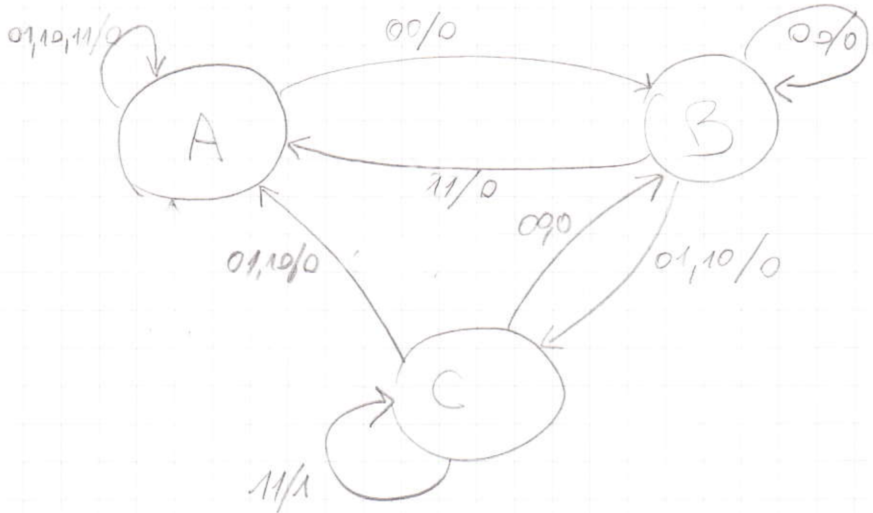
Esercizio 2

Progettare una rete sequenziale sincrona che verifichi l'andamento di 2 segnali in ingresso x, y. L'uscita Z avrà valore 1 quando si verifica 1 delle evoluzioni (00, 01, 11) o (00, 10, 11). Z rimane mantenuta inalterata fino a che rimane config. finale (11).
FF-JK



automa

		00	01	11	10
00	⇐ A	B,0	A,0	A,0	A,0
01	⇐ B	B,0	C,0	A,0	C,0
10	⇐ C	B,0	A,0	C,1	A,0

F_1F_2 \ XY	00	01	11	10
00	01,0	00,0	00,0	00,0
01	01,0	10,0	00,0	10,0
10	01,0	00,0	10,1	00,0

tab. transizione

come funziona FF-JK

clock CK	entrate J	K	uscita Q_{n+1}
0	–	–	Q_n
1	0	0	Q_n
1	0	1	0
1	1	0	1
1	1	1	$\overline{Q_n}$

tabella delle transizioni

presente Q_n	futuro Q_{n+1} → segnali uscita J	K
0 ⇒	0	0	–
0	1	1	–
1	0	–	1
1	1	–	0

X	Y	F_1	F_2	F_{1+}	F_{2+}	J_1	K_1	J_2	K_2	Z
0	0	0	0	0	1	0	–	1	–	0
0	0	0	1	0	1	0	–	–	0	0
0	0	1	0	0	1	–	1	1	–	0
0	0	1	1	–	–	–	–	–	–	–
0	1	0	0	0	0	0	–	0	–	0
0	1	0	1	1	0	1	–	–	1	0
0	1	1	0	0	0	–	1	0	–	0
0	1	1	1	–	–	–	–	–	–	–
1	0	0	0	0	0	0	–	0	–	0
1	0	0	1	1	0	1	–	–	1	0
1	0	1	0	0	0	–	1	0	–	0
1	0	1	1	–	–	–	–	–	–	–
1	1	0	0	0	0	0	–	0	–	0
1	1	0	1	0	0	0	–	–	1	0
1	1	1	0	1	0	–	0	0	–	1
1	1	1	1	–	–	–	–	–	–	–

tabella verità

J_1

F_1F_2 \ xy	00	01	11	10
00	0	0	0	0
01	0	1	0	1
11	-	-	-	-
10	-	-	-	-

Soluzione

$J_1 = F_2\bar{x}y + F_2x\bar{y}$

AND OR

K_1

F_1F_2 \ xy	00	01	11	10
00	-	-	-	-
01	-	-	-	-
11	-	-	-	-
10	1	1	0	1

$K_1 = \bar{x} + \bar{y}$

OR

J_2

F_1F_2 \ xy	00	01	11	10
00	1	0	0	0
01	-	-	-	-
11	-	-	-	-
10	1	0	0	0

$J_2 = \bar{x}\bar{y}$

AND

raccoglim. maggiori poss.

