CSC-257
Theory Of Computation
(BSc CSIT, TU)

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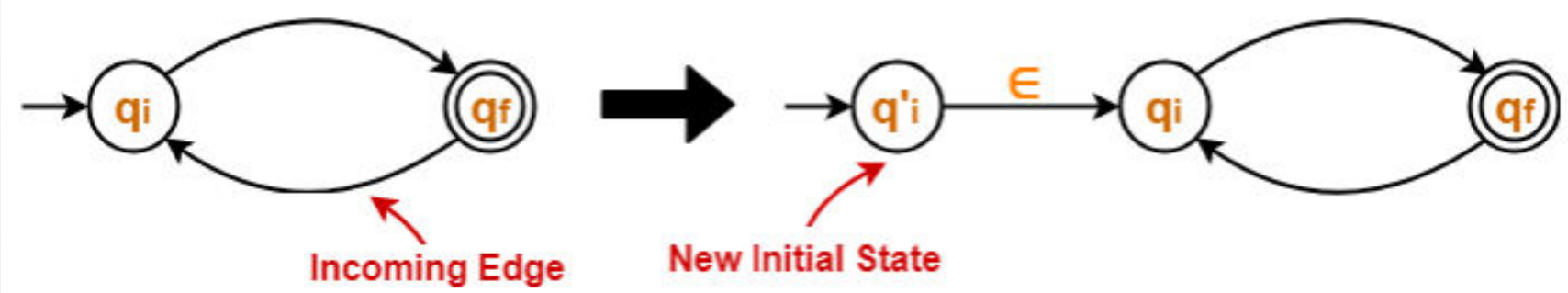
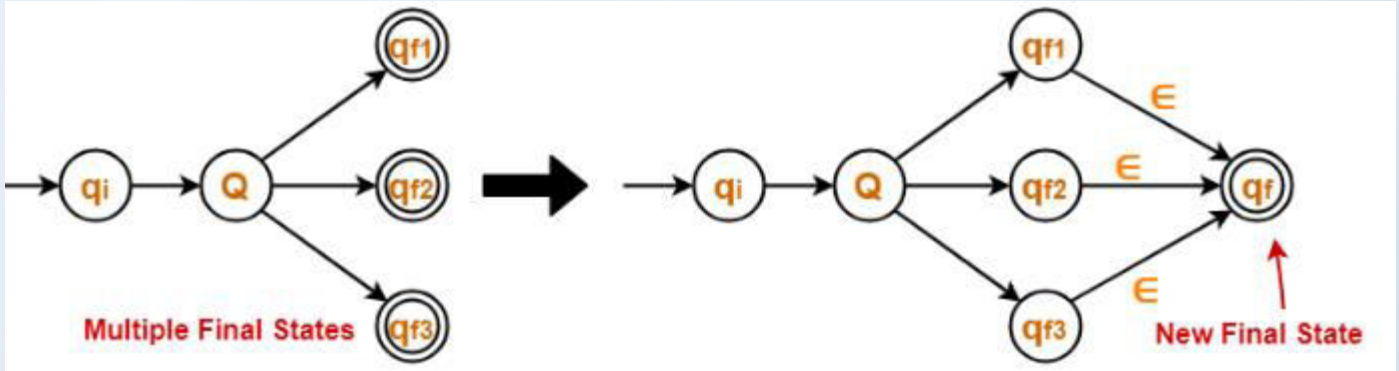
State Elimination Method to Convert DFA into RE

- **Step 1 : The initial state of the DFA must not have any incoming edge :**
  - If there exists incoming edges to initial state, create a new initial state having no incoming edge to it as show in figure.

