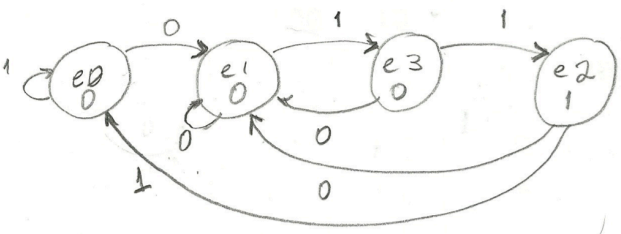
Resolução da Lista 1 de SD2 – 1/2015

1.

$D1 = A \cdot \bar{Q}_0$

$D0 = \bar{A} + \bar{Q1} \cdot Q0$

$Z = Q1 \cdot \bar{Q0}$



Q1 Q0	Q1* Q0* A=0	Q1* Q0* A=1	Saída
e0 0 0	e1 0 1	e0 0 0	0
e1 0 1	e1 0 1	e3 1 1	0
e2 1 0	e1 0 1	e0 0 0	1
e3 1 1	e1 0 1	e2 1 0	0

e0 → 00
e1 → 01
e2 → 10
e3 → 11

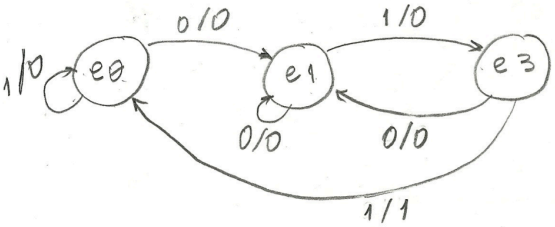
0, 1, 1

Projeto usando máquina de Mealy:

Q1 Q0	Q1* Q0*/Z A=0	Q1* Q0*/Z A=1
0 0	01/0	00/0
0 1	01/0	11/0
1 0	01/0	00/0
1 1	01/0	10/1

e0

Q1 Q0	Q1* Q0*/Z A=0	Q1* Q0*/Z A=1
0 0	01/0	00/0
0 1	01/0	11/0
1 1	01/0	00/1



	00	01	11	10
0	0	0	0	X
1	0	1	0	X

$Q1^* = \bar{Q1} \cdot Q0 \cdot A$

	00	01	11	10
0	1	1	1	X
1	0	1	0	X

$Q0^* = \bar{A} + \bar{Q1} \cdot Q0$

$Z = Q1 \cdot Q0 \cdot A$

2.

7.12) Equações de excitação e saída:

$D1 = \overline{Q_1} + Q_2$

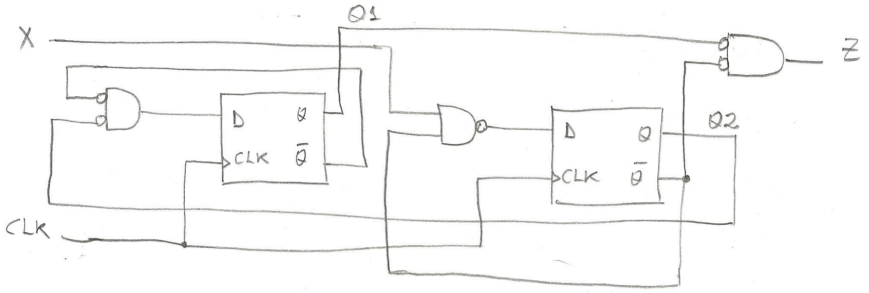
$D2 = \overline{Q_2} \cdot X$

$Z = Q_1 + \overline{Q_2}$

Tabela:

Estado Atual $Q_1\ Q_2$	Prox. Estado $X=0$	Prox. Estado $X=1$	Saída Z
(A) 0 0	(C) 1 0	(D) 1 1	1
(B) 0 1	(C) 1 0	(C) 1 0	0
(C) 1 0	(A) 0 0	(B) 0 1	1
(D) 1 1	(C) 1 0	(C) 1 0	1

7.13) NOR → $\overline{A+B} = \overline{A} \cdot \overline{B}$



Equações:

$D1 = \overline{\overline{Q_1} \cdot \overline{Q_2}} = Q_1 \cdot \overline{Q_2}$

$D2 = \overline{\overline{Q_2} \cdot X}$

$Z = \overline{\overline{Q_1} \cdot \overline{\overline{Q_2}}} = \overline{\overline{Q_1} \cdot Q_2}$

Prox. estado e saída são invertidos.

Estado atual $Q_1\ Q_2$	Prox. Estado $X=0$	Prox. Estado $X=1$	Saída Z
0 0	0 1	0 0	0
0 1	0 1	0 1	1
1 0	1 1	1 0	0
1 1	0 1	0 1	0

7.18) Equações:

$D2 = (Q1 \oplus Q0) \oplus (\overline{Q1} . \overline{Q2})$

$D1 = Q2$

$D0 = Q1$

Estado Atual $Q_2\ Q_1\ Q_0$		Próximo Estado $Q_2^*\ Q_1^*\ Q_0^*$
A	000	E 100
B	001	A 000
C	010	F 101
D	011	B 001
E	100	C 010
F	101	G 110
G	110	H 111
H	111	D 011

7.19) Equações:

$D3 = \overline{Q1} + \overline{\overline{Y . Q2}} = \overline{Q1} + Y . \overline{Q2}$

$D2 = \overline{Q3} . \overline{\overline{Y + Q1}} = \overline{Q3} . (Y + Q1)$

$D1 = X$

Estado Atual $Q_1\ Q_2\ Q_3$	Próximo Estado			
	XY=00	XY=01	XY=11	XY=10
000	001	011	111	101
001	001	001	101	101
010	001	011	111	101
011	001	001	101	101
100	010	011	111	110
101	000	001	101	100
110	010	010	110	110
111	000	000	100	100

1) $S0 \rightarrow 00$

$S1 \rightarrow 01$

$S2 \rightarrow 10$

Estado Atual	Próximo Estado ($Q_1^* Q_0^*$)				Saída
	AB=00	AB=01	AB=11	AB=10	Q
00	00	00	01	01	0
01	00	10	10	00	0
10	00	00	00	00	1

(Q_1 Q_0)

$Q_1^* = Q_0 . B$

$Q_0^* = \bar{Q_1} . \bar{Q_0} . A$

$Q = Q_1 . \bar{Q_0}$

$S0 \rightarrow 00$

$S1 \rightarrow 01$

$S2 \rightarrow 10$

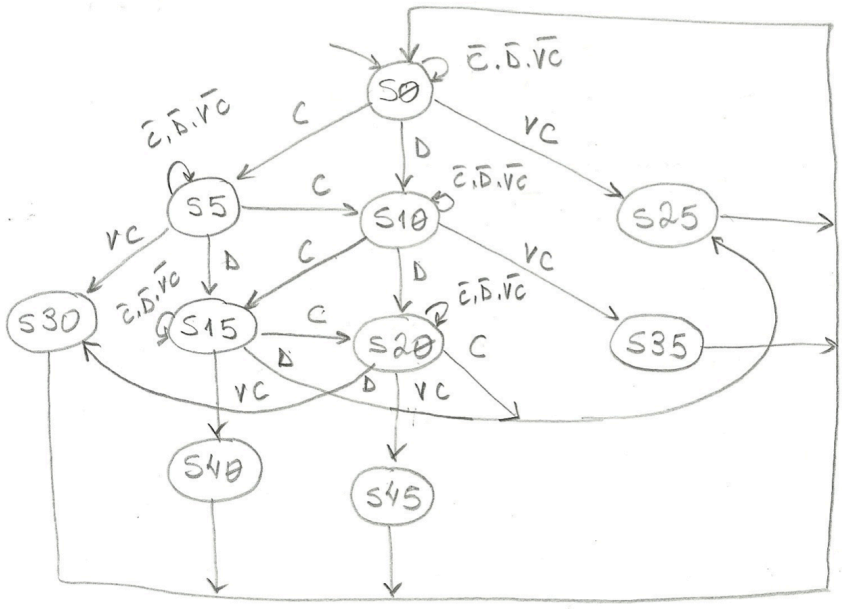
Estado Atual	Próximo Estado ($Q_1^* Q_0^*$)/Saída Q			
	AB=00	AB=01	AB=11	AB=10
00	00/0	00/0	01/0	01/0
01	00/0	10/0	10/0	00/0
10	00/0	00/0	10/1	00/0

