

Subject :- Computer Science
Course Name :- Theory Of Computation

DFA TO REGULAR EXPRESSIONS

Report Submitted by:-

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BASIC DEFINITIONS

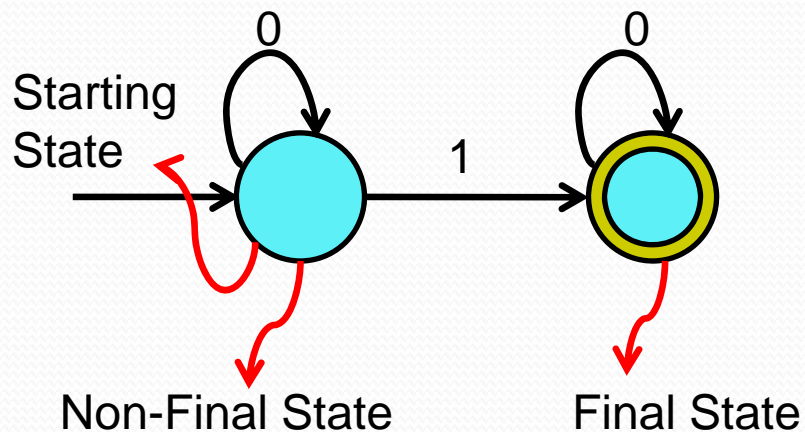
DFA:-

A finite state machine where for each pair of state and input symbol there is one and only one transition to a next state. DFAs recognize the set of regular languages and no other languages.

Regular Expressions:-

Regular expressions consist of constants and operators that denote sets of strings and operations over these sets, respectively. A regular expression represents a "pattern" strings that match the pattern are in the language, strings that do not match the pattern are not in the language.

All strings containing exactly one "1" on $\Sigma = \{0, 1\}^*$.



Regular Expressions for this language over Σ is :-

$$0^* 1 0^*$$

AIM & PROCEDURE

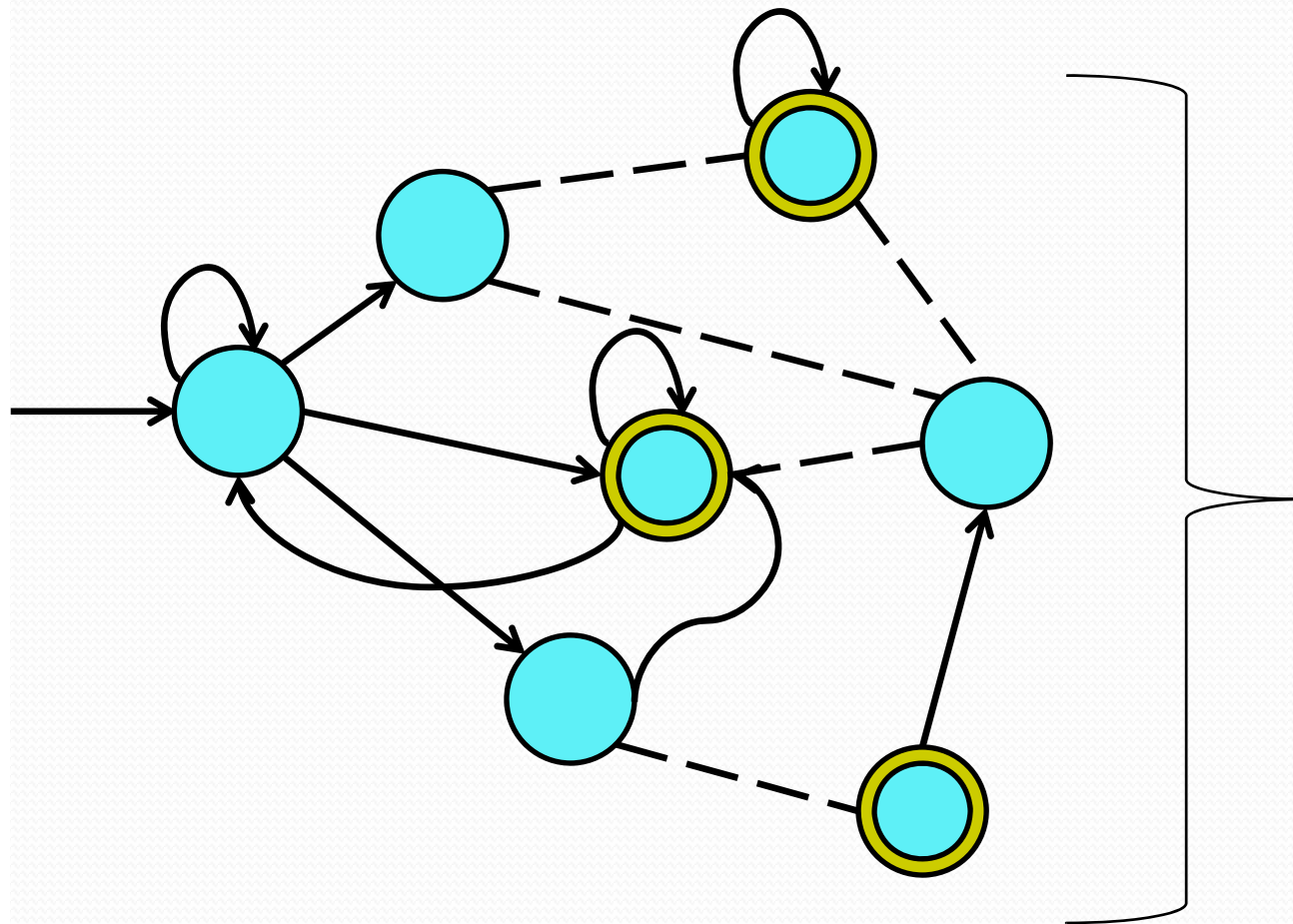
The aim of this animation is to clarify the concepts of **DFA to Regular Expressions** by illustrating some examples.

