Midterm 2

ECE 275

Nov 12th, 2021

(1) Your name: Student ID:

About the exam

1. There are total 4 problems.
2. Problem 1 and Problem 2 are mandatory. You have the option of doing any one of Problem 3 and Problem 4. If you do both, you will receive the best of the two.

Problem description

Design a Mealy sequential circuit which investigates an input sequence X and which will produce an output of Z = 1 for any input sequence ending in 0101 provided that the sequence 110 has never occurred.

Example:

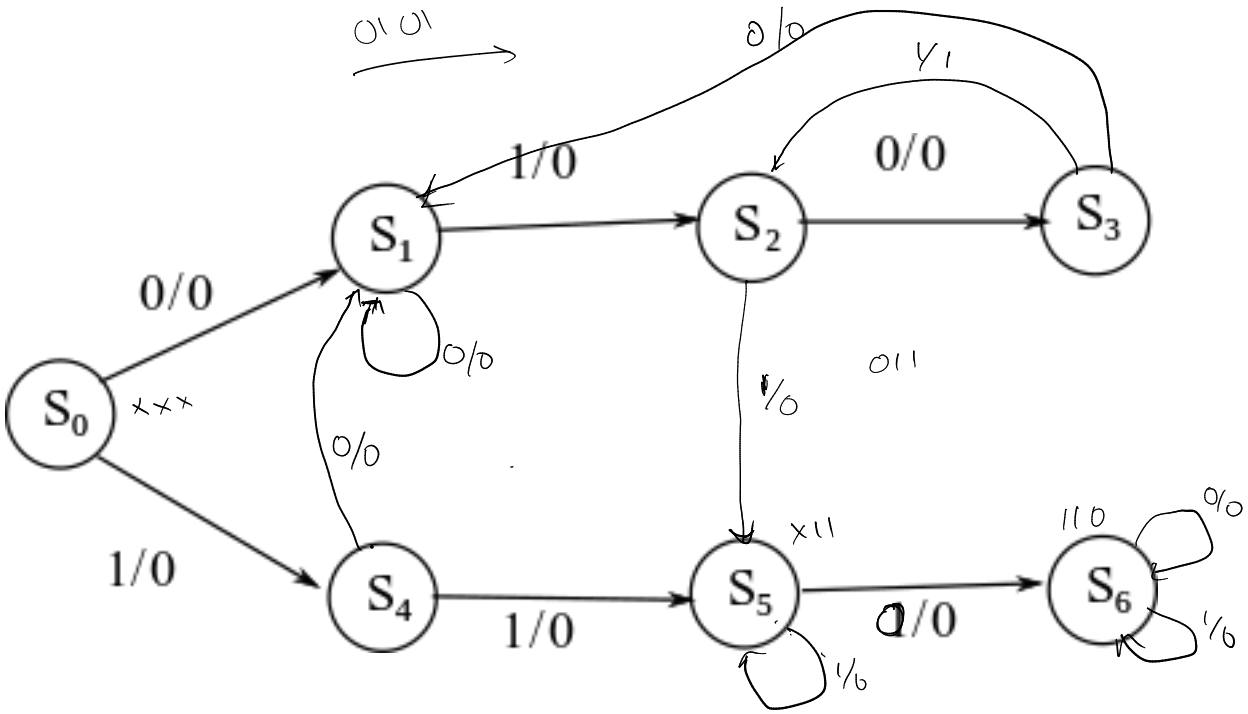
$$X = 0\,1\,0\,1\,0\,1\,1\,0\,1\,0\,1$$
$$Z = 0\,0\,0\,1\,0\,1\,0\,0\,0\,0\,0$$

Notice that the circuit does not reset to the start state when an output of Z = 1 occurs.

Problem 1. Complete the following state diagram. You can also choose to draw state diagram from scratch. Also fill the state transition table. (20 marks)

