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Ques-1 Given,

$A = \{1, 2, 3, 4\}$

$B = \{2, 4, 3, 1\}$

Since, $\forall x \in A \; \exists \; x \in B$

Hence, both set A & B are equal

Q2 $A = \{1, 3, 5, 7\}$ $n = 4$

Subsets of A $= 2^n = 2^4 = 16$

$\{3\}, \{1\}, \{3\}, \{5\}, \{7\}, \{1, 3\}, \{1, 5\}, \{1, 7\}, \{3, 5\}, \{3, 7\}$
$\{5, 7\}, \{1, 3, 5\}, \{1, 3, 7\}, \{1, 5, 7\}, \{3, 5, 7\}, \{1, 3, 7\}$

Q3: $A = \{1, 2, 3, 4, 5 - - -\}$

$A = \{x \in N \mid x \geq 1\}$

Q4: Given $A = \{1, 3, 5, 7, 9, 11\}$

$B = \{1, 2, 3, 13\}$

$A - B = \{5, 7, 9, 15\}$

$B - A = \{2, 1, 3\}$

Q5 Given, $A = \{1, 3, 5\}$ $B = \{2, 4, 6\}$ $C = \{1, 5, 7\}$

$B \cup C = \{1, 2, 4, 5, 6, 7\}$

$A \cup (B \cup C) = \{1, 2, 3, 4, 5, 6, 7\}$

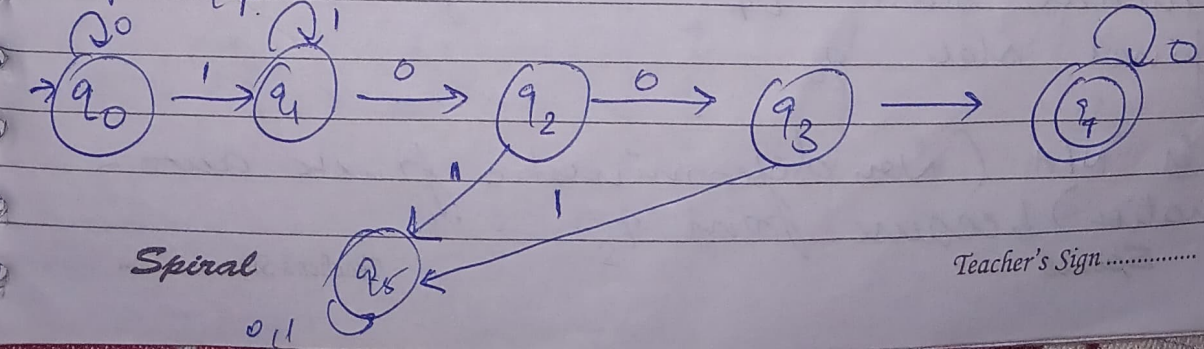
Q3 1. $L = \{1000, 0010, - - -\}$

$Q = q_0, q_1 q_2 q_3 q_4 q_5$

$\Sigma = \{a, b\}$

$q_0 = q_0$

$F = q_4$

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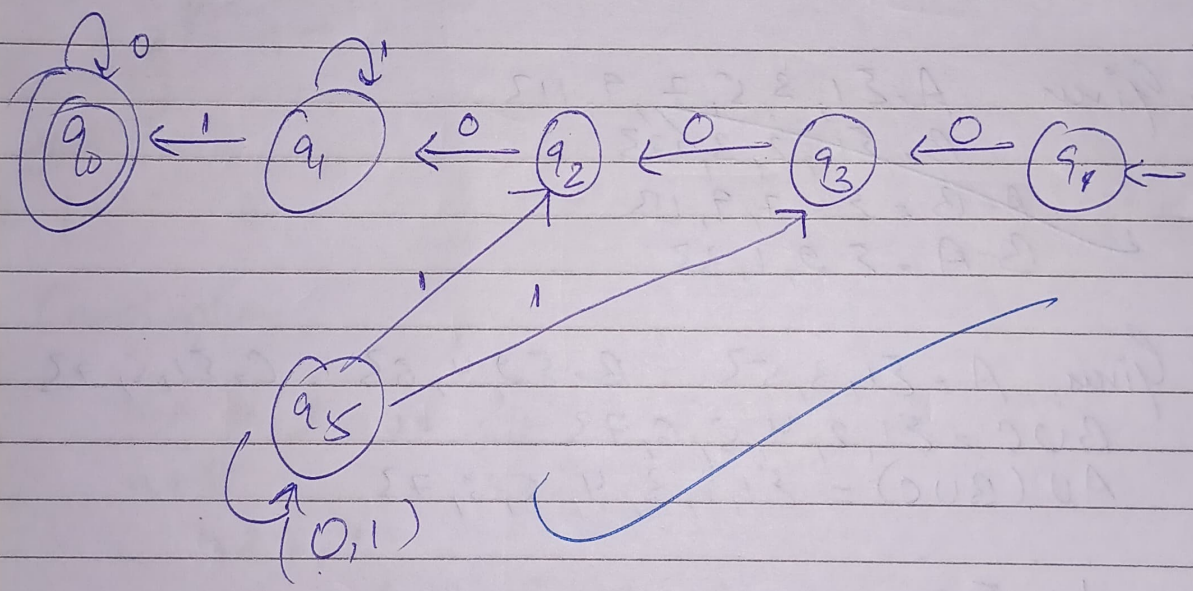
Transition function :-

$\delta : (q_0, 0) = q_0$
$\delta : (q_0, 1) = q_1$
$\delta : (q_1, 0) = q_2$
$\delta : (q_1, 1) = q_1$
$\delta : (q_2, 0) = q_3$
$\delta : (q_2, 1) = q_4$
$\delta : (q_3, 0) = q_4$
$\delta : (q_4, 0) = q_4$
$\delta : (q_4, 1) = q_4$
$\delta : (q_5, 0) = q_5$
$\delta : (q_5, 1) = q_5$

Table

| States | Input 0 | Input 1 |
|---|---|---|
| $q_0$ | $q_0$ | $q_1$ |
| $q_1$ | $q_2$ | $q_1$ |
| $q_2$ | $q_3$ | $q_4$ |
| $q_3$ | $q_4$ | $q_4$ |
| $q_4$ | $q_4$ | $q_4$ |
| $q_5$ | $q_5$ | $q_5$ |




3. yes, it is valid finite automation because it has :-
→ finite no. of states i.e.
→ initial state $q_1$
→ final state $q_0$

