Esercitazione Sistemi Digitali

08/11/2022

Esercizio 1- Traccia

1. **Calcolare la tabella di verità della funzione:**

$$ABC + \bar{A}\bar{B}\bar{C}$$

2. **Realizzare la funzione tramite un multiplexer a 4 ingressi dati e 2 ingressi di selezione**

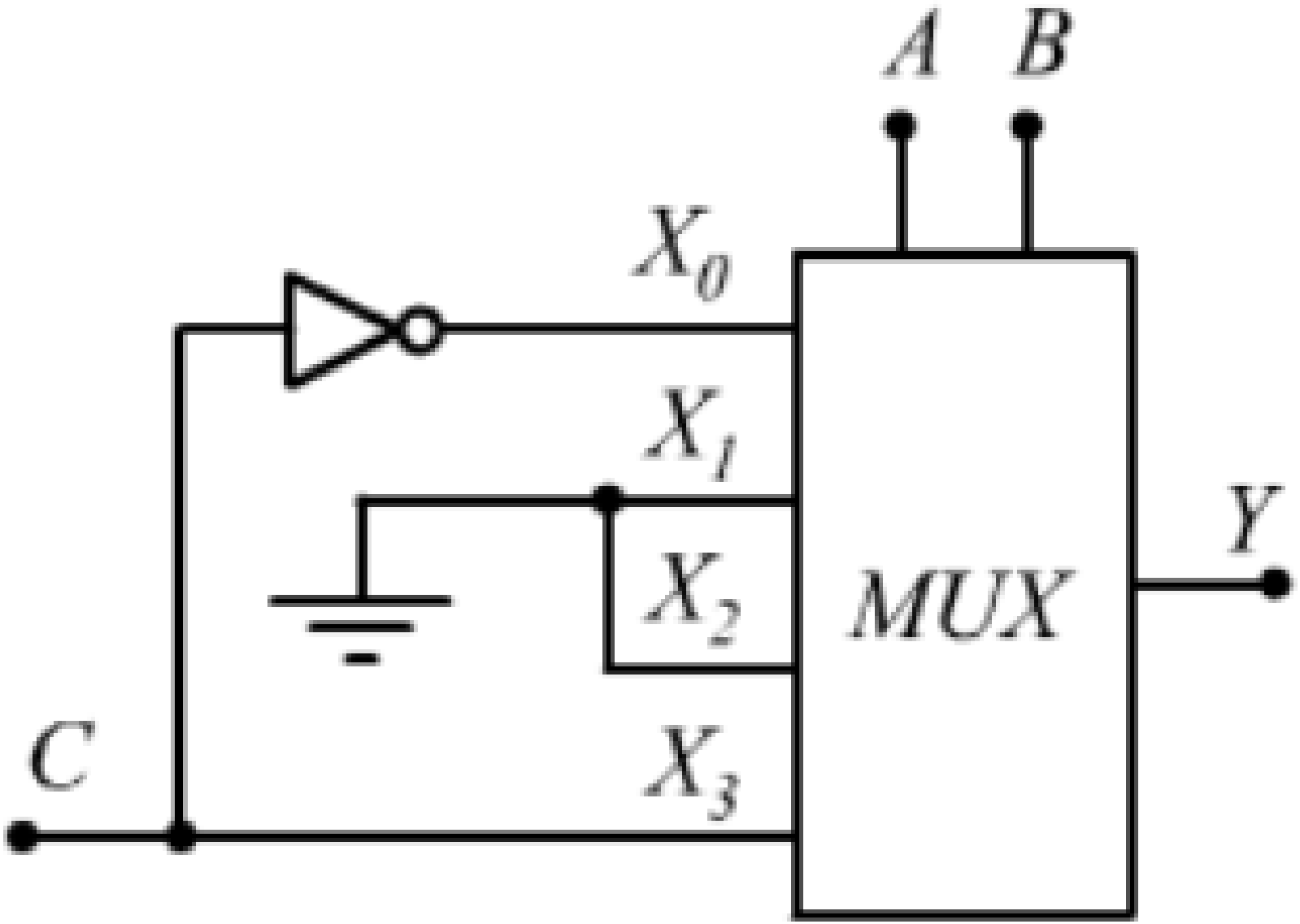
Soluzione esercizio 1 (1)

A	B	C	ABC	$\bar{A}\bar{B}\bar{C}$	$ABC + \bar{A}\bar{B}\bar{C}$
0	0	0	0	1	1
0	0	1	0	0	0
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	0	0	0
1	1	1	1	0	1

Osservare che:

- Se A=0 e B=0 allora Y=$\bar{C}$
- Se A=0 e B=1 allora Y=0
- Se A=1 e B=0 allora Y=0
- Se A=1 e B=1 allora Y=C

Soluzione esercizio 1 (2)



Esercizio 2- Traccia

- **Realizzare con un mux a 8 ingressi dati e 3 ingressi di selezione un rilevatore di numeri primi per un sistema binario a 4 bit**