$Q_1^* = \bar{Q_1} . Q_0 . B + Q_1 . A . B$

$Q_0^* = \bar{Q_1} . \bar{Q_0} . A$

$Q = Q_1 . \bar{Q_0} . A . B$

2)



Codificação One-Hot:

S0 → 0000000001
S5 → 0000000010
S10 → 0000000100
S25 → 0000001000
S30 → 0000010000
S15 → 0000100000
S20 → 0001000000
S35 → 0010000000
S40 → 0100000000
S45 → 1000000000

Estado	Saída
S25	REFRI
S35	REFRI TROCO1D
S45	REFRI TROCO2D
S40	REFRI TROCO1D TROCO1C
S30	REFRI TROCO1C

Estado Atual (Q9 ... Q0)	C	D	VC	Próx. Estado (Q9* ... Q0*)
S0 — 0000000001	0	0	0	S0 — 0000000001
S0 — 0000000001	X	X	1	S25 — 0000001000
S0 — 0000000001	X	1	X	S10 — 0000000100
S0 — 0000000001	1	X	X	S5 — 0000000010
S5 — 0000000010	0	0	0	S5 — 0000000010
S5 — 0000000010	X	X	1	S30 — 0000010000
S5 — 0000000010	X	1	X	S15 — 0000100000
S5 — 0000000010	1	X	X	S10 — 0000000100
S10 — 0000000100	0	0	0	S10 — 0000000100
S10 — 0000000100	X	X	1	S35 — 0010000000
S10 — 0000000100	X	1	X	S20 — 0001000000
S10 — 0000000100	1	X	X	S15 — 0000100000
S25 — 0000001000	X	X	X	S0 — 0000000001
S30 — 0000010000	X	X	X	S0 — 0000000001
S15 — 0000100000	0	0	0	S15 — 0000100000
S15 — 0000100000	X	X	1	S40 — 0100000000
S15 — 0000100000	X	1	X	S35 — 0010000000
S15 — 0000100000	1	X	X	S20 — 0001000000
S20 — 0001000000	0	0	0	S20 — 0001000000
S20 — 0001000000	X	X	1	S45 — 1000000000
S20 — 0001000000	X	1	X	S30 — 0000010000
S20 — 0001000000	1	X	X	S25 — 0000001000
S35 — 0010000000	X	X	X	S0 — 0000000001
S40 — 0100000000	X	X	X	S0 — 0000000001
S45 — 1000000000	X	X	X	S0 — 0000000001

Equações:

$Q9^* = Q6 . VC$

$Q8^* = Q5 . VC$

$Q7^* = Q2 . VC$

$Q6^* = Q2 . D + Q5 . C + Q6 . \bar{C} . \bar{D} . \overline{VC}$

$Q5^* = Q1 . D + Q2 . C + Q5 . \bar{C} . \bar{D} . \overline{VC}$

$Q4^* = Q1 . VC + Q6 . D$

$Q3^* = Q0 . VC + Q5 . D + Q6 . C$

$Q2^* = Q0 . D + Q1 . C + Q2 . \bar{C} . \bar{D} . \overline{VC}$

$Q1^* = Q0 . C + Q1 . \bar{C} . \bar{D} . \overline{VC}$

$Q0^* = Q0 . \bar{C} . \bar{D} . \overline{VC} + Q3 + Q4 + Q7 + Q8 + Q9$

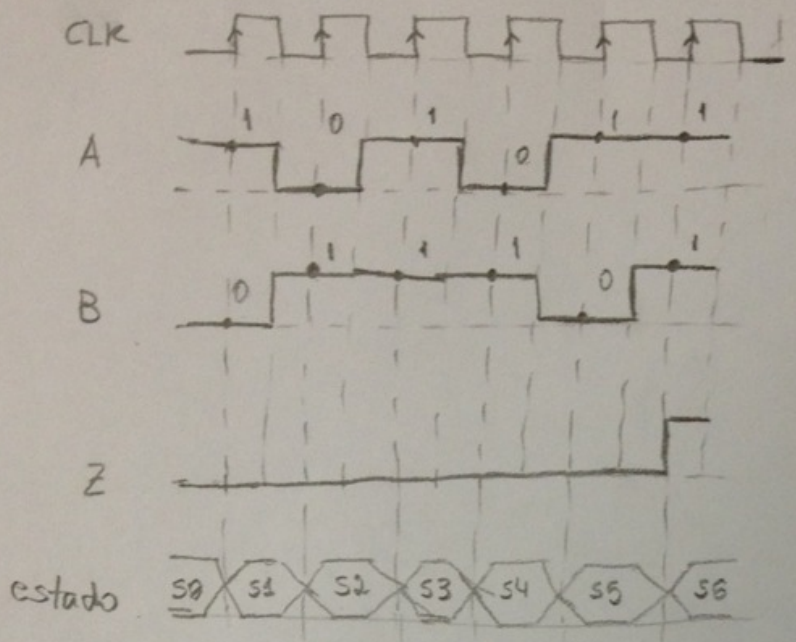
$REFRI = Q3 + Q7 + Q9 + Q8 + Q4$

$TROCO1C = Q8 + Q4$

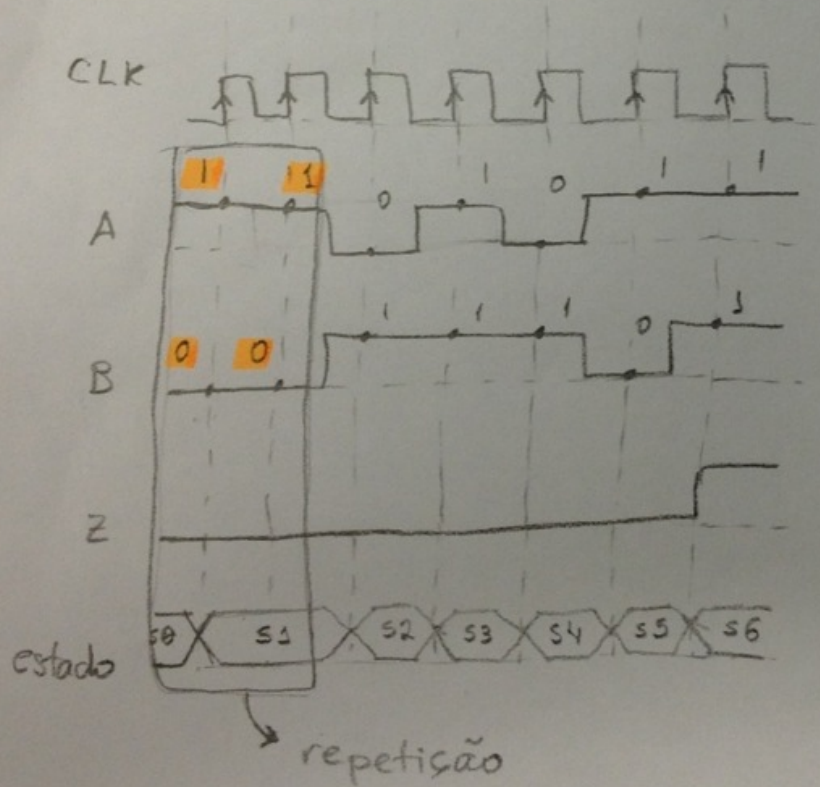
$TROCO1D = Q7 + Q8$

$TROCO2D = Q9$

*OBS: A tabela e as equações foram encontrados supondo-se que não há possibilidade de se colocar 2 moedas ao mesmo tempo.



