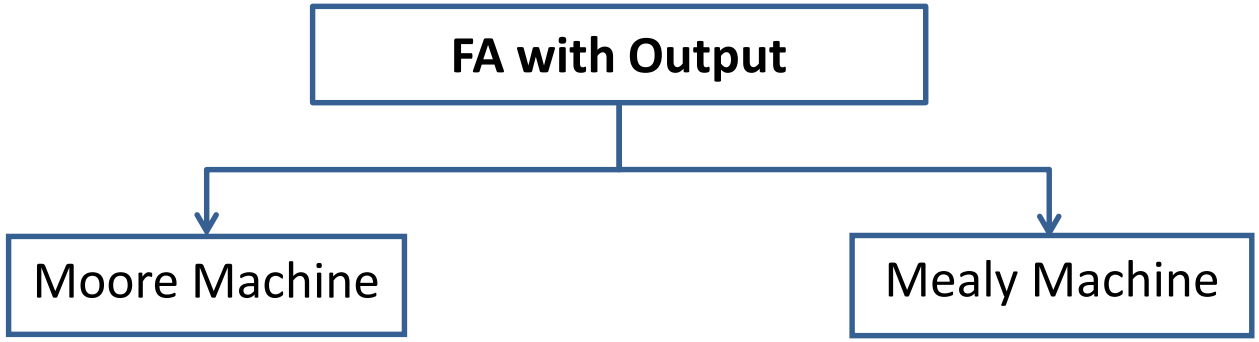
Finite Automata with Output

Finite automata with output

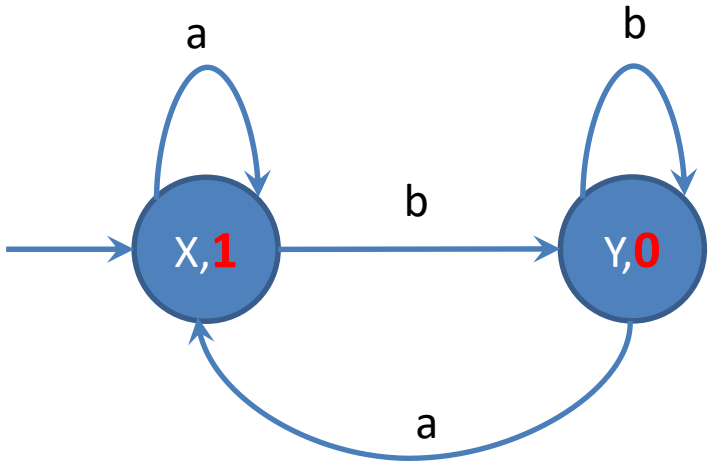
- Finite automata has limited capability of either accepting a string or rejecting a string. Acceptance of string was based on the reachability of a machine from starting state to final state.
- Finite automata with output do not have a final state.
- Machine generates output on every input.
- There are two types of automata with outputs:
  1. Moore machine
  2. Mealy machine

