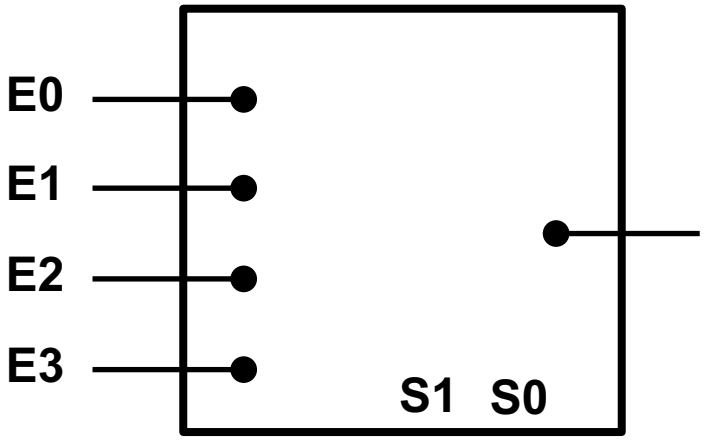


$$F = \overline{S0}E0 + S0E1$$



Multiplexadores (MUX ou Seletores)

- **MUX 4:1**



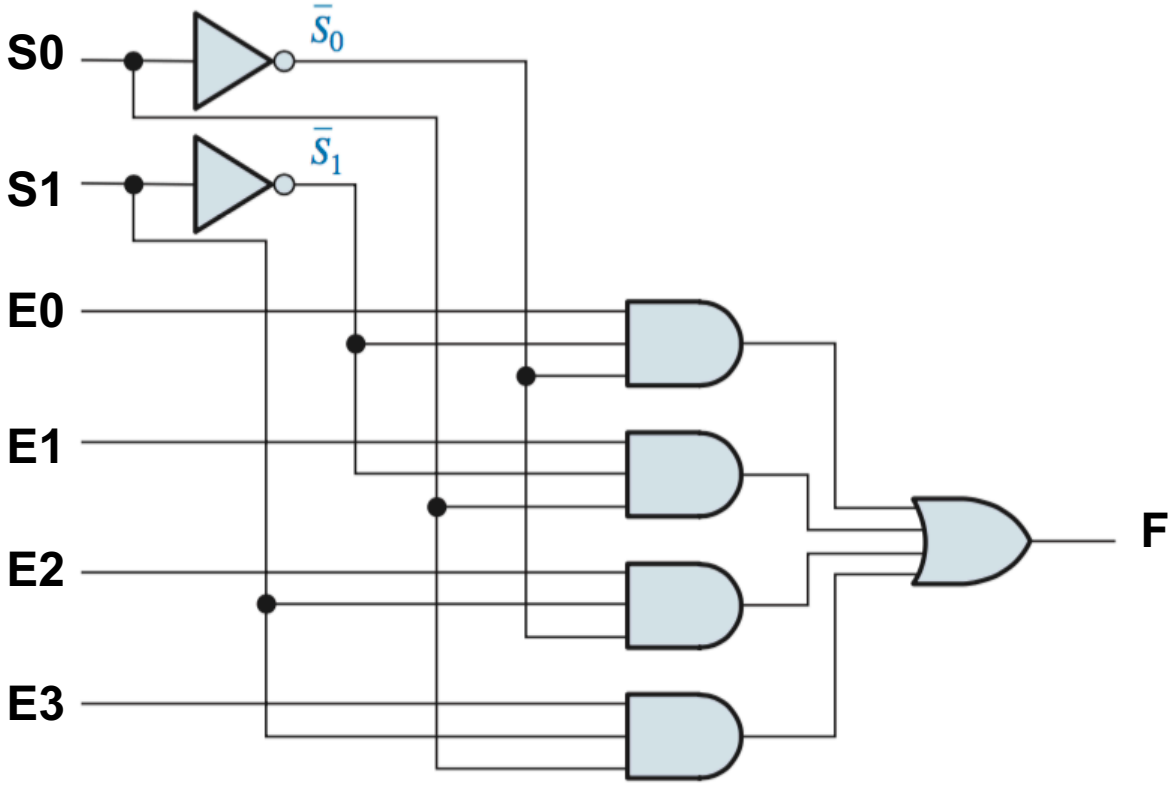
$$F = \overline{S1}\ \overline{S0}E0 + \overline{S1}\ S0E1 + S1\overline{S0}E2 + S1S0E3$$

S1	S0	F
0	0	E0
0	1	E1
1	0	E2
1	1	E3

Multiplexadores (MUX ou Seletores)

- **MUX 4:1**

$$F = \overline{S1}\,\overline{S0}E0 + \overline{S1}\,S0E1 + S1\overline{S0}E2 + S1S0E3$$

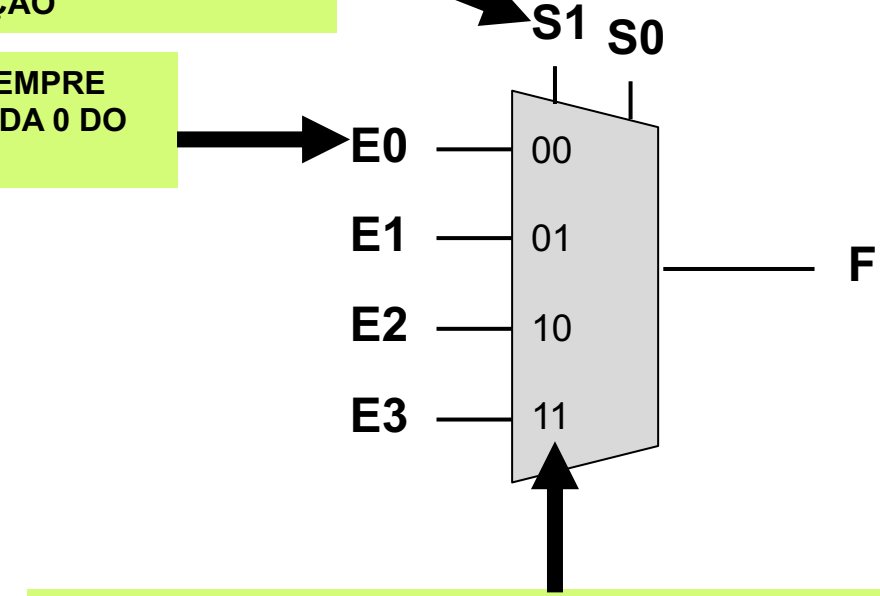


Multiplexadores (MUX ou Seletores)

- **MUX 4:1 → REPRESENTAÇÃO NA DISCIPLINA**

A ENTRADA DE SELEÇÃO MAIS A ESQUERDA (S1 NO EXEMPLO) É CONVENCIONADA COMO O BIT MAIS SIGNIFICATIVO DAS ENTRADAS DE SELEÇÃO

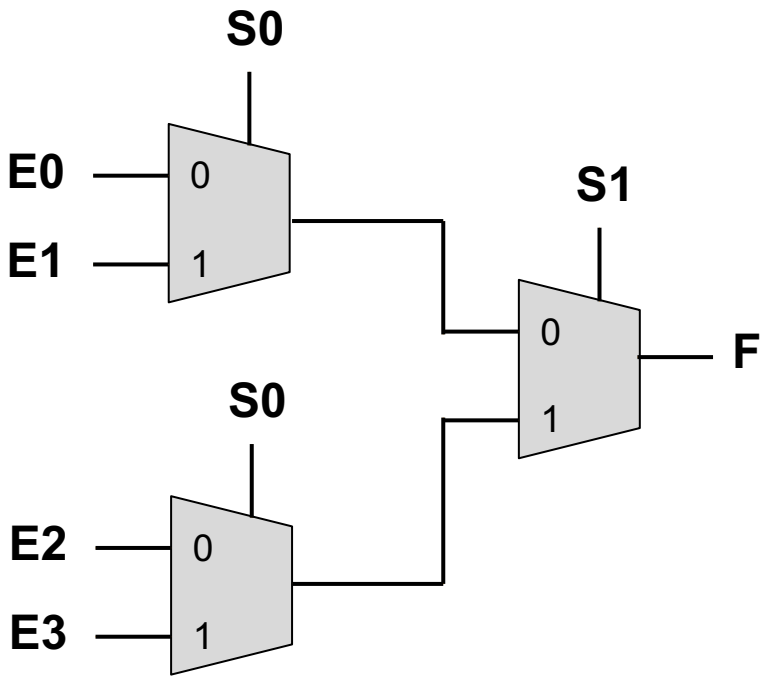
A ENTRADA MAIS ACIMA SERÁ SEMPRE CONVENCIONADA COMO A ENTRADA 0 DO MULTIPLEXADOR



EM CADA ENTRADA DO MULTIPLEXADOR HÁ UM VALOR EM BINÁRIO INDICANDO QUAL É AQUELA ENTRADA. POR EXEMPLO, NA ENTRADA 3 HÁ O VALOR 11 (3 EM BINÁRIO). QUANDO S1 = 1 E S0 = 1 O VALOR DA ENTRADA 3 SERÁ COLOCADO NA SAÍDA F.

Multiplexadores (MUX ou Seletores)

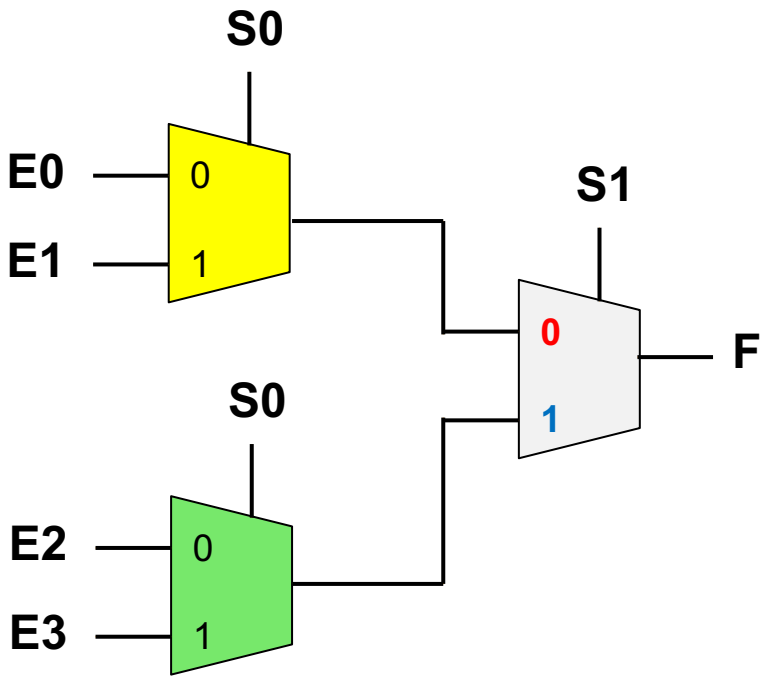
- **MUX 4:1 utlizando MUXES 2:1**



S1	S0	F
0	0	E0
0	1	E1
1	0	E2
1	1	E3

Multiplexadores (MUX ou Seletores)

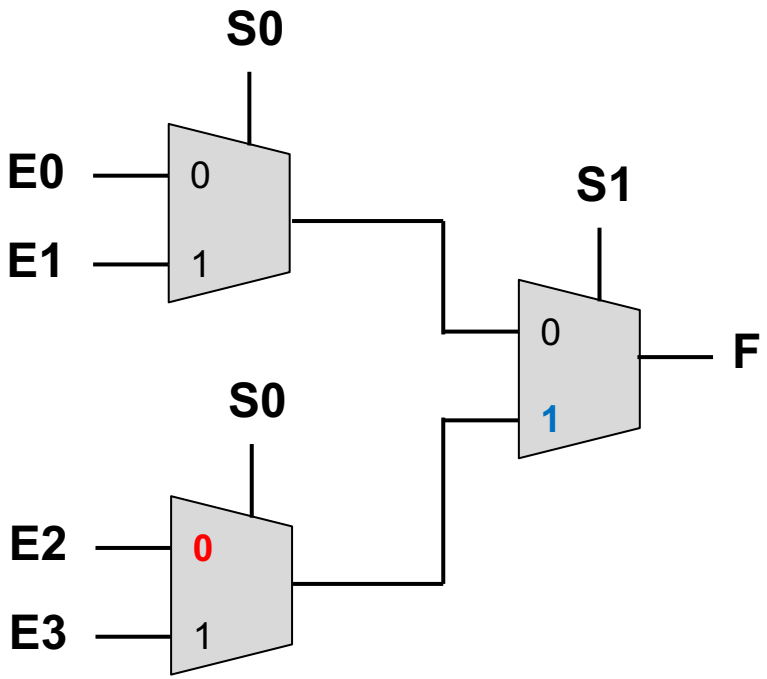
- **MUX 4:1 utlizando MUXES 2:1**



S1	S0	F
0	0	E0
0	1	E1
1	0	E2
1	1	E3

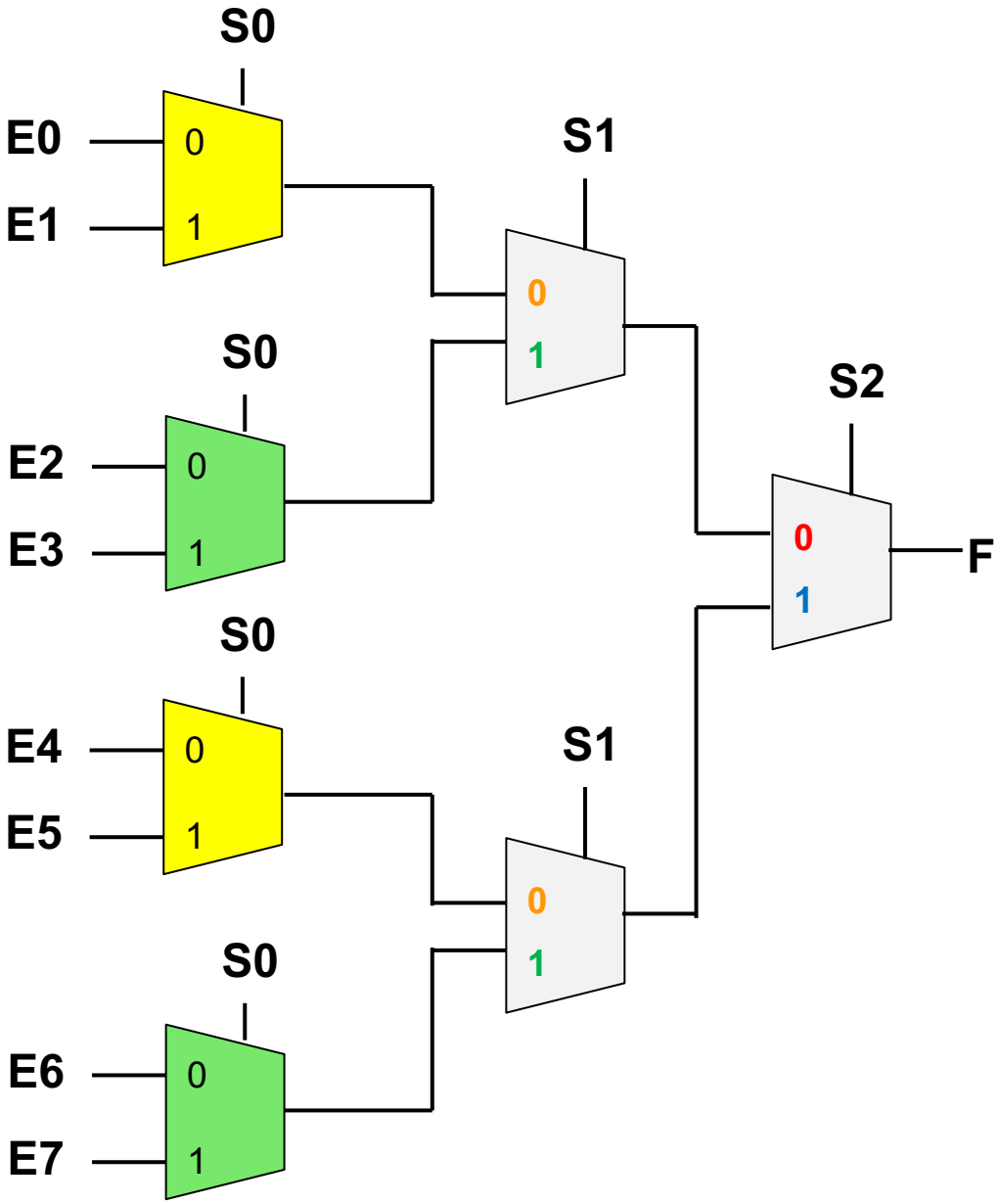
Multiplexadores (MUX ou Seletores)