Sem repetição de uma mesma entrada.



Repetição da primeira entrada.

Como no enunciado considera-se valida a repetição de uma mesma entrada, o circuito deve continuar no mesmo estado.

ESTADO ATUAL	PRÓXIMO ESTADO				SAÍDA
	AB=00	AB=01	AB=11	AB=10	Z
S0	S0	ERRO	ERRO	S1	0
S1	S0	S2	ERRO	S1	0
S2	S0	S2	S3	ERRO	0
S3	S0	S4	S3	ERRO	0
S4	S0	S4	ERRO	S5	0
S5	S0	ERRO	S6	S5	0
S6	S0	ERRO	S6	S1	1
ERRO	S0	ERRO	ERRO	S1	0

Estados equivalentes

$Q_2\ Q_1\ Q_0$	$Q_2^*\ Q_1\ Q_0$				Z
	AB=00	AB=01	AB=11	AB=10	
000	000	111	111	001	0
001	000	010	111	001	0
010	000	010	011	111	0
011	000	100	011	111	0
100	000	100	111	101	0
101	000	111	110	101	0
110	000	111	110	001	1
111	000	111	111	001	0

Estados equivalentes

Tabelas de transição e saída.

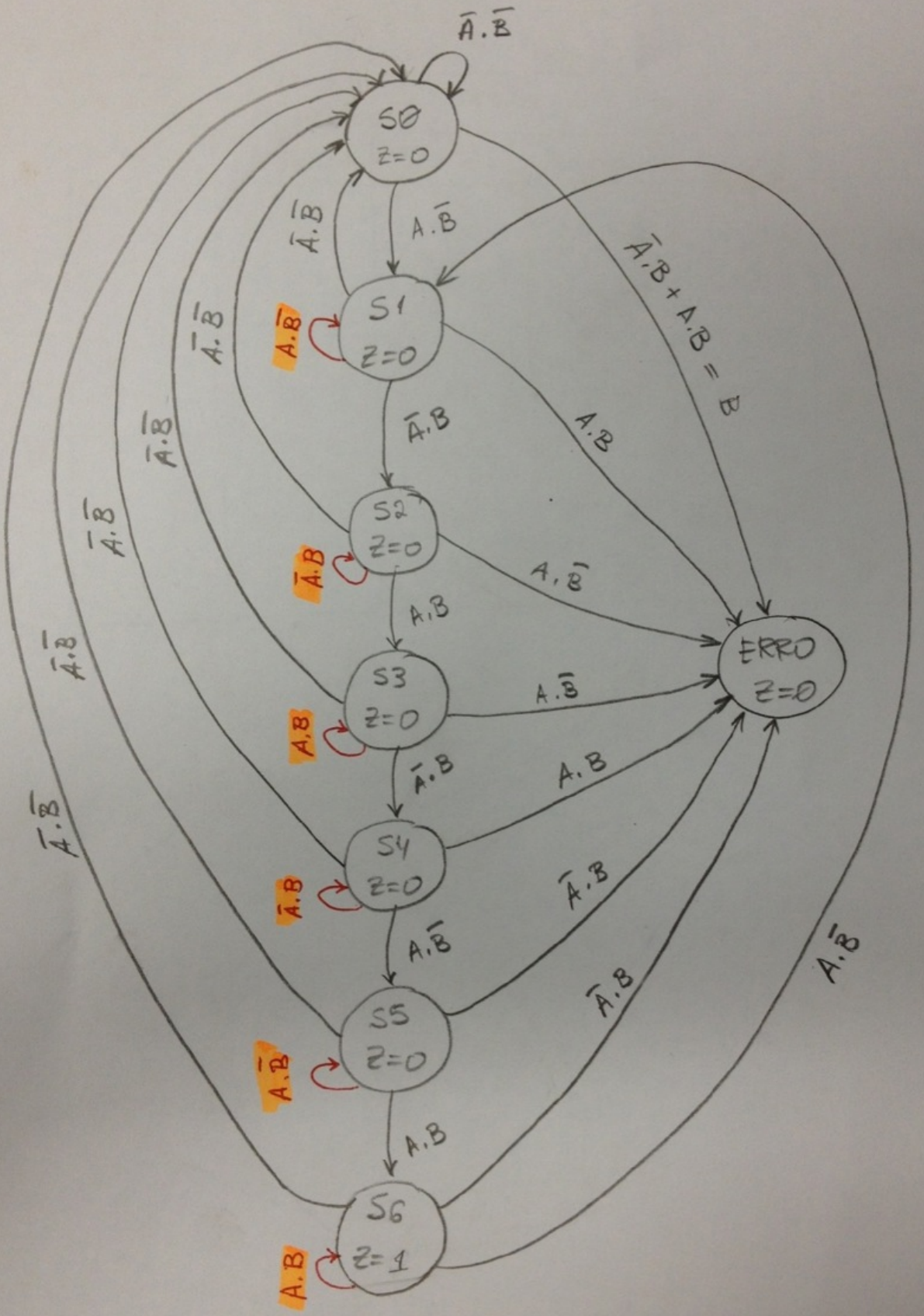
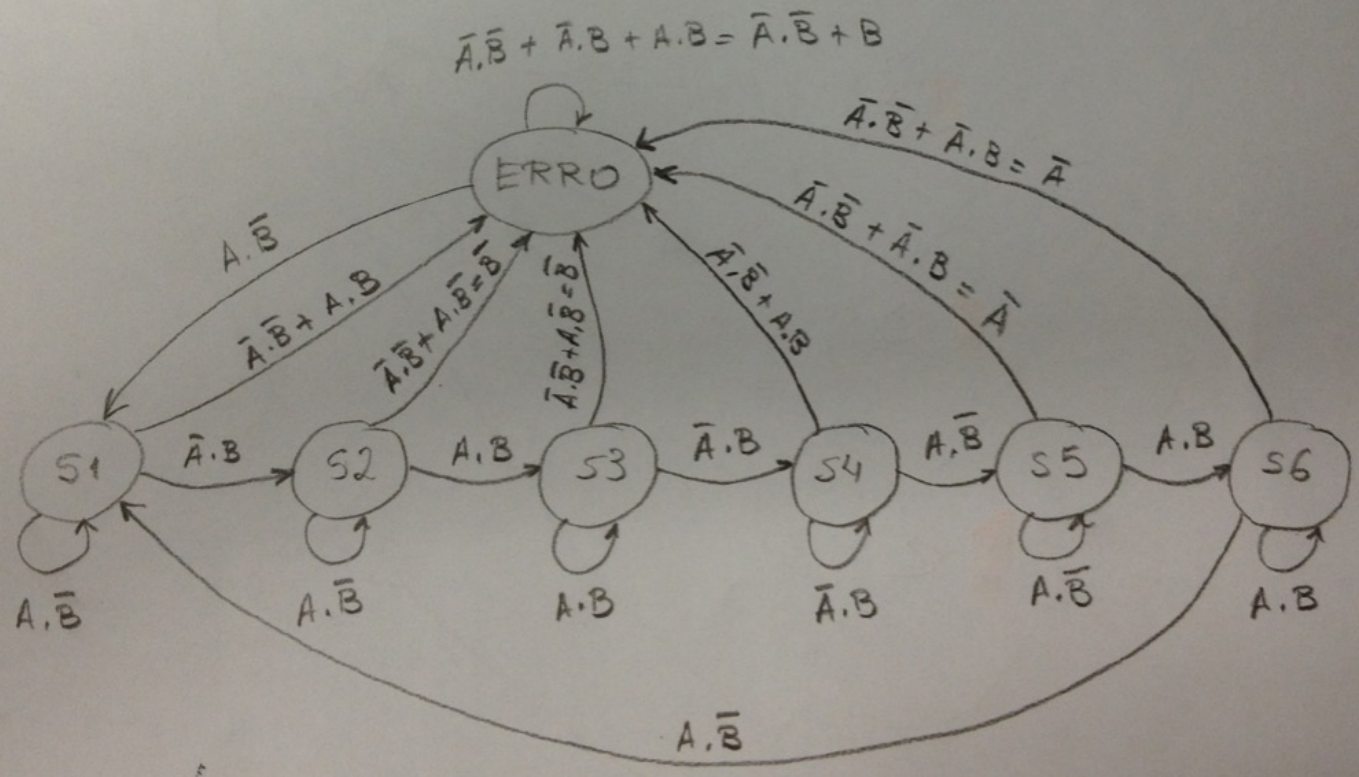
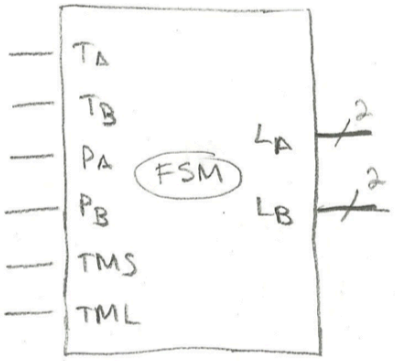