Moore machine & Mealy Machine



$$M_0 = (Q, \Sigma, \Delta, \delta, \lambda', q_0)$$

Output is associated with state ***Output is associated with transition***



Q : set of states

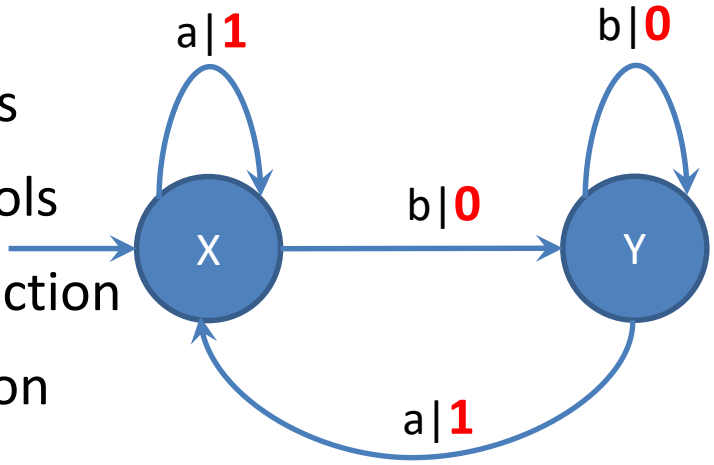
Σ : input symbols

Δ : output symbols

δ : Transition function

λ': output function

q_0 : initial state



Moore Machine

- Mathematically Moore machine is a six tuple machine and defined as

$$M_0 = (Q, \Sigma, \Delta, \delta, \lambda', q_0)$$

where,

Q : a nonempty finite set of states in M_0

Σ : a nonempty finite set of input symbols

Δ : a nonempty finite set of outputs

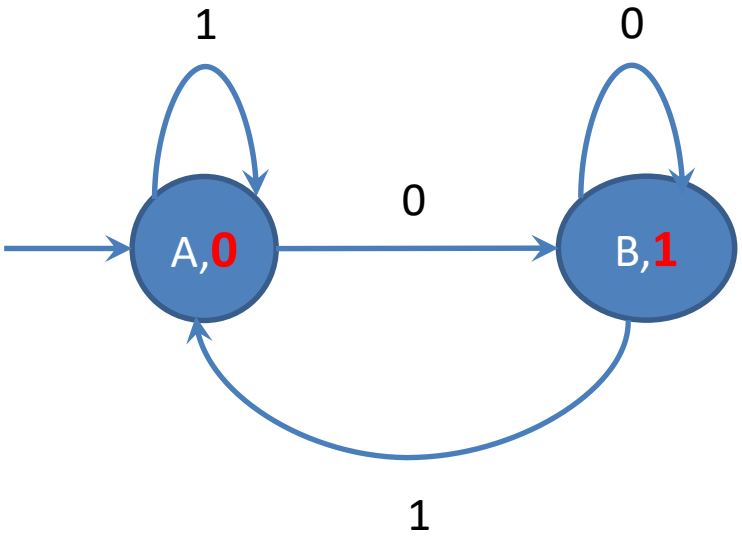
δ : Transition function which takes two arguments as in finite automata, one is input state and other is input symbol. The output of this function is a single state.

λ': it is a mapping function which maps Q to Δ, giving the output associated with each state.

q_0 : the initial state of M_0 and $q_0 \in Q$

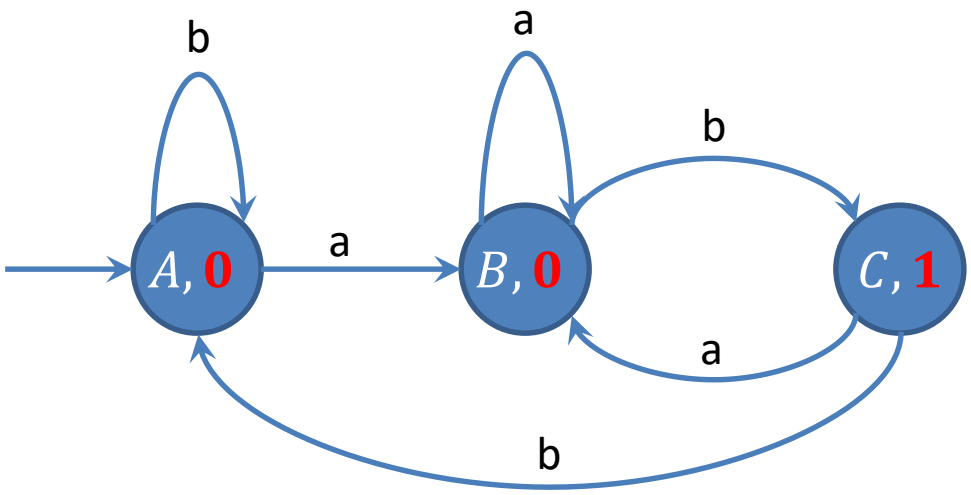
Example: Moore Machine

- Design a moore machine for the 1's compliment of binary number.