K_2

F_1F_2 \ xy	00	01	11	10
00	-	-	-	-
01	0	1	1	1
11	-	-	-	-
10	-	-	-	-

$K_2 = x + y$

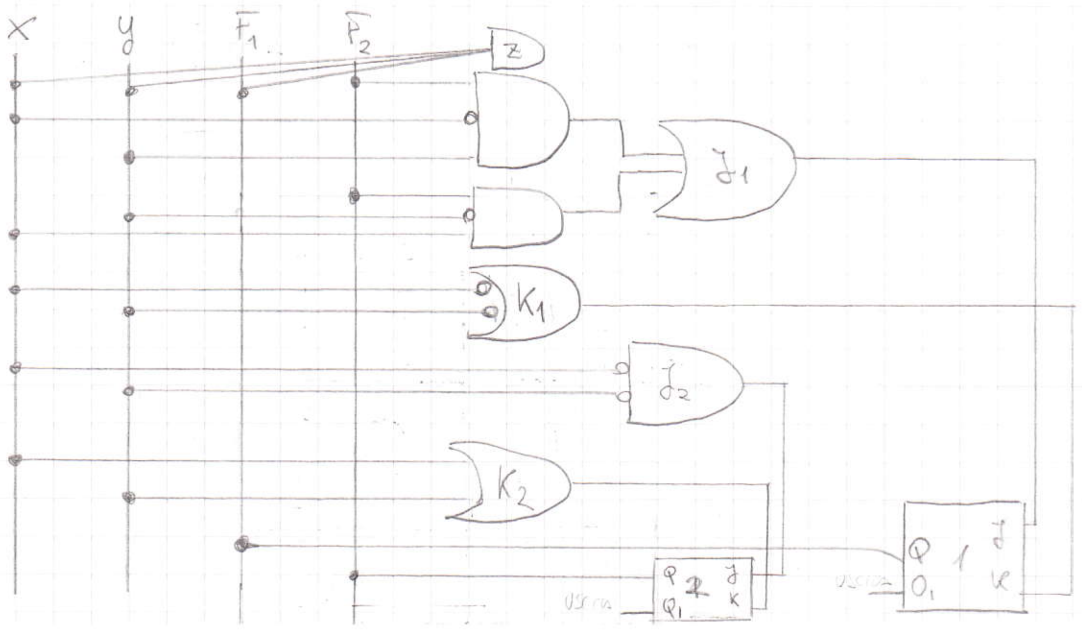
OR

Z

F_1F_2 \ xy	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	-	-	-	-
10	0	0	1	0

$Z = F_1xy$

AND



FOND INFO B - ESERCITAZIONI 15/04/05

semplificare

$$F(x,y,z) = \bar{x}y\bar{z} + \bar{x}yz + x\bar{y}\bar{z} + x\bar{y}z$$

z \ xy	00	01	11	10
0	0	1	0	1
1	0	1	0	1

$\bar{x}y$ $x\bar{y}$

$$= \bar{x}y + x\bar{y} = x \oplus y$$

semplificare:

la D può valere sia 0 che 1

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

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

$\to \bar{B}\bar{C}$

$\to \bar{B}\bar{D}$

$\to \bar{A}C\bar{D}$

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

semplificare:

$$F(x,y,z) = x\bar{y}\bar{z} + xy\bar{z} + xyz + x\bar{y}z + \bar{x}y\bar{z} + \bar{x}yz$$

in qst caso (particolarmente fortunato) facciamo senza mappe

$$= x\bar{z}(\underbrace{\bar{y}+y}_{1}) + xz(\underbrace{\bar{y}+y}_{1}) + \bar{x}y(\underbrace{\bar{z}+z}_{1}) = x\bar{z} + xz + \bar{x}y =$$