It is NFA (Non deterministic finite automation) because from $q_5$ —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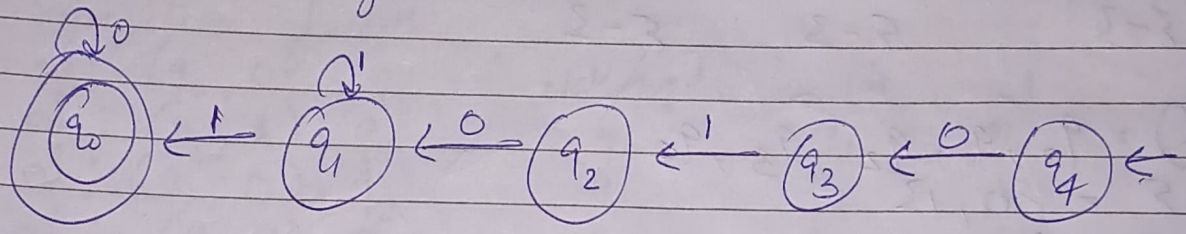
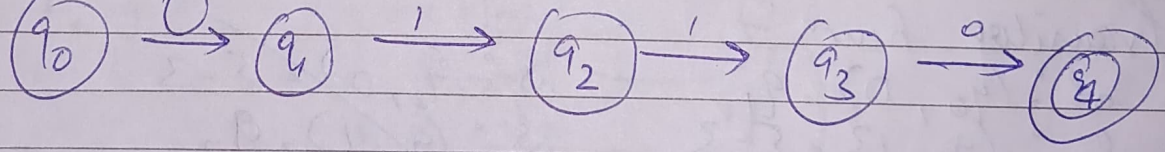
There are 3 possible transitions on 1. In DFA we have at most one transition on 1 In DFA, we have at most one transitio from each symbol.

Q:- Step-1 Remove unreachable states → $q_5$ (no incoming edge, only self loop)
Step-2 (Diagram)




Q) Given,
string begins with 01
string ends ~~with~~ TO

NFA
$Q = q_0, q_1, q_2, q_3, q_4$
$\Sigma = \{0, 1\}$
$q_0 = q_0$
$F = q_4$




Transition func$^n$ :-
$\delta : (q_0, 0) = q_1$
$\delta : (q_1, 1) = q_2$
$\delta : (q_2, 1) = q_3$
$\delta : (q_3, 0) = q_4$

Transition table

| State/Input | 0 | 1 |
|---|---|---|
| $q_0$ | $q_1$ | – |
| $q_1$ | – | $q_2$ |
| $q_2$ | – | $q_3$ |
| $q_3$ | $q_4$ | – |
| $q_4$ | – | – |

Date.....

DFA

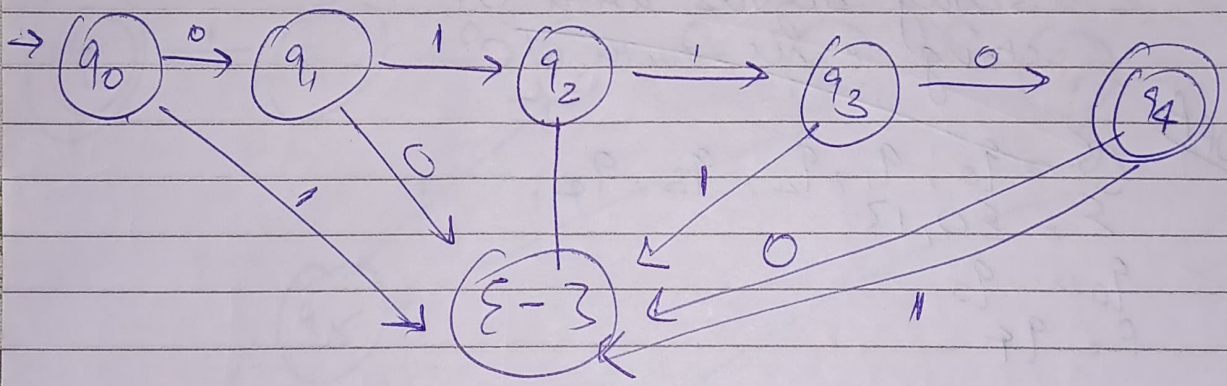
| State/Input | 0 | 1 |
|---|---|---|
| $q_0$ | $q_1$ | $\xi-3$ |
| $q_1$ | $\xi-3$ | $q_2$ |
| $q_2$ | $\xi-3$ | $q_3$ |
| $q_3$ | $q_4$ | $\xi-3$ |
| $q_4$ | $\xi-3$ | $\xi-3$ |
| $\xi-3$ | $\xi-3$ | $\xi-3$ |

$Q = q_0, q_1, q_2, q_3, q_4$

$\Sigma = \{0, 1\}$

$F = q_4$

$q_0 = q_0$




Transition func$^n$ :-

$\delta : (q_0, 0) = q_1$
$\delta : (q_0, 1) = \xi-3$
$\delta : (q_1, 0) = \xi-3$
$\delta : (q_1, 1) = q_2$
$\delta : (q_4, 0) = \xi-3$
$\delta : (q_2, 0) = \xi-3$
$\delta : (q_2, 1) = q_3$
$\delta : (q_3, 0) = q_4$
$\delta = \{q_3, 1) = \xi-3$
$\delta : (q_4, 1) = \xi \rightarrow$

Q: Given — $L = \{0000, 1000, 10001\}$ — 3

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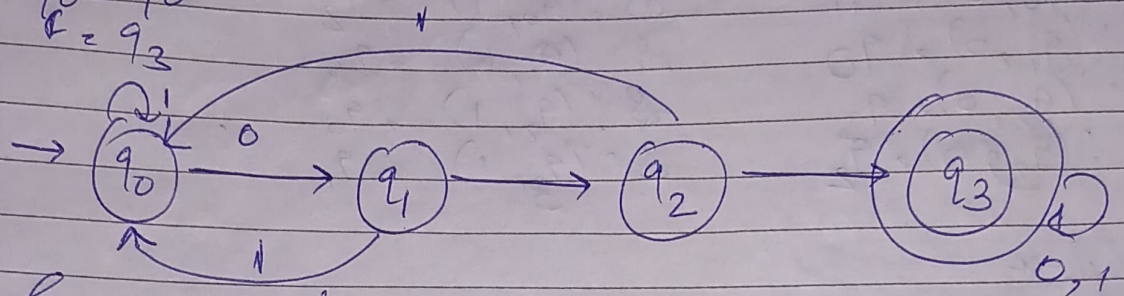
Q. $Q = q_0, q_1, q_2, q_3$
$\Sigma = \{0, 1\}$
$q_0 = q_0$
$F = q_3$

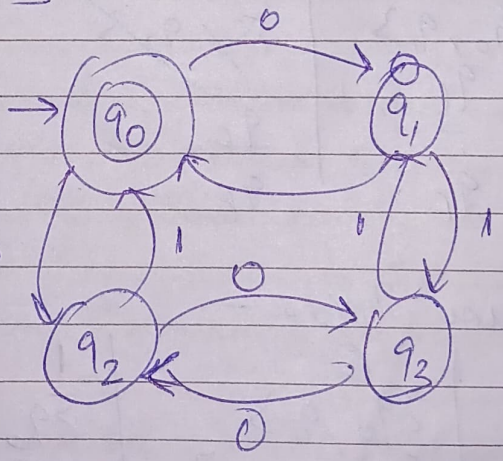



Transition func$^n$

$\delta : (q_0, 0) = q_1$
$\delta : (q_0, 1) = q_1$
$\delta : (q_1, 0) = q_2$
$\delta : (q_1, 1) = q_0$
$\delta : (q_2, 0) = q_3$
$\delta : (q_2, 1) = q_0$
$\delta : (q_3, 0) = q_3$
$\delta : (q_3, 1) = q_3$

| state/Inp$^t$ | 0 | 1 |
|---|---|---|
| $q_0$ | $q_1$ | $q_1$ |
| $q_1$ | $q_2$ | $q_0$ |
| $q_2$ | $q_3$ | $q_0$ |
| $q_3$ | $q_3$ | $q_3$ |