- **MUX 4:1 utlizando MUXES 2:1**



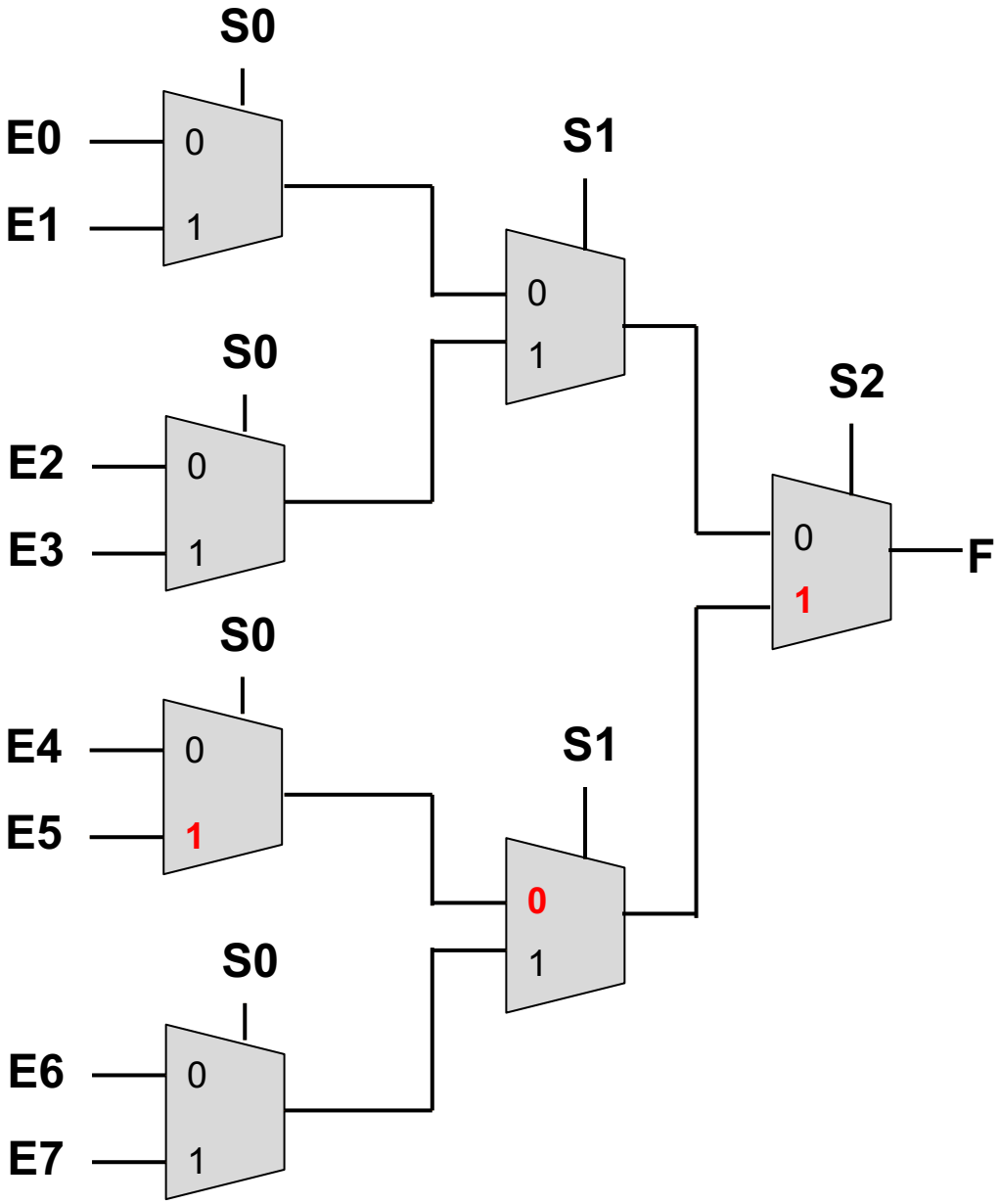
S1	S0	F
0	0	E0
0	1	E1
1	0	E2
1	1	E3

MUX 8:1 utlizando MUXES 2:1



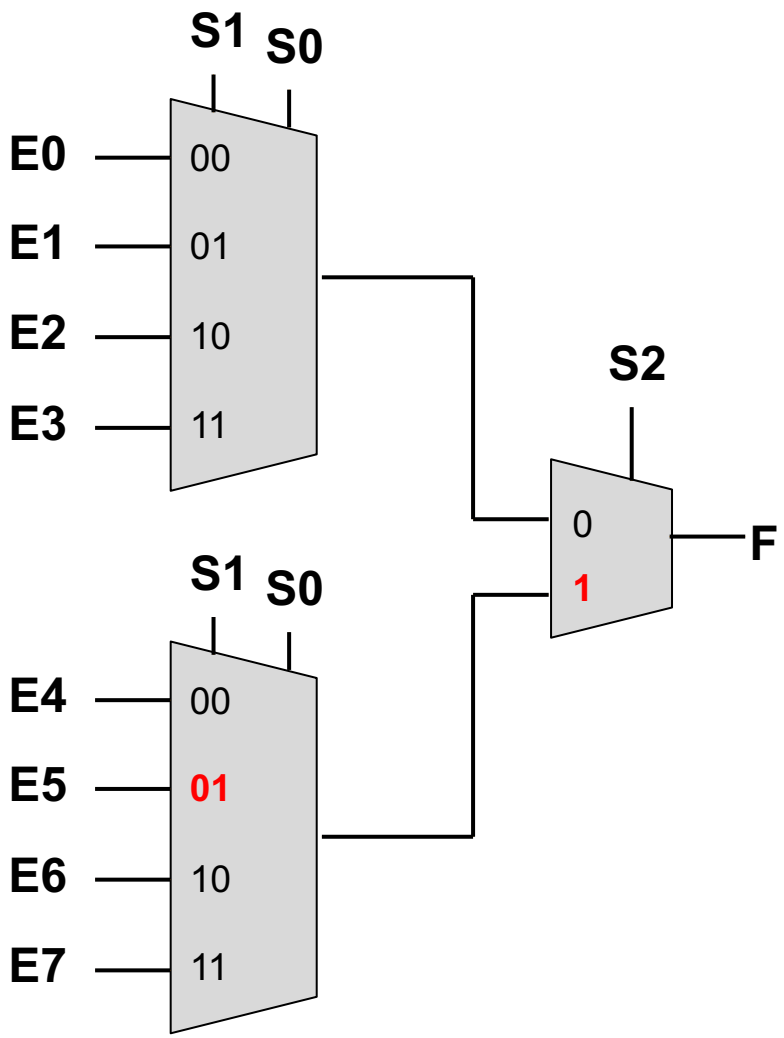
S2	S1	S0	F
0	0	0	E0
0	0	1	E1
0	1	0	E2
0	1	1	E3
1	0	0	E4
1	0	1	E5
1	1	0	E6
1	1	1	E7

MUX 8:1 utlizando MUXES 2:1



S2	S1	S0	F
0	0	0	E0
0	0	1	E1
0	1	0	E2
0	1	1	E3
1	0	0	E4
1	0	1	E5
1	1	0	E6
1	1	1	E7

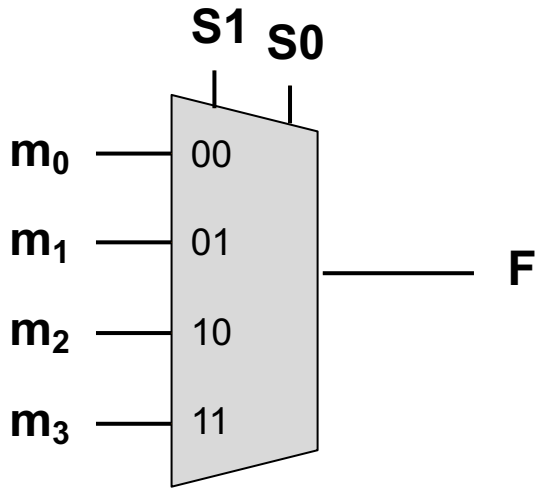
MUX 8:1 com MUXES 4:1 e 2:1



S2	S1	S0	F
0	0	0	E0
0	0	1	E1
0	1	0	E2
0	1	1	E3
1	0	0	E4
1	0	1	E5
1	1	0	E6
1	1	1	E7

Funções booleanas com MUXES

- **F(S1,S0) =**



S1	S0	F
0	0	m_0
0	1	m_1
1	0	m_2
1	1	m_3

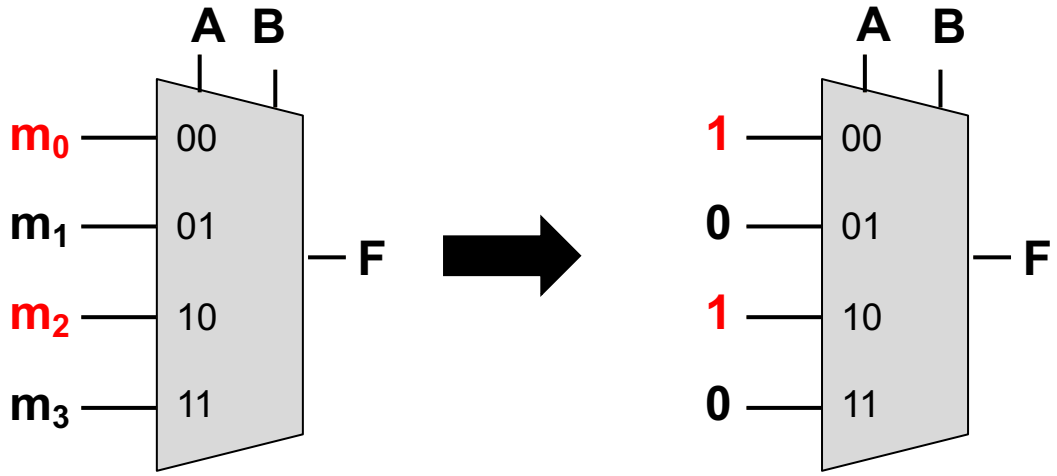
$$F = \overline{S1}\,\overline{S0}m_0 + \overline{S1}\,S0m_1 + S1\overline{S0}m_2 + S1S0m_3$$

→ **CADA ENTRADA HABILITA UM MINTERMO**

Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B) = \overline{A}\,\overline{B} + A\overline{B}$ ou $F(A,B) = \sum m(0,2)$

A	B	F	mintermo
0	0	1	m_0
0	1	0	m_1
1	0	1	m_2
1	1	0	m_3



$$F = \overline{A}\,\overline{B}m_0 + \overline{A}Bm_1 + A\overline{B}m_2 + ABm_3$$

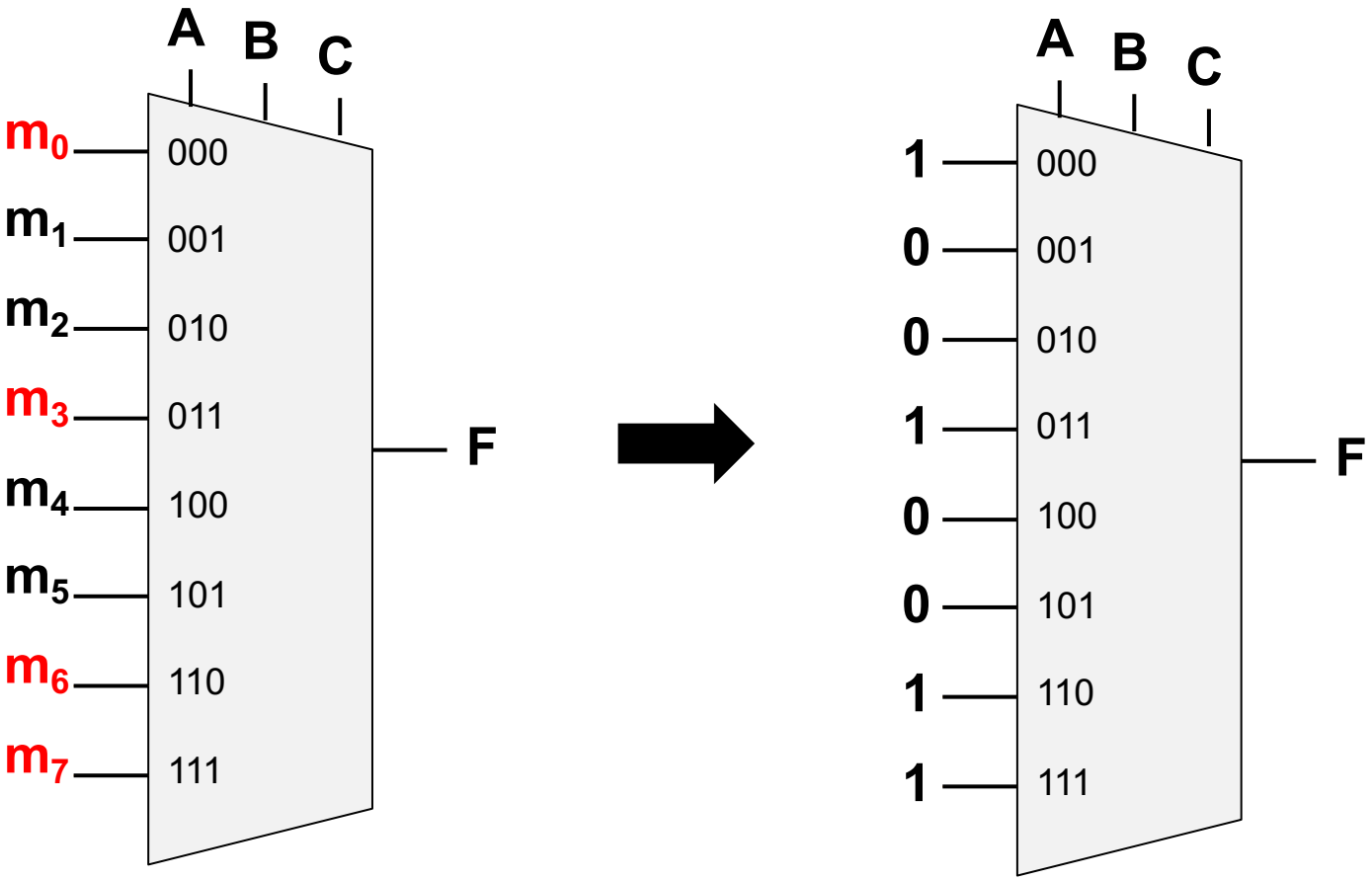
$$F = \overline{A}\,\overline{B}\,1 + \overline{A}B\,0 + A\overline{B}\,1 + AB\,0$$

$$F = \overline{A}\,\overline{B} + A\overline{B}$$

Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

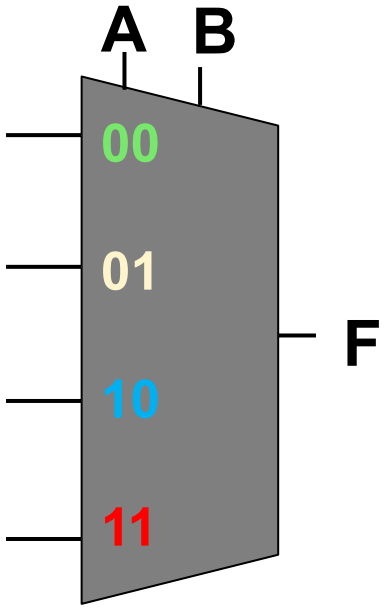


Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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



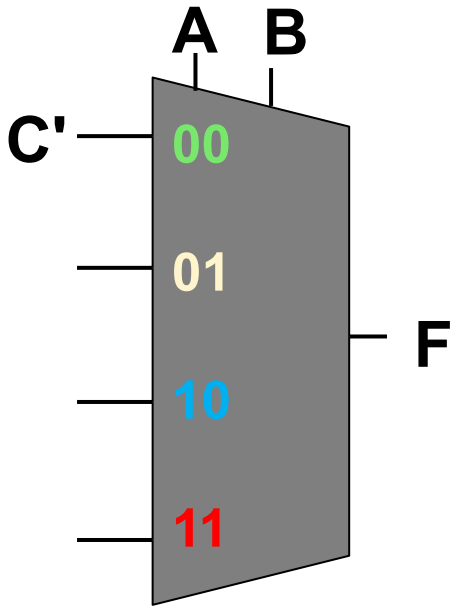
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = C'



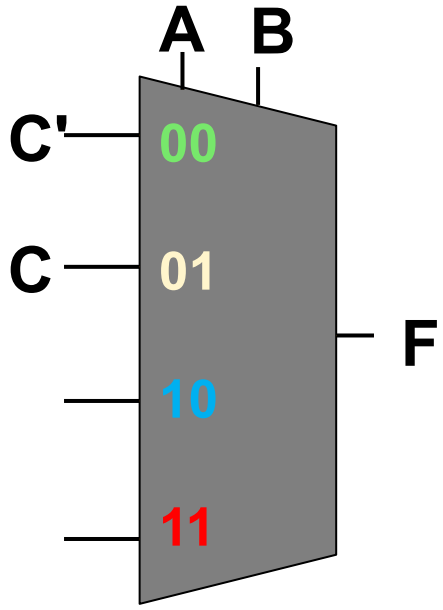
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = C



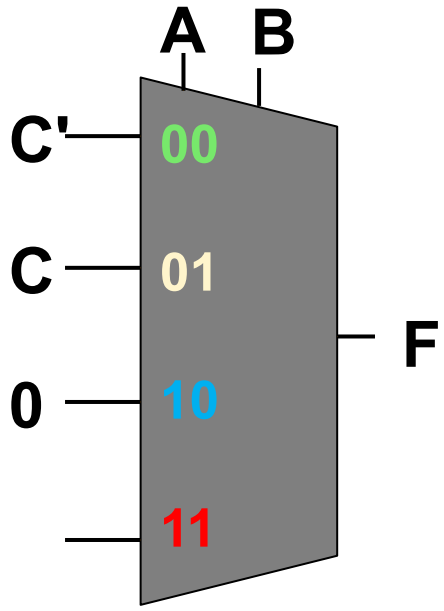
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = 0



