

# Homework #6

Digital System Design 2022 Spring

DUE : 2022-05-25

**i** total 104 pts = maximum 100 pts + 4 bonus pts

**✎** Extension limit = { png , jpg , heic , zip , pdf }

**⚠** You must hand your answer in at the board before due time (2022-05-25 11:00 AM KST).

The problems start from the next page.

Name

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In Korean

Student ID

2021 0774

8 digits

1. The memory units that follow are specified by the number of words times the number of bits per word. How many address lines and input-output data lines are needed in each case? (16pts = 4pts each)

(a)  $32\text{ K} \times 64$

(b)  $8\text{M} \times 32$

$$(a) \quad k = 2^{10}, \quad 32k = 2^5 \cdot 2^{10} = 2^{15}$$

$\Rightarrow$  address line : 15H,

64 bit .. 0123 input output data line : 64H

$\therefore 15, 64$
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$$(b) \quad M = 2^{20}, \quad 8M = 2^3 \cdot 2^{20} = 2^{23}$$

$\Rightarrow$  address line : 23H,

32 bit .. 0123 input output data line : 32H

$\therefore 23, 32$
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2. A finite state machine has one input and one output. The output becomes 1 and remains 1 thereafter when at least two 0's and at least two 1's have occurred as inputs, regardless of the order of occurrence. Assuming this is to be implemented as a Moore machine, draw a state diagram for the machine. (Hint: you can do this in nine states.) (16pts)

