



Group 9

TUTORIAL CHAPTER 5

FINITE AUTOMATA

Yaw Kuan, Hafiz , Scaie

prepared by Razana Alwee



Exercise 1

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

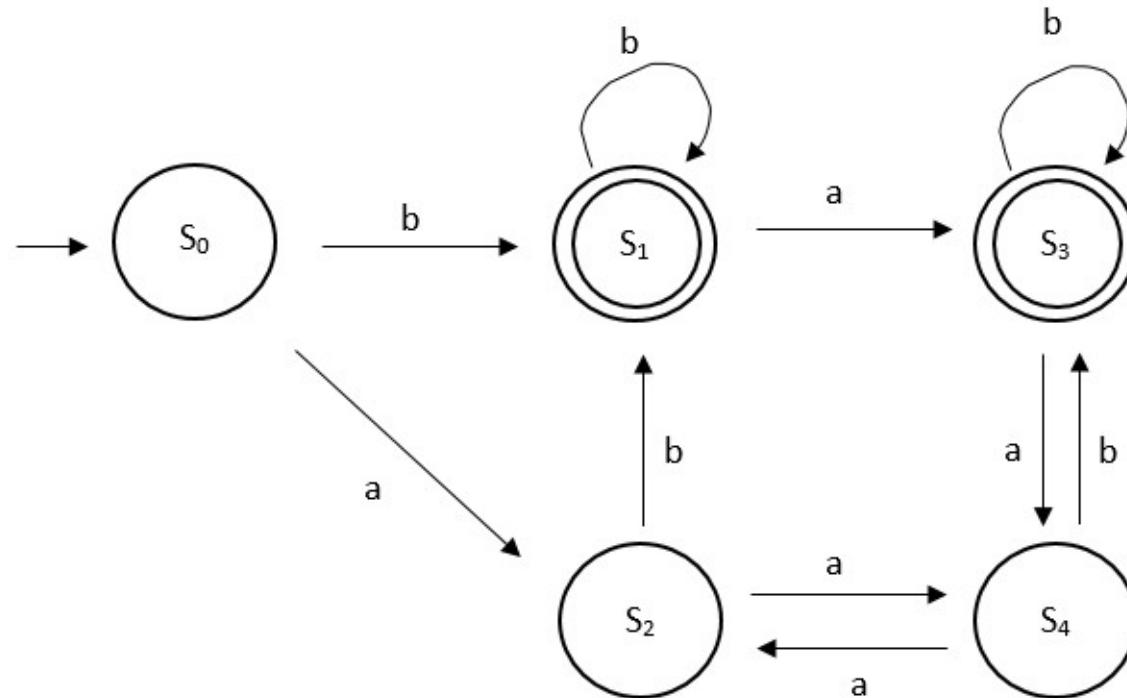


Figure 2

- Construct a state transition table for state transition diagram (4 Marks)
- Identify whether the following input can be accepted by the DFA. Show the transition of each state for the input given. (2 Marks)

- aaaaba
- ababbb

1

(i)

f_5	a	b
s_0	s_2	s_1
s_1	s_3	s_1
s_2	s_4	s_1
s_3	s_4	s_3
s_4	s_2	s_3

ii

$$s_0 \xrightarrow{a} s_1 \xrightarrow{a} s_4 \xrightarrow{a} s_2 \xrightarrow{a} s_4 \xrightarrow{b} s_3 \xrightarrow{a} s_4$$

