# Pregunta 1

## Caja 1 sumador

(dos cajas idénticas, una para cada jugador)

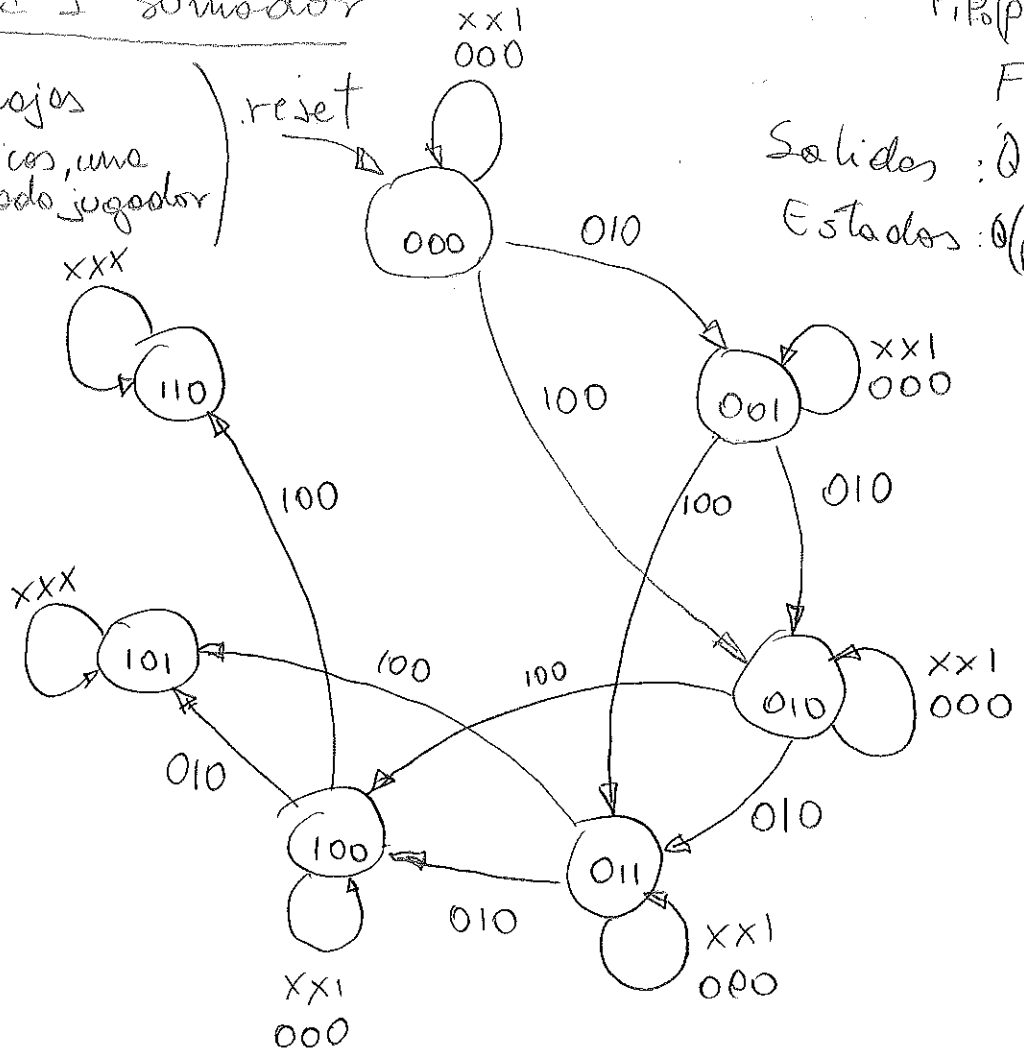
Entradas: P. P. F

P. P. (puntaje ordenado)

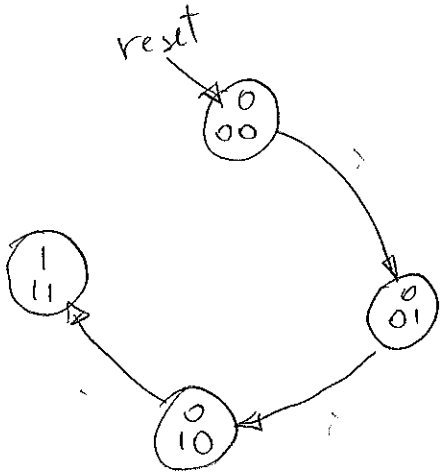
F (fin del juego)

