SCHOOL OF COMPUTING
Faculty of Engineering

SUBJECT:
DISCRETE STRUCTURE (SECI1013-03)

TOPIC :
ASSIGNMENT 5

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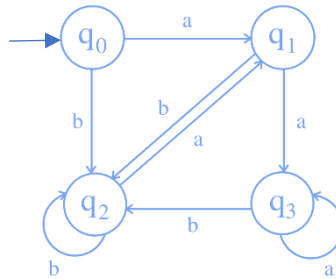**DATE OF SUBMISSION:**
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ASSIGNMENT 5

QUESTION 1

Let M = {S, I, q_0, f_s, F) be the DFA such that S={q_0, q_1, q_2, q_3}, I={a,b}, F={q_1}, q_0=initial state and f_s is given by:

$$f_s (q_0, a) = q_1, \qquad fs (q_0, b) = q_2$$
$$fs (q_1, a) = q_3, \qquad fs (q_1, b) = q_2$$
$$fs (q_2, a) = q_1, \qquad fs (q_2, b) = q_2$$
$$fs (q_3, a) = q_3, \qquad fs (q_3, b) = q_2$$

i. Construct a state transition diagram of the DFA given the state transition function, f_s.

f_s	a	b
q_0	q_1	q_2
q_1	q_3	q_2
q_2	q_1	q_2
q_3	q_3	q_2

ii. DFA can be applied for verification of email password. Justify why DFA is suitable for verification?

DFA is used for verification because it has the ability to determine whether a string of input is accepted or not. DFA only allows the person with the correct password sequence to enter his or her email.

QUESTION 2

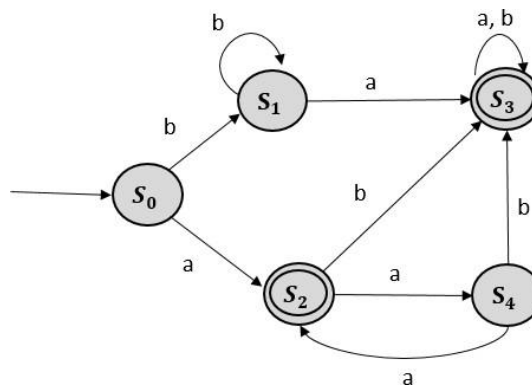Given a deterministic finite automaton (DFA) as in Figure 1.

Figure 1

i. Construct a state transition table for state transition diagram.

f_s	a	b
S_0	S_2	S_1
S_1	S_3	S_1
S_2	S_4	S_3
S_3	S_3	S_3
S_4	S_2	S_3

ii. Identify whether the following input can be accepted by the DFA.

a) w = **aaaaaa**

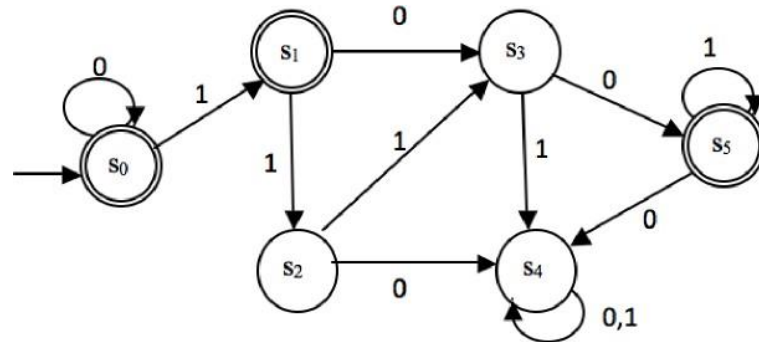b) w = **ababab**

$$S_0 \xrightarrow{a} S_2 \xrightarrow{a} S_4 \xrightarrow{a} S_2 \xrightarrow{a} S_4 \xrightarrow{a} S_2 \xrightarrow{a} S_4 \qquad \text{not accepted}$$

$$S_0 \xrightarrow{a} S_2 \xrightarrow{b} S_3 \xrightarrow{a} S_3 \xrightarrow{b} S_3 \xrightarrow{a} S_3 \xrightarrow{b} S_3 \qquad \text{accepted}$$

QUESTION 3

i. Given a deterministic finite automata (DFA) as in Figure 2.

a) List all the components of S, I, q_o, F.

$S = \{S_o, S_1, S_2, S_3, S_4, S_5\}$
$I = \{0, 1\}$
$q_o = S_o$
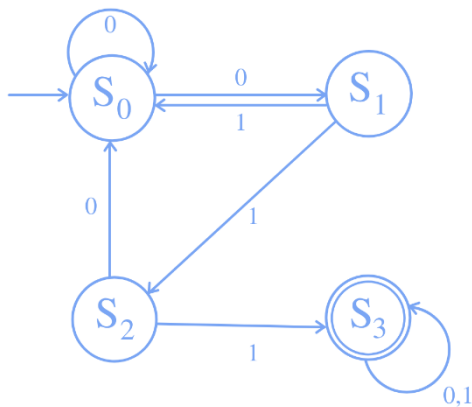$F = \{S_o, S_1, S_5\}$

b) Find the sequence of configurations and state if the string **0011101100** is accepted by the DFA.

$$S_0 \xrightarrow{0} S_0 \xrightarrow{0} S_0 \xrightarrow{1} S_1 \xrightarrow{1} S_2 \xrightarrow{1} S_3 \xrightarrow{0} S_5 \xrightarrow{1} S_5 \xrightarrow{1} S_5 \xrightarrow{0} S_4 \xrightarrow{0} S_4$$

not accepted

ii. Construct a DFA that accepts the set of all bit strings that contain three consecutive 1s.