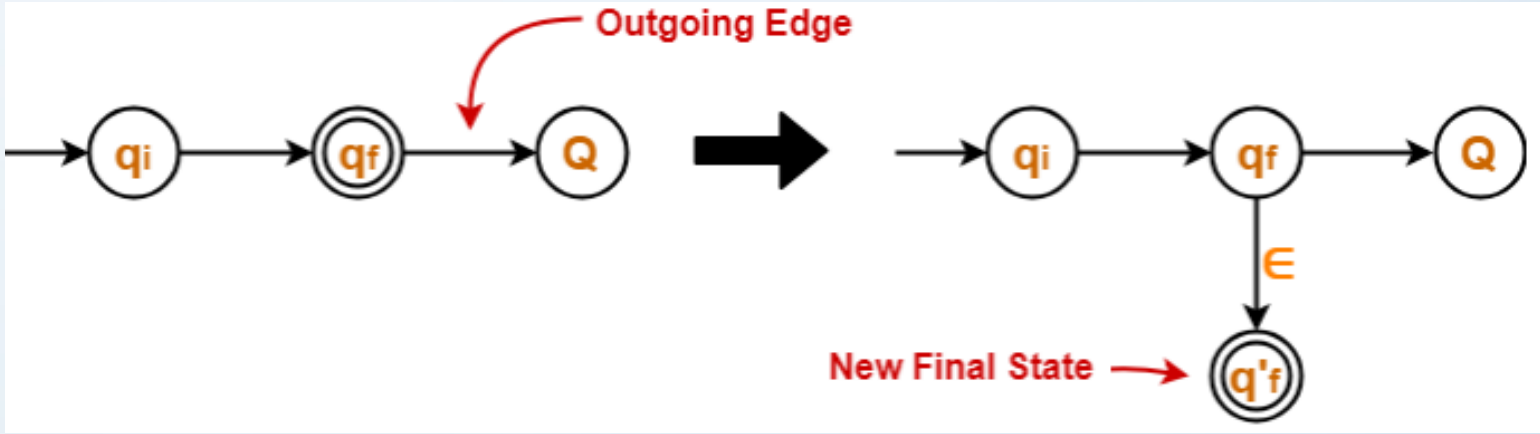


- **Step 2 : There must exist only one final state in the DFA :**
  - If there exist multiple final states in DFA, convert all final states into non-final states and create a new single final state as shown in figure.



State Elimination Method to Convert DFA into RE

- **Step 3 :** Final state of the DFA must not have any outgoing edge :
  - If there exists any outgoing edge from the final state, then create a new final state having no outgoing edge from it as in figure.



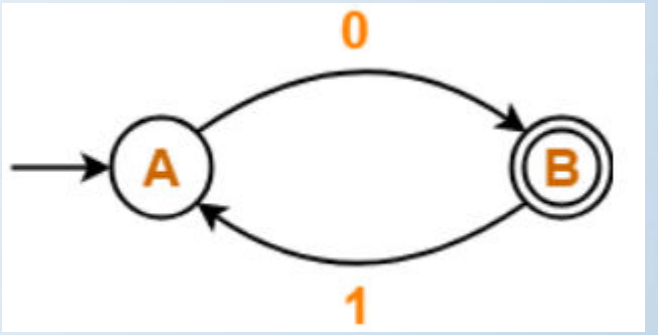
- **Note :** The state elimination method can be applied to any finite automata. i.e. DFA, NFA, ∈-NFA

State Elimination Method to Convert DFA into RE

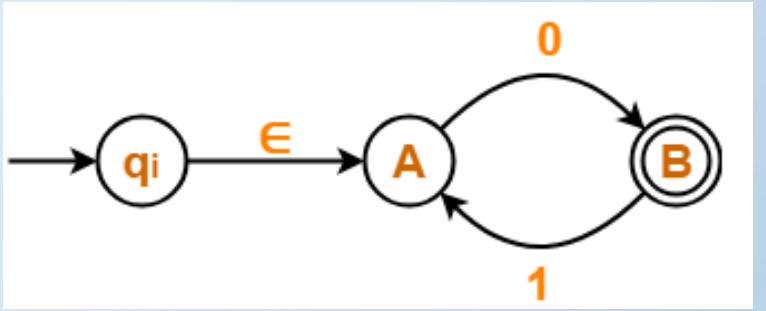
- **Step 4 :**
  - Eliminate all the intermediate states one by one.
  - These states may be eliminated in any order.
  - At the end, only an initial state going to the final state will be left
  - The cost of this transition is the required regular expression

Examples

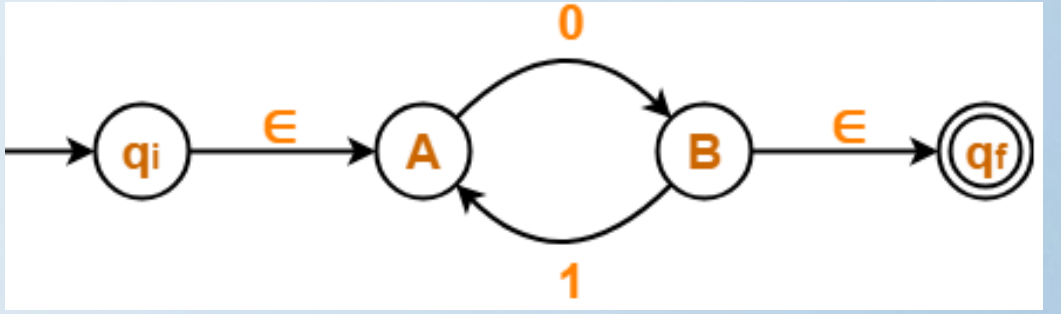
- Find regular expression for the following DFA
- **Solution :**



