Name: SOLUTIONS

Read each question carefully before answering. Answer all parts. Show all work, calculations, and/or reasoning, otherwise no points will be awarded. Properly labeled loops must be shown on K-maps. Point values are as indicated.

1. Your buddy (who may or may not be any good at digital systems) gives you the following state table...

Current State	Next State $X=0$	Next State $X=1$	Output $X=0$	Output $X=1$
A	F	B	0	0
B	E	A	0	1
C	H	G	0	1
D	H	D	1	0
E	B	F	1	1
F	G	B	0	0
G	A	C	0	0
H	C	A	1	1

(a) (5 points) Is this a Mealy machine or a Moore machine? Explain how you know.

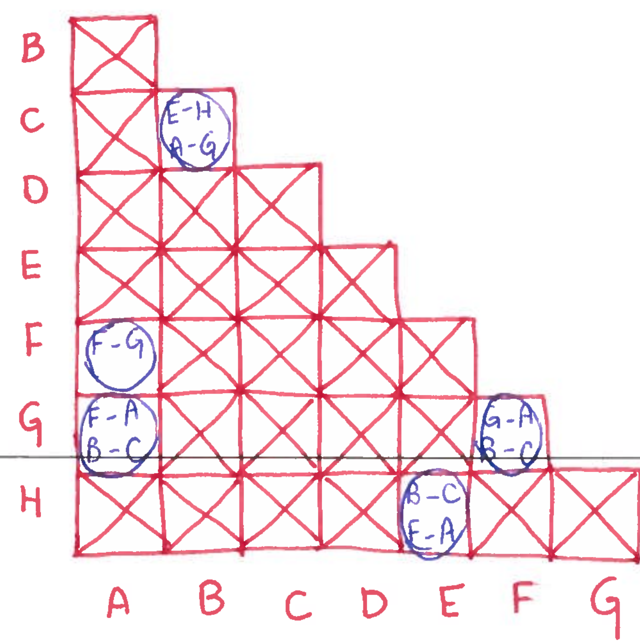
MEALY - The output depends on the input value!

(b) (10 points) Use an implication table to reduce the number of states. Indicate which (if any) states are equivalent.

A ≡ F ≡ G

B ≡ C

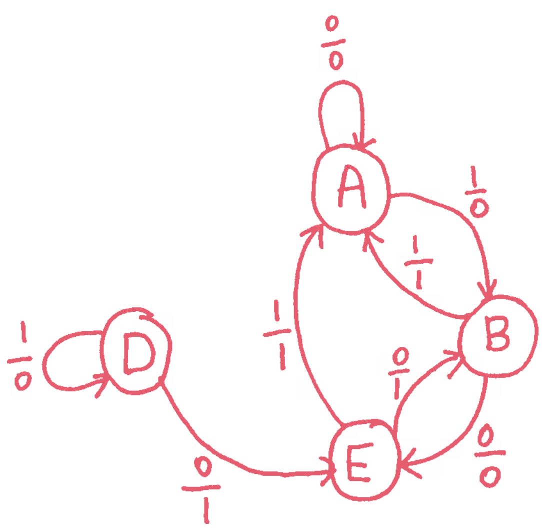
E ≡ H



(c) (10 points) Fill out a new (reduced) state table.

Current State	Next State		Output	
	$X=0$	$X=1$	$X=0$	$X=1$
A	A	B	0	0
B	E	A	0	1
D	E	D	1	0
E	B	A	1	1

(d) (10 points) Draw a reduced state diagram.



2. You wish to design a Moore machine non-overlapping sliding window detector that has an output $Z = 1$ when the input sequence contains **101101**.

   (a) (10 points) Clearly define all states that are required to implement this circuit.