Salidas: Ø (los estados)

Estados: Ø (puntaje acumulado)




## Caja 2 contador de lanzamientos

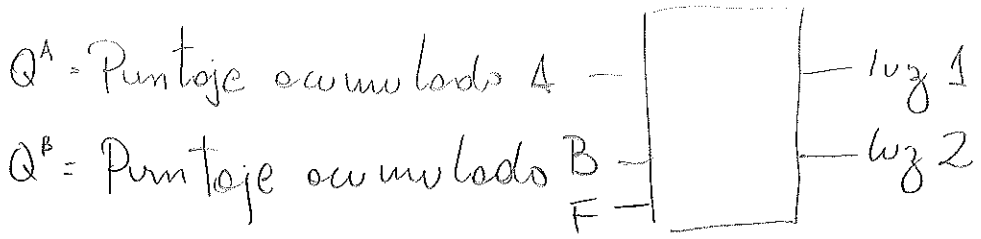



Entradas: no hay

Salidas F

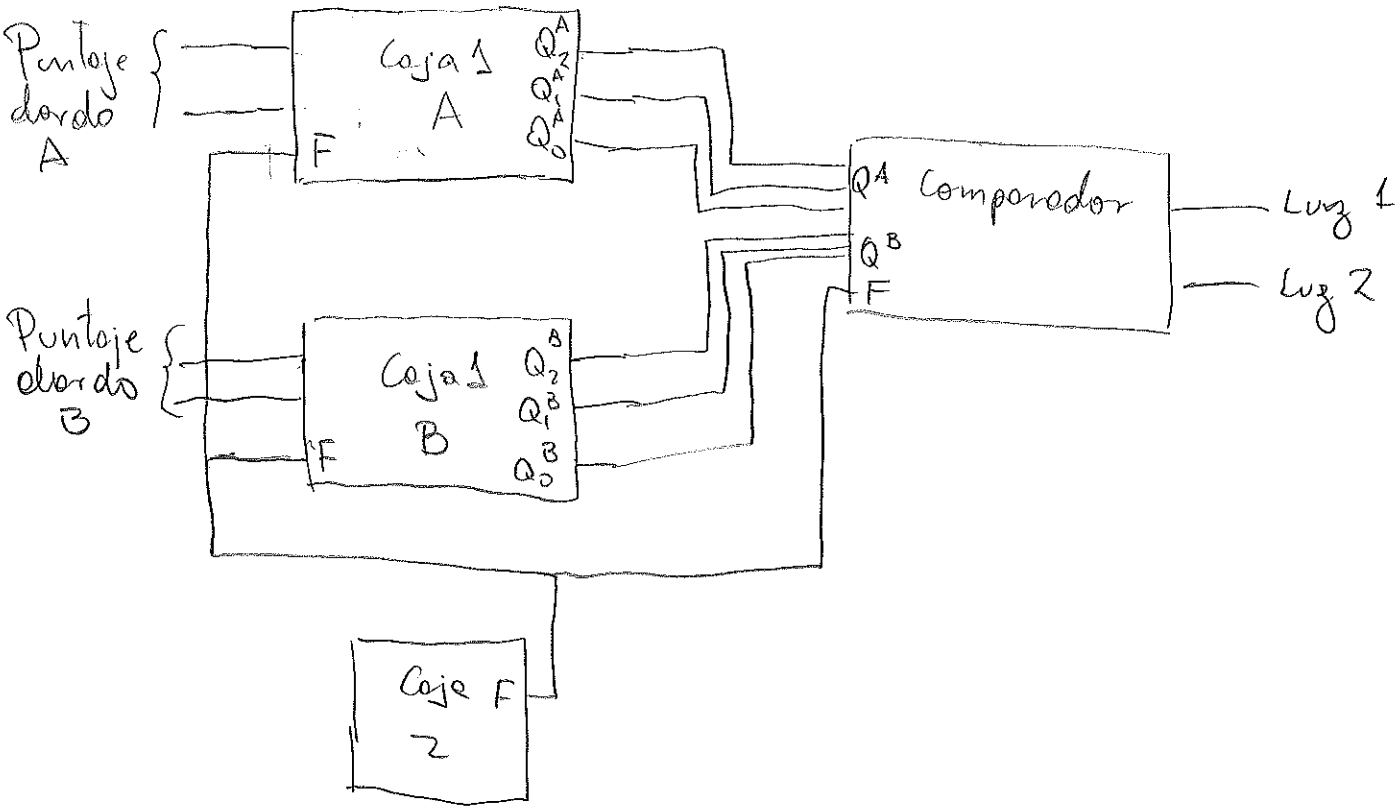
Estados: número de lanzamientos

# Caja 3 comparador y luces (caja combinacional)




—— o ——

$Q_2 Q_1 Q_0$: puntaje acumulado



Cojo 1

| F | $P_1$ | $P_0$ | $Q_2^t$ | $Q_1^t$ | $Q_0^t$ | $Q_2^{t+1}$ | $Q_1^{t+1}$ | $Q_0^{t+1}$ |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | x | x | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | x | x | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | x | x | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | x | x | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | x | x | 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | x | x | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | x | x | 1 | 1 | 0 | 1 | 1 | 0 |

$Q_2^{t+1} = Q_2^t$

$FP_1 = 00$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 0 | 0 |
| 01 | 1 | 1 | X | 1 |
| 11 | 1 | 1 | X | 1 |
| 10 | 0 | 0 | 0 | 0 |

$FP_1 = 01$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 0 | 0 |