- In this animation we will explain this topic by first giving its brief introduction through its definition and then some notations of Automata Theory.
- In this animation we will have two examples for explaining this topic .
- In the first example we will play with less number of states simply displaying circles for the states and lines connecting them and then according to the algorithm we will convert that DFA into regular expression.
- In the second example we will handle with more number of states. And do the required animation like first example.
- The animation will show the construction of a simple states reducing diagrams and change in their transaction and strings over the transaction happening . And Finally we will get our Regular Expression for the given DFA.

Problem Statement

Input:- A figure with given number of non-final states and final states.

Output:- A regular expression for the given DFA.



Regular Expression
containing combinations
of some finite symbols
over Σ .

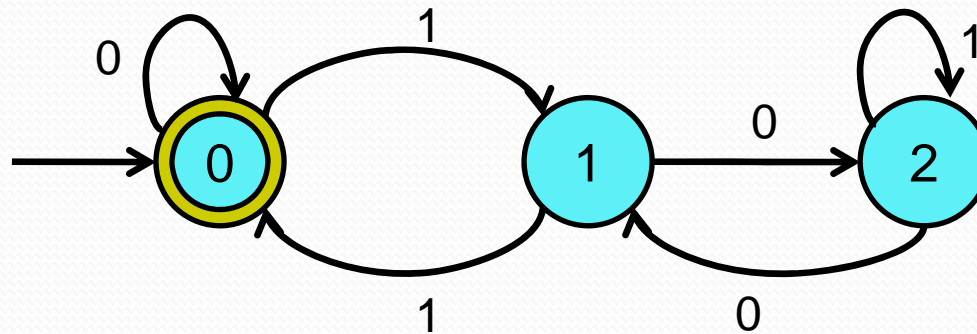
Problem 1:-

Input :- Language over $\Sigma = \{0,1\}^*$, such that every string is a multiple of 3 in binary.

Output:- A Regular Expression representing the above DFA.