$$= x(\bar{z}+z) + \bar{x}y = x + \bar{x}y$$

propr. distribut. $= (x+\bar{x})(x+y) = x+y$

feb. 2004

$$DB \oplus (D\bar{A} + AB) = DA\bar{B} + \bar{D}AB$$

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

$D\bar{A}$ DB

A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

$D\bar{A}$

0	0	0	0
1	1	0	0

DB

0	0	0	0
0	1	1	0

1) mi serve 1 mappa che sommata dia

2) 1 0

mappa da sommare (AB) a $D\bar{A}$ per ottenere DB tramite $\oplus$

AB

0	0	1	0
–	–	1	0

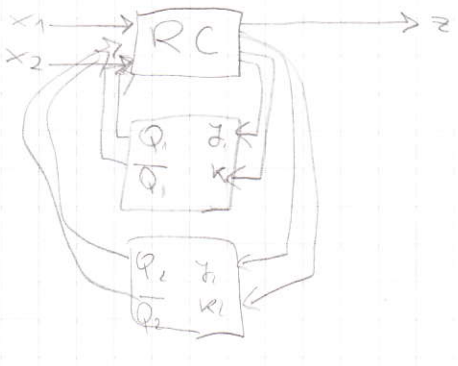
RETE SEQUENZIALE SINCRONA

1) forme d'onda
2) automa (ASF)
3) tabella di transizione
4) modello di Huffman

stato presente \ X_1X_2	00	01	11	10
A	B,0			
B				
C				
D				

stato futuro
uscita

rete combinatoria



5) tabella verità

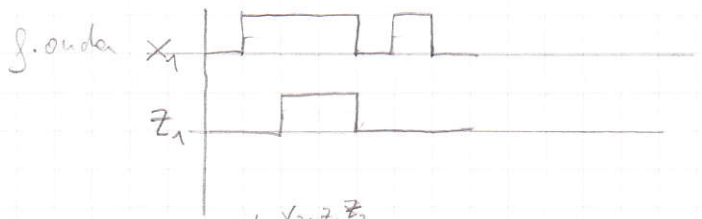
es

2 uscite

a) $x_1 = x_2 = 1$ MA! gli ingressi non possono salire a 1 entrambi

b) $z_1 = 1$ se x_1 resta 1 per almeno 2 intervalli consecutivi

$z_2 = 1$ .. x_2



automa

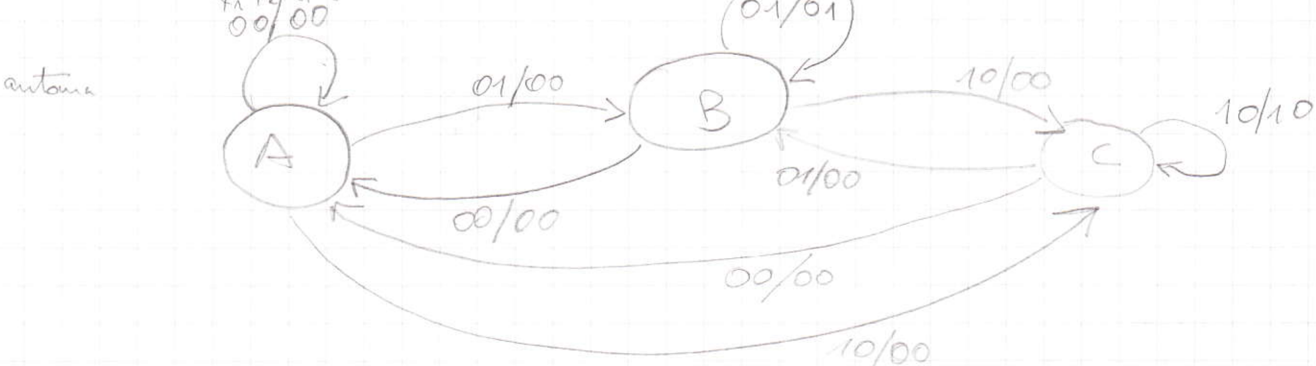


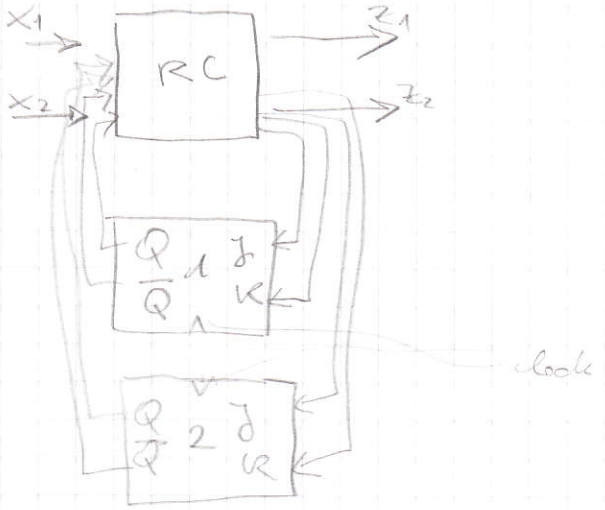
tabella transizione

$y_1 y_2$ \ $x_1 x_2$	00	01	10	11
A = 00	A,00	B,00	C,00	/
B = 01	A,00	B,01	C,00	/
C = 10	A,00	B,00	C,10	/
11	/	/	/	/

Q_n	$\Rightarrow$	Q_{n+1}	J	K
0	$\Rightarrow$	0	0	–
0		1	1	–
1		0	–	1
1		1	–	0
0		–	–	–

x_1	x_2	g_1	g_2	y_1+	y_2+	J_1	K_1	J_2	K_2	z_1	z_2
0	0	0	0	0	0	0	–	0	–	0	0
0	0	0	1	0	0	0	–	–	1	0	0
0	0	1	0	0	0	–	1	0	–	0	0
0	0	1	1	–	–	–	–	–	–	–	–
0	1	0	0	0	1	0	–	1	–	0	0
0	1	0	1	0	1	0	–	–	0	0	1
0	1	1	0	0	1	–	1	1	–	0	0
0	1	1	1	–	–	–	–	–	–	–	–
1	0	0	0	1	0	1	–	0	–	0	0
1	0	0	1	1	0	1	–	–	1	0	0
1	0	1	0	1	0	–	0	0	–	1	0
1	0	1	1	–	–	–	–	–	–	–	–
1	1	0	0	–	–	–	–	–	–	–	–
1	1	0	1	–	–	–	–	–	–	–	–
1	1	1	0	–	–	–	–	–	–	–	–
1	1	1	1	–	–	–	–	–	–	–	–

modello di Huffmann



J_1

$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	0	0	-	1
01	0	0	-	1
11	-	-	-	-
10	-	-	-	-

$J_1 = x_1$

K_1

$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	-	-	-	-
01	-	-	-	-
11	-	-	-	-
10	1	1	-	0

$K_1 = \overline{x_1}$

J_2

$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	0	1	-	0
01	-	-	-	-
11	-	-	-	-
10	0	1	-	0

$J_2 = x^2$

K_2

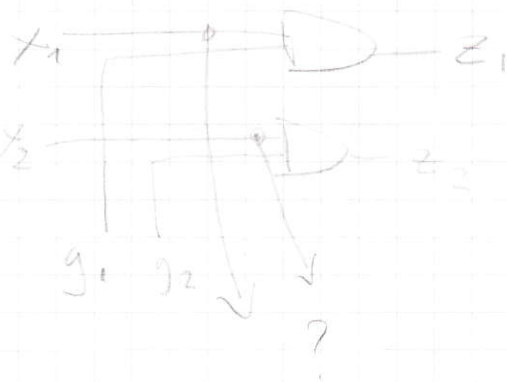
$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	-	-	-	-
01	1	0	-	1
11	-	-	-	-
10	-	-	-	-

$K_2 = \overline{x_2}$

z_1

$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	0	0	-	0
01	0	0	-	0
11	-	-	-	-
10	0	0	-	1

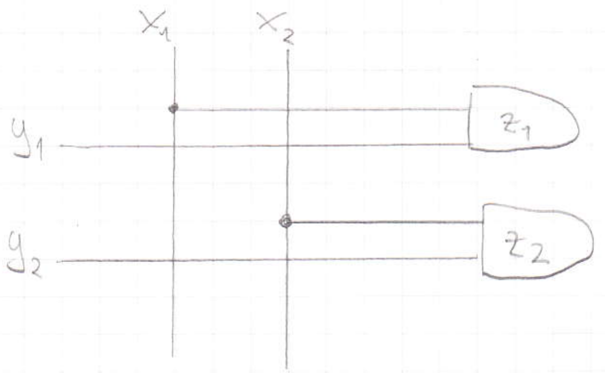
$z_1 = x_1 y_1$



z_2

$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	0	0	-	0
01	0	1	-	0
11	-	-	-	-
10	0	0	-	0

