ASSIGNMENT 4

GROUP 5

SECTION 03 - SEM 1, 2024/2025

SECI1013 *(DISCRETE STRUCTURE)*

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"Framing thoughts with logic"

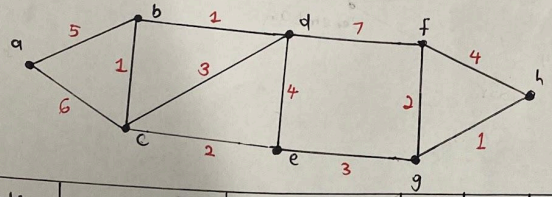
ANSWER

CHAPTER 4 (4.7) : SHORTEST PATH PROBLEM

QUESTION 1

Chapter 4 (4.7) : Shortest Path Problem (25 Marks)

1. Find the shortest path between a and h in weighted graphs given. Show all the work procedures of bijkstra's algorithm.

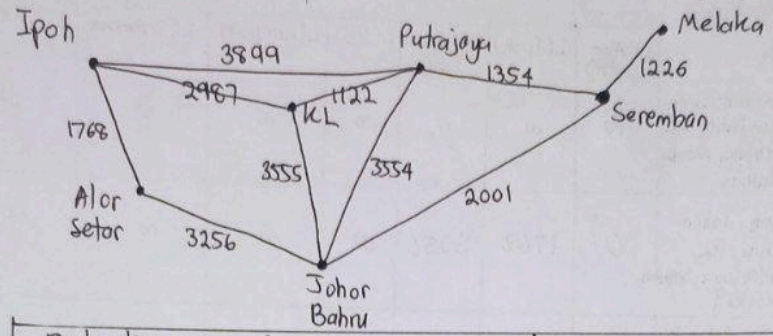


Iteration	S	N	L(a)	L(b)	L(c)	L(d)	L(e)	L(f)	L(g)	L(h)
1	{ }	{a,b,c,d,e,f,g,h}	0	∞	∞	∞	∞	∞	∞	∞
1	{a}	{b,c,d,e,f,g,h}	0	5	6	∞	∞	∞	∞	∞
2	{a, b}	{c,d,e,f,g,h}	0	5	6	6	∞	∞	∞	∞
3	{a,b,c}	{d,e,f,g,h}	0	5	6	6	8	∞	∞	∞
4	{a,b,c,d}	{e,f,g,h}	0	5	6	6	8	13	∞	∞
5	{a,b,c,d,e}	{f,g,h}	0	5	6	6	8	13	11	∞
6	{a,b,c,d,e,g}	{f,h}	0	5	6	6	8	13	11	12
7	{a,b,c,d,e,g,h}	{f}	0	5	6	6	8	13	11	12

a →(6) c →(2) e →(3) g →(1) h = 12

QUESTION 2

2. Given is the distance between an important city in Malaysia. The table shows the cost of transportation and time for travelling between cities.



Destination	Aeroplane		Car	
	Cost	Time spent	Cost	Time spent
Ipoh-Putrajaya	1500	1 H 30 MIN	700	4 H 30 MIN
Ipoh - Alor Setar	500	0H 25MIN	100	2 H 30MIN
Ipoh - KL	1000	1H 00MIN	500	4 H 00MIN
ALor Setar - Johor Bahru	1400	1 H 25MIN	700	5 H 00 MIN
KL -Johor Bahru	2000	2 H 00MIN	1000	6 H 00 MIN
KL - Putrajaya	500	0 H 30 MIN	100	2 H 30 MIN
Johor Bahru - Putrajaya	2000	2 H 00 MIN	1000	6 H 00 MIN
Johor Bahru - Seremban	2000	2 H 10 MIN	1000	6 H 20 MIN
Putrajaya - Seremban	500	0 H 20 MIN	100	2 H 30 MIN
Seremban - Melaka	500	0 H 20MIN	100	2H 00 MIN