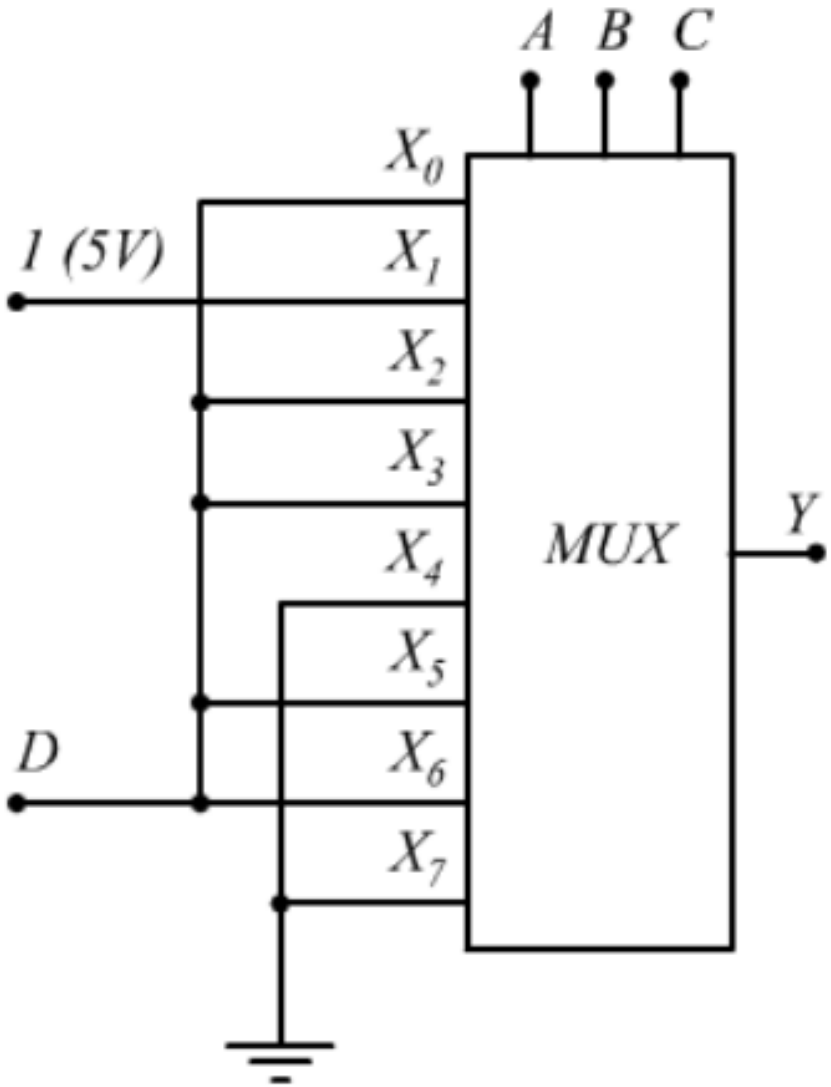
Soluzione esercizio 2 (1)

A	B	C	D	Y
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	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

Osservare che:

- Se A=0, B=0, e C=0 allora Y=D
- Se A=0, B=0, e C=1 allora Y=1
- Se A=0, B=1, e C=0 allora Y=D
- Se A=0, B=1, e C=1 allora Y=D
- Se A=1, B=0, e C=0 allora Y=0
- Se A=1, B=0, e C=1 allora Y=D
- Se A=1, B=1, e C=0 allora Y=D
- Se A=1, B=1, e C=1 allora Y=0

Soluzione esercizio 2 (2)



Esercizio 3- Traccia

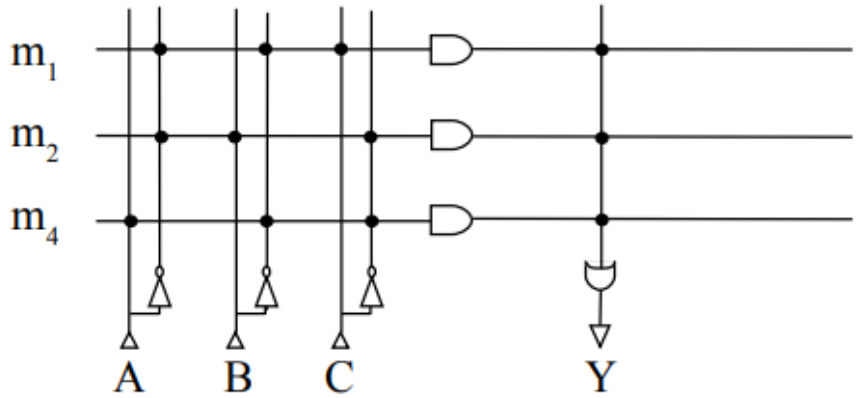
- **Realizza mediante PLA e ROM con 3 ingressi la funzione che vale 1 se e solo se un solo bit in input vale 1**