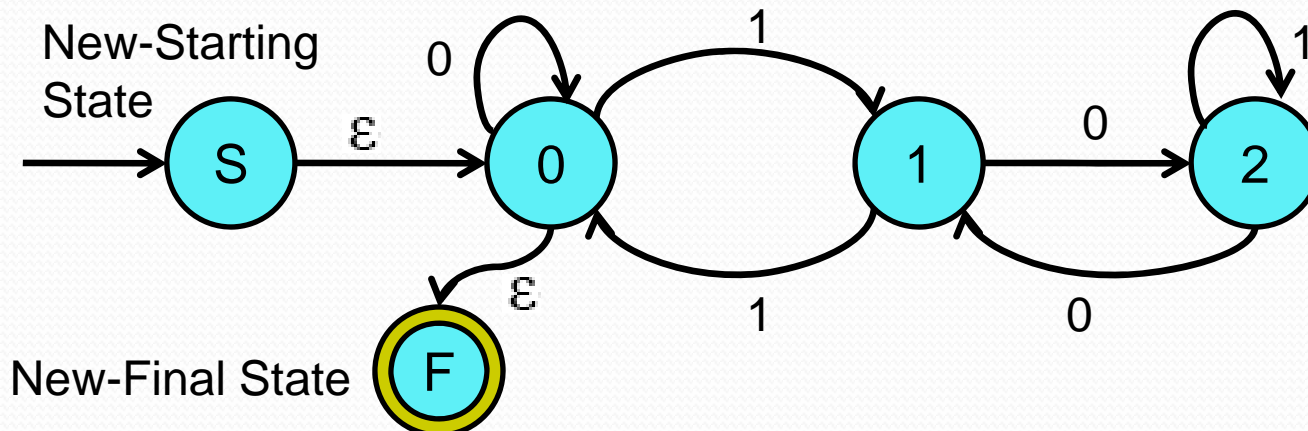
Solution:-

DFA representing the above problem:-

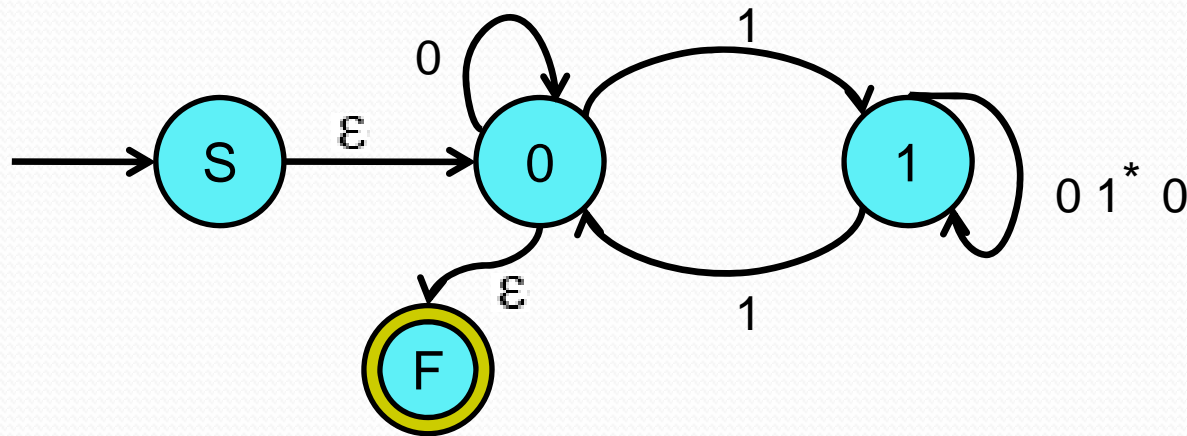


Where 0,1,2 in circles represents the remainders.

Step 1:- Add a new initial state (S) and a new final state (F) with ϵ - transition:-

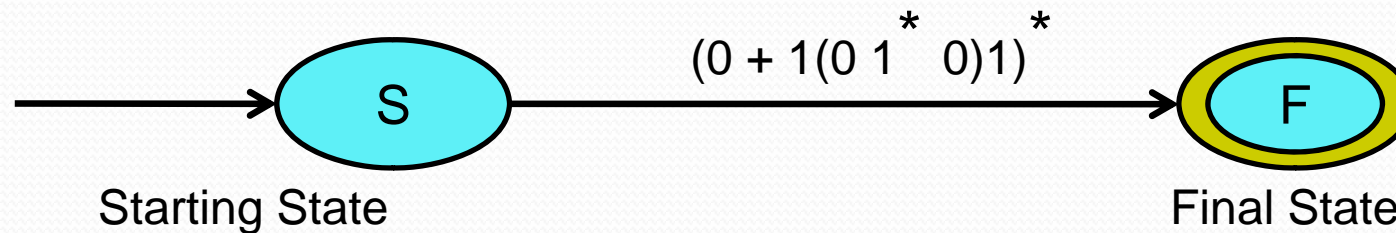


Step 2:- Remove the circle with remainder 2.



Now circles with 0,1
doesn't represent
remainders here.