Not accepted

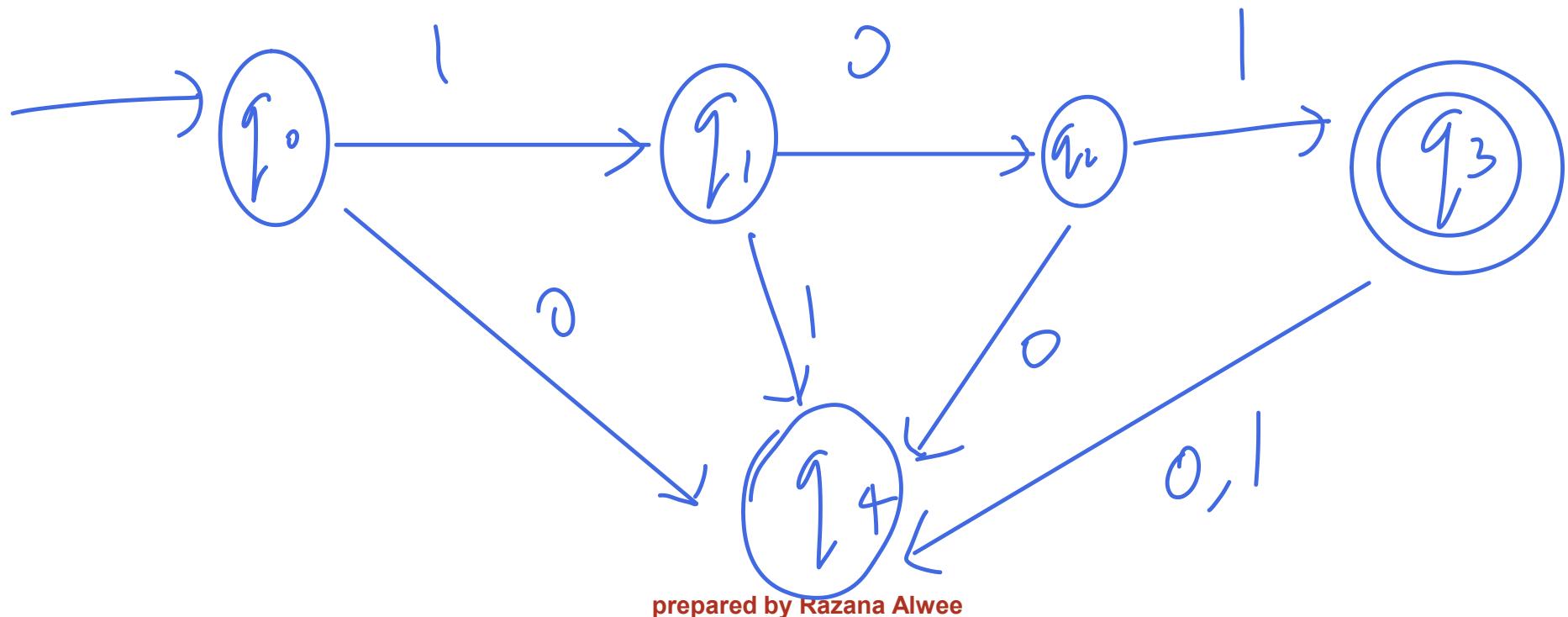
iii

$$s_0 \xrightarrow{a} s_2 \xrightarrow{b} s_1 \xrightarrow{a} s_3 \xrightarrow{b} s_2 \xrightarrow{b} s_3 \xrightarrow{b} s_3$$

