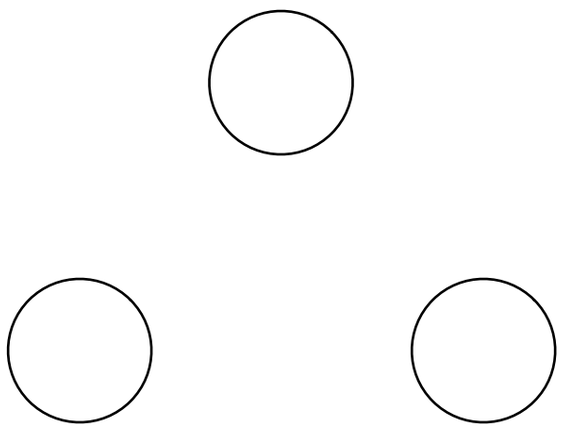
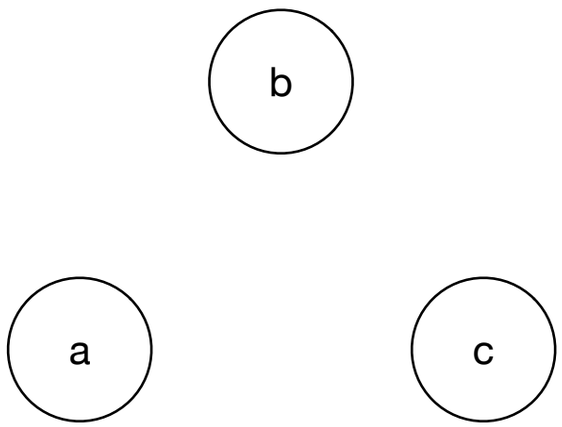
- A finite automata (FA) is a collection of states, represented as circles.



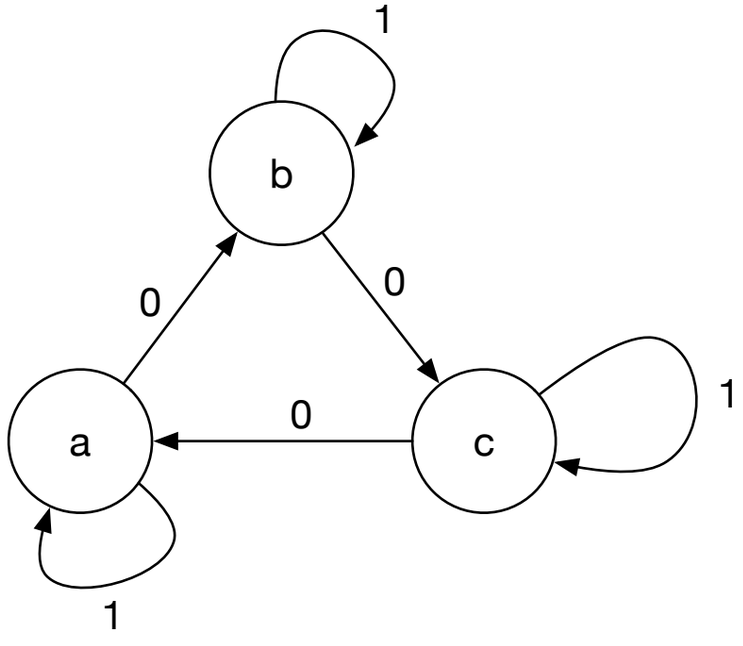
- A finite automata (FA) is a collection of states, represented as circles.

- If we wanted to represent the FA mathematically, we would need to label each state and put the labels in a set $S = \{a, b, c\}$



- Every state **must** have an arrow coming from it for every character in the input alphabet.

