Pregunta 1

R1 ← sl R3 — SHL 1,3 — 15 14 13 12 11 10 9 — 0 0 0 1 1 1 0 — 0 0 1 — 0 0 0 — 0 1 1

DA	AA	BA	MB	FS	MD	RW	MW	PL	JB	BC
001	000	011	0	1110	0	1	0	0	0	0

R1 ← R2+5 — ADI 1,2,5 — 15 14 13 12 11 10 9 — 1 0 0 0 0 1 0 — 0 0 1 — 0 1 0 — 1 0 1

DA	AA	BA	MB	FS	MD	RW	MW	PL	JB	BC
001	010	101	1	0010	0	1	0	0	0	0

M[R1] ← R3 — ST 1,3 — 15 14 13 12 11 10 9 — 0 1 0 0 0 0 0 — 0 0 0 — 0 0 1 — 0 1 1

DA	AA	BA	MB	FS	MD	RW	MW	PL	JB	BC
000	001	011	0	0000	0	0	1	0	0	0

R4 ← M[R2] — LD 4,2 — 15 14 13 12 11 10 9 — 0 0 1 0 0 0 0 — 1 0 0 , 0 1 0

DA	AA	BA	MB	FS	MD	RW	MW	PL	JB	BC
100	010	000	0	0000	1	1	0	0	1	0

R3 ← R3 ∧ R2 — AND 3,3,2 — 15 14 13 12 11 10 9 — 0 0 0 1 0 0 0 — 0 1 1 — 0 1 1 — 0 1 0

DA	AA	BA	MB	FS	MD	RW	MW	PL	JB	BC
011	011	010	0	1000	0	1	0	0	0	0

if R4 = 0
  PC ← PC-15;
else
  PC ← PC+1;

BRZ 4,-15 — 15 14 13 12 11 10 9 — 1 1 0 0 0 0 0 — 1 1 0 — 1 0 0 — 0 0 1

DA	AA	BA	MB	FS	MD	RW	MW	PL	JB	BC
110	100	001	1	0000	0	0	0	1	0	0

15 → 0 0 1 1 1 1

-15 → 1 1 0 0 0 1

Pregunta 2

```
0   LDI  0,7
1   ADI  0,0,6     R0 = 13
2   LD   1,0       A en R1
3   ADI  0,0,3     R0 = 16
4   LD   2,0       N en R2
5   INC  0,0       R0 = 17
6   LD   3,0       B en R3
7   LDI  4,7
8   ADI  4,4,2     9 guardado en R4 para JMP
9   DEC  2,2       decrementa N
10  SUB  1,1,3     resta
11  BRZ  2,2       pregunta si se hicieron los N restas
12  JMP  4         salto a línea 9
```

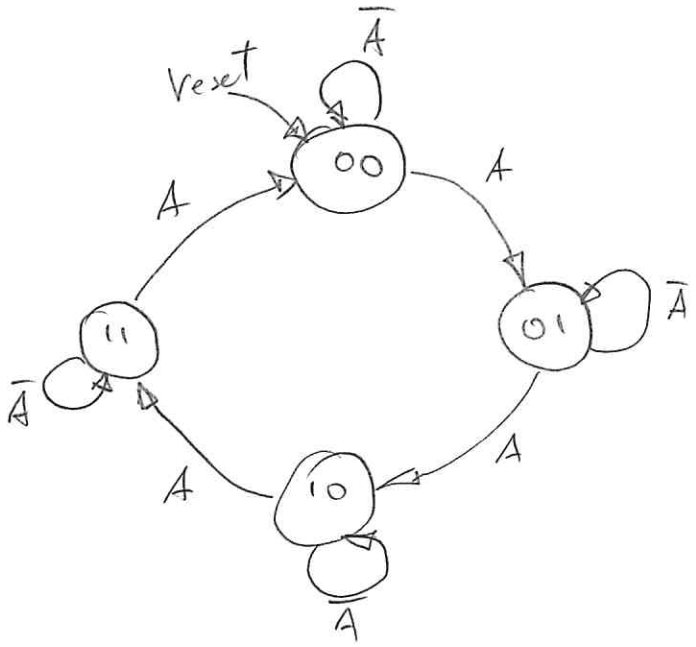
Pregunta 3

Máquina 1 (selector de modos)