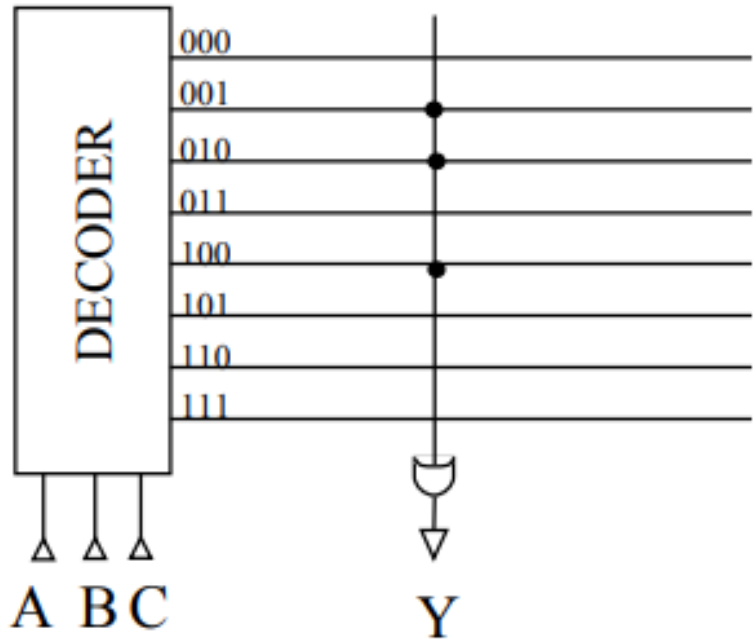
Esercizio 3- Soluzione

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

FormaSOP

$$Y = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C}$$





Esercizio 4- Traccia

- **Realizza mediante PLA e ROM con 4 ingressi la funzione che identifica i multipli di 3**

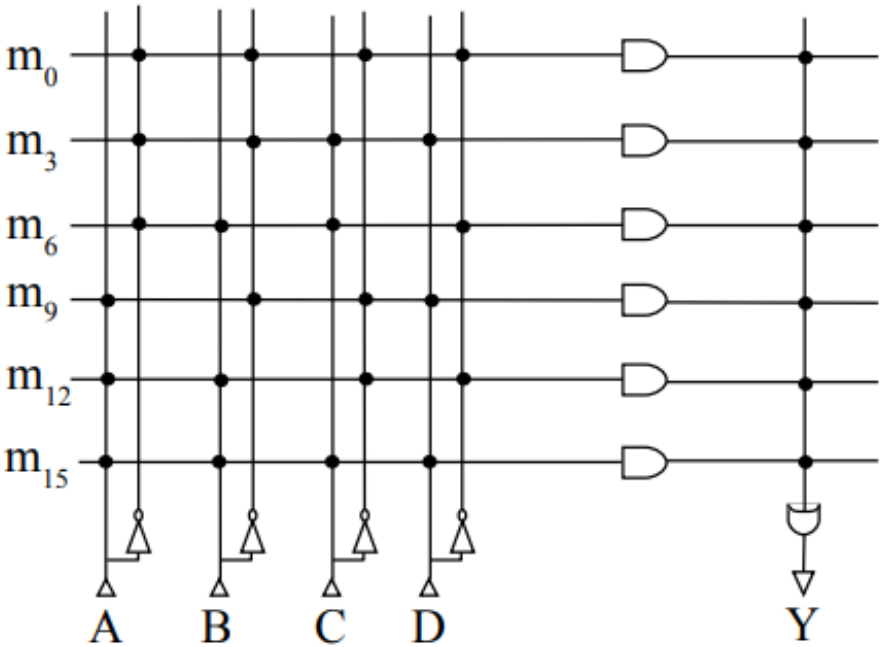
Esercizio 4- Soluzione (1)

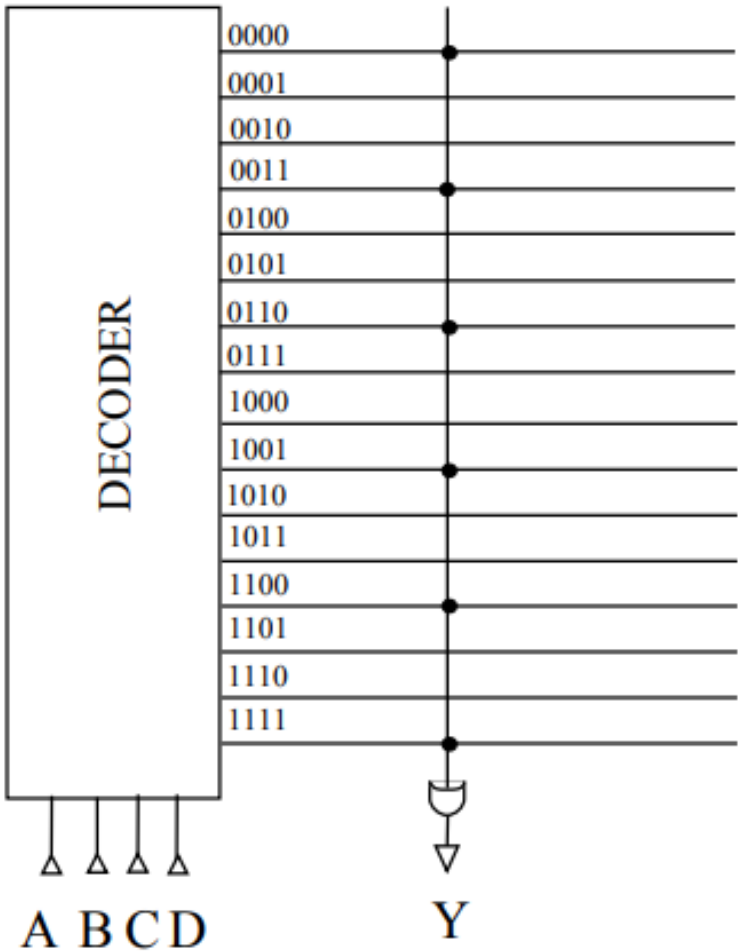
A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

