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CS303 Tutorial 2

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Ans 1:

For all strings containing at least two 0's, we can generalise the following,

The first 0 can be preceded by any no. of 1's.

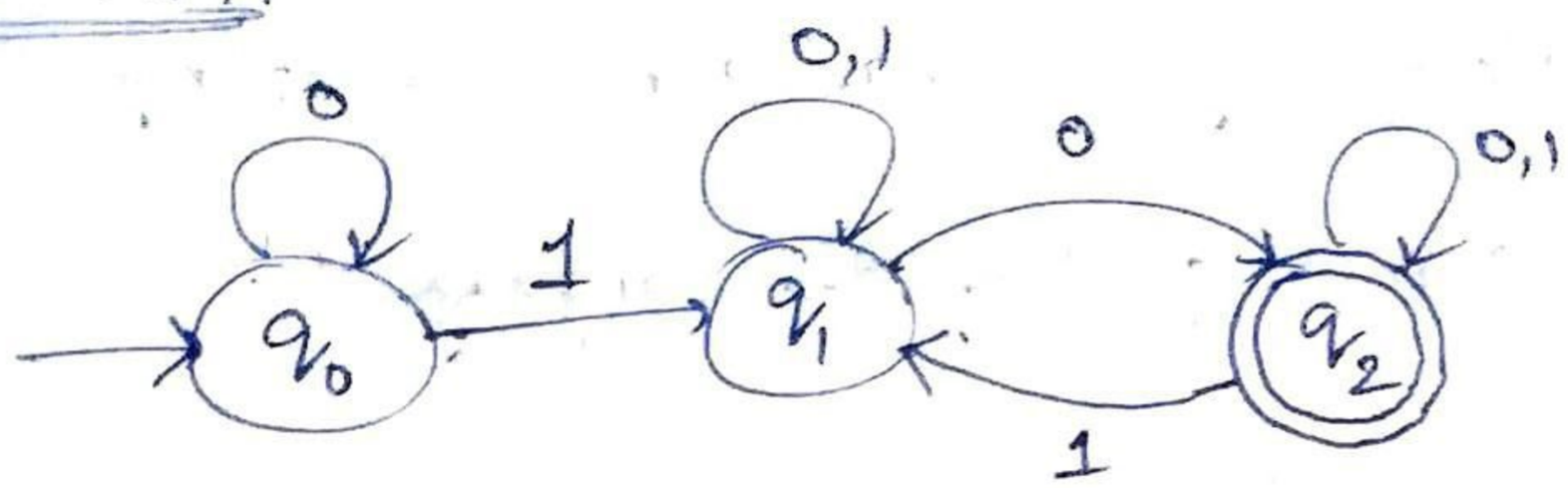
There can be any no. of 1's between the first and second 0

After that there can be any combination of 0's and 1's.

Hence, the regular expression would be, $\boxed{1^*01^*0(0+1)^*}$

Ans 2.

Input NFA

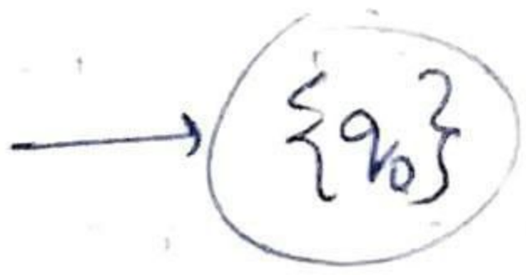


Language of NFA = $\{0, 1\}$

States of NFA = $\{q_0, q_1, q_2\}$
q_2 ⟵ accepting state

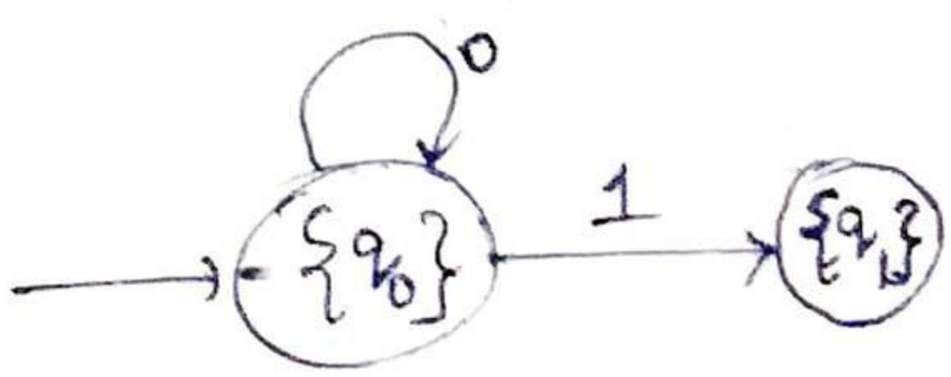
Conversion of given NFA to DFA:

Step 1: $\{q_0\}$ is the initial state of the DFA. Since, q_0 is initial state of NFA.