Accepted

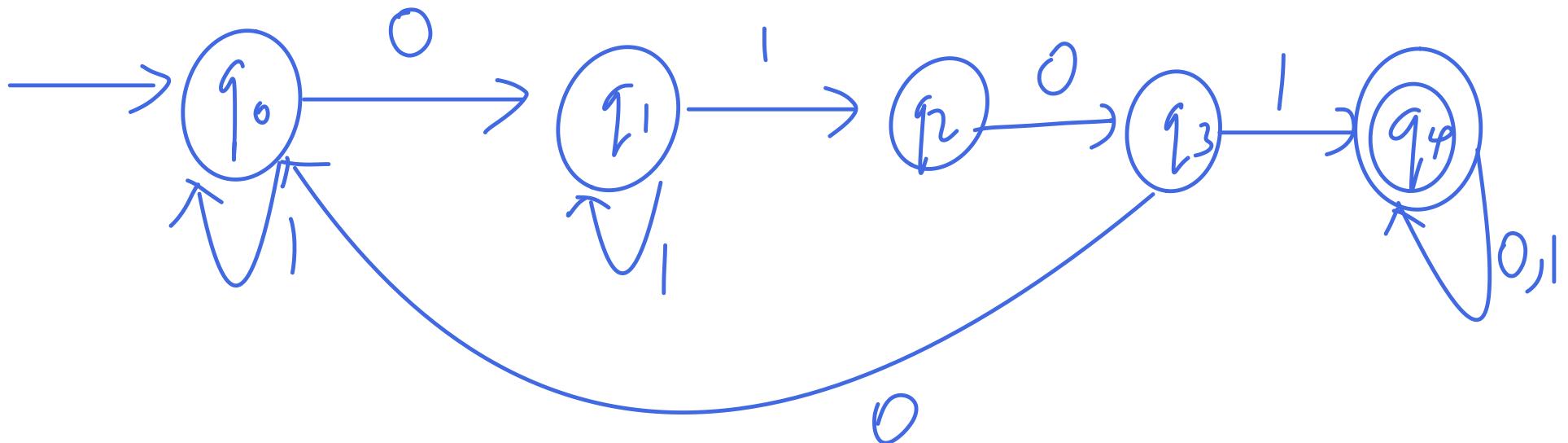
Exercise 2

- Construct a state transition diagram of a DFA M with the input set $\{0, 1\}$ such that M accepts only the string 101.



Exercise 3

- Construct a deterministic finite automaton (DFA) that accepts the set of all bit strings that contain string '0101'.

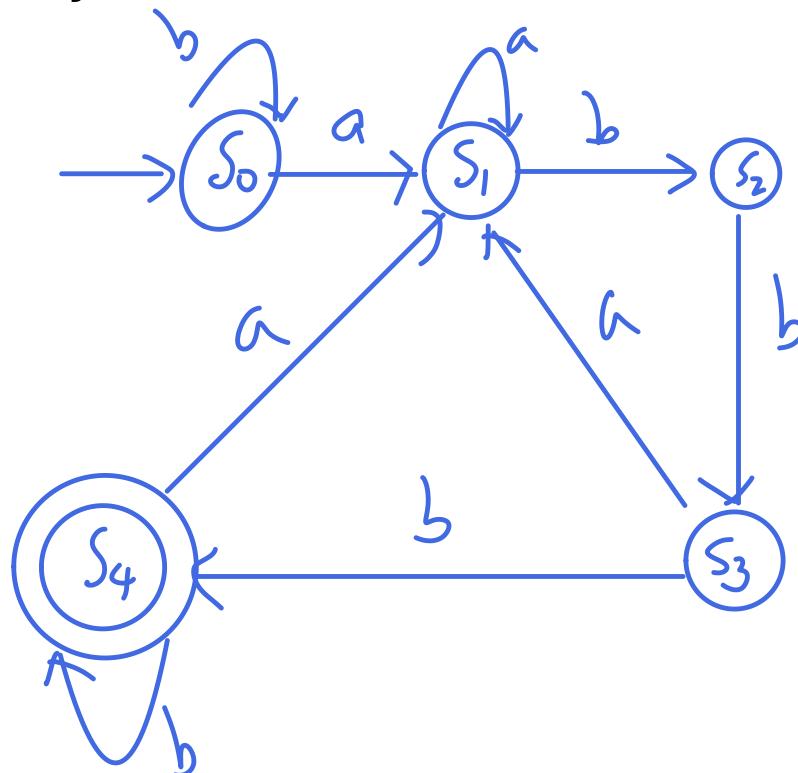


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Exercise 4

- Construct a deterministic finite automaton (DFA) that accepts all string over $\{a,b\}$ that contain ab and end in bbb