Entradas : pulsador A

Estados : modos

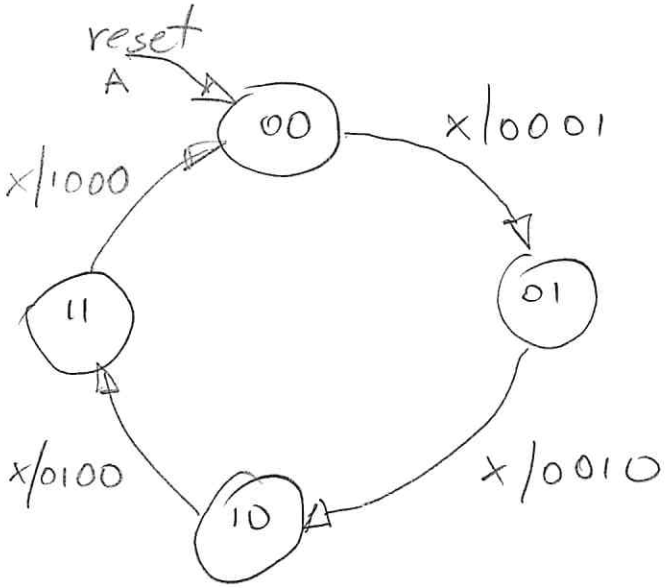
Salidas : estados (P_1 P_0)



Máquinas 2 (controlador de luces)

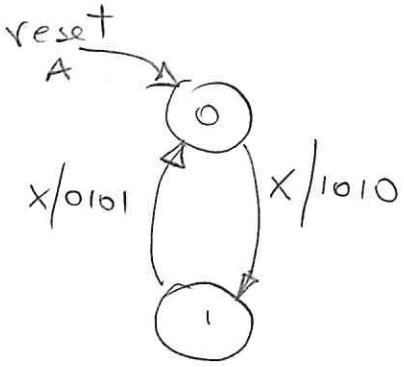
Controlador luces modo 01

Entradas: pulsador A
Salidas: luces l^1_{1-4}



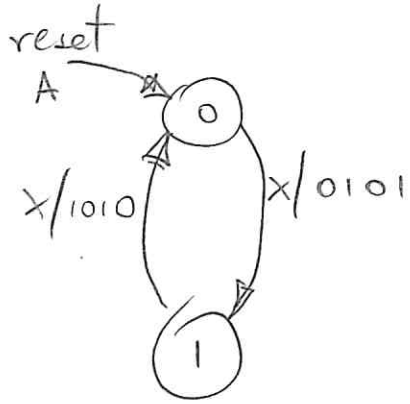
Controlador luces modo 10

Entradas: pulsador A
Salidas: luces l^2_{1-4}



Controlador luces modo 11

Entradas: pulsador A
Salidas: luces l^3_{1-4}



Máquina 1

AQ_1Q_0	Q_1^{t+1}	Q_0^{t+1}
000	0	0
001	0	1
010	1	0
011	1	1
100	0	1
101	1	0
110	1	1
111	0	0

A \ Q_1Q_0	00	01	11	10
0	0	0	1	1
1	0	1	0	1

$$Q_1^{t+1} = \bar{A}Q_1 + Q_1\bar{Q_0} + A\bar{Q_1}Q_0 = P_1$$

A \ Q_1Q_0	00	01	11	10
0	0	1	1	0
1	1	0	0	1

$$Q_0^{t+1} = \bar{A}Q_0 + A\bar{Q_0} = P_0$$

Máquina 2

Contador modo 01

Q_1Q_0	Q_1Q_0	l_4^1	l_3^1	l_2^1	l_1^1
00	01	0	0	0	1
01	10	0	0	1	0
10	11	0	1	0	0
11	00	1	0	0	0