FormaSOP

$$Y = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}CD + \bar{A}BC\bar{D}$$
$$+A\bar{B}\bar{C}D + AB\bar{C}\bar{D} + ABCD$$

Esercizio 4- Soluzione (2)



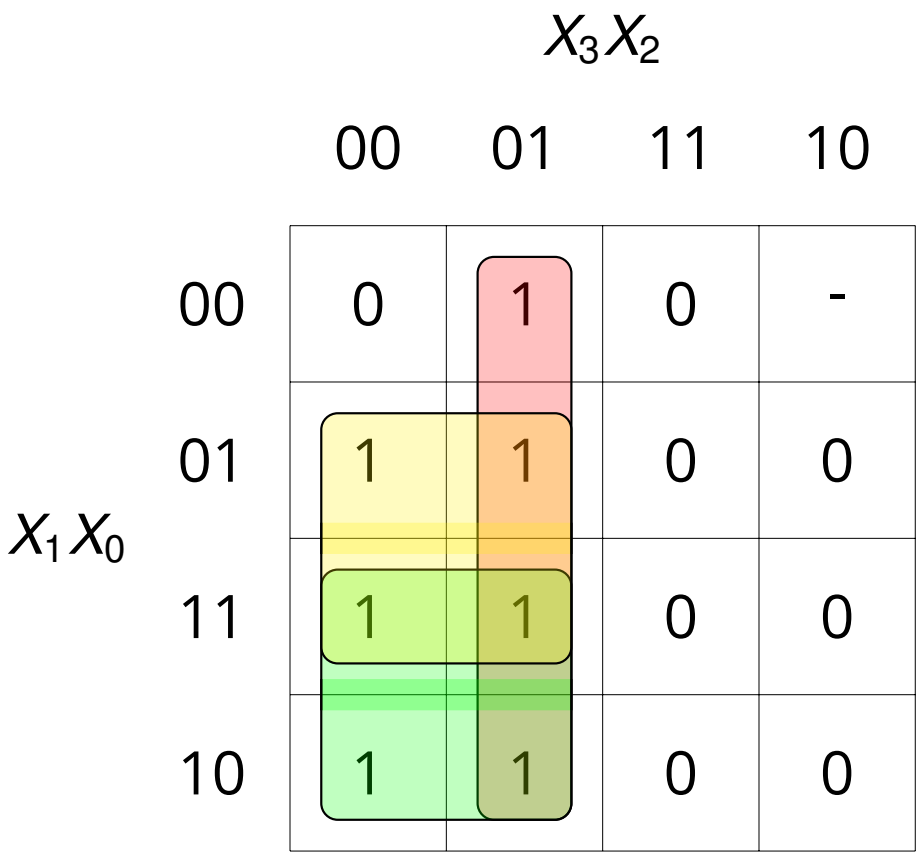


Esercizio 5- Traccia

- **Realizza un circuito che calcola il valore opposto di un intero a 4 bits, rappresentandolo in Ca2. Realizzare il circuito nei seguenti modi:**
  1. Porte logiche (Costruire mappa di Karnaugh per ogni output e semplificare)
  2. ROM
  3. PLA
  4. MUX (un multiplexer delle opportune dimensioni per ogni output)

Esercizio 5- Soluzione Punto 1 (1)

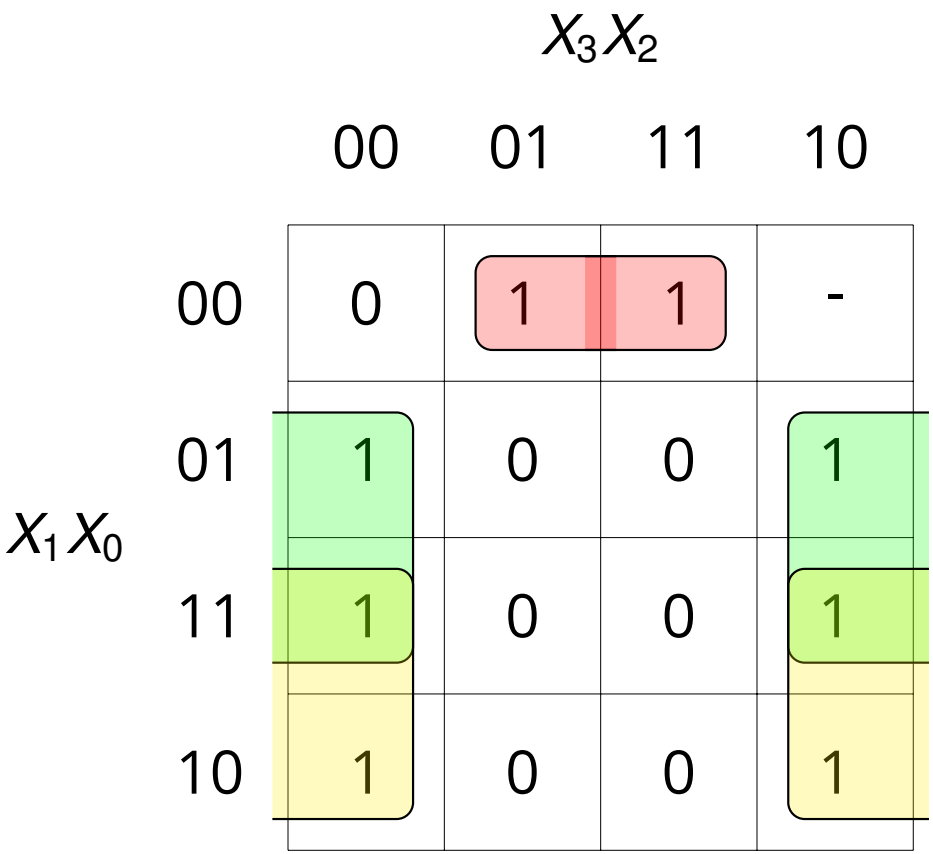
X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	–	–	–	–
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1