- **Step 1 :**
  - Initial state A has an incoming edge.
  - So, we create a new initial state q_i and resulting DFA is

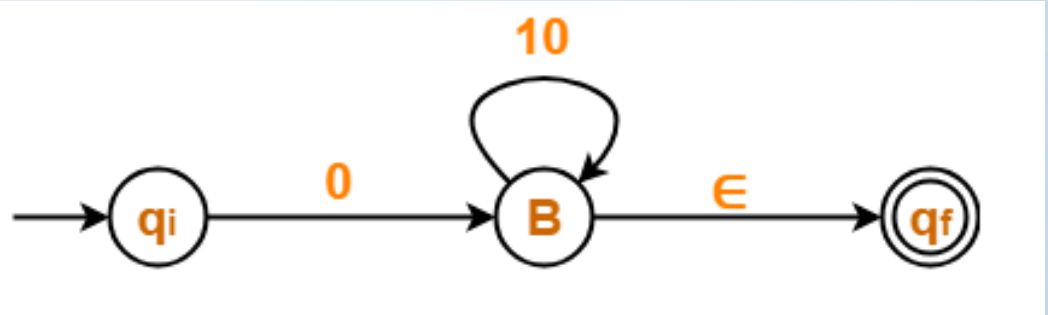


- **Step 2:**
  - Final state B has an outgoing edge
  - So, we create a new final state q_f and resulting DFA is



Examples

- **Step 3 :** Now, we start eliminating the intermediate states.
  - First, let us eliminate state A
  - There is a path going from state qi to state B via state A
  - So, after eliminating state A, we put a direct path from state q_i to state B having cost $\in .0 = 0$
  - There is a loop on state B using state A
  - So, after eliminating state A, put a direct loop on state B having cost 1.0 = 10
  - Eliminating state A, we get :



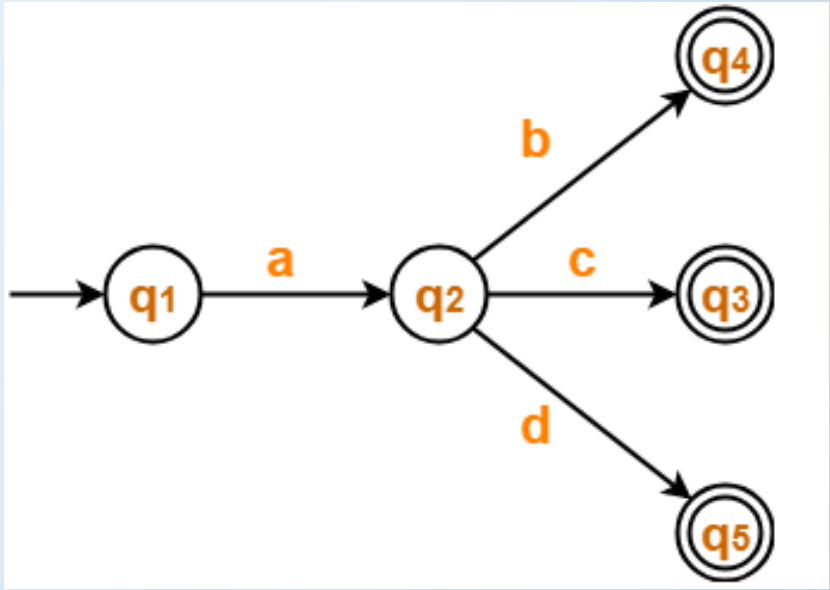
Examples

- **Step 3 :**
  - Now, let us eliminate state B
  - There is a path going from state qi to state q_f via state B
  - So, after eliminating state B, put a direct path from state q_i to state q_f having cost 0.(10)*.∈ = 0(10)*
  - Eliminating state B, we get :