Q6. $L = \{$"0011", "00110011", ---$\}$
$Q = q_0, q_1, q_2, q_3$
$\Sigma = \{0, 1\}$
$q_0 = q_0$
$F = q_0$




| State/Inp$^t$ | 0 | 1 |
|---|---|---|
| $q_0$ | $q_1$ | $q_2$ |
| $q_1$ | $q_0$ | $q_3$ |
| $q_2$ | $q_3$ | $q_0$ |
| $q_3$ | $q_2$ | $q_1$ |

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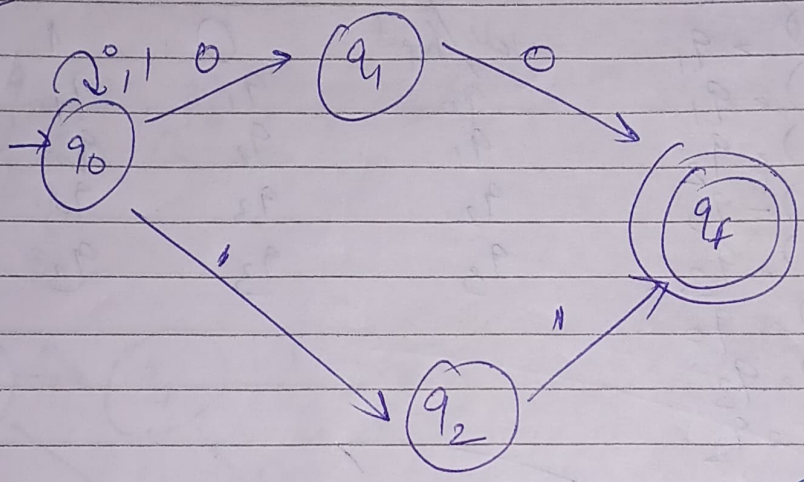
Transition func$^n$ :—

$\delta : (q_0, 0) = q_1$ $\quad$ $\delta : (q_0, 1) = q_2$
$\delta : (q_1, 0) = q_0$ $\quad$ $\delta : (q_1, 1) = q_3$
$\delta : (q_2, 0) = q_3$ $\quad$ $\delta : (q_2, 1) = q_0$
$\delta : (q_3, 0) = q_2$ $\quad$ $\delta : (q_3, 1) = q_1$

Q) Given NFA:




NFA

| State / Input | 0 | 1 |
|---|---|---|
| $q_0$ | $\{q_0, q_1\}$ | $\{q_0, q_2\}$ |
| $q_1$ | $q_f$ | |
| $q_2$ | – | $q_f$ |
| $q_f$ | $q_f$ | $q_f$ |

DFA transition table :—

| $q_0$ | 0 | 1 |
|---|---|---|
| $q_0$ | $\{q_0, q_1\}$ | $\{q_0, q_2\}$ |
| $\{q_0, q_1\}$ | $\{q_0, q_1, q_f\}$ | $\{q_0, q_2\}$ |
| $\{q_0, q_2\}$ | $\{q_0, q_1\}$ | $\{q_0, q_1, q_f\}$ |
| $\{q_0, q_1, q_f\}$ | $\{q_0, q_1, q_f\}$ | $\{q_0, q_2, q_f\}$ |
| $\{q_0, q_f, q_f\}$ | $\{q_0, q_1, q_f\}$ | $\{q_0, q_2, q_f\}$ |

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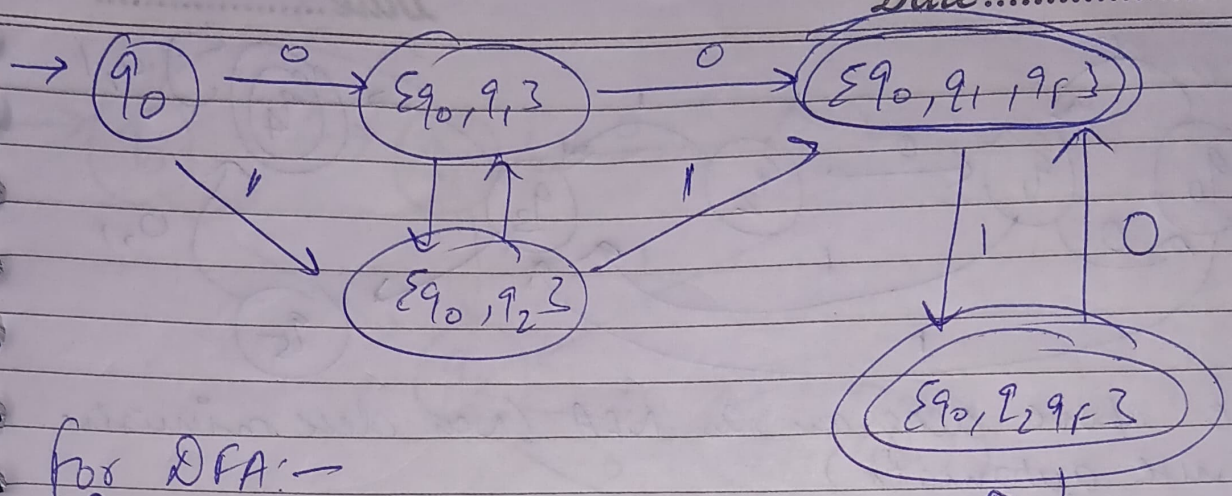


For DFA:-

Q = $q_0$ $\{q_0, q_1\}$, $\{q_0, q_2\}$, $\{q_0, q_1, q_f\}$, $\{q_0, q_2, q_f\}$

$\Sigma = \{0, 1\}$

$q_0 = q_0$

$F = \{q_0, q_1, q_f\}$, $\{q_0, q_2, q_f\}$

Transition func$^n$

$\delta: (q_0, 0) = \{q_0, q_1\}$

$\delta: (\{q_0, q_1\}, 0) = \{q_0, q_1, q_f\}$

$\delta: (q_0, 1) = \{q_0, q_2\}$

$\delta: (\{q_1, q_f\}, 1) = \{q_0, q_2\}$

$\delta: (\{q_0, q_2\}, 0) = \{q_0, q_1\}$

$\delta: (\{q_0, q_2\}, 1) = \{q_1, q_f\}$

$\delta: (\{q_0, q_1, q_f\}, 1) = \{q_0, q_2, q_f\}$

$\delta: (\{q_0, q_2, q_f\}) = \{q_0, q_2, q_f\}$

Q8 Step-1 - Remove the unreachable states

Step-2 - Create the transition table of DFA

Step-3 - Create the transition table for non final state

Step-4 - " " " " for final state

Step-5 - Remove duplicate rows from both the tables

Step-6 - Redraw DFA with transition table formed after combining final & non final state table