- $Y_3 = \bar{X}_3X_0 + \bar{X}_3X_1 + \bar{X}_3X_2 =$
  $= \bar{X}_3(X_2 + X_1 + X_0)$

Esercizio 5- Soluzione Punto 1 (2)

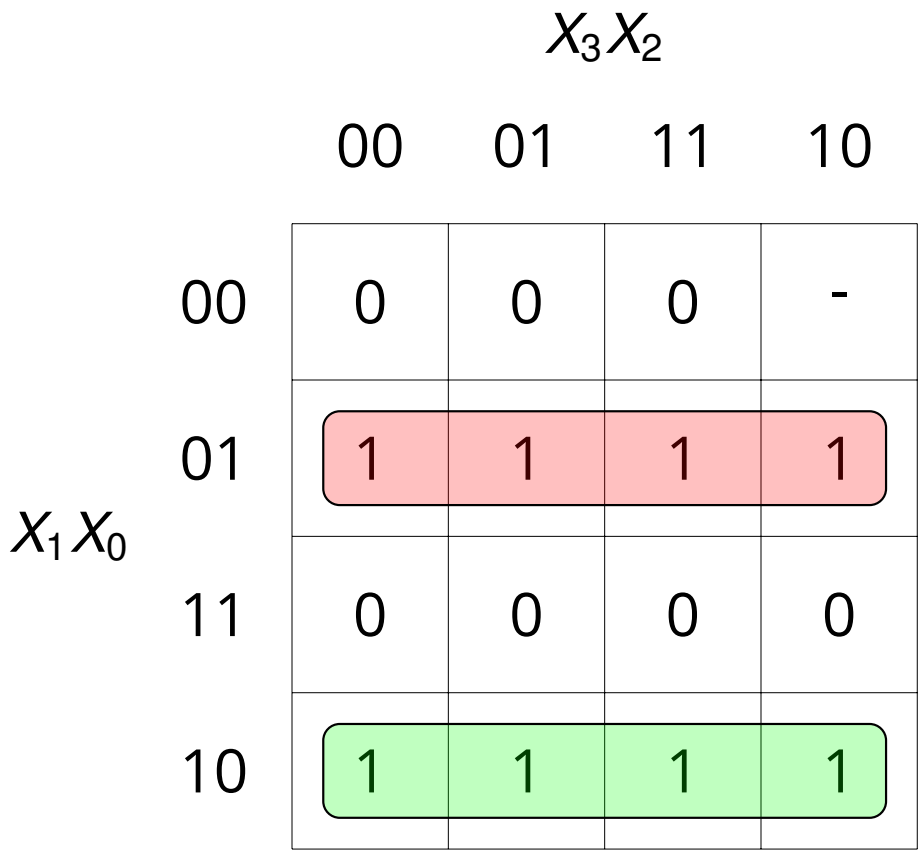
X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	–	–	–	–
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1



$$Y_2 = X_2\bar{X}_1\bar{X}_0 + \bar{X}_2X_0 + \bar{X}_2X_1 =$$
$$= \bar{X}_2(X_1 + X_0) + X_2\bar{X}_1\bar{X}_0 =$$
$$X_2 \oplus (X_1 + X_0)$$

Esercizio 5- Soluzione Punto 1 (3)