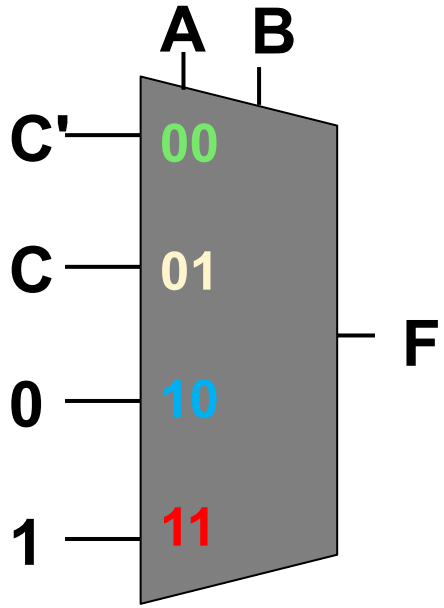
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

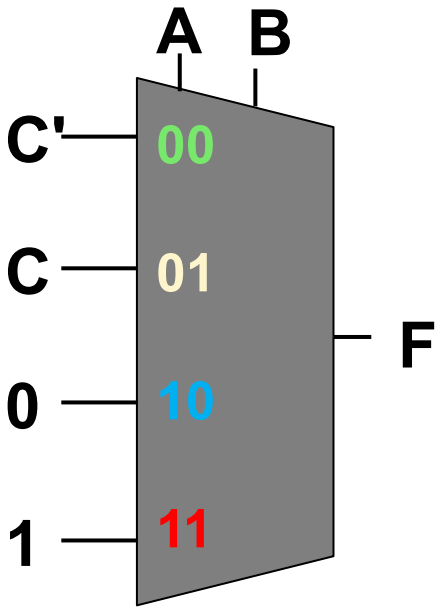
F = 1



Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$



$$F(A,B,C) = \overline{A}\,\overline{B}(\overline{C}) + \overline{A}\,B(C) + A\overline{B}(0) + AB(1)$$

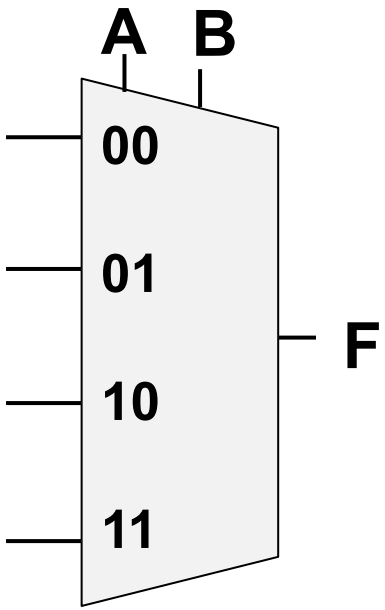
$$F(A,B,C) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,BC + AB$$

Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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



→ **VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA**

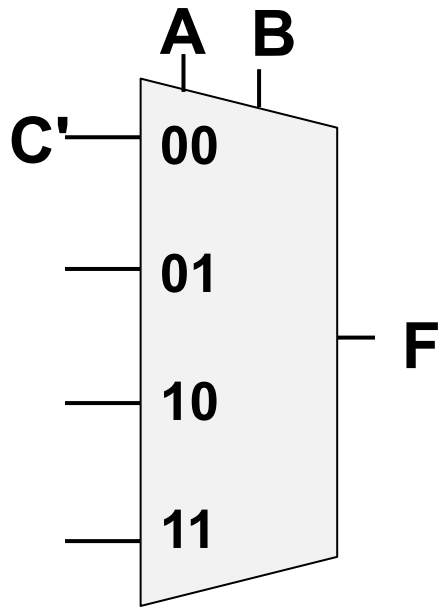
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = C'



→ VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA

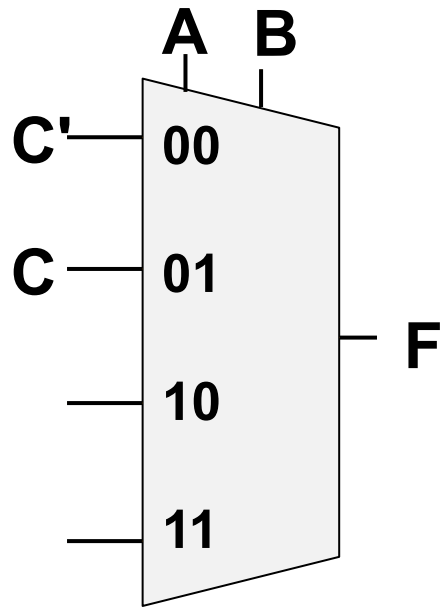
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = C



→ **VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA**

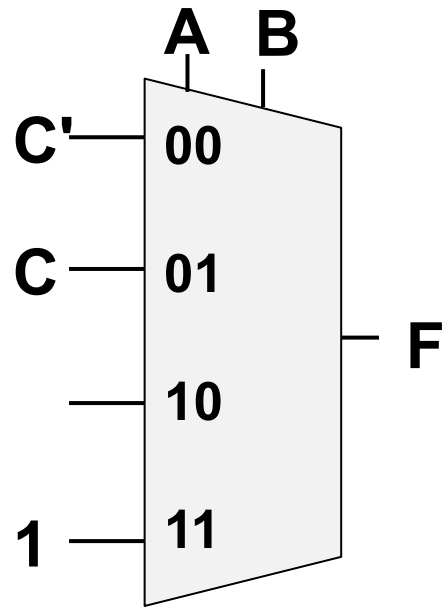
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = 1



→ **VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA**

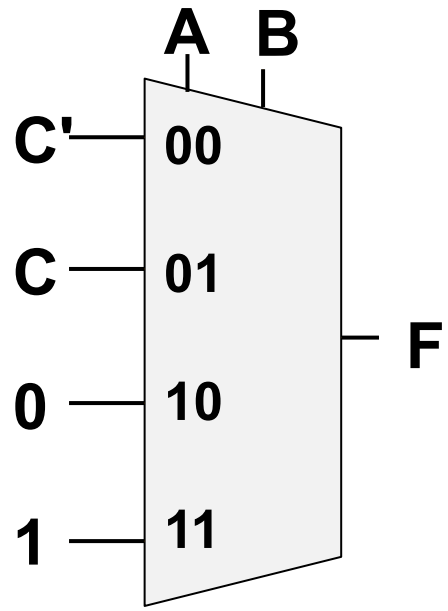
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = 0



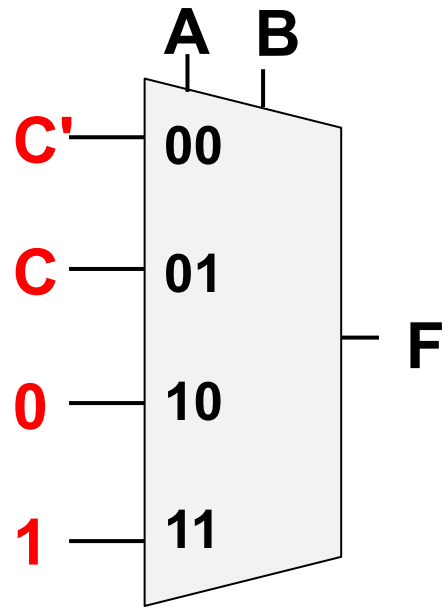
→ VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA

Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

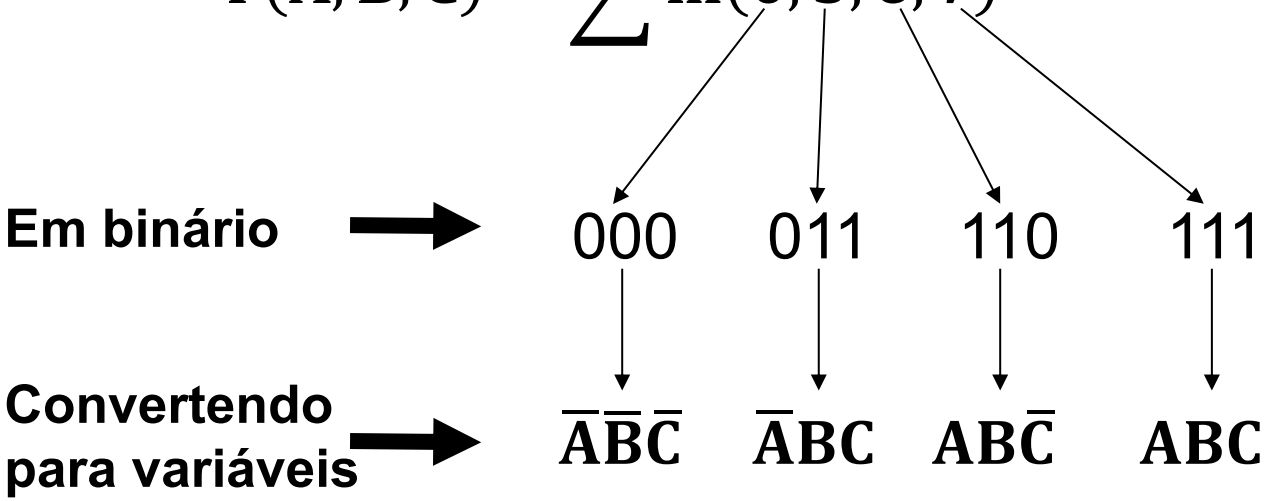


F(A,B,C) = A'B'C' + A'BC + AB'(0) + AB(1)

F(A,B,C) = A'B'C' + A'BC + AB

Conversão - Mintermos

$$\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$$

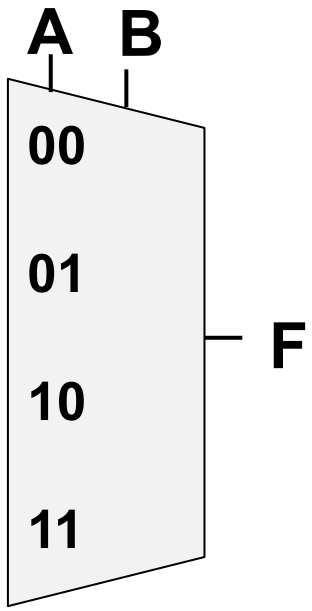


$$\mathbf{F(A,B,C) = \overline{A}\overline{B}\overline{C} + \overline{A}BC + AB\overline{C} + ABC}$$

Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

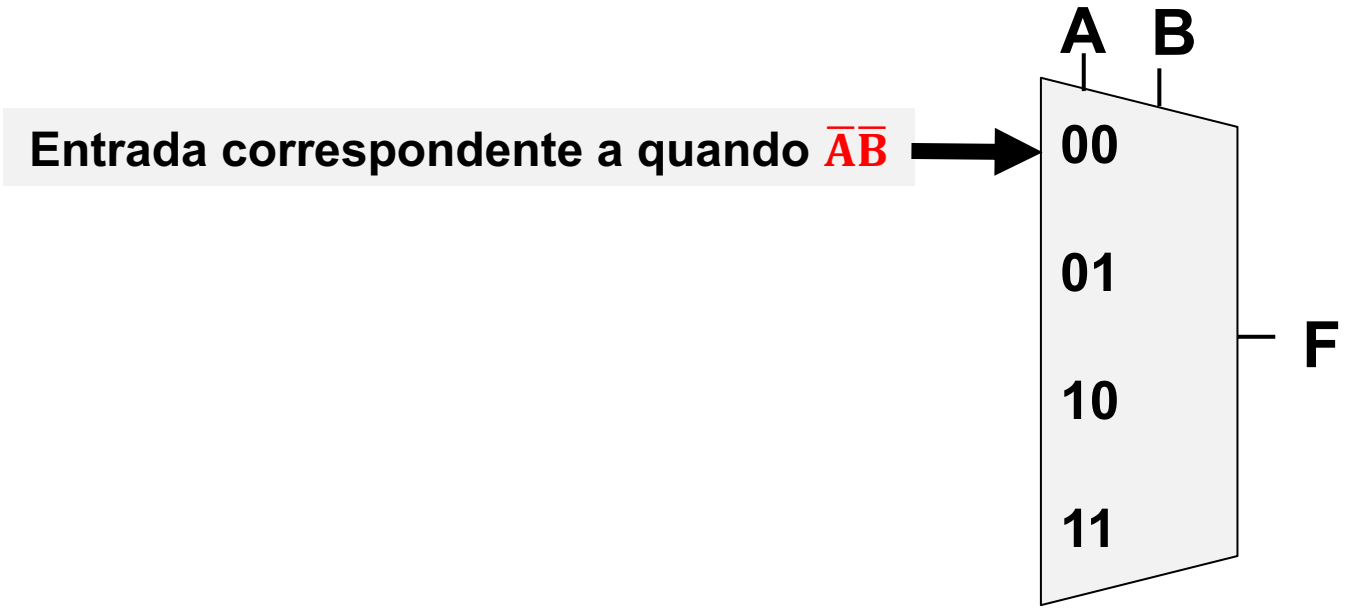
$$\mathbf{F(A,B,C) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}BC + AB\overline{C} + ABC}$$



Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

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



Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

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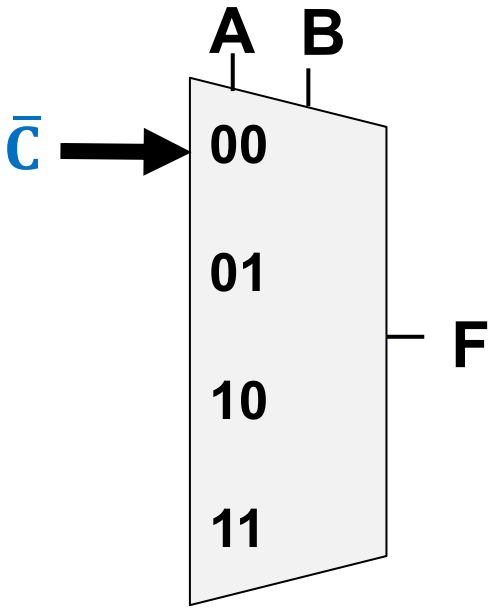
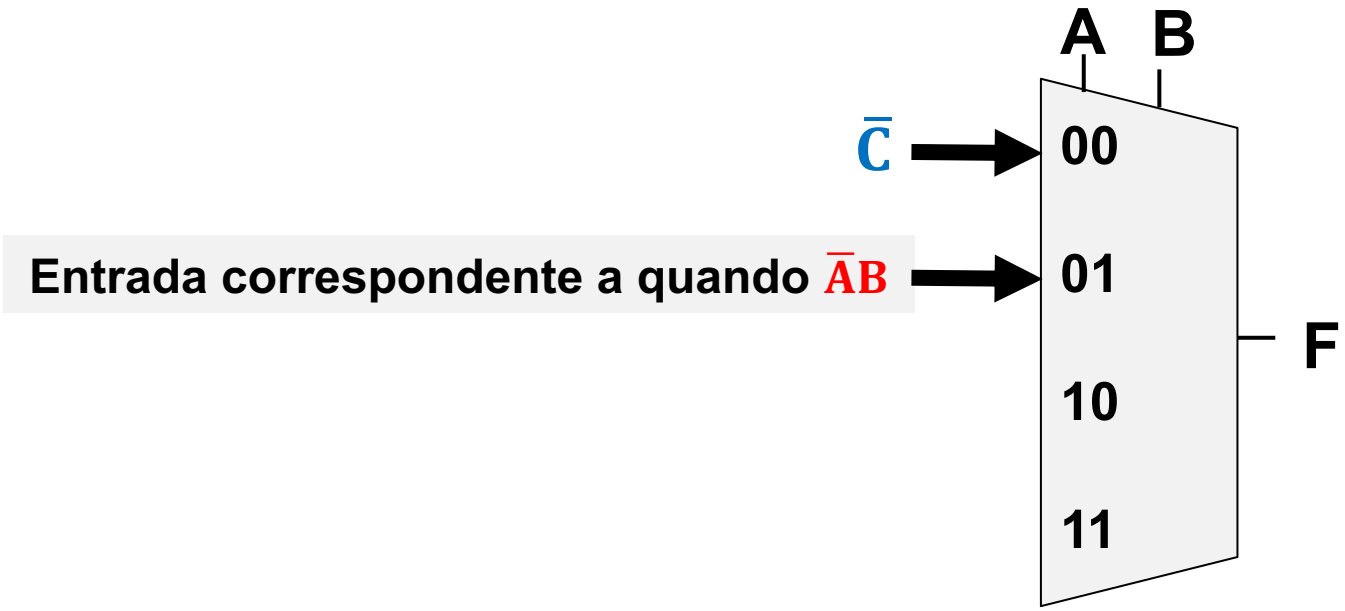


Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

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



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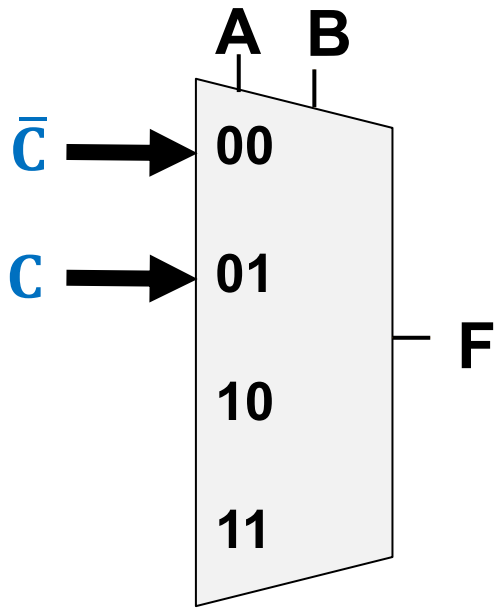
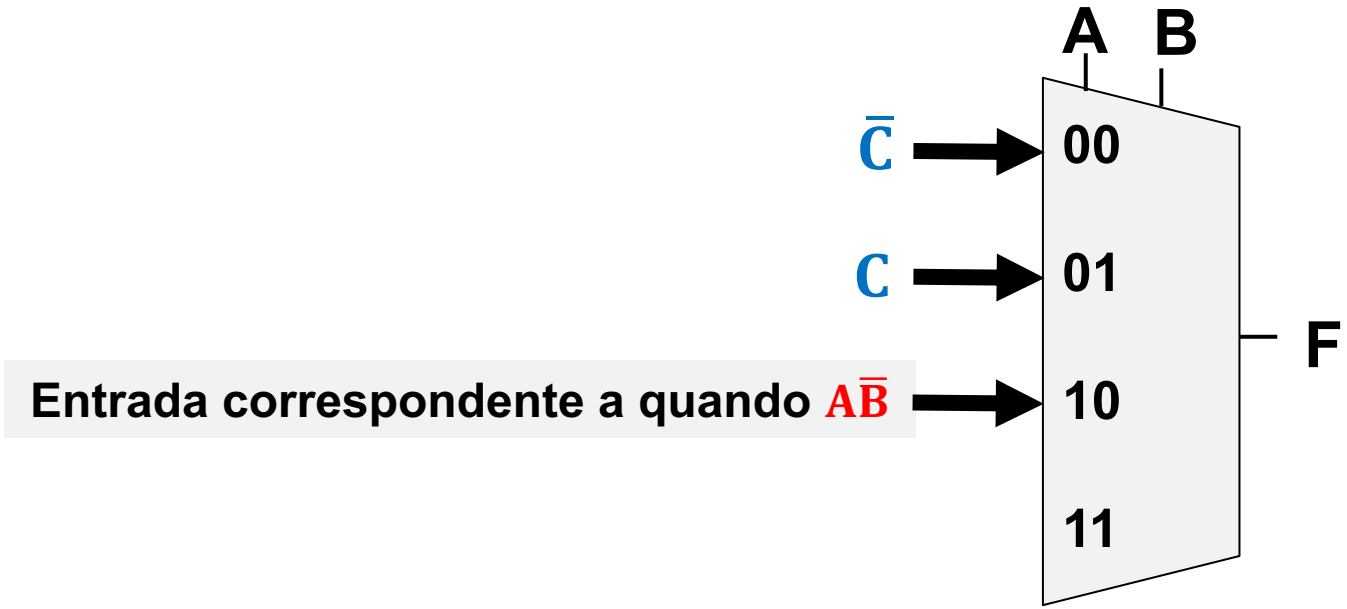


Exercício – MUX 4:1

- **EXEMPLO:** $F(A,B,C) = \sum m(0,3,6,7)$

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

Não há $A\bar{B}$ na equação!



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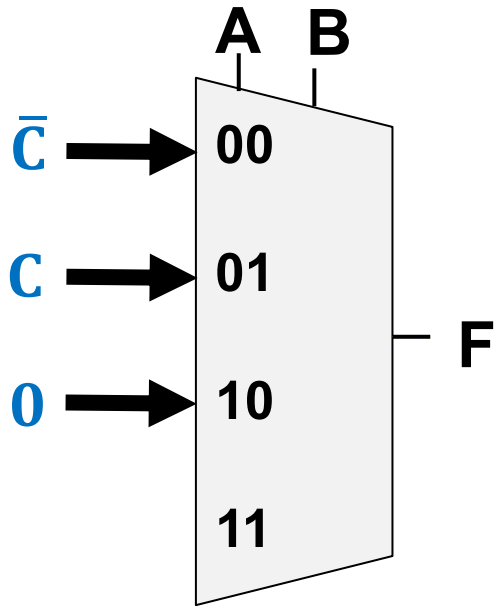
$$\mathbf{F(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}BC + AB\bar{C} + ABC}$$

Não há $A\bar{B}$ na equação! → coloca-se 0 na entrada do MUX



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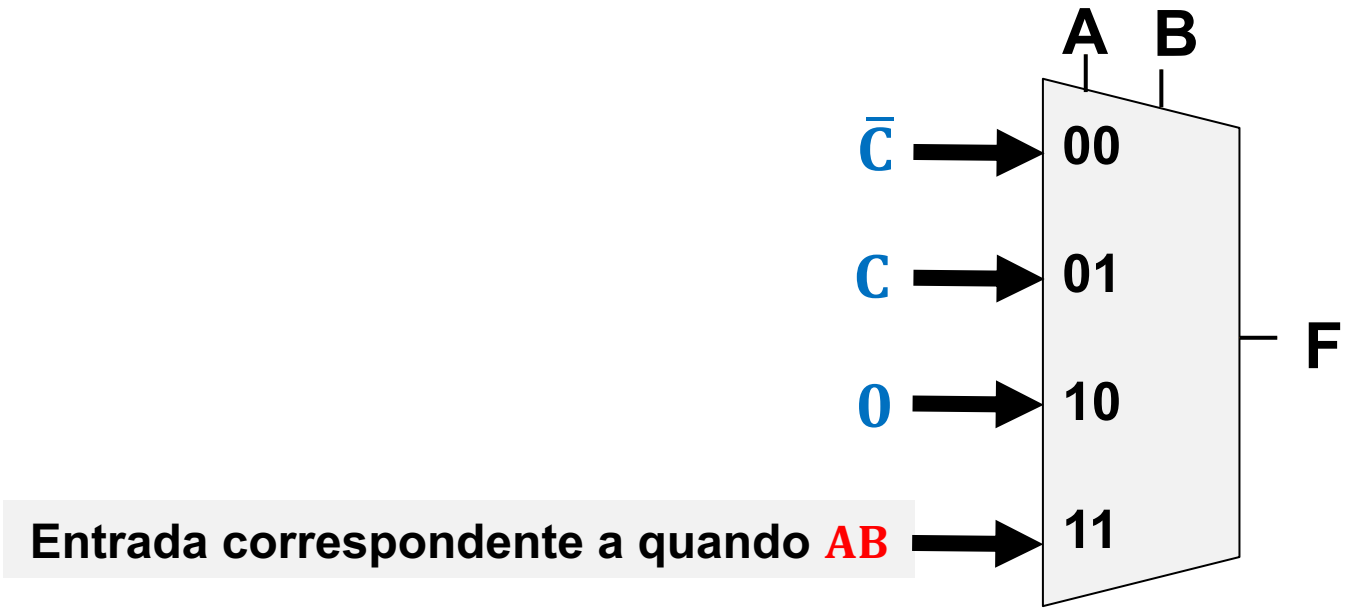

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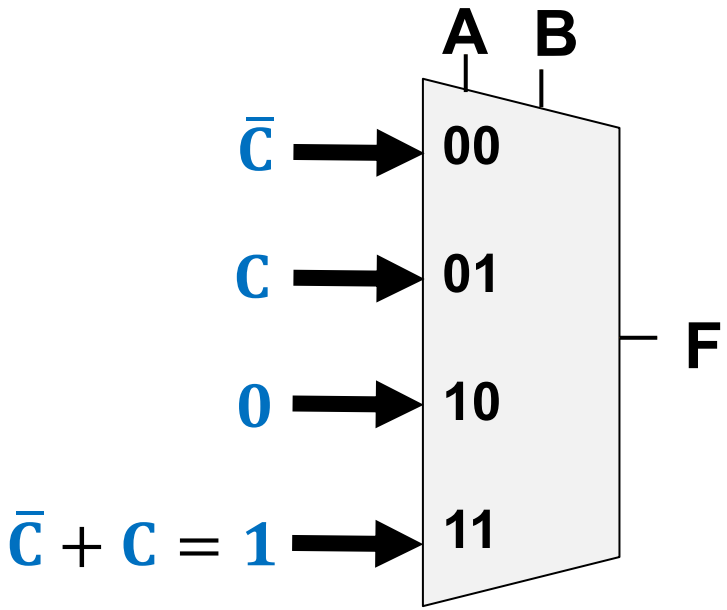

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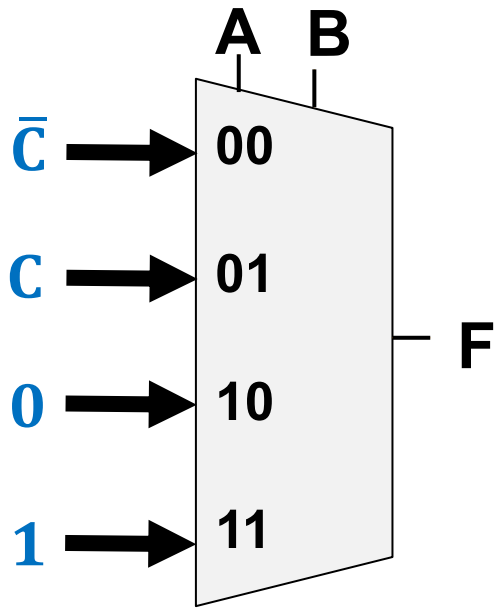
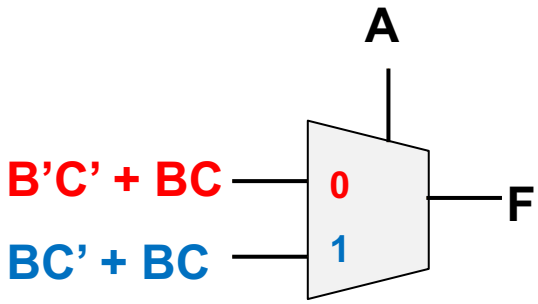


Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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



Funções booleanas com MUXES

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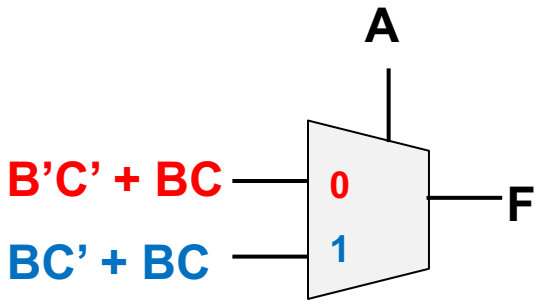
$$F(A,B,C) = \sum m(0,3,6,7)$$



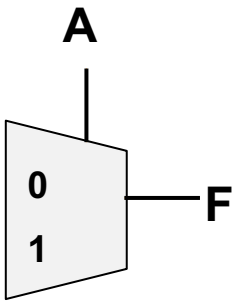
$$F(A,B,C) = \overline{A}\left(\overline{B}\,\overline{C} + BC\right) + A\left(B\overline{C} + BC\right)$$

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

Funções booleanas com MUXES

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

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



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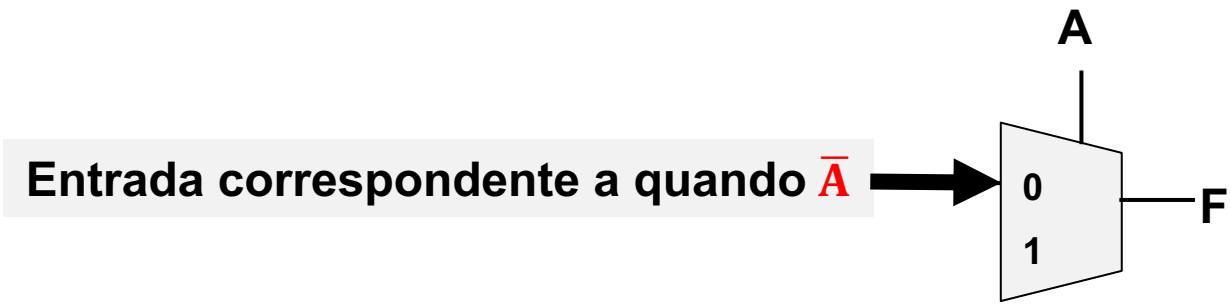

Funções booleanas com MUXES

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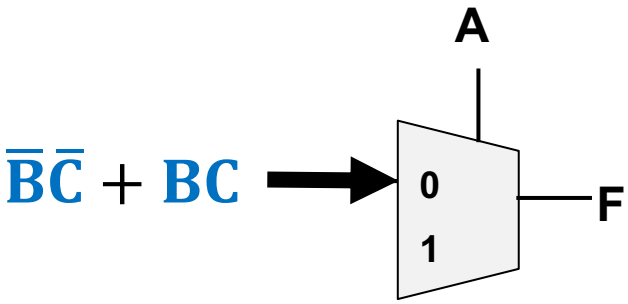
$$\mathbf{F(A,B,C) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}BC + AB\overline{C} + ABC}$$



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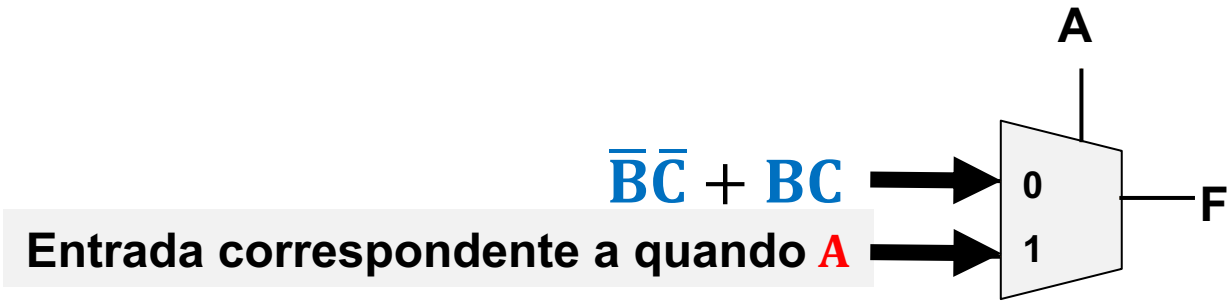

Funções booleanas com MUXES

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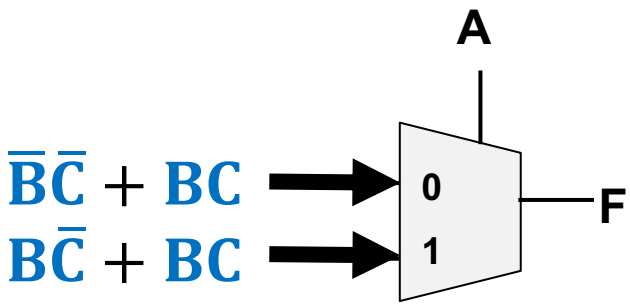
$$\mathbf{F(A,B,C) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}BC + AB\overline{C} + ABC}$$



Funções booleanas com MUXES

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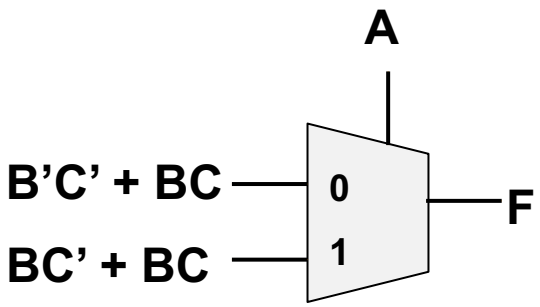
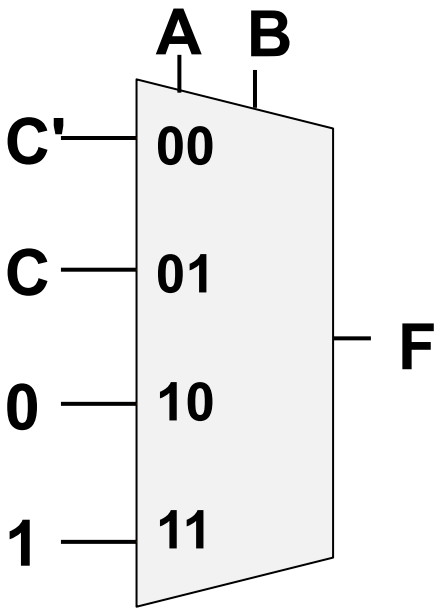
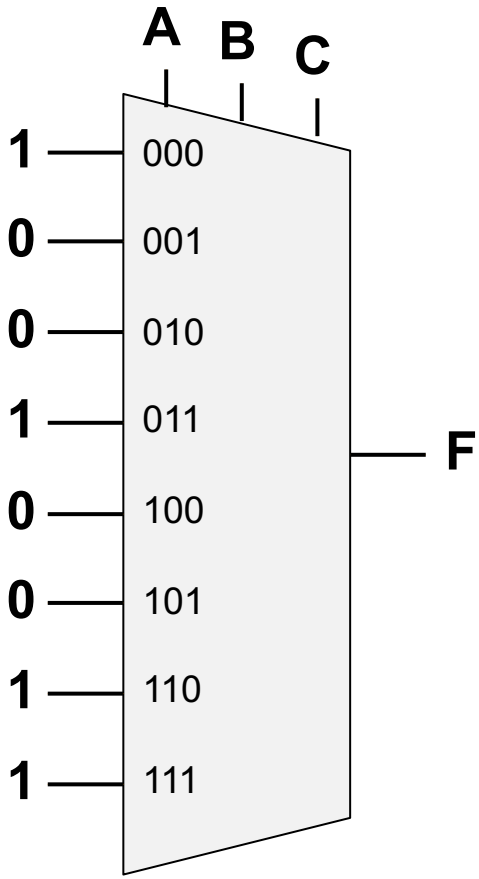
$$F(A,B,C) = \sum m(0,3,6,7)$$