Example: Moore Machine

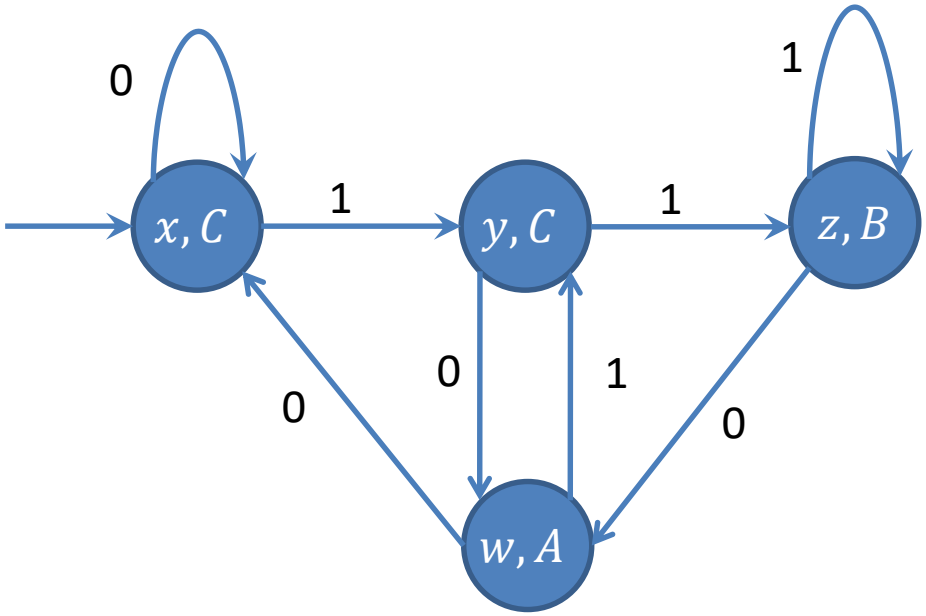
- Design a moore machine to count occurrence of “ab” as substring.



Example: Moore Machine

- Construct a moore machine that takes set of all strings over {0, 1} and produces ‘A’ if i/p ends witg ‘10’ , produces ‘B’ if i/p ends with ’11’ otherwise produces ‘C’.

