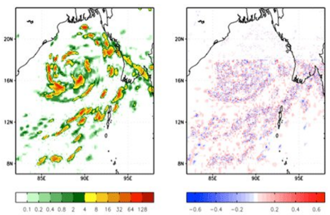
Finite Automata

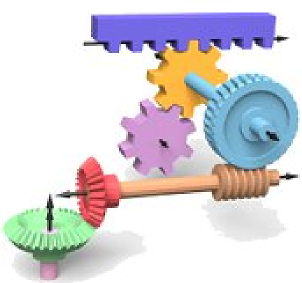
CS 2800: Discrete Structures, Fall 2014

Sid Chaudhuri


12:34

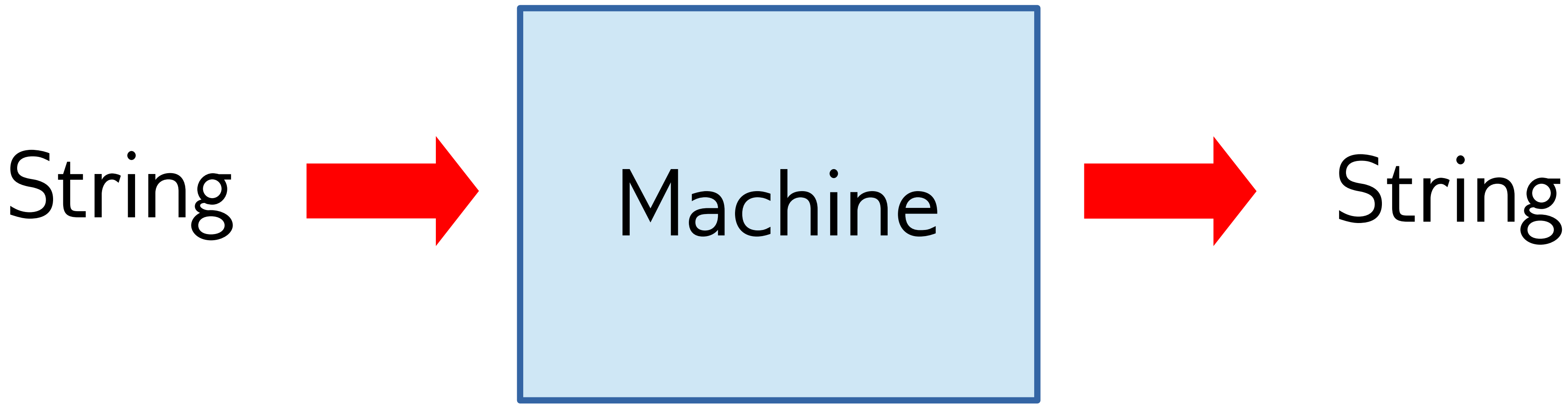
```
<!DOCTYPE html>
<html id="home-layout">
  <head>
    <meta http-equiv="content-type" conte
    <title>Source Code Pro</title>
      <!-- made with <3 and AFDKO -->
    <meta name="keywords" content="sans,
      monospace, open source, coding, for
    <link rel="stylesheet" type="text/css
  </head>
  <body>
    <div id="main">
```



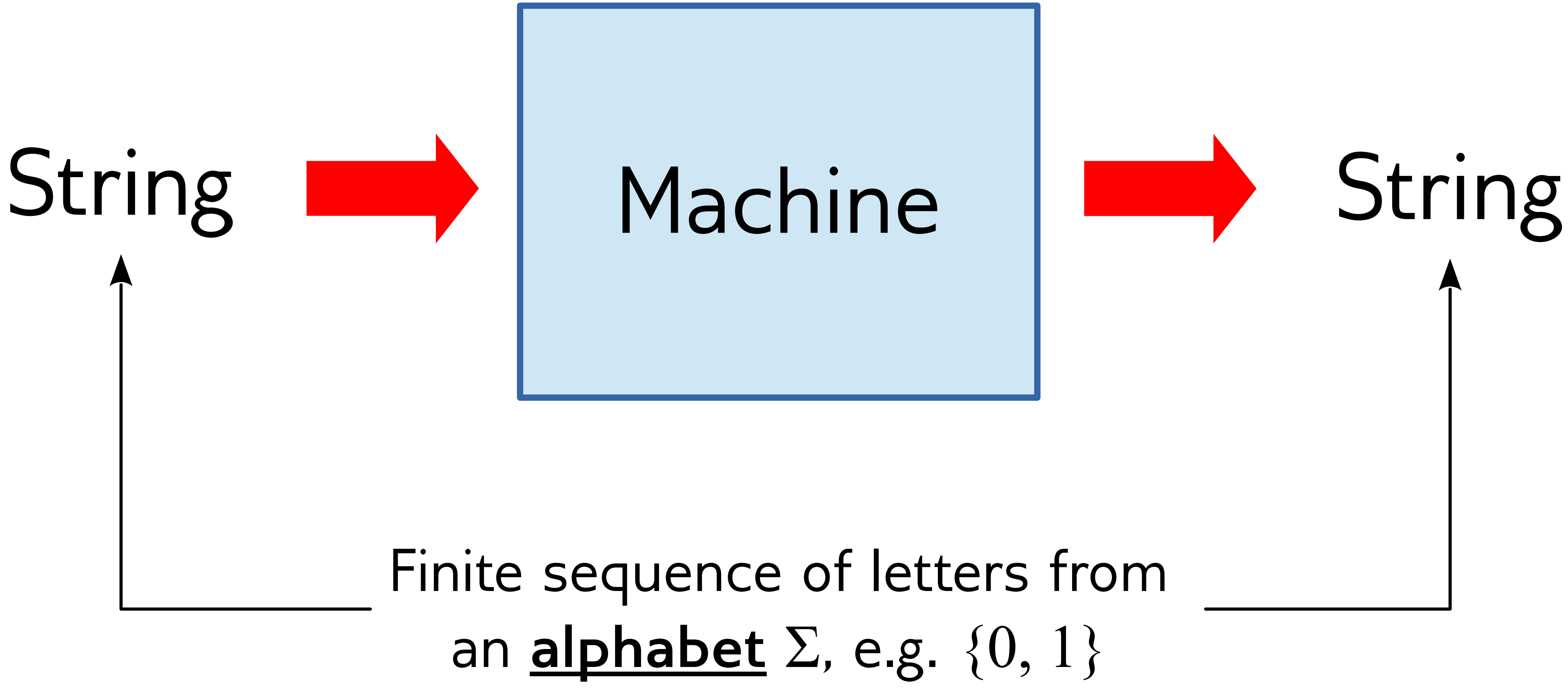



<!DOCTYPE html>
<html id="home-layout">
<head>
<meta http-equiv="content-type" conte
<title>Source Code Pro</title>
<!-- made with <3 and AFDKO -->
<meta name="keywords" content="sans,
monospace, open source, coding, for
<link rel="stylesheet" type="text/css
</head>
<body>
<div id="main">
LIFE CYCLE OF A
FLOWERING PLANT
REPORT
Seed Germination

