Cairo University
Faculty of Computers & Artificial Intelligence
Theory of Computations

Lab#6

Description

1- Construct DFA for a given language problem.
2- Construct a NFA for a given language problem.
3- Convert NFA to DFA problem.
TA's will revise topic and let Students solve the questions

Problem 1

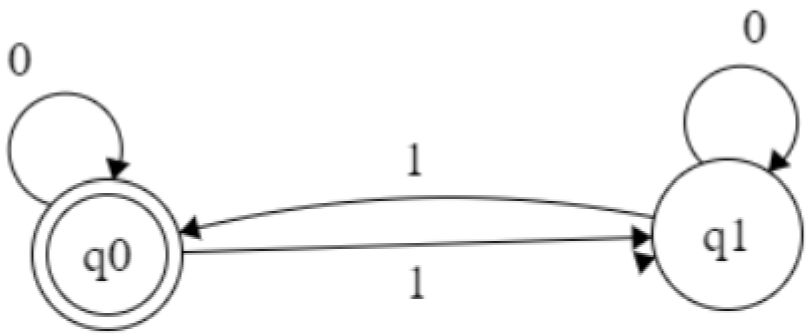
- **Construct a DFA recognizing the language {x | the number of 1's is divisible by 2, and 0'sby 3} over an alphabet ∑={0,1}**

The given language L={ x | the number of 1's is divisible by 2, and 0's by 3} over an alphabet ∑={0,1}.

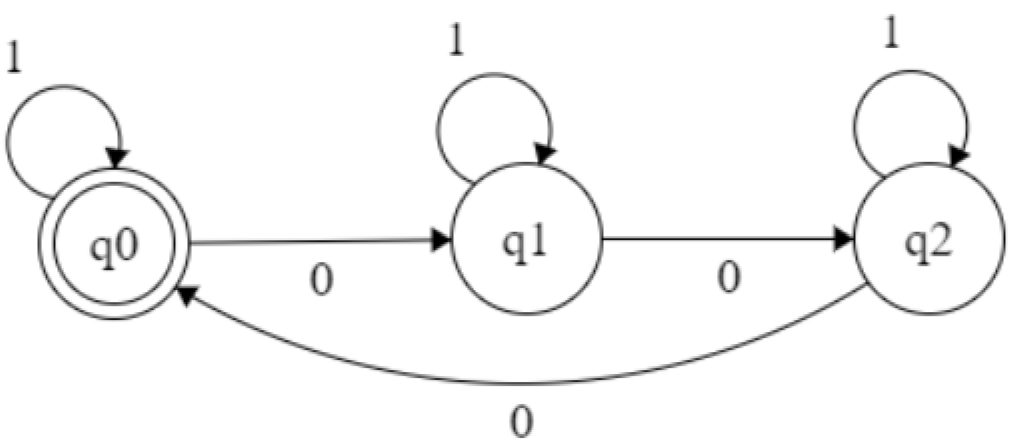
The language is divided into two parts, first we need to find the number of 1's divisible by 2 and second find out the number of 0's divisible by 3, finally combine the two parts to generate a result.

Lab 6

Step 1 – DFA for the first part, number of 1’s divisible by 2.



Step 2 – DFA for the second part, number of 0’s divisible by 3.

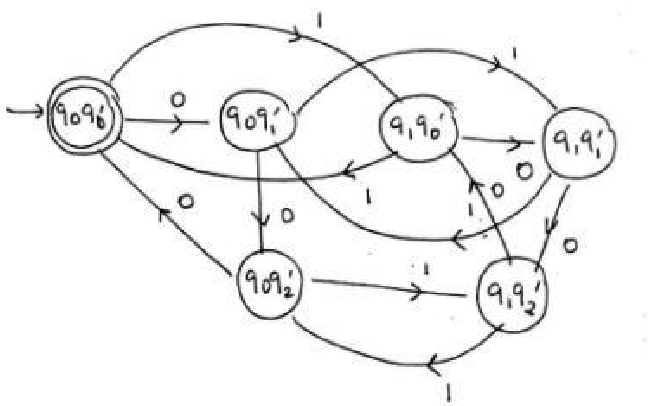


Step 3 – The final DFA is: DFA first part X DFA second part.