a. Find the shortest route (in the distance) between
i) Ipoh to Melaka

Iteration	S	N	L(Ipoh)	L(Alor Setar)	L(KL)	L(Putrajaya)	L(Johor Bahru)	L(Seremban)	L(Melaka)
0	{}	{Ipoh, Alor Setar, KL, Putrajaya, Johor Bahru, Seremban, Melaka}	0	∞	∞	∞	∞	∞	∞
1	{Ipoh}	{Alor Setar, KL, Putrajaya, Johor Bahru, Seremban, Melaka}	0	1768	2987	3899	∞	∞	∞
2	{Ipoh, Alor Setar}	{KL, Putrajaya, Johor Bahru, Seremban, Melaka}	0	1768	2987	3899	5024	∞	∞
3	{Ipoh, Alor Setar, KL}	{Putrajaya, Johor Bahru, Seremban, Melaka}	0	1768	2987	3899	5024	∞	∞
4	{Ipoh, Alor Setar, KL, Putrajaya}	{Johor Bahru, Seremban, Melaka}	0	1768	2987	3899	5024	5253	∞
5	{Ipoh, Alor Setar, KL, Putrajaya, Johor Bahru}	{Seremban, Melaka}	0	1768	2987	3899	5024	5253	∞
6	{Johor Bahru, KL, Ipoh, Alor Setar, Putrajaya, Seremban}	{Melaka}	0	1768	2987	3899	5024	5253	6479

Shortest Path : Ipoh -> Putrajaya -> Seremban -> Melaka = 6479

a) ii. Alor Setar to Melaka

Iteration	S	N	L(Alor Setar)	L(Ipoh)	L(Johor Bahru)	L(KL)	L(Putrajaya)	L(Seremban)	L(Melaka)
0	{}	{Alor Setar, Ipoh, Johor Bahru, KL, Putrajaya, Seremban, Melaka}	0	∞	∞	∞	∞	∞	∞
1	{Alor Setar}	{Ipoh, Johor Bahru, KL, Putrajaya, Seremban, Melaka}	0	1768	3256	∞	∞	∞	∞
2	{Alor Setar, Ipoh}	{Johor Bahru, KL, Putrajaya, Seremban, Melaka}	0	1768	3256	4755	5667	∞	∞
3	{Alor Setar, Ipoh, Johor Bahru}	{KL, Putrajaya, Seremban, Melaka}	0	1768	3256	4755	5667	5257	∞
4	{Alor Setar, Ipoh, Johor Bahru, KL}	{Putrajaya, Seremban, Melaka}	0	1768	3256	4755	5667	5257	∞
5	{Alor Setar, Ipoh, Johor Bahru, KL, Seremban}	{Putrajaya, Melaka}	0	1768	3256	4755	5667	5257	6483
6	{Alor Setar, Ipoh, Johor Bahru, KL, Seremban, Putrajaya}	{Melaka}	0	1768	3256	4755	5667	5257	6483

Shortest Path: Alor Setar -> Johor Bahru -> Seremban -> Melaka = 6483

b) Find the cheapest way using an Aeroplane if we consider the shortest time travelling and distance between

i) Ipoh to Melaka

Cheapest way = 1500 + 500 + 500
= 2500
= RM 2500

ii) Alor Setar to Melaka

Cheapest way = 1400 + 2000 + 500
= 3900
= RM 3900

c) Find the cheapest way using the car if we consider the shortest ~~way~~ time travelling and distance between.

i) Ipoh to Melaka

Cheapest way = 700 + 100 + 100
= 900
= RM 900

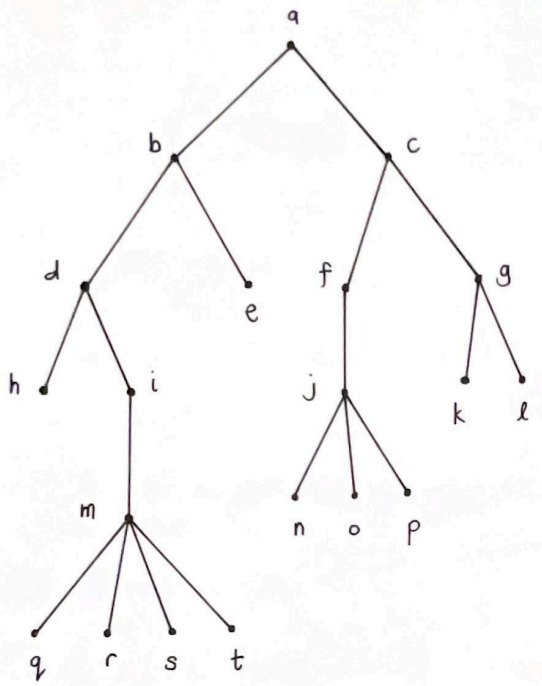
ii) Alor Setar to Melaka

Cheapest way = 700 + 1000 + 100
= 1800
= RM 1800

CHAPTER 4 (4.8): TREE

QUESTION 1

1. Answer the following questions based on the rooted tree shown below:



a. List the children of vertex j.