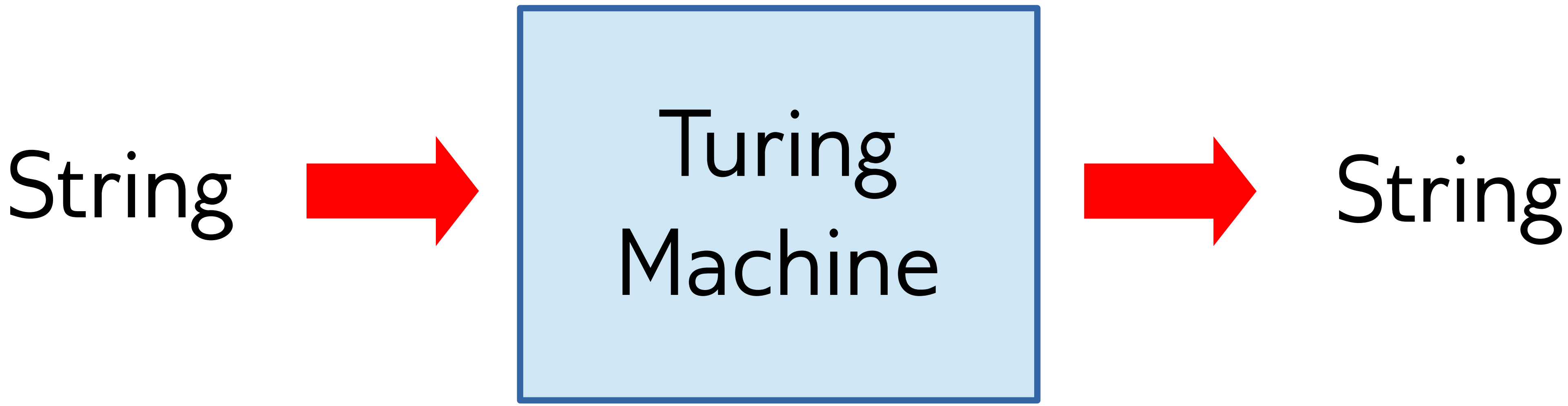
A simplified model



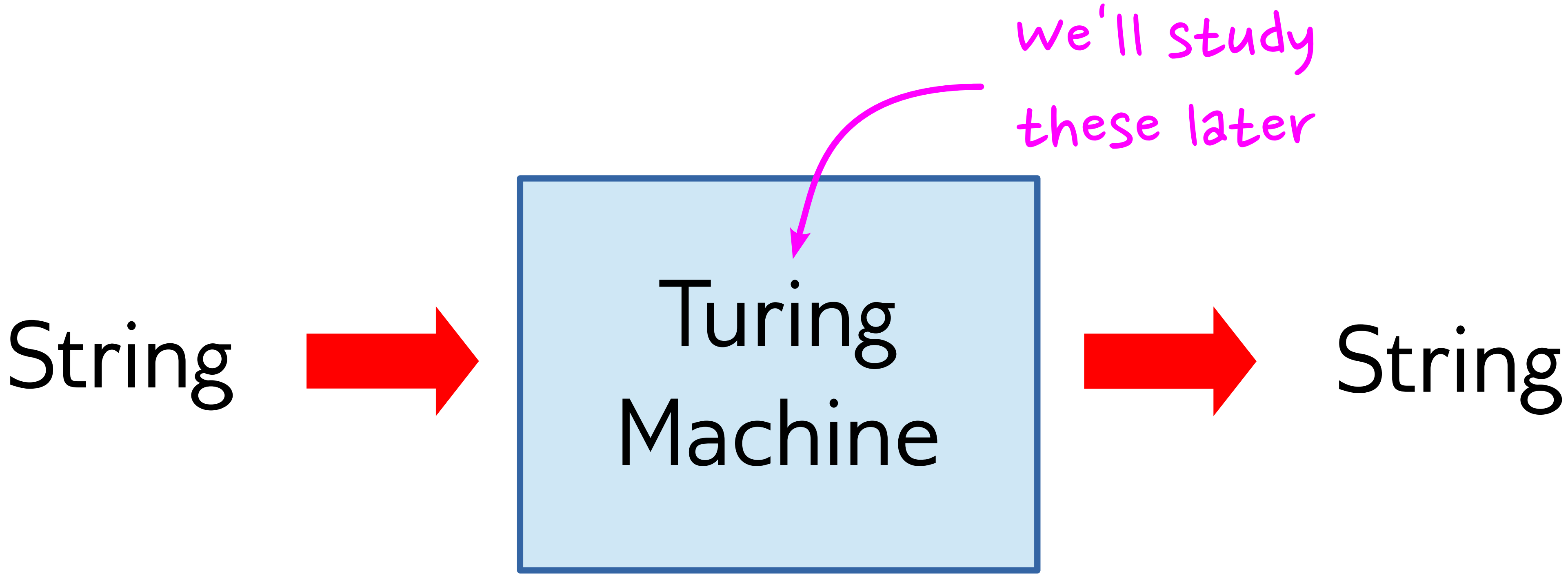
A simplified model



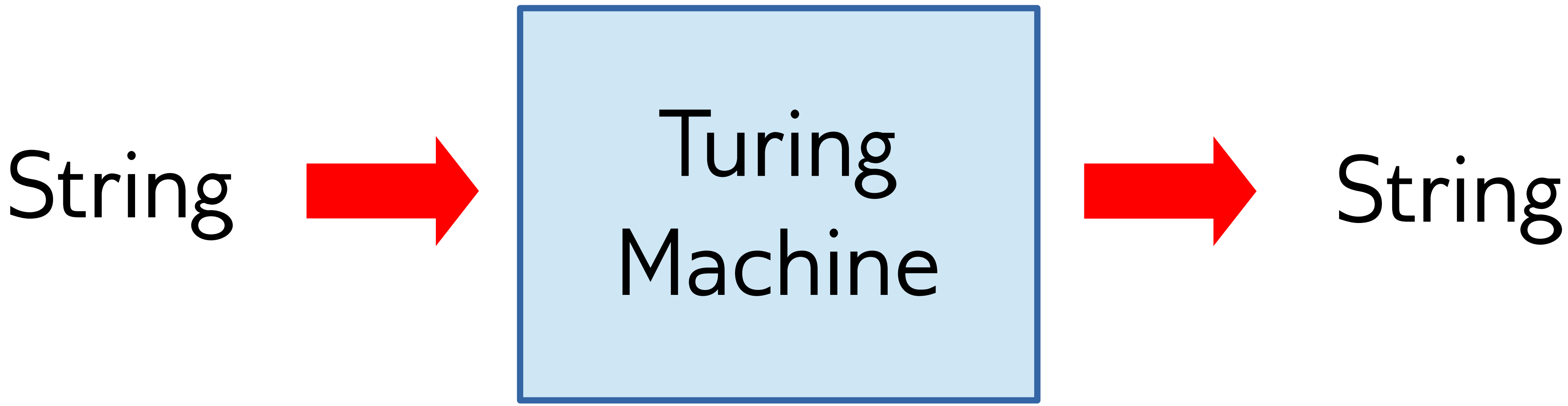
A general-purpose computer



A general-purpose computer



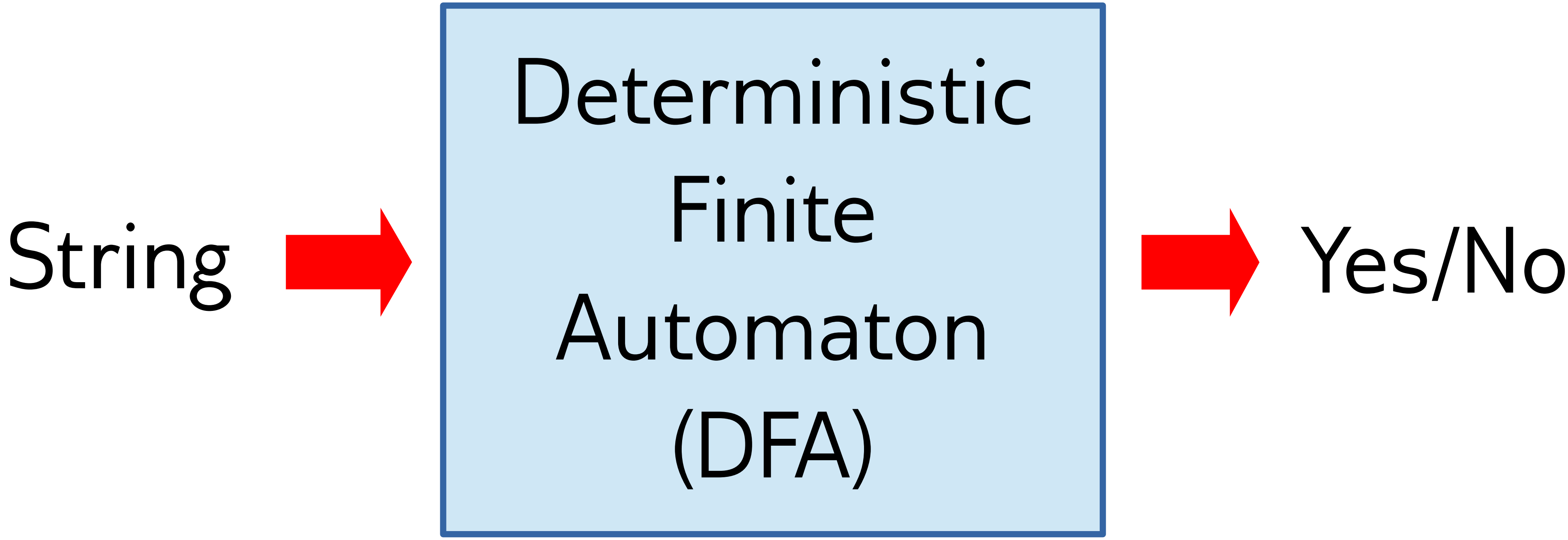
A general-purpose computer



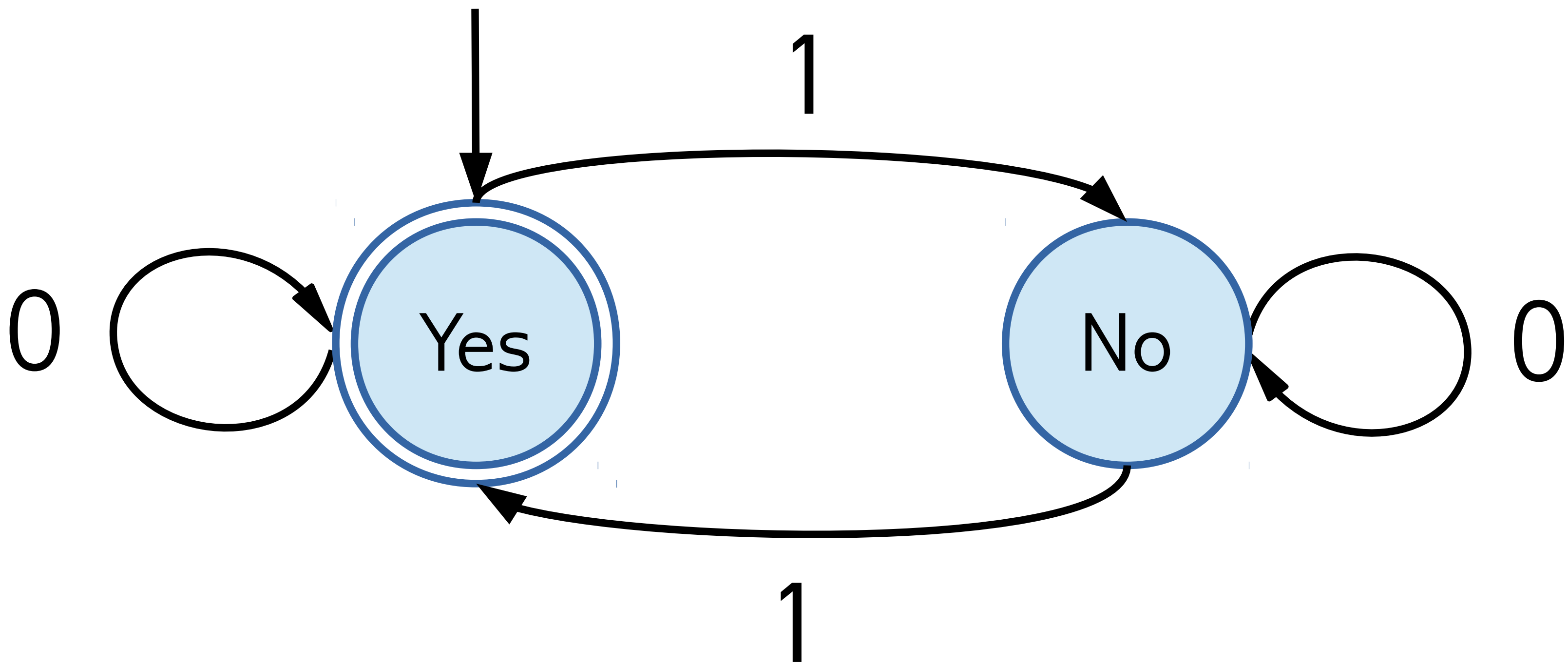
Church-Turing Thesis: Any "effective/mechanical/real-world" calculation can be carried out on a Turing machine

Alan Turing, 1912 – 1954

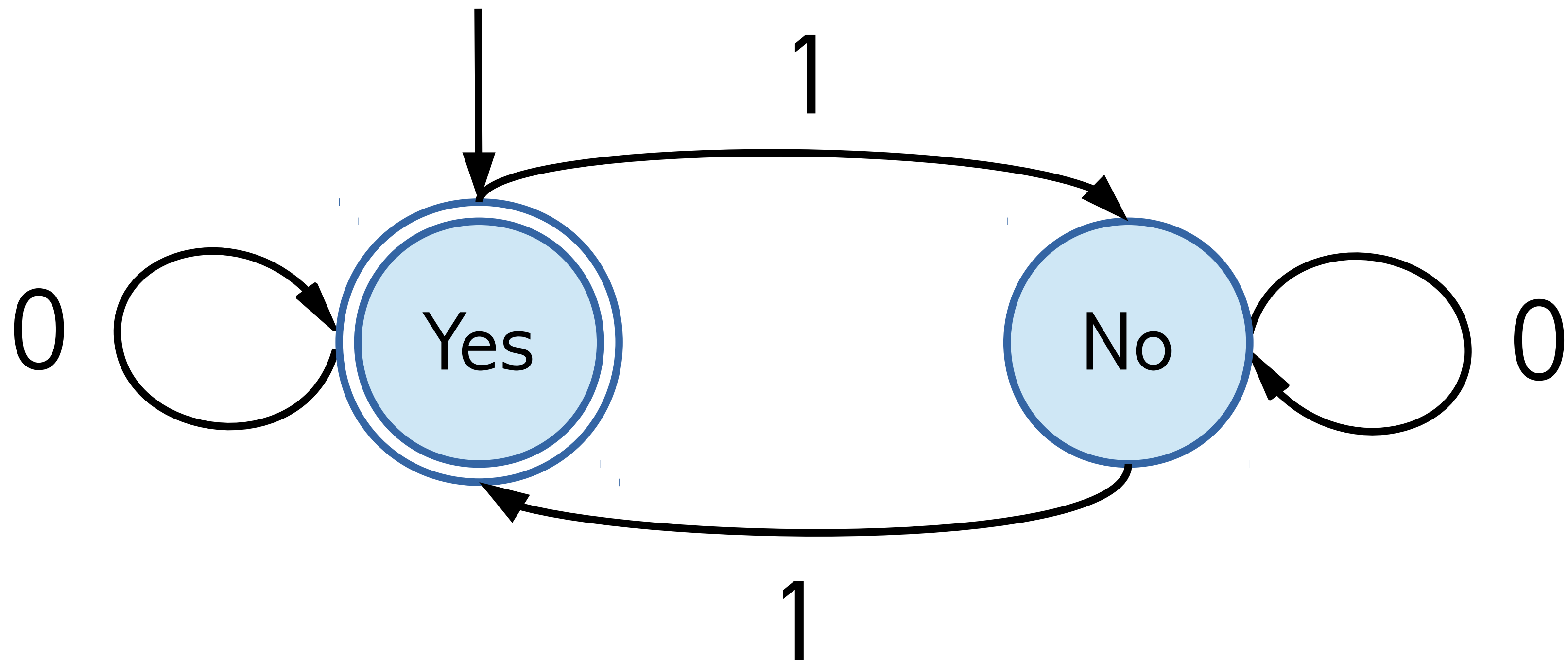
A simple “computer”