States	0	1
{q0q0'}	{q0q1'}	{q1q0'}
{q0q1'}	{q0q2'}	{q1q1'}
{q0q2'}	{q0q0'}	{q1q2'}
{q1q0'}	{q1q1'}	{q0q0'}
{q1q1'}	{q1q2'}	{q0q1'}
{q1q2'}	{q1q0'}	{q0q2'}

Transition diagram

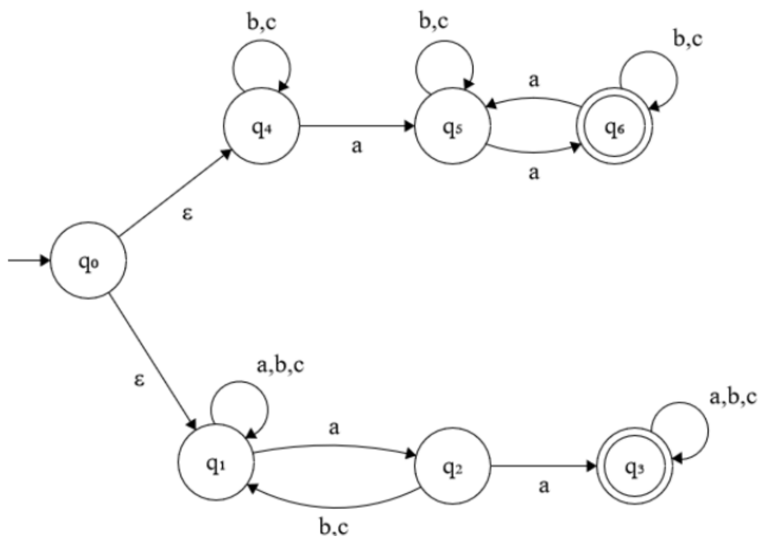
The transition diagram for the DFA is as follows –



Problem 2

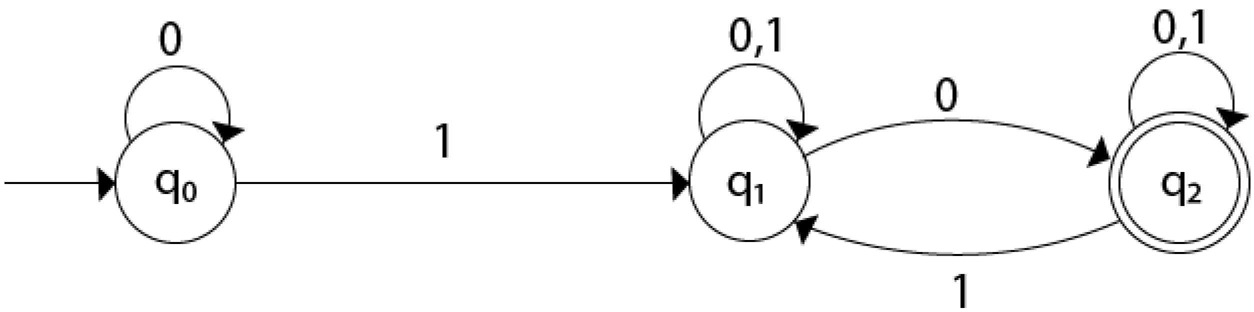
2. Construct an NFA to recognize the following language, where Σ = {a, b, c} L2 = {w : w contains an even number of a's or contains the pattern 'aa'}

Answer:



Problem 3

- Convert the given NFA to DFA.



Solution: For the given transition diagram we will first construct the transition table.

State	0	1
→q0	q0	q1
q1	{q1, q2}	q1
*q2	q2	{q1, q2}

Now we will obtain δ' transition for state q0.

1. δ'([q0], 0) = [q0]
2. δ'([q0], 1) = [q1]

The δ' transition for state q1 is obtained as:

1. δ'([q1], 0) = [q1, q2]   (**new** state generated)
2. δ'([q1], 1) = [q1]

Now we will obtain δ' transition on [q1, q2].

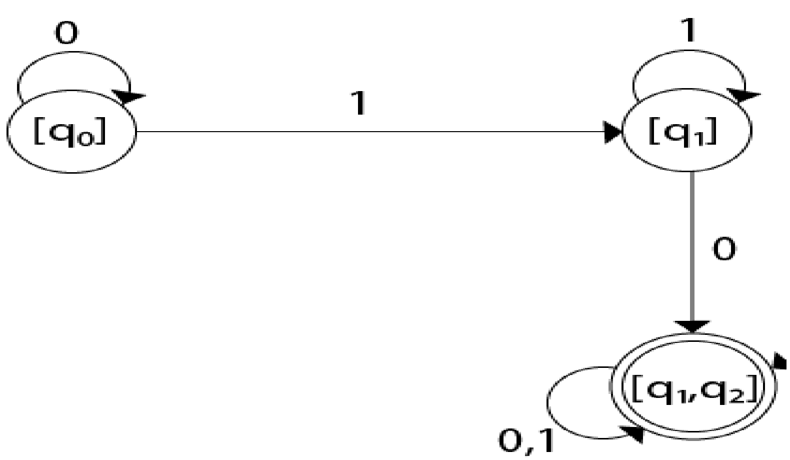
1. δ'([q1, q2], 0) = δ(q1, 0) ∪ δ(q2, 0)

