Acceptors, Classifiers, and Transducers

Acceptor (Recognizer):

An automaton that computes a Boolean function is called an **acceptor**. All the states of an acceptor are either accepting or rejecting the inputs given to it.

Classifier:

A **classifier** has more than two final states and it gives a single output when it terminates.

Transducer:

An automaton that produces outputs based on current input and/or previous state is called a **transducer**. Transducers can be of two types: Mealy Machine and Moore Machine.

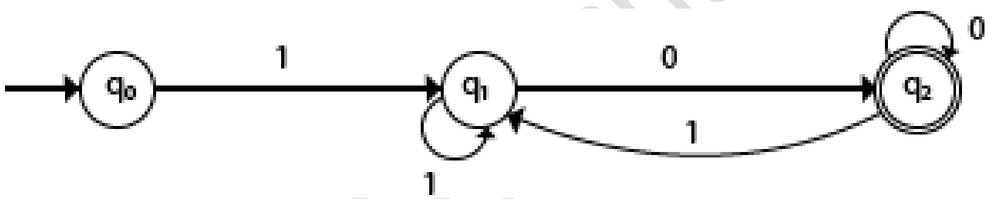
Examples (Finite Automata as an Acceptor)

Example 1:

Design a FA with ∑ = {0, 1} accepts those strings which starts with 1 and ends with 0.

Solution:

The FA will have a start state q_0 from which only the edge with input 1 will go to the next state.

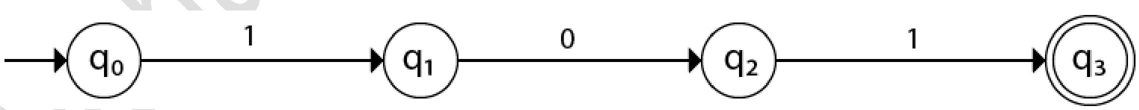


In state q_1, if we read 1, we will be in state q_1, but if we read 0 at state q_1, we will reach to state q_2 which is the final state. In state q_2, if we read either 0 or 1, we will go to q_2 state or q_1 state respectively. Note that if the input ends with 0, it will be in the final state.

Example 2:

Design a FA with ∑ = {0, 1} accepts the only input 101.

Solution:

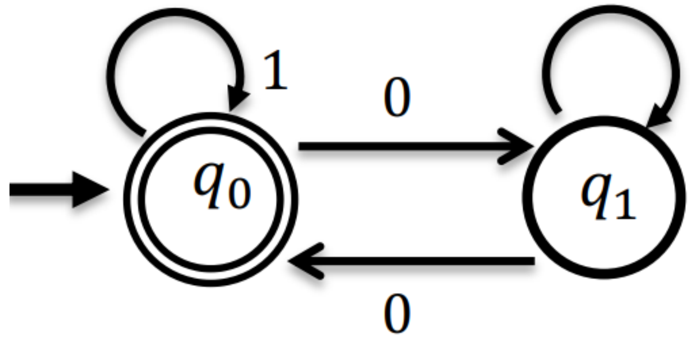


In the given solution, we can see that only input 101 will be accepted. Hence, for input 101, there is no other path shown for other input.

مثال توضيحي: أنشئ الأوتومات المنتهي الحتمي الذي يقبل السلاسل التي تحوي عدد زوجي من الأصفار (ليس بالضرورة تعاقب الأصفار) وأي عدد من الواحدات. حيث الأبجدية هي {0, 1}=∑ وأكتب التعبير المنتظم (RE) لها:

الحل (الرسم):

(*) أستاذ مساعد، قسم علوم الحاسوب، كلية علوم الحاسوب والرياضيات، جامعة الموصل.