An example

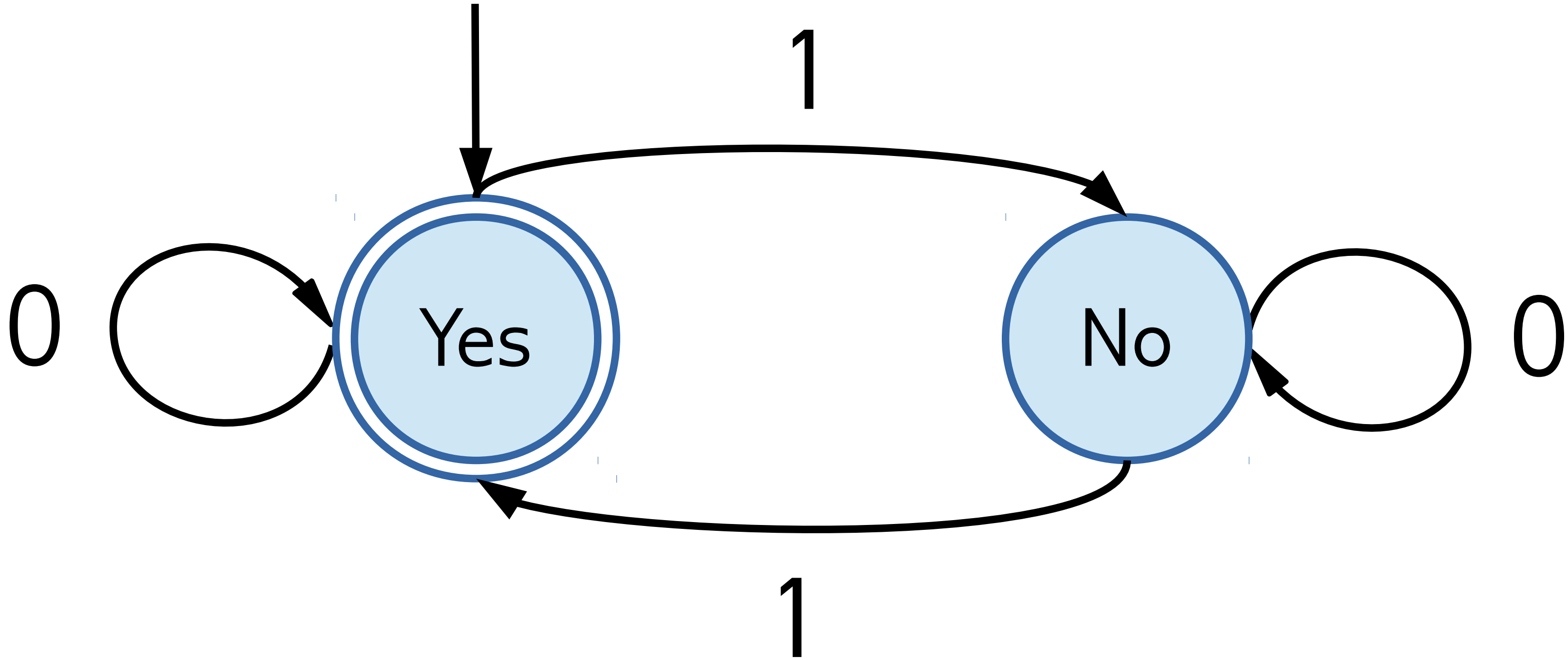


An example



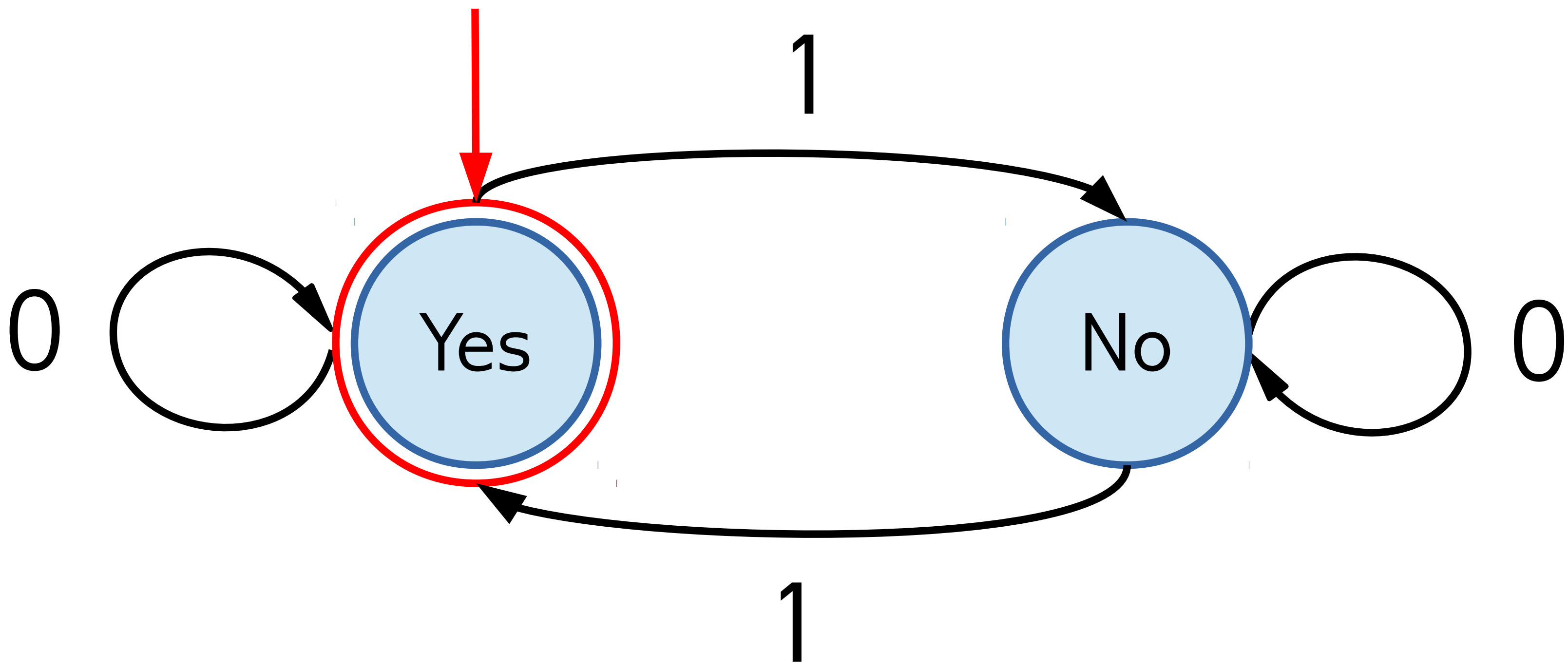
(Binary input)

