



**PES UNIVERSITY, Bangalore**  
(Established under Karnataka Act No. 16 of 2013)  
**Department of Computer Science & Engineering**

**Automata Formal Languages & Logic**

**Homework - Regular Expressions**

**Regular Expression**

- 1) Write regular expression for the following language over the alphabet  $\Sigma = \{a, b\}$   
All strings that contain at most one b
- 2) Write regular expression for the following language over the alphabet  $\Sigma = \{0,1\}$   
All strings that contain even number of 0's
- 3) Write a regular expression denoting the set of all strings of a's and b's such that every a is immediately preceded by at least three consecutive b's
- 4) Write a regular expression to match binary string having exactly one pair of consecutive 0's
- 5) Write a regular expression to match all the strings with even number of a's followed by odd number of b's

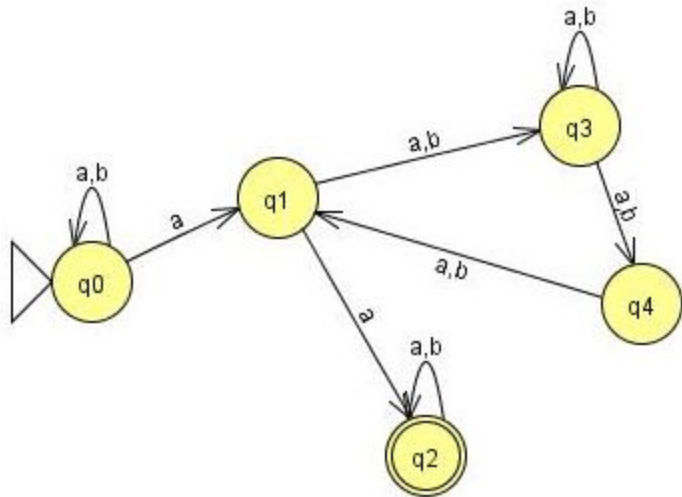
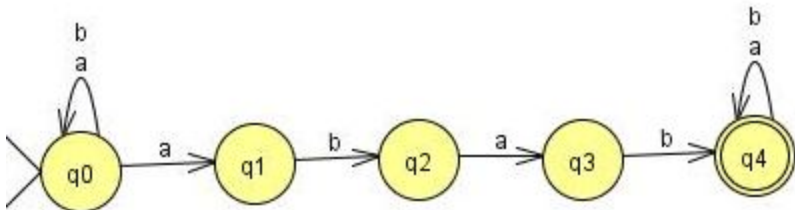
**Regular Expression to Finite Automata**

- 1) Convert the following regular expression to finite automata
  - a)  $a^*b^*$
  - b)  $(a+b)^* a (a+b)^* b (a+b)^*$
  - c)  $(0+1)^*1$
  - d)  $(0+1)^+(0+2)^+(1+2)^+$
  - e)  $10(0+1)^*01$

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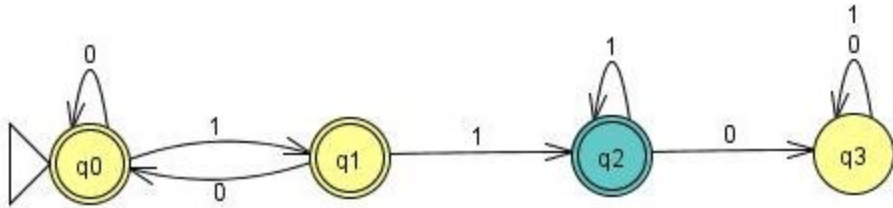
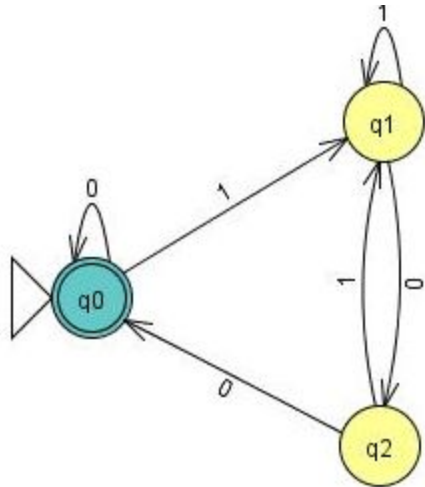
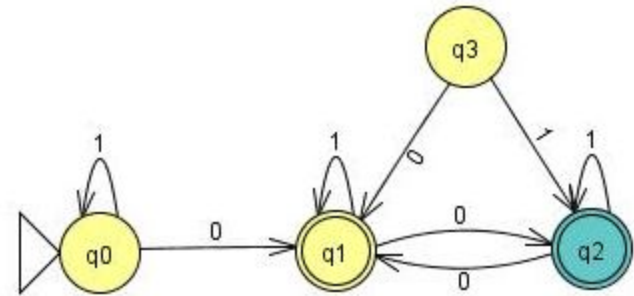
**Finite Automata to regular expression**