10→A
11→B
Otherwise →C

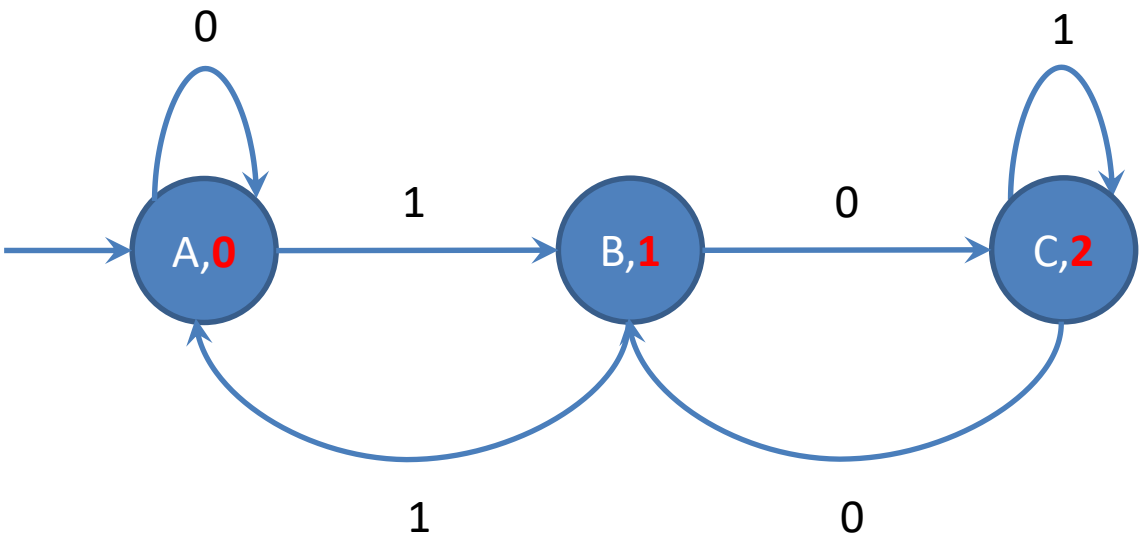


Example: Moore Machine

- Construct a moore machine that takes binary number as an i/p and produces residue modulo ‘3’ as an output.

Input={0,1}

Δ={0, 1, 2}



	0	1	Δ
A			0
B			1
C			2
Transition Table			

Mealy Machine

- Mathematically Mealy machine is a six tuple machine and defined as

$$M_e = (Q, \Sigma, \Delta, \delta, \lambda', q_0)$$

where,

Q : a nonempty finite set of states in M_e

Σ : a nonempty finite set of input symbols

Δ : a nonempty finite set of outputs

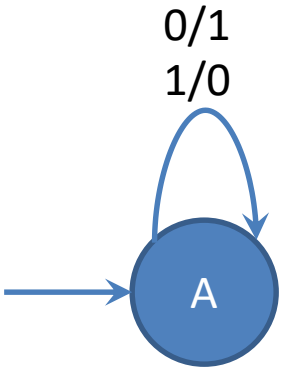
δ : Transition function which takes two arguments as in finite automata, one is input state and other is input symbol. The output of this function is a single state.

λ': It is a mapping function which maps $Q \times \Sigma$ to Δ, giving the output associated with each transition.