| 01 | 1 | 1 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$FP_1 = 10$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 0 | 0 |
| 01 | 1 | 1 | X | 1 |
| 11 | 1 | 1 | X | 1 |
| 10 | 0 | 0 | 0 | 0 |

$FP_1 = 11$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 0 | 0 |
| 01 | 1 | 1 | X | 1 |
| 11 | 1 | 1 | X | 1 |
| 10 | 0 | 0 | 0 | 0 |

$$Q_1^{t+1} = \bar{F}Q_1 + \bar{P}_1 Q_1 \bar{Q}_0 + P_1 \bar{P}_0 Q_1 + \bar{F}P_0 \bar{Q}_2 \bar{Q}_1 Q_0 + \bar{F}P_1 \bar{Q}_2 \bar{Q}_1 + \bar{F}P_1 \bar{Q}_1 \bar{Q}_0 + Q_2 Q_1$$

$FP_1 = 00$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 1 | 1 |
| 01 | 0 | 0 | X | 1 |
| 11 | 0 | 0 | X | 1 |
| 10 | 0 | 1 | 0 | 1 |

$FP_1 = 01$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 1 | 0 | 0 |
| 01 | 1 | 0 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$FP_1 = 10$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 1 | 1 |
| 01 | 0 | 0 | X | 1 |
| 11 | 0 | 0 | X | 1 |
| 10 | 0 | 0 | 1 | 1 |

$FP_1 = 11$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 1 | 1 |
| 01 | 0 | 0 | X | 1 |
| 11 | 0 | 0 | X | 1 |
| 10 | 0 | 0 | 1 | 1 |

$$Q_0^{t+1} = F\bar{Q}_0 + \bar{F}P_0Q_0 + \bar{F}P_0Q_2\bar{Q}_1 + \bar{F}P_0\bar{Q}_2\bar{Q}_0$$

