Compiler Construction

Finite State Machines with Output

- Mealy Machine
- Moore Machine

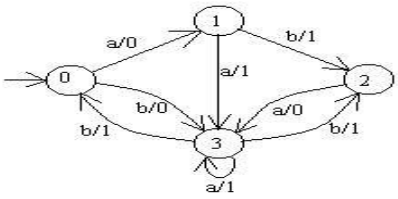
Mealy Machine & Moore Machine

- Finite automata are like computers in that they receive input and process the input by changing states. The only output that we have seen finite automata produce so far is a yes/no at the end of processing.
- We will now look at two models of finite automata that produce more output than a yes/no.

Mealy Machine

Transitions are labelled *i/o* where

- *i* is a character in the input alphabet and
- *o* is a character in the output alphabet.

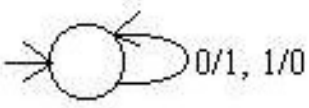



```
Input:  aaabb
Output: 01110
```

- Mealy machines are complete in the sense that there is a transition for each character in the input alphabet leaving every state.
- There are no accept states in a Mealy machine because it is not a language recogniser, it is an output producer. Its output will be the same length as its input.

Mealy Machine

- Mealy Machines are exactly as powerful as Moore machines
  - (we can implement any Mealy machine using a Moore machine, and vice versa).
- However, Mealy machines move the output function from the state to the transition. This turns out to be easier to deal with in practice, making Mealy machines more practical.




```
Input:  010110
Output: 101001
```

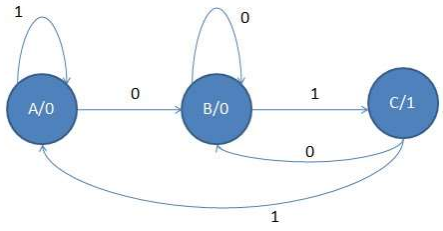
The above Mealy machine takes the one's complement of its binary input. In other words, it flips each digit from a 0 to a 1 or from a 1 to a 0.

Mealy Machine & Moore Machine

- Moore Machine M1=(Q,∑,λ,O,δ,qo)
  - ✓Q: Set of States
  - ✓∑: input alphabet
  - ✓O: Output alphabet
  - ✓λ : Output function, Q→O
  - ✓δ : Transition Function, Qx ∑ → Q
  - ✓qo: Initial State

- Mealy Machine M1=(Q,∑,O, λ',Δ,qo)
  - ✓Q: Set of States
  - ✓∑: input alphabet
  - ✓O: Output alphabet
  - ✓Δ : Transition Function, Qx ∑ → Q
  - ✓λ': Output function, Qx ∑ →O
  - ✓qo: Initial State

Mealy Machine (Count Substring 01)



