Finite State Machine

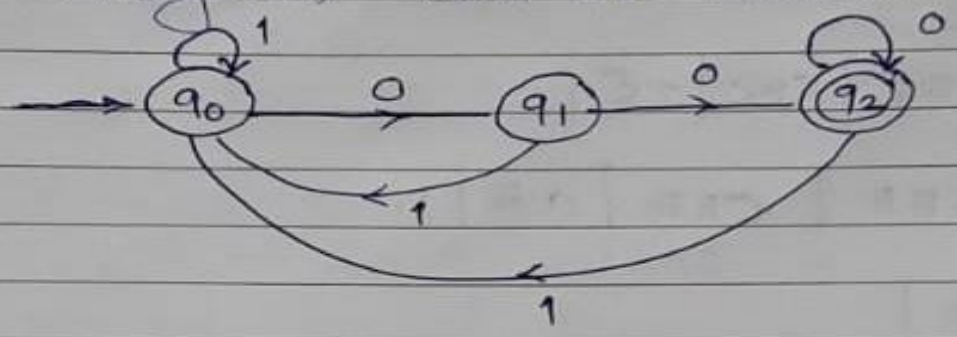
-- Sakshi Surve

Definition of DFA

- Deterministic Finite automata or DFA is defined as
- $M = (Q , \Sigma , \delta , q_0 , F)$
- Where
- Q is a finite set of internal states
- Σ is a finite set of symbols called the input alphabet
- $\delta : Q \times \Sigma \rightarrow Q$ is a Total Function called Transition Function
- q_0 is an initial state $q_0 \in Q$
- F is a set of final states $F \subseteq Q$

Q. Design FSM for accepting set of all strings over $\Sigma = \{0, 1\}$, that end with '00'.

With the given condition, the transition state diagram can be drawn as:



The tuples of the FA can be explained as

$Q = \{q_0, q_1, q_2\}$
$F = \{q_2\}$
$q_0 = q_0$
$\Sigma = \{0, 1\}$

The transition mapping function 'δ' becomes -

	0	1
q_0	q_1	q_0
q_1	q_2	q_0
q_2	q_2	q_0

Taking into consideration two strings as exampl

① 0010

$\delta(q_0, 0) = q_1$

$\delta(q_1, 0) = q_2$

$\delta(q_2, 1) = q_0$

$\delta(q_0, 0) = q_0$

As $q_0 \notin F$, string '0010' is Rejected by the FSM.

