



UTM
UNIVERSITI TEKNOLOGI MALAYSIA

SECI1013-06

DISCRETE STRUCTURE

Assignment 5

Group 13

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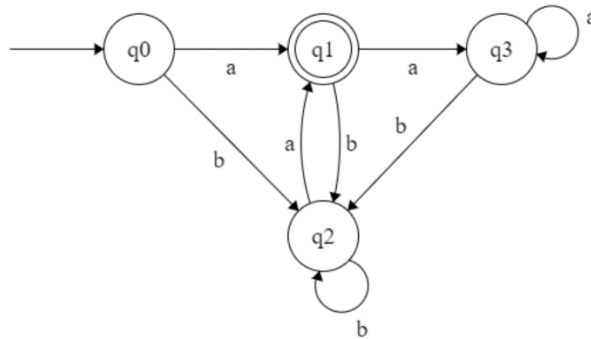
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QUESTION 1

Let $M = \{S, I, q_0, fs, F\}$ 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 fs is given by:

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

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



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

A deterministic finite automaton (DFA) is a mathematical model of a machine that accepts language of some alphabet. It is a finite-state machine that accepts or rejects a given string of symbols such as email password, it runs through a state sequence uniquely determined by string. In this case if one single symbol or alphabet is incorrect or the length of the password is wrong, it will loop back to itself. Only the exactly correct input string will reach the final state and be accepted. Therefore, DFA is suitable for verification.

QUESTION 2

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

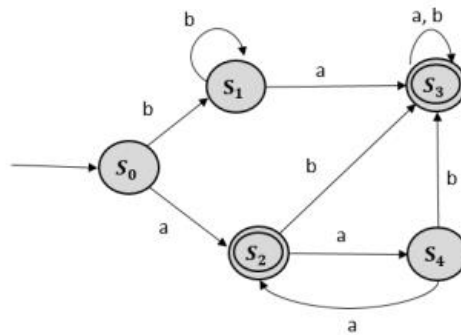


Figure 1

- 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) $w = \text{aaaaaa}$

$S_0 \xrightarrow{a} S_2 \xrightarrow{a} S_4 \xrightarrow{a} S_2 \xrightarrow{a} S_4 \xrightarrow{a} S_2 \xrightarrow{a} S_4$

w is not accepted by the DFA. This is because S_4 is not the final state.

b) $w = \text{ababab}$

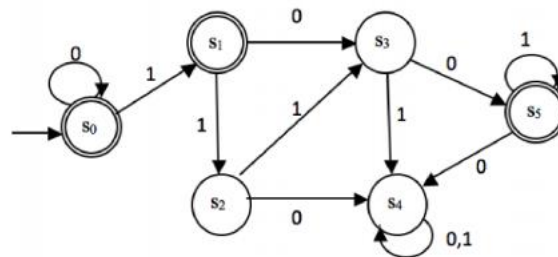
$S_0 \xrightarrow{a} S_2 \xrightarrow{b} S_3 \xrightarrow{a} S_3 \xrightarrow{b} S_3 \xrightarrow{a} S_3 \xrightarrow{b} S_3$

w is accepted by the DFA. This is because S_3 is the final state.

Show the configuration of the state transition in each question.

QUESTION 3

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



- a) List all the components of S , I , q_0 , F .

$S = \{ S_0, S_1, S_2, S_3, S_4, S_5 \}$

$I = \{ 0, 1 \}$

$q_0 = S_0$

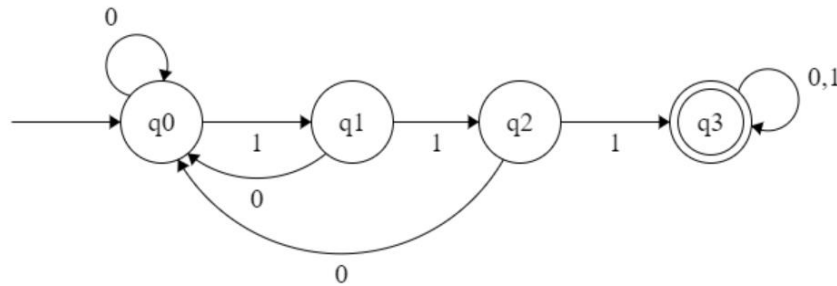
$F = \{ S_0, S_1, S_5 \}$

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

$S_0 \longrightarrow S_0 \longrightarrow S_0 \longrightarrow S_1 \longrightarrow S_2 \longrightarrow S_3 \longrightarrow S_5 \longrightarrow S_5 \longrightarrow S_5 \longrightarrow$
 $S_4 \longrightarrow S_4$

The string 0011101100 is not accepted by DFA because S_4 is not the final state.

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



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	

Let

States:

q0: WANDER

q1: ATTACK

q2: EVADE

Input:

a: not enemies

b: enemies & not vulnerable

c: enemies & vulnerable

Output:

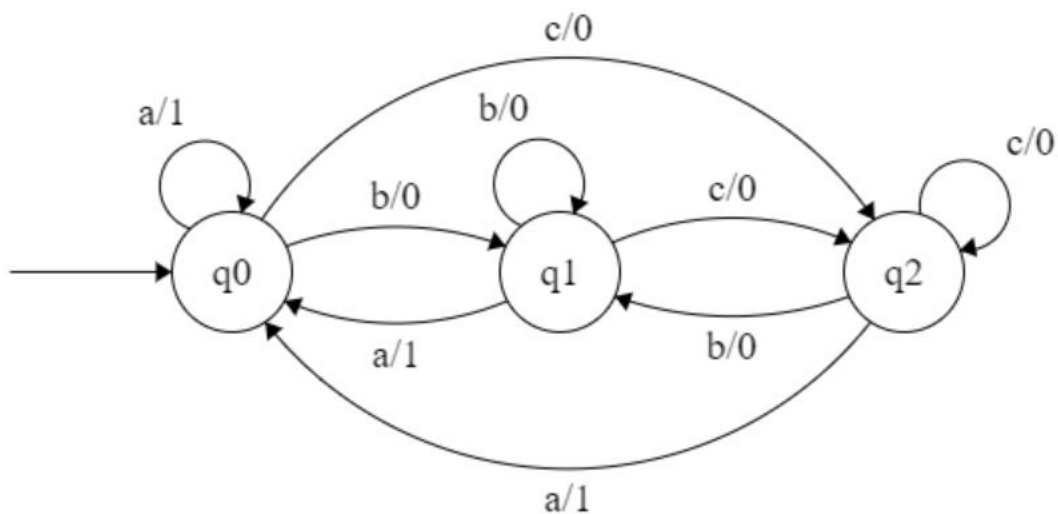
0: shoot

1: not shoot

State transaction table:

	f _s			f _o		
	a	b	c	a	b	c
q0	q0	q1	q2	1	0	0
q1	q0	q1	q2	1	0	0
q2	q0	q1	q2	1	0	0

Finite state diagram:



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:

S1: Welcome screen

S6: Choosing transaction screen

S2: Validating card

S7: Performing transaction

S3: 1st PIN entering screen

S8: Asking for other transaction screen

S4: 2nd PIN entering screen

S9: Terminate ATM session

S5: 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

I: No for other transaction screen

E: Incorrect PIN

Outputs:

0: Nothing happened

1: Eject ATM card

2: Lock ATM card

State transaction table:

[illegible]

Draw the transition diagram for the above system.