f_s	a	b
s_0	s_1	s_0
s_1	s_1	s_2
s_2	s_1	s_3
s_3	s_1	s_4
s_4	s_1	s_4



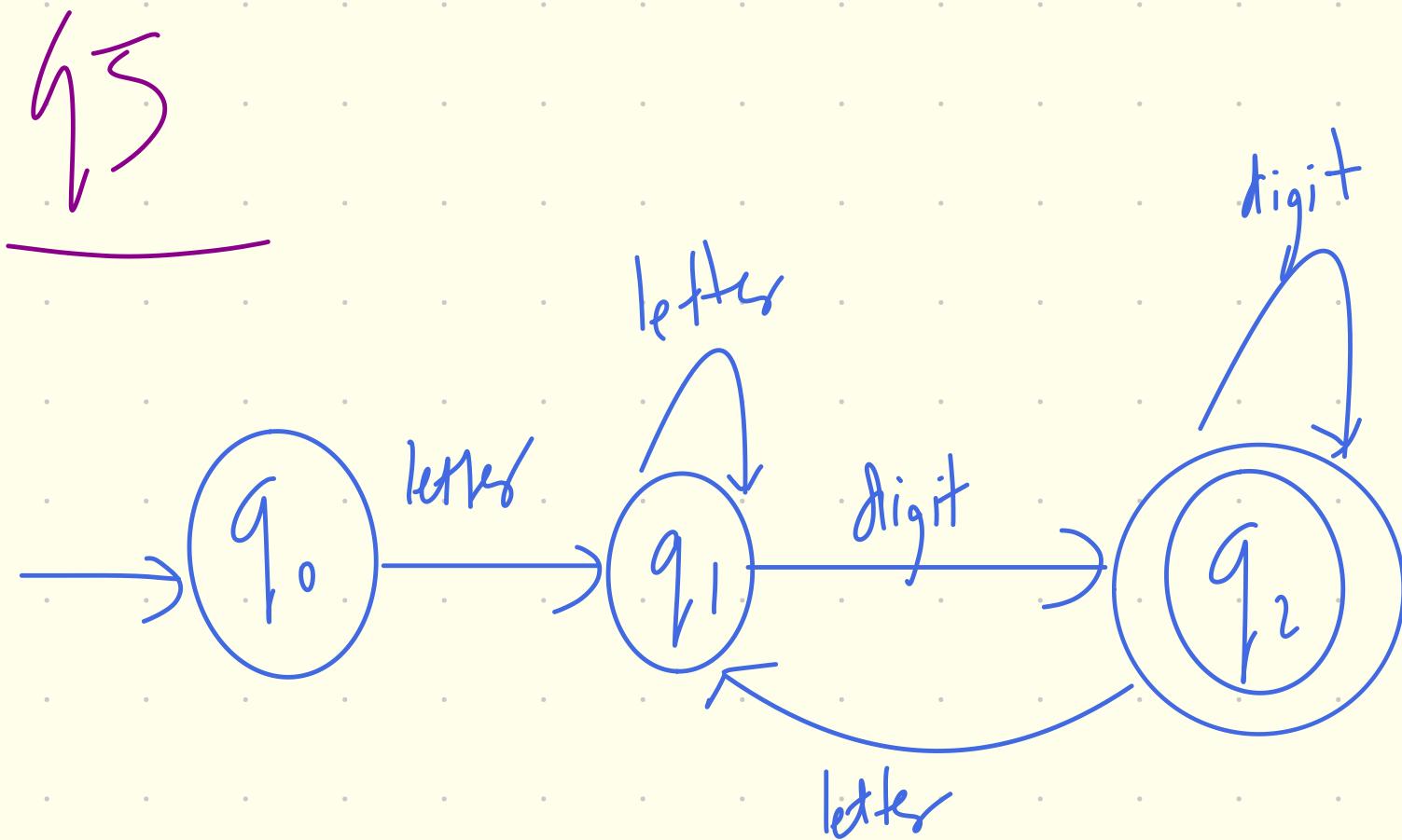
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Exercise 5

Construct a state transition diagram of a DFA that accepts all string over $\{a, b, \dots, z, 0, 1, \dots, 9\}$ that start with a letter (a-z) and end with a digit (0-9).

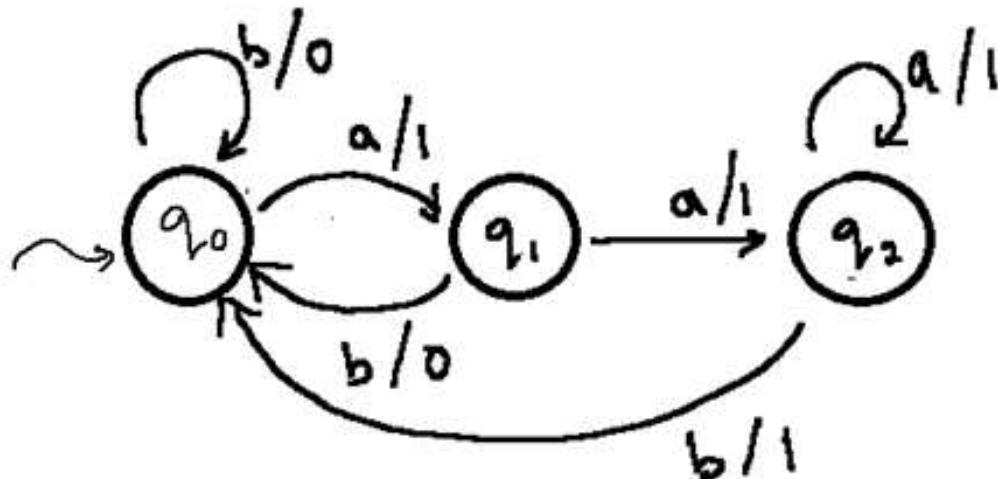
Example of accepted strings are $a9$, $xy12$, $a1b2c3$ ect.