An example



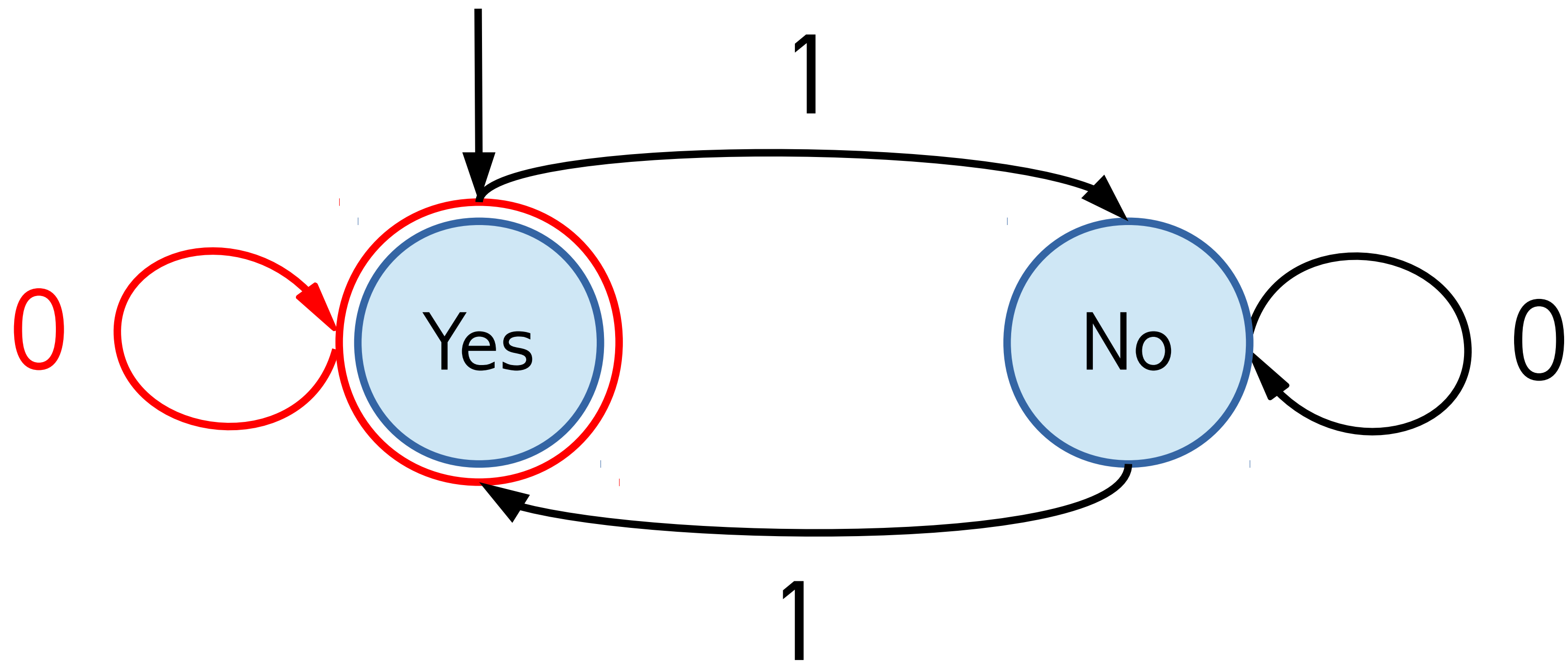
Input: 01001

An example



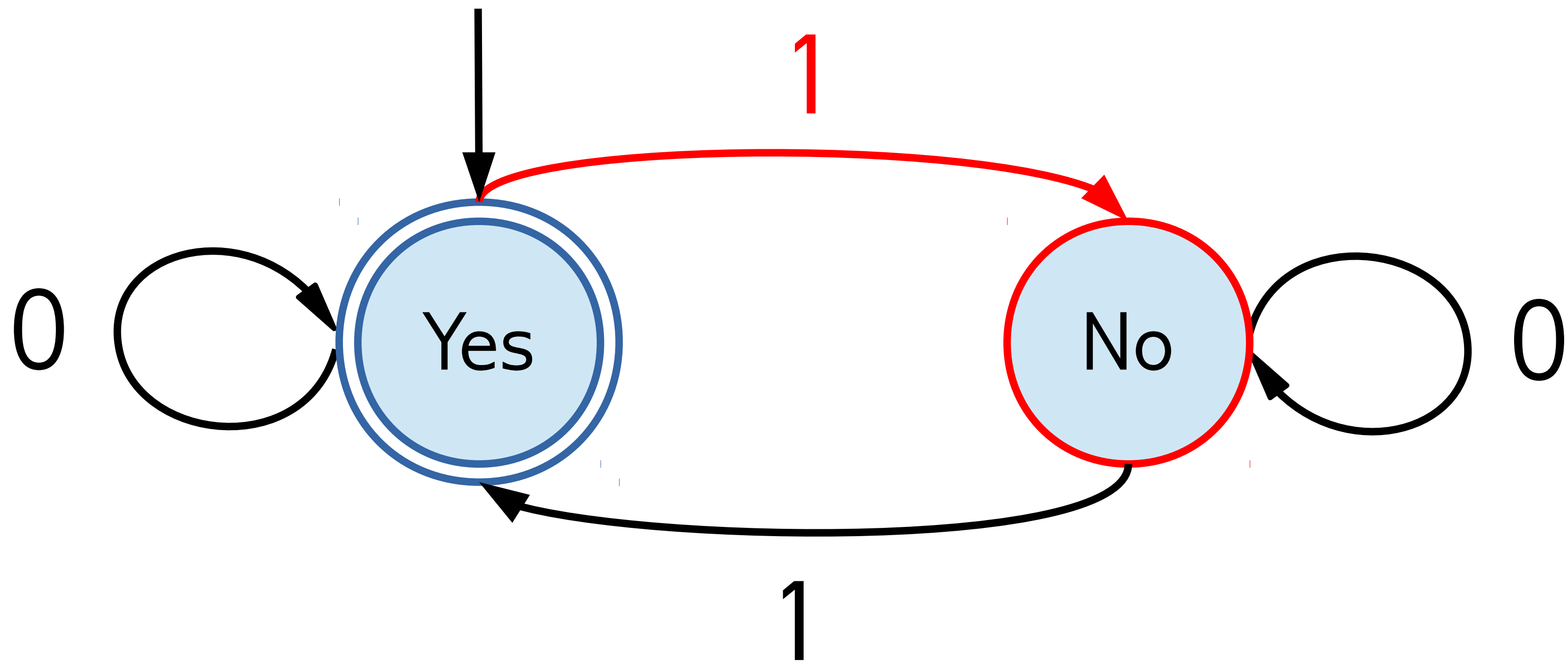
Input: 01001

An example



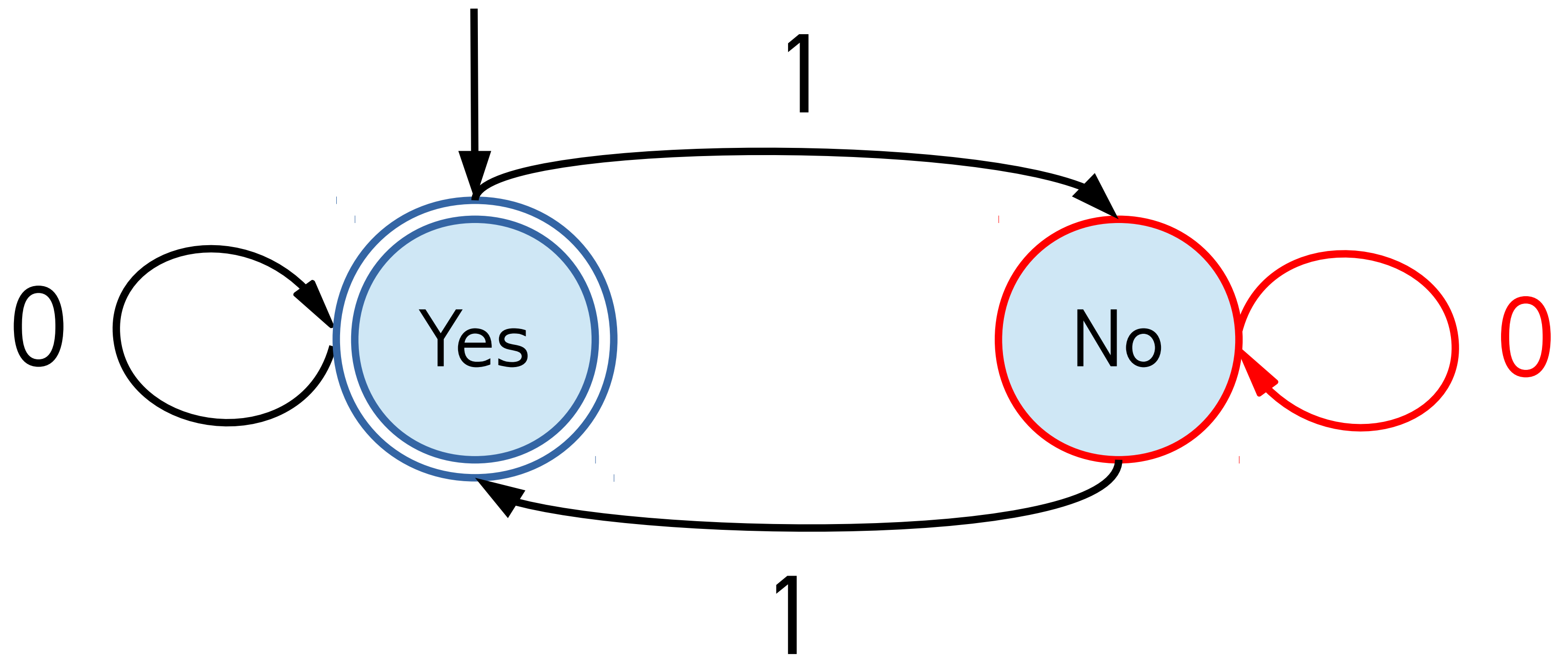
Input: 01001

An example



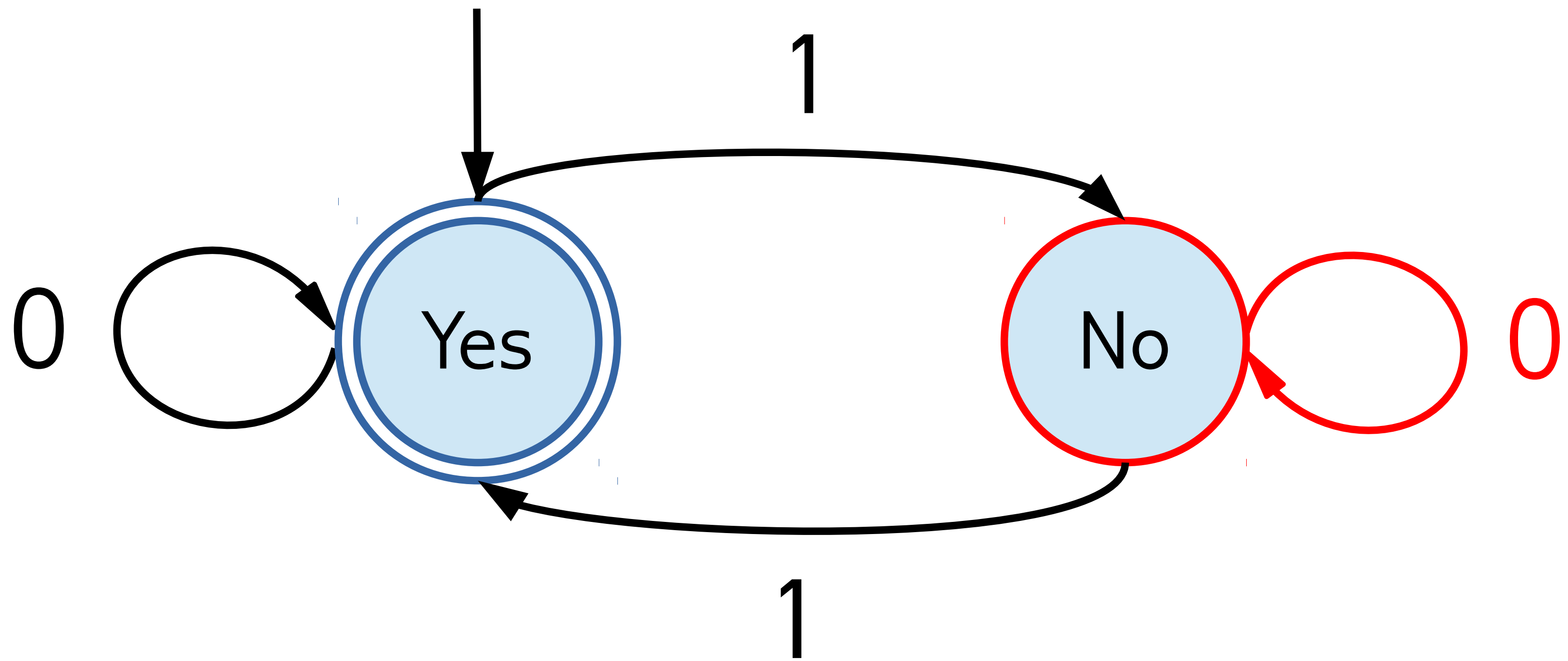
Input: 01001

An example



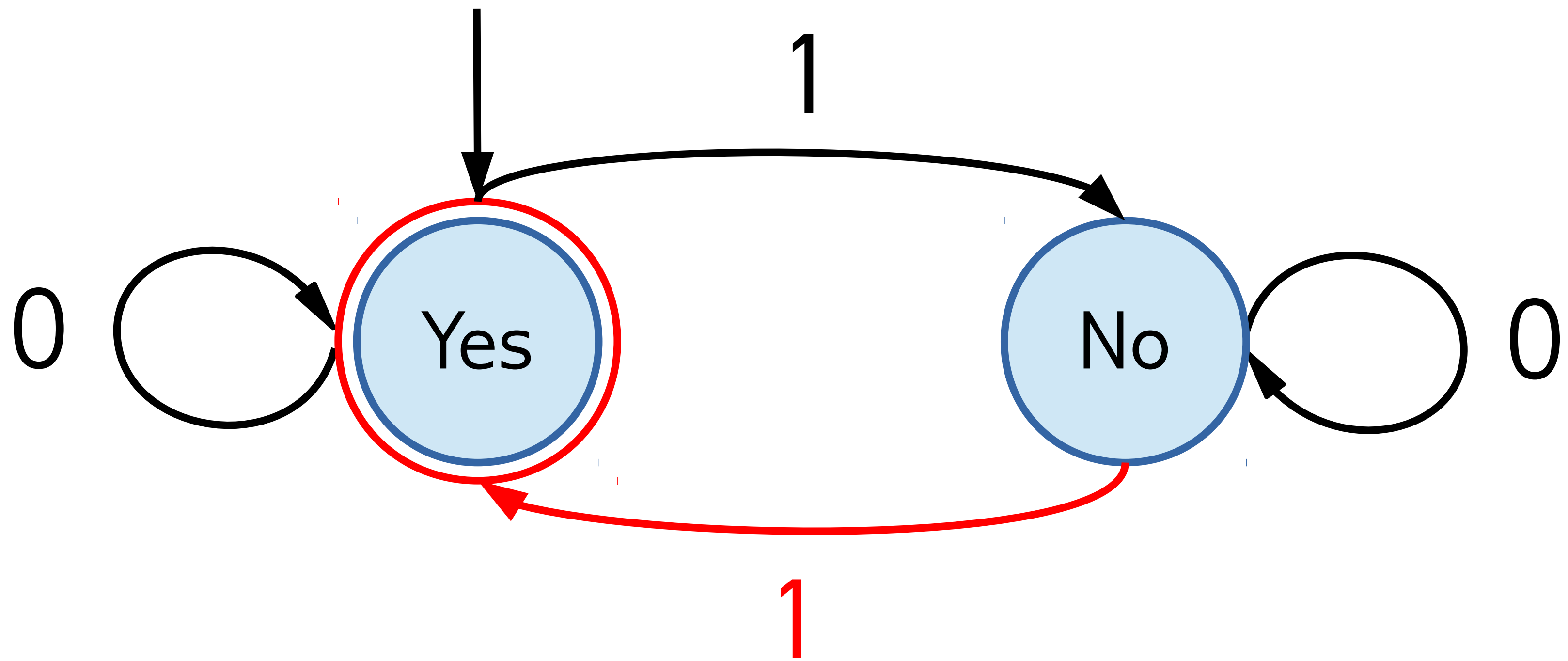
Input: 01001

An example



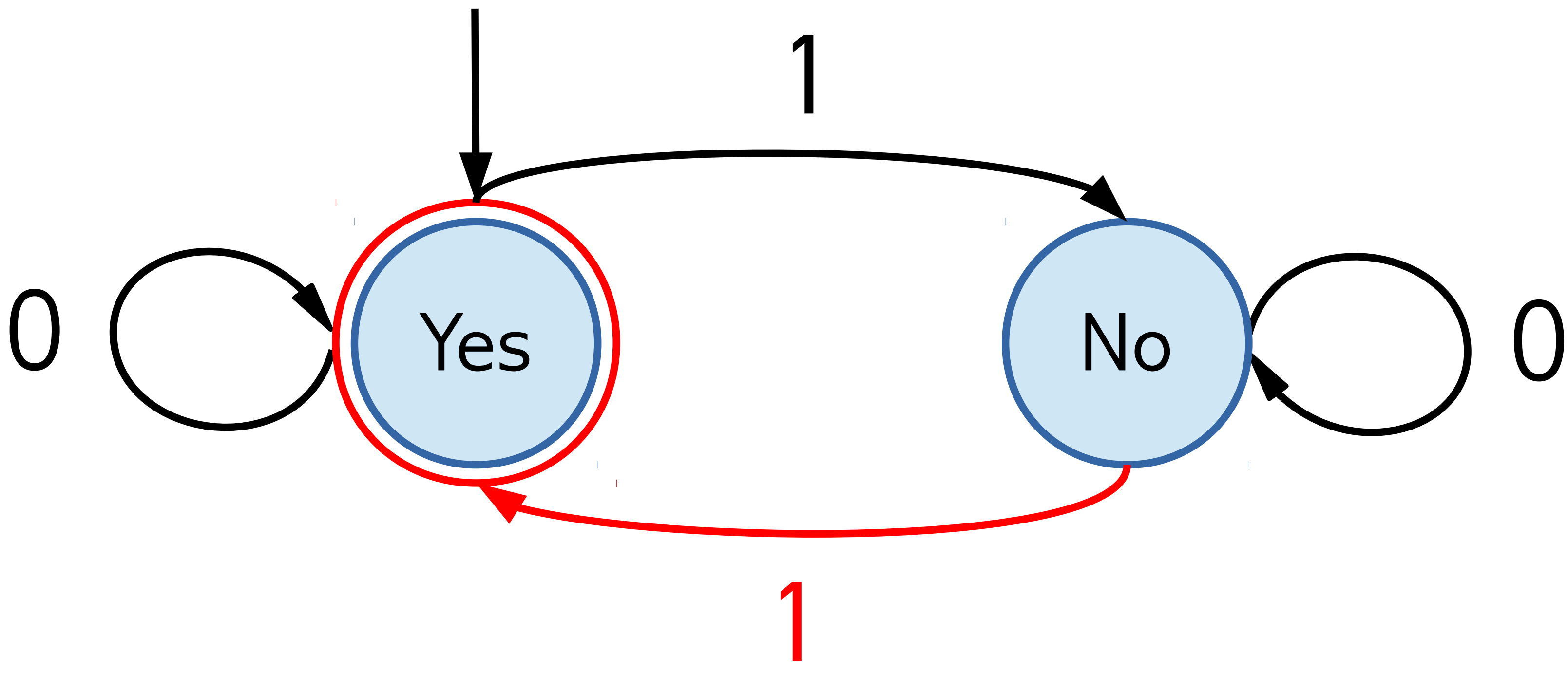
Input: 01001

An example



Input: 01001

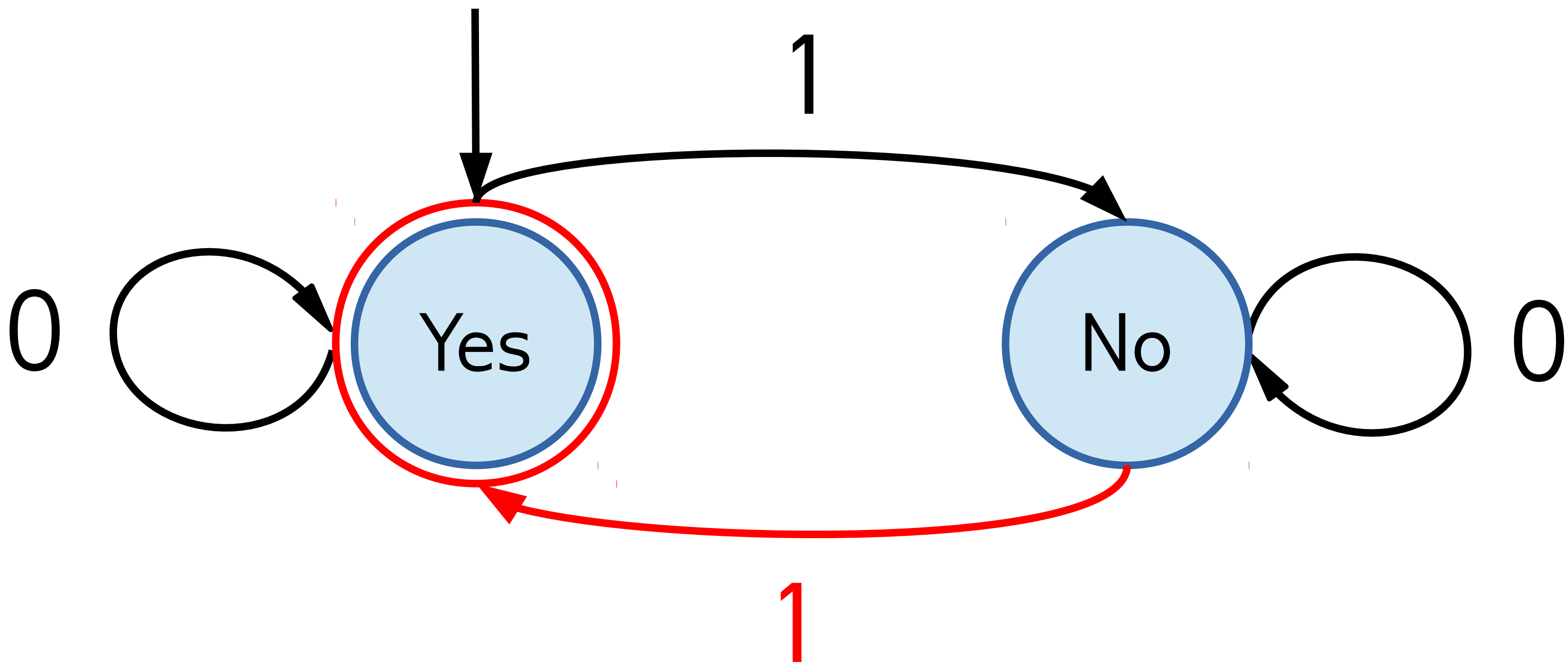
An example



Input: 01001

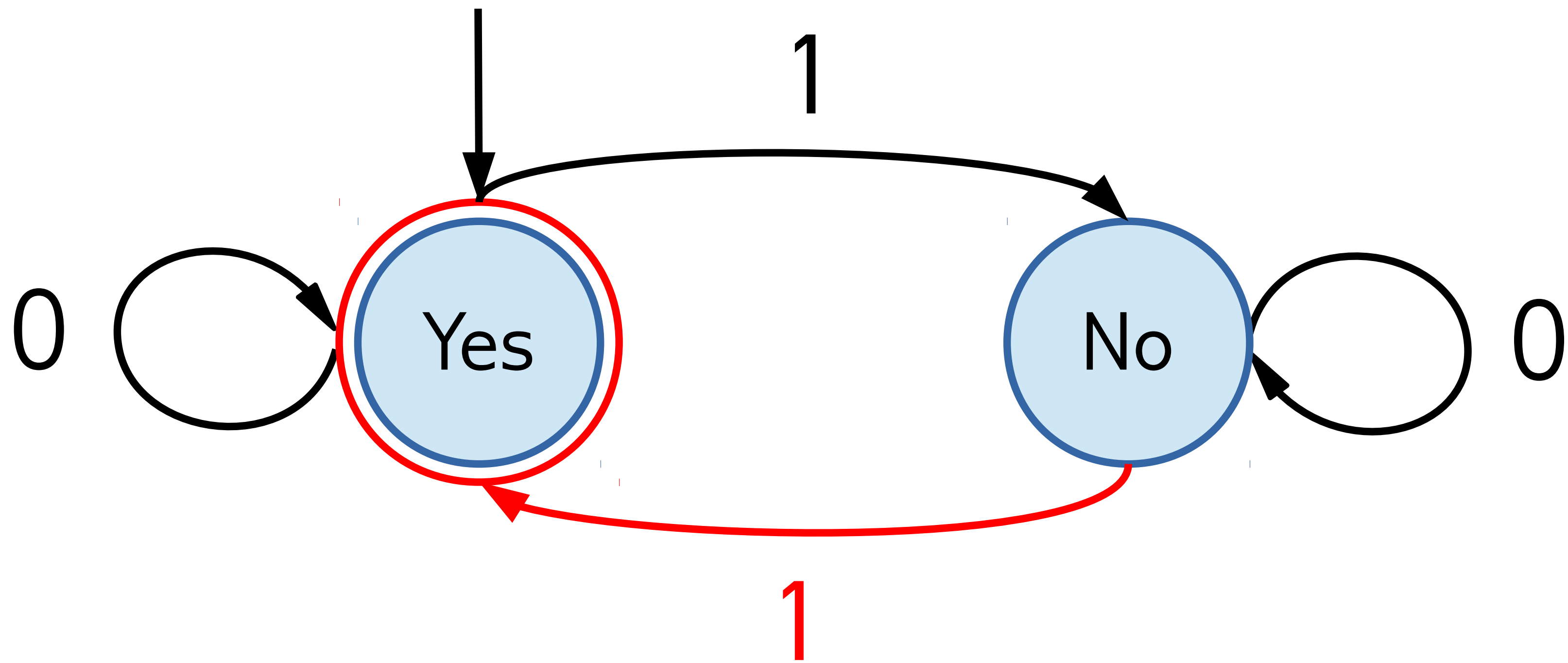
Output: Yes!

An example



In general, on what binary strings does this DFA return Yes?

An example



Ans: All strings with an even number of 1's

Deterministic Finite Automaton

- A DFA is a 5-tuple $M = (Q, \Sigma, \delta, q_0, F)$

Deterministic Finite Automaton

- A DFA is a 5-tuple $M = (Q, \Sigma, \delta, q_0, F)$