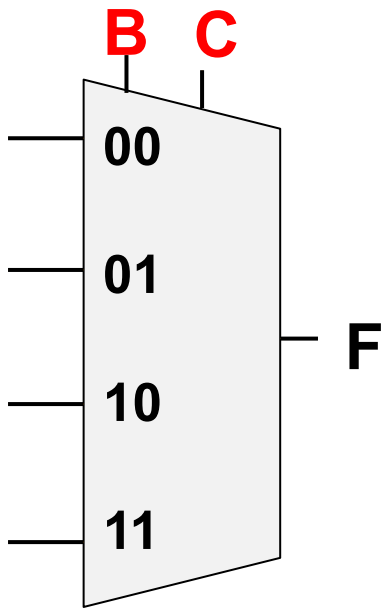


Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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



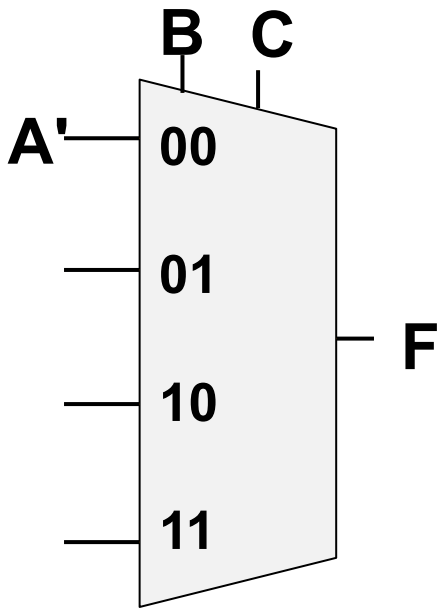
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = A'



→ VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA

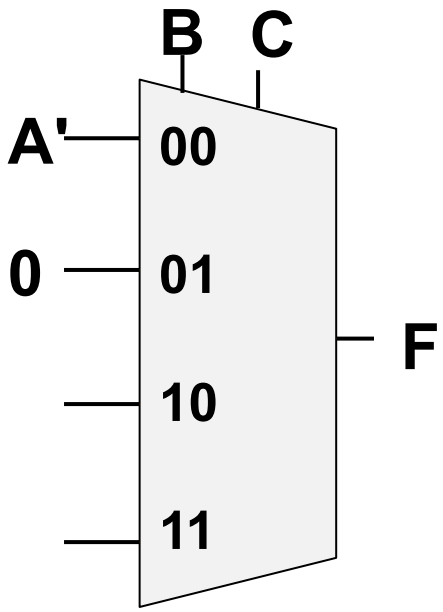
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = 0



→ **VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA**

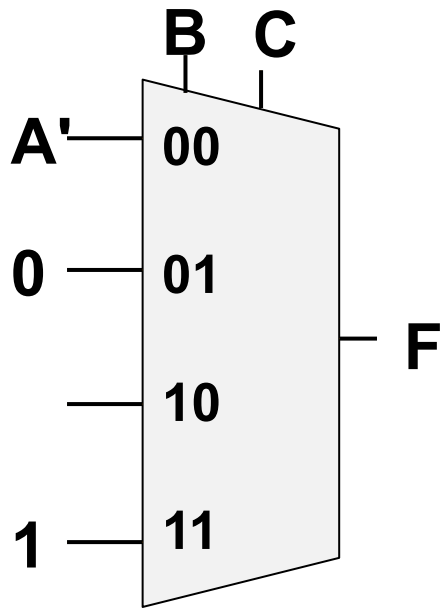
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = 1



→ **VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA**

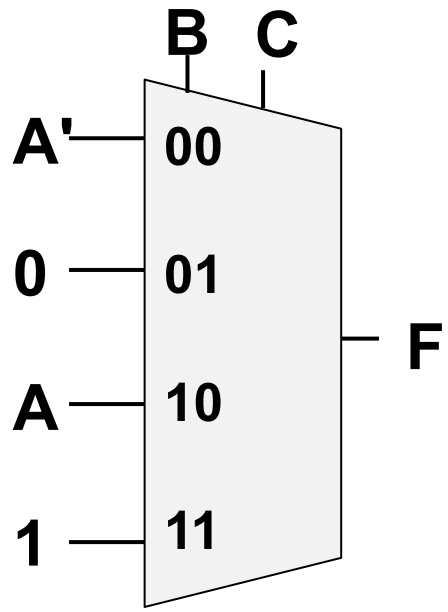
Funções booleanas com MUXES

- **EXEMPLO:**

$$F(A,B,C) = \sum m(0,3,6,7)$$

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

F = A



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Funções booleanas com MUXES

- **EXEMPLO:**

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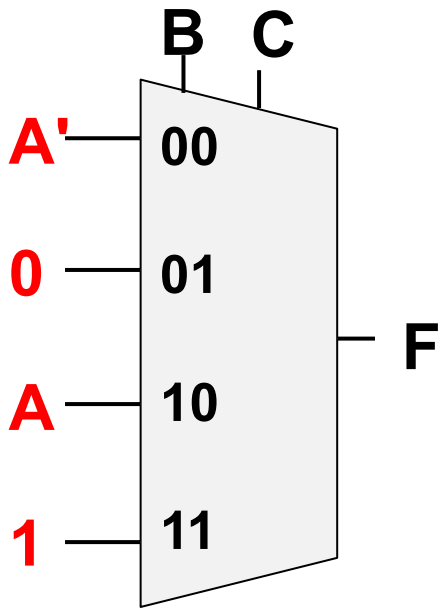
BC \ A	0	1
00	1	0
01	0	0
11	1	1
10	0	1



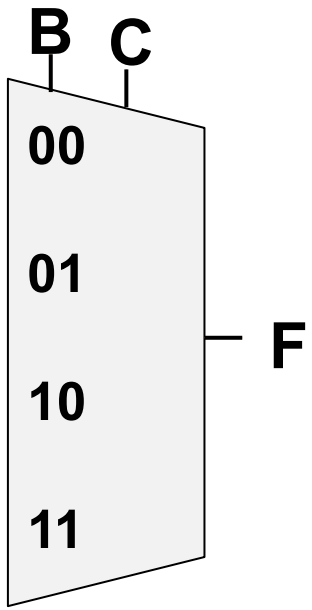
F(A,B,C) = A'B’C' + (0)B’C + ABC’ + (1)BC

F(A,B,C) = A'B’C' + ABC’ + BC

Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

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



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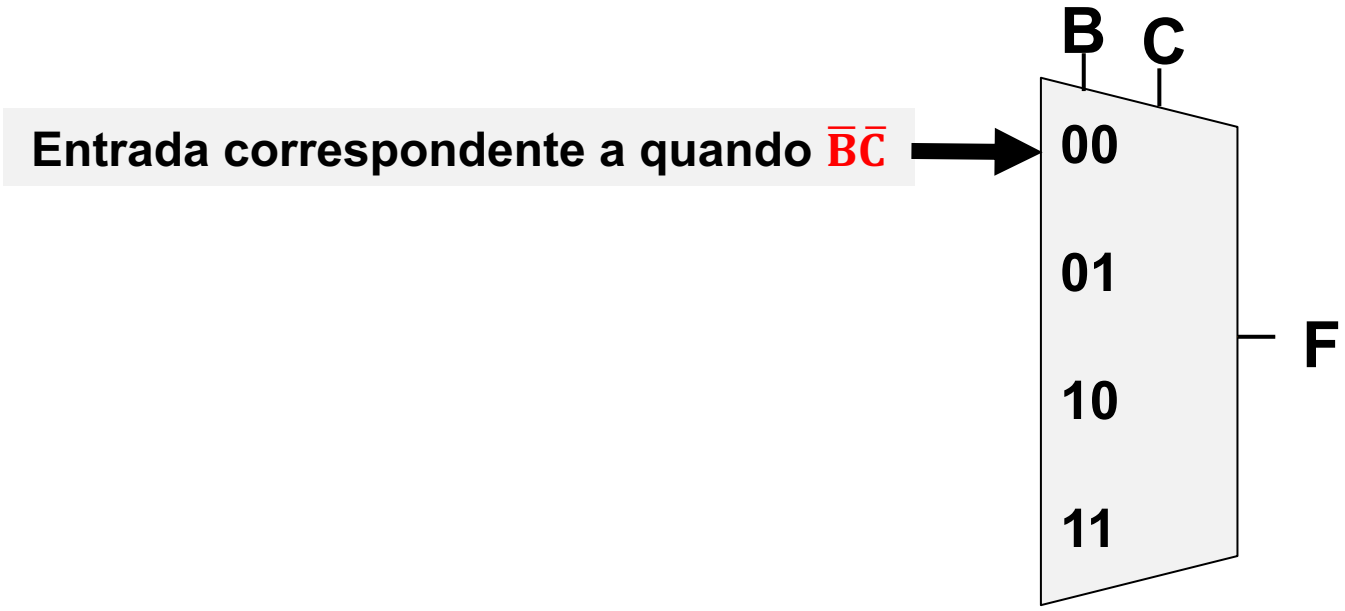

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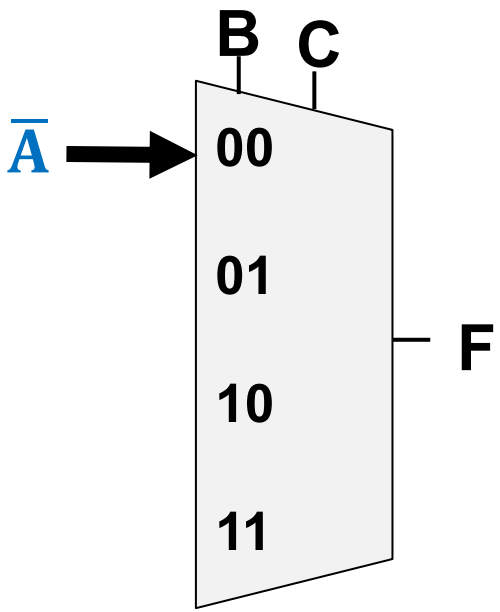

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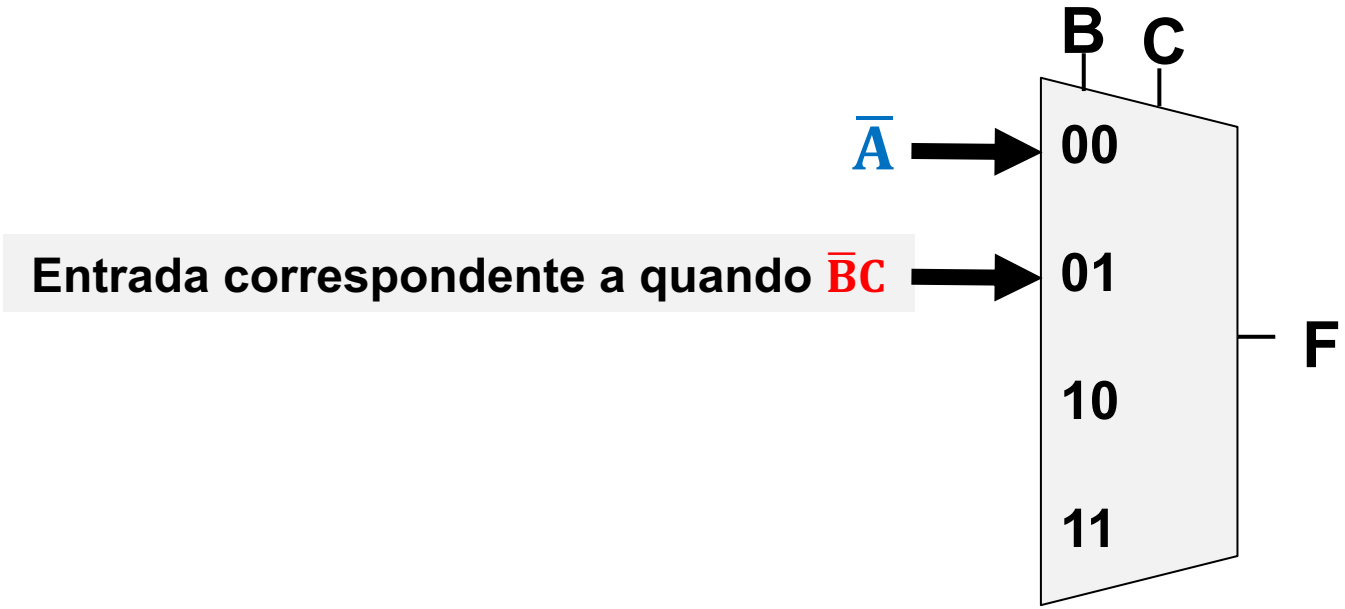
$$F(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}BC + AB\bar{C} + ABC$$

Não há $\bar{B}C$ na equação!



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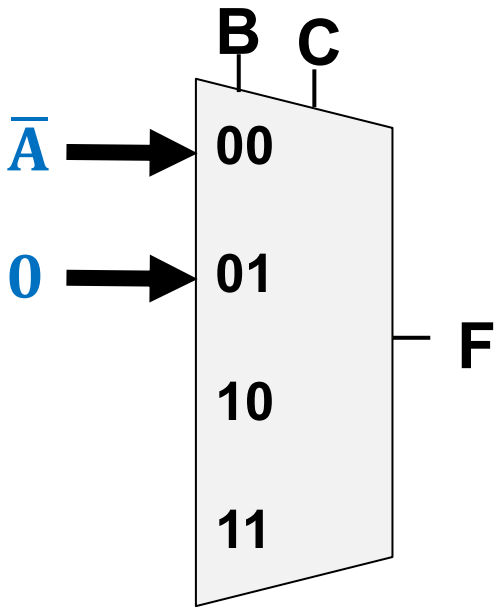
- **EXEMPLO:** $F(A,B,C) = \sum m(0,3,6,7)$

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

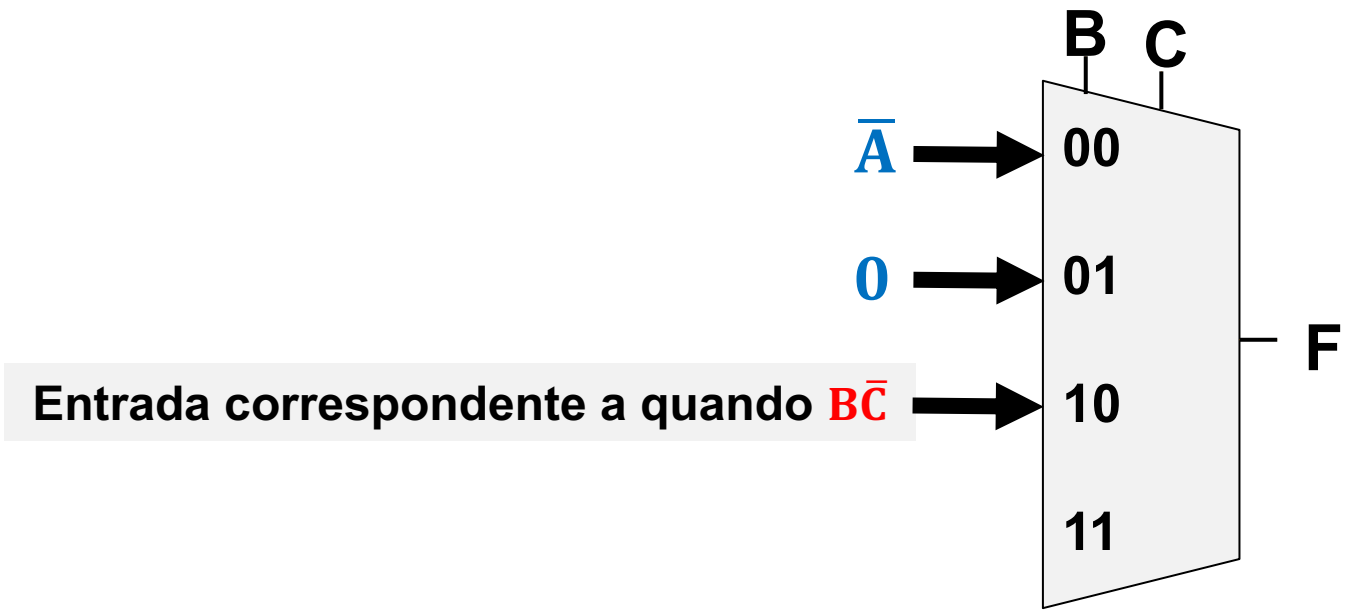
Não há $\bar{B}C$ na equação! → coloca-se 0 na entrada do MUX