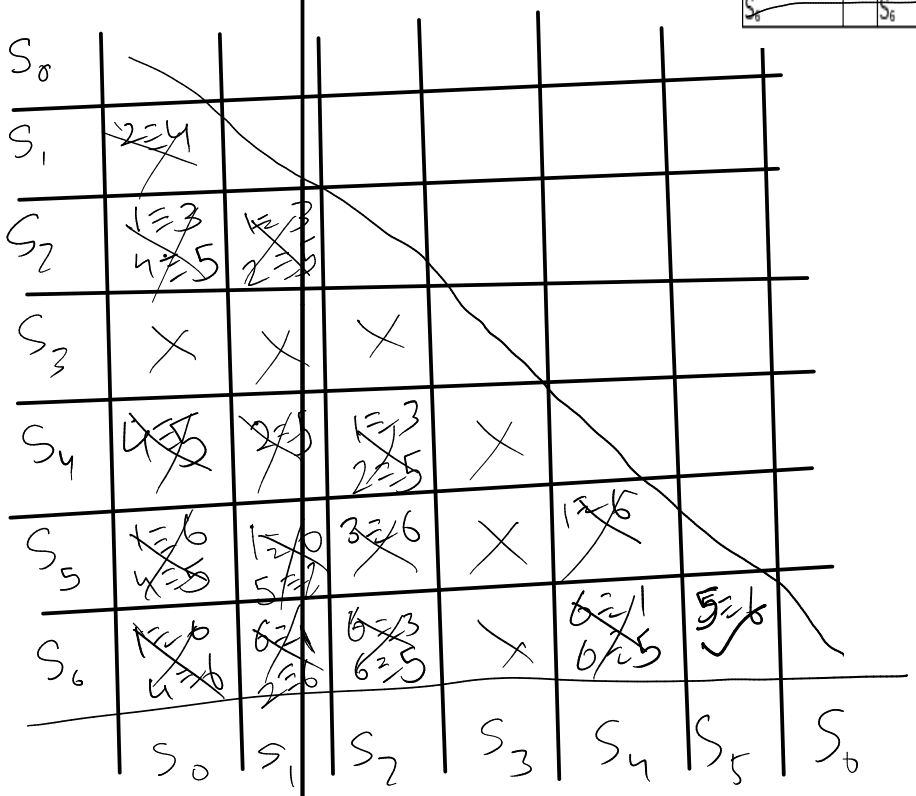
State	Meaning
S_0	xxx
S_1	xx0
S_2	x01
S_3	"010"
S_4	xx1
S_5	x11
S_6	"110"

Present State		Next State			Output	
		X=0	X=1		X=0	X=1
S_0		S_1	S_4		0	0
S_1		S_1	S_2		0	0
S_2		S_3	S_5		0	0
S_3		S_1	S_2		0	1
S_4		S_1	S_5		0	0
S_5		S_6	S_5		0	0
S_6		S_6	S_6		0	0



Problem 2. Can the above state table be reduced? Find
Only specify which states are equivalent to each other
the state table again. (10 marks)

Present State	Next State		Output	
	X=0	X=1	X=0	X=1
S_0	S_1	S_4	0	0
S_1	S_1	S_2	0	0
S_2	S_3	S_5	0	0
S_3	S_1	S_2	0	1
S_4	S_1	S_5	0	0
S_5	S_5	S_5	0	0
S_6	S_6	S_6	0	0



$S_5 \equiv S_6$

Problem 3. (State assignment).
Using the guideline method find the groups of states that should be grouped together. Draw the state assignment map. Assign a 3-bit state encoding to the states in the reduced state table derived in Problem 2. (20 marks).

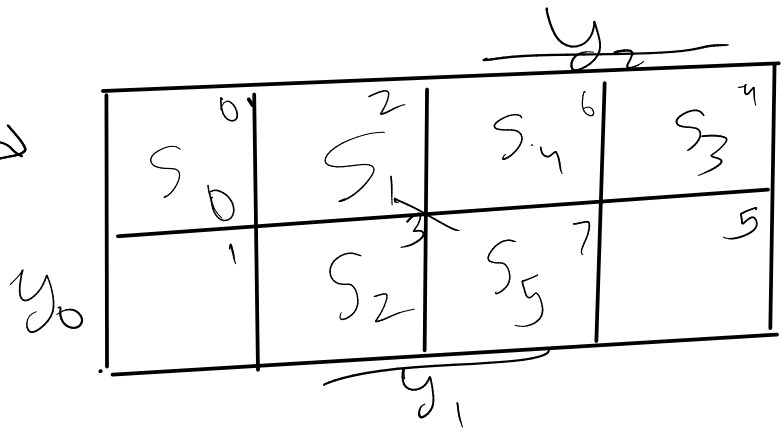
Present State		Next State			Output	
		X=0	X=1		X=0	X=1
S_0		S_1	S_4		0	0
S_1		S_1	S_2		0	0
S_2		S_3	S_5		0	0
S_3		S_1	S_2		0	1
S_4		S_1	S_5		0	0
S_5		$S_6 \rightarrow S_5$	S_5		0	0
S_6		S_6	S_6		0	0

