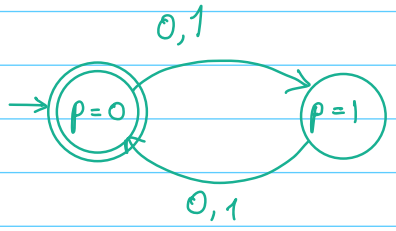
Finite Automata

- Programs that can read the input once
- The values stored in any variable is a constant, independent of the length of the input

Q: Write a program that checks if the length of the input is even

```
p = 0
while inp[i] ≠ ⊥
    p = 1 - p
return p
```

≡



* Captures many simple computational problems
  - Lexical analyzer of a compiler

→ As a language L = set of all binary strings of even length

if $x \in L$, accept → after reading the input should be in an accepting state

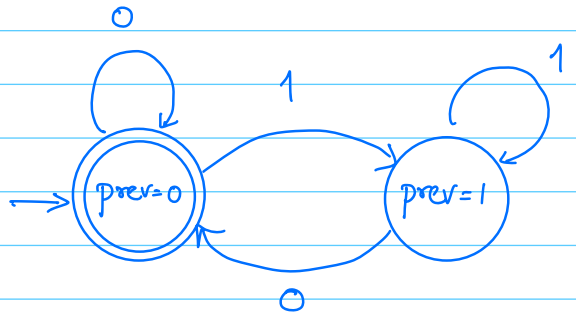
if $x \notin L$, reject

↳ after reading the input should be in a non-accepting state

Examples

① set of strings $w \in \{0,1\}^*$ that correspond to even integers

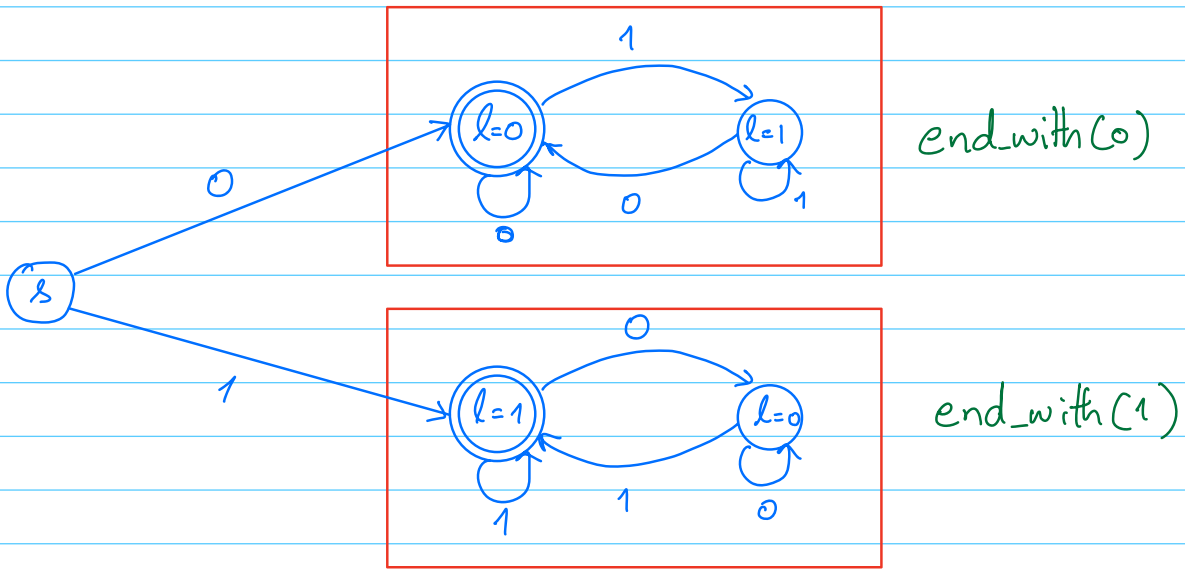
```
prev ← 0
while a[i] ≠ ⊥
    prev = a[i]
return prev
```



② strings that start and end with the same bit

```
end_with(b)
    last = b
    while a[i] ≠ ⊥
        last = a[i]
    if last = b
        return 1
    else 0
```

```
main()
    first ← a[1]
    end_with(first)
```



Definition: A Deterministic Finite Automaton (DFA) is a 5-tuple $(Q, \Sigma, \delta, q_0, F)$ where

* Q - set of states
* Σ - alphabet
* δ - transition function
  $\delta: Q \times \Sigma \to Q$
* q_0 - start state
* $F \subseteq Q$ - set of final/accepting states