Exercício – MUX 4:1

- **EXEMPLO:** $F(A,B,C) = \sum m(0,3,6,7)$

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



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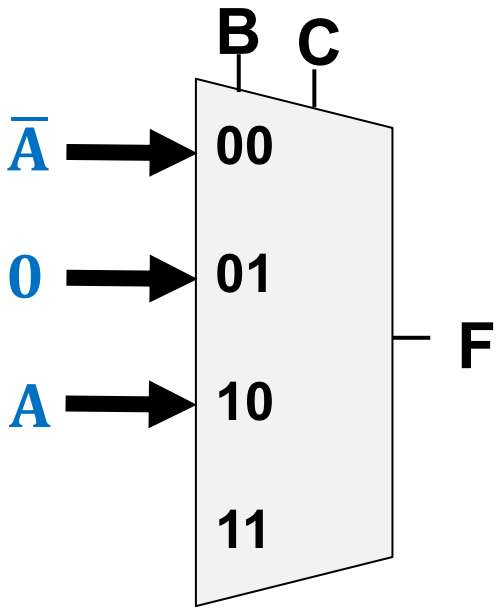
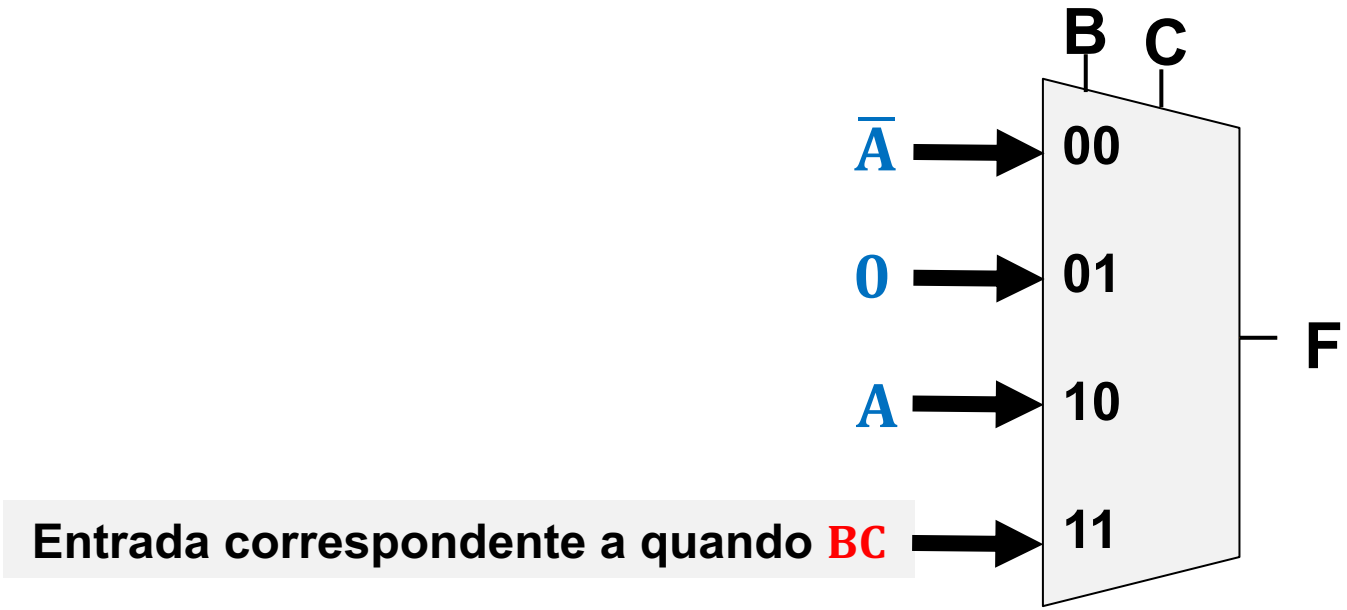


Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

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



Exercício – MUX 4:1

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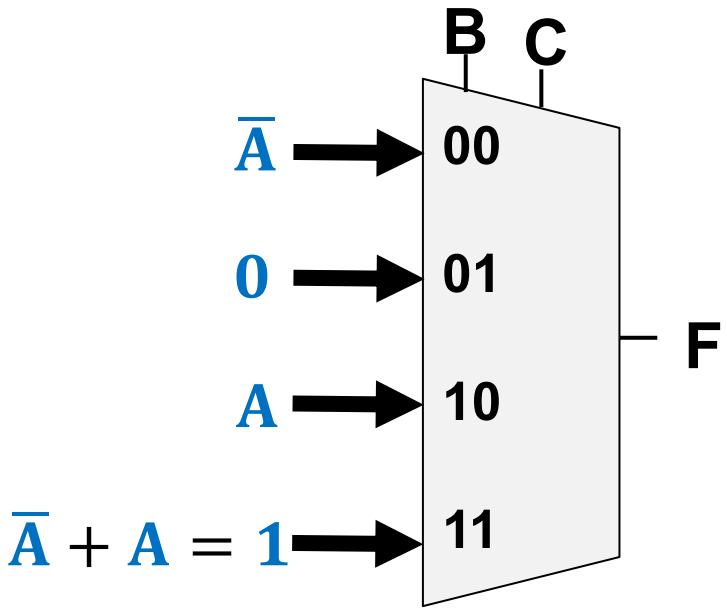
$$F(A,B,C) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}BC + AB\overline{C} + ABC$$



Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C) = \sum m(0,3,6,7)}$

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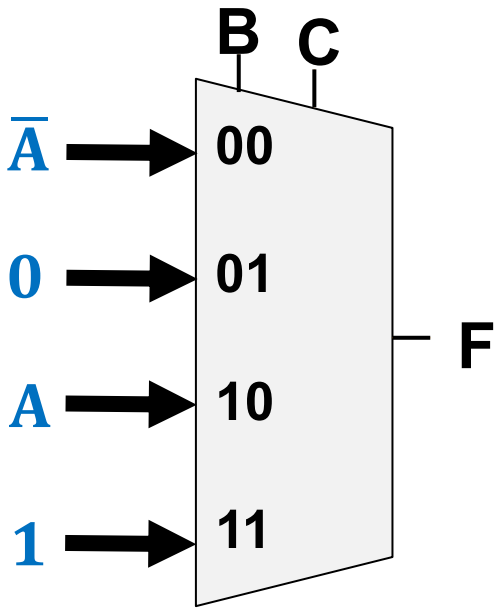
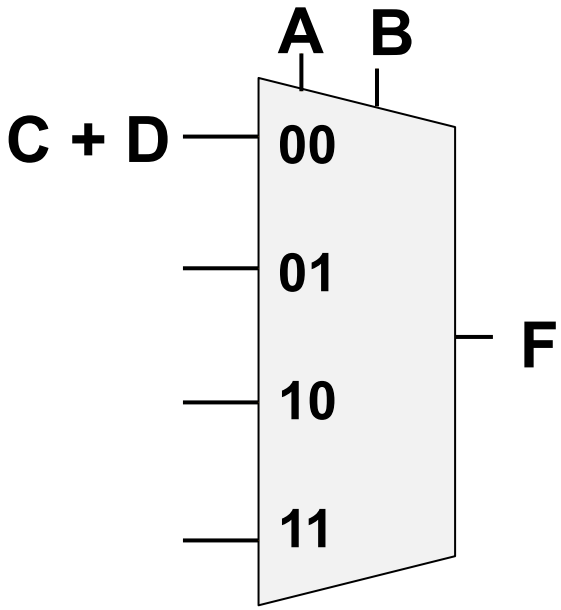


Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

AB \ CD	00	01	11	10
00	0 (0)	1 (1)	1 (3)	1 (2)
01	0 (4)	1 (5)	0 (7)	0 (6)
11	1 (12)	0 (13)	1 (15)	0 (14)
10	0 (8)	0 (9)	0 (11)	0 (10)

F = C + D



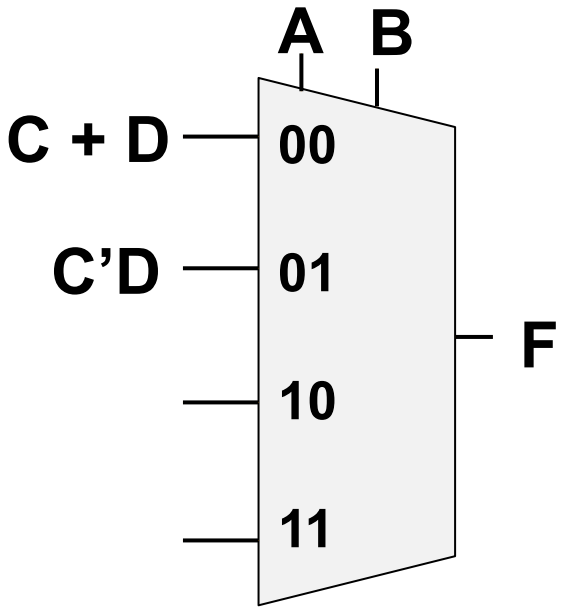
→ **VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA**

Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

AB \ CD	00	01	11	10
00	0 (0)	1 (1)	1 (3)	1 (2)
01	0 (4)	1 (5)	0 (7)	0 (6)
11	1 (12)	0 (13)	1 (15)	0 (14)
10	0 (8)	0 (9)	0 (11)	0 (10)

F = C'D



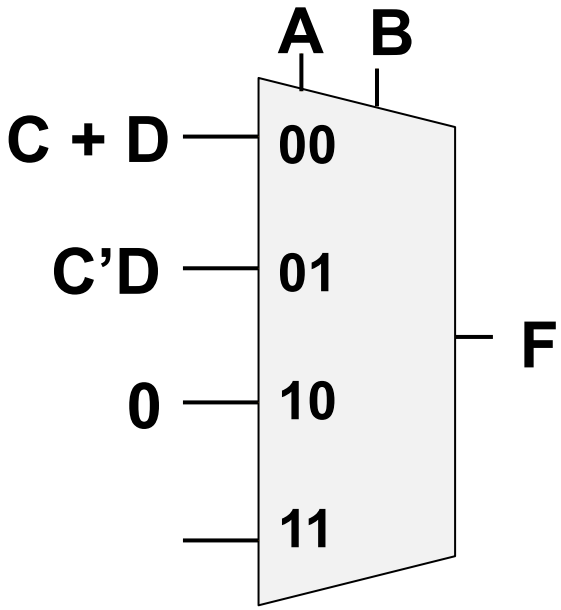
→ VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA

Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

AB \ CD	00	01	11	10
00	0 (0)	1 (1)	1 (3)	1 (2)
01	0 (4)	1 (5)	0 (7)	0 (6)
11	1 (12)	0 (13)	1 (15)	0 (14)
10	0 (8)	0 (9)	0 (11)	0 (10)

F = 0



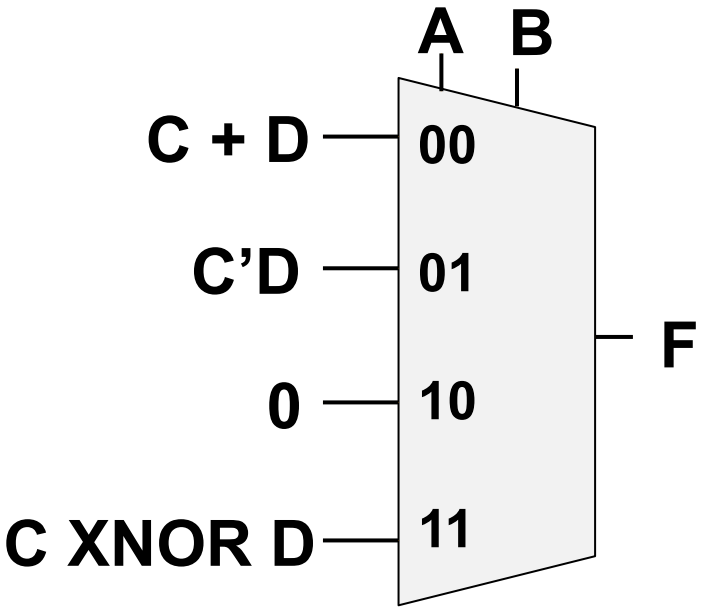
→ **VERIFICAR CÍRCULOS NO MAPA LINHA A LINHA**

Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

AB \ CD	00	01	11	10
00	0 (0)	1 (1)	1 (3)	1 (2)
01	0 (4)	1 (5)	0 (7)	0 (6)
11	1 (12)	0 (13)	1 (15)	0 (14)
10	0 (8)	0 (9)	0 (11)	0 (10)

F = C'D' + CD
= C XNOR D



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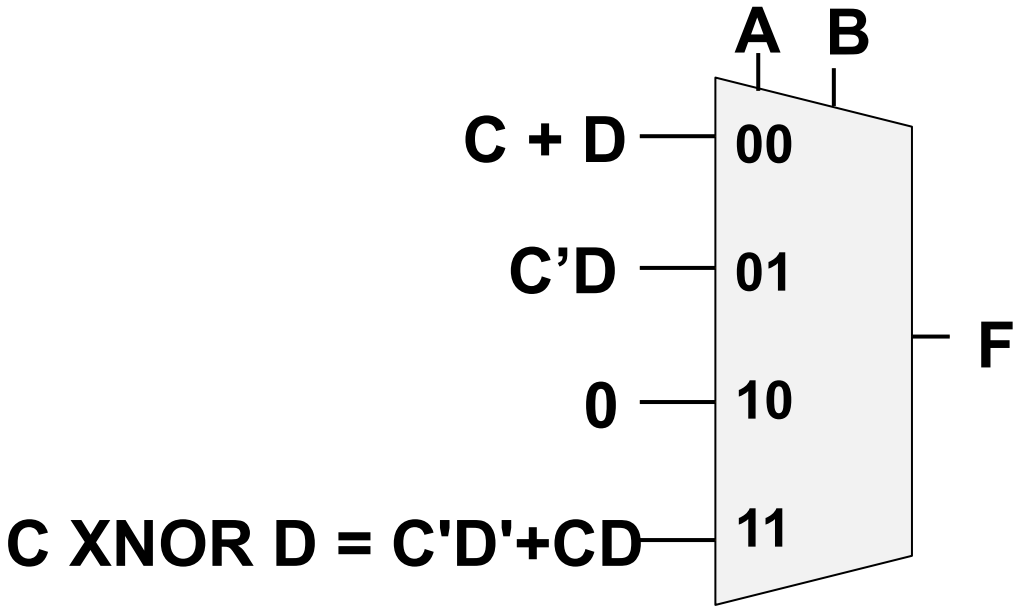
Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

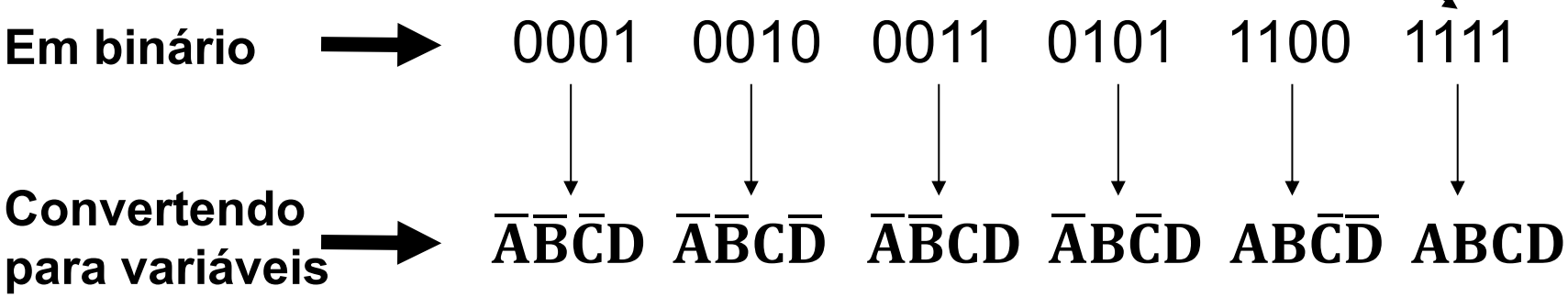


$$F(A,B,C,D) = \overline{A}\,\overline{B}\,(C+D) + \overline{A}\,B(\overline{C}D) + A\overline{B}(0) + AB(\overline{C}\,\overline{D} + CD)$$

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

Conversão - Mintermos

$$\mathbf{F(A,B,C,D) = \sum m(1,2,3,5,12,15)}$$

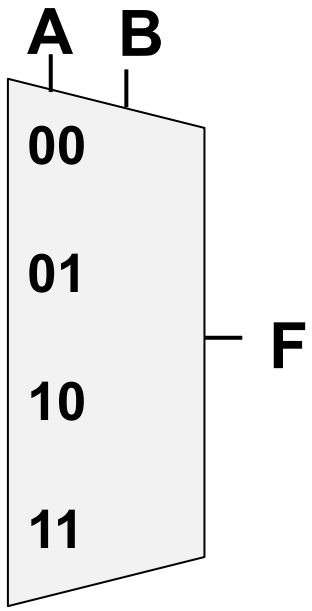


$$\mathbf{F(A,B,C,D) = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + AB\bar{C}\bar{D} + ABCD}$$