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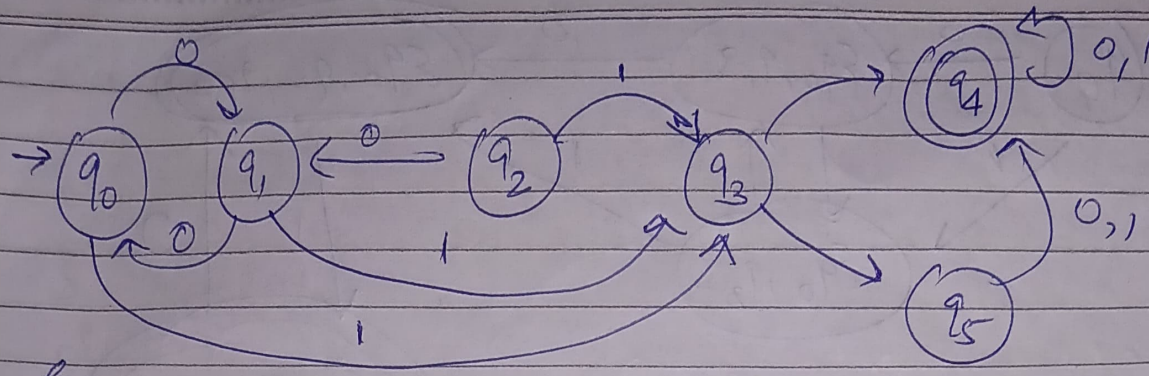


The above diagram is NFA (Non deterministic finite automata)

NFA Transaction table :-

| State/Input | 0 | 1 |
|---|---|---|
| → $q_0$ | $q_1$ | $q_3$ |
| $q_1$ | $q_0$ | $q_3$ |
| $q_2$ | $q_1$ | $q_3$ |
| $q_3$ | $q_4$ | $\{q_4, q_5\}$ |
| ($q_4$) | $q_4$ | $q_4$ |
| $q_5$ | $q_4$ | $q_4$ |

DFA Transition Table :-

| States/Input | 0 | 1 |
|---|---|---|
| → $q_0$ | $q_1$ | $q_3$ |
| $q_1$ | $q_0$ | $q_3$ |
| $q_3$ | $q_4$ | $\{q_4, q_5\}$ |
| $q_4$ | $q_4$ | $q_4$ |
| $\{q_0, q_5\}$ | $\{q_4\}$ | $q_4$ |
| $q_2$ | $q_1$ | $q_3$ |

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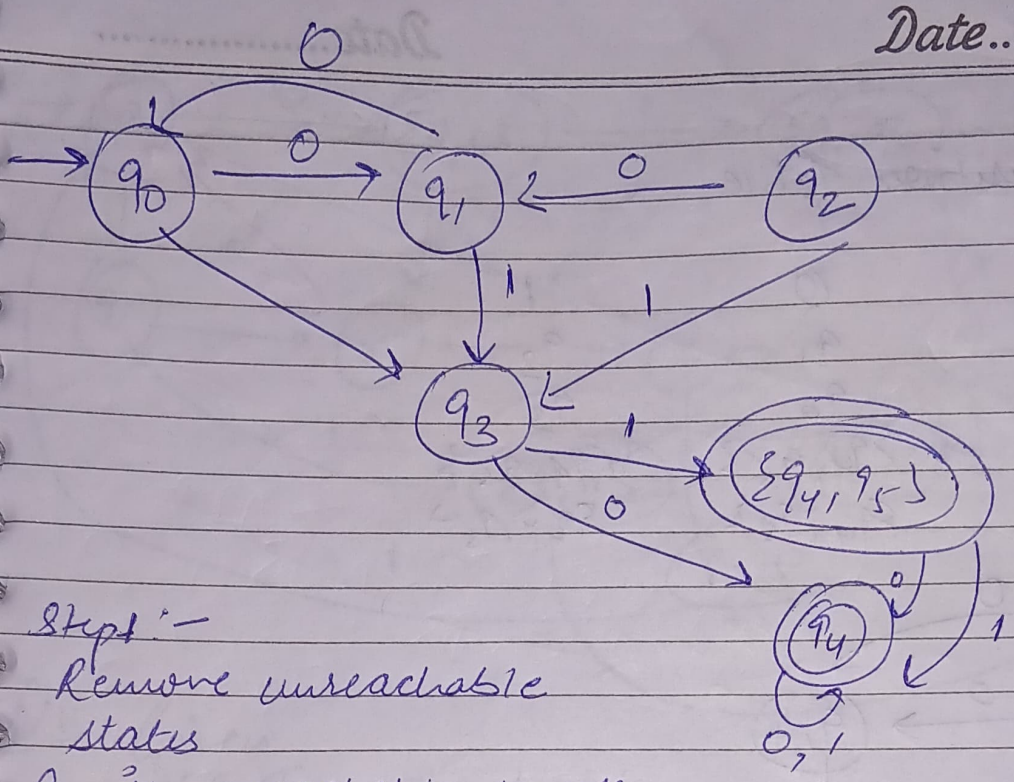


Step1 :-
Remove unreachable states
$q_2$ is unreachable so we remove it

Step-2 :-
DFA transition table

| state/Input | 0 | 1 |
|---|---|---|
| $q_0$ | $q_1$ | $q_3$ |
| $q_1$ | $q_0$ | $q_4$ |
| $q_3$ | $q_4$ | $\{q_4, q_5\}$ |
| $q_4$ | $q_4$ | $q_4$ |
| $\{q_4, q_5\}$ | $q_4$ | $q_4$ |

Step 3 Remove duplicate rows
$q_4$ & $\{q_4, q_5\}$ are duplicate rows so we replace $q_4$ with $\{q_4, q_5\}$ from final states table

Step 3 Transition table (Non final)

| state/Input | 0 | 1 |
|---|---|---|
| $q_0$ | $q_4$ | $q_3$ |
| $q_1$ | $q_0$ | $q_3$ |
| $q_3$ | $q_4$ | $\{q_4, q_5\}$ |
| Spiral | | |

Step 4 Transition table (Final state)

| state/Input | 0 | 1 |
|---|---|---|
| $q_4$ | $q_4$ | $q_4$ |
| $\{q_4, q_5\}$ | $q_4$ | $q_4$ |