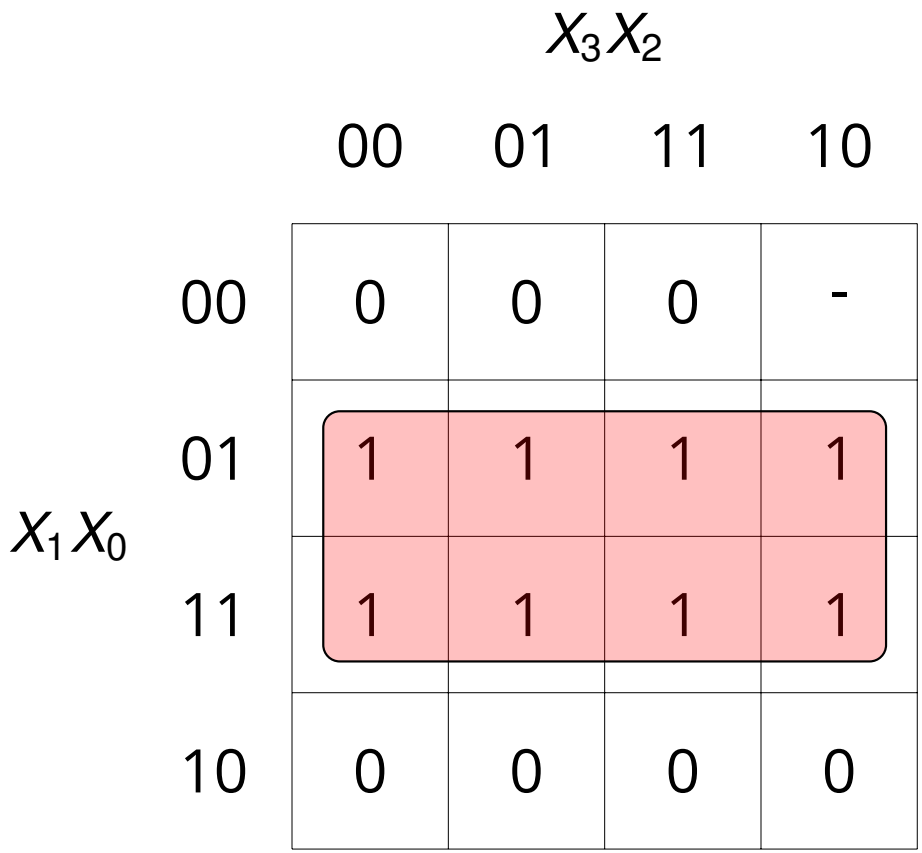
X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	–	–	–	–
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1



$$Y_1 = \bar{X}_1 X_0 + X_1 \bar{X}_0 = X_1 \oplus X_0$$

Esercizio 5- Soluzione Punto 1 (4)

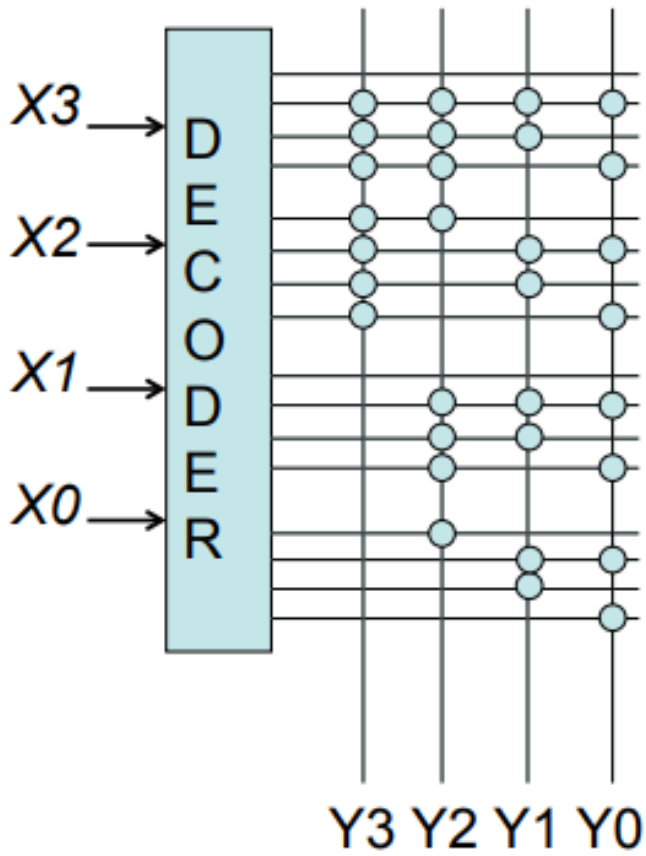
X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	–	–	–	–
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1



$$Y_0 = X_0$$

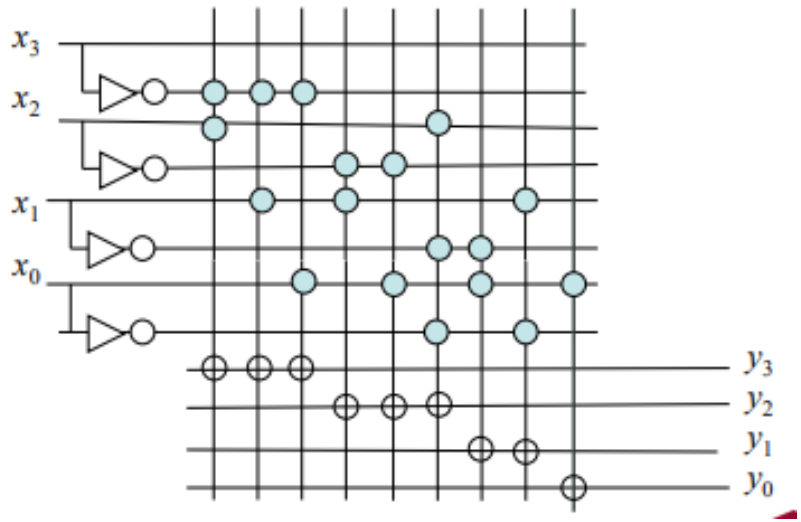
Esercizio 5- Soluzione Punto 2

X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	–	–	–	–
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1