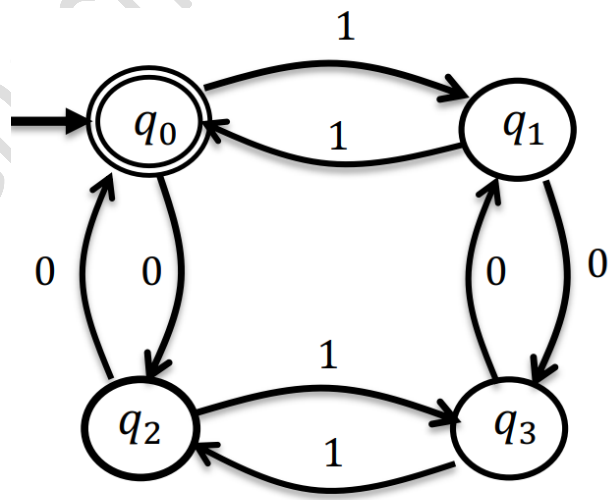
ويكون التعبير المنتظم (RE) هو: $(1^*+01^*0)^*$

Example 3:
Design FA with ∑ = {0, 1} accepts even number of 0's and even number of 1's. Test whether or not the following words belong to this FA: 01, 1000, 0000, 111, and 110101.

Solution:
This FA will consider four different stages for input 0 and input 1.

The table could be: and the stages could be:

δ	0	1
q_0	q_2	q_1
q_1	q_3	q_0
q_2	q_0	q_3
q_3	q_1	q_2



لنختبر السلسلة **1000:** $q_0 \xrightarrow{1} q_1 \xrightarrow{0} q_3 \xrightarrow{0} q_1 \xrightarrow{0} q_3$

ونصل إلى q_0 وهي ليست حالة نهائية، ومنه السلسلة 1000 لا تنتمي إلى اللغة التي يولدها الأوتوميت.

الآن لنختبر السلسلة **110101:** $q_0 \xrightarrow{1} q_1 \xrightarrow{1} q_0 \xrightarrow{0} q_2 \xrightarrow{1} q_3 \xrightarrow{0} q_1 \xrightarrow{1} q_0$

ونصل إلى q_0 وهي حالة نهائية وبالتالي السلسة 110101 بدأت بالحالة الابتدائية وانتهت بحالة نهائية وبالتالي هي تنتمي إلى اللغة التي يولدها الأوتوميت. وهنا نلاحظ أن اللغة التي يولدها الأوتوميت السابق تحوي عدد زوجي من الأصفار وعدد زوجي من الواحدات.

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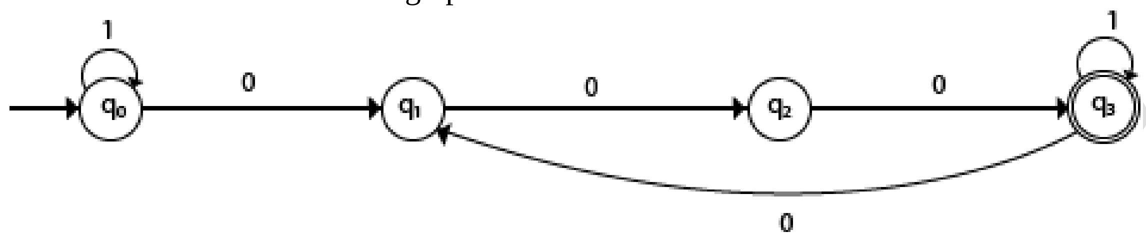
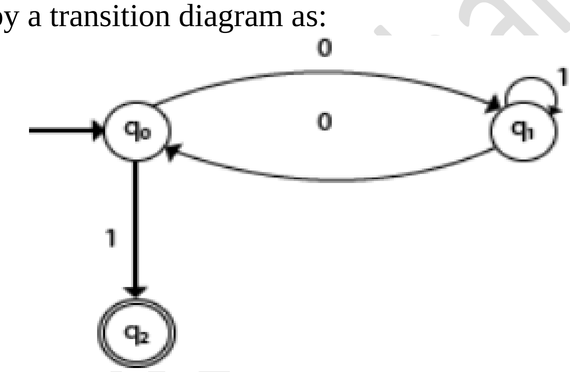
Example 4:
Design FA with ∑ = {0, 1} accepts the set of all strings with three consecutive 0's.

