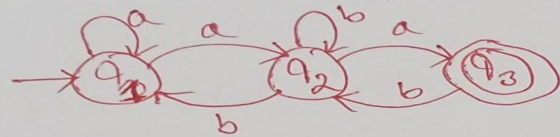


Inter-conversion (RE & FA)

Designing Regular Expression - Examples

⇒ Find the RE for the following NFA



$$q_3 = q_2 a \rightarrow \textcircled{1}$$

$$q_2 = q_1 a + q_2 b + q_3 b \rightarrow \textcircled{2}$$

$$q_1 = \epsilon + q_1 a + q_2 b \rightarrow \textcircled{3}$$

$$\begin{aligned} \textcircled{1} \rightarrow q_3 &= q_2 a \\ &= (q_1 a + q_2 b + q_3 b) a \\ &= q_1 a a + q_2 b a + q_3 b a \rightarrow \textcircled{4} \end{aligned}$$

$$\textcircled{2} \rightarrow q_2 = q_1 a + q_2 b + q_3 b \quad \text{Putting value of } q_3 \text{ from } \textcircled{1}$$

$$= q_1 a + q_2 b + (q_2 a) b$$

$$= q_1 a + q_2 b + q_2 a b$$

$$\underbrace{q_2}_{R} = \underbrace{q_1 a}_{Q} + \underbrace{q_2}_{R} \underbrace{(b + a b)}_P$$

$$\begin{aligned} R &= Q + R P \\ R &= Q P^* \quad \text{[Arden's Theorem]} \end{aligned}$$

$$q_2 = q_1 a (b + a b)^* \rightarrow \textcircled{5}$$

$$\textcircled{3} \rightarrow q_1 = \epsilon + q_1 a + q_2 b$$

Putting value of q_2 from $\textcircled{5}$

$$q_1 = \epsilon + q_1 a + ((q_1 a) (b + a b)^*) b$$

$$\underbrace{q_1}_{R} = \underbrace{\epsilon}_{Q} + \underbrace{q_1}_{R} \underbrace{(a + a(b + a b)^* b)}_P$$

$$q_1 = \epsilon (a + (a(b+ab)^*)b)^* \quad \text{C.R} = R$$

$$q_1 = a + a(b+ab)^*b \longrightarrow (6)$$

Final state $\rightarrow (q_3)$

$$q_3 = \underline{q_2} a$$

Putting the value of q_2 from (5)

$$q_3 = \underline{q_1} a(b+ab)^*a$$

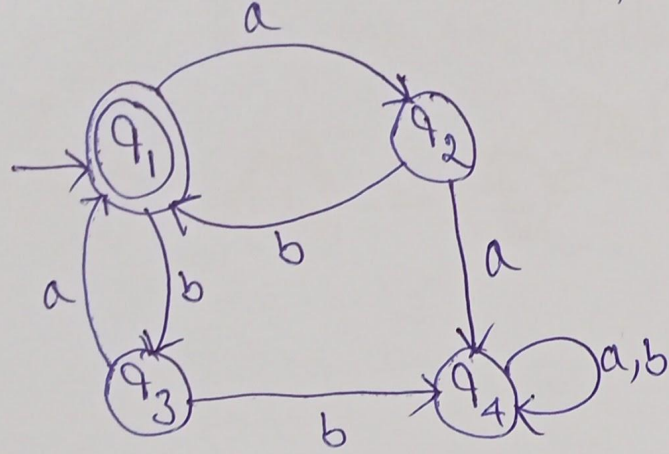
Putting the value of q_1 from (6)

$$q_3 = \underline{(a + a(b+ab)^*b)^* a(b+ab)^*a}$$

= Required RE for the given NFA

Designing Regular Expression - Examples

Find the RE for the following DFA



$$q_1 = \epsilon + q_2 b + q_3 a \rightarrow \textcircled{i}$$

$$q_2 = q_1 a \rightarrow \textcircled{ii}$$

$$q_3 = q_1 b \rightarrow \textcircled{iii}$$

$$q_4 = q_2 a + q_3 b + q_4 a + q_4 b \rightarrow \textcircled{iv}$$

$$\textcircled{i} \rightarrow q_1 = \epsilon + \underline{q_2} b + \underline{q_3} a$$

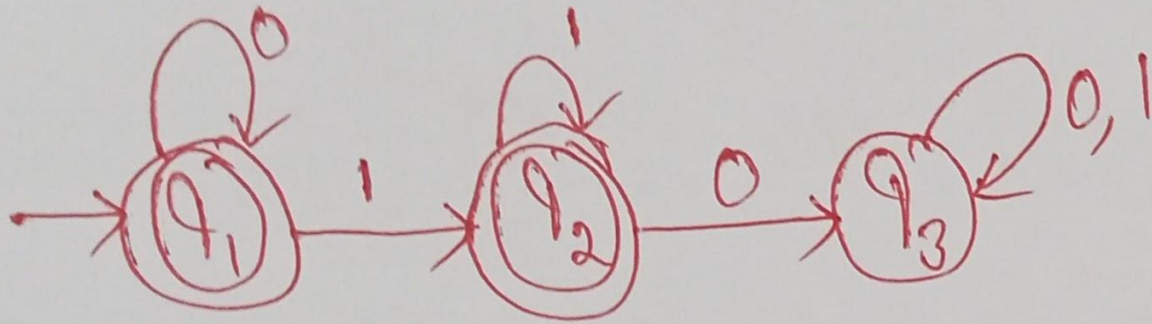
Putting values of q_2 and q_3 from \textcircled{ii} and \textcircled{iii}