Diagrama de estados.

Após a equivalência de estados:

ESTADO ATUAL	PRÓXIMO ESTADO				SAÍDA Z
	AB=00	AB=01	AB=11	AB=10	
ERRO	ERRO	ERRO	ERRO	S1	0
S1	ERRO	S2	ERRO	S1	0
S2	ERRO	S2	S3	ERRO	0
S3	ERRO	S4	S3	ERRO	0
S4	ERRO	S4	ERRO	S5	0
S5	ERRO	ERRO	S6	S5	0
S6	ERRO	ERRO	S6	S1	1

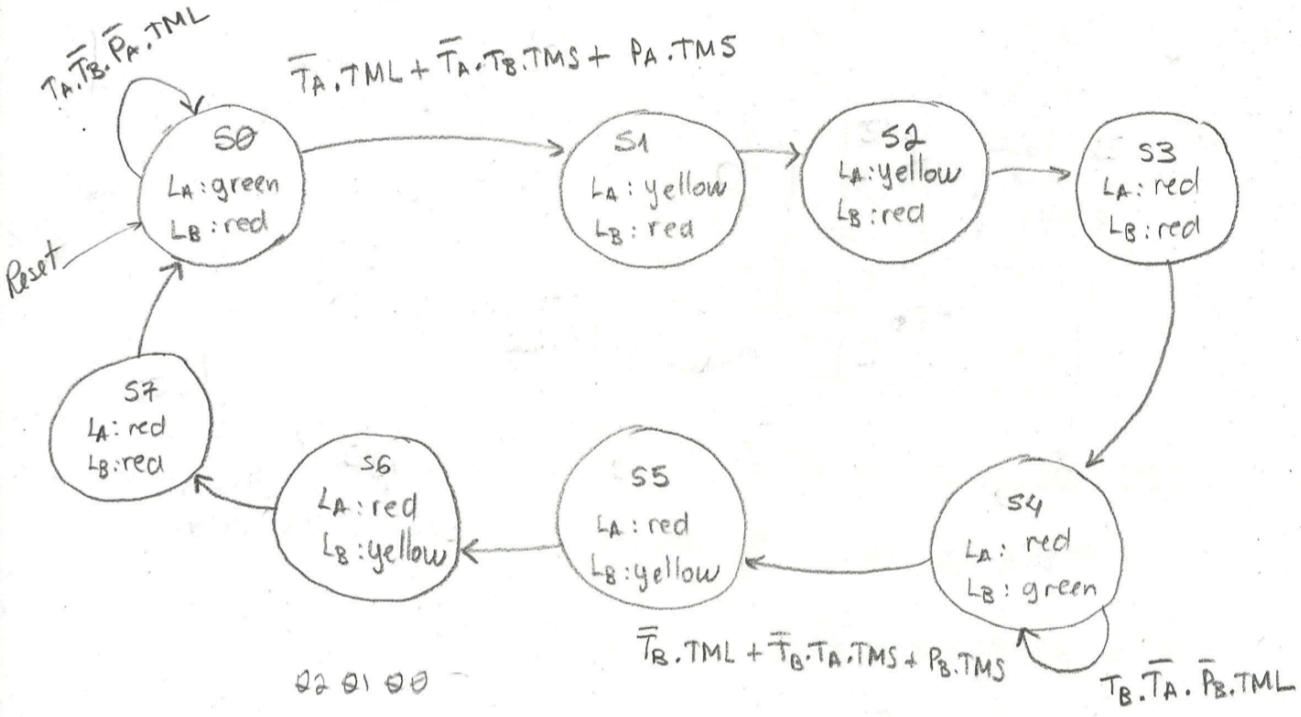




CLK = 1 Hz

↓

Cada estado dura 1 segundo.



$Q_2\ Q_1\ Q_0$

S0 → 0 0 0
S1 → 0 0 1
S2 → 0 1 0
S3 → 0 1 1
S4 → 1 0 0
S5 → 1 0 1
S6 → 1 1 0
S7 → 1 1 1

Sardos:

00 → green
01 → yellow
10 → red

Estado Atual Q2 Q1 Q0	Entradas						Próximo Estado Q2* Q1* Q0*
	T_A	T_B	P_A	P_B	TMS	TML	
000	1	0	0	X	X	1	000
000	0	X	X	X	X	1	001
000	0	1	X	X	1	X	001
000	X	X	1	X	1	X	001
001	X	X	X	X	X	X	010
010	X	X	X	X	X	X	011
011	X	X	X	X	X	X	100
100	0	1	X	0	X	1	100
100	X	0	X	X	X	1	101
100	1	0	X	X	1	X	101
100	X	X	X	1	1	X	101
101	X	X	X	X	X	X	110
110	X	X	X	X	X	X	111
111	X	X	X	X	X	X	000

$$Q2^* = \overline{Q2}.Q1.Q0 + Q2.\overline{Q1}.\overline{Q0}\,(\overline{T_A}.T_B.\overline{P_B}.TML + \overline{T_B}.TML + T_A.\overline{T_B}.TMS + P_B.TMS) + Q2.\overline{Q1}.Q0 + Q2.Q1.\overline{Q0}$$

$$Q1^* = \overline{Q2}.\overline{Q1}.Q0 + \overline{Q2}.Q1.\overline{Q0} + Q2.\overline{Q1}.Q0 + Q2.Q1.\overline{Q0}$$

$$Q0^* = \overline{Q2}.\overline{Q1}.\overline{Q0}\,(P_A.TML + \overline{T_A}.TML + \overline{T_A}.T_B.TMS) + \overline{Q2}.Q1.\overline{Q0} + Q2.\overline{Q1}.\overline{Q0}\,(\overline{T_B}.TML + T_A.\overline{T_B}.TMS + P_B.TML) + Q2.Q1.\overline{Q0}$$