  - Q is a finite set of states

Yes

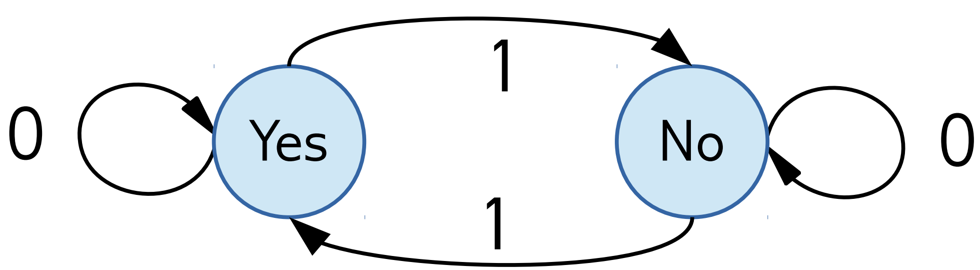
No

Deterministic Finite Automaton

- A DFA is a 5-tuple $M = (Q, \Sigma, \delta, q_0, F)$
  - Q is a finite set of states
  - Σ is a finite input alphabet (e.g. $\{0, 1\}$)

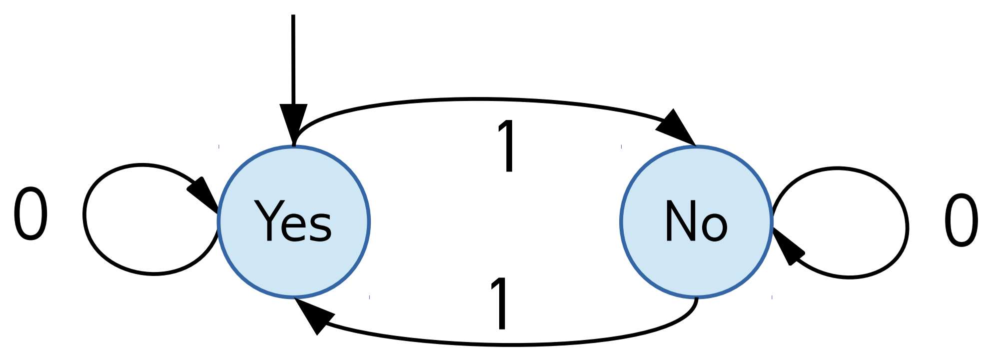
Deterministic Finite Automaton

- A DFA is a 5-tuple $M = (Q, \Sigma, \delta, q_0, F)$
  - Q is a finite set of states
  - Σ is a finite input alphabet (e.g. $\{0, 1\}$)
  - δ is a transition function $\delta : Q \times \Sigma \to Q$



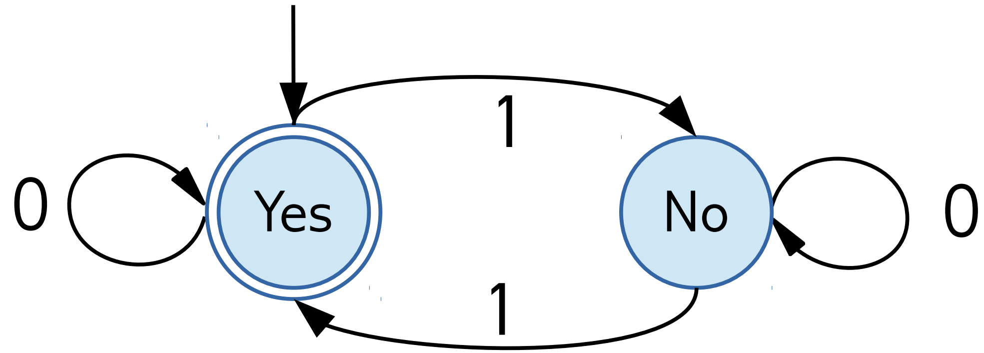
Deterministic Finite Automaton

- A DFA is a 5-tuple $M = (Q, \Sigma, \delta, q_0, F)$
  - Q is a finite set of states
  - Σ is a finite input alphabet (e.g. $\{0, 1\}$)
  - δ is a transition function $\delta : Q \times \Sigma \to Q$
  - $q_0 \in Q$ is the start/initial state