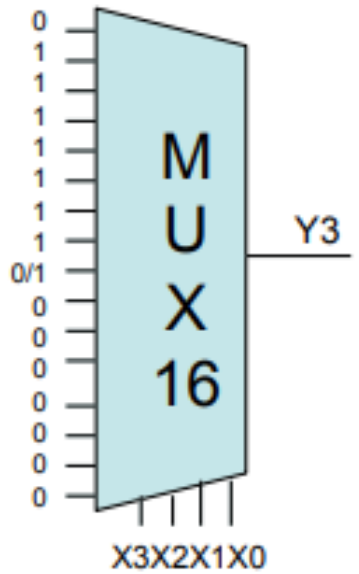
Esercizio 5- Soluzione Punto 3

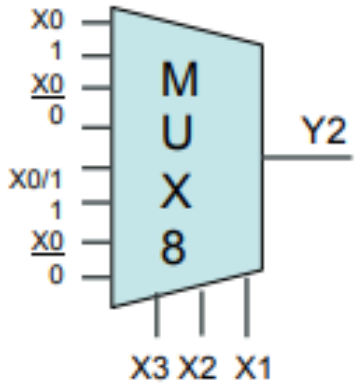
X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	–	–	–	–
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1

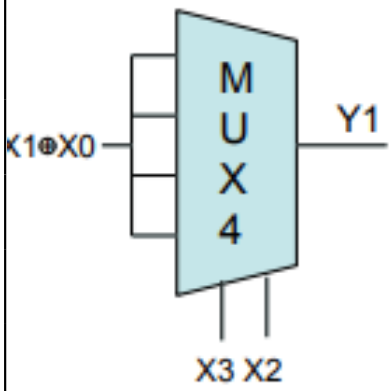
- $Y_3 = \bar{X}_3 X_0 + \bar{X}_3 X_1 + \bar{X}_3 X_2$
- $Y_2 = X_2 \bar{X}_1 \bar{X}_0 + \bar{X}_2 X_0 + \bar{X}_2 X_1$
- $Y_1 = \bar{X}_1 X_0 + X_1 \bar{X}_0$
- $Y_0 = X_0$
- 

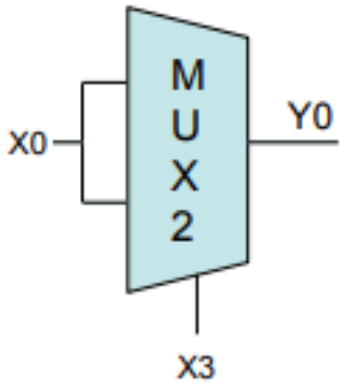
Esercizio 5- Soluzione Punto 4

X_3	X_2	X_1	X_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	–	–	–	–
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1



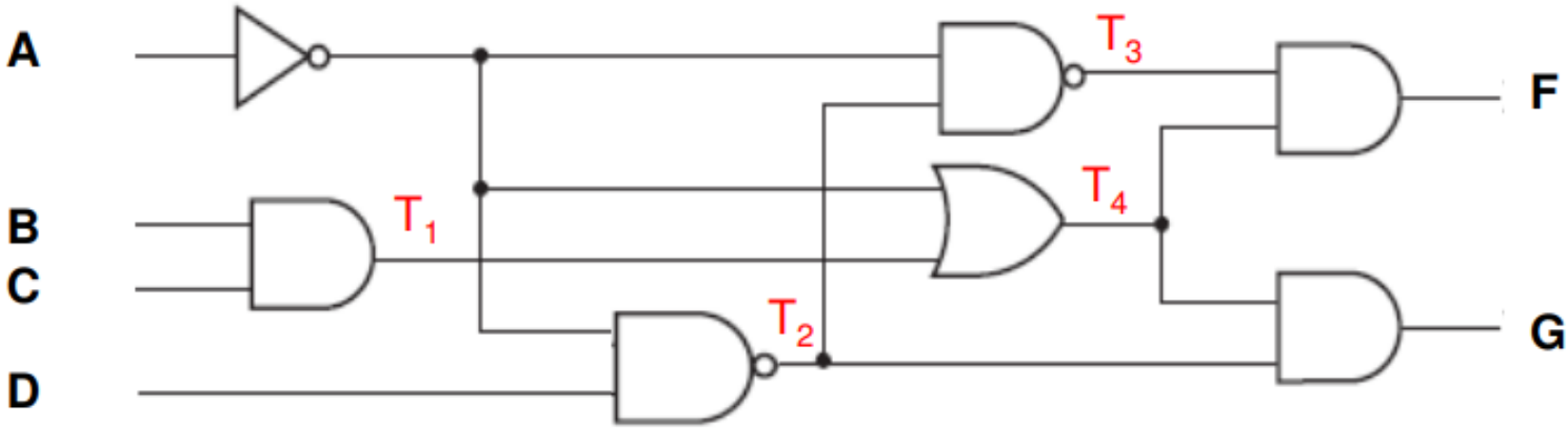






Esercizio 7 esercitazione 4- Traccia

- **Analizzare il seguente circuito**



1. Determinare le espressioni booleane per F e G in forma SoP
2. Semplificare le espressioni ottenute per F e G tramite le mappe di Karnaugh

