Esercitazione Sistemi Digitali

08/11/2022



Esercizio 1- Traccia

1 Calcolare la tabella di verità della funzione:

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

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

Soluzione esercizio 1 (1)

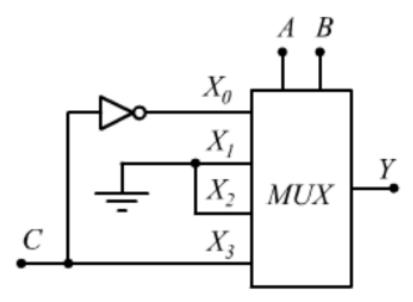
A	В	C	ABC	ĀĒĈ	$ig $ $ABC + ar{A}ar{B}ar{C}$
0	0	0	0	1	1
0	0	1	0	0	0
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	0	0	0
1	1	1	1	0	1

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

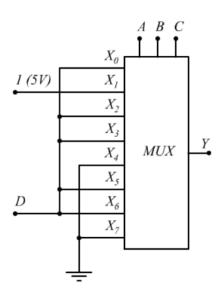
Soluzione esercizio 2 (1)

Α	В	C	D	Y
0	0	0	0	0
0	0	0		1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	0 0 0 1 1	0	1	1
A 0 0 0 0 0 0 0 0 1 1 1 1		0 1 1 0 0 1 1 0 0	1 0 1 0 1 0 1 0 1 0 1 0	0
0	1 0 0 0 0	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		1 0 0 1 1	0 1	1 1 1 0 1 0 0 0 0 1 0 0 1 0 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

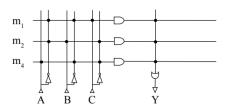
 Realizza mediante PLA e ROM con 3 ingressi la funzione che vale 1 se e solo se un solo bit in input vale 1

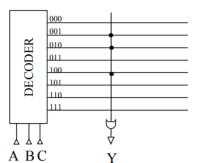
Esercizio 3- Soluzione

Α	В	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

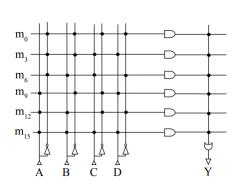
Esercizio 4- Soluzione (1)

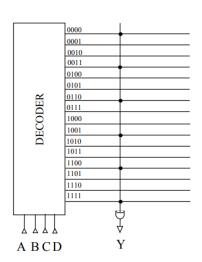
A	В	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	0 0 0 0 1 1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
0 0 0 0 0 0 0 0 1 1 1 1 1 1	1 1 0 0 0 0 1 1	0 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1	1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	0 0 1 0 0 1 0 0 1 0 0 1 0 0 1
1	1	1	0	0
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)



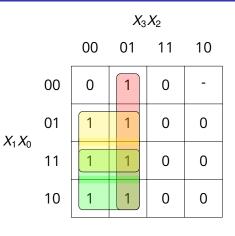


Esercizio 5- Traccia

- 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
 - MUX (un multiplexer delle opportune dimensioni per ogni output)

Esercizio 5- Soluzione Punto 1 (1)

<i>X</i> ₃	X_2	<i>X</i> ₁	<i>X</i> ₀	<i>Y</i> ₃	<i>Y</i> ₂	<i>Y</i> ₁	<i>Y</i> ₀
0	0	0	0	0	0	0	0
0	0	0	1 0	1	1	1	1 0
0	0	1		1	1	1 1	0
0	0	1	1	1	1	0	1
0	0 1 1	1 0 0	0	1	1 0	0	0
0 0 0 0 0 0 0 0 1 1 1 1	1		1 0 1 0 1 0 1 0	1	0	0 0 1 1 0	1 0 1 0 1
0	1	1 1 0	0	1	0	1	0
0	1	1	1	1		0	1
1	0	0	0	_	_	_	_
1	1 0 0 0 0	0	1	0	_ 1 1	1	1
1	0	1	0	0		1	0
1	0	1 1 0	1	0	1	0	1
1		0	0	0		1 0 0 1	0 1 0 1
1	1	0	1	- 0 0 0 0 0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1