n, o, p.

b. List the ancestors of vertex s.

a, b, d, i, m, s.

c. List the siblings of vertex q.

r, s, t.

d. Find the number of leaves in this rooted tree.

e, h, k, l, n, o, p, q, r, s, t

= 11 leaves

e. List all level 3 vertices in this rooted tree.

h, i, j, k, l

f. Find the least m for which this tree is a rooted m-ary tree.

4

g. Find the height of this rooted tree.

5

h. Find the order that which you would visit the vertices of this tree if you use postorder traversal to visit the vertices.

h, q, r, s, t, m, i, d, e, b, n, o, p, j, f, k, l, g, c, a.

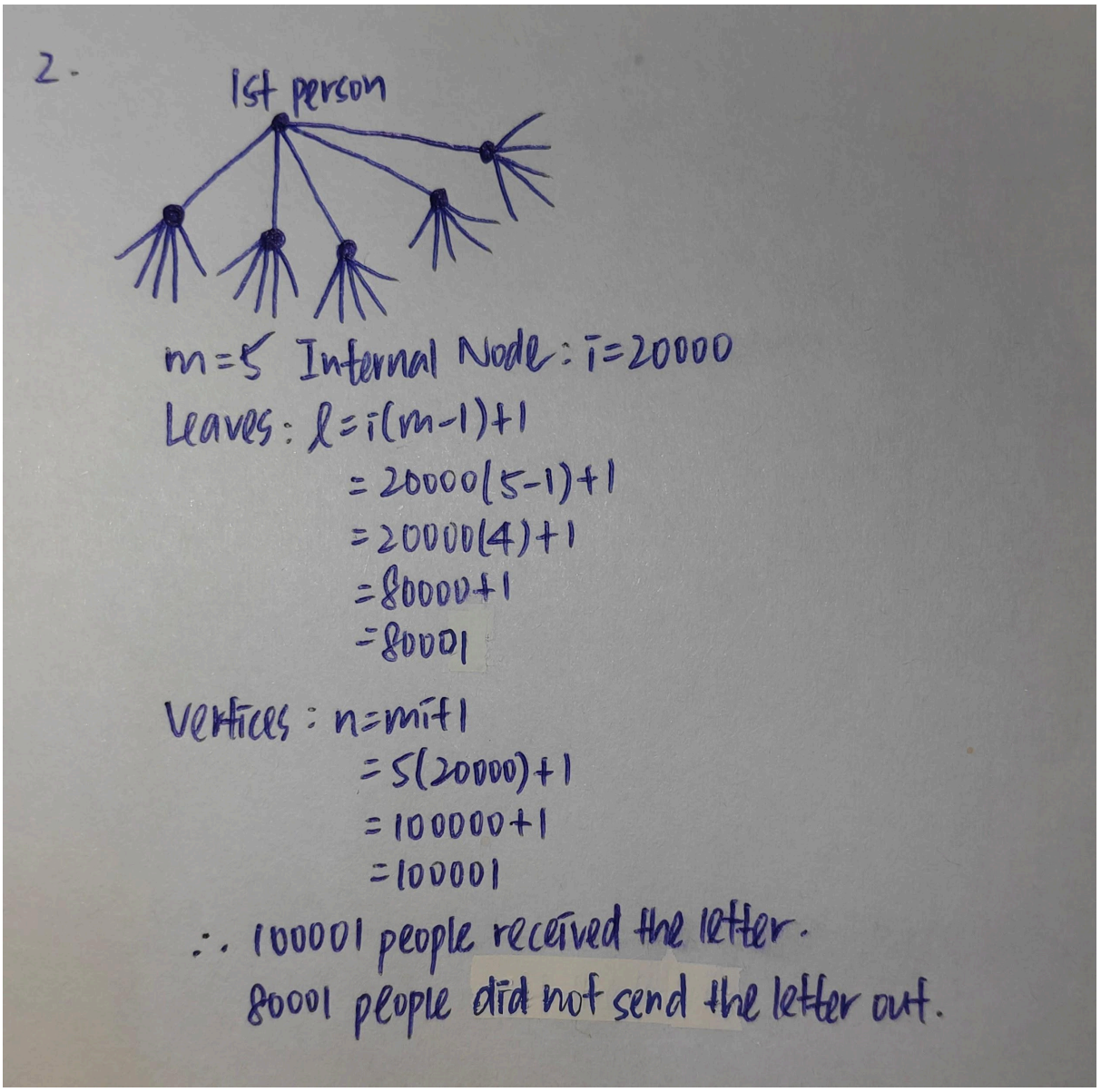
i. Find the order that which you would visit the vertices of this tree if you use preorder traversal to visit the vertices.