$z_2 = x_2 y_2$



somme di prodotti

SP → NAND

PS → NOR

prodotti di somme

$$z_{SP} = (x_1x_2)+(x_3x_4) = \overline{\overline{(x_1x_2)+(x_3x_4)}} =$$

$$= \overline{\overline{(x_1x_2)}\cdot\overline{(x_3x_4)}} = \overline{(\underbrace{x_1 \uparrow x_2}_{NAND})\cdot(x_3 \uparrow x_4)} =$$

$$= (x_1 \uparrow x_2) \uparrow (x_3 \uparrow x_4)$$

esame 29 aprile 2004/a

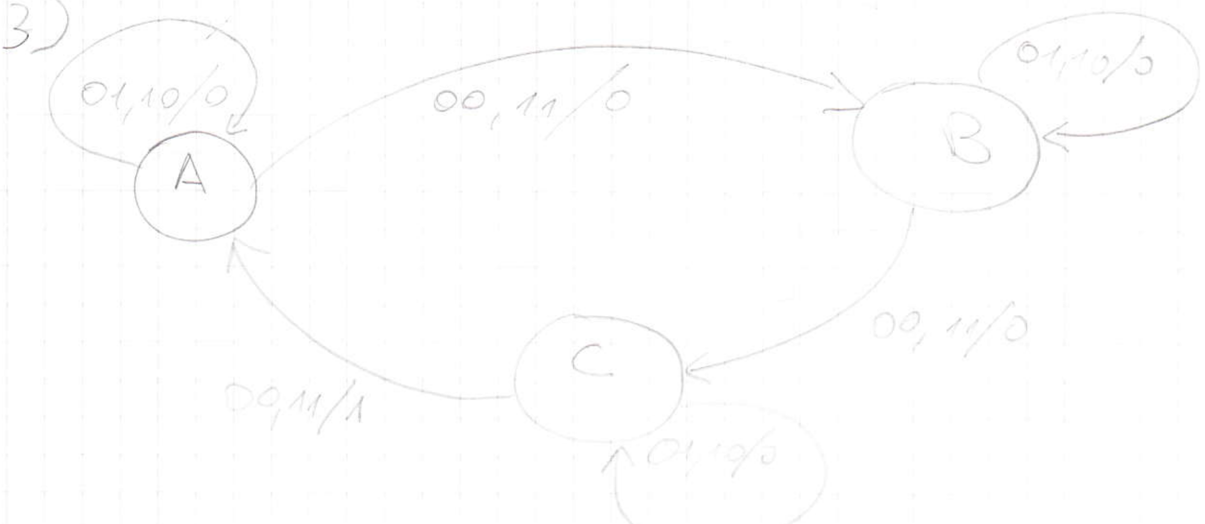
$A+B=1 \quad AB=0$

1) $A C+\bar{A} B+B C=B+C$

$\underbrace{C(A+B)}_{1}+\bar{A} B= \quad C+\bar{A} B+\overset{C}{A B} \quad = \quad C+B\underbrace{(\bar{A}+A)}_{1}=$

$=C+B$

3)



stati \ $x_1 x_2$		00	01	10	11
00	A	B,0	A,0	A,0	B,0
01	B	C,0	B,0	B,0	C,0
10	C	A,1	C,0	C,0	A,1

$y_1 y_2$ \ $x_1 x_2$	00	01	10	11
00	01,0	00,0	00,0	01,0
01	10,0	01,0	01,0	10,0
10	00,1	10,0	10,0	00,1

stati prossimi

tabella transizioni

Q_n	Q_{n+1}	J	K
0 →	0	0	–
0	1	1	–
1	0	–	1
1	1	–	0

x_1	x_2	y_1	y_2	y_{1+}	y_{2+}	J_1	K_1	J_2	K_2	Z
0	0	0	0	0	1	0	–	1	–	0
0	0	0	1	1	0	1	–	–	1	0
0	0	1	0	0	0	–	1	0	–	1
0	0	1	1	–	–	–	–	–	–	–
0	1	0	0	0	0	0	–	0	–	0
0	1	0	1	0	1	0	–	–	0	0
0	1	1	0	1	0	–	0	0	–	0
0	1	1	1	–	–	–	–	–	–	–
1	0	0	0	0	0	0	–	0	–	0
1	0	0	1	0	1	0	–	–	0	0
1	0	1	0	1	0	–	0	0	–	0
1	0	1	1	–	–	–	–	–	–	–
1	1	0	0	0	1	0	–	1	–	0
1	1	0	1	1	0	1	–	–	1	0
1	1	1	0	0	0	–	1	0	–	1
1	1	1	1	–	–	–	–	–	–	–

J_1

y_1y_2 \ x_1x_2	00	01	11	10
00	0	0	0	0
01	1	0	0	1
11	–	–	–	–
10	–	–	–	–

$J_1 = \overline{x_2}\, y_2$

K_1

y_1y_2 \ x_1x_2	00	01	11	10
00	–	–	–	–
01	–	–	–	–
11	–	–	–	–
10	1	0	0	1

$K_1 = \overline{x_2}$

J_2

y_1y_2 \ x_1x_2	00	01	11	10
00	1	0	0	1
01	–	–	–	–
11	–	–	–	–
10	0	0	0	0

$J_2 = \overline{y_1}\, \overline{x_2}$

K_2

y_1y_2 \ x_1x_2	00	01	11	10
00	–	–	–	–
01	1	0	0	1
11	–	–	–	–
10	–	–	–	–

$K_2 = \overline{x_2}$

2)

