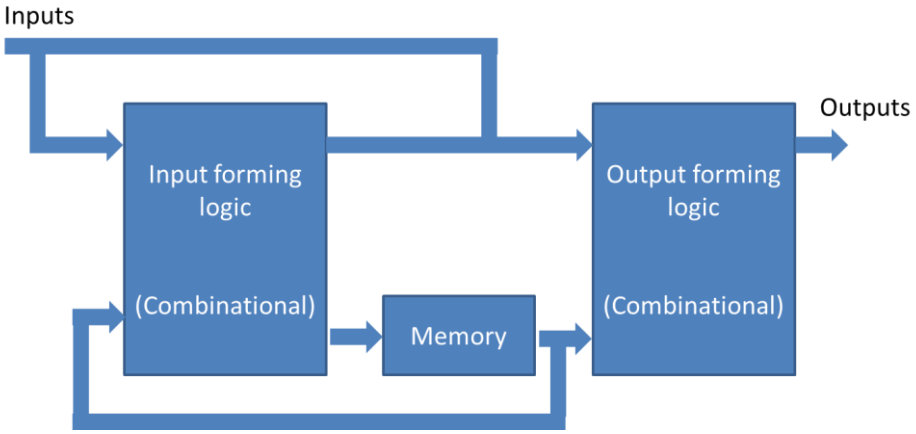
Need for State Machine or Advantages of State Machine

- The first advantage is that many electronic systems require the type of sequential operation exhibited by state machines. Therefore, state machine design can he applied to the solution of a wide variety of practical circuit problems.
- The second advantage is that state machine design methods lead to minimal design. In combinational circuits, we found that the Karnaugh map was useful in minimizing the number of gates required to implement a logic function. Although the importance of this tool has perhaps diminished as a result of the availability of MUXs, PLAs, PALS, and decoders, it remains a significant method in combinational design. The state machine design procedure relates to sequential circuit design the same way the K-map relates to combinational circuit design. This method results in the minimum number of required flip-flops and can minimize other circuitry in the system as well.
- The third advantage of the design method is that it is a well-developed, orderly procedure that anticipates and solves commonly occurring problems of sequential circuits. Trial-and-error design procedures often result in the appearance of very narrow unwanted pulses or glitches on output lines or occasional oscillation problems. State machine methods eliminate these problems and reduce the time taken to debug the implemented hardware.

General model for a sequential or state machine

- A large majority of practical state machines use clocked flip-flops as the storage elements.
- The general model of the sequential machine is shown in figure.



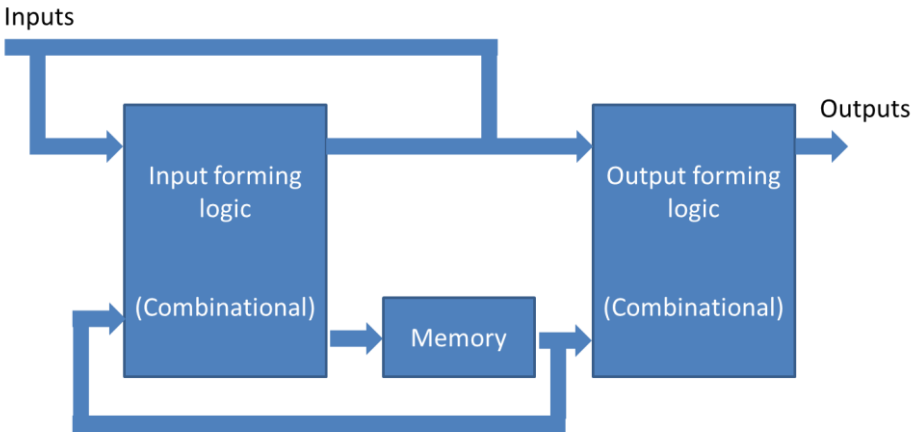
- This model is also called the Mealy machine after the man who first proposed the model.
- The input forming logic (IFL) and the output forming logic (OFL) sections are made up of combinational logic circuits.
- The memory section contains the state of the system.
- A path is provided from memory output to the IFL.
- Both input signals and present state signals drive the IFL to determine the next state of the system.
- The outputs are determined by the present state and the system inputs.
- A slight variation of the Mealy machine is the Moore machine, which uses only the memory to drive the OFL.
- In this case, the output is a function only of the state of the system.
- Another important characteristic of the state machine depends on whether the system is clock-driven or not.
- In many digital systems, a timing reference signal is required.
- Some type of astable multivibrator is generally used to produce a continuous clock signal. We refer to a variable as clock-driven if that variable changes value only at the time of a clock transition. When a variable is clock-driven, it is considered a synchronous variable.

- If a variable can change at a time not related to transitions of the reference clock, it is called an asynchronous variable.

Types of finite state machines

Mealy Model

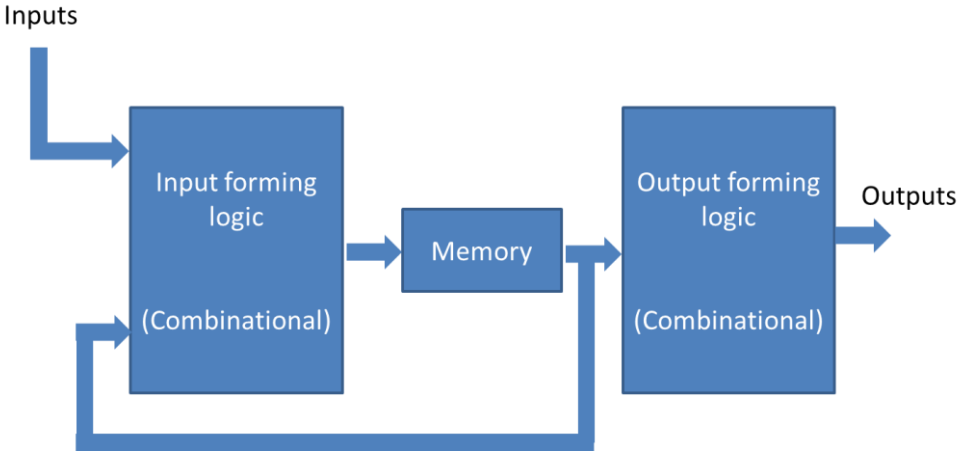
- When the output of the sequential circuit depends on both the present state of the flip-flops and on the inputs, the sequential circuit is referred to as Mealy circuit or Mealy machine.
- Mealy circuit can be represented with its block schematic as shown in the figure.



- A path is provided from memory output to the IFL.
- Both input signals and present state signals drive the IFL to determine the next state of the system.
- The outputs are determined by the present state and the system inputs.

Moore Model

- When the output of the sequential circuit depends only on the present state of the flip-flop, the sequential circuit is referred to as Moore circuit or Moore Machine.
- Moore circuit can be represented with its block schematic as shown in figure.



- A path is provided from memory output to the IFL.
- As shown in the figure, present state signals drive the IFL to determine the next state of the system.
- The outputs are determined by the present state and not the system inputs.