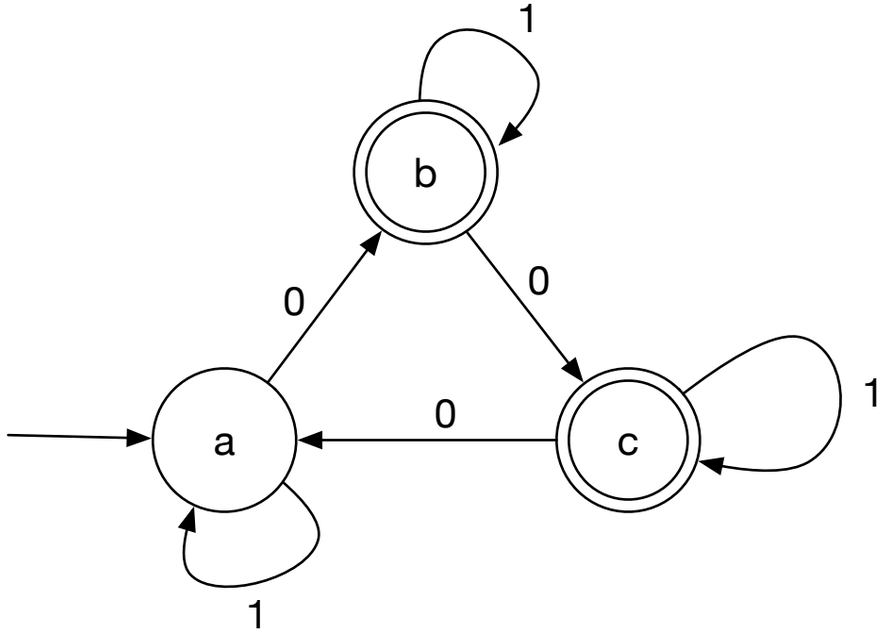
- Mathematically, we need to indicate the input alphabet A = {0, 1} and arrows. Since each arrow maps a (state, char) pair to a state, a function is a good representation F: S x $A \rightarrow S$.



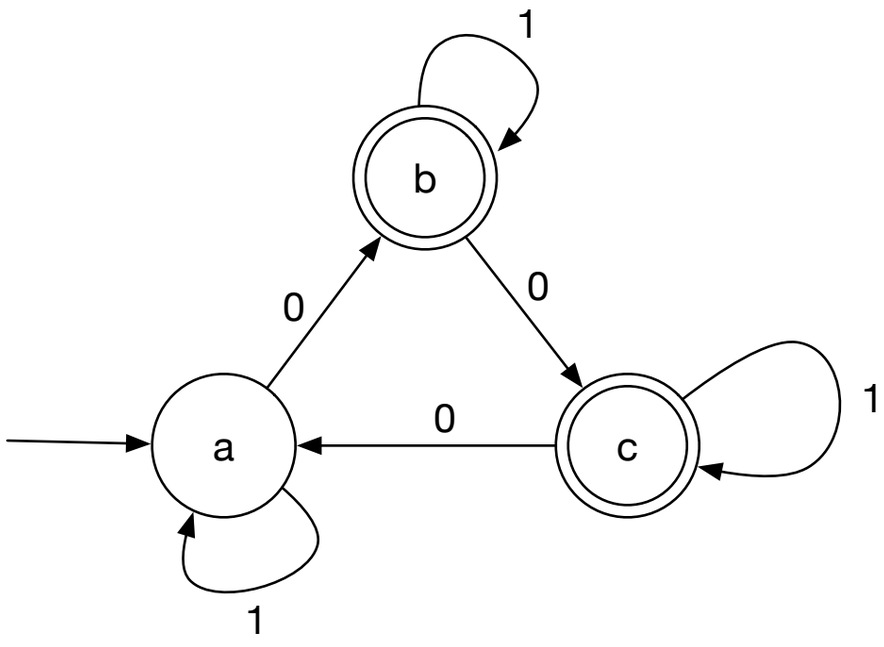
F	**0**	**1**
a	b	a
b	c	b
c	a	c

- There **must** be exactly one start state indicated by an unlabeled arrow from nowhere. And zero or more accept states (also called final) indicated by double circles.

- Mathematically, we can call S_i the start (initial) state, S_i = a, and let Y = {b, c} be the set of accept states.



- Because you can represent a FA graphically or mathematically, these are identical FA.