Saídas:

Estado atual $Q_2\,Q_1\,Q_0$	Saídas $L_{A1}\,L_{A0}$	$L_{B1}\,L_{B0}$
0 0 0	0 0	1 0
0 0 1	0 1	1 0
0 1 0	0 1	1 0
0 1 1	1 0	1 0
1 0 0	1 0	0 0
1 0 1	1 0	0 1
1 1 0	1 0	0 1
1 1 1	1 0	1 0

Q_2Q_1 / Q_0	00	01	11	10
0	0	0	1	1
1	0	1	1	1

$$L_{A1} = Q_2 + Q_1 \cdot Q_0$$

Q_2Q_1 / Q_0	00	01	11	10
0	0	1	0	0
1	1	0	0	0

$$L_{A0} = \bar{Q}_2 \cdot Q_1 \cdot \bar{Q}_0 + \bar{Q}_2 \cdot \bar{Q}_1 \cdot Q_0$$

Q_2Q_1 / Q_0	00	01	11	10
0	1	1	0	0
1	1	1	1	0

$$L_{B1} = \bar{Q}_2 + Q_1 \cdot Q_0$$

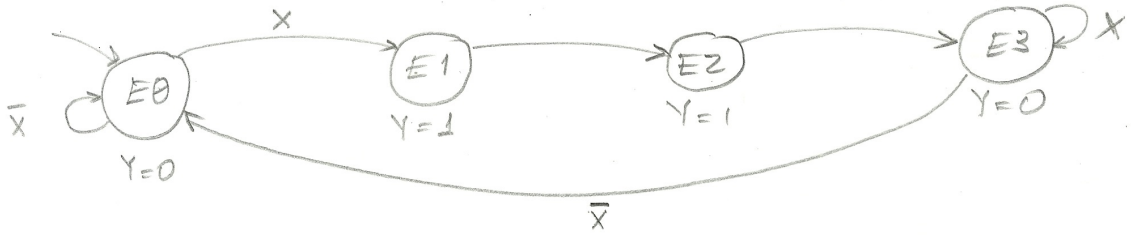
Q_2Q_1 / Q_0	00	01	11	10
0	0	0	1	0
1	0	0	0	1

$$L_{B0} = Q_2 Q_1 \cdot \bar{Q}_0 + Q_2 \cdot \bar{Q}_1 \cdot Q_0$$

3.23. Entrada X

Saída Y

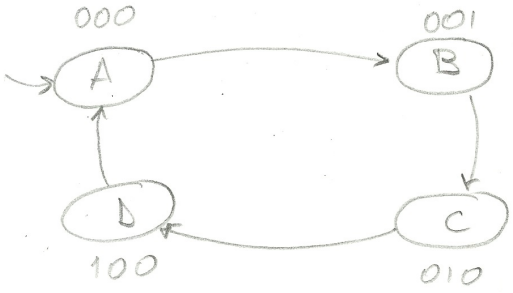
X : 0 → 1 → Y=1 por 2 ciclos de clock e depois Y=0.



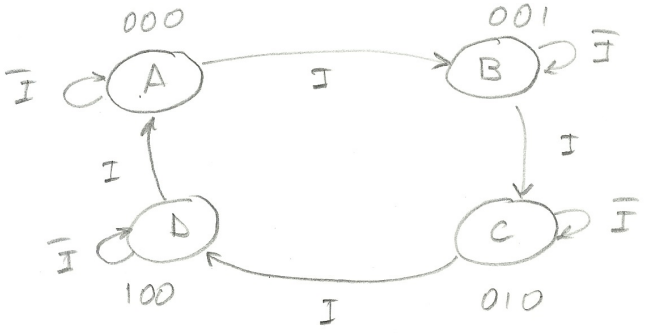
3.24. Saídas: X, y e Z

Sequência: 000, 001, 010, 100, 000, ...

