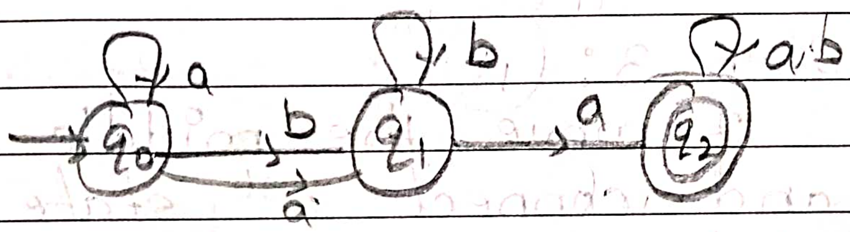
ASSIGNMENT NO:- 03

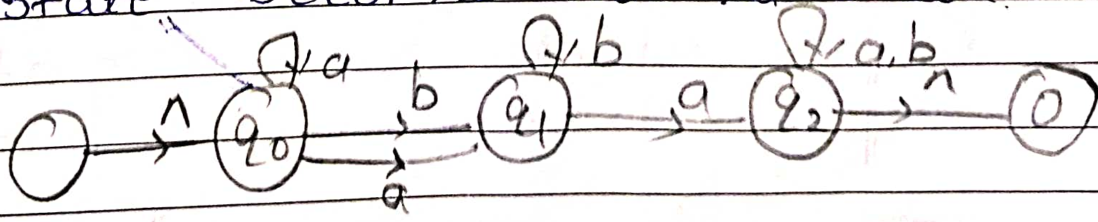
Q1] What is kleene theorem?

⇒ If language can be accepted by TG (Transition Graph) then it can also be expressed by R.E.

Given :-

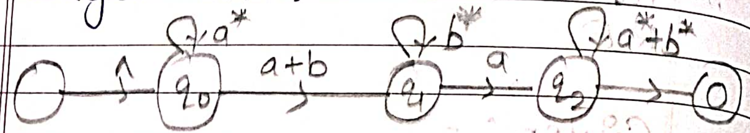


Step 1 :-
Add a new initial state & give null transition to previous initial state. Also, add a new final state and give a null transition from previous accepting state and ~~giv~~ previous accepting state becomes normal state.



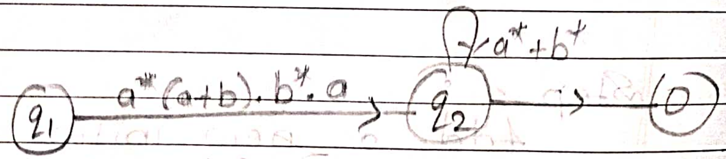
Step 2 :-

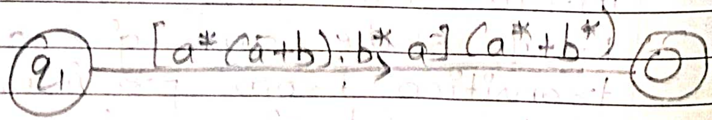
Try to Reduce the transaction. If a state has two (more than one) incoming transition edges, then replace all transition edges with '+', '*' as required.



Step 3 :-

Remove the middle state and connect 1st state to 3rd state.





Q2] Explain minimization of FSA for a regular language.

⟹ Minimization of DFA means reducing the no. of state from given FA.

We have to follow the various-steps to minimize the FSA

Step 1 :- Remove all the states that are unreachable from the initial state via any set of transition of DFA

Step 2 :- Draw the transition table for all pairs of states.

Step 3 :- Now split the transition table into two tables T_1 & T_2. T_1 contains all final states & T_2 contains non-final states

Step 4 :- Find similar rows from T_1. That means, find two states which have the same value of a & b. and remove one of them

$\delta(q,a) = p$

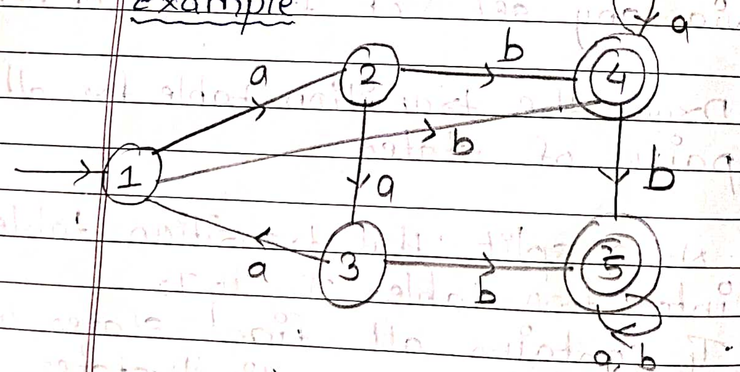
$\delta(r,a) = p$

Step 5 : Repeat step 3 until we find no similar rows available in the Transition Table T_1.