② 1100

$\delta(q_0, 1) = q_0$

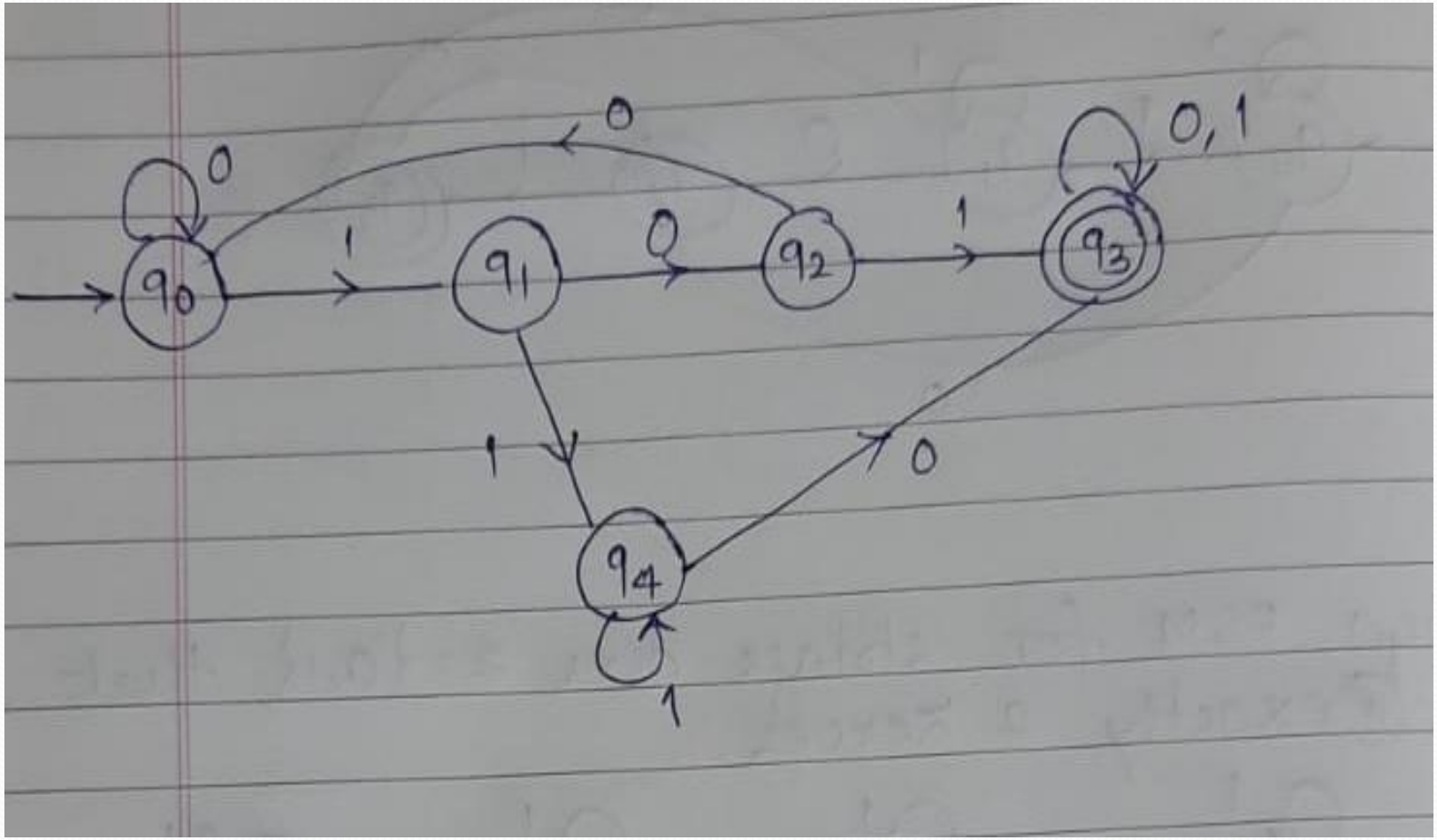
$\delta(q_0, 1) = q_0$

$\delta(q_0, 0) = q_1$

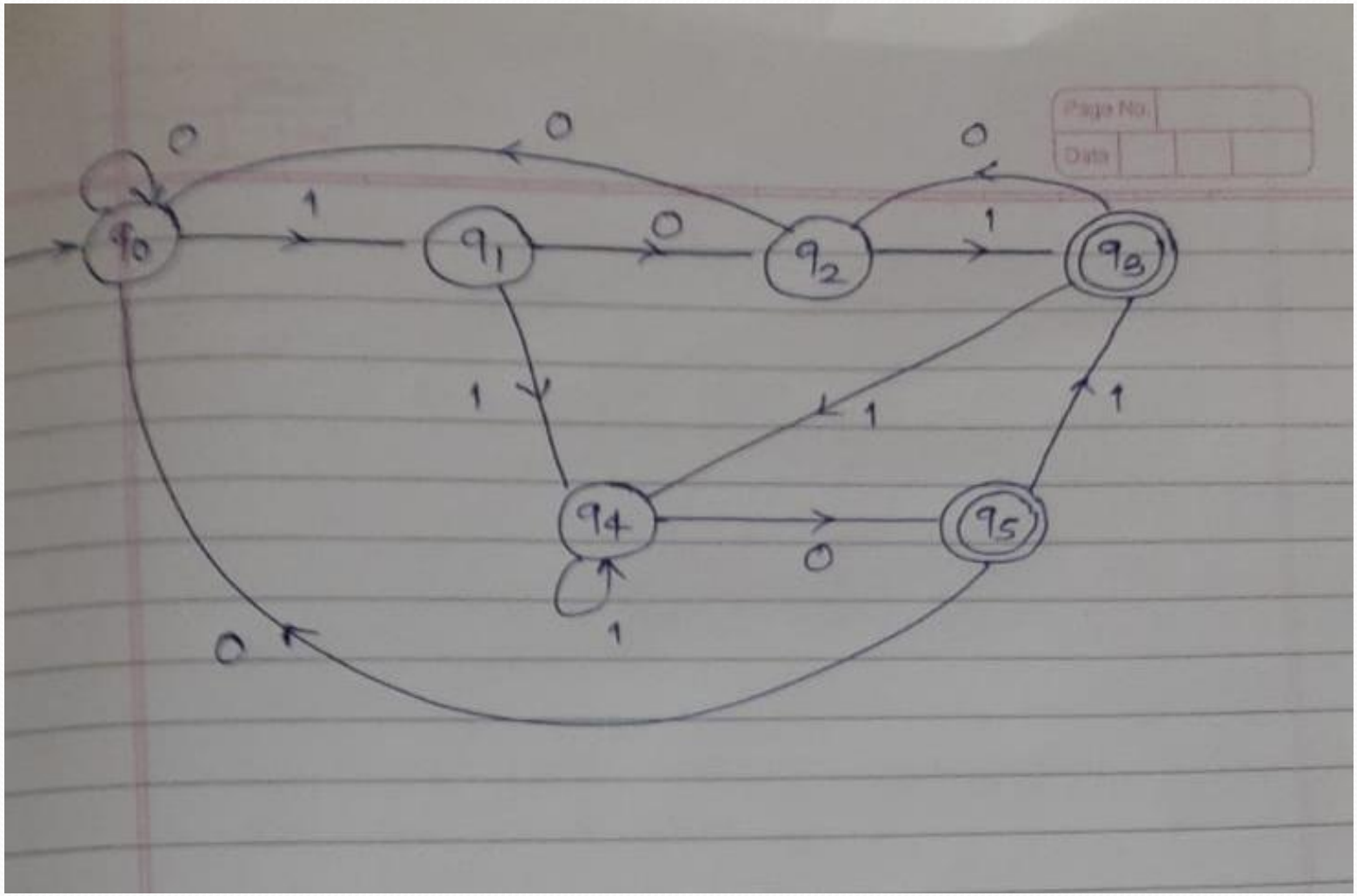
$\delta(q_1, 0) = q_2$

As $q_2 \in F$, the string '1100' is Accepted by the machine.