a, b, d, h, i, m, q, r, s, t, e, c, f, j, n, o, p, g, k, l.

j. Find the order that which you would visit the vertices of this tree if you use in-order traversal to visit the vertices.

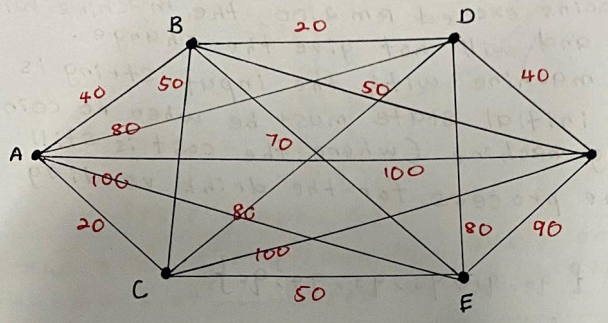
h, d, q, m, r, s, t, i, b, e, a, n, j, o, p, f, c, k, g, l.

QUESTION 2

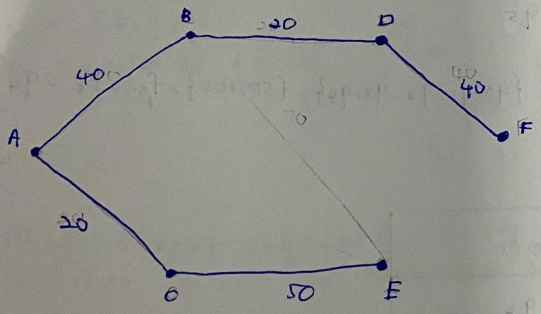

2.
1st person
m=5 Internal Node : i=20000
Leaves : l=i(m-1)+1
=20000(5-1)+1
=20000(4)+1
=80000+1
=80001
Vertices : n=mi+1
=5(20000)+1
=100000+1
=100001
∴ 100001 people received the letter.
80001 people did not send the letter out.

QUESTION 3

3. Find the minimum spanning tree using Krustal's algorithm and provide the overall weight of the MST. Show all the procedures of the Kruskal algorithm and give the reason behind the path you choose.



AB 40 ✓
AC 20 ✓
AD 80
AE 100
AF 100
BD 20 ✓
BC 50
BE 70
BF 50
CD 80
CF 100
DE 80
DF 40 ✓
EF 90
CE 50 ✓



1. AC is chosen
2. BD is chosen
3. AB is chosen
4. DF is chosen
5. CE is chosen
6. Ended since chosing other edges will form cycle.

Overall weightage of MST:
= AC + BD + AB + DF + CE
= 20 + 20 + 40 + 40 + 50
= 170

Path

E → C → A → B → D → F

∴ It has the smallest weightage

CHAPTER 5 (5.1 AND 5.2): FINITE AUTOMATA

QUESTION 1

1.

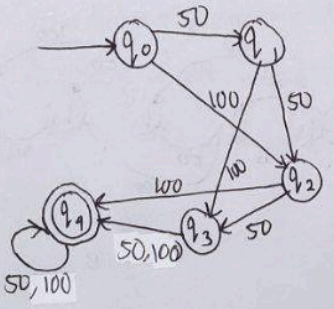
A simple drink vending machine sells the can drinks that cost RM 2.00. The machine only accepts the coins of 50 and 100 cents. If the total coins exceed RM 2.00, the machine will accept the overpayment and will not give the change. Represent the vending machine with the input string is {50 and 100} and the initial state must be when no coin is put into the vending machine (where the cost is still RM2.00 Represent the process for the ~~drinking~~ drink vending machine using the DFA.