Step 6 : Repeat step 3 & step 4 for Table T_2 also.

Step 7 : Now combine the reduced T_1 & T_2 tables. The combined table is transition table of minimized FSA.

Example



States	a	b
1	2	4
2	3	4
3	1	5
4	4	5
5	5	5

$\pi_0 = \{\text{Accepting state}\}\{\text{Non-accepting}\}$
$= \{4, 5\} \ \{1, 2, 3\}$
$= \{\pi_{01}, \ \pi_{02}\}$

$\pi_{01} = \{4, 5\}$

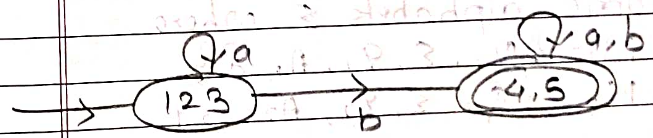
$\left.\begin{array}{l}\delta(4,a) = 4 \\ \delta(5,a) = 5\end{array}\right\} \in \pi_{01}$ $\quad$ $\left.\begin{array}{l}\delta(4,b) = 5 \\ \delta(5,b) = 5\end{array}\right\} \in \pi_{01}$

$\pi_{02} = \{1, 2, 3\}$

$\left.\begin{array}{l}\delta(1,a) = 2 \\ \delta(2,a) = 3 \\ \delta(3,a) = 1\end{array}\right\} \in \pi_{02}$ $\quad$ $\left.\begin{array}{l}\delta(1,b) = 4 \\ \delta(2,b) = 4 \\ \delta(3,b) = 5\end{array}\right\} \in \pi_{01}$

$\pi_1 = \{\{1,2,3\}, \{4,5\}\}$

Minimized F.A :



Q3] Explain kleene's theorem part-1 with proof?

⟹ Kleene's theorem states that for every Regular Expression of a language, there exists a Finite Automata.

Regular Expressions are composed of unions, concatenation & kleene's star.

Kleene's theorem defines rules to perform these operation on regular expressions to convert them into finite Automata.