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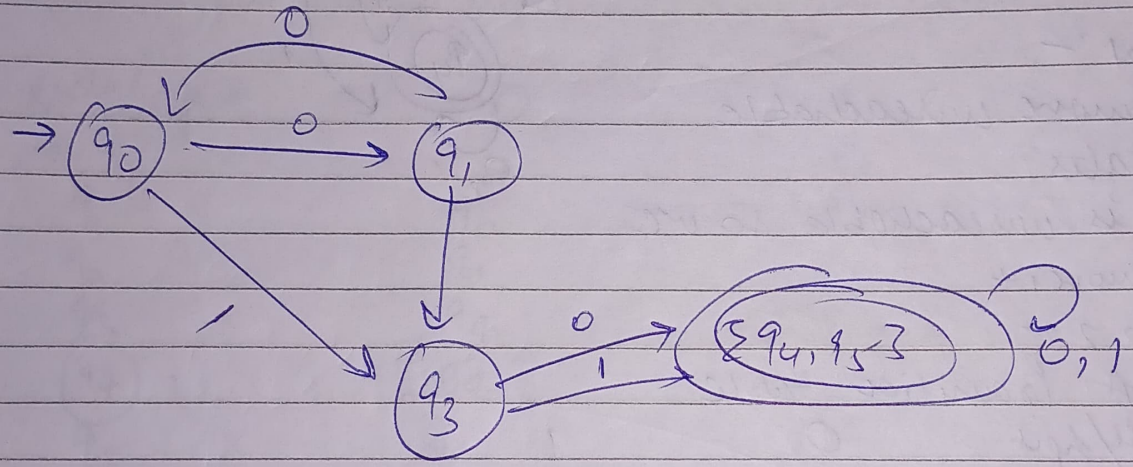
Step-6
Final Transition Table

| State / Input | 0 | 1 |
|---|---|---|
| $q_0$ | $q_1$ | $q_3$ |
| $q_1$ | $q_0$ | $q_3$ |
| $q_3$ | $\{q_4, q_5\}$ | $\{q_4, q_5\}$ |
| $\{q_4, q_5\}$ | $\{q_4, q_5\}$ | $\{q_4, q_5\}$ |




Q:

| S | 0 | 1 |
|---|---|---|
| p | {q, s} | {q} |
| q | {r} | {q, r} |
| r | {s} | {p} |
| s | - | {p} |

| δ | 0 | 1 |
|---|---|---|
| p | {q, s} | {q} |
| q | {r} | {q, r} |
| {q, s} | {r} | {q, p} |
| r | {s} | {p} |
| {q, r} | {r, s} | {q, r, p} |
| {q, p} | {r, q, s} | {q, r} |
| s | {-} | {p} |
| {r, s} | {s} | {p} |
| {q, r, p} | {r, s, q} | {q, r, p} |
| {r, q, s} | {q, r} | {p, q, r} |
| {-} | {-} | {-} |

~~DFA transition table~~

| δ | 0 | 1 |
|---|---|---|

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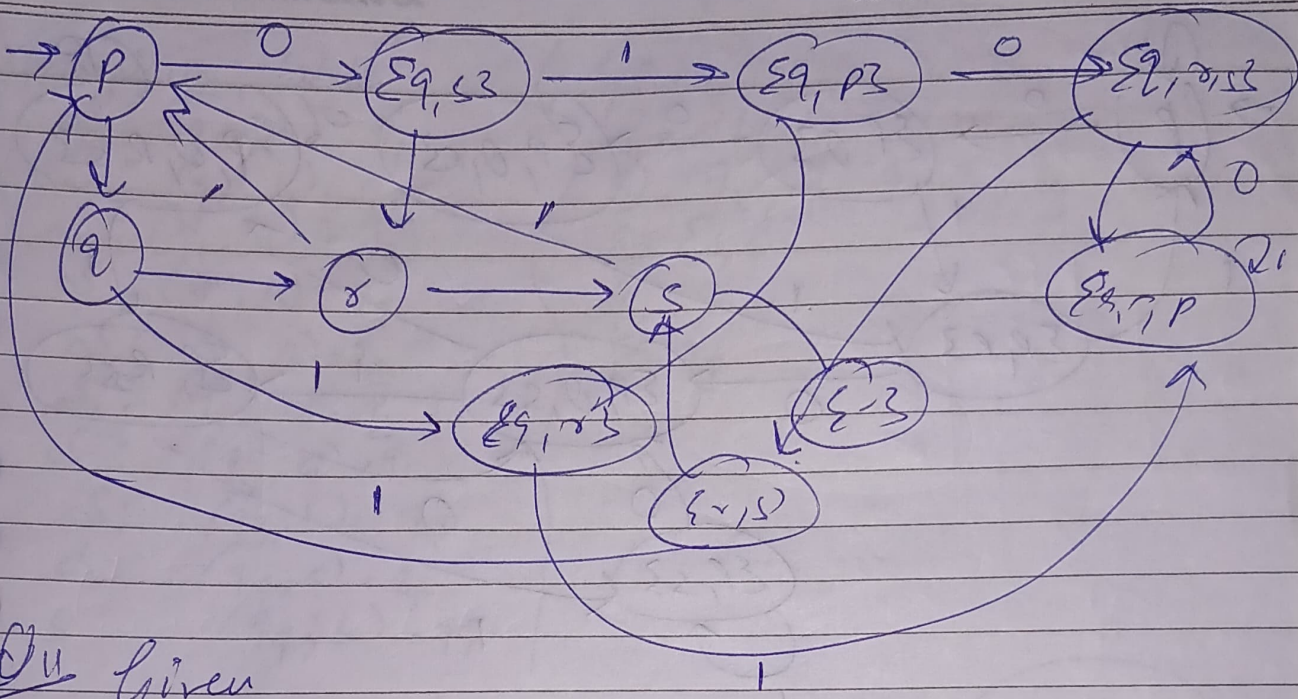


Q11 Given

NFA Transation table:-

| δ | 0 | 1 |
|---|---|---|
| P | {P,Q} | P |
| Q | R | R |
| R | S | - |
| S | S | S |

DFA Transition ta

| δ | 0 | 1 |
|---|---|---|
| P | {P,Q} | P |
| {P,Q} | {P,Q,R} | {P,R} |
| {P,R} | {P,Q,S} | {P} |
| {P,Q,R} | {P,Q,S} | {P,R} |
| {P,Q,S} | {P,Q,R,S} | {P,R,S} |
| {P,R,S} | {P,Q,S} | {P,S} |
| {P,S} | {P,Q,S} | {P,S} |
| {P,Q,R,S} | {P,Q,R,S} | {P,R,S} |