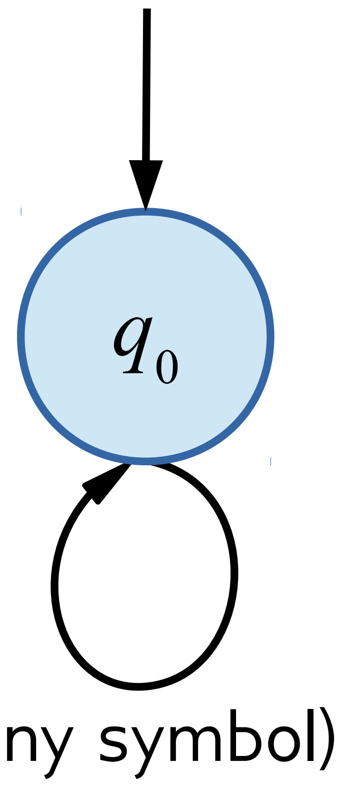


Deterministic Finite Automaton

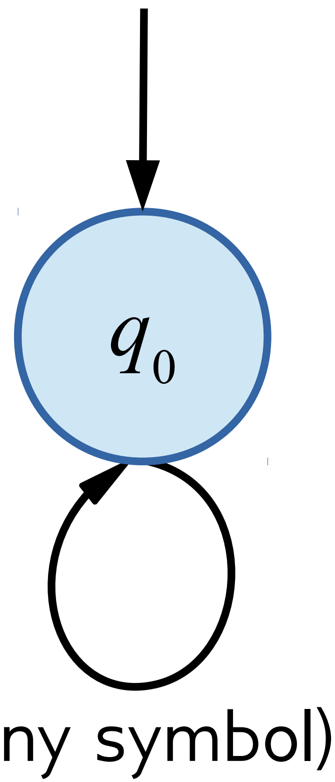
- A DFA is a 5-tuple $M = (Q, \Sigma, \delta, q_0, F)$
  - Q is a finite set of states
  - Σ is a finite input alphabet (e.g. $\{0, 1\}$)
  - δ is a transition function $\delta : Q \times \Sigma \rightarrow Q$
  - $q_0 \in Q$ is the start/initial state
  - $F \subseteq Q$ is the set of final/accepting states



What does this DFA accept?

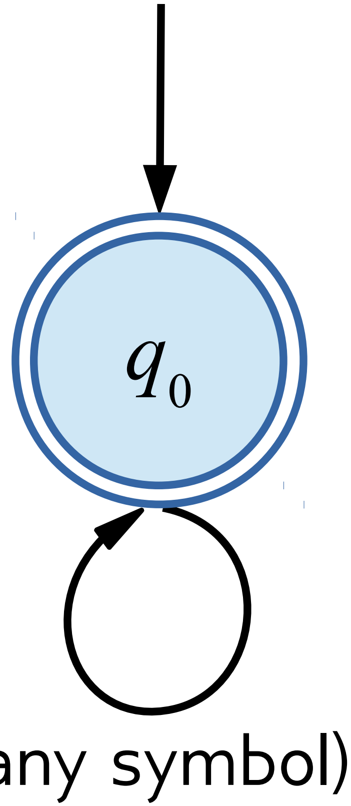


What does this DFA accept?

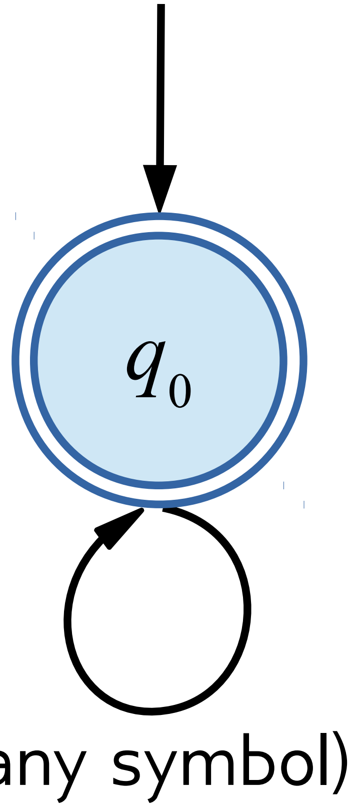


Answer: No strings

What does this DFA accept?

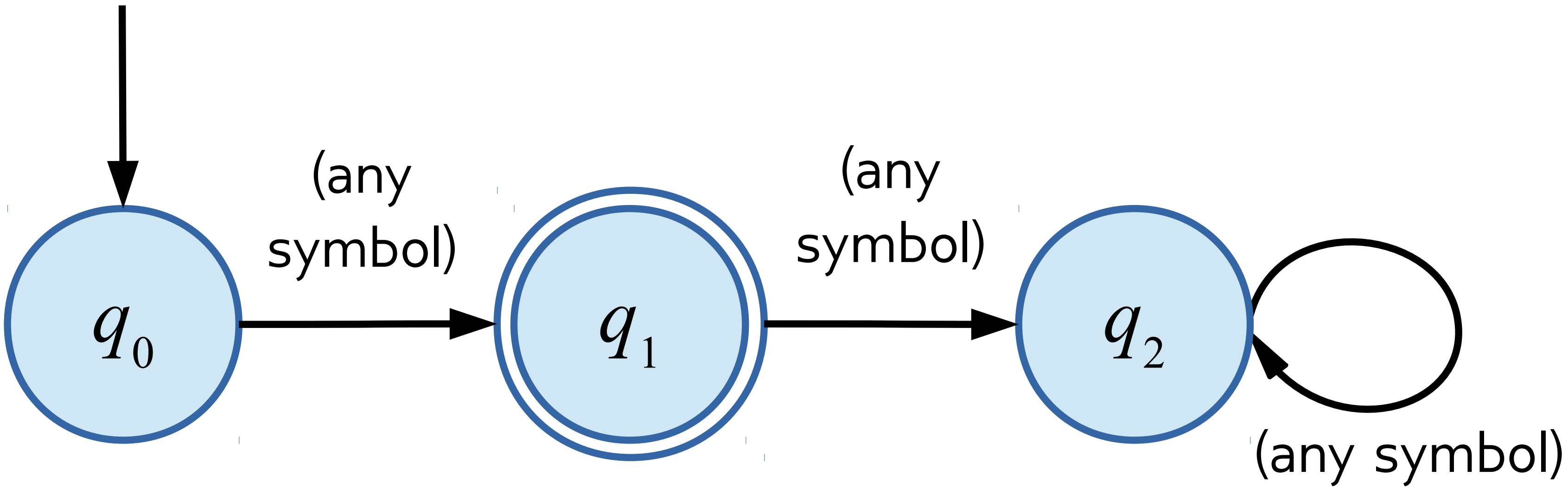


What does this DFA accept?

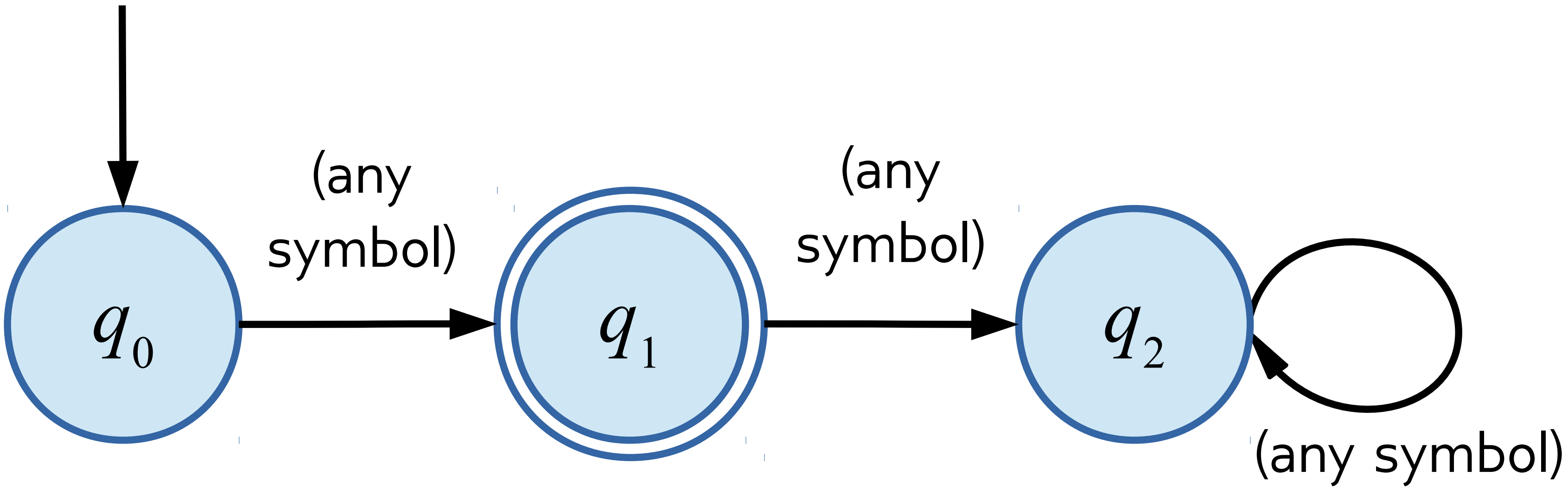


Answer: All strings

What does this DFA accept?

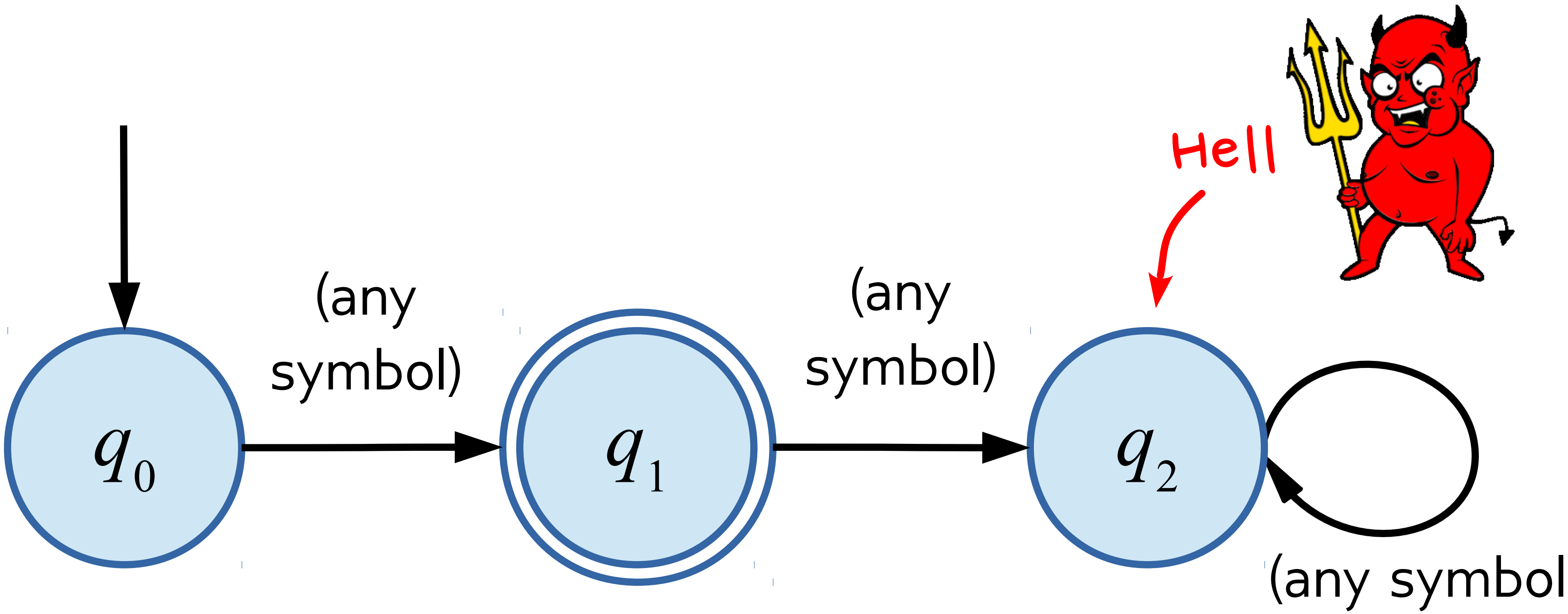


What does this DFA accept?