- So the required RE = **0(10)***

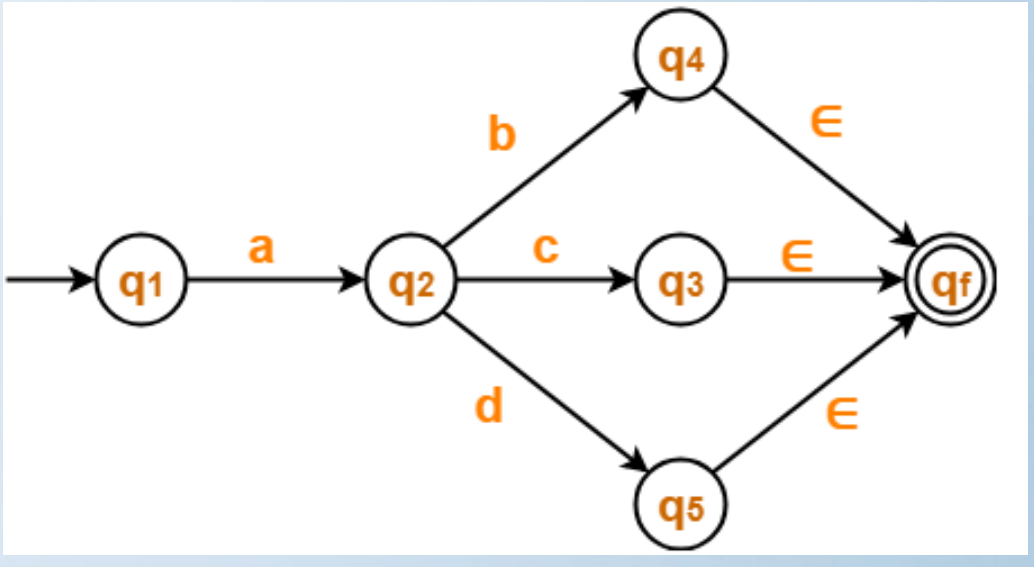
Examples

- Find regular expression for the following DFA



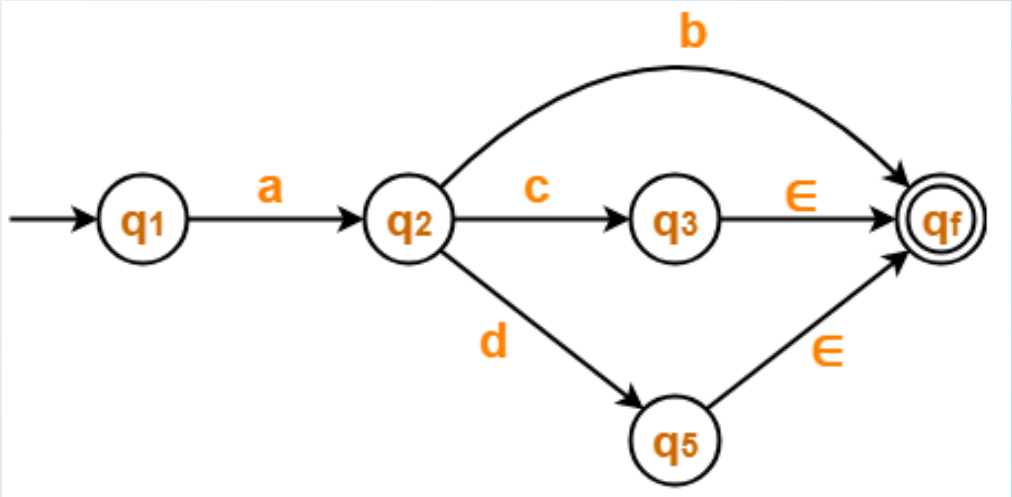
- **Solution :**

- **Step 1 :**
  - There exist multiple final states
  - So, we convert them into a single state as

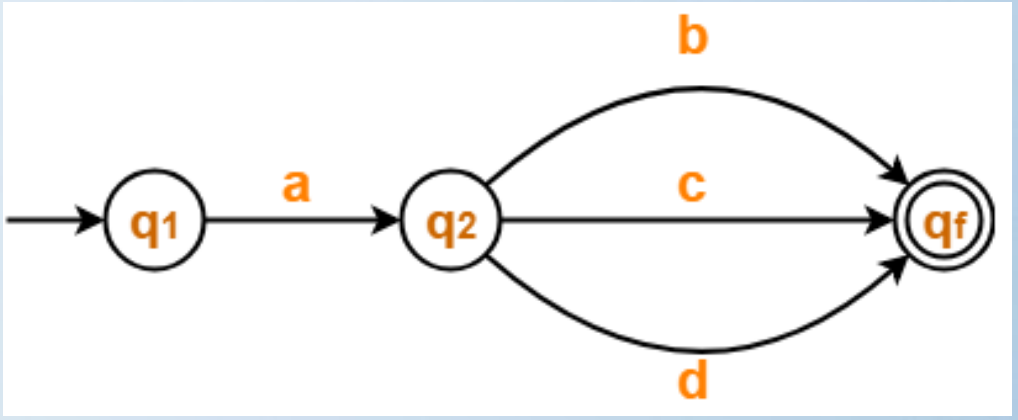


Examples

- **Step 2 :** Now, we start eliminating the intermediate states
  - First, let us eliminate state q_4
  - So, after eliminating state q_4 :