λ'(C,0)= λ(δ(C,0))
= λ(B)
=0

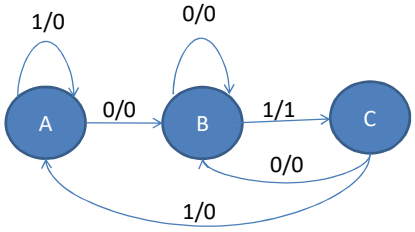
λ'(C,1)= λ(δ(C,1))
= λ(A)
=0

λ'(A,0)=λ(δ(A,0))
= λ(B)
=0

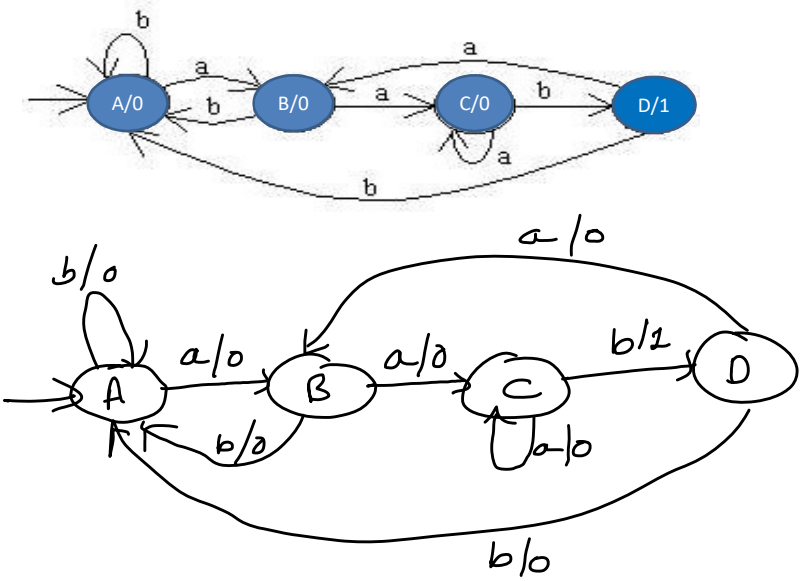
λ'(B,0)= λ(δ(B,0))
= λ(B)
=0

λ'(A,1)= λ(δ(A,1))
= λ(A)
=0

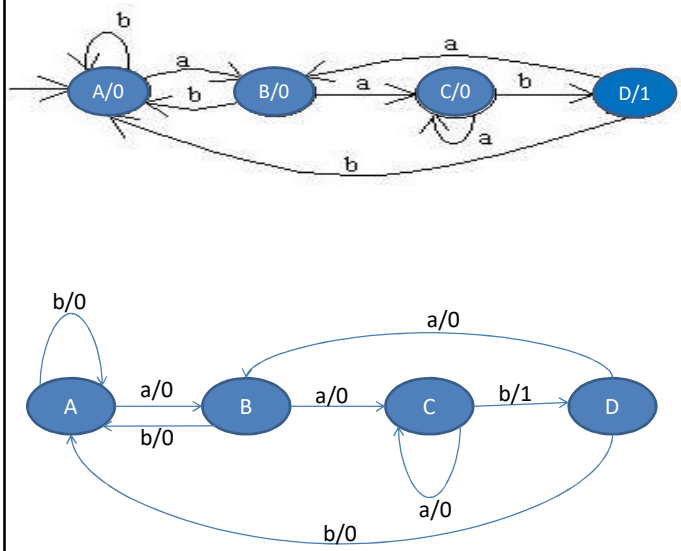
λ'(B,1)= λ(δ(B,1))
= λ(C)
=1



Mealy Machine (Count Substrings aab)

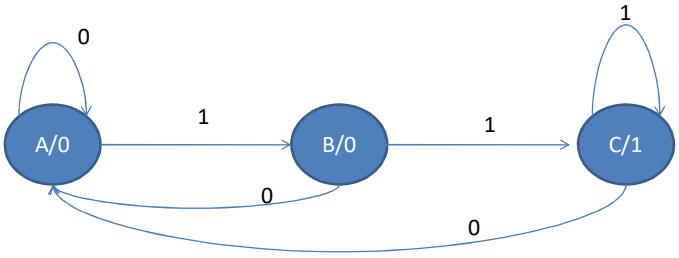


Mealy Machine (Count Substrings aab)



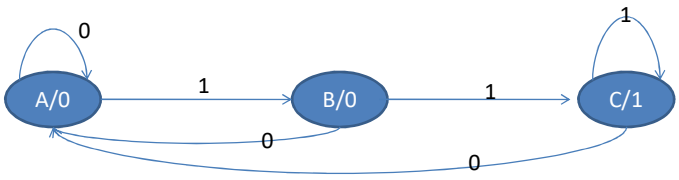
Moore Machine To Mealy Machine

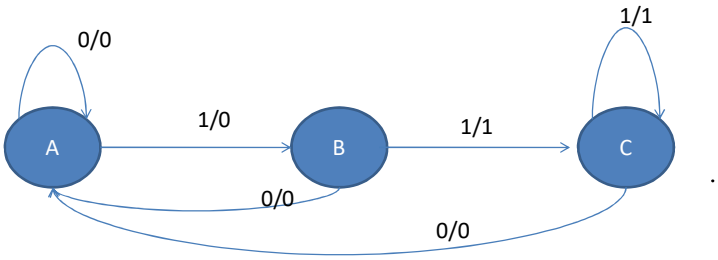
- Replaces the first 1 with 0 from every substring starting with 1



Input	Result
0111001	0011000
0001001110	0000000110
1110101110	0110000010

Moore Machine To Mealy Machine





Input	Result
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0001001110	0000000110
1110101110	0110000010