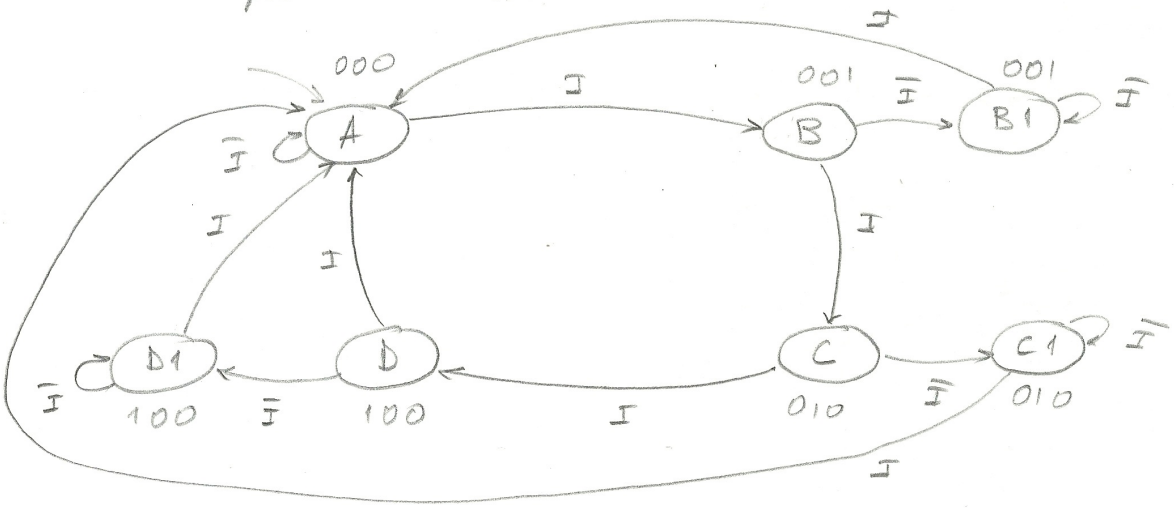
A B C D A



3.25. Entrada I: para a sequência quando I=0.



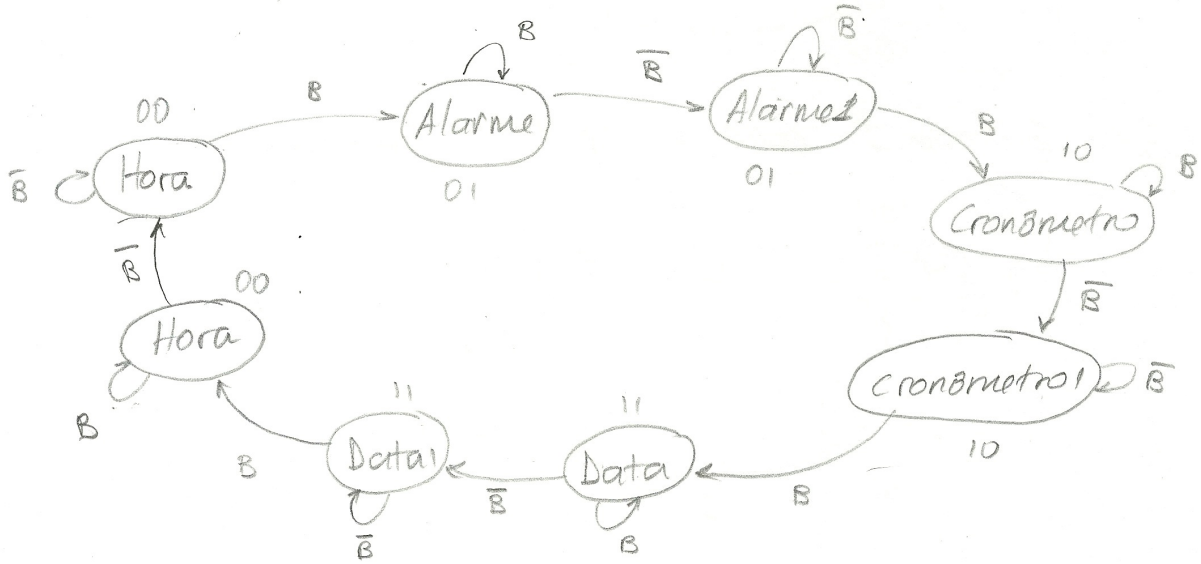
3.26. Se I=0, sequência é interrompida e, quando I=1, sequência começará em 000.



3.27.

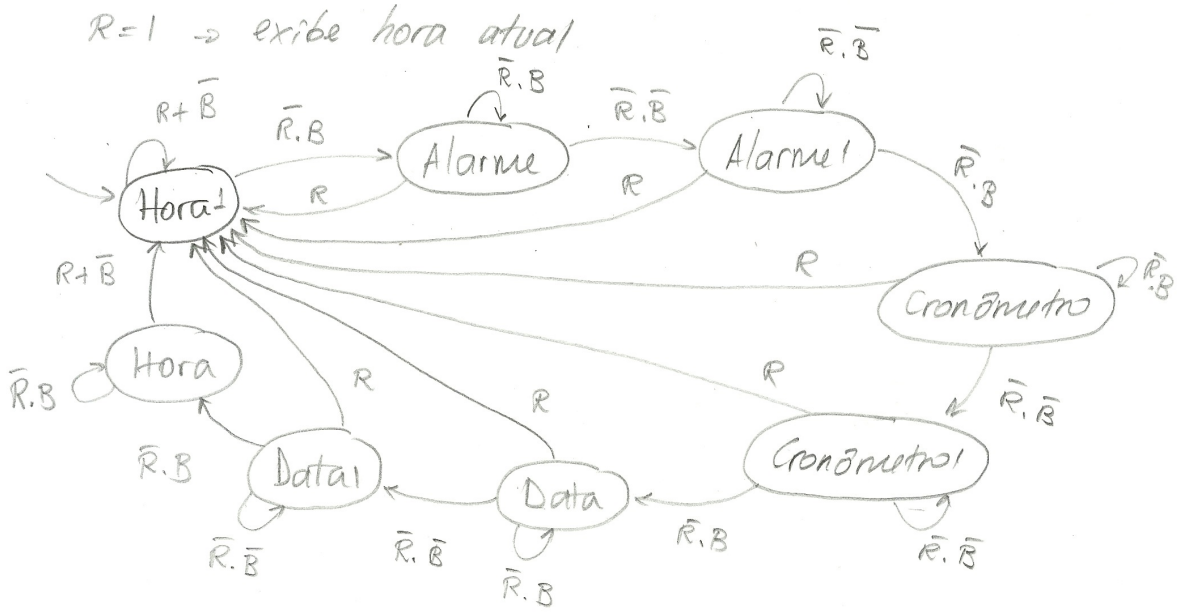
S1	S0	Operação
0	0	Hora atual
0	1	Alarme
1	0	Cronômetro
1	1	Data

B=1 : próximo item
Entrada B
Saídas S1, S0



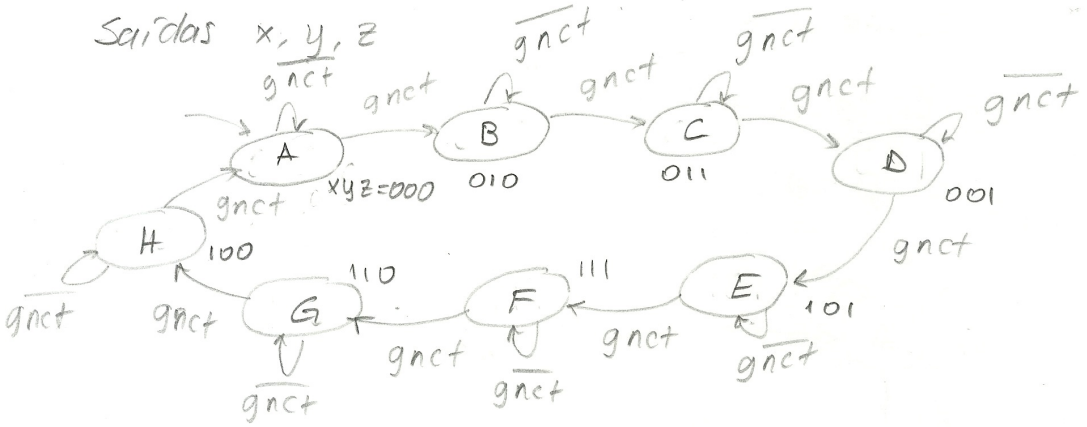
3.28. Entrada R

R=1 → exibe hora atual

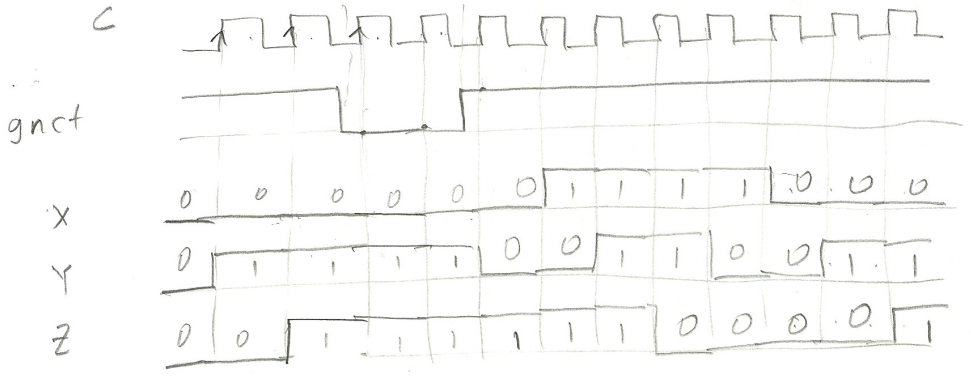


3.29. Entrada gcnt

Saídas x, y, z



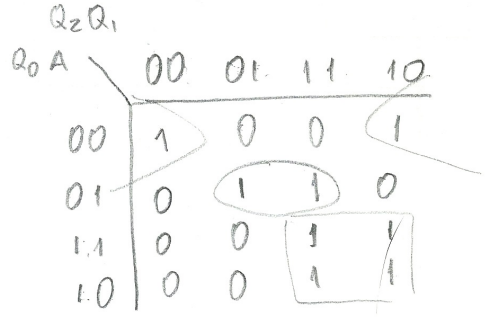
3.30.