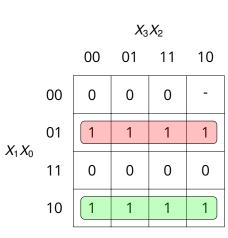
•
$$Y_3 = \bar{X}_3 X_0 + \bar{X}_3 X_1 + \bar{X}_3 X_2 = \bar{X}_3 (X_2 + X_1 + X_0)$$

Esercizio 5- Soluzione Punto 1 (2)

<i>X</i> ₃	<i>X</i> ₂	<i>X</i> ₁	<i>X</i> ₀	<i>Y</i> ₃	<i>Y</i> ₂	<i>Y</i> ₁	<i>Y</i> ₀				<i>X</i> ₃	<i>X</i> ₂	
0	0	0	0	0	0	0	0			00			4.0
0	0	0	1	1	1	1	1			00	01	11	10
0	0	1	0	1	1	1	0						
0	0	1	1	1	1	0	1		00	0	1	1	-
0	1	0	0	1	1	0	0		_				
0	1	0	1	1	0	1	1		01	1	0	0	1
0	1	1	0	1	0	1	0	X_1X_0					
0	1	1	1	1	0	0	1		11	1	0	0	1
1	0	0	0	_	_	_	_						
1	0	0	1	0	1	1	1		10	1	0	0	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	$Y_2 = \lambda$	$\langle _2 \bar{X_1} \rangle$	$\bar{\zeta}_0 + \bar{\lambda}$	$\bar{X}_{2}X_{0} +$	\bar{X}_2X_1	=
1	1	1	0	0	0	1	0	$=ar{X_2}(\lambda$			$X_2\bar{X_1}$	$\bar{K}_0 =$	
1	1	1	1	0	0	0	1	$X_2 \oplus (X_2)$	$X_1 + $	X_0	l ► ∢ ≣ ►	< <u>₹</u> >	₹ ୭९७

Esercizio 5- Soluzione Punto 1 (3)

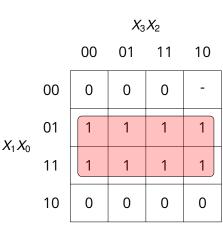
<i>X</i> ₃	X_2	<i>X</i> ₁	<i>X</i> ₀	<i>Y</i> ₃	Y ₂	<i>Y</i> ₁	<i>Y</i> ₀
	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0 0 0 0 1 1	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0		0	1	1	0	1 1 0 0 1 1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
0 0 0 0 0 0 0 0 1 1 1 1	0	1 1 0 0 1 1 0 0 1 1 0 0	1 0 1 0 1 0 1 0 1 0 1	_	1 1 1 0 0 0 - 1 1 1 0	_	_
1	0 0 0 0	0	1	0	1	1 1 0 0	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1		0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	1 1 1 1 1 1 1 0 0 0 0 0	0	1 0	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1
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)

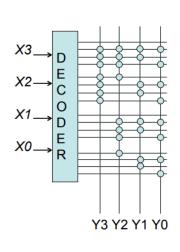
<i>X</i> ₃	X_2	<i>X</i> ₁	<i>X</i> ₀	<i>Y</i> ₃	<i>Y</i> ₂	<i>Y</i> ₁	Y_0	
0	0	0	0	0	0	0	0	
0	0	0	1	1	1	1	1	
0	0	1	0	1	1	1	0	
0	0	1	1	1	1	0	1	
0	1	0	0	1	1	0	0	
0	1	0	1	1	0	1	1	
0	1	1	0	1	0	1	0	
0	1	1	1	1	0	0	1)
1	0	0	0	_	_	_	_	
1	0	0	1	0	1	1	1	
1	0	1	0	0	1	1	0	
1	0	1	1	0	1	0	1	
1	1	0	0	0	1	0	0	
1	1	0	1	0	0	1	1	
1	1	1	0	0	0	1	0	Y
1	1	1	1	0	0	0	1	