$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	–	–	–	–
10	1	0	0	1

$z = \bar{x}_2 y_1$

ASSORBIMENTO $x + x \cdot y = \cancel{x}$

$x + xy + \bar{x}y = x + y(\bar{x} + x)$

$x \qquad\qquad x + y$

es

$x + \bar{x}y = x + y$

$\overline{\overline{x + \bar{x}y}} = \overline{\bar{x} \cdot \overline{\bar{x}y}} = \overline{\bar{x} \cdot (\bar{x} + y)}$

DE MORGAN

$x \cdot (\bar{x} + y)$

$y \backslash x$	0	1
0	0	1
1	1	1

KARNAUGH

$x + y$

29 aprile 2004/6

1) $D+B=1 \qquad DB=0$

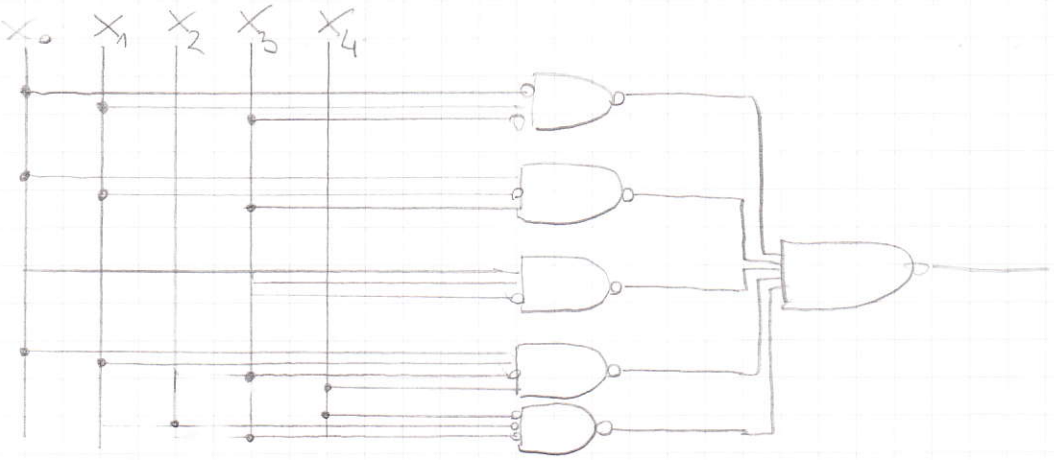
verificare $\qquad BC+\overline{D}B+DC = B+C$

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

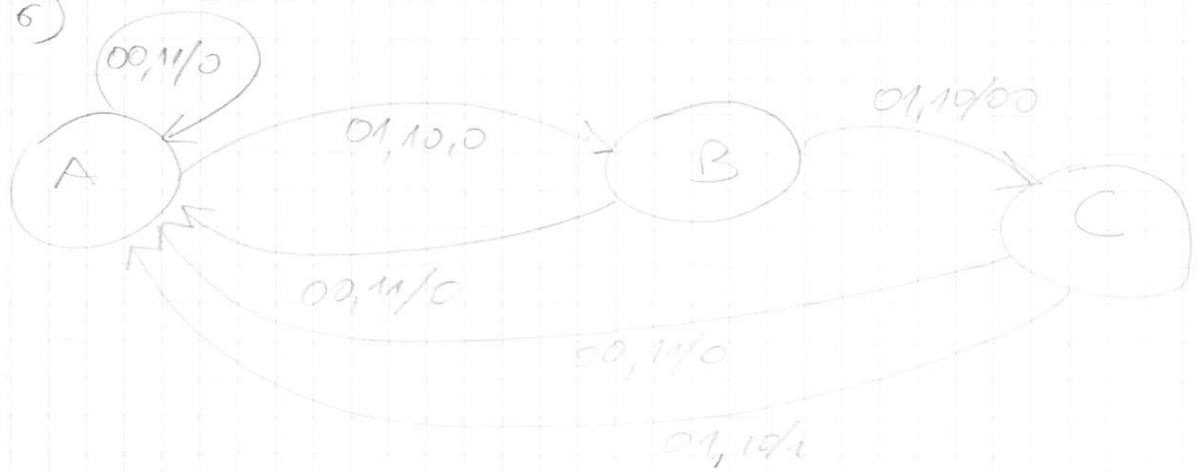
$$= C+B(\overline{D}+D) = C+B$$

5)

$$\overline{x_0}x_1\overline{x_3} + x_0\overline{x_1}x_3 + x_0x_3\overline{x_4} + x_0x_2\overline{x_3}x_4 + \overline{x_2x_3x_4}$$



6)



x_1x_2 / stato	00	01	10	11
A	A,0	B,0	B,0	A,0
B	A,0	C,0	C,0	A,0
C	A,0	A,1	A,1	A,0

x_1x_2 / y_1y_2	00	01	10	11
00	00,0	01,0	01,0	00,0
01	00,0	10,0	10,0	00,0
10	00,0	00,1	00,1	00,0

tab. transizioni:

$Q_n \Rightarrow Q_{n+1}$		J	K
0	0	0	–
0	1	1	–
1	0	–	1
1	1	–	0

x_1	x_2	y_1	y_2	y_{1+}	y_{2+}	J_1	K_1	J_2	K_2	Z
0	0	0	0	0	0	0	–	0	–	0
0	0	0	1	0	0	0	–	–	1	0
0	0	1	0	0	0	–	1	0	–	0
0	0	1	1							
0	1	0	0	0	1	0	–	1	–	0
0	1	0	1	1	0	1	–	–	1	0
0	1	1	0	0	0	–	1	0	–	1
0	1	1	1							
1	0	0	0	0	1	0	–	1	–	0
1	0	0	1	1	0	1	–	–	1	0
1	0	1	0	0	0	–	1	0	–	1
1	0	1	1							
1	1	0	0	0	0	0	–	0	–	0
1	1	0	1	0	0	0	–	–	1	0
1	1	1	0	0	0	–	1	0	–	0
1	1	1	1							