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QUESTION 4

You are going to develop a simple shooting game. There is one hero in a battle field with few enemies and other characters. There are three states in the game which are *WANDER*, *EVADE* and *ATTACK*. When the hero is wandering the field and suddenly encounters enemies while he is not in vulnerable situation, he will go into *ATTACK* stage by shooting the enemies. However, if while wandering the field and the hero suddenly encounters enemies and he is in vulnerable situation, he will shoot the enemies and goes into *EVADE* stage. While in *ATTACK* stage, if the hero encounters enemies and he is not vulnerable, he will remain in that stage and continues shooting. But if he encounters enemies and he is vulnerable, he will shoot and goes into *EVADE* stage. While in *EVADE* stage, if the hero encounters enemies and he is not vulnerable, he will go into *ATTACK* stage and shoots. But if he encounters enemies and he is vulnerable, he will remain in that stage and continues shooting. When the hero encounters characters that are not his enemies, he will not shoot. If he is in the *WANDER* stage at that time, he will continue wandering the field. If he is in *ATTACK* or *EVADE* stages, he will switch into *WANDER* stage. The inputs and outputs are given in the Table 1 below. **Construct a finite state diagram to model the game**.

Table 1

Input	Output
not enemies	shoot
enemies & not vulnerable	not shoot
enemies & vulnerable	

States:
S_1 = WANDER
S_2 = EVADE
S_3 = ATTACK

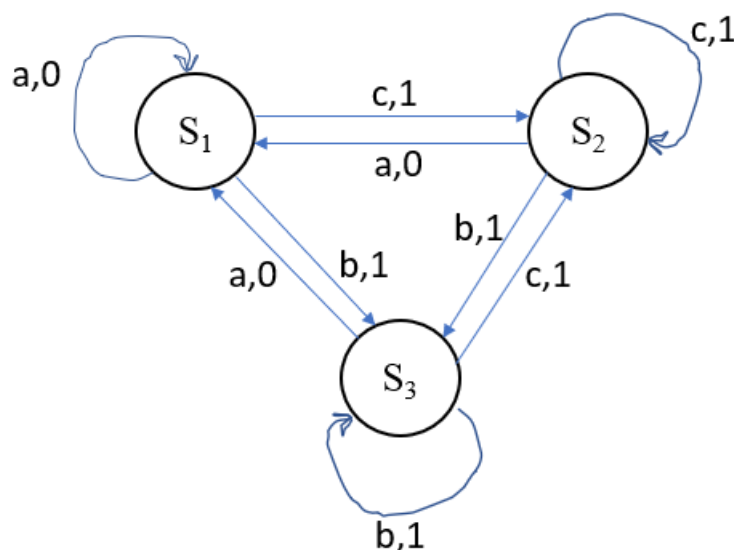Inputs:
a = not enemies
b = enemies & not vulnerable
c = enemies & vulnerable

Outputs:
0 = not shoot
1 = shoot

State	Input			Output		
	a	b	c	a	b	c
S_1	S_1	S_3	S_2	0	1	1
S_2	S_1	S_3	S_2	0	1	1
S_3	S_1	S_3	S_2	0	1	1

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QUESTION 5

ATM is a computerized machine that provides bank customers to gain access to their accounts using magnetic encoded plastic card and code number. It enables the customer to perform online transactions without involving cashier, clerk and bank teller. The customer makes cash withdrawal, check account balances, transfer money as well as purchase prepaid mobile phone credit by using ATM card. Typical PIN based ATM has following processes:

 • Insert ATM card to establish interface. The card will be validated to ensure the correct ATM card is inserted. If the card is unsuccessfully validated, the card is ejected and ATM session is terminated.
 • For valid ATM card, user is asked to enter the PIN and press the execution key for the system to match the PIN, if PIN does not match, then user access is denied to the next stage and he or she is requested to repeat the operation with the correct PIN for a fixed two retries.
 • If after the third time the PIN is unmatched, the card will be locked and ATM session is terminated.
 • If the PIN matches then the transaction interface is displayed and user has to select the transaction that they wish to perform.
 • After the machine performs the chosen transaction, it will prompt user if a new transaction is to be performed. If the response is 'Yes', the transaction interface is again displayed and if 'No' the transaction is terminated and card ejected and ATM session is terminated.

Based on the above description, the states, inputs and outputs are as follow:

States:

S_1: Welcome screen S_6: Choosing transaction screen

S_2: Validating card S_7: Performing transaction

S_3: 1st PIN entering screen S_8: Asking for other transaction screen

S_4: 2nd PIN entering screen S_9: Terminate ATM session

S_5: 3rd PIN entering screen

Inputs:

A: Insert ATM card   F: Transaction is selected

B: Valid ATM card   G: Complete transaction

C: Invalid ATM card   H: Yes for other transaction

D: Correct PIN   I: No for other transaction screen

E: Incorrect PIN

Outputs:

0: Nothing
happened
1: Eject
ATM card
2: Lock
ATM card

Draw the transition diagram for the above system.