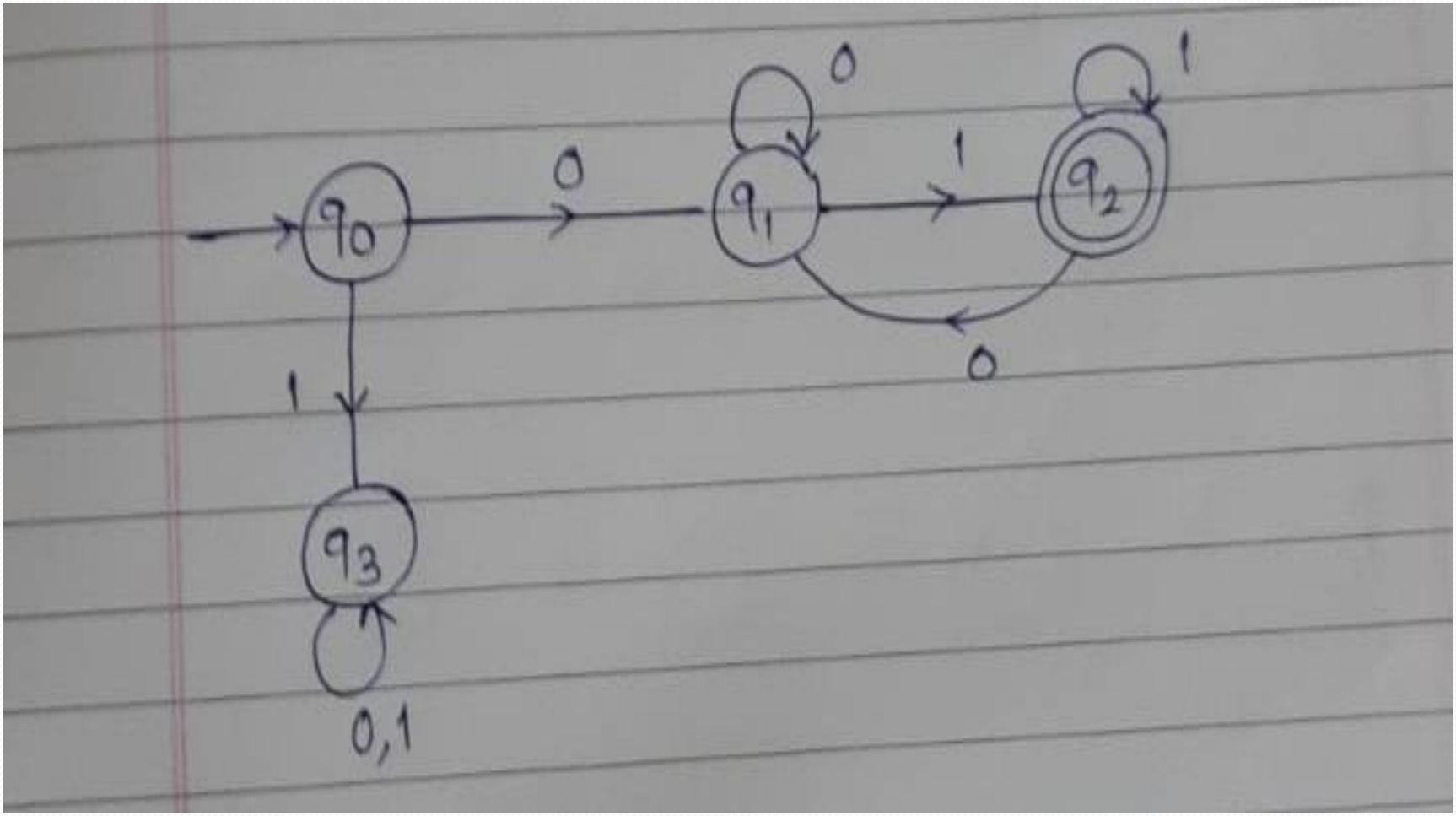
- Design an FSM for strings containing ‘101’ or ‘110’ as substrings



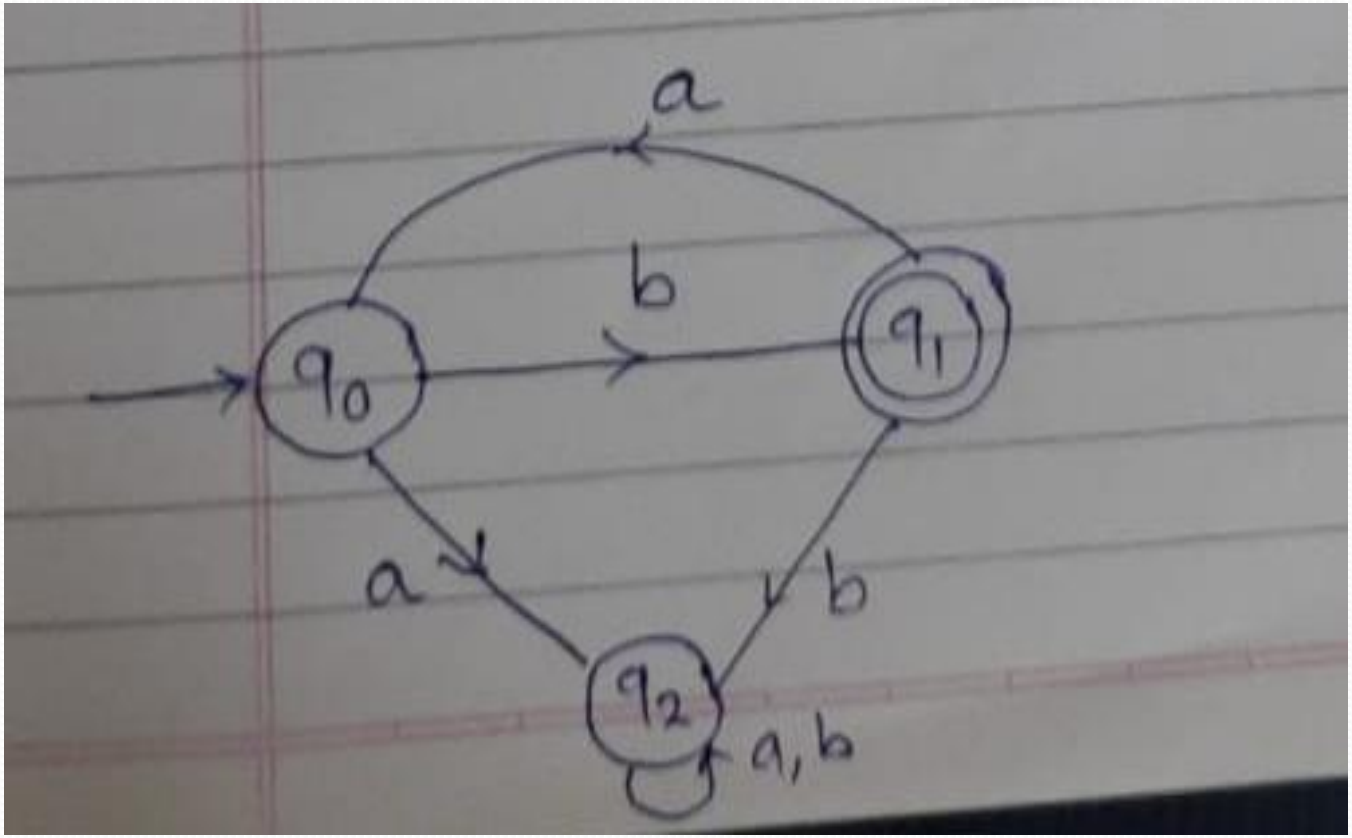
- Design an FSM for strings ending with ‘101’ or ‘110’