J_1

$y_1y_2 \backslash x_1x_2$	00	01	11	10
00	0	0	0	0
01	0	1	0	1
11	–	–	–	–
10	–	–	–	–

$$J_1 = \overline{x_1} x_2 y_2 + x_1 \overline{x_2} y_2$$

K_1

–	–	–	–
–	–	–	–
–	–	–	–
1	1	1	1

J_2

		01		10
00	0	1	0	1
01	–	–	–	–
	–	–	–	–
	0	0	0	0

$$J_2 = \overline{x_1} x_2 \overline{y_1} + x_1 \overline{x_2}\, \overline{y_1}$$

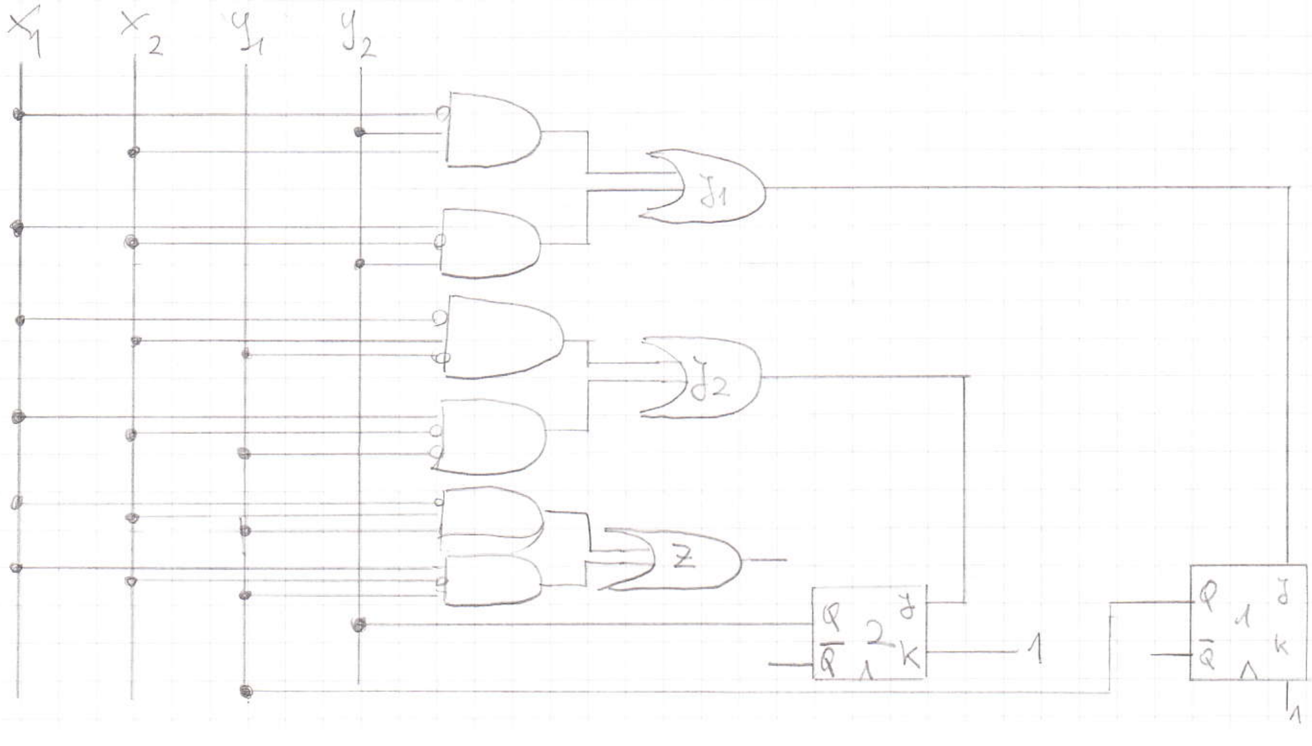
K_2

–	–	–	–
1	1	1	1
–	–	–	–
–	–	–	–

Z

		01		10
	0	0	0	0
	0	0	0	0
11	–	–	–	–
10	0	1	0	1

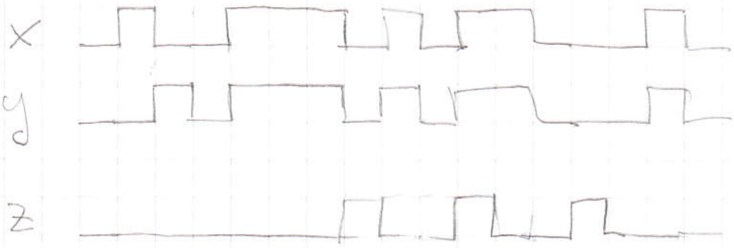
$$Z = \overline{x_1} x_2 y_1 + x_1 \overline{x_2} y_1$$