- **Union Operation**

Let M_1 & M_2 are the given two automata with same alphabets Σ, where,

$M_1 = \{Q_1, \Sigma, q_1, A_1, \delta_1\}$

$M_2 = \{Q_2, \Sigma, q_2, A_2, \delta_2\}$

$M_u = M_1 \cup M_2 = \{Q_u, \Sigma, q_u, A_u, \delta_u\}$

Here,

$Q_u = Q_1 \cup Q_2$

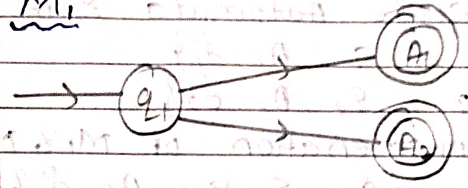
q_u = New initial state

$\delta(q_u, \lambda) = \{q_1, q_2\}$

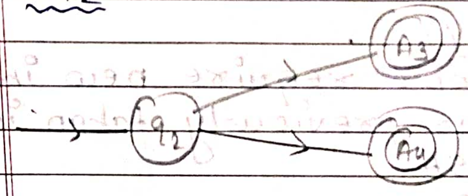
$A_u = A_1 \cup A_2$

$\delta_u = (\delta_1, \delta_2, q_i) \ \forall \ q_i \in \Sigma$

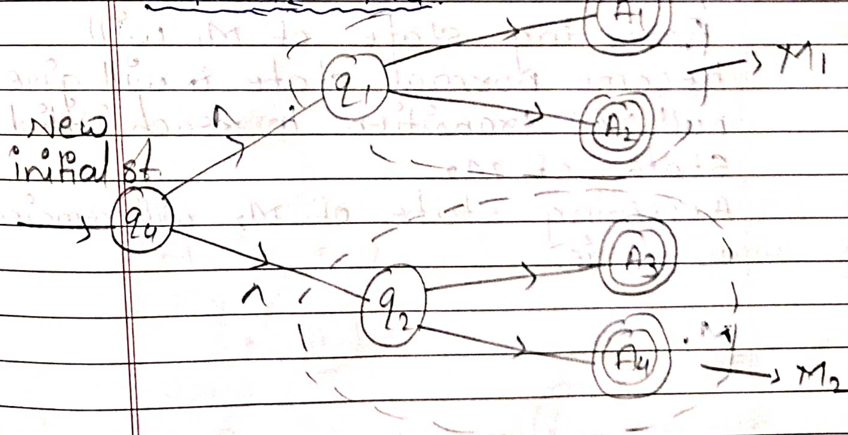
M_1



M_2



$M_1 \cup M_2 = M_u$

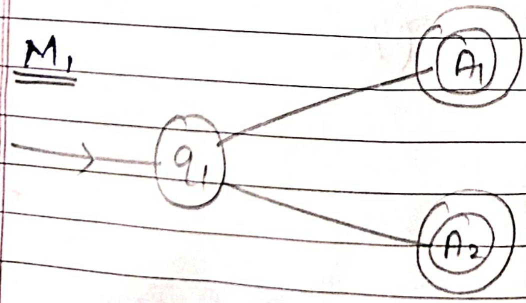


Concatenation Operation :

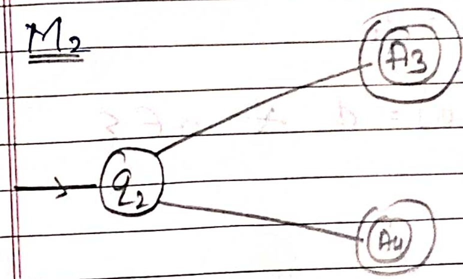
If M_1 & M_2 are given 2 Finite state Automata with
$M_1 = \{Q_1, \Sigma, q_1, A_1, \delta_1\}$
$M_2 = \{Q_2, \Sigma, q_2, A_2, \delta_2\}$
then concatenation of M_1 & M_2 will be $M_c = \{Q_c, \Sigma, q_c, A_c, \delta_c\}$
Here,
$q_c = q_1$,
we don't require new initial state as previously taken in 'U' of 2 FSA
$Q_c = Q_1 \cup Q_2$

Accepting state of M_1 will become normal state & will give null 'Λ' transition to reach initial state of M_2.
Accepting state of M_2 will remain as it is

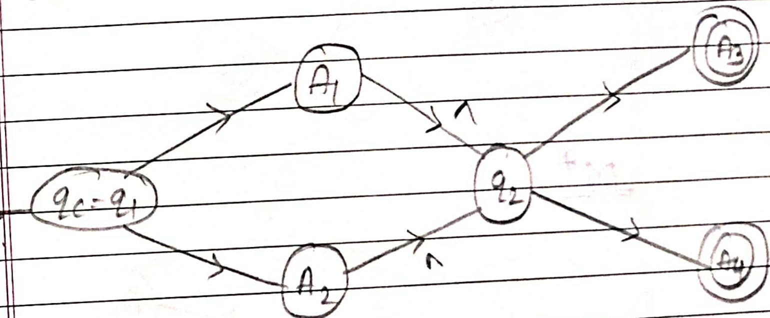
M_1



M_2



$M_1 \cdot M_2 = M_c$



Kleene Operation

If M is a given FSA with $M = \{Q, \Sigma, q_0, A, \delta\}$ then kleene operation on M is 'M_K'
$M_K = \{Q_K, \Sigma, q_K, A_K, \delta_K\}$
Here,
q_K is a new initial state apart from Q. Hence $\boxed{Q_K = Q \cup q_K}$

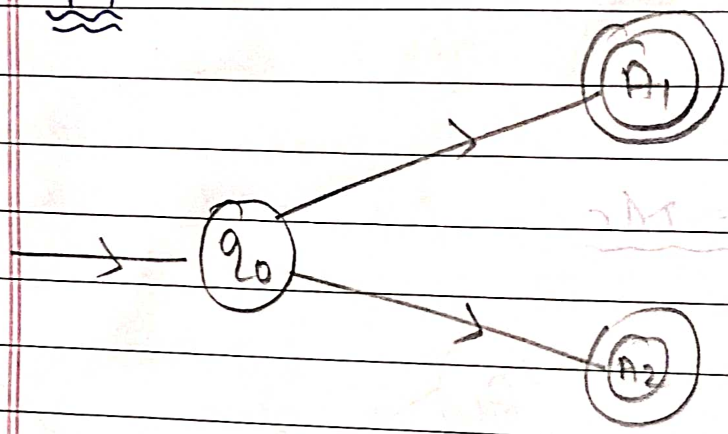
Also, $\boxed{A_K = q_K}$

$$\delta_K(q_K, \Lambda) = q_0$$

&

$$\delta_K(q_K, a) = \phi \quad \forall \; a \in \Sigma$$

M



M^*