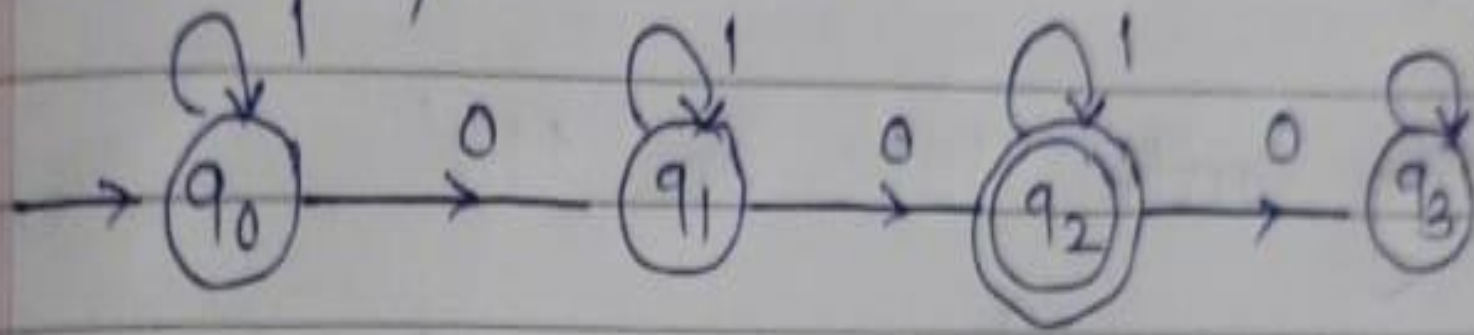
- FSM for Stings starting with a ‘0’ and ending with a ‘1’



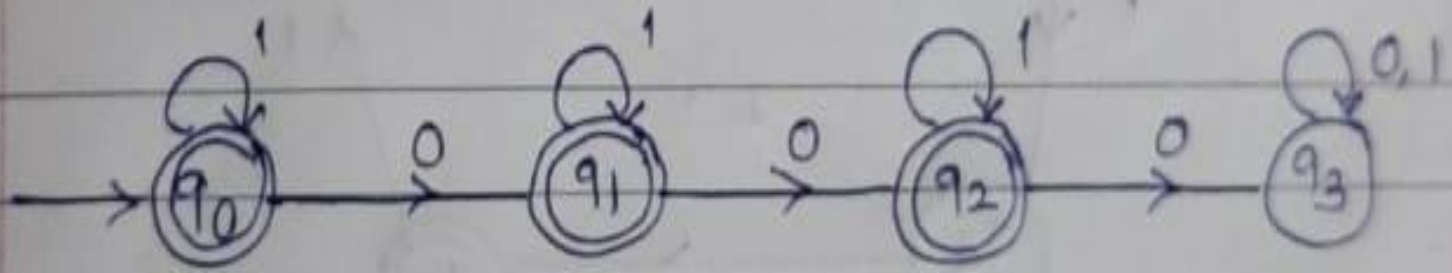
- FSM for Stings starting with even positioned ‘a’s and odd positioned ‘b’s



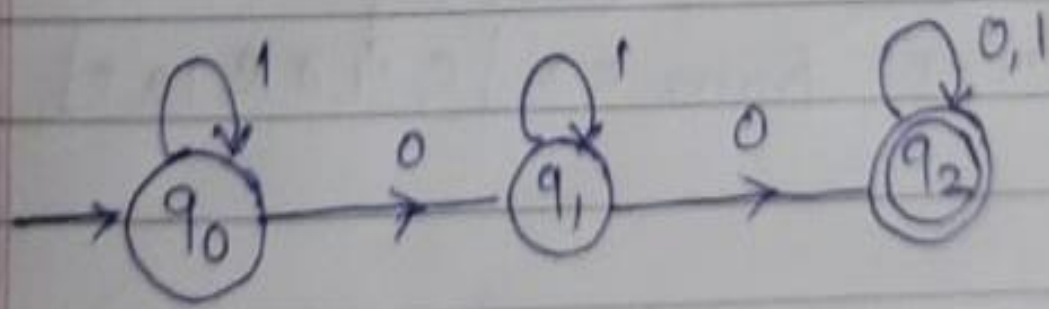
Q. Design FSM for strings over $\Sigma = \{0,1\}$, that have exactly 2 zeroes.



(b) Atmost 2 zeroes



(c) Atleast 2 zeroes.

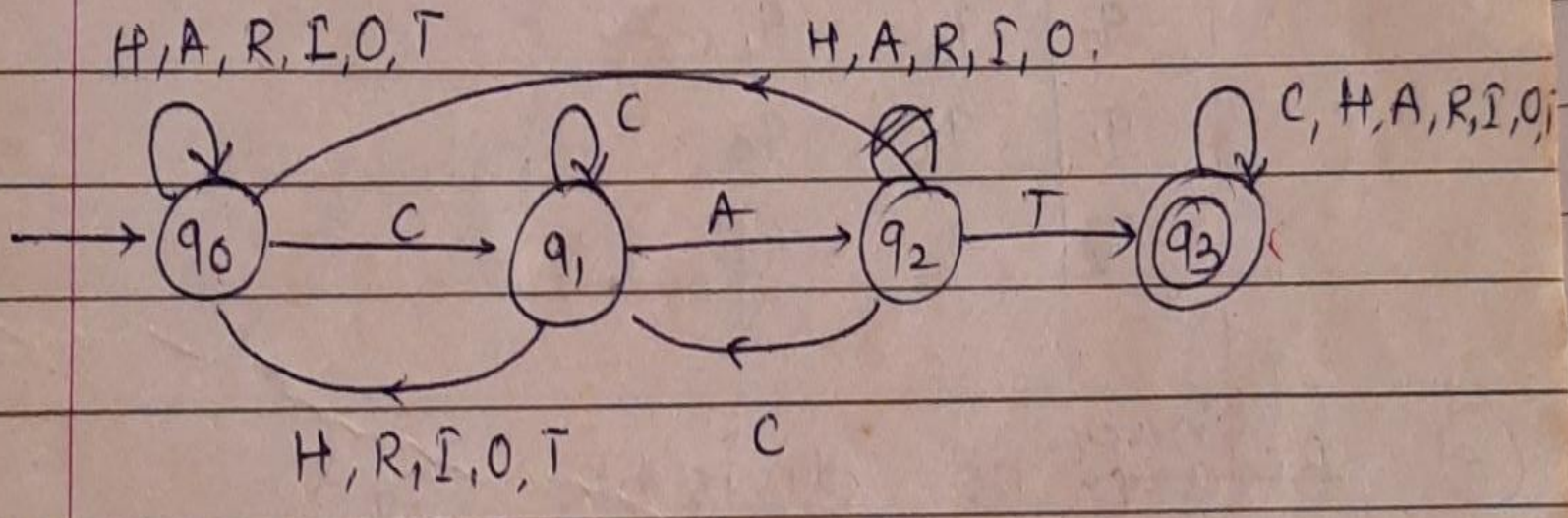


Homework :

