# Finite Automaton with output

Finite automaton discussed so far, is just associated with the RE or the language.

There is a question whether does there exist an FA which generates an output string corresponding to each input string ? The answer is yes. Such machines are called machines with output.

There are two types of machines with output. Moore machine and Mealy machine

# Moore machine

A Moore machine consists of the following

1. A finite set of states $q_0, q_1, q_2, \ldots$ where $q_0$ is the initial state.
2. An alphabet of letters $\Sigma = \{a,b,c,\ldots\}$ from which the input strings are formed.
3. An alphabet $\Gamma=\{x,y,z,\ldots\}$ of output characters from which output strings are generated.

# Moore machine continued …

4. A transition table that shows for each state and each input letter what state is entered the next.

5. An output table that shows what character is printed by each state as it is entered.

# Moore machine continued …

**Note**: It is to be noted that since in Moore machine no state is designated to be a final state, so there is no question of accepting any language by Moore machine. However in some cases the relation between an input string and the corresponding output string may be identified by the Moore machine. Moreover, the state to be initial is not important as if the machine is used several times and is restarted after some time, the machine will be started from the state where it was left off. Following are the examples

# Example

Consider the following Moore machine having the states $q_0$, $q_1$, $q_2$, $q_3$ where $q_0$ is the start state and

$\Sigma = \{a,b\}$,

$\Gamma=\{0,1\}$

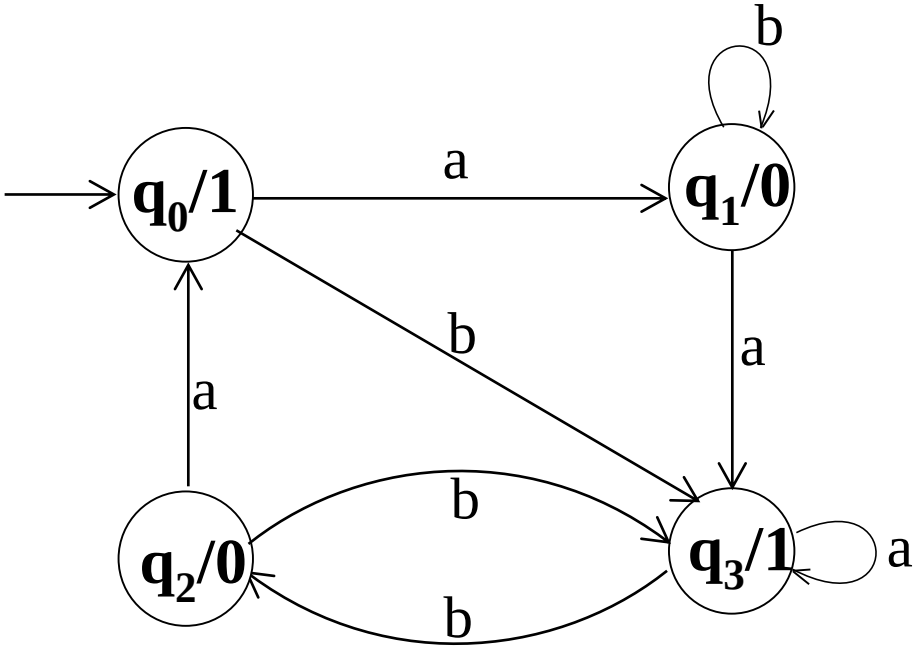
the transition table follows as

# Example continued …

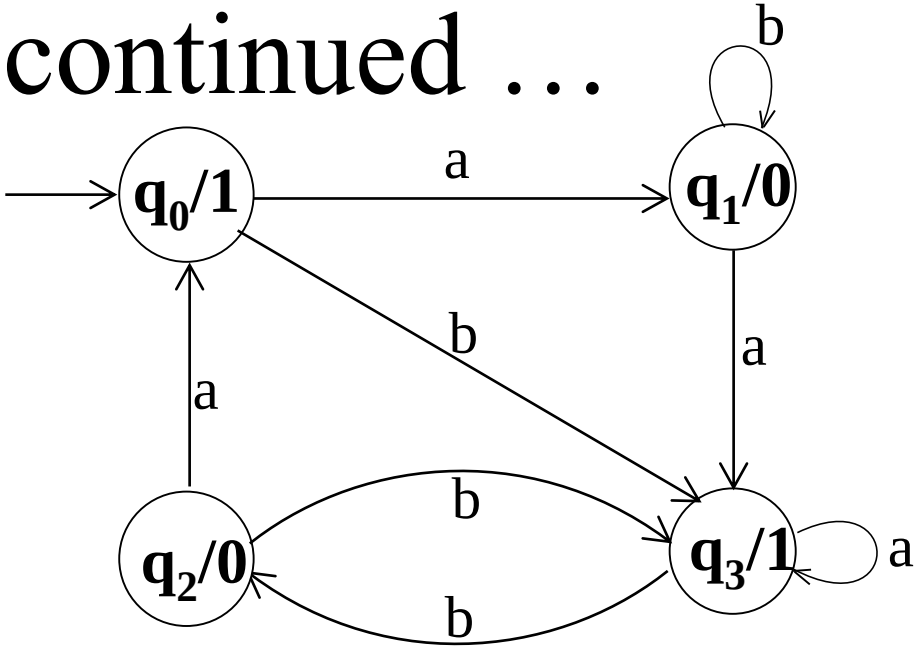
| **Old States** | **New States after reading** | | Characters to be printed |
|---|---|---|---|
| | **a** | **b** | |
| **$q_0$-** | **$q_1$** | **$q_3$** | 1 |
| **$q_1$** | **$q_3$** | **$q_1$** | 0 |
| **$q_2$** | **$q_0$** | **$q_3$** | 0 |
| **$q_3$** | **$q_3$** | **$q_2$** | 1 |

# Example continued …

the transition diagram corresponding to the previous transition table may be



# Example continued …




It is to be noted that the states are labeled along with the characters to be printed. Running the string abbabbba over the above machine, the corresponding output string will be 100010101, which can be determined by the following table as well

# Example continued …

| Input | | a | b | b | a | b | b | b | a |
|---|---|---|---|---|---|---|---|---|---|
| State | $q_0$ | $q_1$ | $q_1$ | $q_1$ | $q_3$ | $q_2$ | $q_3$ | $q_2$ | $q_0$ |
| output | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |

It may be noted that the length of output string is l more than that of input string as the initial state prints out the extra character 1, before the input string is read.

# Summing Up

Recap Theorem, Example, Finite Automaton with output, Moore machine, Examples