q_0 : the initial state of M_e and $q_0 \in Q$

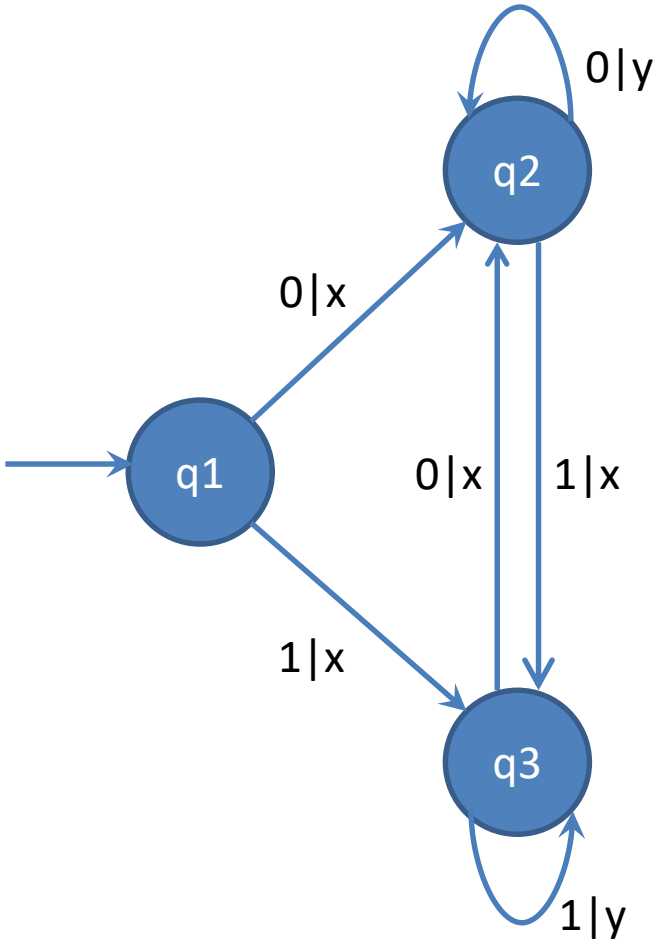
Example: Mealy Machine

- Design a mealy machine for the 1's compliment of binary number



Example: Mealy Machine

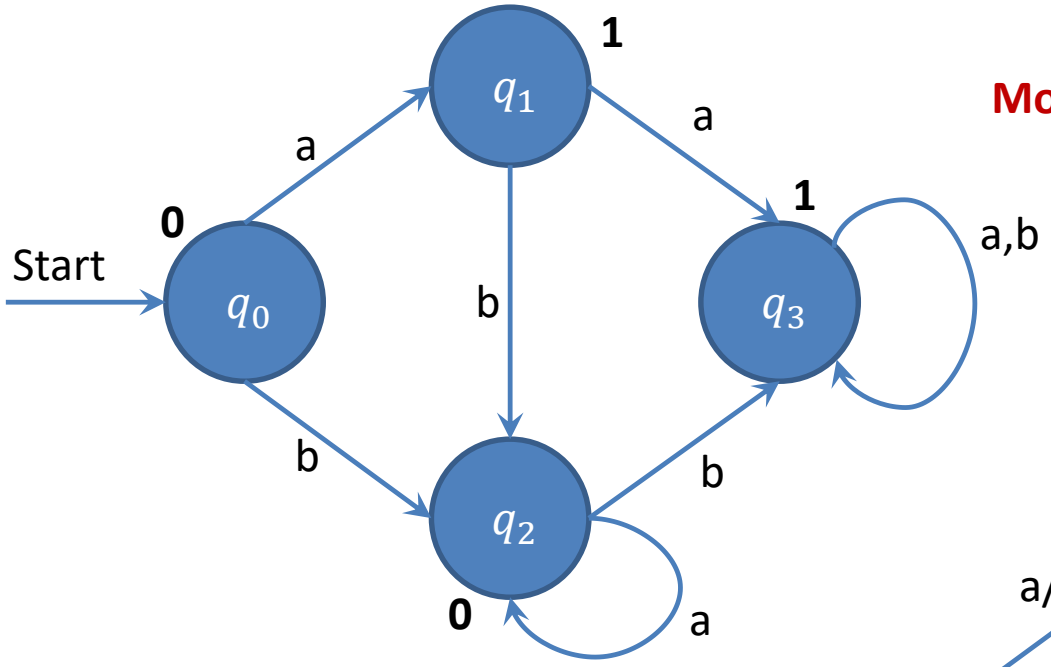
- Design a mealy machine for regular expression (0+1)*(00+11).