Esercizio 7- Soluzione (1)

1.

$$T1 = B \cdot C$$

$$T2 = \overline{\bar{A} \cdot D}$$

$$T3 = \overline{\bar{A} \cdot T2}$$

$$T4 = \bar{A} + T1$$

$$F = T3 \cdot T4 = (\overline{\bar{A} \cdot T2}) \cdot (\bar{A} + T1) =$$

$$= (\overline{\bar{A} \cdot \overline{(\bar{A} \cdot D)}}) \cdot (\bar{A} + (B \cdot C)) = (A + (\bar{A}D)) \cdot (\bar{A} + (B \cdot C)) =$$

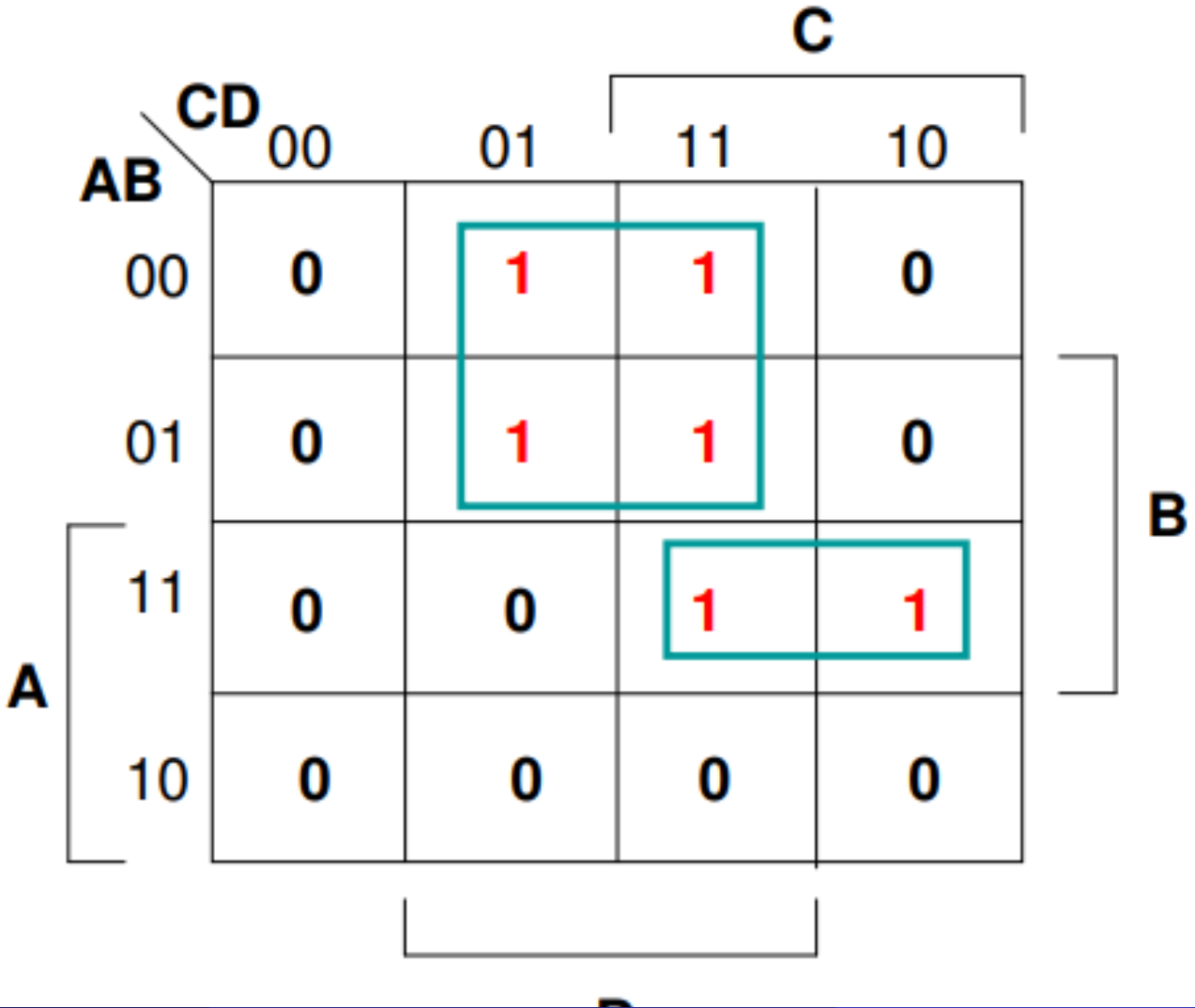
$$= (A + D)(\bar{A} + BC) = ABC + BCD + \bar{A}D$$

$$G = T4 \cdot T2 = (\bar{A} + T1) \cdot (\overline{\bar{A} \cdot D}) = (\bar{A} + (B \cdot C)) \cdot (\overline{\bar{A} \cdot D}) =$$

$$= (\bar{A} + (B \cdot C)) \cdot (A + \bar{D}) = \bar{A}\bar{D} + BC\bar{D} + ABC$$

Esercizio 7- Soluzione (2)

$$F = ABC + BCD + A'D$$



Esercizio 7- Soluzione (2)

$$G = ABC + BCD' + A'D'$$