$FP_1 = 00$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 1 | 0 |
| 01 | 0 | 1 | X | 0 |
| 11 | 1 | 1 | X | 0 |
| 10 | 1 | 0 | 0 | 1 |

$FP_1 = 01$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 1 | 0 |
| 01 | 0 | 1 | X | 0 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$FP_1 = 10$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 1 | 0 |
| 01 | 0 | 1 | X | 0 |
| 11 | 0 | 1 | X | 0 |
| 10 | 0 | 1 | 1 | 0 |

$FP_1 = 11$

| $P_0Q_2$ \ $Q_1Q_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 1 | 0 |
| 01 | 0 | 1 | X | 0 |
| 11 | 0 | 1 | X | 0 |
| 10 | 0 | 1 | 1 | 0 |

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Cajo 2

| $Q_1$ $Q_0$ | $Q_1^{t+1}$ | $Q_0^{t+1}$ | F |
|---|---|---|---|
| 0 0 | 0 | 1 | 0 |
| 0 1 | 1 | 0 | 0 |
| 1 0 | 1 | 1 | 0 |
| 1 1 | 1 | 1 | 1 |

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

| $Q_1$ \ $Q_0$ | 0 | 1 |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 1 | 1 |

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

| $Q_1$ \ $Q_0$ | 0 | 1 |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |

$$F = Q_1Q_0$$

| $Q_1$ \ $Q_0$ | 0 | 1 |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 1 |

Caso 3

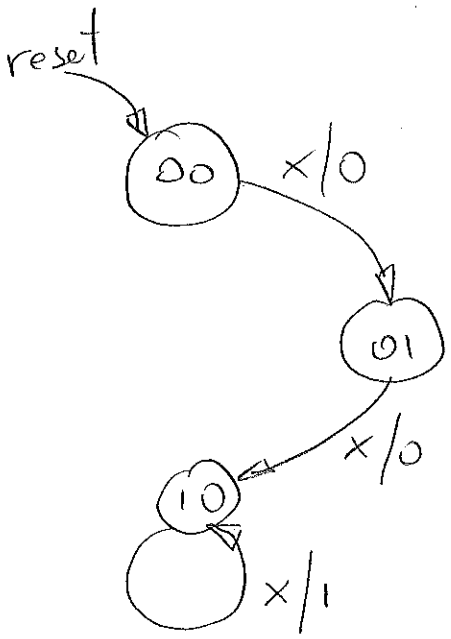
| F | $Q_2^A$ | $Q_1^A$ | $Q_0^A$ | $Q_2^B$ | $Q_1^B$ | $Q_0^B$ | $L_1$ | $L_2$ |
|---|---|---|---|---|---|---|---|---|
| 0 | x | x | x | x | x | x | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| ⋮ | | | | | | | ⋮ | |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| ⋮ | | | | | | | ⋮ | |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| ⋮ | | | | | | | ⋮ | |
| 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| ⋮ | | | | | | | ⋮ | |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| ⋮ | | | | | | | ⋮ | |
| 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| ⋮ | | | | | | | ⋮ | |
| 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |

| | | | |
|---|---|---|---|
| 1 | 0 0 0 | 1 1 0 | 0 1 |
| | ⋮ | ⋮ | ⋮ |
| 1 | 1 0 1 | 1 1 0 | 0 1 |
| 1 | 1 1 0 | 1 1 0 | 1 1 |

# Pregunta 2

La solución es idéntica a la de la pregunta 1 salvo que hay que cambiar la caja 2

## Caja 2




| $Q_1$ $Q_0$ | $Q_1^{t+1}$ | $Q_0^{t+1}$ | F |
|---|---|---|---|
| 0 0 | 0 | 1 | 0 |
| 0 1 | 1 | 0 | 0 |
| 1 0 | 1 | 0 | 1 |

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

| $Q_1$ \ $Q_0$ | 0 | 1 |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 1 | X |

$$Q_1^{t+1} = \overline{Q_1}\,\overline{Q_0}$$

| $Q_1$ \ $Q_0$ | 0 | 1 |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 0 | X |

$$F = Q_1$$

| $Q_1$ \ $Q_0$ | 0 | 1 |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 1 | X |