Exercise 6

Based on the transition diagram given;



- a. Find out all the information for Deterministic Finite Automaton, $M = \{S, I, O, q_0, f_s, f_o\}$
(7 marks)

- b. Find the output string for the given input string.

- i. abbabbaaaab (4 mark)
ii. bbabaabbaaa (4 mark)

Q6

⑥ $S = \{q_0, q_1, q_2\}$

$I = \{a, b\} \quad O = \{0, 1\}$

$q_0 = q_0$

$f_S(q_0, a) = q_1$

$f_O(q_0, a) = 1$

$f_S(q_0, b) = q_0$

$f_O(q_0, b) = 0$

$f_S(q_1, a) = q_2$

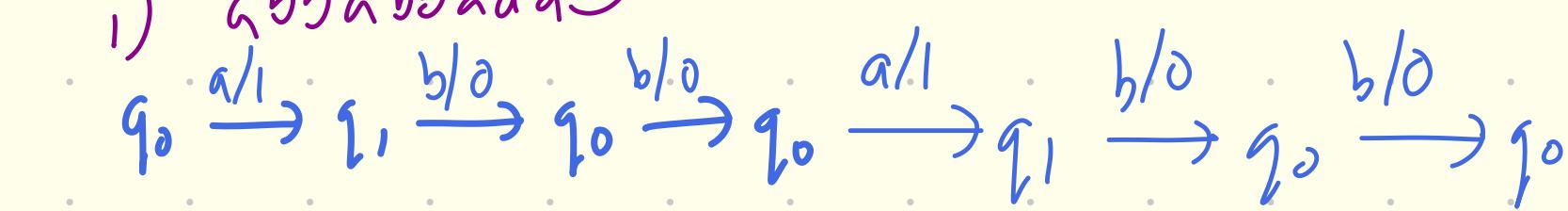
$f_O(q_1, a) = 0$

$f_S(q_2, a) = q_0$

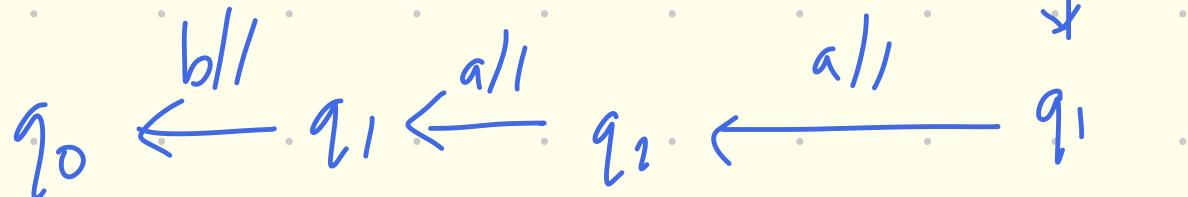
$f_O(q_2, a) = 1$

b)