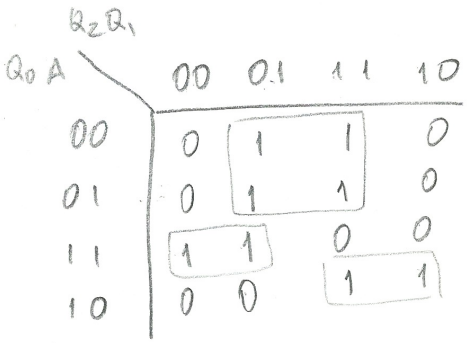
1)

ESTADO ATUAL $(Q_2\ Q_1\ Q_0)$	PRÓXIMO ESTADO	
	A = 0	A = 1
0 0 0	1 0 0	0 0 1
0 0 1	0 0 0	0 1 1
0 1 1	0 0 1	0 1 0
0 1 0	0 1 1	1 1 0
1 1 0	0 1 0	1 1 1
1 1 1	1 1 0	1 0 1
1 0 1	1 1 1	1 0 0
1 0 0	1 0 1	0 0 0

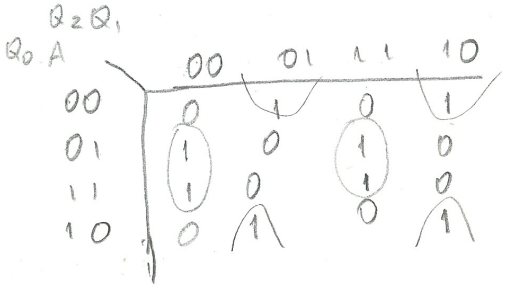
→ Contador Gray crescente/decrescente.



$$Q_2^* = \bar{Q}_1 \cdot \bar{Q}_0 \cdot \bar{A} + Q_1 \cdot \bar{Q}_0 \cdot A + Q_2 \cdot Q_0$$



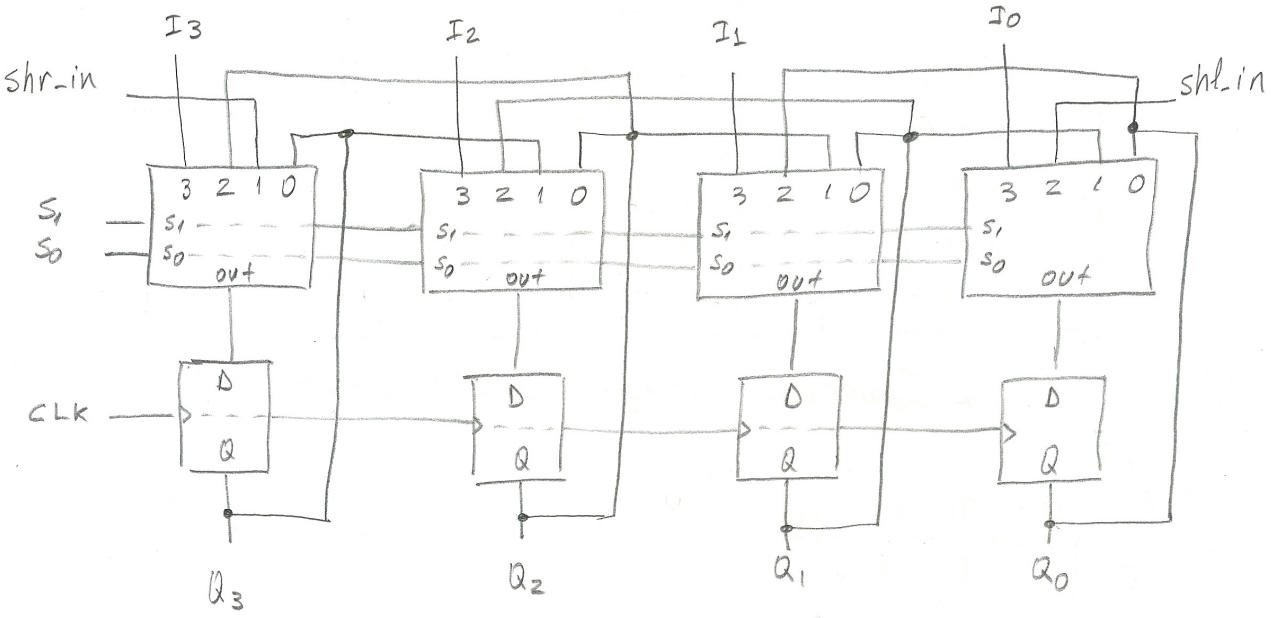
$$Q_1^* = Q_1 \cdot \bar{Q}_0 + \bar{Q}_2 \cdot Q_0 \cdot A + Q_2 \cdot Q_0 \cdot \bar{A}$$



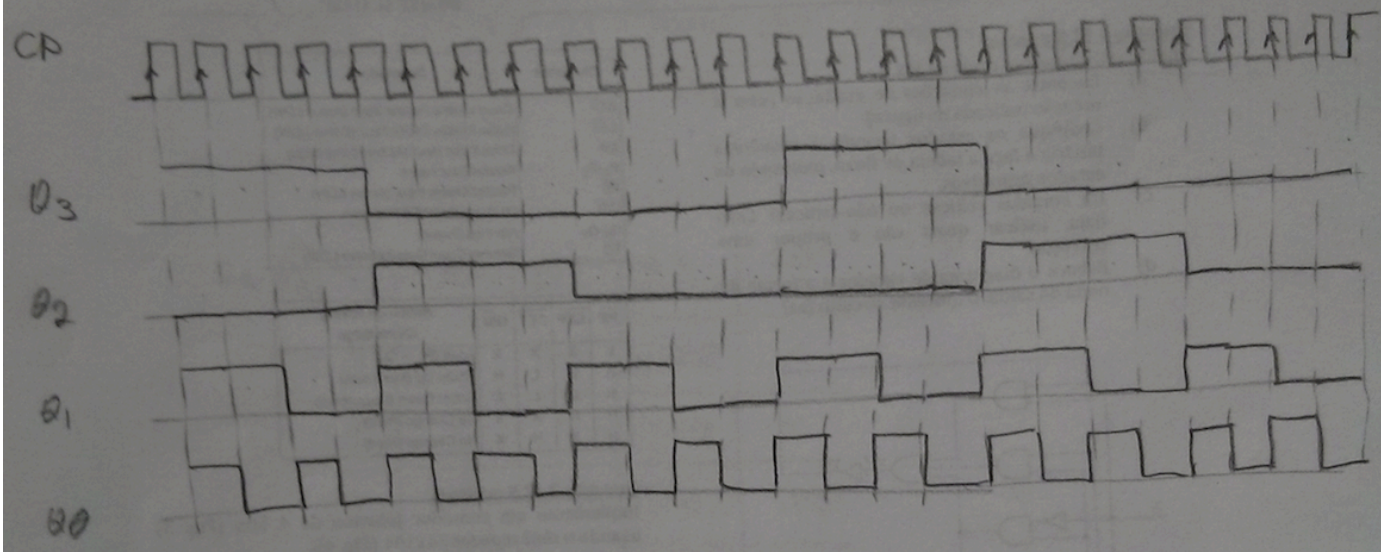
$$Q_0^* = \bar{Q}_2 \cdot Q_1 \cdot \bar{A} + Q_2 \cdot \bar{Q}_1 \cdot \bar{A} + \bar{Q}_2 \cdot \bar{Q}_1 \cdot A + Q_2 Q_1 \cdot A$$

2)

S_1	S_0	Operação
0	0	Hold
0	1	Shift Right
1	0	Shift Left
1	1	Load



O contador conta de 11 até 0, Logo, o módulo é 12.