Exercício – MUX 4:1

- **EXEMPLO:** $\mathbf{F(A,B,C,D) = \sum m(1,2,3,5,12,15)}$

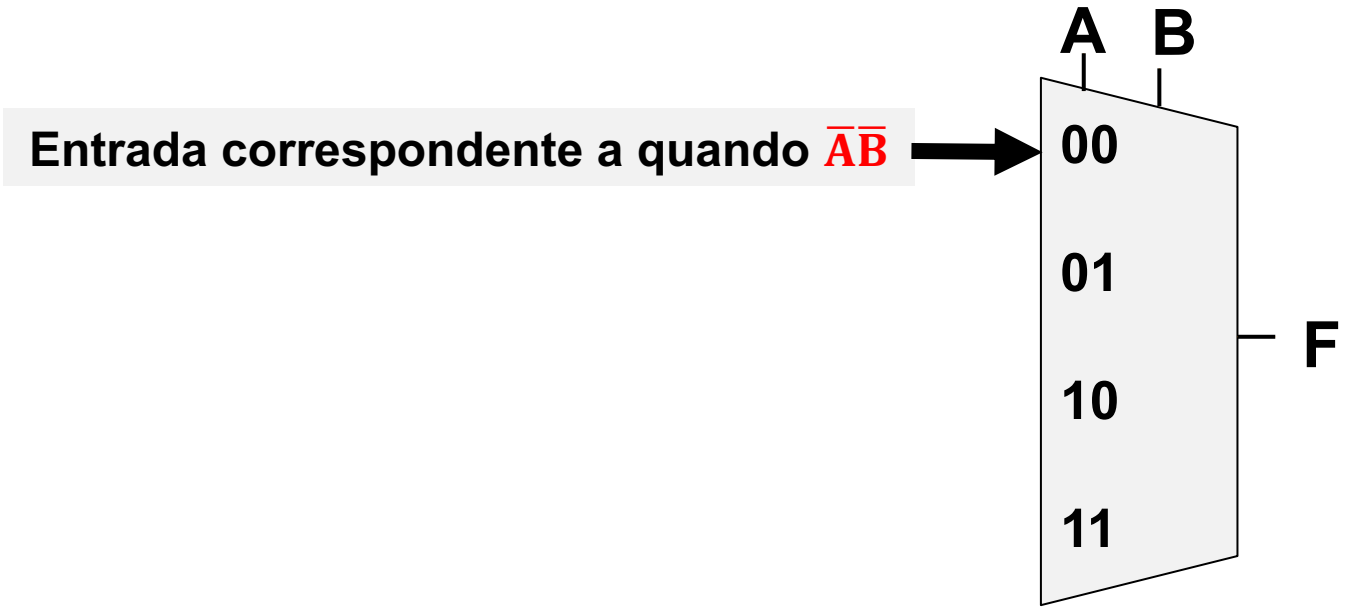
$$\mathbf{F(A,B,C,D) = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + AB\bar{C}\bar{D} + ABCD}$$



Exercício – MUX 4:1

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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



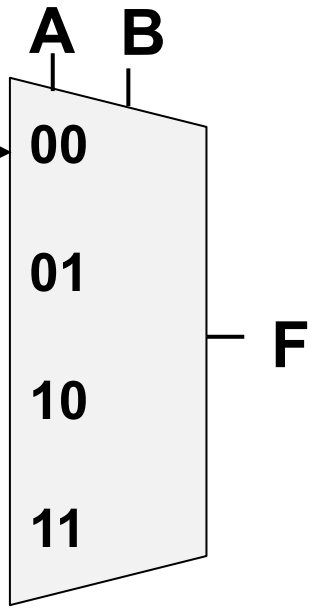
Exercício – MUX 4:1

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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

$$\bar{C}D + C\bar{D} + CD = C + D$$

$$\bar{C}D + C\bar{D} + CD$$
$$\bar{C}D + C(\bar{D} + D)$$
$$\bar{C}D + C$$
$$C + D$$



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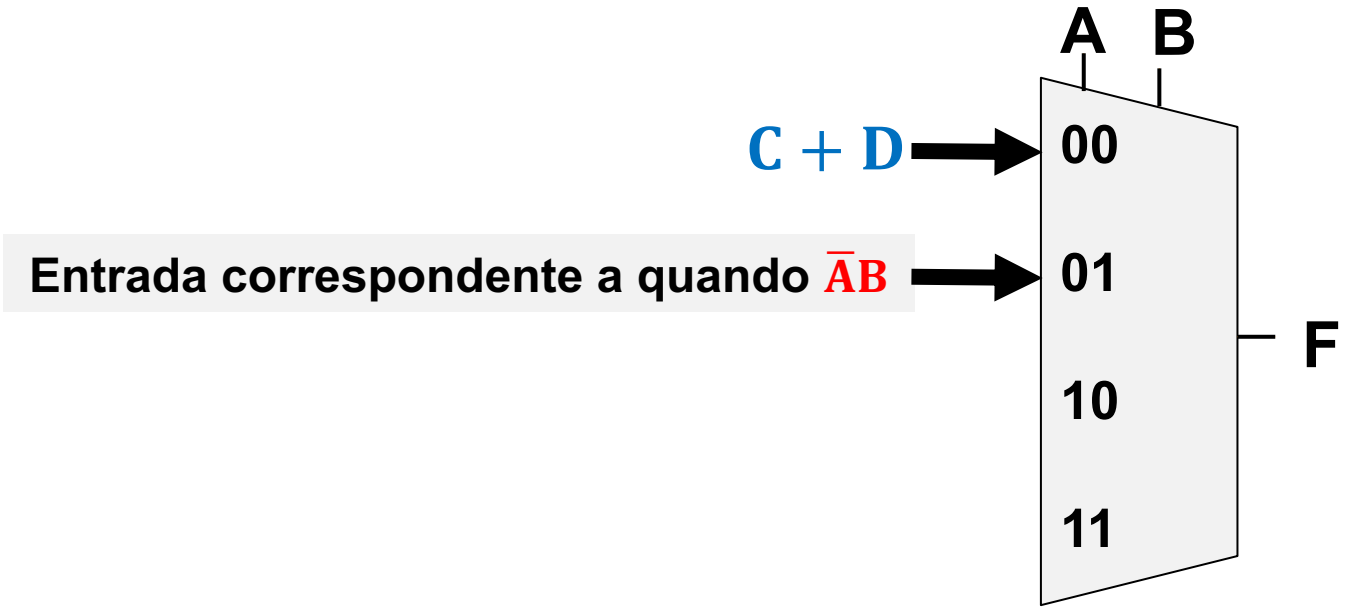

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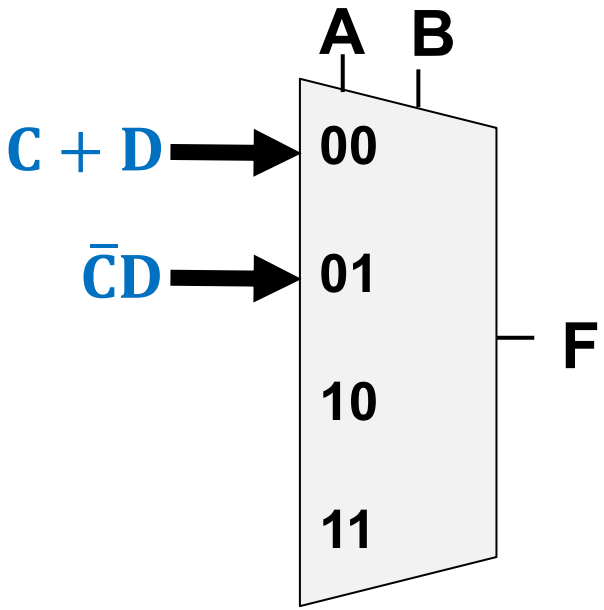

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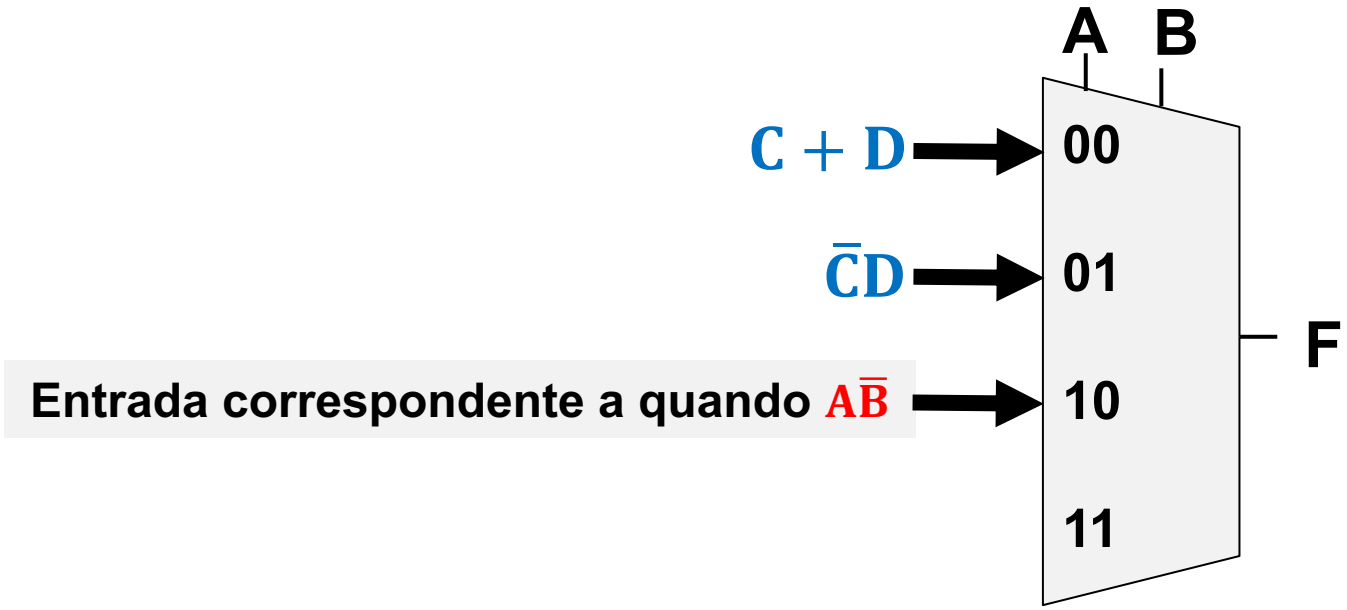
Não há $A\bar{B}$ na equação!

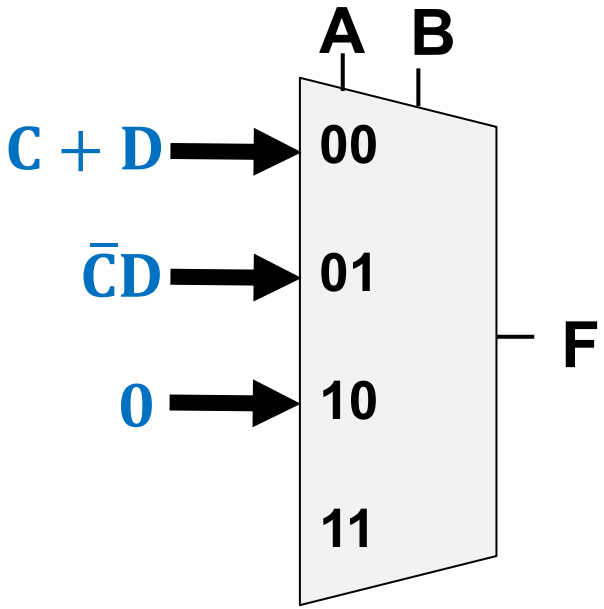


Exercício – MUX 4:1

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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

Não há $A\bar{B}$ na equação! → coloca-se 0 na entrada do MUX



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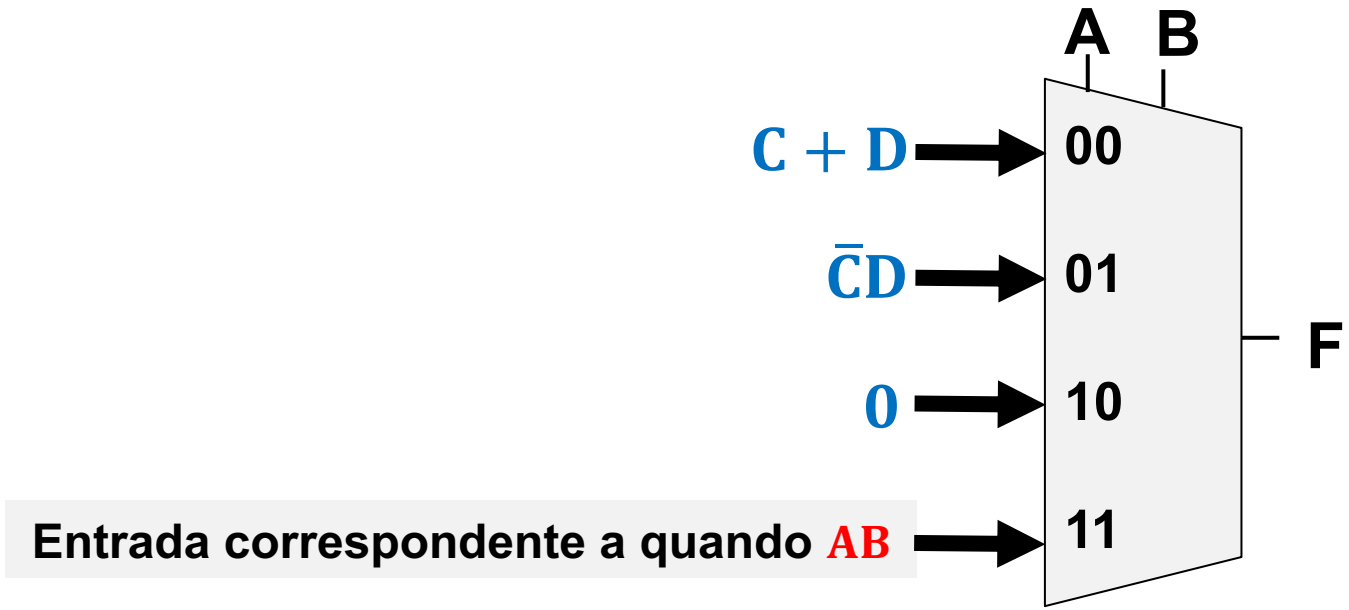

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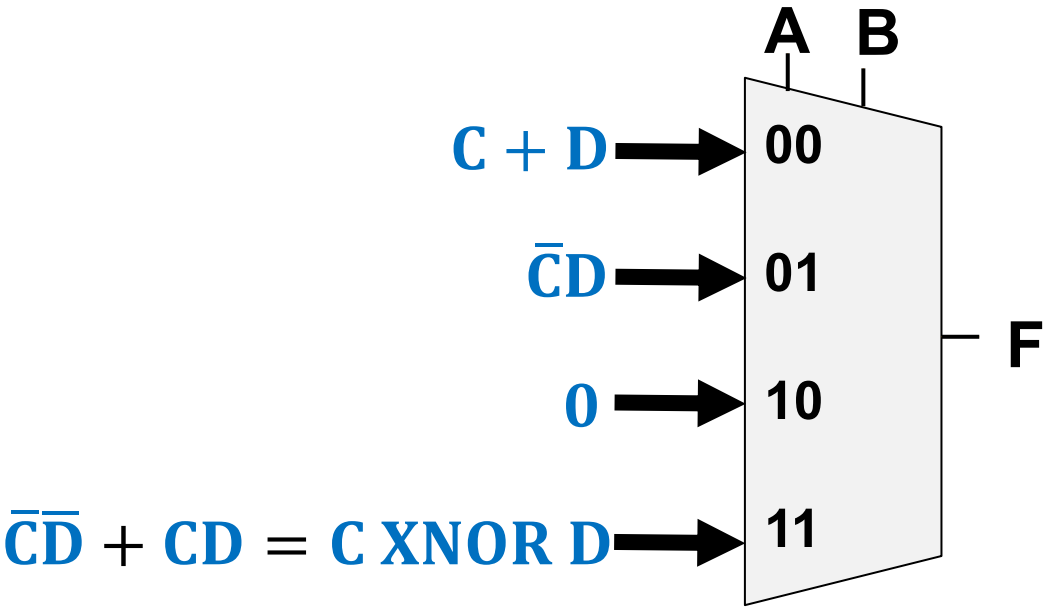

Exercício – MUX 4:1

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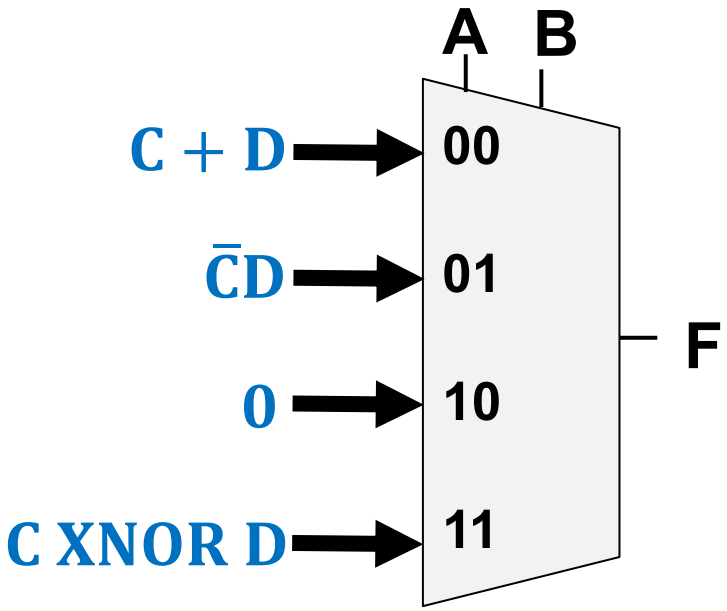
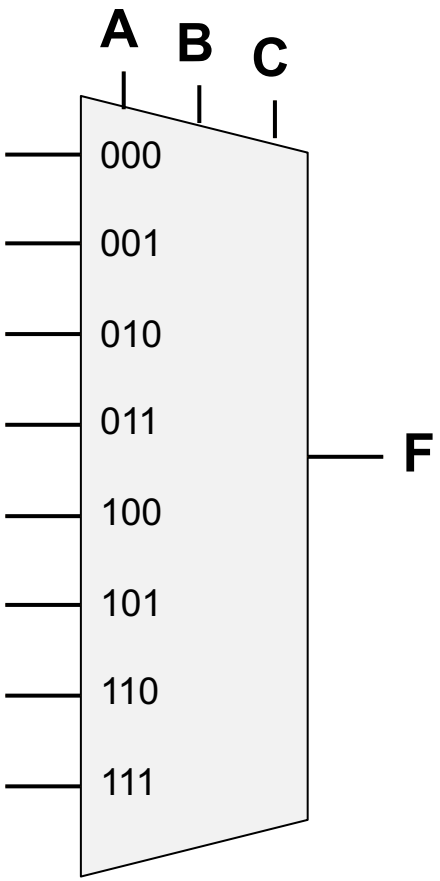


Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**



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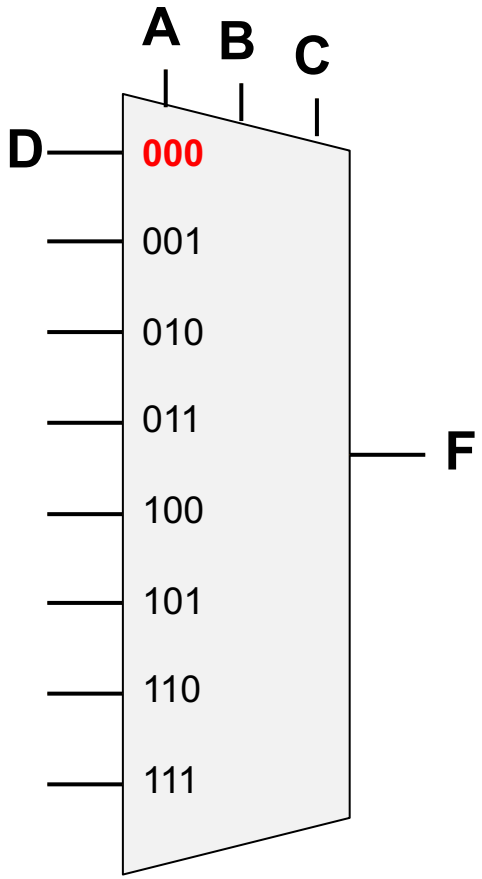
- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**

F = D

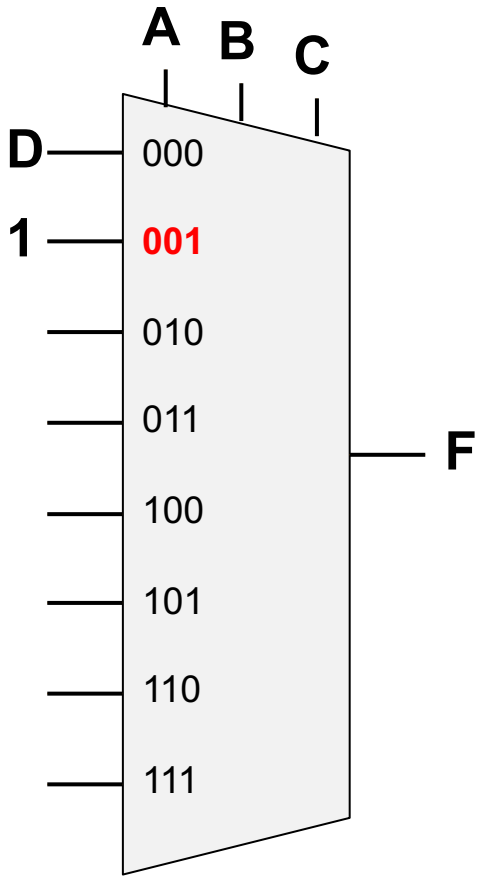


Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**

F = 1

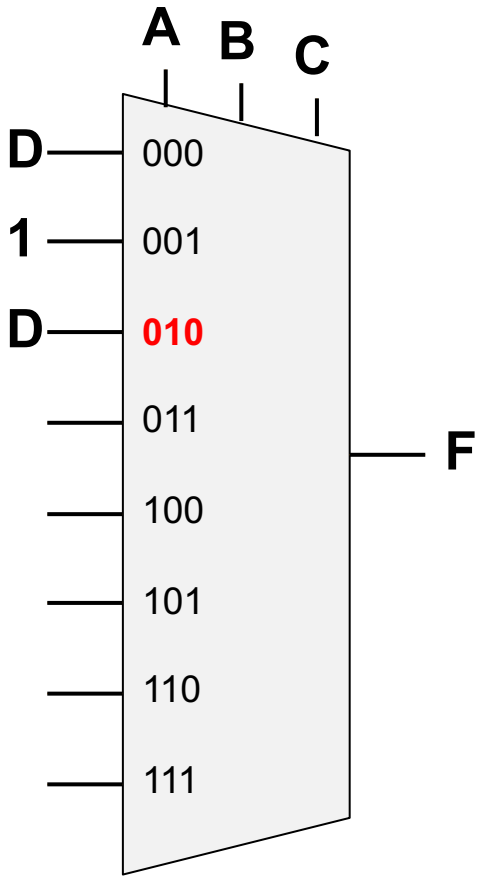


Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**

F = D



Funções booleanas com MUXES

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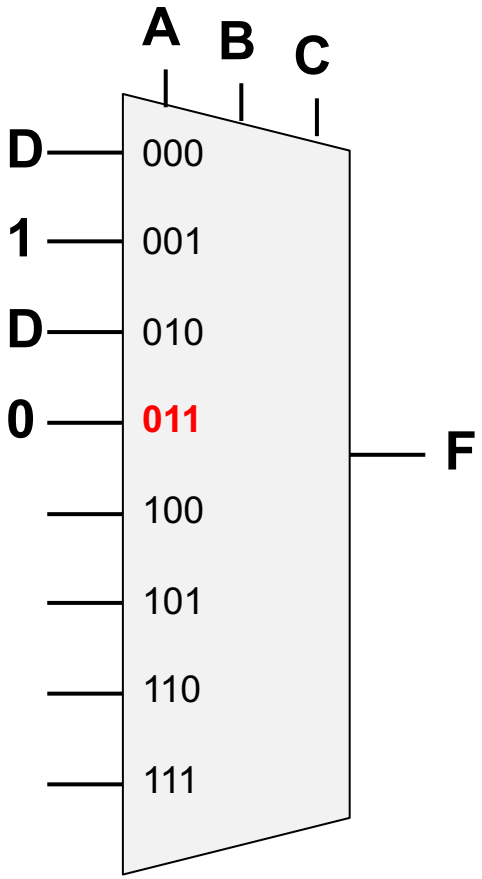
A	B	C	D	F
0	0	0	0	**0**
0	0	0	1	**1**
0	0	1	0	**1**
0	0	1	1	**1**
0	1	0	0	**0**
0	1	0	1	**1**
0	1	1	0	**0**
0	1	1	1	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**

F = 0



Funções booleanas com MUXES

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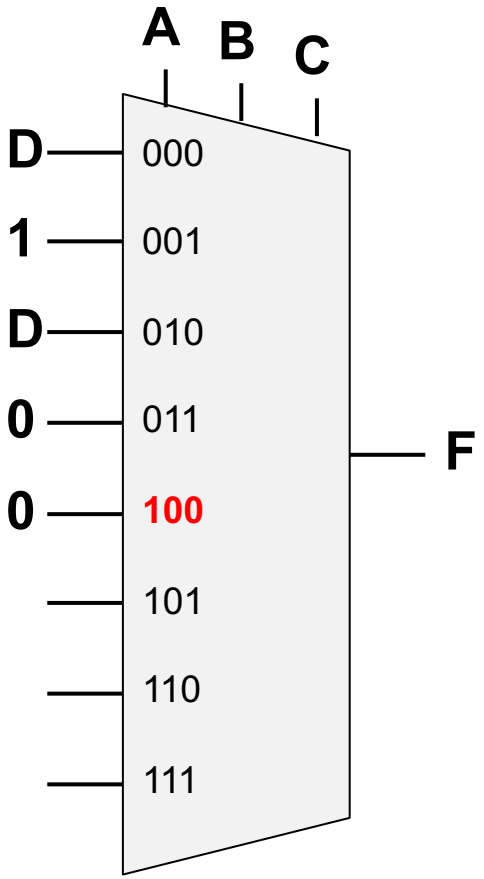
A	B	C	D	F
0	0	0	0	**0**
0	0	0	1	**1**
0	0	1	0	**1**
0	0	1	1	**1**
0	1	0	0	**0**
0	1	0	1	**1**
0	1	1	0	**0**
0	1	1	1	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**

F = 0



Funções booleanas com MUXES

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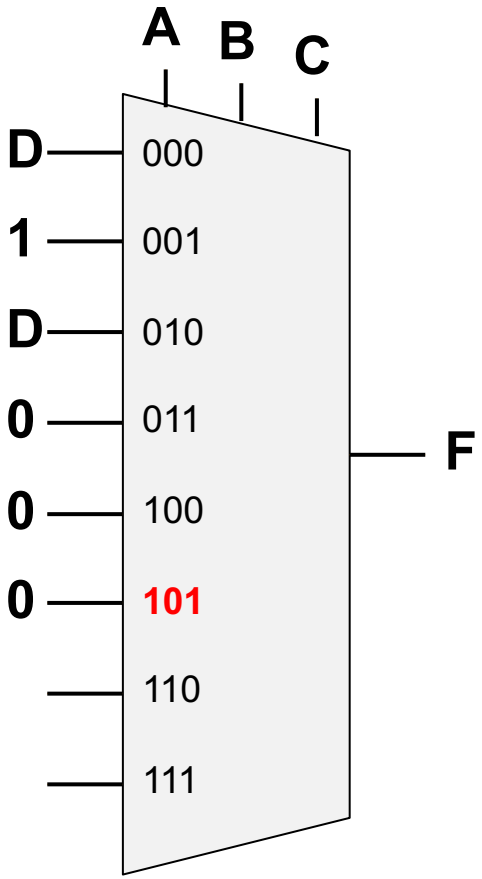
A	B	C	D	F
0	0	0	0	**0**
0	0	0	1	**1**
0	0	1	0	**1**
0	0	1	1	**1**
0	1	0	0	**0**
0	1	0	1	**1**
0	1	1	0	**0**
0	1	1	1	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**

F = 0



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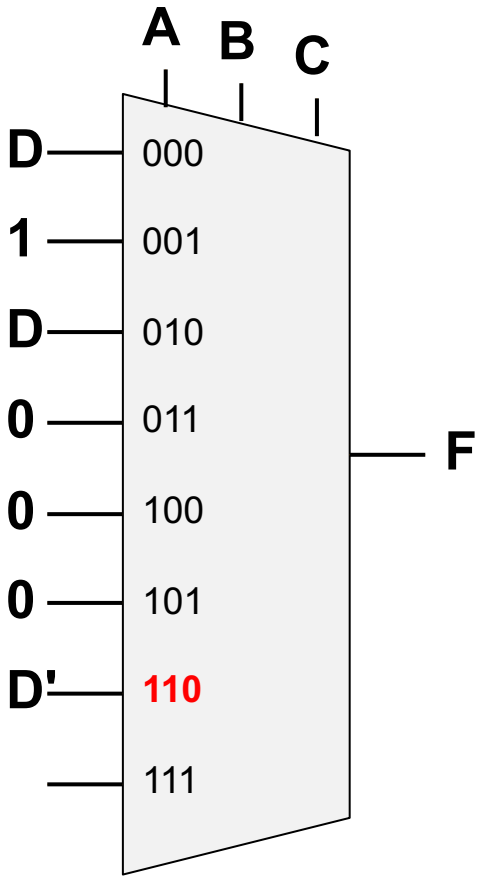
A	B	C	D	F
0	0	0	0	**0**
0	0	0	1	**1**
0	0	1	0	**1**
0	0	1	1	**1**
0	1	0	0	**0**
0	1	0	1	**1**
0	1	1	0	**0**
0	1	1	1	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**

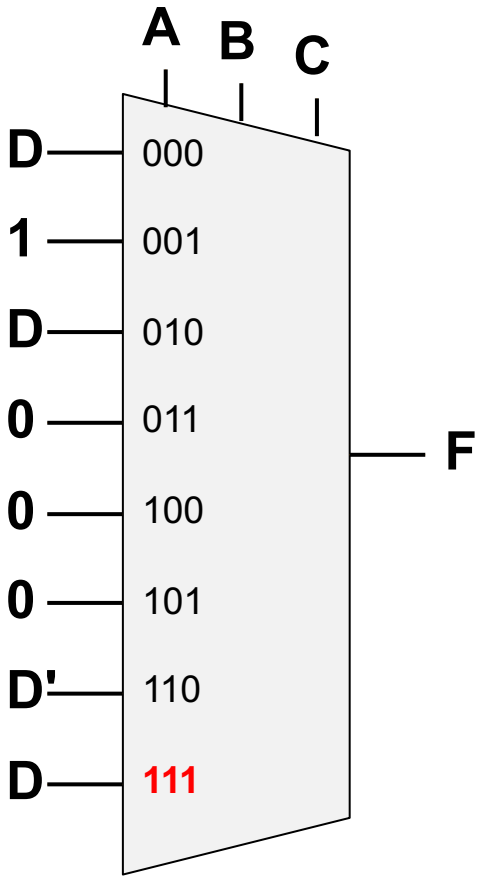
F = D'



Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

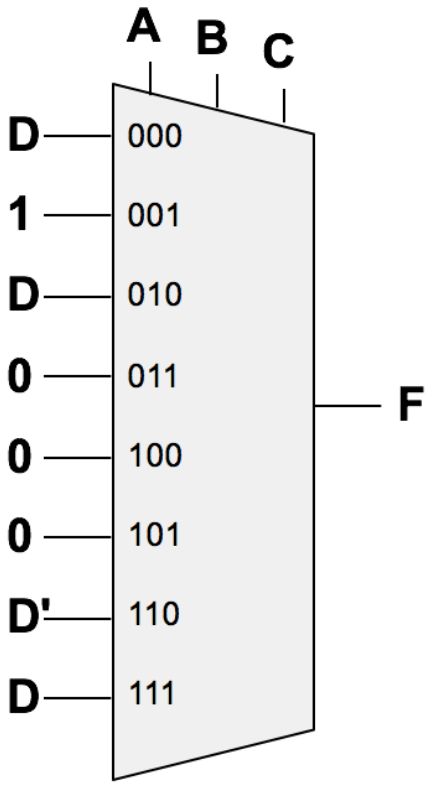
A	B	C	D	F
0	0	0	0	**0**
0	0	0	1	**1**
0	0	1	0	**1**
0	0	1	1	**1**
0	1	0	0	**0**
0	1	0	1	**1**
0	1	1	0	**0**
0	1	1	1	**0**
1	0	0	0	**0**
1	0	0	1	**0**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**1**
1	1	0	1	**0**
1	1	1	0	**0**
1	1	1	1	**1**



F = D

Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$



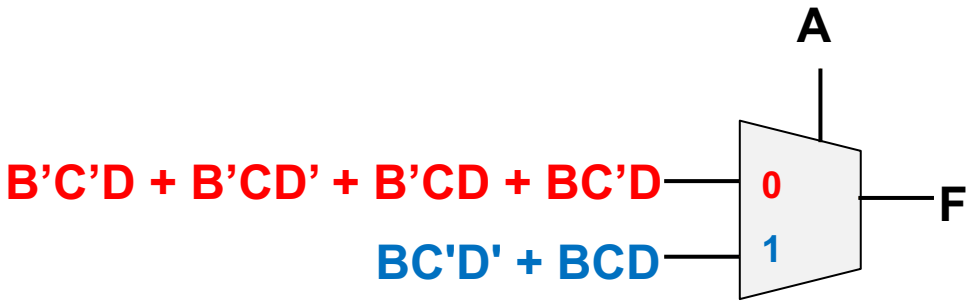
$$F(A,B,C,D) = \overline{A}\,\overline{B}\,\overline{C}(D) + \overline{A}\,\overline{B}C(1) + \overline{A}\,B\overline{C}(D) + \overline{A}BC(0) + A\overline{B}\,\overline{C}(0) + A\overline{B}C(0) + AB\overline{C}(\overline{D}) + ABC(D)$$

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

Funções booleanas com MUXES

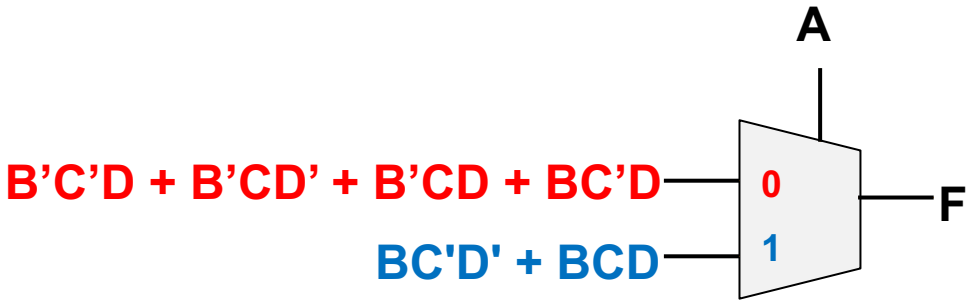
- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$

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



Funções booleanas com MUXES

- **EXEMPLO:** $F(A,B,C,D) = \sum m(1,2,3,5,12,15)$



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

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