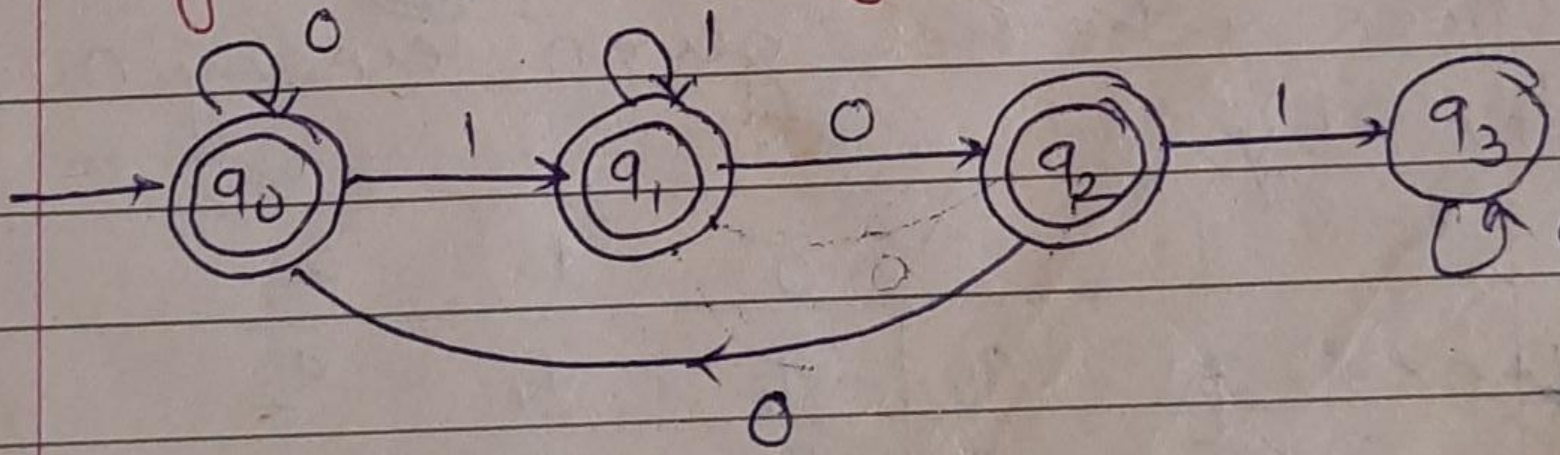
- FSM for strings Not having ‘101’ as a substring

- FSM for recognizing substring ‘CAT’ from input symbols {‘C’, ‘H’, ‘A’, ‘R’, ‘I’, ‘O’, ‘T’ }

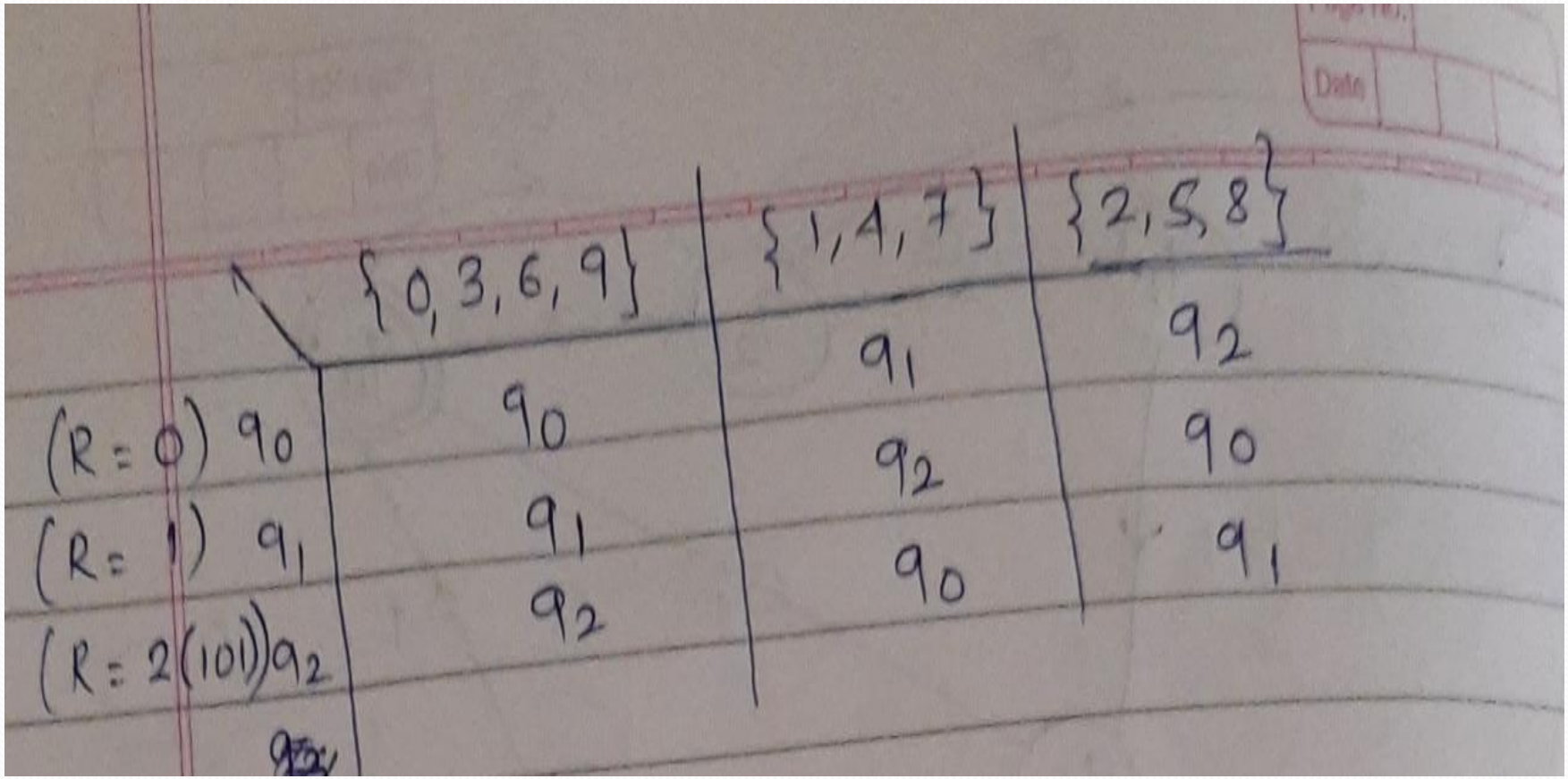
② FSM to recognise substring 'CAT' from set { C, H, A, R, I, O, T }



