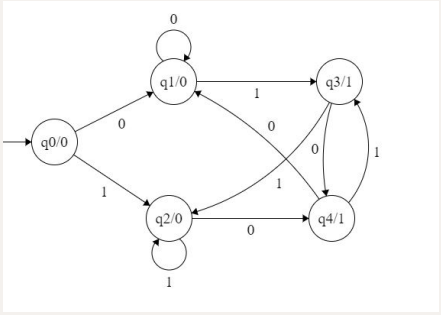
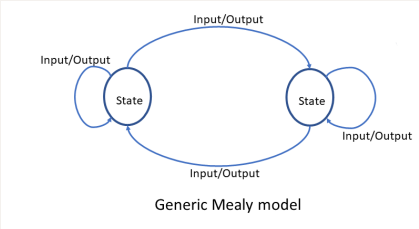
MEALY MACHINES

A Mealy machine is a type of finite state machine in automata theory and digital logic that defines its output as a function of both its current state and the input. Mealy machines are named after George H. Mealy, who introduced this concept in the 1950s. They are often used for various applications in digital electronics, including sequence recognition, data encoding/decoding, and control circuit design

It can be defined as (Q, q0, ∑, O, δ, λ) where

- Q is a finite set of states.
- q0 is the initial state.
- ∑ is the input alphabet.
- O is the output alphabet.
- δ is the transition function which maps Q×∑ → Q.
- λ is the output function which maps Q → O.





Generic Mealy model

In a Mealy machine:

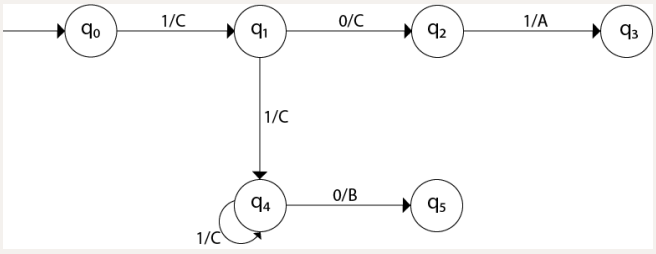
- States: The machine has a finite number of states (q0, q1, q2, etc.). It starts in an initial state and transitions between states based on input.
- Input: At each step, the machine reads an input symbol (0 or 1, for example).
- Transitions: The machine transitions from one state to another based on the current state and the input symbol. Each transition is associated with an output.
- Output: Unlike Moore machines (another type of finite state machine), in Mealy machines, the output depends on both the current state and the input symbol. Each transition has an associated output, which is produced when the machine takes that transition.

Example :

Design a Mealy machine for a binary input sequence such that if it has a substring 101, the machine output A, if the input has substring 110, it outputs B otherwise it outputs C.

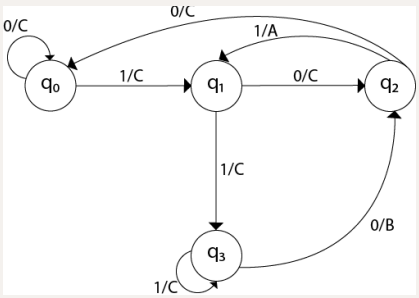
Step 1:

For designing such a machine, we will check two conditions, and those are 101 and 110. If we get 101, the output will be A. If we recognize 110, the output will be B. For other strings the output will be C. The partial diagram will be:



Step 2:

Now we will insert the possibilities of 0's and 1's for each state. Thus the Mealy machine becomes:



Mealy machines, with their ability to produce outputs based on both current states and input symbols, find applications in various fields of computer science and engineering. Here are some common applications of Mealy machines:

1. Sequence Detection: Mealy machines are frequently used for detecting specific sequences or patterns in data streams. They can be employed in communication systems to recognize header patterns in data packets or in error-detection circuits to identify specific error patterns.

2. Data Encoding and Decoding: Mealy machines are used to encode and decode data in various communication protocols. For example, they can be used in encoding and decoding schemes like Manchester encoding, which is commonly used in networking and serial communication.

3. Digital Control Systems: Mealy machines play a vital role in digital control systems, such as those used in industrial automation and robotics. They can be used to control the behavior of machines based on sensor inputs and produce outputs accordingly.

4. Pattern Recognition: Mealy machines are employed in pattern recognition applications, like speech recognition and optical character recognition (OCR). They can analyze input patterns and generate appropriate responses or classifications.

These are just a few examples of how Mealy machines are applied in various fields