Solution:
The strings that will be generated for this particular language could be 000, 0001, 1000, 10001, ... in which 0 always appears in a clump of 3. Note that the sequence of triple zeros is maintained to reach the final state. The transition graph is as follows:



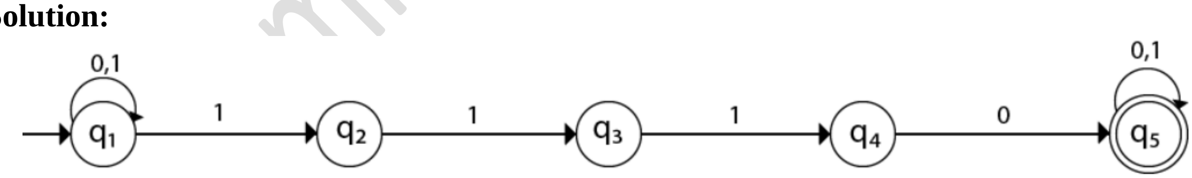
Example 5:
Design a FA with ∑ = {0, 1} accepts the strings with an even number of 0's followed by a single 1.

Solution:
The DFA can be shown by a transition diagram as:



Example 6:
Design a NFA in which all the string contain a substring 1110.

Solution:



The transition table for the above transition diagram can be given below:

Present State	Next State for Input 0	Next State for Input 1
→q1	q1	q1, q2
q2		q3
q3		q4
q4	q5	
*q5	q5	q5

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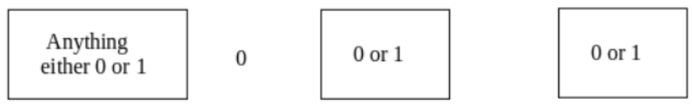
Example 7

Design an NFA with $\sum = \{0, 1\}$ accepts all string in which the third symbol from the right end is always 0.

Solution:



Thus, we get the third symbol from the right end as '0' always. The NFA can be:

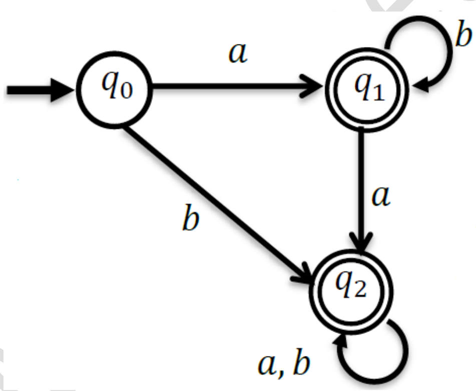
This graph is an NFA because in state q_0 with input 0, we can either go to state q_0 or q_1.

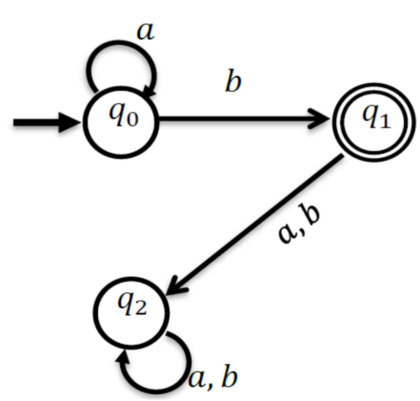
HW 1. *Design an NFA with $\sum = \{0, 1\}$ accepts all string ending with 01.*

HW 2. *Design an NFA with $\sum = \{0, 1\}$ in which double '1' is followed by double '0'.*

HW 3. *Design a NDFA $L(M) = \{w \mid w \varepsilon \{0, 1\}^*\}$ and W is a string that does not contain consecutive 1's.*

HW 4. *Find the Regular expressions of the following DFA:*





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