Q_0 \ Q_1	0	1
0	0	1
1	1	0

$$Q_1^{t+1} = Q_0 \oplus Q_1$$

Q_0 \ Q_1	0	1
0	1	0
1	1	0

$$Q_0^{t+1} = \bar{Q_0}$$

$$l_1^1 = \bar{Q_1}\bar{Q_0} \qquad l_2^1 = \bar{Q_1}Q_0 \qquad l_3^1 = Q_1\bar{Q_0}$$

$$l_4^1 = Q_1Q_0$$

Contador modo 10

Q_0	Q_0^{t+1}	l_4^2	l_3^2	l_2^2	l_1^2
0	1	1	0	1	0
1	0	0	1	0	1

$$Q_0^{t+1} = \bar{Q_0}$$

$$l_4^2 = l_2^2 = Q_0$$

$$l_3^2 = l_1^2 = \bar{Q_0}$$

Controlador modo 11

Q_0	Q_0^{t+1}	l_4^3	l_3^3	l_2^3	l_1^3
0	1	0	1	0	1
1	0	1	0	1	0

$$\boxed{Q_0^{t+1} = Q_0}$$

$$\boxed{\begin{aligned} l_4^3 &= l_2^3 = \overline{Q_0} \\ l_3^3 &= l_1^3 = Q_0 \end{aligned}}$$

Luces

$$L_N = l_1^1 \overline{P_1} P_0 + l_1^2 P_1 \overline{P_0} + l_1^3 P_1 P_0$$

$$L_{N+1} = l_2^1 \overline{P_1} P_0 + l_2^2 P_1 \overline{P_0} + l_2^3 P_1 P_0$$

$$L_{N+2} = l_3^1 \overline{P_1} P_0 + l_3^2 P_1 \overline{P_0} + l_3^3 P_1 P_0$$

$$L_{N+3} = l_4^1 \overline{P_1} P_0 + l_4^2 P_1 \overline{P_0} + l_4^3 P_1 P_0$$

Pregunta 4

Es idéntica a la pregunta 3 pero hay que cambiar flip flops D por JK

J	K	Q^{t+1}
0	0	Q^t
0	1	0
1	0	1
1	1	$\overline{Q^t}$

Máquina 1

A	Q_1	Q_0	Q_1	Q_0	J_1	K_1	J_0	K_0
0	0	0	0	0	0	x	0	x
0	0	1	0	1	0	x	x	0
0	1	0	1	0	x	0	0	x
0	1	1	1	1	x	0	x	0
1	0	0	0	1	0	x	1	x
1	0	1	1	0	1	x	x	1
1	1	0	1	1	x	0	1	x
1	1	1	0	0	x	1	x	1

A \ Q_1Q_0	00	01	11	10
0	0	0	x	x
1	0	1	x	x

$J_1 = A\,Q_0$

A \ Q_1Q_0	00	01	11	10
0	x	x	0	0
1	x	x	1	0

$K_1 = A\,Q_0$

A \ Q_1Q_0	00	01	11	10
0	0	x	x	0
1	1	x	x	1

$J_0 = A$

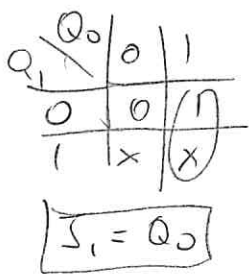
A \ Q_1Q_0	00	01	11	10
0	x	0	0	x
1	x	1	1	x

$K_0 = A$

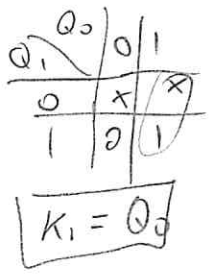
Máquina 2

Controlador modo 01

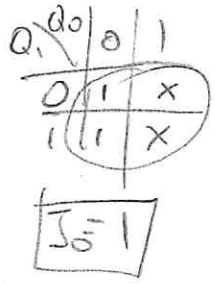
$Q_1 Q_0$	$Q_1^{t+1} Q_0^{t+1}$	J_1	K_1	J_0	K_0
0 0	0 1	0	x	1	x
0 1	1 0	1	x	x	1
1 0	1 1	x	0	1	x
1 1	0 0	x	1	x	1



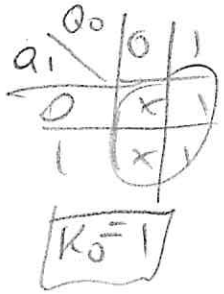
$J_1 = Q_0$



$K_1 = Q_0$



$J_0 = 1$



$K_0 = 1$

Controlador modo 10 y 11

Q_0	Q_0^{t+1}	J_0	K_0
0	1	1	x
1	0	x	1

$J_0 = K_0 = 1$