   S_0: reset $Z = 0$

   S_1 = 1, 11, 111... $Z=0$

   S_2 = 10 $Z=0$

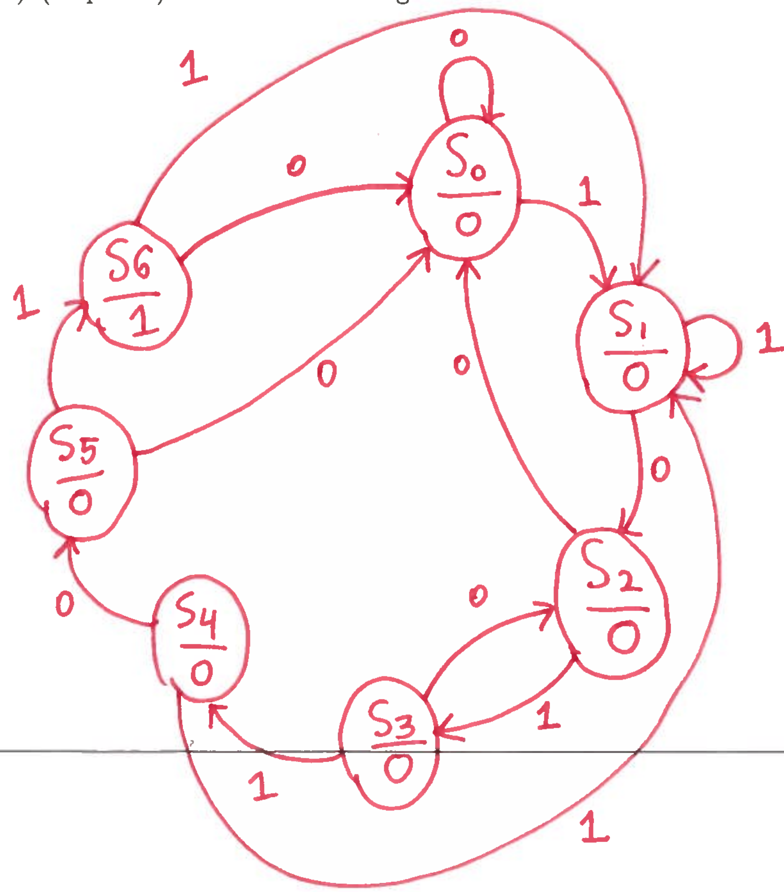
   S_3 = 101 $Z=0$

   S_4 = 1011 $Z=0$

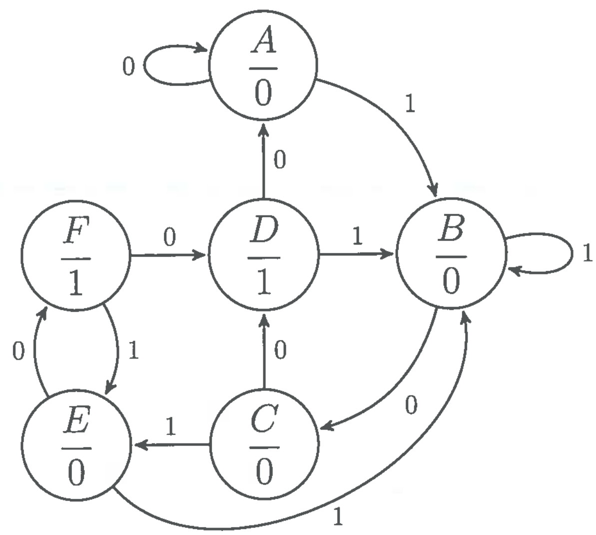
   S_5 = 10110 $Z=0$

   S_6 = 101101 $Z=1$

   (b) (10 points) Draw the state diagram for this circuit.



3. Given the following state diagram...



(a) (10 points) ...fill the corresponding state table.

Current State	Next State $X=0$	Next State $X=1$	Output
A	A	B	0
B	C	B	0
C	D	E	0
D	A	B	1
E	F	B	0
F	D	E	1

(b) (5 points) There are no redundant states! (Although, feel free to create an implication table and check if you don't believe me.) How many flip-flops will you need to implement this circuit?

3 flip-flops

(c) (10 points) Implement the guidelines for state assignment.

Guideline 1:

- A, D
- C, F x2
- A, B, D, E

Guideline 2:

- A, B x2
- F, B
- C, B
- D, E x2

Guideline 3:

- D, F
- A, B, C, E

(d) (5 points) Use a K-map to determine state assignments for each state. Indicate the binary values for each state.

BC \ A	0	1
00	B	E
01	A	D
11	C	F
10	X	X

A = 001
B = 000
C = 011
D = 101
E = 100
F = 111

(e) (10 points) Fill out the corresponding transition table.

	Current State	Next State						Output (Z)
		$X = 0$			$X = 1$			
B	000	0	1	1	0	0	0	0
A	001	0	0	1	0	0	0	0
C	011	1	0	1	1	0	0	0
	010	X	X	X	X	X	X	X
E	100	1	1	1	0	0	0	0
D	101	0	0	1	0	0	0	1
F	111	1	0	1	1	0	0	1
	110	X	X	X	X	X	X	X

(f) (5 points) Derive an equation for Z.

BC \ A	0	1
00	0	0
01	0	1
11	0	1
10	X	X

→ AC

Z = AC

(g) (10 points) Using D flip-flops, derive an equation for each flip-flop.

BC \ XA	00	01	11	10
00	0	1	0	0
01	0	0	0	0
11	1	1	1	1
10	X	X	X	X

→ B

→ X'AC'

$A^+ = B + X'AC'$

BC \ XA	00	01	11	10
00	1	1	0	0
01	0	0	0	0
11	0	0	0	0
10	X	X	X	X

→ X'C'

$B^+ = X'C'$

BC \ XA	00	01	11	10
00	1	1	0	0
01	1	1	0	0
11	1	1	0	0
10	X	X	X	X

→ X'

$C^+ = X'$