Pregunta 2

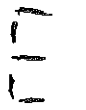
| ASCII $S_6 S_5 S_4 S_3 S_2 S_1 S_0$ | 7 segmentos a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|
| 1 0 0 0 0 0 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 0 0 0 0 1 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 0 0 0 0 1 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 0 0 0 1 0 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| 1 0 0 0 1 0 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 0 0 0 1 1 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| todo el resto | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

A → 

B → 

C → 

D → 

E → 

F → 

Para apagar todos los segmentos podemos establecer reglas simples

① Cuando $S_6 S_5 S_4 S_3 \neq 1000$

② Cuando $S_6 S_5 S_4 S_3 = 1000$ y $\begin{cases} S_2 S_1 S_0 = 000 \\ \text{o} \\ S_2 S_1 S_1 = 111 \end{cases}$

Con el procedimiento anterior entradas trabajar con una tabla de verdad gigante. Asumimos $S_6 S_5 S_4 S_3 = 1000$ y luego trabajamos solo con $S_2 S_1 S_0$

a

| $S_2$ \ $S_1S_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |

b

| $S_2$ \ $S_1S_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |

c

| $S_2$ \ $S_1S_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 |

d

| $S_2$ \ $S_1S_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 |

e

| $S_2$ \ $S_1S_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 |

f

| $S_2$ \ $S_1S_0$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 | 1 |

$$a = S_6 \bar{S}_5 \bar{S}_4 \bar{S}_3 (\bar{S}_1 S_0 + \bar{S}_2 S_0 + S_2 S_1 \bar{S}_0)$$

$$b = S_6 \bar{S}_5 \bar{S}_4 \bar{S}_3 (S_2 \bar{S}_1 \bar{S}_0 + \bar{S}_2 \bar{S}_1 S_0)$$

$$c = S_6 \bar{S}_5 \bar{S}_4 \bar{S}_3 (S_2 \bar{S}_1 \bar{S}_0 + \bar{S}_2 \bar{S}_1 S_0 + \bar{S}_2 S_1 \bar{S}_0)$$

$$d = S_6 \bar{S}_5 \bar{S}_4 \bar{S}_3 (\bar{S}_2 S_1 + S_2 \bar{S}_1)$$

$$e = S_6 \bar{S}_5 \bar{S}_4 \bar{S}_3 (S_2 \bar{S}_1 + \bar{S}_2 S_0 + S_1 \bar{S}_0)$$

$$f = S_6 \bar{S}_5 \bar{S}_4 \bar{S}_3 (S_2 \bar{S}_1 + \bar{S}_1 S_0 + S_1 \bar{S}_0)$$

Código Verilog

```
module ASCII_to_7seg (input [6:0] S,
                      output a, b, c, d, e, f);

assign a = S[6] & ~S[5] & ~S[4] & ~S[3] & (~S[1] & S[0] |
           ~S[2] & S[0] | S[2] & S[1] & ~S[0]);

assign b = S[6] & ~S[5] & ~S[4] & ~S[3] & (S[2] & ~S[1] & ~S[0] |
           ~S[2] & ~S[1] & S[0]);

assign c = S[6] & ~S[5] & ~S[4] & ~S[3] & (S[2] & ~S[1] & ~S[0] |
           ~S[2] & ~S[1] & S[0] | ~S[2] & S[1] & ~S[0]);

assign d = S[6] & ~S[5] & ~S[4] & ~S[3] & (~S[2] & S[1] |
           S[2] & ~S[1]);

assign e = S[6] & ~S[5] & ~S[4] & ~S[3] & ( S[2] & ~S[1] |
           ~S[2] & S[0] | S[1] & ~S[0]);

assign f = S[6] & ~S[5] & ~S[4] & ~S[3] & ( S[2] & ~S[1] |
           ~S[1] & S[0] | S[1] & ~S[0]);

endmodule
```