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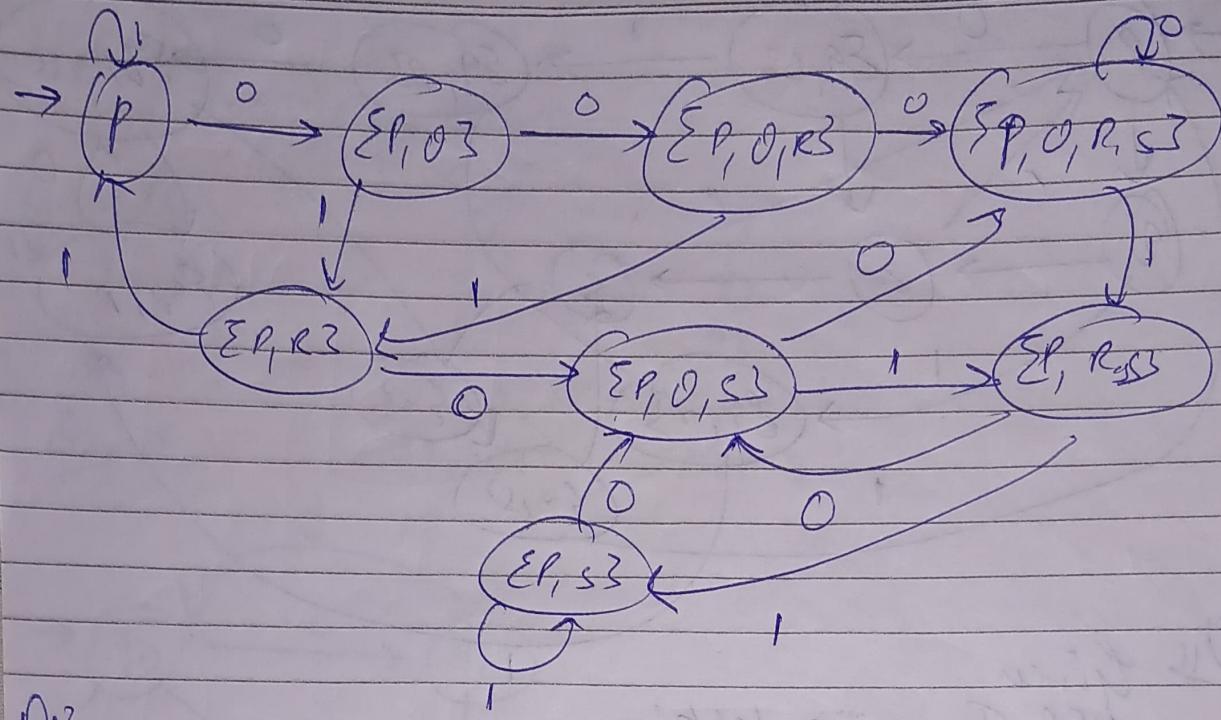



Q3

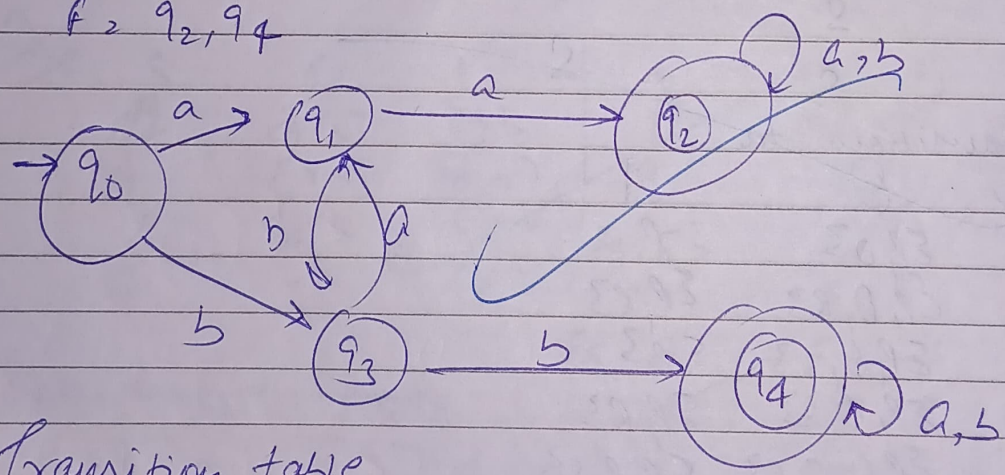
$\Sigma = \{$"aa", "bb" $\}$

$Q = q_0, q_1, q_2, q_3, q_4$

$\Sigma = \{a, b\}$

$q_0 = q_0$

$F = q_2, q_4$




Transition table

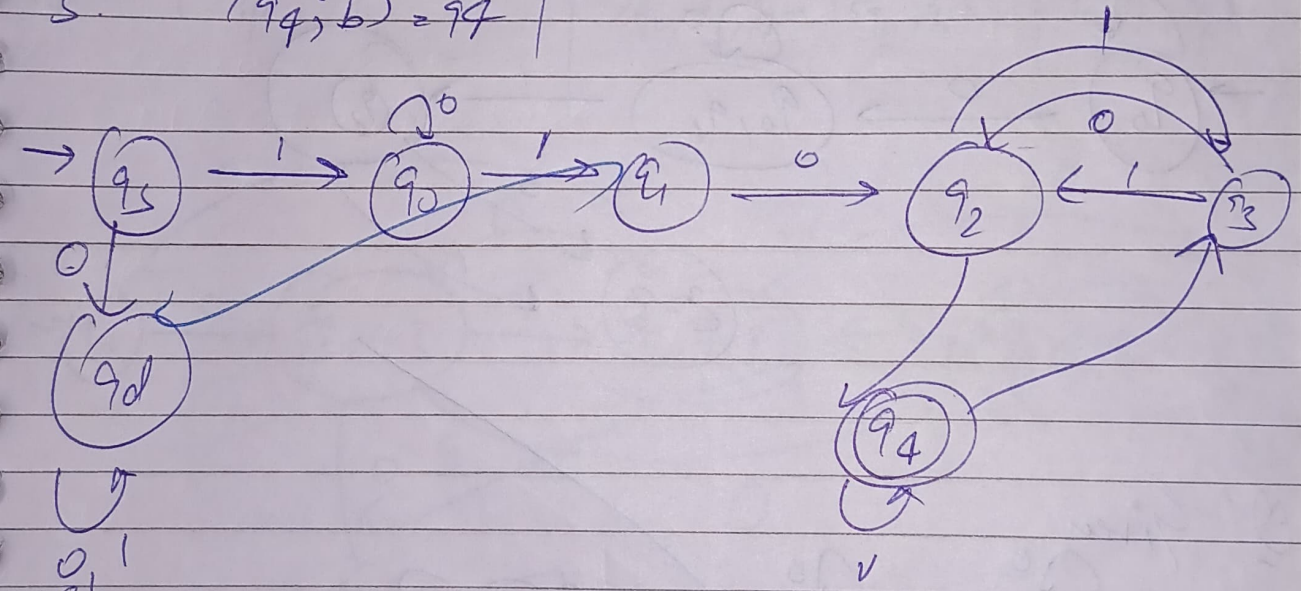
| $\delta$ | a | b |
|---|---|---|
| $q_0$ | $q_1$ | $q_2$ |
| $q_1$ | $q_2$ | $q_3$ |
| $q_2$ | $q_2$ | $q_2$ |
| $q_3$ | $q_1$ | $q_4$ |
| $q_4$ | $q_4$ | $q_4$ |

Date.....