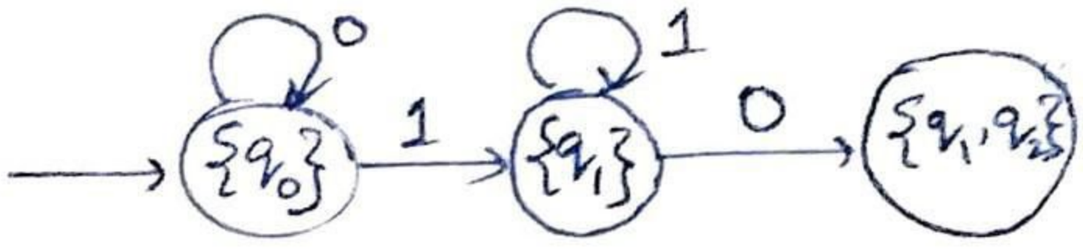
Step 2: For each state of the DFA, calculate one final state for each input 0, 1.

$\delta(\{q_0\}, 0) = \{q_0\}$ $\delta(\{q_0\}, 1) = \{q_1\}$

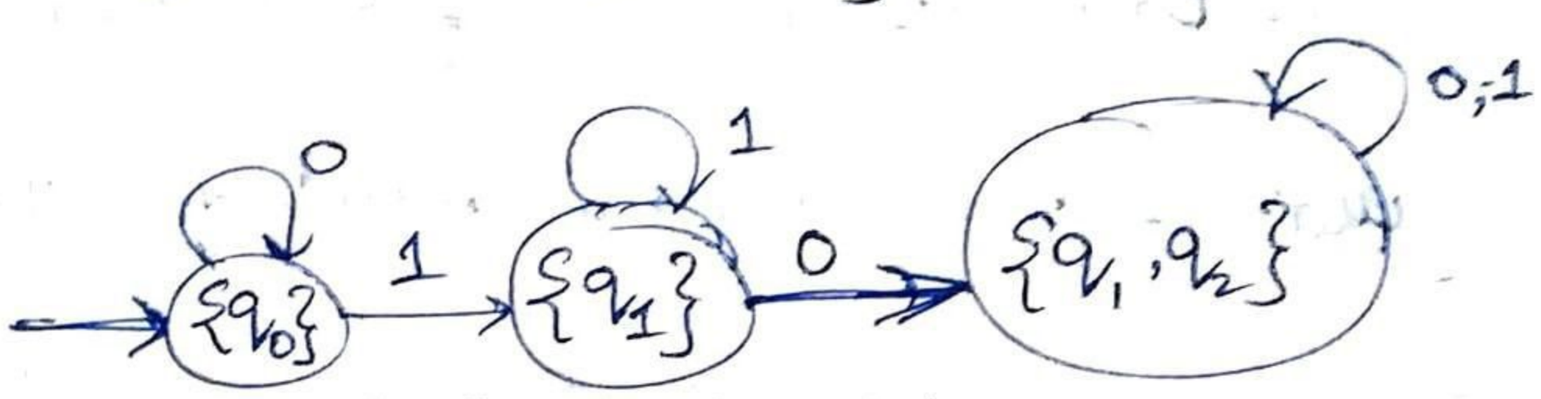


Step 3: Repeat step 2 until no more states can be added to DFA.