$\langle \text{state} \rangle \rightarrow 0x7H, 1y7H \quad (x, y)$

$S_0: (0, 0)$

$S_1: (1, 0)$

$S_2: (x \geq 2, 0)$

$S_3: (0, 1)$

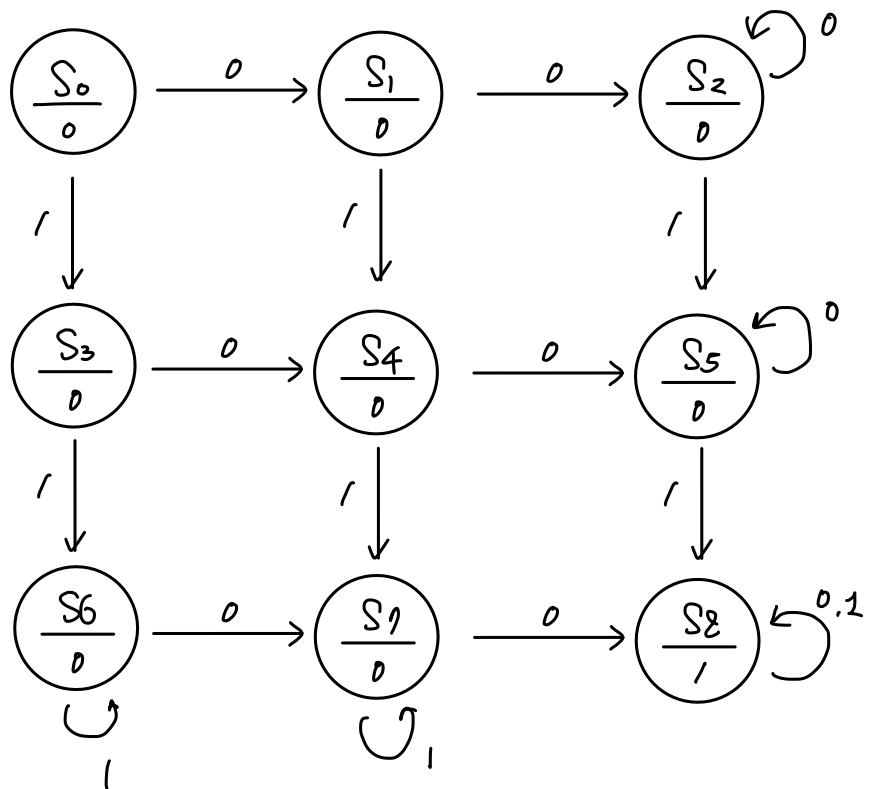
$S_4: (1, 1)$

$S_5: (x \geq 2, 1)$

$S_6: (0, 2)$

$S_7: (1, 2)$

$S_8: (x \geq 2, y \geq 2)$

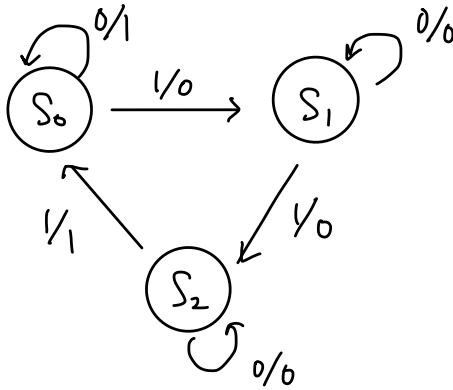


3. A sequential circuit has one input (X) and one output (Z). Draw a Mealy state diagram for each of the following cases:

(a) The output is  $Z = 1$  iff the total number of 1's received is divisible by 3 or is zero (12pts)

(b) The output is  $Z = 1$  iff the total number of 1's received is divisible by 3 (including 0) and the total number of 0's received is an even number greater than zero. Nine states are sufficient. (20pts)

(a)



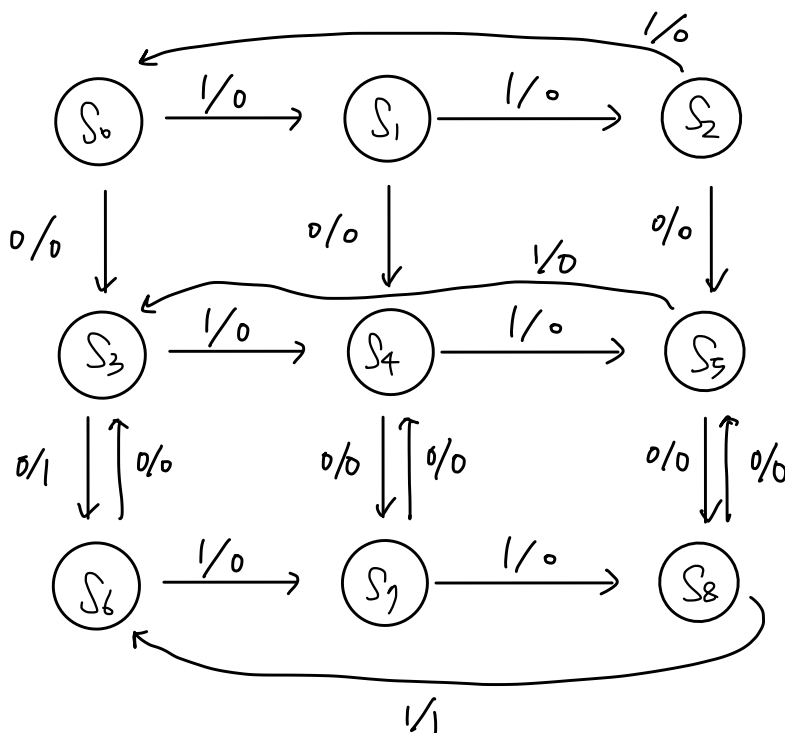
<state> - 0개수와 독립적.

$S_0$ : 1의 개수가  $3n$  ( $n=0,1,2,\dots$ )

$S_1$ : 1의 개수:  $3n+1$  ( $n=0,1,2,\dots$ )

$S_2$ : 1의 개수:  $3n+2$  ( $n=0,1,2,\dots$ )

(b)



<state> - ((0의 개수), (1의 개수))

$S_0$ : (0,  $3n$ )

$S_1$ : (0,  $3n+1$ )

$S_2$ : (0,  $3n+2$ )

$S_3$ : (odd,  $3n$ )

$S_4$ : (odd,  $3n+1$ )

$S_5$ : (odd,  $3n+2$ )

$S_6$ : (even,  $3n$ )

$S_7$ : (even,  $3n+1$ )

$S_8$ : (even,  $3n+2$ )

(even=12, 170)