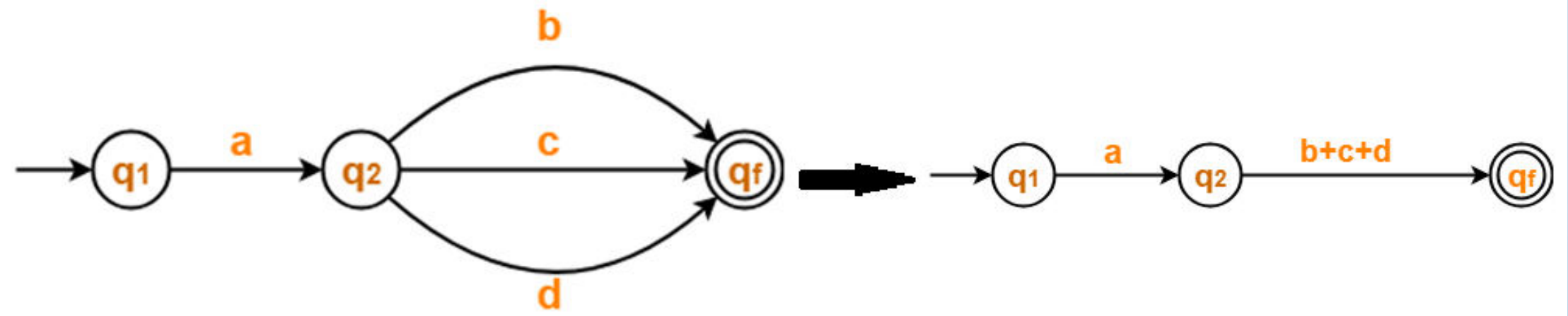


  - Similarly,
  - After eliminating state q_3 and q_5:

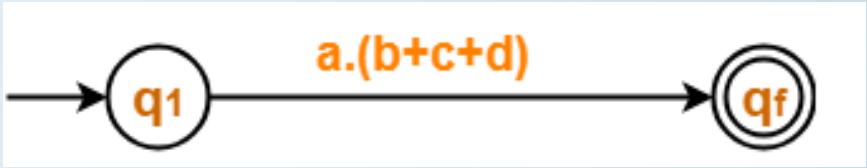


Examples

- **Step 2 :**
  - Now, it can be reconstructed as :



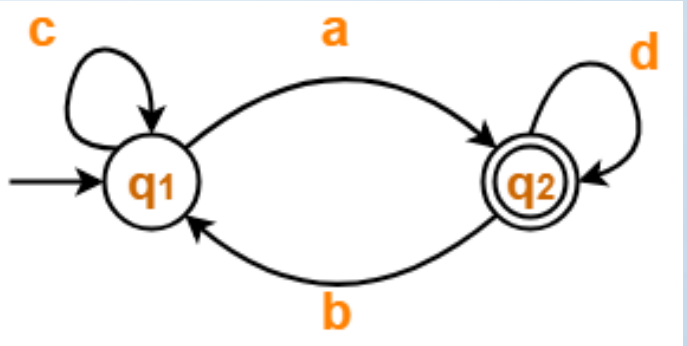
  - Now, after eliminating state q2 :



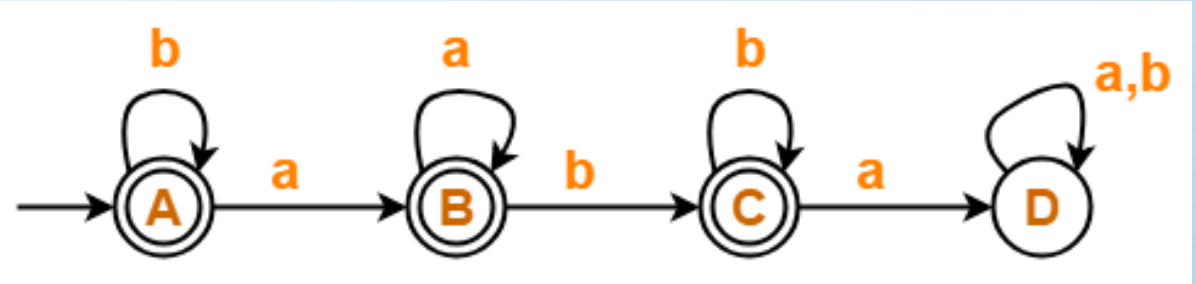
- So, resulting RE = **a(b+c+d)**

Examples

- Find regular expression for the following DFA



- Find regular expression for the following DFA



- Find regular expression for the following DFA