Theory Of Automata (TOA)

(Assignment 02)

Session (2022-2026)

Program

BS-Computer Science

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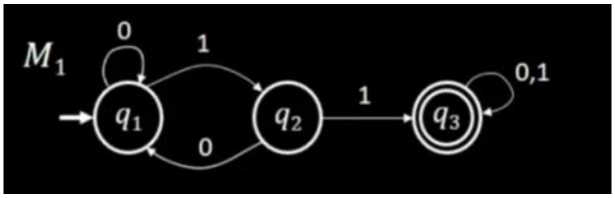
Question No 1:

Convert the following FA Machine into equivalent Regular Expression using Kleene's Method. Specify each step clearly.



Answer:

- States: q1, q2, q3
- Alphabet: {0, 1}
- Transitions:
    - $q_1 \xrightarrow{0} q_1$
    - $q_1 \xrightarrow{1} q_2$
    - $q_2 \xrightarrow{0} q_1$
    - $q_2 \xrightarrow{1} q_3$
    - $q_3 \xrightarrow{0} q_3$
    - $q_3 \xrightarrow{1} q_3$

Steps to convert the FA to a regular expression:

1. Initial Regular Expressions:

- For $q_1 \to q_1$: $R_{11} = 0 \cup \epsilon$
- For $q_1 \to q_2$: $R_{12} = 1$
- For $q_2 \to q_1$: $R_{21} = 0$
- For $q_2 \to q_3$: $R_{23} = 1$
- For $q_3 \to q_3$: $R_{33} = 0 \cup 1 \cup \epsilon$

2. Remove State q2:

    - Update transitions involving q_2:
        - For $q_1 \rightarrow q_3$: $R_{13} = R_{12} \cdot R_{23} = 1 \cdot 1 = 11$
        - For $q_1 \rightarrow q_1$ (through q_2): $R_{11} = R_{11} \cup (R_{12} \cdot R_{21}) = (0 \cup \epsilon) \cup (1 \cdot 0) = 0 \cup \epsilon \cup 10$
        - For $q_3 \rightarrow q_1$ (if there were a loop through q_2, but not in this case, hence unchanged)

3. Final expression (removing q1):

    - q_1 is the start state and q_3 is the final state.
    - We need to connect paths from q_1 to q_3 using the updated expressions.
    - For $q_1 \rightarrow q_3$ directly and via loops:
        - $R_{13} = 11$ (direct path through q_2)
    - Consider loops at q_1:
        - $R_{11} = 0 \cup \epsilon \cup 10$
    - For loops at q_3:
        - $R_{33} = (0 \cup 1)^*$
    - Combine the expressions:
        - The final regular expression is $(0 \cup \epsilon \cup 10)^* 11 (0 \cup 1)^*$

4. Simplify the regular expression:

- Since ϵ in R_{11} denotes zero or more occurrences of 0 or 10, the final regular expression can be simplified to $(0 \cup 10)^*11(0 \cup 1)^*$.

Thus the equivalent regular expression is:

$$(0 \cup 10)^*11(0 \cup 1)^*$$

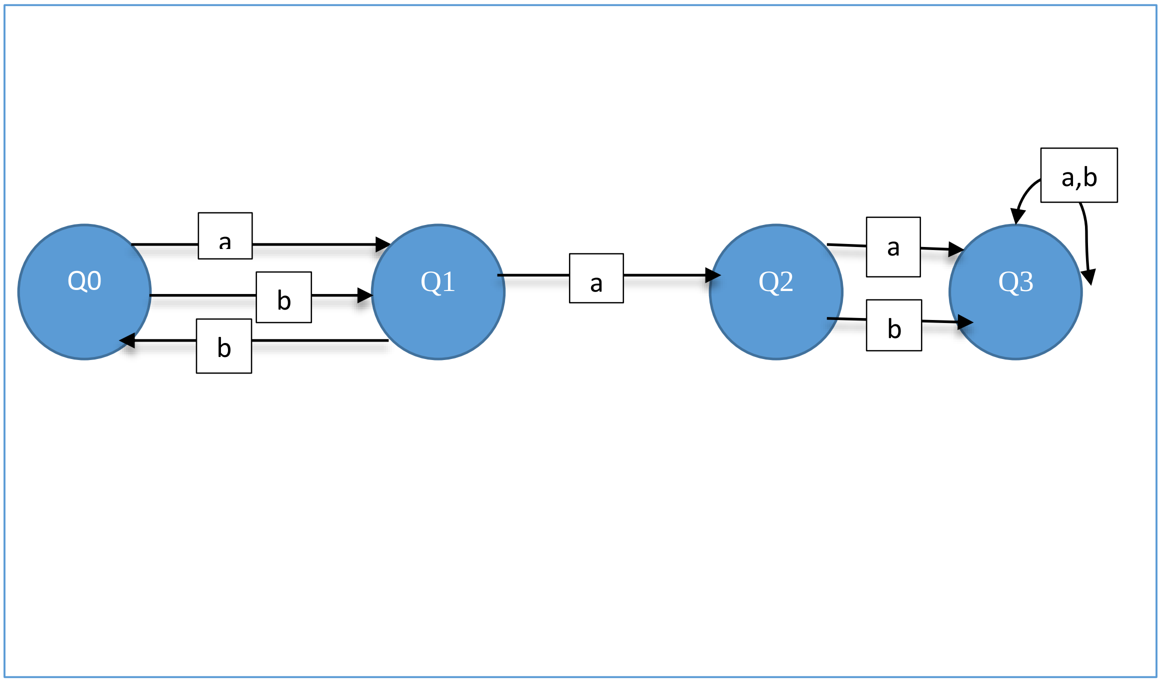
This regular expression represents the language accepted by the give FA using Kleene's method.