1) Write regular expression for the following Finite Automata

a	 <p>A finite automaton with five states: q0, q1, q2, q3, and q4. q0 is the start state, indicated by an incoming arrow from the left. q2 is the final state, indicated by a double circle. Transitions are as follows: q0 has a self-loop labeled 'a,b'; q0 transitions to q1 on input 'a'; q1 transitions to q2 on input 'a' and to q3 on input 'a,b'; q2 has a self-loop labeled 'a,b'; q3 transitions to q4 on input 'a,b'; q4 transitions back to q1 on input 'a,b'; and q3 has a self-loop labeled 'a,b'.</p>
b	 <p>A finite automaton with five states: q0, q1, q2, q3, and q4. q0 is the start state, indicated by an incoming arrow from the left. q4 is the final state, indicated by a double circle. Transitions are as follows: q0 has a self-loop labeled 'a' and 'b'; q0 transitions to q1 on input 'a'; q1 transitions to q2 on input 'b'; q2 transitions to q3 on input 'a'; q3 transitions to q4 on input 'b'; and q4 has a self-loop labeled 'a' and 'b'.</p>

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c	 <p>A finite automaton with four states: q0, q1, q2, and q3. q0 is the start state (indicated by a double circle) and q2 is the final state (indicated by a double circle). Transitions are as follows: q0 has a self-loop on input 0; q0 transitions to q1 on input 1; q1 transitions to q0 on input 0 and to q2 on input 1; q2 has a self-loop on input 1 and transitions to q3 on input 0; q3 has a self-loop on input 0 and transitions to q2 on input 1.</p>
d	 <p>A finite automaton with three states: q0, q1, and q2. q0 is the start state (indicated by a double circle). Transitions are as follows: q0 has a self-loop on input 0; q0 transitions to q1 on input 1; q1 transitions to q2 on input 0 and to q1 on input 1; q2 transitions to q0 on input 0 and to q1 on input 1.</p>
e	 <p>A finite automaton with four states: q0, q1, q2, and q3. q0 is the start state (indicated by a double circle) and q2 is the final state (indicated by a double circle). Transitions are as follows: q0 has a self-loop on input 1 and transitions to q1 on input 0; q1 has a self-loop on input 1 and transitions to q2 on input 0; q2 has a self-loop on input 1 and transitions to q1 on input 0; q3 is an unreachable state with no incoming transitions.</p>



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**Equivalence of regular expression**

- 1) Show that the following two regular expression are same
  - a)  $(a + b)^*a(a + b)^*b(a + b)^*$  and  $(a + b)^*ab(a + b)^*$
  - b)  $0^*(10^*10^*)^*$  and  $0^*(10^*1)^*0^*$
  - c)  $(abba + ab)(ba)^*$  and  $ab(ba)^*$

**Regular expression in Practice**

- 1) Write a regular expression for matching HTML tag that satisfies the following scenario
  - > The start tag must begin with < followed by one or more characters and end with >
  - > The end tag must start with </ followed by one or more characters and end with >
  - > must match the content inside a TAG element
- 2) Write a regular expression to validate a password that satisfies the following scenario
  - > 5 to 10 characters in length
  - > Must have at least two uppercase letter
  - > Must have at least one lower case letter
  - > Must have at least one digit
  - > Should contain other characters
- 3) Write a regular expression to validate a URL that satisfies the following scenario
  - > Must start with https or ftp followed by ://
  - > Must match a valid domain name
  - > Could contain a port specification (<http://www.xyz.com:8080>)
  - > Could contain digit, letter, dots, hyphens, forward slashes, multiple times



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Link: <https://www.sitepoint.com/demystifying-regex-with-practical-examples/>