Pharos University in Alexandria
Faculty of Computer Science & Artificial Intelligence
Course Title: Theory of Computation
Code: CS 307

Theory of Computation

Lecturer: Sherine Shawky

Text Books

1. Introduction to formal languages and automata, Peter Linz, 6th edition, 2017.

Week 2

Finite Automata and Regular Languages

Finite Automata

- Finite automata are good models for computers with an extremely limited amount of memory.
- A ***finite automaton*** is a 5-tuple $(Q,\Sigma, \delta, q0, F)$,

where

  Q is a finite set called the ***states***,

  Σ is a finite set called the ***alphabet***,

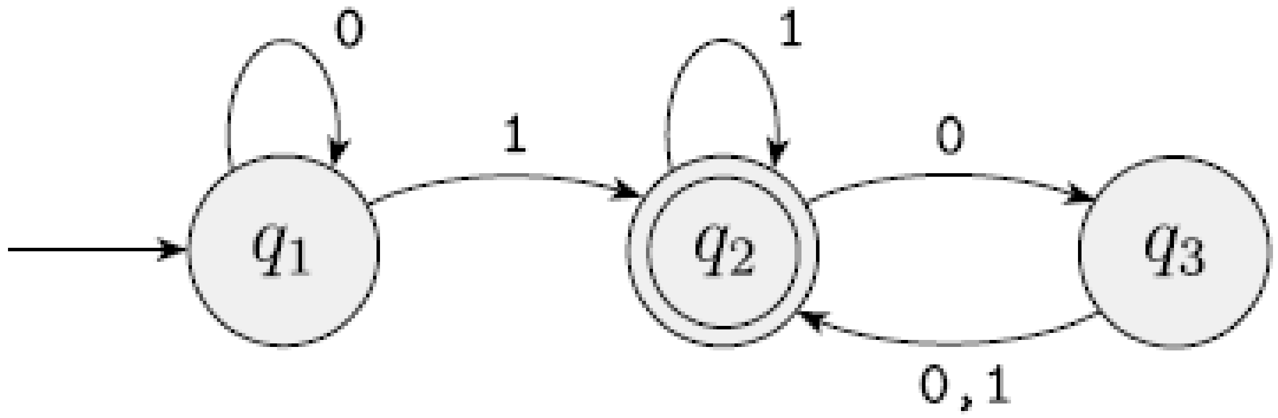
  $\delta : Q \times \Sigma \rightarrow Q$ is the ***transition function***

  $q_0 \in Q$ is the ***start state***, and

  $F \in Q$ is the ***set of accept states***.

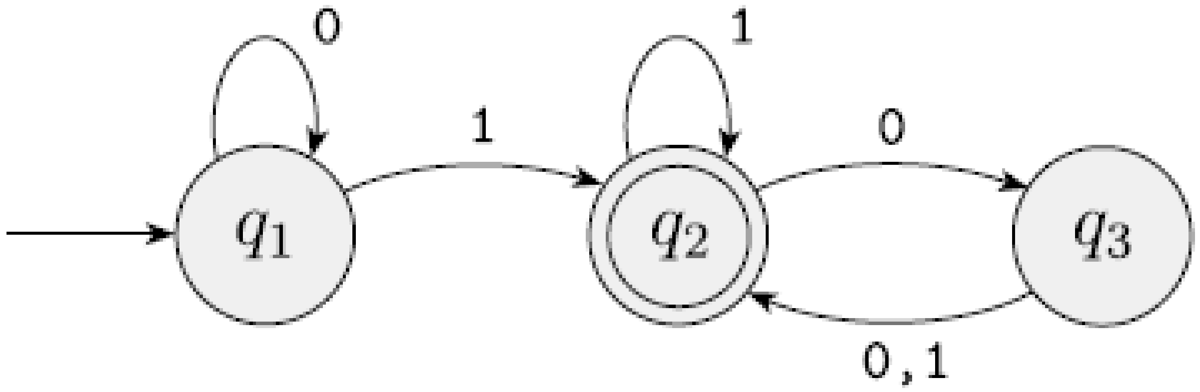
Finite Automata

- Shown figure called the ***state diagram*** of M1.
- Example, with input string 1101 into M1, find finite automata parameters.