$A = \{0, 1\}$
$S = \{a, b, c\}$
$S_i = a$
$Y = \{b, c\}$
F shown below in table form

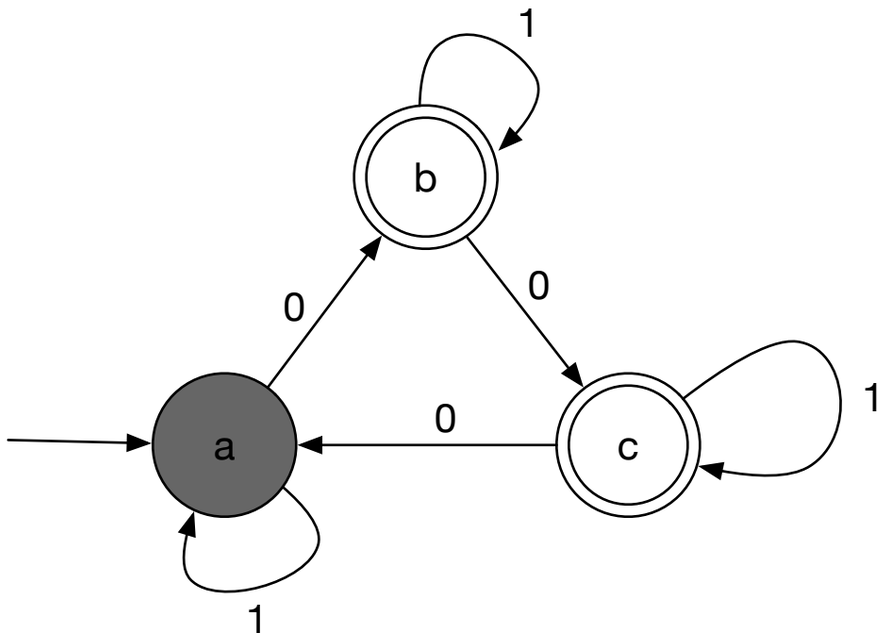
F	**0**	**1**
a	b	a
b	c	b
c	a	c

- Note about state labels: They can be any name you wish and are optional in drawings.

FA Operation

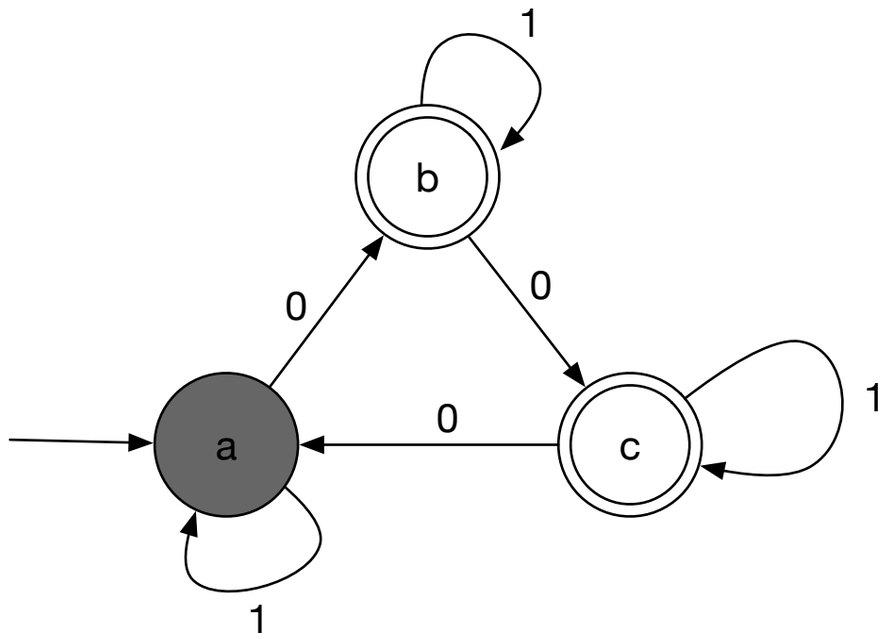
- When presented an input:
    - Start at start state
    - Consume characters from left to right
    - Follow arrow for each character consumed
    - If end in accept state "accept", else "reject"

- Example: Input is 10011. Start in the start state.