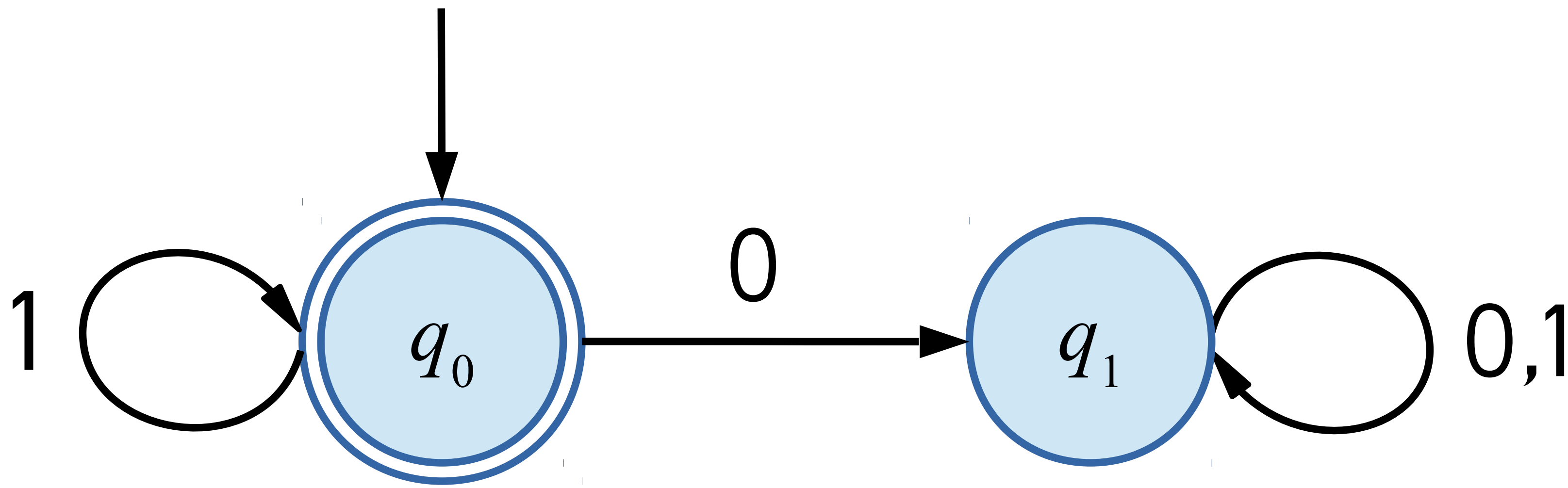
Answer: Strings of length 1

What does this DFA accept?

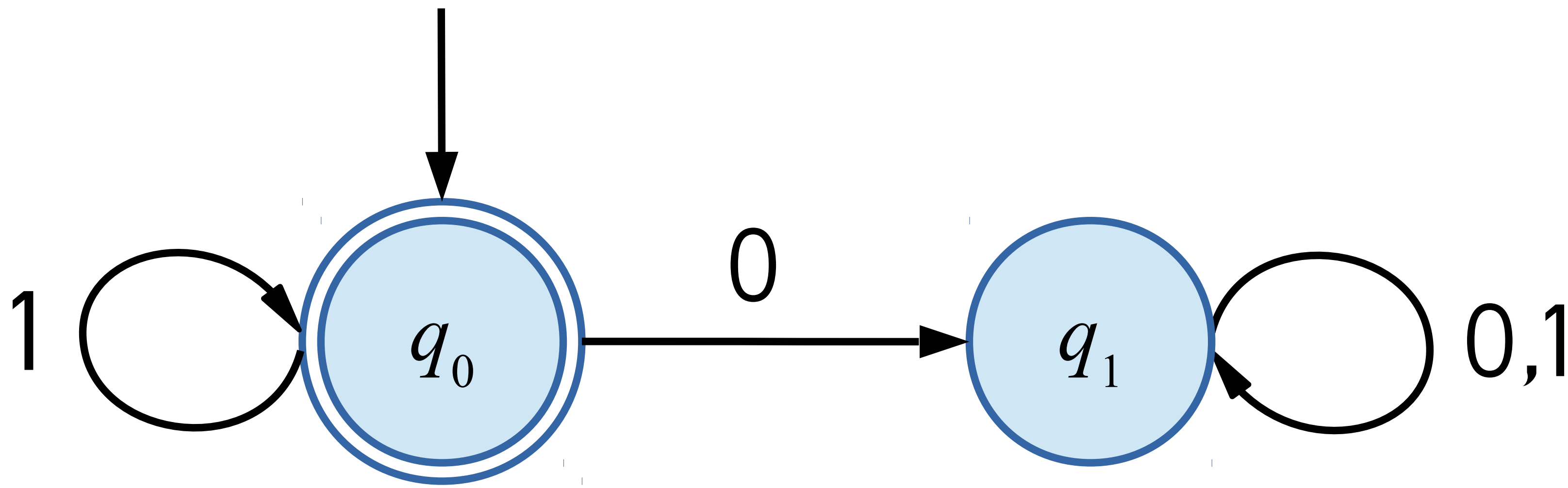


Answer: Strings of length 1

What does this DFA accept?

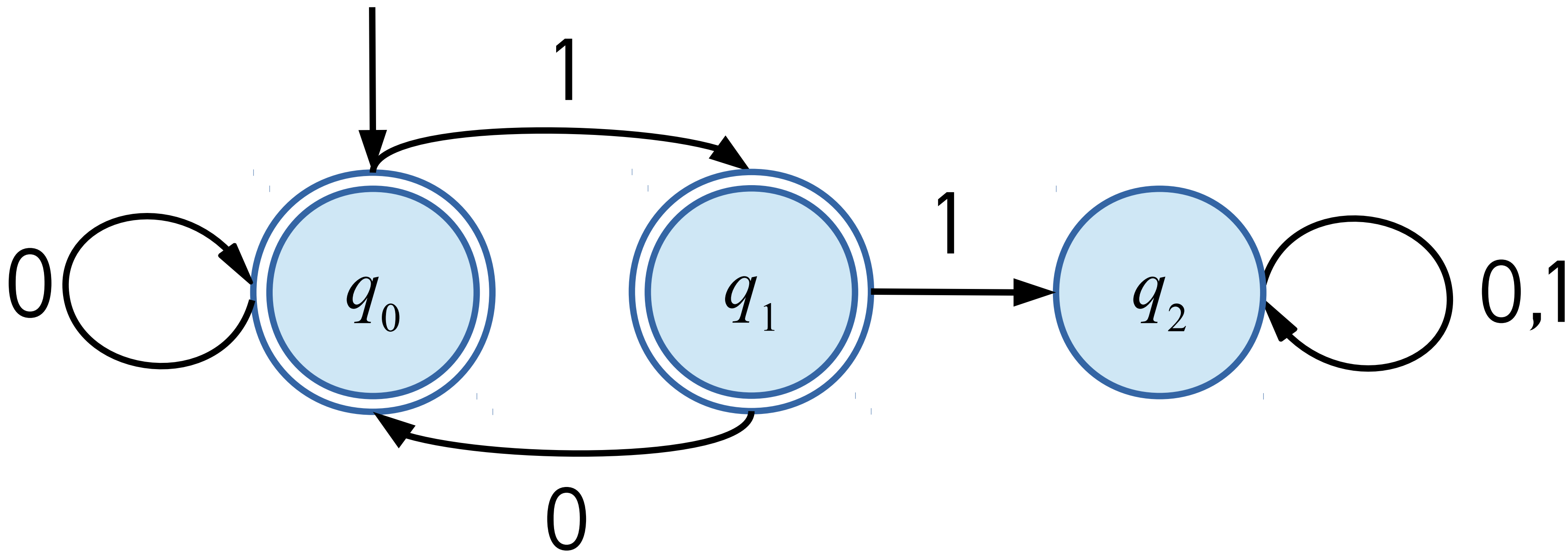


What does this DFA accept?

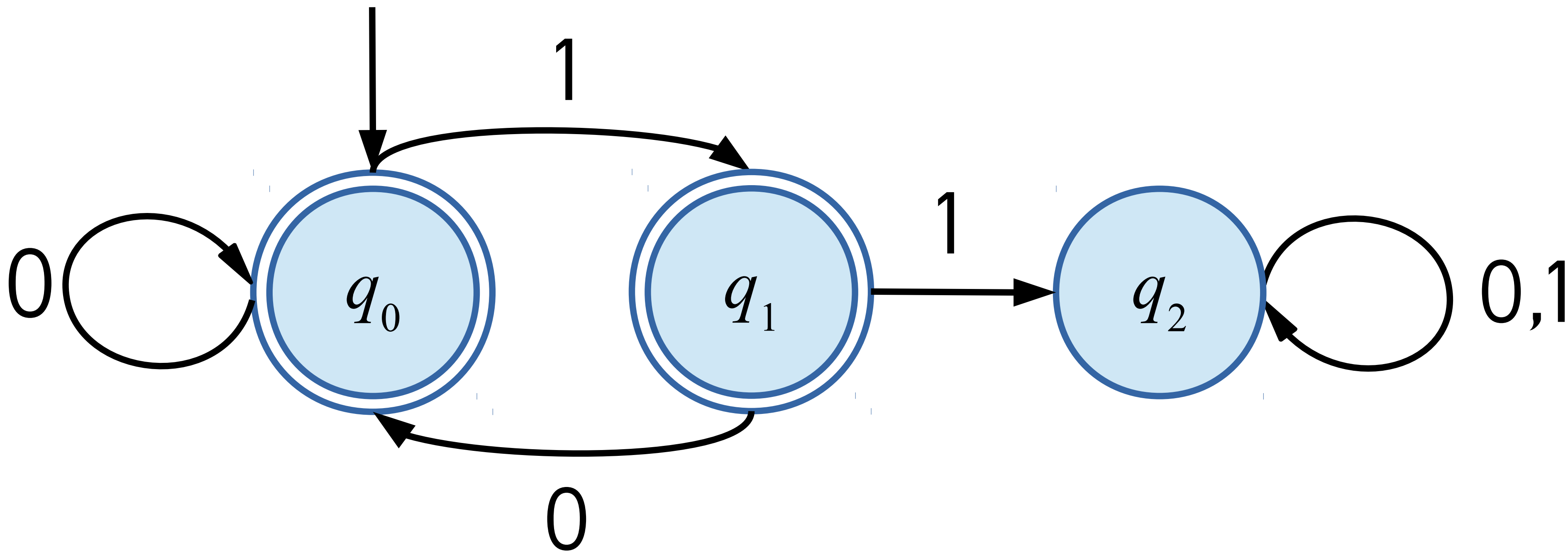


Answer: Strings containing only 1's

What does this DFA accept?



What does this DFA accept?



Answer: Strings containing no two consecutive 1's

Language

- Given alphabet Σ, a language L is a set of strings over the alphabet, i.e. $L \subseteq \Sigma^*$

Language

- Given alphabet Σ, a language L is a set of strings over the alphabet, i.e. $L \subseteq \Sigma^*$

Set of all possible strings over Σ

- We say a language L is accepted/recognized by a DFA M, if M accepts input string $x \in \Sigma^*$ if and only if $x \in L$

Language

- Given alphabet Σ, a language L is a set of strings over the alphabet, i.e. $L \subseteq \Sigma^*$