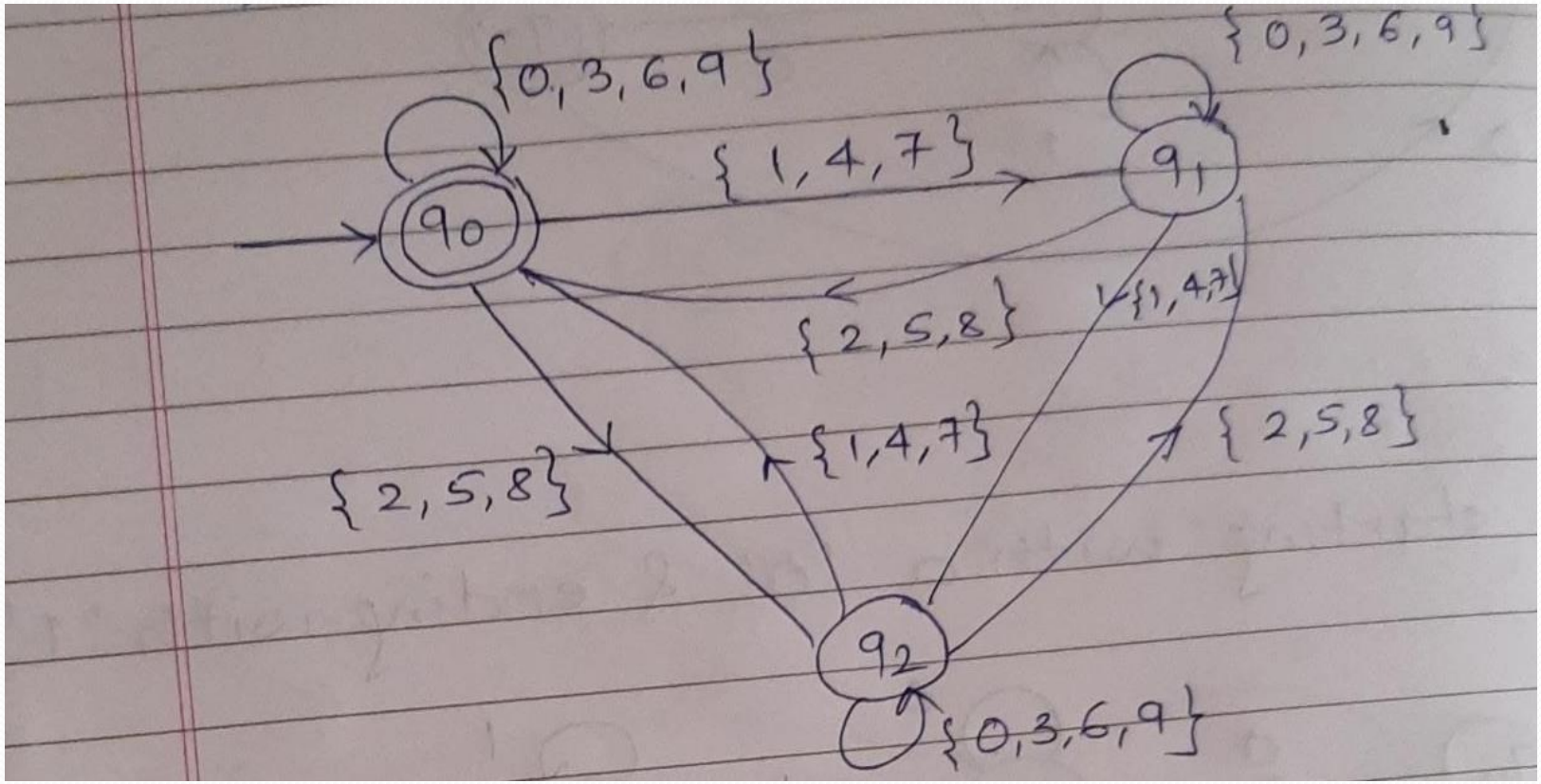
strings not having 101 as substring



- FSM for checking whether a decimal number is divisible by 3



	{0, 3, 6, 9}	{1, 4, 7}	{2, 5, 8}
(R = 0) q_0	q_0	q_1	q_2
(R = 1) q_1	q_1	q_2	q_0
(R = 2 (101)) q_2	q_2	q_0	q_1


{0,3,6,9}
{1,4,7}
{0,3,6,9}
q0
q1
{2,5,8}
{1,4,7}
{1,4,7}
{2,5,8}
{2,5,8}
q2
{0,3,6,9}

e.g. 1002.