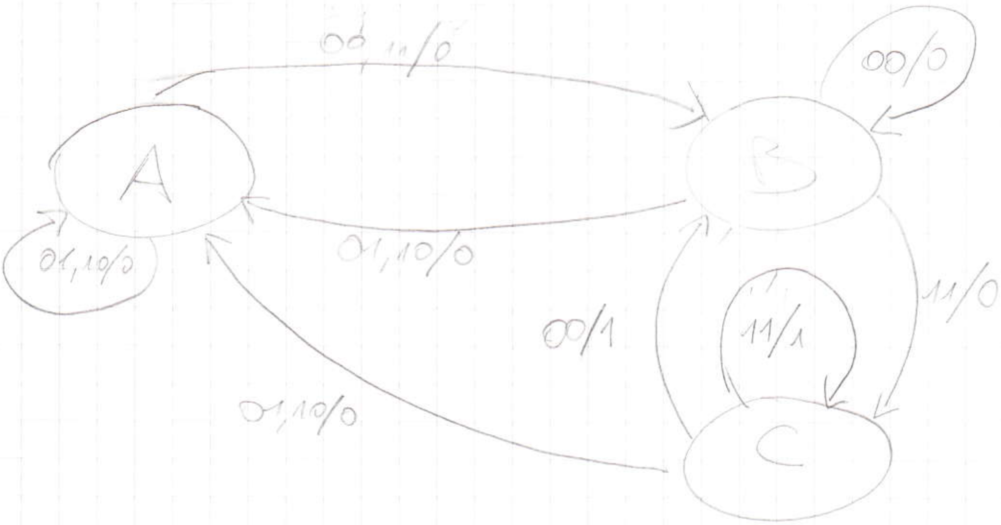


24 giugno 2004

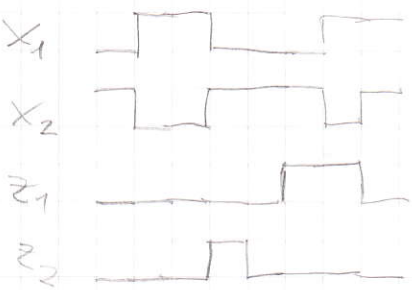
2) $\overline{x_0} x_1 + x_1 \overline{x_2} + x_0 \overline{x_1} x_2 \overline{x_4} + x_1 x_3 \overline{x_4} + x_0 x_2 \overline{x_3} x_4$

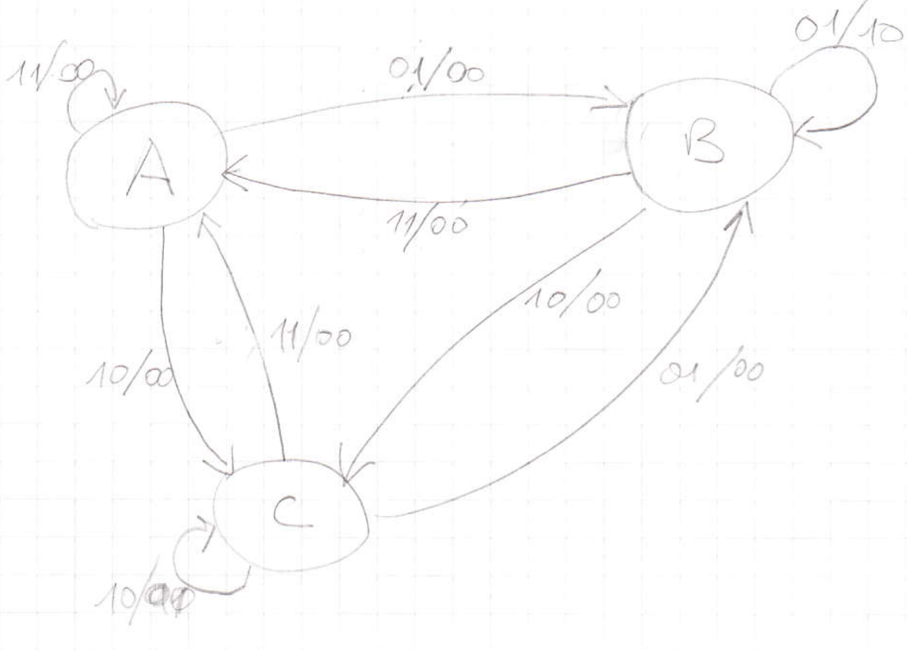
3)





es. 3 NO $x_1 = x_2 = 0$





15 luglio 04

semplificare (con soli NOR) e implementare

1)

$A\bar{B}\bar{C} + AC + \bar{A}C\bar{D}$

$\left(\begin{array}{l} AB = \overline{\bar{A} + \bar{B}} \\ \overline{AB} = \bar{A} + \bar{B} \end{array}\right)$

$A\bar{B}\bar{C} + AC(\bar{B}+1) + \bar{A}C\bar{D}$

$A\bar{B}\bar{C} + A\bar{B}C + AC + \bar{A}C\bar{D}$

$A\bar{B}(\underbrace{\bar{C}+C}_{1}) + AC + \bar{A}C\bar{D}$

$A\bar{B} + AC + \bar{A}C\bar{D}$

$A\bar{B} + AC(\bar{D}+1) + \bar{A}C\bar{D}$

$A\bar{B} + AC\bar{D} + AC + \bar{A}C\bar{D}$

$A\bar{B} + AC + C\bar{D}(A+\bar{A})$

$\boxed{A\bar{B} + AC + C\bar{D}}$

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con NOR

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

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

$\overline{\bar{A}\bar{A}\bar{C} + \bar{A}B\bar{C} + \bar{A}\bar{C}\bar{C} + B\bar{C}\bar{C} + \bar{A}\bar{A}D + \bar{A}BD + \bar{A}\bar{C}D + B\bar{C}D}$

$\overline{\bar{A}\bar{C} + \cancel{\bar{A}B\bar{C}} + \cancel{\bar{A}\bar{C}} + B\bar{C} + \bar{A}D + \cancel{\bar{A}BD} + \cancel{\bar{A}\bar{C}D} + \cancel{B\bar{C}D}}$