Set of all possible strings over Σ

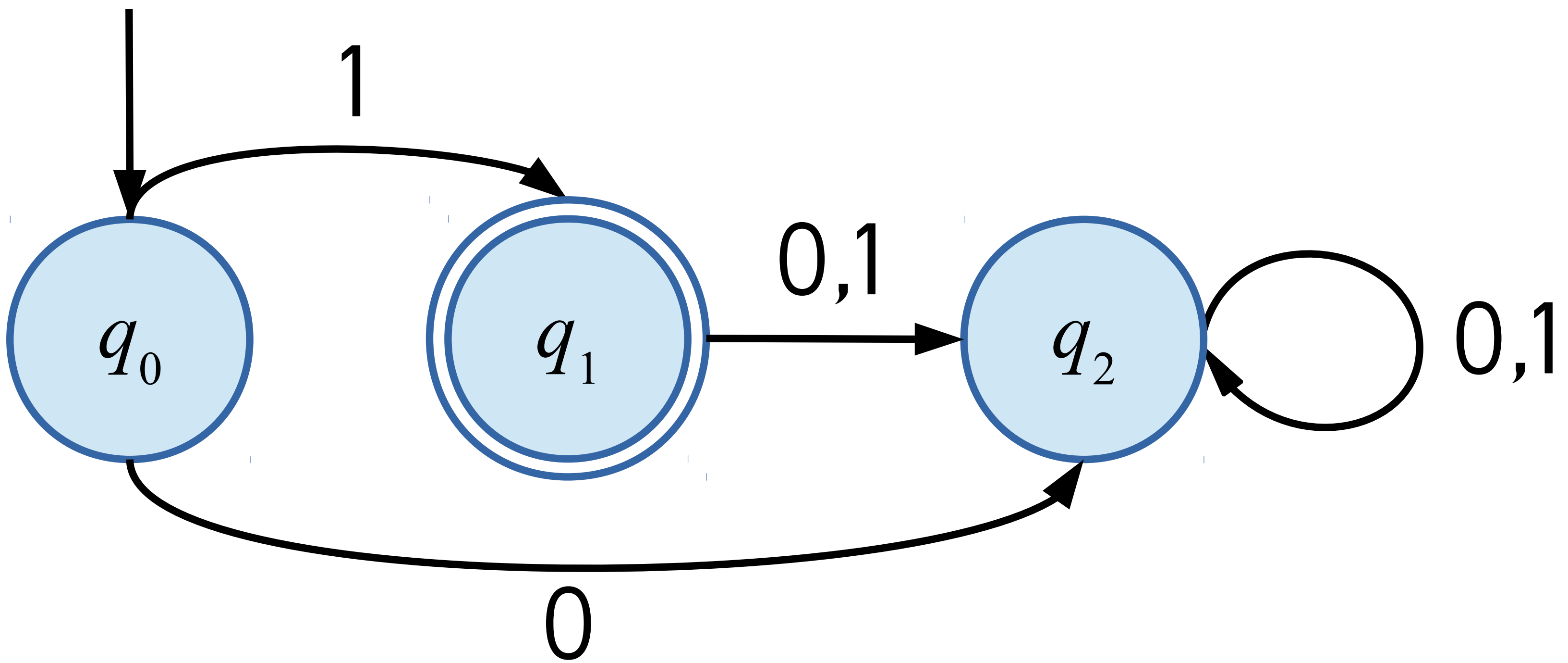
Language

- Given alphabet Σ, a language L is a set of strings over the alphabet, i.e. $L \subseteq \Sigma^*$

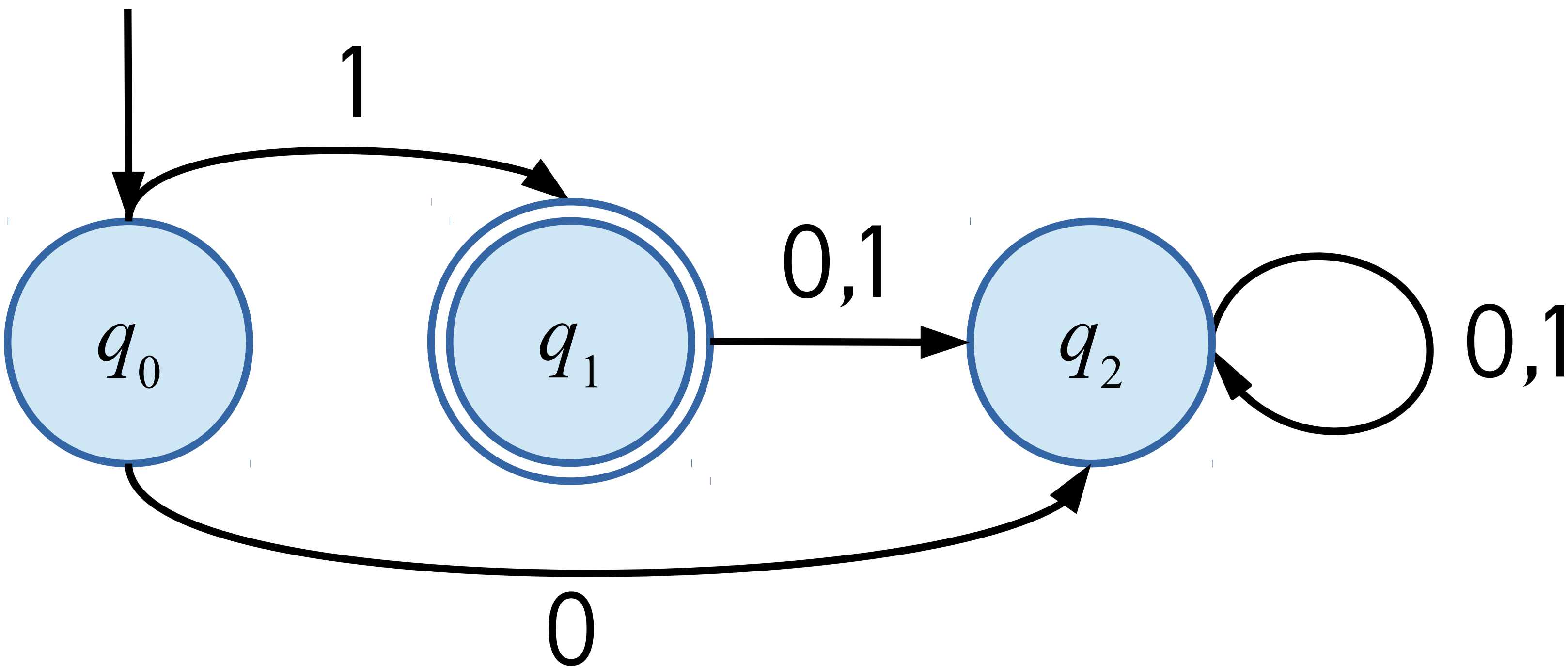
Set of all possible strings over Σ

- We say a language L is accepted/recognized by a DFA M, if M accepts input string $x \in \Sigma^*$ if and only if $x \in L$

What language does this DFA accept?

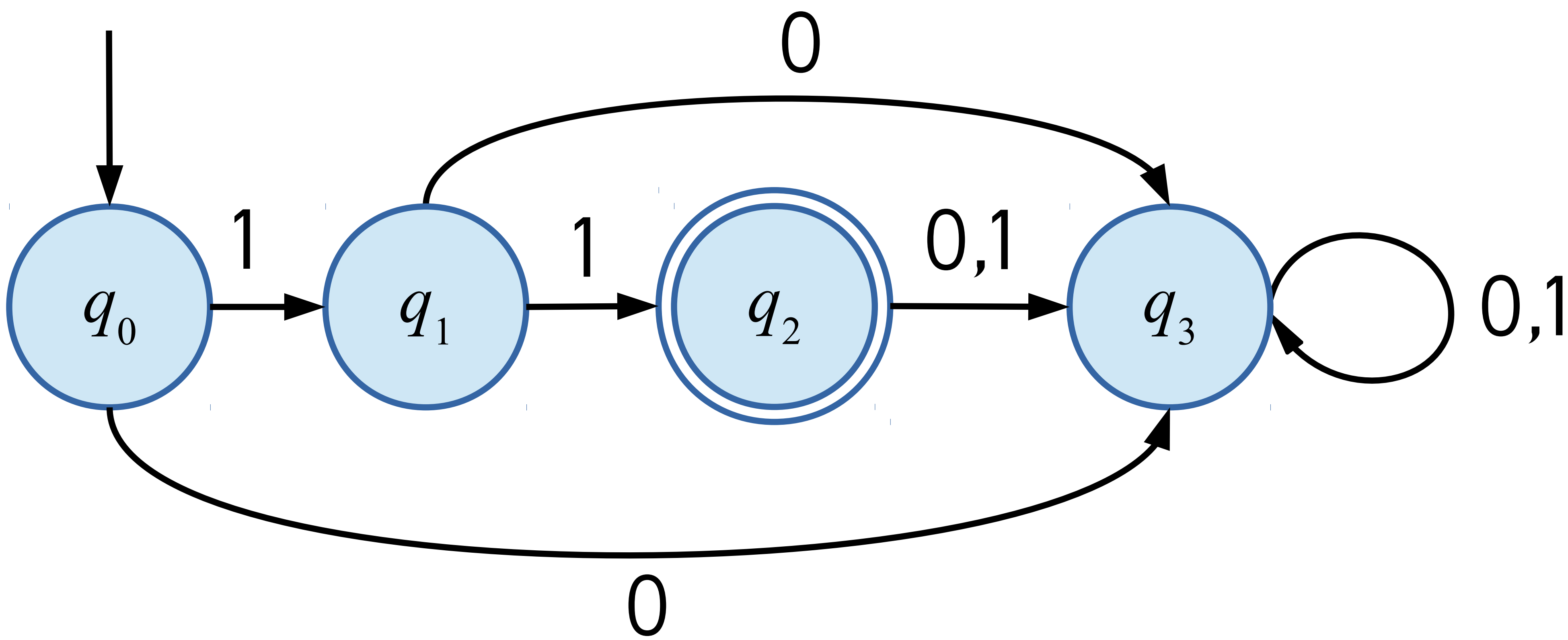


What language does this DFA accept?

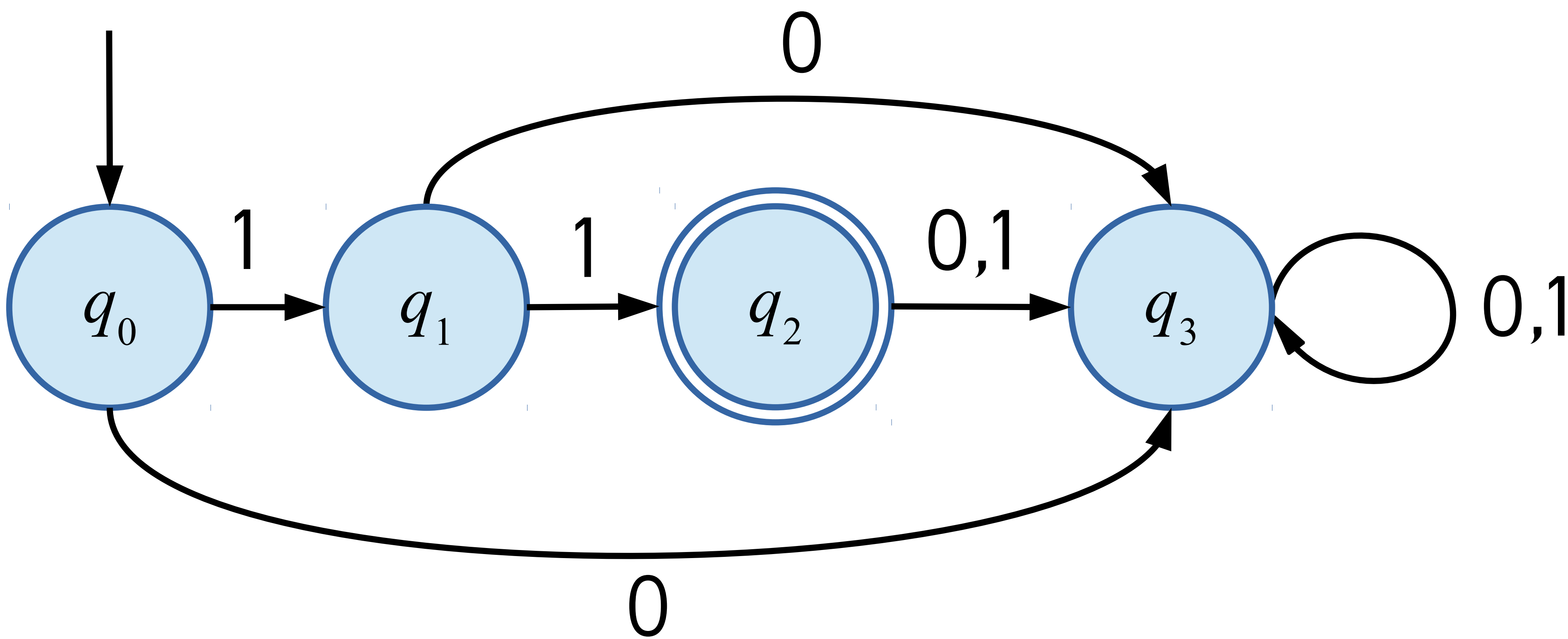


Answer: Only the string 1

What language does this DFA accept?



What language does this DFA accept?



Answer: Only the string 11

DFA's find it difficult to count

- A DFA that recognizes the language $\{1^c\}$ (the single string of c 1's) must have at least c states

DFA's find it difficult to count

- A DFA that recognizes the language $\{1^c\}$ (the single string of c 1's) must have at least c states
  - The parent alphabet is irrelevant (but must of course contain 1)

(Proof discussion to be completed next class)