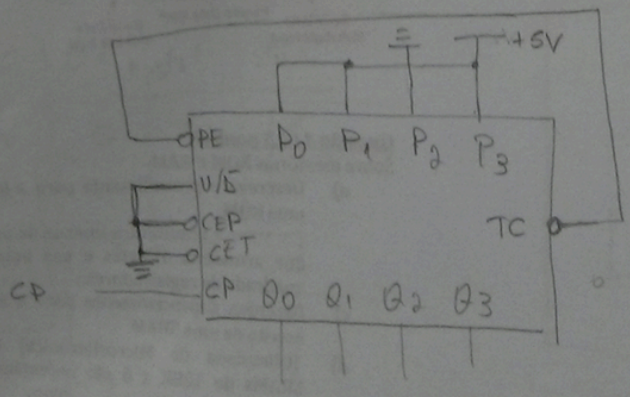


$f_{Q3} = f_{CP}/12 = 120/12 = 10$

$f_{Q2} = f_{CP}/12 = 120/12 = 10$

$f_{Q1} = f_{CP}/4 = 120/4 = 30$

$f_{Q0} = f_{CP}/2 = 120/2 = 60$



4) 74x194

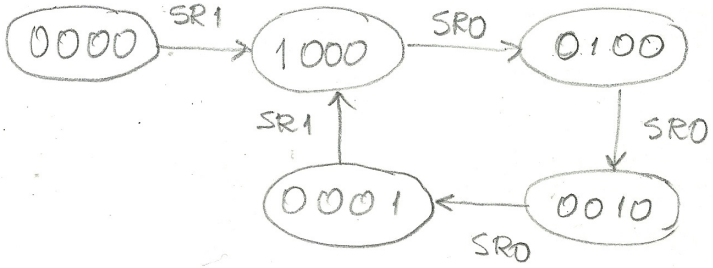
$Q_A Q_B Q_C Q_D$

1000 → ROR1 = 0100

ROR2 = 0010

ROR3 = 0001

ROR4 = 1000



Shift Right:

$S_1 S_0 = 01$

$Q_C Q_D$ \ $Q_A Q_B$	00	01	11	10
00	SR1	SRO	×	SRO
01	SR1	×	×	×
11	×	×	×	×
10	SRO	×	×	×

$SL1 = X$

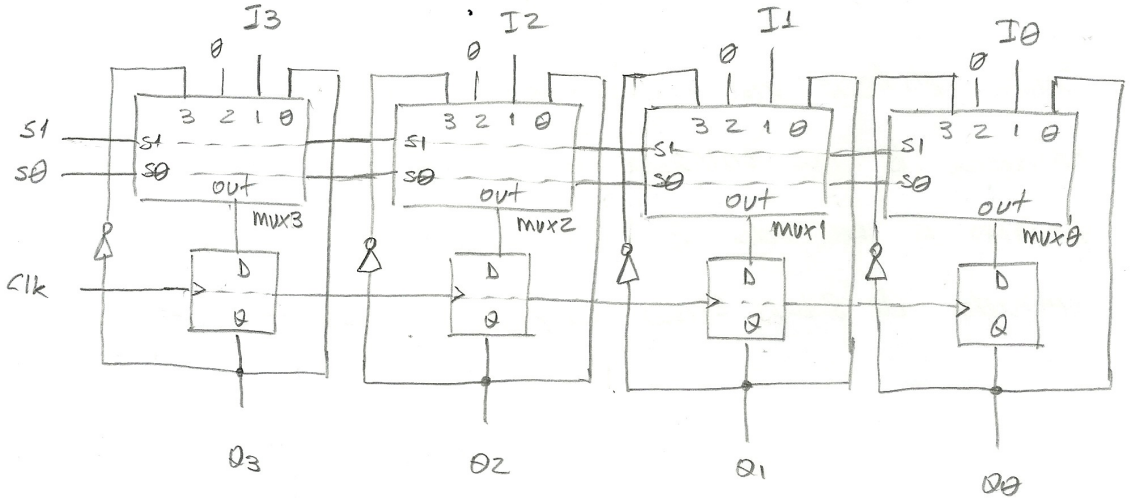
$P_A, P_B, P_C, P_D = X$

$SRI = \overline{Q_A} \cdot \overline{Q_B} \cdot \overline{Q_C}$

	00	01	11	10
00	1	0	×	0
01	1	×	×	×
11	×	×	×	×
10	0	×	×	×

4.3.

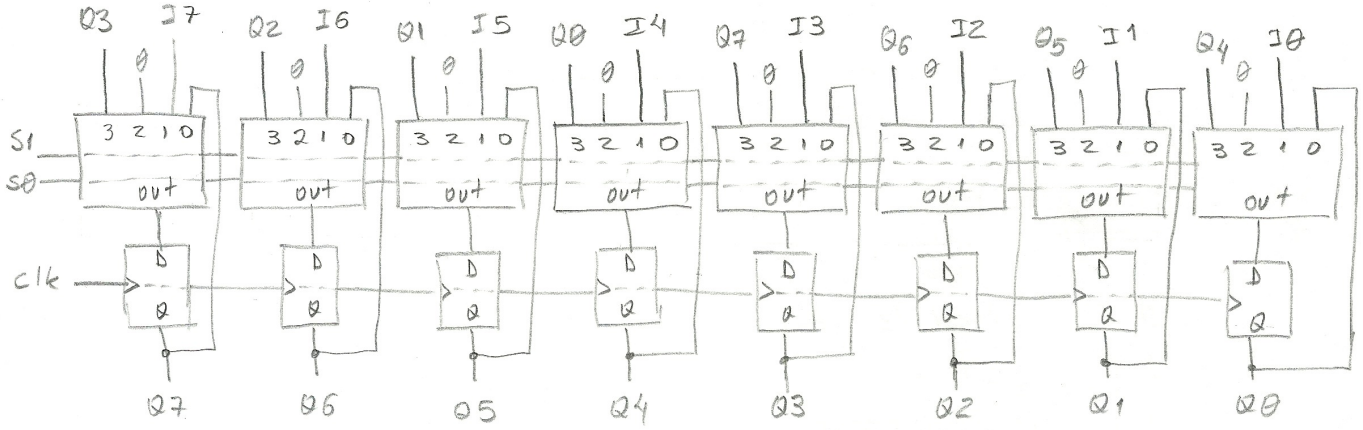
S1	S0	Op
0	0	Hold
0	1	Load $I_3 .. I_0$
1	0	Clear
1	1	Complement



4.4. Basta ligar Q0 na entrada 3 do mux3, Q1 na entrada 3 do mux2, Q1 na entrada 3 do mux2, Q2 na entrada 3 do mux1 e Q3 na entrada 3 do mux0.

4.5.

S1	S0	Op.
0	0	Hold
0	1	Load
1	0	Clear
1	1	Swap nibble



4.6. Basta utilizar um registrador de 8 bits e ligar a entrada B na entrada "load" do registrador. Assim, quando a entrada B for acionada, os dados de entrada de 8 bits serão carregados no registrador.