Answer :

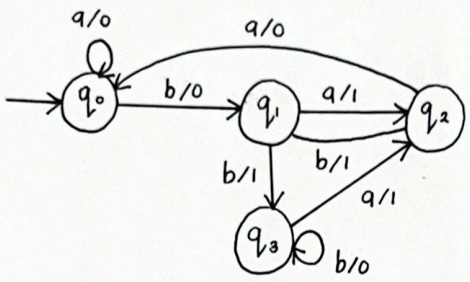
q_0 = 0 cents
q_1 = 50 cents
q_2 = 100 cents
q_3 = 150 cents
q_4 = 200 cents or more

$M = \{\{q_0, q_1, q_2, q_3, q_4\}, \{50, 100\}, q_0, f_s, \{q_4\}\}$

f_s	50	100
q_0	q_1	q_2
q_1	q_2	q_3
q_2	q_3	q_4
q_3	q_4	q_4
q_4	q_4	q_4



QUESTION 2



State graph, G1

i. Draw the state transition table and the output function for machine M based on the state graph G1. [4 Marks]

	f_s a	f_s b	f_o a	f_o b
q_0	q_0	q_1	0	0
q_1	q_2	q_3	1	1
q_2	q_0	q_1	0	1
q_3	q_2	q_3	1	0

Output function:

$f_o(q_0, a) = 0$
$f_o(q_0, b) = 0$
$f_o(q_1, a) = 1$
$f_o(q_1, b) = 1$
$f_o(q_2, a) = 0$
$f_o(q_2, b) = 1$
$f_o(q_3, a) = 1$
$f_o(q_3, b) = 0$

ii. Write the output sequence of the input string and determine whether it will be accepted by the machine or not.

a. abbaaab [4 Marks]

$$q_0 \xrightarrow[0]{a} q_0 \xrightarrow[0]{b} q_1 \xrightarrow[1]{b} q_3 \xrightarrow[1]{a} q_2 \xrightarrow[0]{a} q_0 \xrightarrow[0]{a} q_0 \xrightarrow[0]{b} q_1$$

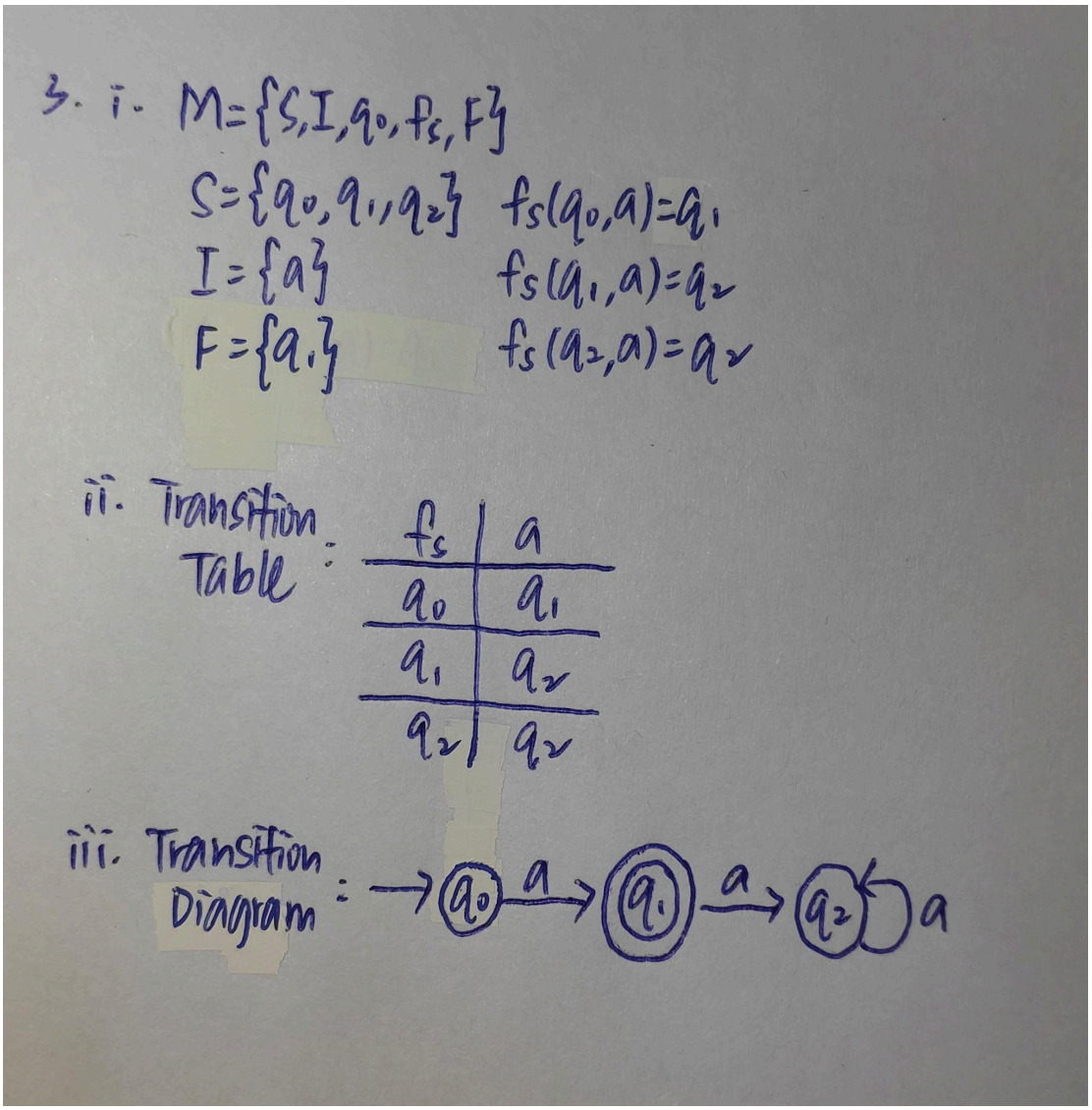
Output string = 0011000 Output = 0, not accepted.