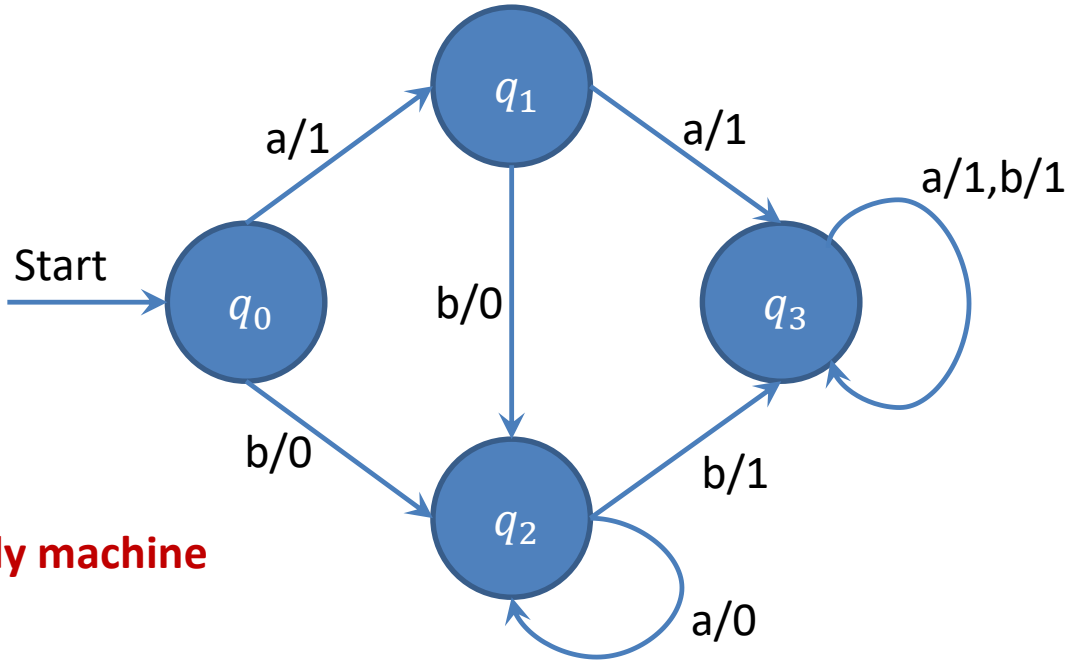
00→y
11→y
Otherwise →x

Moore to Mealy Machine Conversion

Conversion of Moore into Mealy Machine



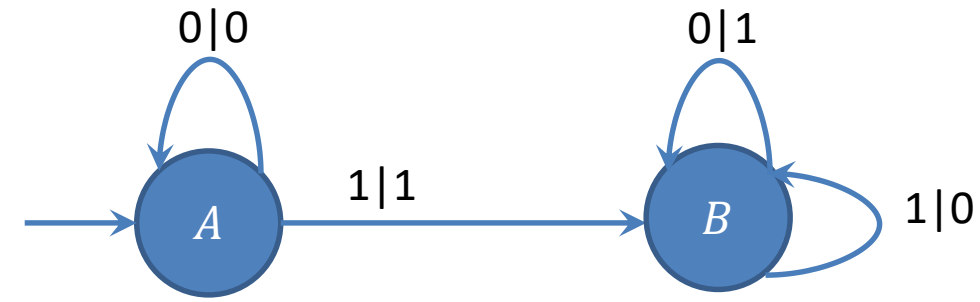
Moore machine



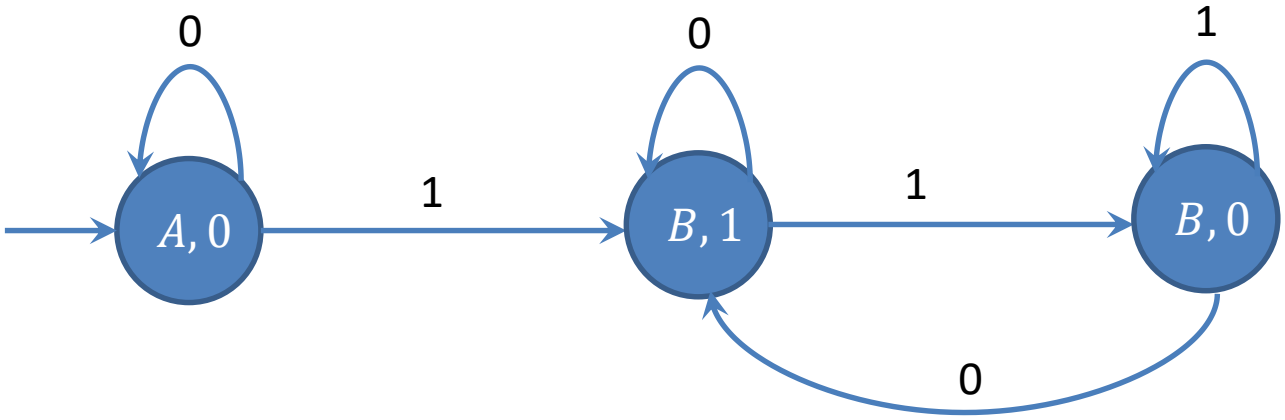
Mealy machine

Mealy to Moore Machine Conversion

Conversion of Mealy to Moore machine



Mealy machine



Moore machine

Exercise: Mealy machine to Moore machine