Question No 2:

Using the technique discussed by Martin , Build an FA that accept the following language.

L={w belong to {a,b}*: Length(w) >=2 and second letter of w, from right is a}.

Answer:



Question No 3:

Build an FA for the following regular Language L defined over ∑= {a,b}

L= {a, ab, bab, bb}

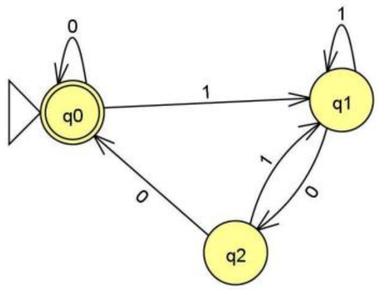
Answer:

For constructing an FA for this language, we need to create states and transitions for each of the strings:

1. **States:**
   - q0 (start state)
   - q1 (accepting state for 'a')
   - q2 (accepting state for 'ab')
   - q3 (intermediate state)
   - q4 (accepting state for 'bab')
   - q5 (accepting state for 'bb')
2. **Transitions:**
   - From **q0**:
     - Read 'a': Go to **q1** (final for 'a')
     - Read 'b': Go to **q3**
   - From **q1**:
     - Read 'b': Go to **q2** (final for 'ab')
   - From **q3**:
     - Read 'a': Go to **q4** (intermediate state)
   - From **q4**:
     - Read 'b': Go to **q2** (final for 'bab')
   - From **q3**:
     - Read 'b': Go to **q5** (final for 'bb')

Question No 4:

Give the 5-tuple representation and draw the transition table for the following FA.



Answer:

5-Tuple Representation

The 5-tuple representation of a finite automaton (FA) is given by $(Q, \Sigma, \delta, q_0, F)$, where:

- Q is the set of states
- Σ is the alphabet
- δ is the transition function
- q_0 is the start state
- F is the set of accept states

From the provided FA diagram:

1. **Set of States (Q):** $Q = \{q_0, q_1, q_2\}$
2. **Alphabet (Σ):** $\Sigma = \{0, 1\}$
3. **Transition Function (δ):**
   - $\delta(q_0, 0) = q_0$
   - $\delta(q_0, 1) = q_1$
   - $\delta(q_1, 0) = q_2$
   - $\delta(q_1, 1) = q_1$
   - $\delta(q_2, 0) = q_2$
   - $\delta(q_2, 1) = q_0$

4. **Start State (q_0):** q_0
5. **Set of Accept States (F):** The diagram does not indicate accept states explicitly. Assuming there are no special markers, we need this information to be provided. If we assume q_2 is the accepting state (common in simple diagrams), then $F = \{q_2\}$.

Transition Table

The transition table represents the state transitions based on the input symbols. Here is the transition table for the given FA:

Current State	Input	Next State
q_0	0	q_0
q_0	1	q_1
q_1	0	q_2
q_1	1	q_1
q_2	0	q_2
q_2	1	q_0

Summary of the 5-Tuple Representation:

- $Q = \{q_0, q_1, q_2\}$
- $\Sigma = \{0, 1\}$
- δ is as defined in the transition table above
- q_0 is the start state
- $F = \{q_2\}$ (assuming q_2 is the accept state; please adjust based on actual accept state information if different)