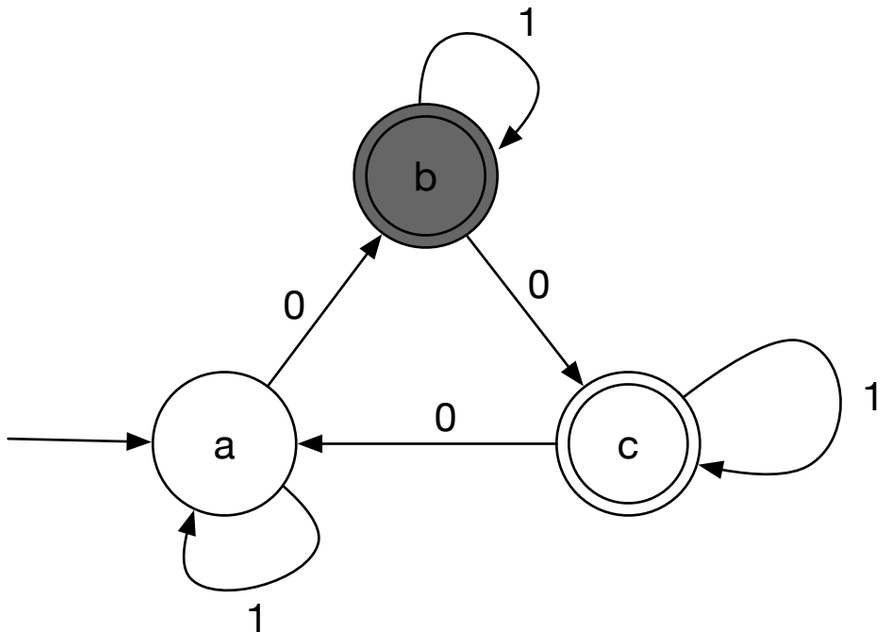
Input: 10011

- Consume 1, follow arrow with 1, still in state "a"



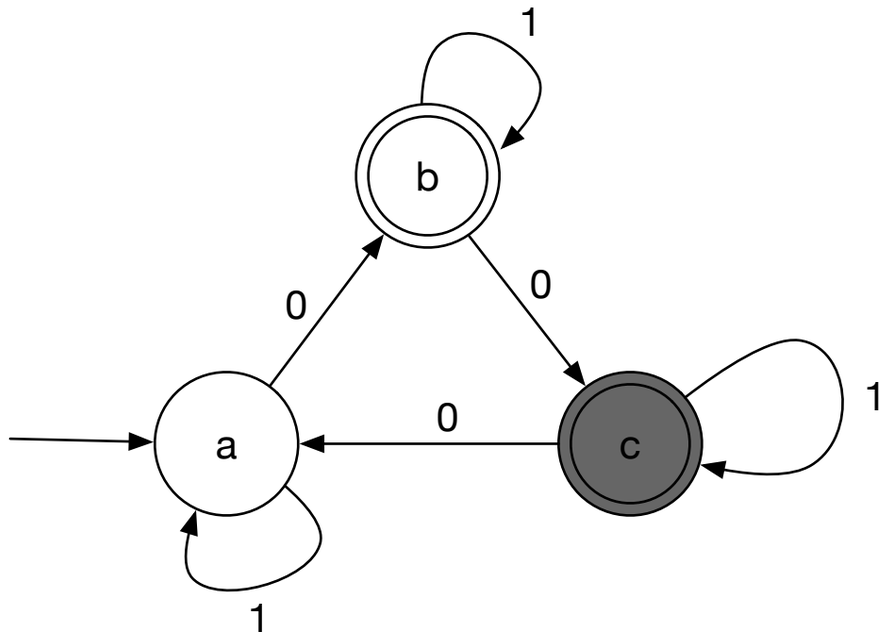
Remaining after consume and move: 0011

- Consume 0, follow arrow with 0, now in state "b"