Final Step:- After Removing all the circles with 0, 1.



So, the final **Regular Expression** for the above **DFA** is :-

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

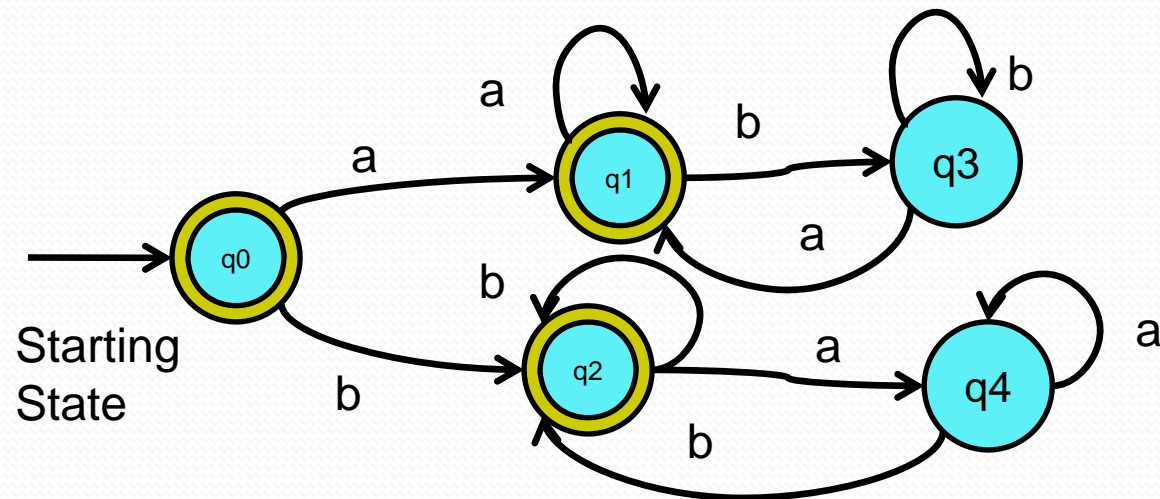
Problem 2:-

Input :- Language over $\Sigma = \{a, b\}^*$, such that every string starts and ends with the same symbol.

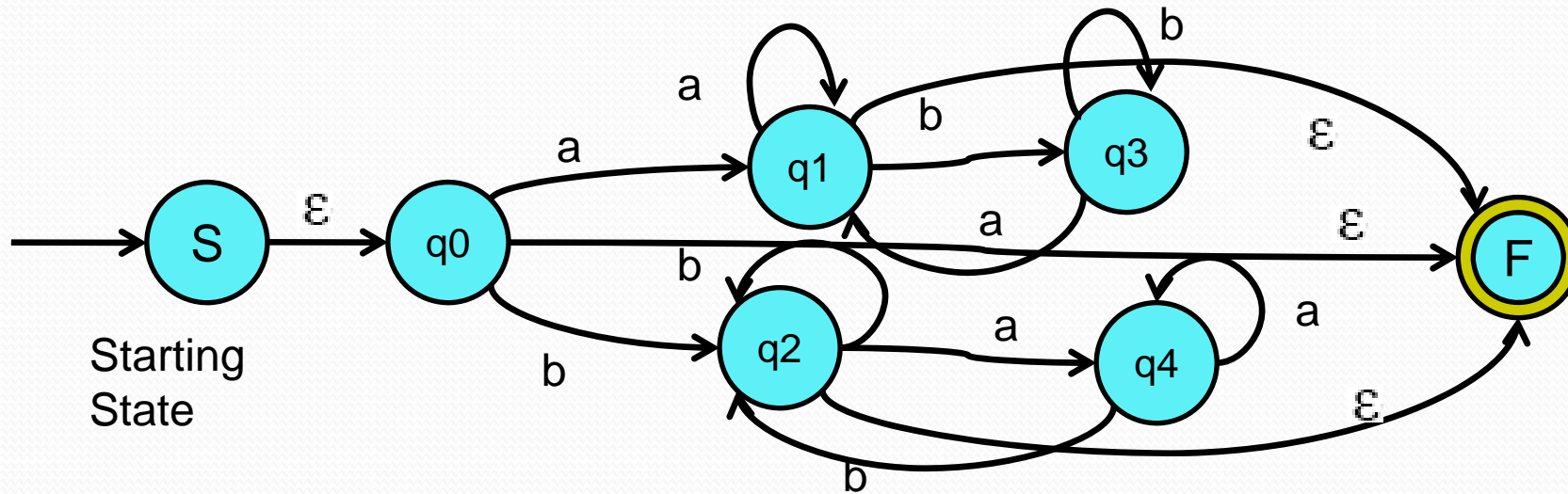
Output:- A Regular Expression representing the above DFA.