$\delta(q_0, 1) = q_1$

$\delta(q_1, 0) = q_1$

$\delta(q_1, 0) = q_1$

$\delta(q_1, 2) = q_0$

As $q_2 \in F$, the string is accepted.

e.g. 25783

$\delta(q_0, 2) = q_2$

$\delta(q_2, 5) = q_1$

$\delta(q_1, 7) = q_2$

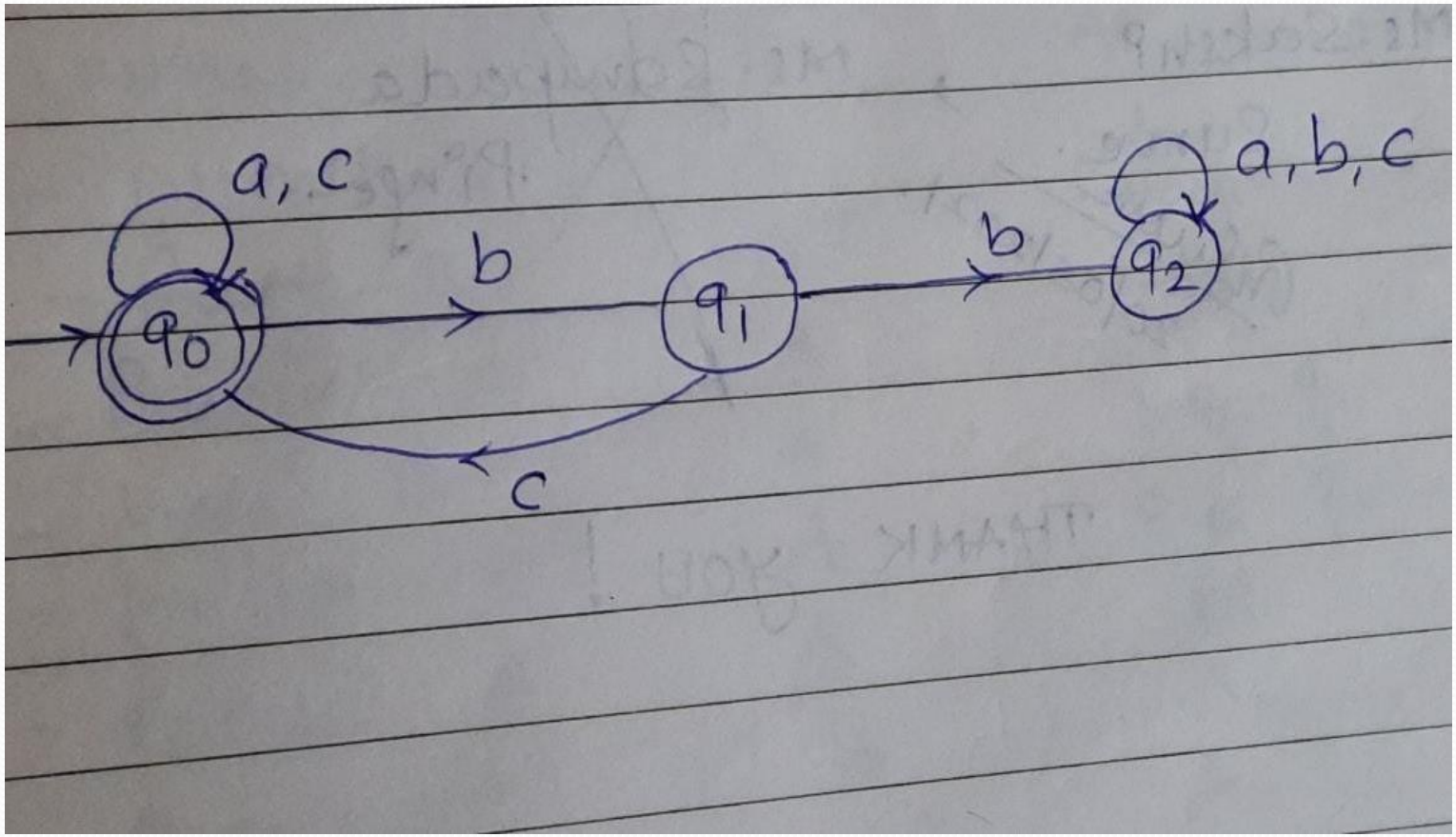
$\delta(q_2, 8) = q_1$

$\delta(q_1, 3) = q_1$

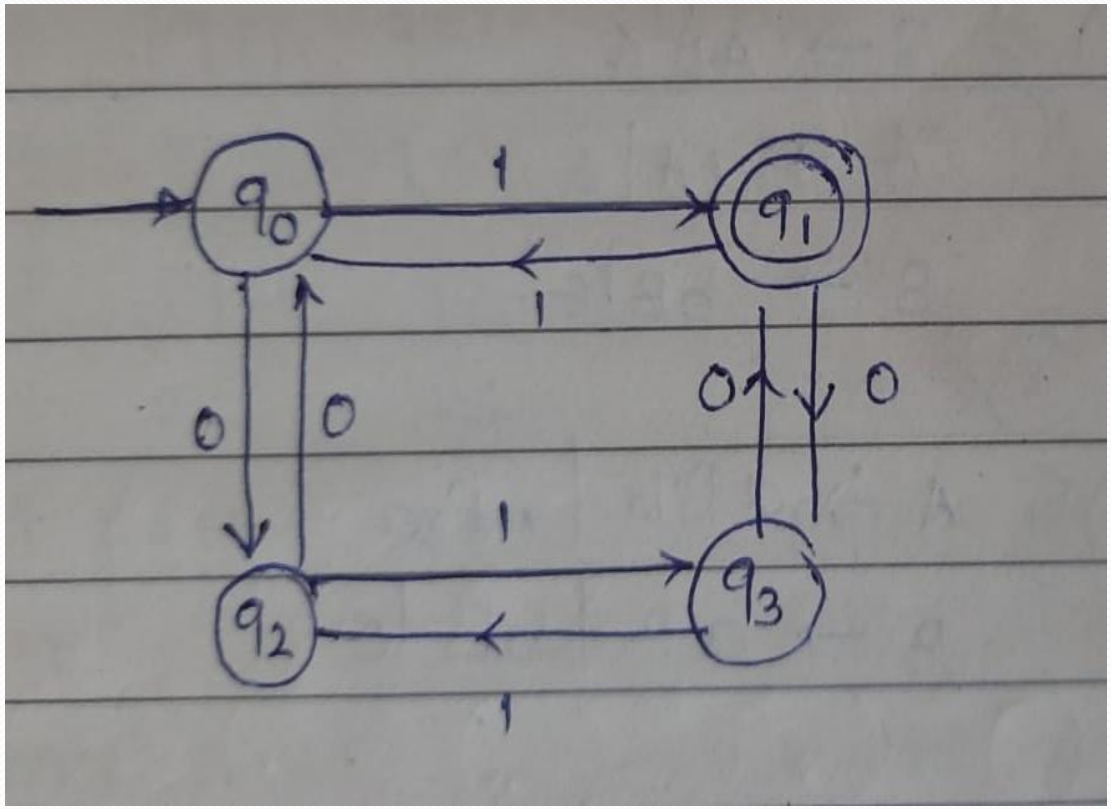
As $q_1 \notin F$, the string is rejected.