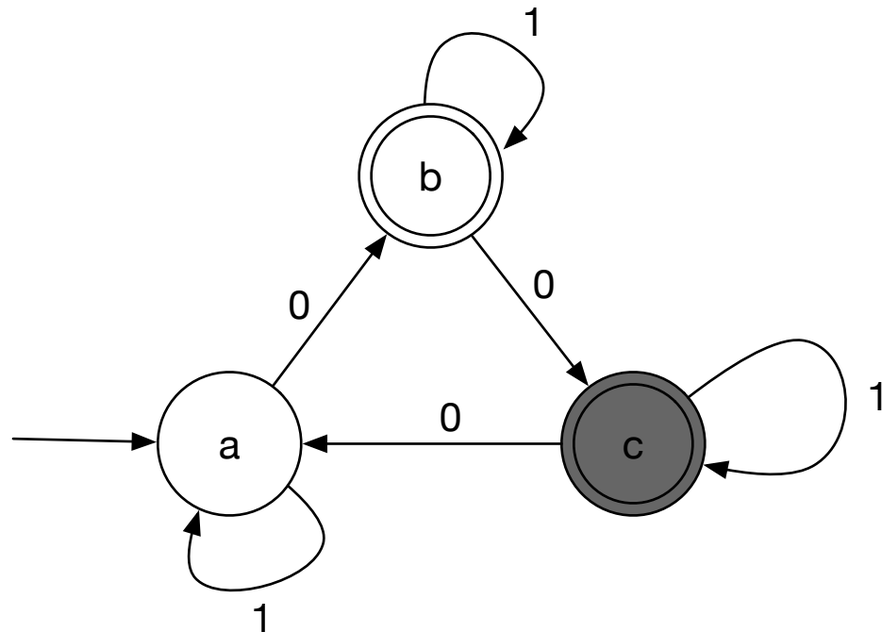
Remaining after consume and move: 011

- Consume 0, follow arrow with 0, now in state "c"



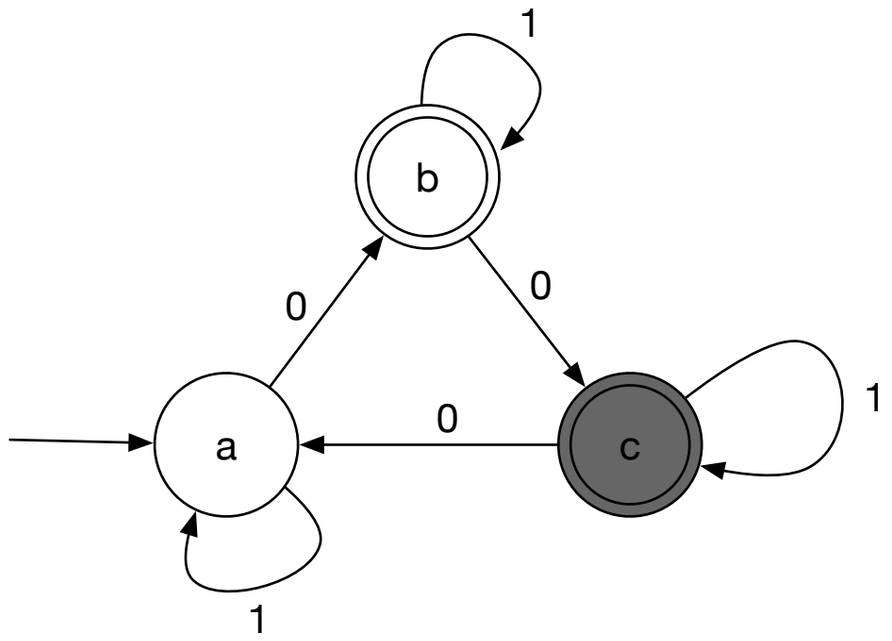
Remaining after consume and move: 11

- Consume 1, follow arrow with 1, still in state "c"



Remaining after consume and move: 1

- Consume 1, follow arrow with 1, still in state "c"



Remaining after consume and move: (empty)

- After consuming input, we end in an accept state.
  10011 is accepted by this FA.
  10011 is in the "language" of this machine.

Meaning of FA

- You can often design an FA to accept strings that are easily described in English.

- This FA accepts all strings over alphabet {0, 1} that don't have a multiple of three 0's.

- If this machine is called *M*, then *L(M)* = { x | x is a string over alphabet {0,1} and the number of 0's in x mod 3 = 0 }

Designing FA

- Give each state meaning. The only "memory" an FA has is the current state.
- Design the part of an FA that accepts good strings first.
- Make sure the FA is legal: one start state, arrow from each state for each character in the input alphabet.
- Test: try to find good string that's rejected; try to find bad string that's accepted. (This is how I grade FA's!)