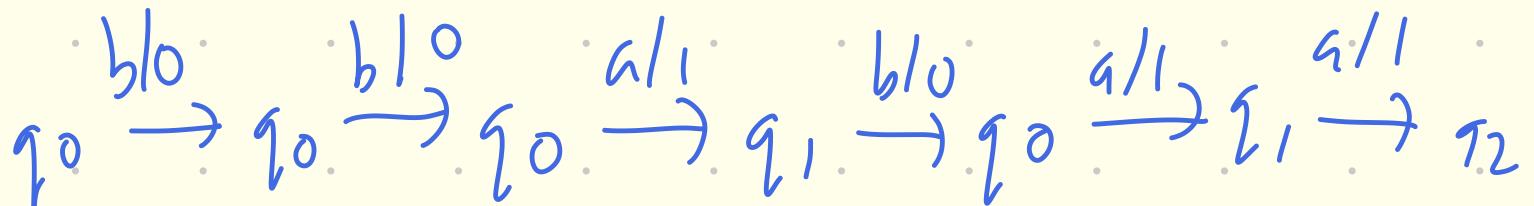
i) abbabbbaaa



100100



ii) bbababbbaaa



001011011





Exercise 7

In a standard washing machine operation, there are four phases which start with Idle/Stop, Wash, Rinse and Spin. When the start/stop button is pressed, the door will be automatically locked, timer will start and the washing machine will begin to wash. After the timer end, the washing machine starts the rinse phase and timer for rinsing phase will begin. After the timer is end, the spin phase will begin. At this point, the timer will start again and after it end, operation of the washing machine is finish and it returns to Idle/Stop condition. At any time during the operation, if the start/stop button is pressed again, the washing machine will stop the operation and return to Idle/Stop condition. The door will always remain locked during the operation unless it is in Idle/Stop condition.

Based on the above washing machine operation,

- define all the states, inputs and outputs.
- construct a transition diagram.

Q7

i) $S = \{\text{Idle/Stop; Wash; Rinse; Spin}\}$

$I =$



Exercise 8

A smart microwave oven manages various cooking and operational states based on user actions.

Microwave oven operates with four states: Idle (S_0), Cooking (S_1), Paused (S_2), and Door Opened (S_3).

Initially, the system is in the Idle state, waiting for input.

The microwave oven has a control panel with 3 buttons. Start/Resume (R) button to initiate or resume cooking,

Pause button (P) to pause an active cooking process and Cancel button(C) to stop the operation and return to Idle. The user can open the microwave door (O) to adjust the food or clean the microwave.

In the Door Opened state, closing the door (D) returns the system to the Idle state.

The microwave provides outputs to indicate its actions:

0 : No significant change occurs.

1 :Microwave Start/Resume cooking

2 :Pause cooking

3 :Stop cooking

4 :Door closed



Exercise 8(cont.)

In the Idle state, if the Pause or Cancel button is pressed the system remains Idle and no significant change occurs. Pressing Start/Resume button transitions the system to the Cooking state and begins the cooking process. Opening the door moves the system to **Door Opened state**.

In the Cooking state, pressing Pause button transitions the system to the Paused state and cooking process is paused. However, cancelling the operation via Cancel button transitions the system to Idle and cooking process is stopped.

The Paused state transitions back to Cooking when Start/Resume button is pressed, resuming the cooking process. Pressing Cancel button from the paused state transitions back to Idle state.

If the door is opened while Cooking or Paused state, stops the cooking process and transitions to the Door Opened state. If the Start/Resume), Pause or Cancel button is pressed while the door is open, the system remains in the Door Opened state with no significant change occurs.

Consider the microvan oven system described.

i) Construct the state transition table to model the microwave oven system's behaviour.

(8 Marks)