 $Y_0 = X_0$

Esercizio 5- Soluzione Punto 2

<i>X</i> ₃	X_2	<i>X</i> ₁	X_0	<i>Y</i> ₃	<i>Y</i> ₂	<i>Y</i> ₁	<i>Y</i> 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	0	1	1	1	1	0	1
0	0 0 0 1 1	0	0	1	1	0	0
0 0 0 0 0 0 0 1 1 1	1	0 0 1	0 1 0 1 0 1 0 1 0 1	1	0	1	1 0 1 0 1
0	1	1	0	1	0	1 0	0
0	1	1	1	1	0	0	1
1	0	0	0	_	 1	_	_
1		0	1	0 0		1	1
1	0 0 0	1	0		1	1	0
	0	1	1	0	1	0	1
1	1	0	0	0	1	0	1 0 1 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

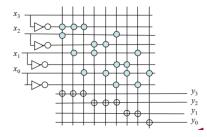
<i>X</i> ₃	X_2	<i>X</i> ₁	X_0	<i>Y</i> ₃	<i>Y</i> ₂	<i>Y</i> ₁	<i>Y</i> ₀
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1 1 0	1	1 1 1	1	0	1
0	0 0 1 1	0	0	1	1	0	0
0		0	1 0 1 0 1 0	1	1 1 1 1 0 0	1 0 0 1 1 0	1
0	1	1 1 0 0	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	_	_	_	_
1	0 0 0 0		1 0 1 0 1 0	0	- 1 1 1 1	1 1 0 0	1
1	0	1 1 0	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1		0	0	1	0	0
0 0 0 0 0 0 0 1 1 1 1 1	1	0	1	1 1 1 1 - 0 0 0 0 0	0	1 1	1 0 1 0 1 0 1 - 1 0 1 0 1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1

•
$$Y_3 = \bar{X_3}X_0 + \bar{X_3}X_1 + \bar{X_3}X_2$$

•
$$Y_2 = X_2 \bar{X_1} \bar{X_0} + \bar{X_2} X_0 + \bar{X_2} X_1$$

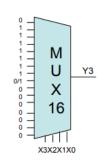
•
$$Y_1 = \bar{X_1}X_0 + X_1\bar{X_0}$$

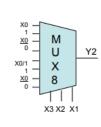
•
$$Y_0 = X_0$$

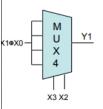


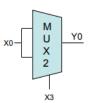
Esercizio 5- Soluzione Punto 4

<i>X</i> ₃	<i>X</i> ₂	<i>X</i> ₁	X_0	<i>Y</i> ₃	<i>Y</i> ₂	<i>Y</i> ₁	<i>Y</i> ₀	
0	0	0	0	0	0	0	0	1
0	0	0	1	1	1	1	1	
0	0	1	0	1	1	1	0	
0	0	1	0	1	1	0	1	
0	1	0	0	1	1	0	0	
0	1	0	1 0	1	1 0 0	1	1 0 1 0 1 0	
0 0 0 0 0 0 0 1 1 1 1	1	1 1 0 0 1 1 0 0 1 1 0	0	1	0	1	0	
0	1	1	1	1	0	0	1	
1	1 0 0	0	1 0 1 0 1 0	_	_ 1	_	_	
1	0	0	1	- 0 0 0		- 1 1 0	1 0	
1	0	1	0	0	1	1	0	
1	0	1	1	0	1	0	1	K 1
	1	0	0	0	1	0	0	
1	1	0	1	0	0	1	1	
1	1	0	0	0	0 0 0		0	
1	1	1	1	0	0	0	1	



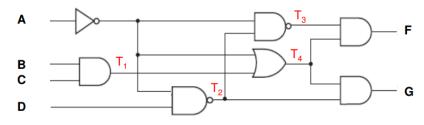






Esercizio 7 esercitazione 4- Traccia

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)



$$T1 = B \cdot C$$

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

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

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

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

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

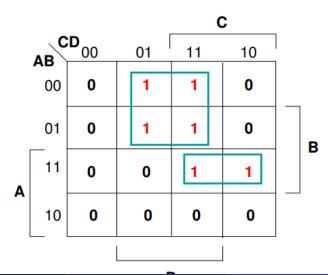
$$= (A + D)(\overline{A} + BC) = ABC + BCD + \overline{A}D$$

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



Esercizio 7- Soluzione (2)

$$F = \overline{ABC} + BCD + A'D$$



Esercizio 7- Soluzione (2)

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