S_1 (4) ✓ S_2 S_5

G1: $(S_0, S_1, S_3, S_4), (S_1, S_3), (S_2, S_4, S_5)$

G2: $(S_1, S_4), (S_1, S_2)^{\times 2}, (S_3, S_5),$

(S_1, S_5)



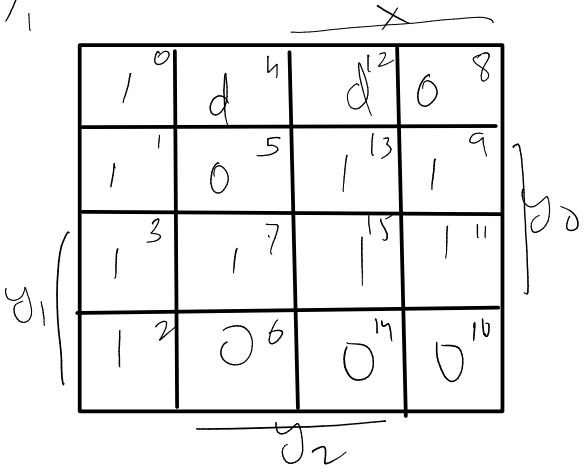
3-ff

	y_2	y_1	y_0
S_0	0	0	0
S_1	0	1	0
S_2	0	1	1
S_3	1	0	0
S_4	1	1	0
S_5	1	1	1

Problem 4. The following state-assigned table is given. Find the boolean expressions for inputs J_1 and K_1 to a J-K flip flop that implments the transition from Present state y_1 to Next state Y_1. Express the inputs J_1 and K_1 in terms of input X and present state y_2, y_1 and y_0 (20 marks).

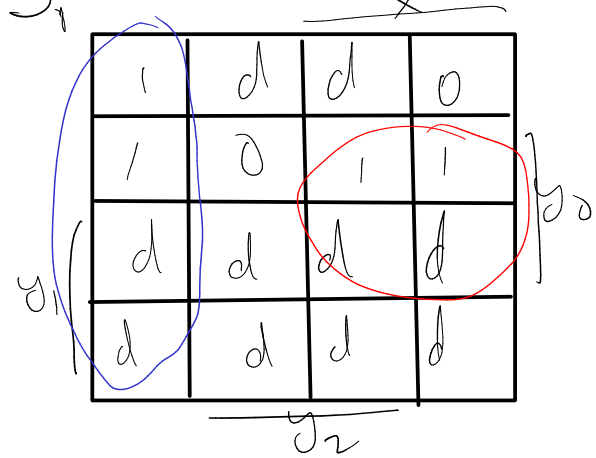
Present state			Next State						Output	
			X=0			X=1			X=0	X=1
y_2	y_1	y_0	Y_2	Y_1	Y_0	Y_2	Y_1	Y_0		
0	0	0	0	1	0	0	0	0	0	0
0	0	1	1	1	0	1	1	1	1	0
0	1	0	0	1	1	0	0	0	0	0
0	1	1	0	1	1	1	1	1	0	0
1	0	0	d	d	d	d	d	d	d	d
1	0	1	1	0	1	1	1	1	0	0
1	1	0	1	0	1	0	0	1	0	0
1	1	1	1	1	0	1	1	1	0	0

Y_1

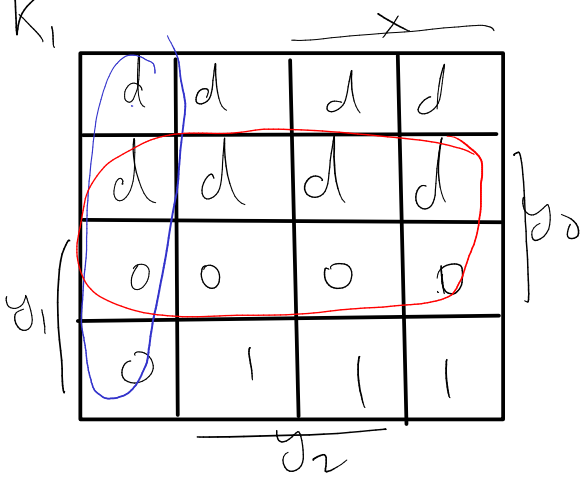


y_1	Y_1	J_1	K_1
0	0	0	d
0	1	1	d
1	0	d	1
1	1	d	0

$J_1 = x y_0 + \bar{x} \bar{y}_2$



K_1



$\bar{K}_1 = y_0 + \bar{x} \bar{y}_2$

$\Rightarrow K_1 = \bar{y}_0 (x + y_2)$