ii) What happens to the system after the following input sequence :RPOCR

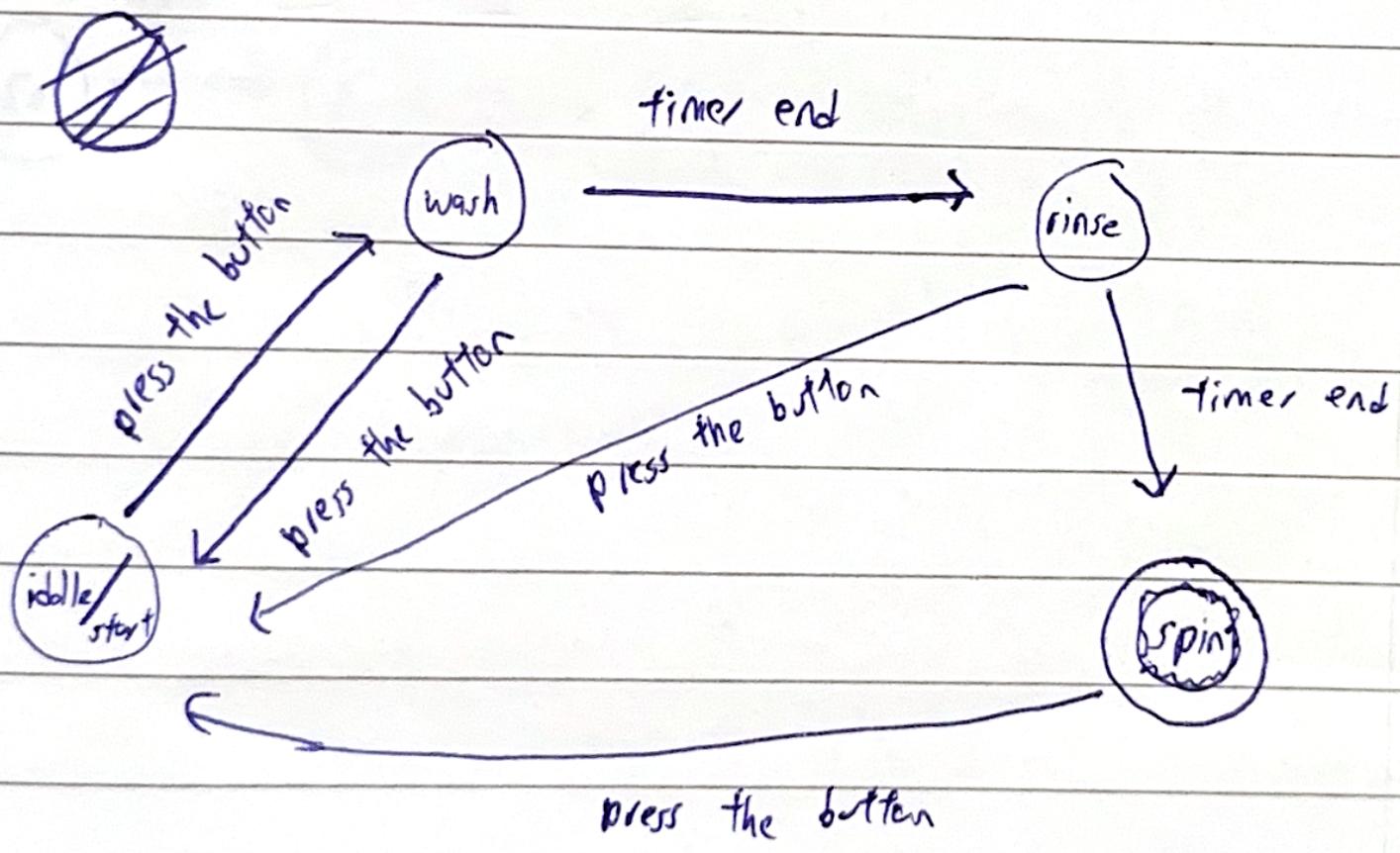
(2 Marks)

Question 7

states = { idle/stop, wash, rinse, spin }

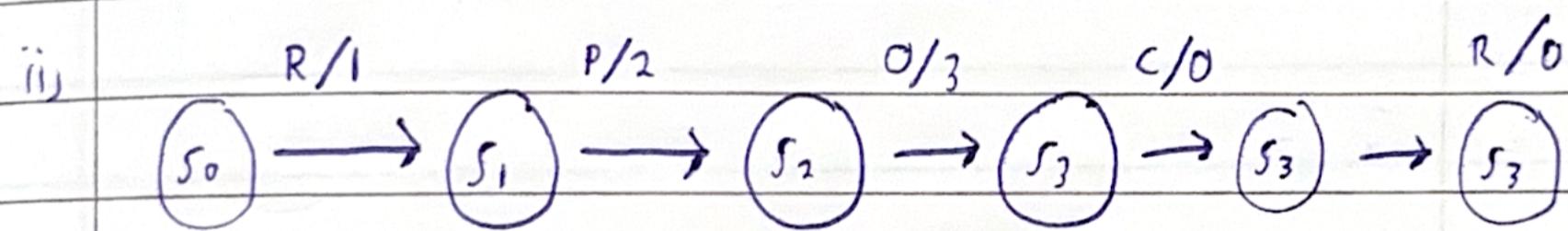
input = { stop/start button, timer end }

output = { times start, door locked, door unlocked, washing machine action }



Question 8

	F_s	F_o
ij	R C P O D	R C P O D
S_0	$S_1 \ S_0 \ S_0 \ S_3 \ S_0$	1 0 0 0 4
S_1	$S_1 \ S_0 \ S_2 \ S_3 \ S_1$	0 3 2 3 4
S_2	$S_1 \ S_0 \ S_2 \ S_3 \ S_2$	1 3 0 3 4
S_3	$S_3 \ S_3 \ S_3 \ S_3 \ S_0$	0 0 0 0 4



The system will end at S_3 phase which is
door opened state