b. bbbaababb [4 Marks]

$$q_0 \xrightarrow[0]{b} q_1 \xrightarrow[1]{b} q_3 \xrightarrow[0]{b} q_3 \xrightarrow[1]{a} q_2 \xrightarrow[0]{a} q_0 \xrightarrow[0]{b} q_1 \xrightarrow[1]{a} q_2 \xrightarrow[1]{b} q_1 \xrightarrow[1]{b} q_3$$

Output string = 010100111 Output = 1, accepted.

QUESTION 3


3. i. M={S,I,q0,fs,F}
S={q0,q1,q2}
I={a}
F={q1}
fs(q0,a)=q1
fs(q1,a)=q2
fs(q2,a)=q2
ii. Transition Table :
fs | a
q0 | q1
q1 | q2
q2 | q2
iii. Transition Diagram :
q0
a
q1
a
q2
a

QUESTION 5

Question 5

A machine M is written as $M = \{\{s_0, s_1\}, \{a, b\}, \{0, 1\}, s_0, f_s, f_0\}$, with the state transition function and output function as follows:

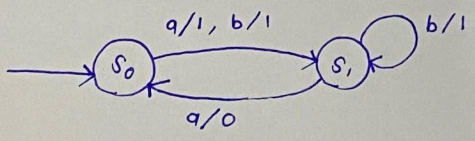
$f_s(s_0, a) = s_1$ $\quad f_0(s_0, a) = 1$
$f_s(s_0, b) = s_1$ $\quad f_0(s_0, b) = 1$
$f_s(s_1, a) = s_0$ $\quad f_0(s_1, a) = 0$
$f_s(s_1, b) = s_1$ $\quad f_0(s_1, b) = 1$

i. Draw a transition table of machine, M. [3m]

$S = \{s_0, s_1\}$ $\quad s_0$ = initial state
$I = \{a, b\}$
$O = \{0, 1\}$

	f_s		f_0	
	a	b	a	b
s_0	s_1	s_1	1	1
s_1	s_0	s_1	0	1

ii. Shows the transition diagram that for machine, M. [5m]



iii. Shows the output sequence for the input and determine whether the output is accepted by machine M or not.

a. abbab [4m]

$s_0 \xrightarrow{a/1} s_1 \xrightarrow{b/1} s_1 \xrightarrow{b/1} s_1 \xrightarrow{a/0} s_0 \xrightarrow{b/1} s_1$

output: 1, accepted

b. bbaa [4m]