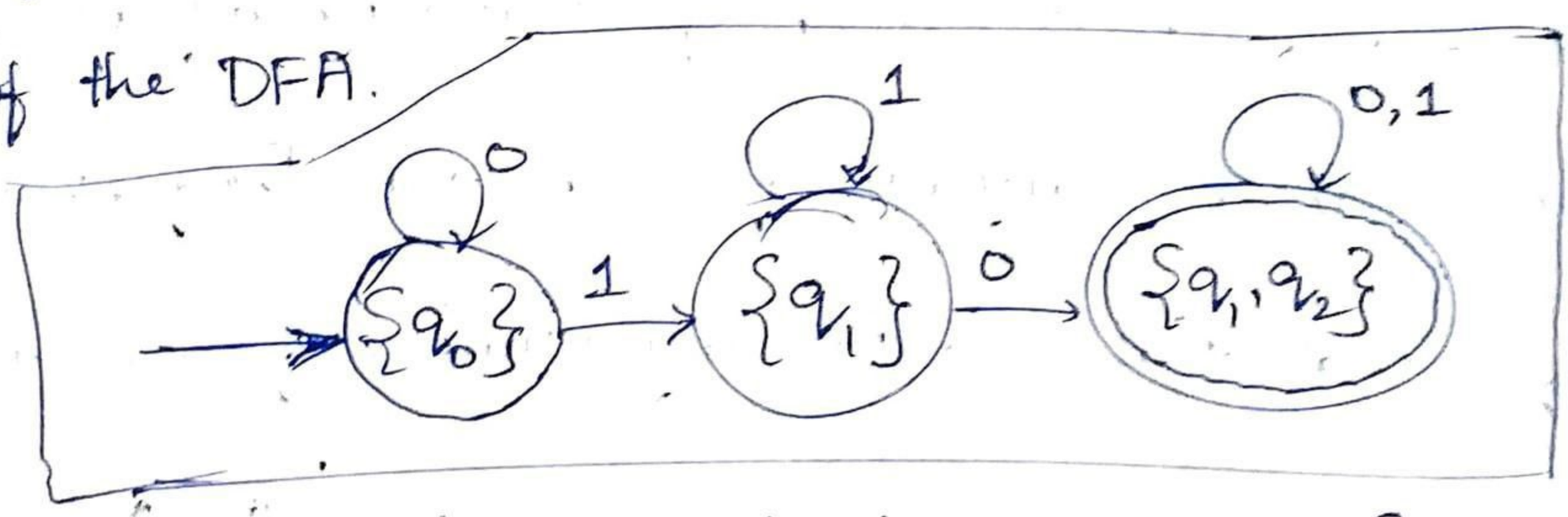
$\delta(\{q_1\}, 0) = \{q_1, q_2\}$ $\quad \delta(\{q_1\}, 1) = \{q_1\}$



$\delta(\{q_1, q_2\}, 0) = \{q_1, q_2\}$ $\quad \delta(\{q_1, q_2\}, 1) = \{q_1, q_2\}$



Step 4: The DFA state that consists of an accepting state of the NFA as a member, becomes an accepting state of the DFA.



q_2 is an accepting state of NFA. Since, $\{q_1, q_2\}$ consists of q_2, it is an accepting of the DFA.

Hence, NFA is converted to DFA.

- Language of DFA = $\{0, 1\}$
  - States of DFA = $\{\{q_0\}, \{q_1\}, \underline{\{q_1, q_2\}}\}$
    ↳ accepting state

Ans 3. Finding Regular Expression

The no. of 1's present in the strings, can be 0, 2, 4, 6, ...

The strings having 0 1's can be represented by the regular expression 0^*.

For strings having 2, 4, 6, ... no. of 1's, regular expression to represent them can be found as follows.

(1) Before the first 1 occurs, there can be any no. of 0's. Hence the regular expression starts with 0^*

(2) Between the first 1 and second 1, there can be any no. of 0's. After the second 1 too, there can be any no. of zeroes. Hence the expression contains 10^*10^*

But this expression represents only those strings with two 1's. For 0, 2, 4, 6, 8 ... 1's, the regular expression must have $(10^*10^*)^*$

So, taking into account all these observations, the desired regular expression is $\boxed{0^*(10^*10^*)^*}$

Finding DFA.

① The initial state, say q_0, has to be an accepting state so that λ becomes part of the language L.

② When we give 0 as input to DFA in q_0 state, the no. of 1's remains same. Therefore DFA has self loop at q_0.

③ When we give 1 as input at q_0 state, the no. of 1's becomes odd, therefore DFA state changes, say to q_1 state, which is rejecting state.

④ Point ② applies to state q_1 also.

⑤ When we give 1 as input at q_1 state, the no. of 1's counted so far becomes even. So, the string should be accepted. So, DFA can go back to state q_0.

With the observations, the DFA can be drawn as shown.