Solution:-

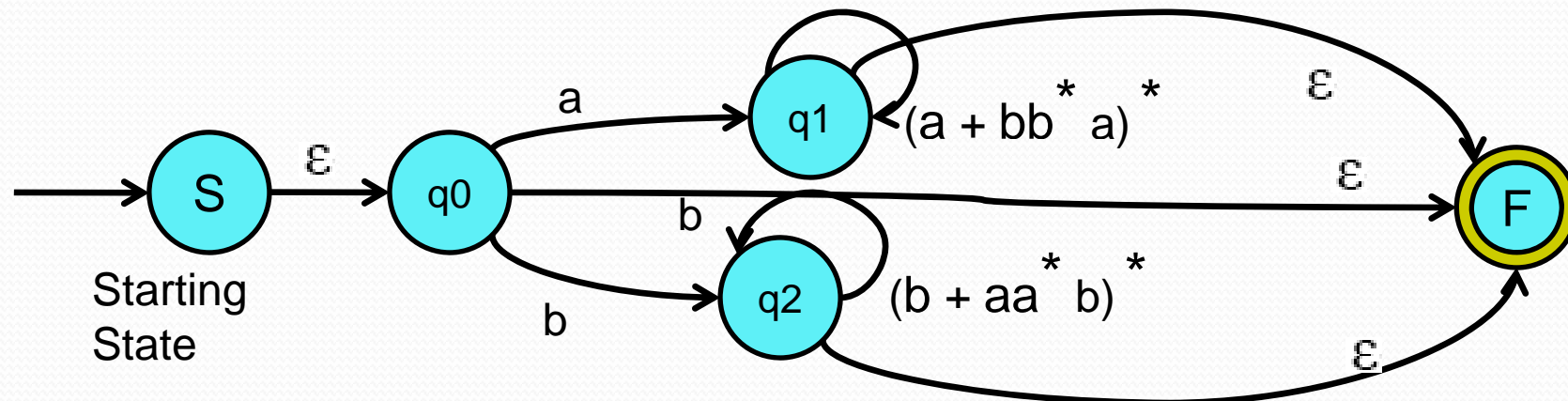
DFA representing the above problem:-



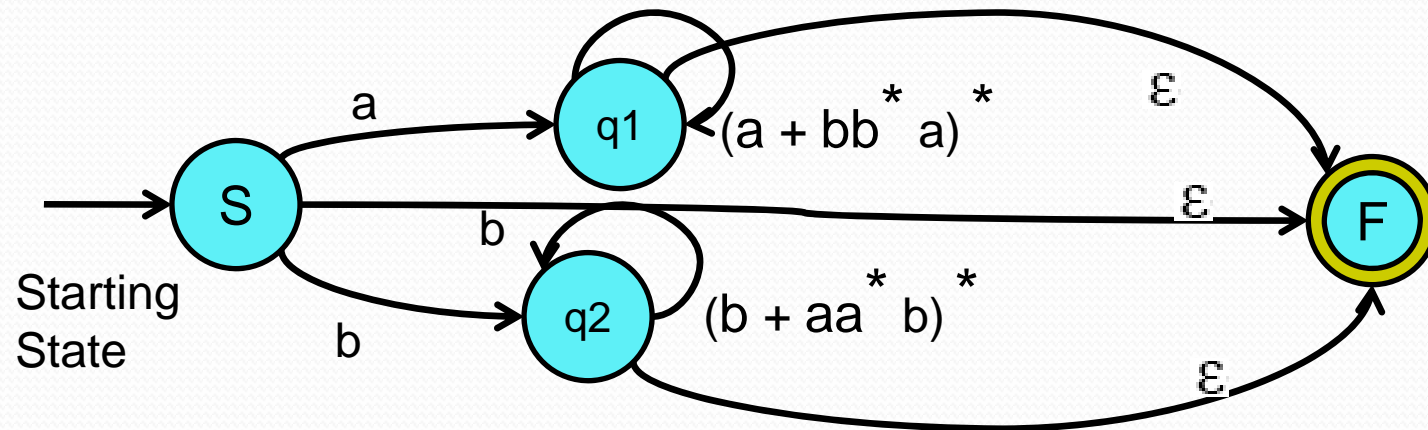
Step 1:- Add a new initial state (S) and a new final state (F) with ϵ - transition:-