$s_0 \xrightarrow{b/1} s_1 \xrightarrow{b/1} s_1 \xrightarrow{a/0} s_0 \xrightarrow{a/1} s_1$

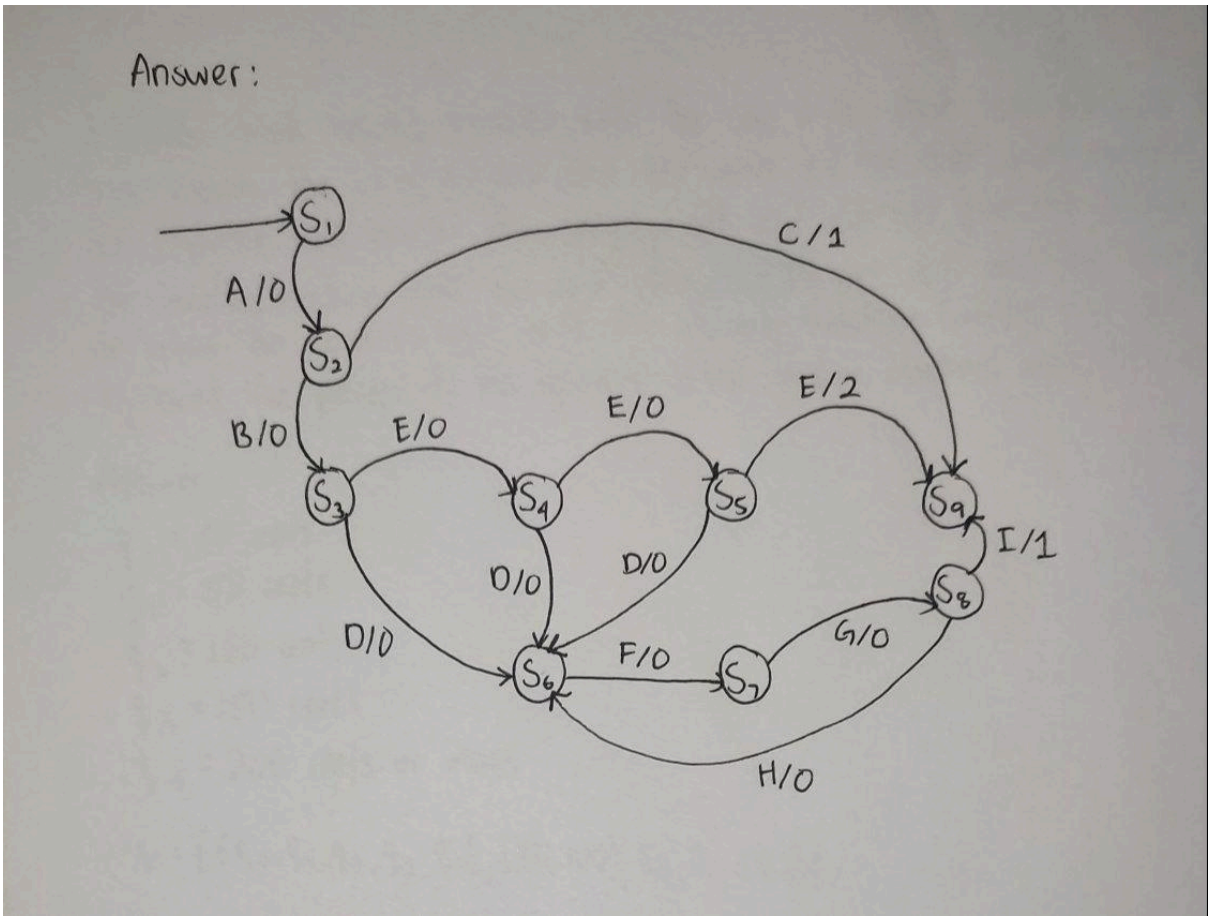
output: 1, accepted

c. baaba [4m]

$s_0 \xrightarrow{b/1} s_1 \xrightarrow{a/0} s_0 \xrightarrow{a/1} s_1 \xrightarrow{b/1} s_1 \xrightarrow{a/0} s_0$

output: 0, not accepted

QUESTION 6


Answer:
S1
S2
S3
S4
S5
S6
S7
S8
S9
A/0
B/0
C/1
E/0
E/0
E/2
D/0
D/0
D/0
F/0
G/0
H/0
I/1