4. Starting with the state diagram of figure below, use the implication chart method to find the minimum state diagram. Which of the original states are combined? (40pts)

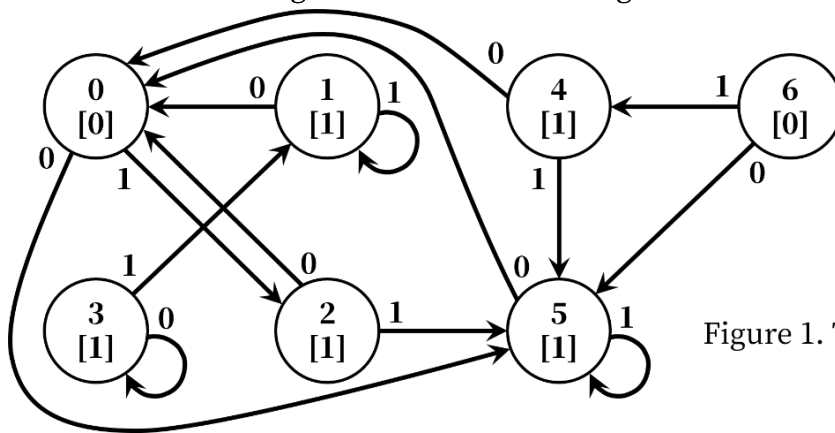


Figure 1. The original state diagram

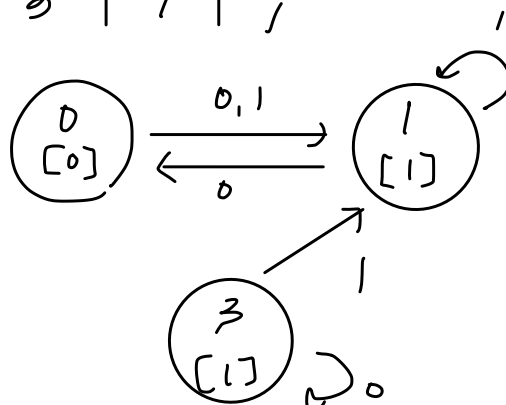
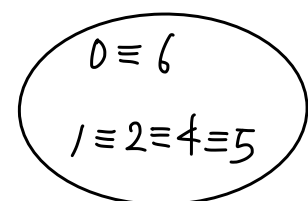
PS	NS		Z
	x=0	x=1	
0	5	2	0
1	0	1	1
2	0	5	1
3	3	1	1
4	0	5	1
5	0	5	1
6	5	4	0

1	X					
2	X	$\begin{smallmatrix} 0-0 \\ 1-5 \end{smallmatrix}$				
3	X	$\begin{smallmatrix} 0-3 \\ 1-4 \end{smallmatrix}$	$\begin{smallmatrix} 0-5 \\ 1-2 \end{smallmatrix}$			
4	X	$\begin{smallmatrix} 0-0 \\ 1-5 \end{smallmatrix}$	$\begin{smallmatrix} 0-0 \\ 5-5 \end{smallmatrix}$	$\begin{smallmatrix} 3-0 \\ 1-5 \end{smallmatrix}$		
5	X	$\begin{smallmatrix} 0-0 \\ 1-5 \end{smallmatrix}$	$\begin{smallmatrix} 0-0 \\ 5-5 \end{smallmatrix}$	$\begin{smallmatrix} 3-0 \\ 1-5 \end{smallmatrix}$	$\begin{smallmatrix} 0-0 \\ 5-5 \end{smallmatrix}$	
6	$\begin{smallmatrix} 5-5 \\ 2-4 \end{smallmatrix}$	X	X	X	X	X
	0	1	2	3	4	5

$0=6$   $1=5$   $2=4$   
 $1=4$   $2=5$   $4=5$   
 $1=2$

PS	x=0	x=1	Z
0	1	1	0
1	0	1	1
3	3	1	1

$0=6$   
 $1=2$   
 $1=4$   
 $1=5$   
 $2=4$   
 $2=5$   
 $4=5$



End of the Homework #6