Transition table

$\delta : (q_0, a) = q_1$
$\delta : (q_0, b) = q_d$
$\delta : (q_1, a) = q_2$
$\delta : (q_1, b) = q_3$
$\delta : (q_2, a) = q_2$
$\delta : (q_2, b) = q_2$
$\delta : (q_3, a) = q_1$
$\delta : (q_3, b) = q_4$
$\delta : (q_4, a) = q_4$
$\delta : (q_4, b) = q_4$

Given
$L = \{1010, 10100, \ldots\}$ — 3
$Q = \{q_5, q_0, q_1, q_2, q_3, q_4, q_d\}$
$\Sigma = \{1, 0\}$
$q_0 = q_0$
$F = q_4$




Transition table :—

| $\delta$ | 0 | 1 |
|---|---|---|
| $q_0$ | $q_d$ | $q_0$ |
| $q_1$ | $q_0$ | $q_3$ |
| $q_2$ | $q_4$ | $q_0$ |
| $q_3$ | $q_1$ | $q_2$ |
| $q_4$ | $q_3$ | $q_4$ |
| $q_d$ | $q_d$ | $q_4$ |

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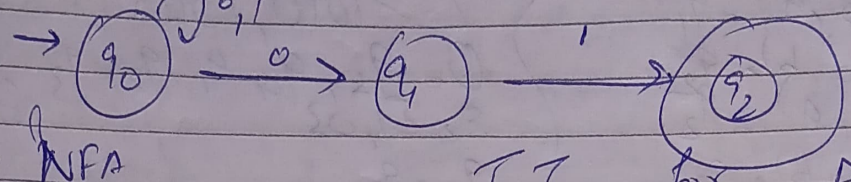
1. Given NFA

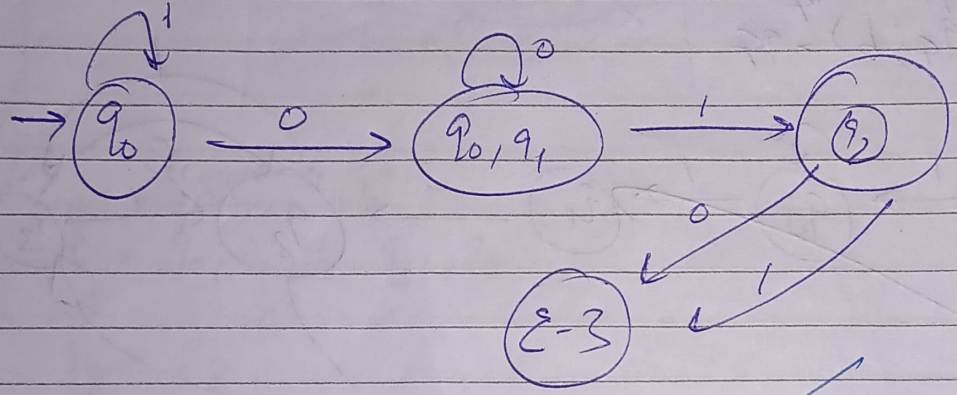



T.T for NFA

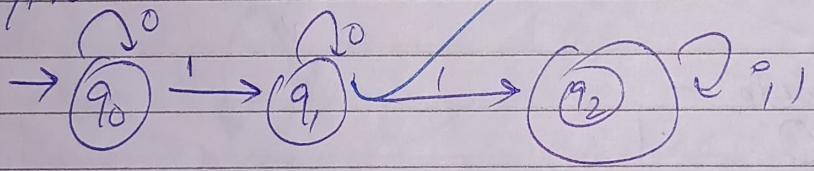
| → | | | |
|---|---|---|---|
| $q_0$ | $\{q_0, q_1, 3\}$ | $\{q_0, 3\}$ |
| $q_1$ | - | $\{q_2, 3\}$ |
| $(q_2)$ | - | $\phi$ |

T.T for DFA

| S | 0 | 1 |
|---|---|---|
| $q_0$ | $\{q_0, q_1, 3\}$ | $\{q_0, 3\}$ |
| $\{q_0, q_1, 3\}$ | $\{q_0, q_1, 3\}$ | $\{q_2, 3\}$ |
| $q_2$ | $\{-3\}$ | $\{-3\}$ |




2. Given




checking for 1011 or 01

for 1: $q_0 \xrightarrow{1} q_1$

" 0: $q_1 \xrightarrow{0} q_1$

" 1 $q_1 \xrightarrow{1} q_2$

" 1

" 0 $q_2 \xrightarrow{0} q_2$

" Spiral $q_2 \rightarrow q_2$

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Hence the given automata is acceptable for given string