$\overline{\bar{A}\bar{C} + B\bar{C} + \bar{A}D}$

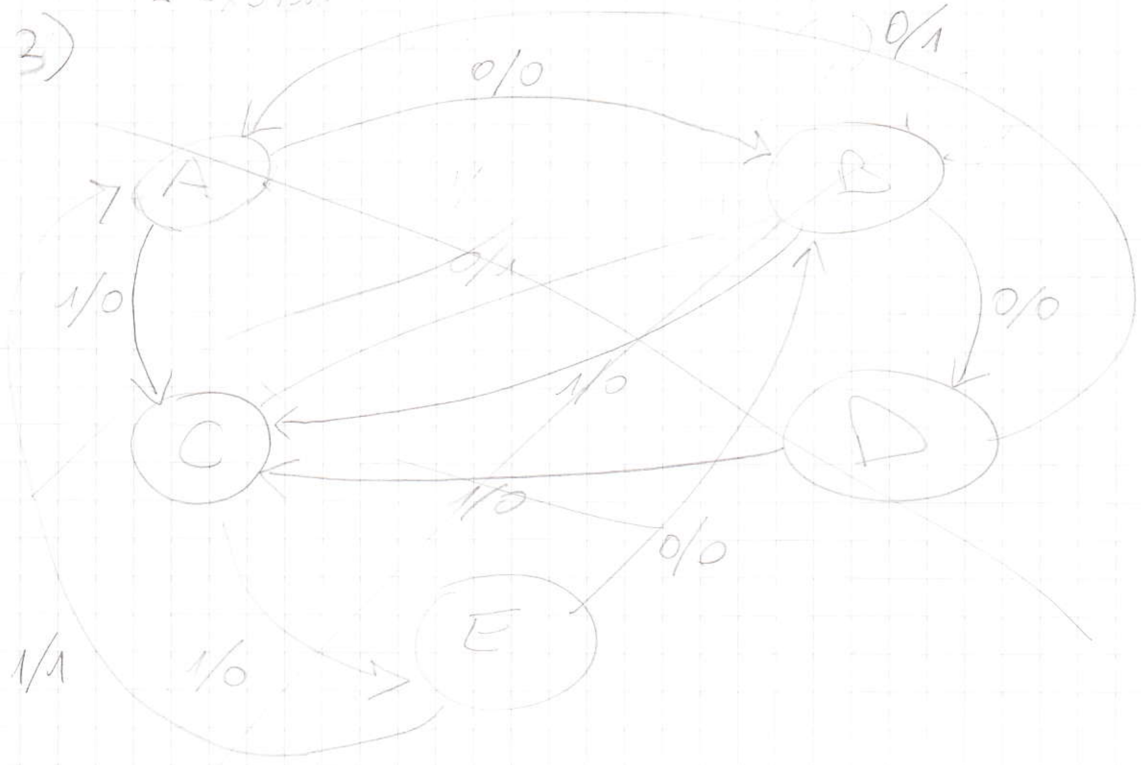
$\overline{\bar{A}\bar{C} + \bar{A}D + B\bar{C}} = \overline{\overline{(A+C)} + \overline{(A+\bar{D})} + \overline{(\bar{B}+C)}}$

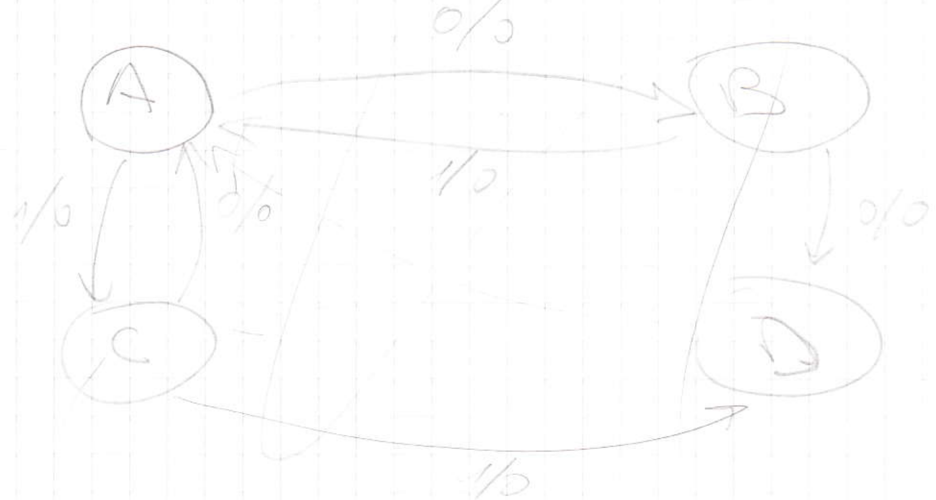
oppure con mappe Karnaugh

$A\bar{B} + C\bar{D} + AC$

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

3)





26 genn 05

2) sintesi a NAND

$x_4 = 0$

$x_3x_2 \backslash x_1x_0$	00	01	11	10
00	-	1	-	1
01	-	1	0	1
11	0	-	0	-
10	0	-	1	0

$x_4 = 1$

$x_3x_2 \backslash x_1x_0$	00	01	11	10
00	-	1	1	-
01	0	1	1	1
11	-	0	0	
10	0	1	1	0

$$x_0\overline{x_2} + \overline{x_0}x_1\overline{x_3} + x_0\overline{x_1}\,\overline{x_3} + x_1\overline{x_3}x_4$$

$$= \overline{\overline{x_0\overline{x_2}} \cdot \overline{\overline{x_0}x_1\overline{x_3}} \cdot \overline{x_0\overline{x_1}\,\overline{x_3}} \cdot \overline{x_1\overline{x_3}x_4}}$$