2. $= \{q1, q2\} \cup \{q2\}$
3. $= [q1, q2]$
4. $\delta'([q1, q2], 1) = \delta(q1, 1) \cup \delta(q2, 1)$
5. $= \{q1\} \cup \{q1, q2\}$
6. $= \{q1, q2\}$
7. $= [q1, q2]$

The state [q1, q2] is the final state as well because it contains a final state q2. The transition table for the constructed DFA will be:

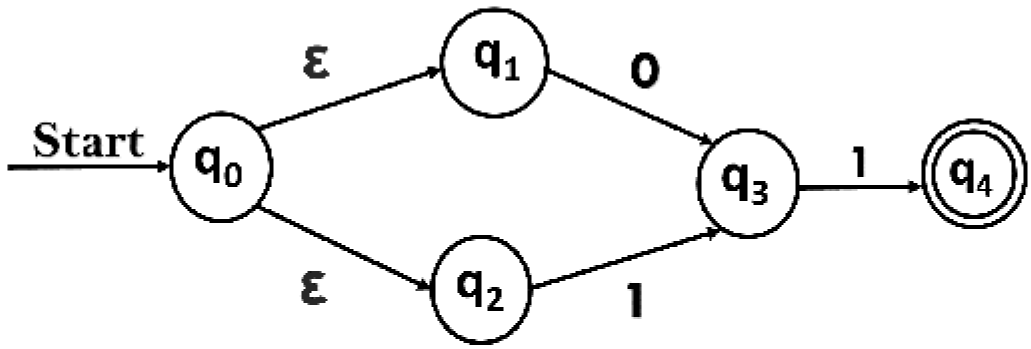
State	0	1
→[q0]	[q0]	[q1]
[q1]	[q1, q2]	[q1]
*[q1, q2]	[q1, q2]	[q1, q2]

The Transition diagram will be:



Problem 4

Convert the NFA with ε into its equivalent DFA.



Solution:

Let us obtain ε-closure of each state.

1. ε-closure {q0} = {q0, q1, q2}
2. ε-closure {q1} = {q1}
3. ε-closure {q2} = {q2}
4. ε-closure {q3} = {q3}
5. ε-closure {q4} = {q4}

Now, let ε-closure {q0} = {q0, q1, q2} be state A.

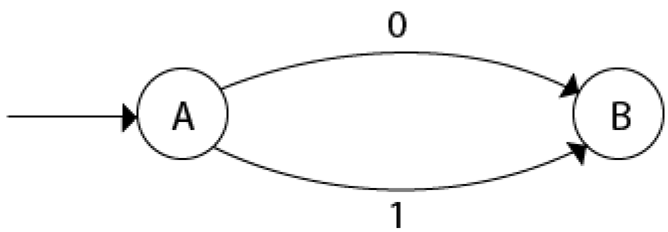
Hence

δ'(A, 0) = ε-closure {δ((q0, q1, q2), 0) }
= ε-closure {δ(q0, 0) ∪ δ(q1, 0) ∪ δ(q2, 0) }
= ε-closure {q3}
= {q3} **call it as state B**.

Lab 6

$\delta'(A, 1) = \varepsilon\text{-closure } \{\delta((q0, q1, q2), 1)\}$
$= \varepsilon\text{-closure } \{\delta((q0, 1) \cup \delta(q1, 1) \cup \delta(q2, 1)\}$
$= \varepsilon\text{-closure } \{q3\}$
$= \{q3\} = B.$

The partial DFA will be



Now,

$\delta'(B, 0) = \varepsilon\text{-closure } \{\delta(q3, 0)\}$
$= \phi$
$\delta'(B, 1) = \varepsilon\text{-closure } \{\delta(q3, 1)\}$
$= \varepsilon\text{-closure } \{q4\}$
$= \{q4\}$ **i.e. state C**

For state C:

1. $\delta'(C, 0) = \varepsilon\text{-closure } \{\delta(q4, 0)\}$
2. $= \phi$
3. $\delta'(C, 1) = \varepsilon\text{-closure } \{\delta(q4, 1)\}$
4. $= \phi$

Lab 6

The DFA will be,