Design FSM to accept language

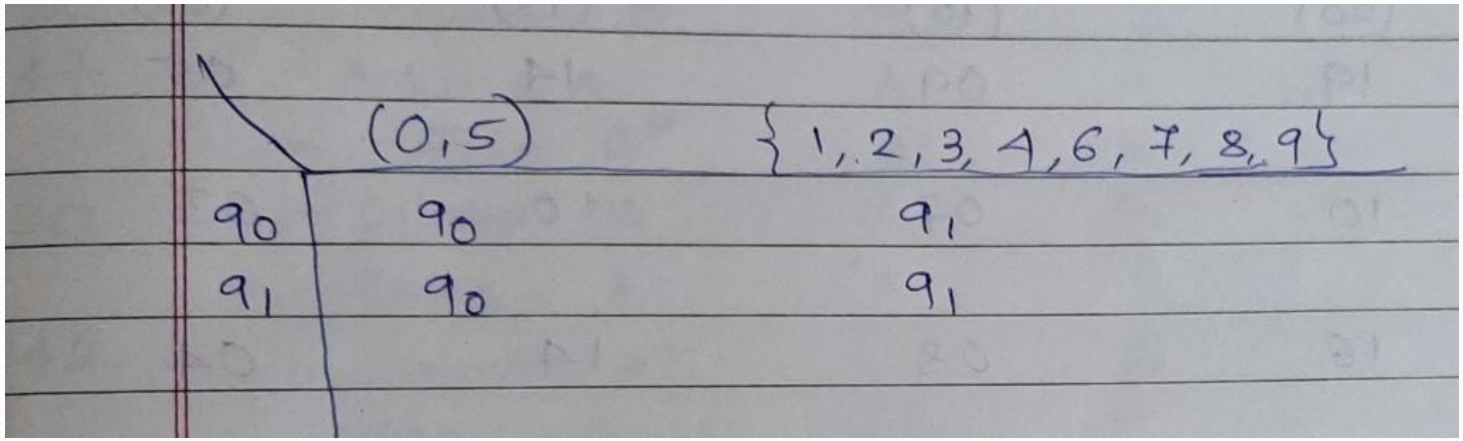
L={x € {a, b, c} * | Every ‘b’ in x is immediately followed by ‘c’ }

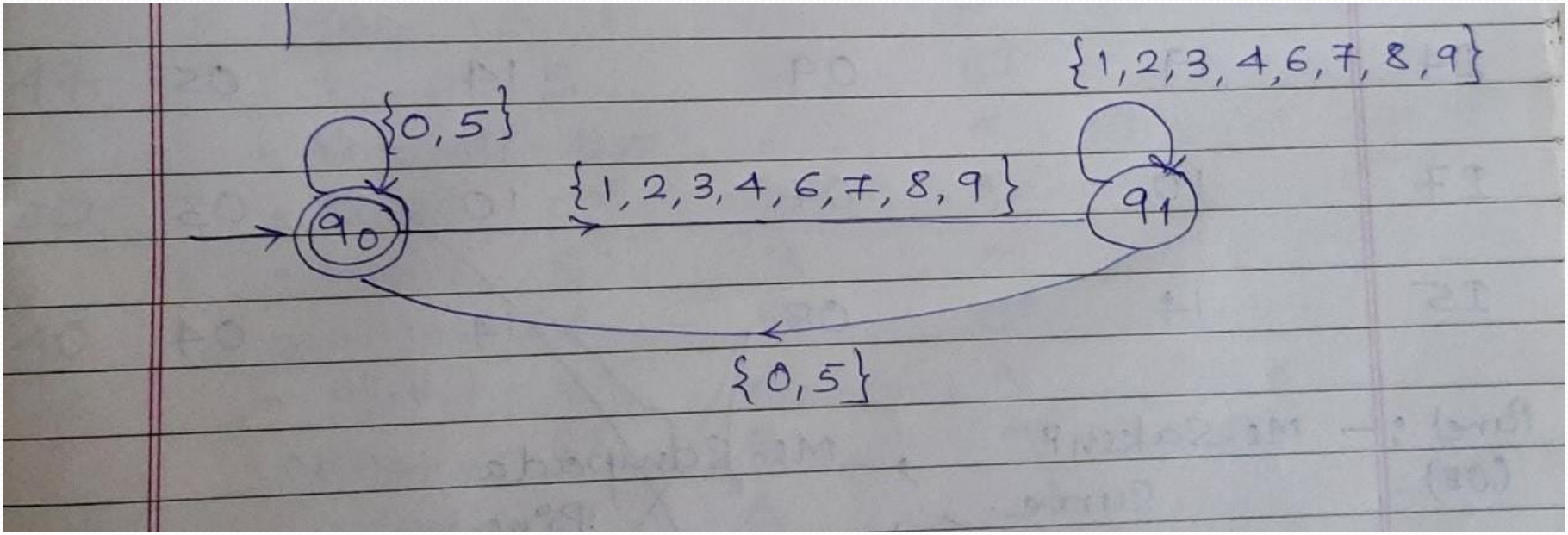


- FMS to accept even number of 0's and add number of 1's



- FSM to check divisibility of a decimal number by 5




{1,2,3,4,6,7,8,9}
{0,5}
{1,2,3,4,6,7,8,9}
q0
q1
{0,5}