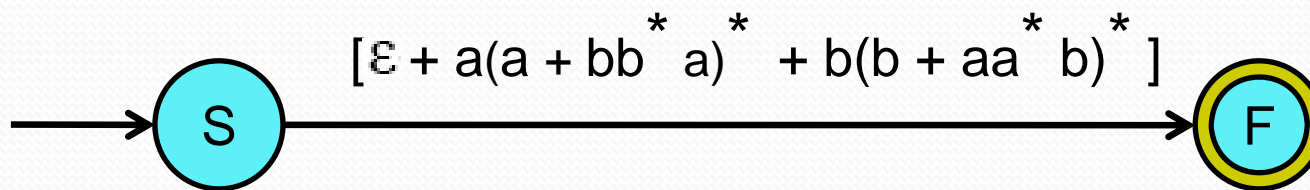
Step 2:- Remove the circle named as q3 and q4.



Step 3:- Remove the circle named as q0.



Final Step:- After Removing all the circles named as q1 ,q2.



So, the final **Regular Expression** for the above **DFA** is :-

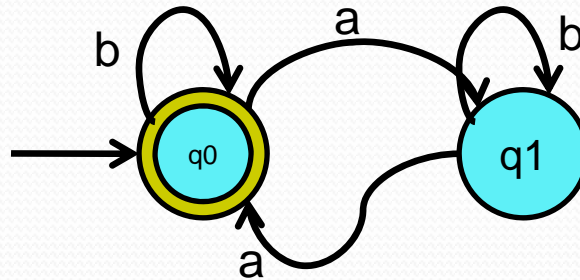
$$[\epsilon + a(a + bb^* a)^* + b(b + aa^* b)^*]$$

Further Interactivity

- We will arrange more and more questions for the user by which he or she can do some questions based on this topic.
- For this animation user input is very-very hard so I am avoiding it.
- We will show the formation of reduced diagrams/figure according to the algorithm in the animation.
- We will show how the algorithm works in the animation part and how the no of states changes when they are removed or added in the animation.

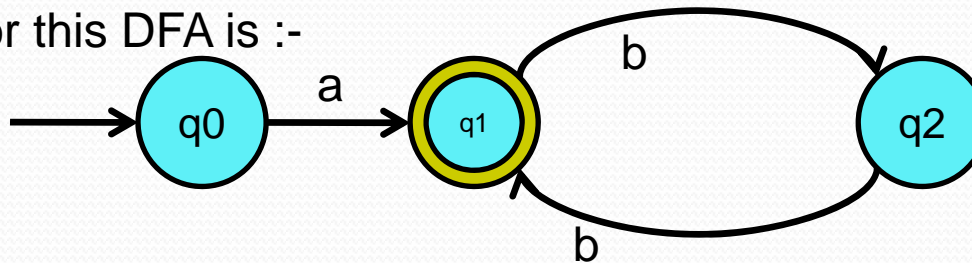
Review Questions

- Output is the _____ DFA listed as a regular expressions.
(ans:- minimal)
- A DFA represents a finite state machine that recognizes a _____.
(ans:- Regular Expression)
- What is the regular expression for the given DFA of language containing even number of "a":-



_____. -----[ans :- $(b + ab^*a)^*$]

- Regular Expression for this DFA is :-



_____. -----[ans:- $(a(bb)^*)$]

Further Reading Links

- <http://www.cs.geneseo.edu/~baldwin/csci342/fall2006/0919dfa2re.html>
- <http://www.cs.uiuc.edu/class/fa05/cs475/Lectures/new/leco5.pdf>
- <http://www.mec.ac.in/resources/notes/notes/automata/Transforming%20FSA%20into%20RE.htm>
- http://en.wikipedia.org/wiki/Deterministic_finite-state_machine
- http://en.wikipedia.org/wiki/Regular_expressions



CREDITS

Developed &
Idea by

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