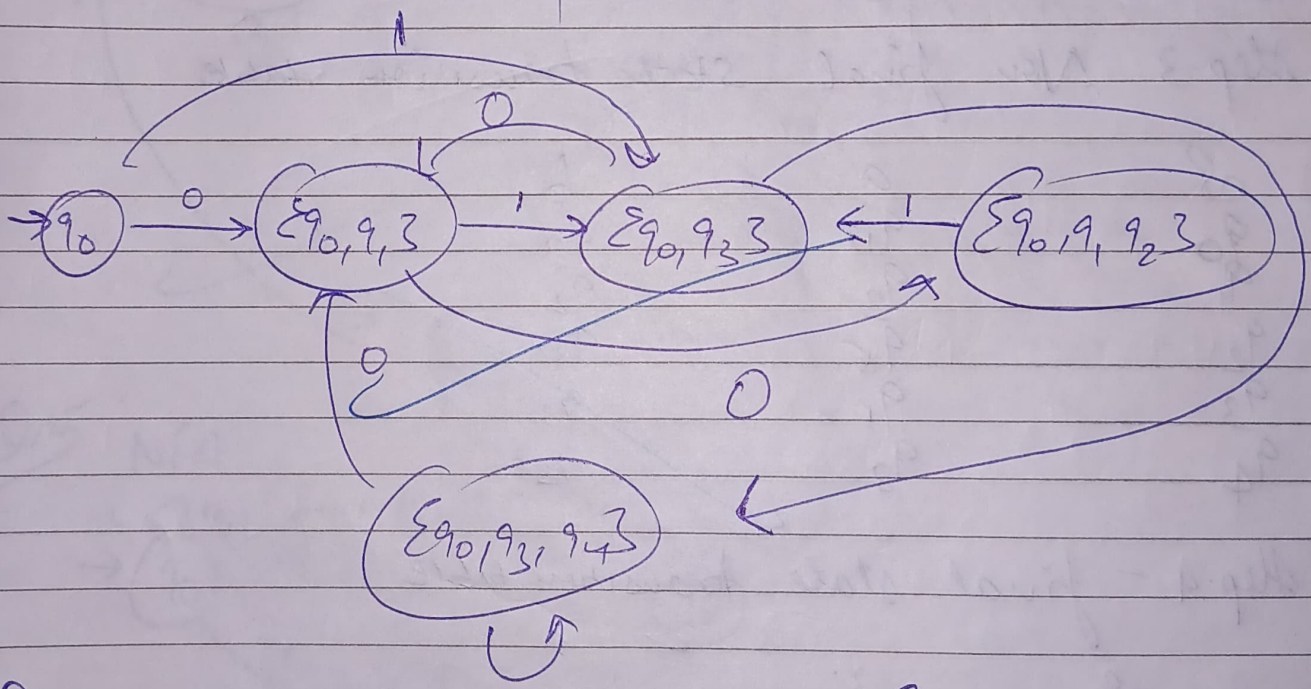
Or Given

NFA

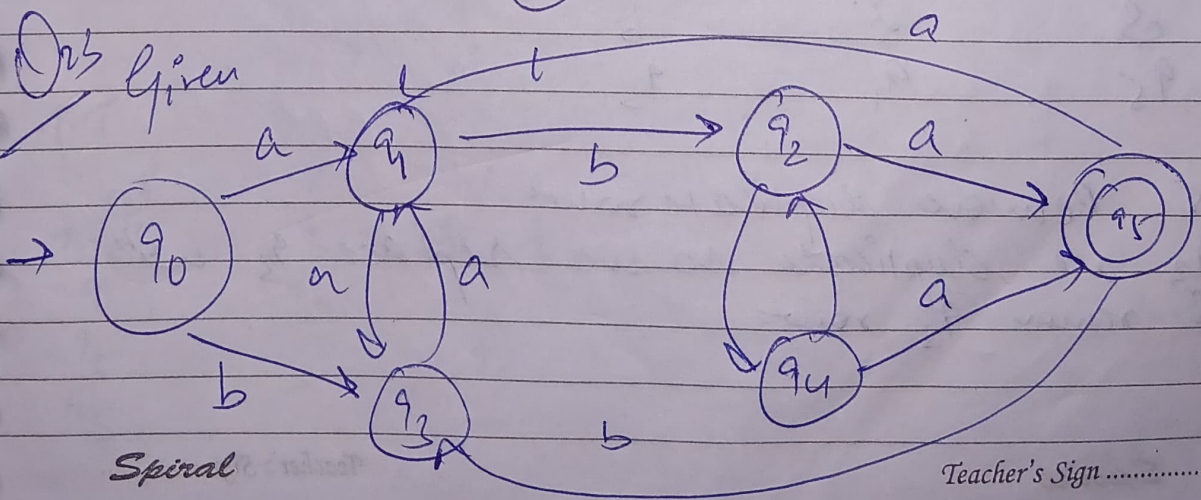
| δ | 0 | 1 |
|---|---|---|
| $q_0$ | $\{q_0, q_1\}$ | $\{q_0, q_3\}$ |
| $q_1$ | $\{q_2\}$ | $\phi$ |
| $q_2$ | $\phi$ | $\phi$ |
| $q_3$ | $\phi$ | $\{q_4\}$ |
| $q_4$ | $\phi$ | $\phi$ |

DFA

| δ | 0 | 1 |
|---|---|---|
| $q_0$ | $\{q_0, q_1\}$ | $\{q_0, q_3\}$ |
| $\{q_0, q_1\}$ | $\{q_0, q_1, q_2\}$ | $\{q_0, q_3\}$ |
| $\{q_0, q_3\}$ | $\{q_0, q_1\}$ | $\{q_0, q_3, q_4\}$ |
| $\{q_0, q_1, q_2\}$ | $\{q_0, q_1, q_2\}$ | $\{q_0, q_3\}$ |
| $\{q_0, q_3, q_4\}$ | $\{q_0, q_1\}$ | $\{q_0, q_3, q_4\}$ |




Or Given




Spiral

Teacher's Sign .....

Date.....

Step-1 - Remove unreachable states
There are no unreachable states

Step-2 Transition table for given DFA

| δ | a | b |
|---|---|---|
| $q_0$ | $q_1$ | $q_3$ |
| $q_1$ | $q_3$ | $q_2$ |
| $q_2$ | $q_5$ | $q_4$ |
| $q_3$ | $q_1$ | $q_3$ |
| $q_4$ | $q_2$ | $q_5$ |
| $(q_5)$ | $q_1$ | $q_5$ |

Step-3 Non final state transition table

| δ | a | b |
|---|---|---|
| $q_0$ | $q_1$ | $q_3$ |
| $q_1$ | $q_3$ | $q_2$ |
| $q_2$ | $q_5$ | $q_4$ |
| $q_3$ | $q_1$ | $q_3$ |
| $q_4$ | $q_2$ | $q_5$ |

Step-4 - final state transition table

| δ | a | b |
|---|---|---|
| $q_5$ | $q_1$ | $q_5$ |

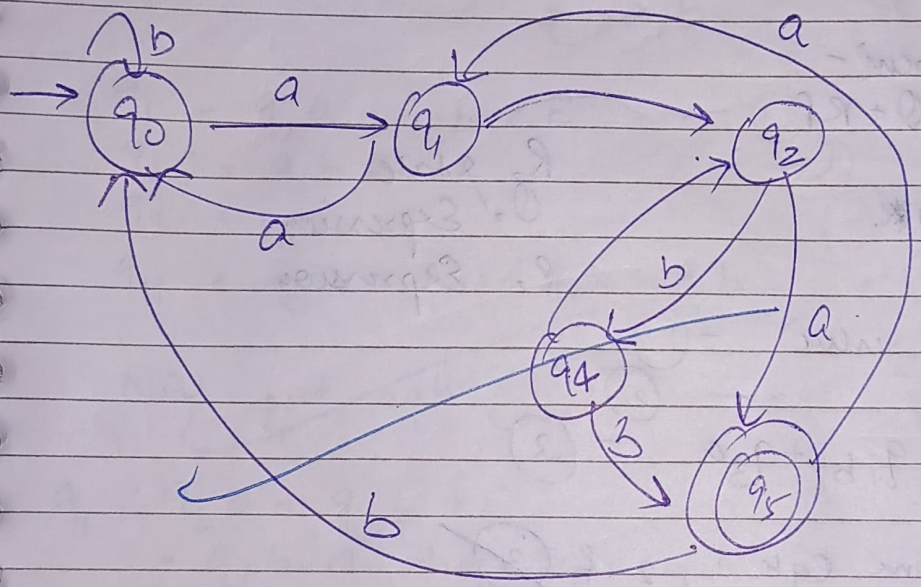
step-5 Remove duplicate row
$q_0$, $q_3$ are duplicate so we replace $q_3$ with $q_0$ & remove $q_3$ row

Date.....

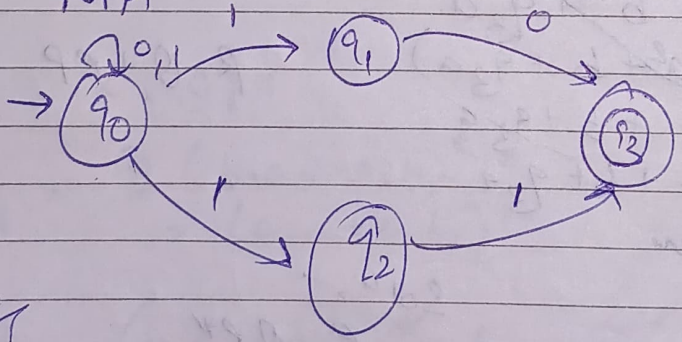
Step 6 Final transition table

Marks 8/10

| δ | a | b |
|---|---|---|
| $q_0$ | $q_1$ | $q_0$ |
| $q_1$ | $q_0$ | $q_2$ |
| $q_2$ | $q_5$ | $q_4$ |
| $q_4$ | $q_5$ | $q_5$ |
| $q_5$ | $q_1$ | $q_0$ |




Ans NFA




RT

| δ | 0 | 1 |
|---|---|---|
| → $q_0$ | $q_1$ | $\{q_0, q_2\}$ |
| $q_1$ | $q_3$ | – |
| $q_2$ | – | $q_3$ |
| $q_3$ | – | – |



Teacher's Sign .....