Assignment

Designing RE - Examples

(when there are multiple final states)

Find the RE for the following DFA

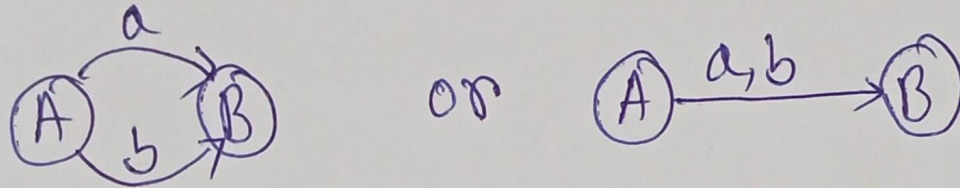


Assignment

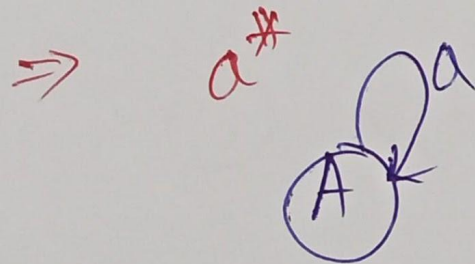
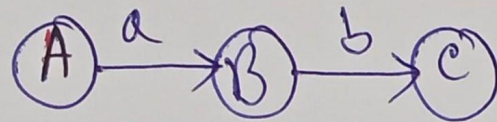
Conversion of RE to Finite Automata

Important Rules →

⇒ $(a+b)$



⇒ $(a.b)$



Conversion of RE to FA - Examples

Convert the following RE to their equivalent FA:

① ba^*b

① ba^*b

$\rightarrow \underline{bb}, bab, baab, \dots$

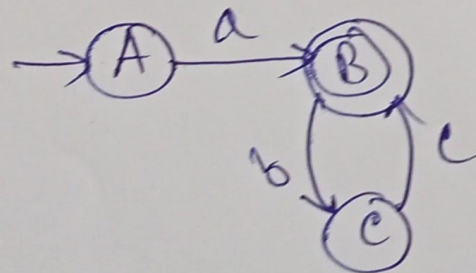
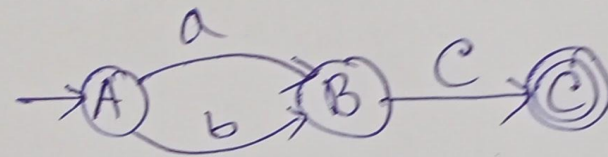
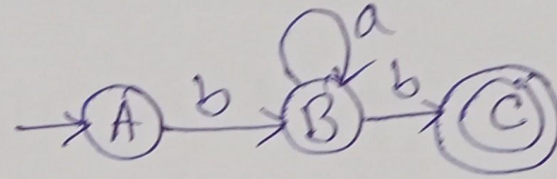
② $(a+b)c$

② $(a+b)c$

$\rightarrow \underline{ac}, \underline{bc}$

③ $a(bc)^*$

③ $a(bc)^*$ $\rightarrow \underline{a}, a\underline{b}, a\underline{bc}, a\underline{bcb}, a\underline{bcbcb}, \dots$

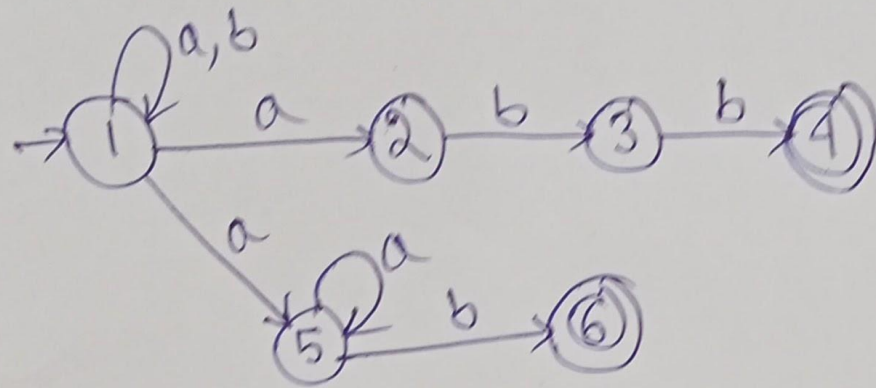


Conversion of RE to FA - Examples

⇒ Convert the following RE to its equivalent FA!

$$(a|b)^* (ab|a^+b)$$

$$\boxed{+/1}$$



$$a^+ = \{a, aa, aaa, \dots\}$$

$$a^* = \{\epsilon, a, aa, aaa, \dots\}$$

⇒ Convert the following RE to its equivalent FA!

$$10 + (0 + 11) 0^* 1$$

Assignment.

Thank You