Finite Automata

- M1 = (Q,Σ, δ, q1, F), where
  Q = {q1, q2, q3},
  Σ = {0,1},
  δ is described as



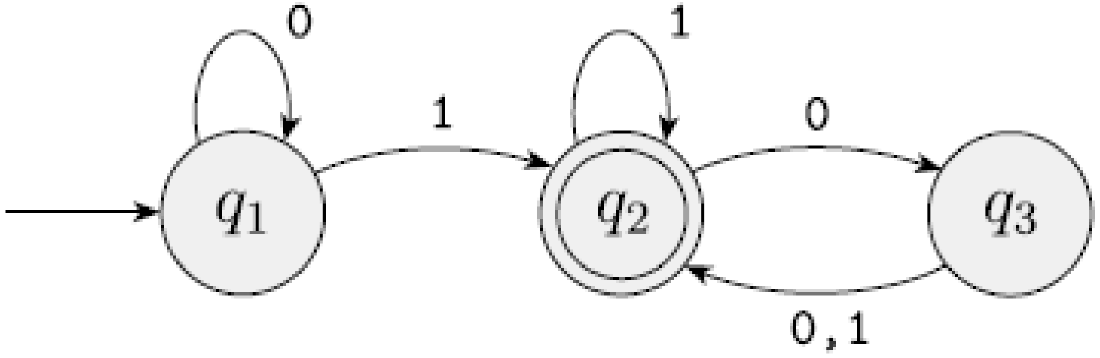
	0	1
q_1	q_1	q_2
q_2	q_3	q_2
q_3	q_2	q_2,

Finite Automata

q1 is the start state, and

F = {q2}.

- In our example, let A = {w| w contains at least one 1 and an even number of 0s follow the last 1}.
- Then L(M1) = A, or equivalently, M1 recognizes A.



Finite Automata

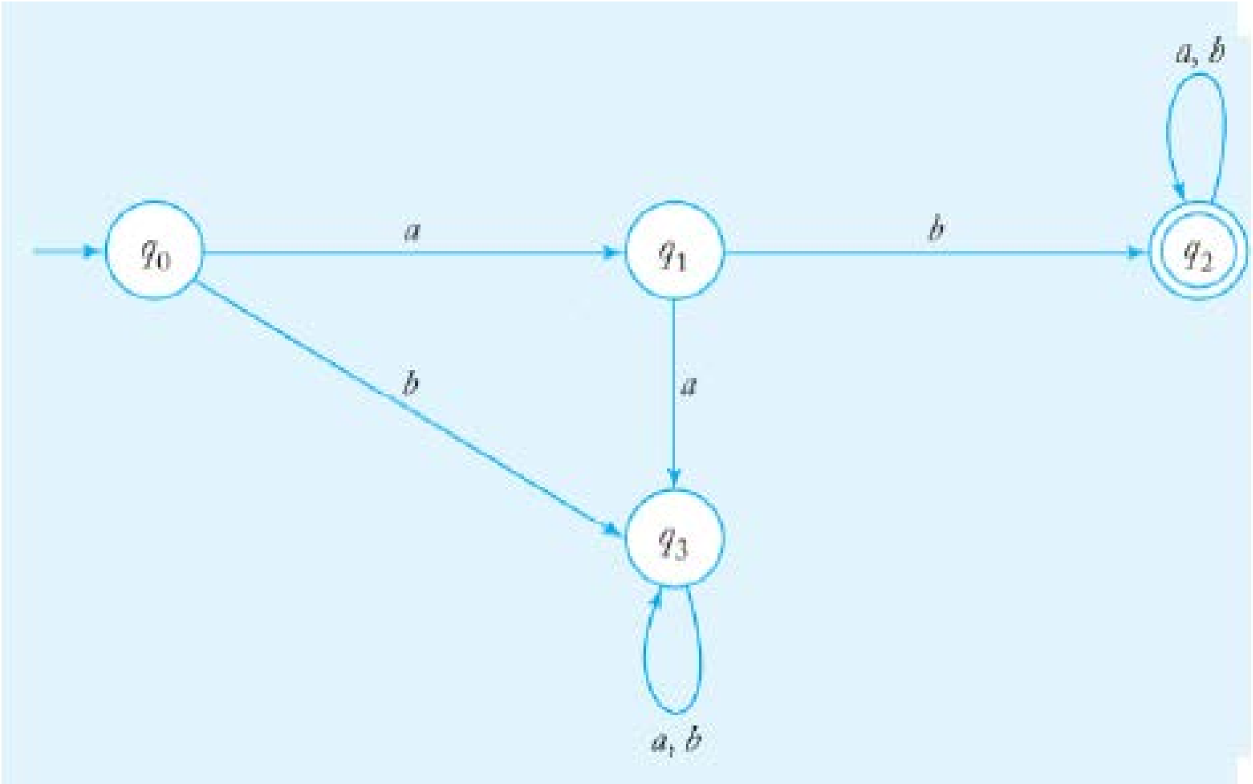
- Definition 2: the language is the set of all the strings accepted by the automaton.
- The language accepted by DFA $M = (Q, \Sigma, \delta, q0, F)$ is the set of all strings on Σ accepted by M.

  $L(M) = \{w \in \Sigma^* : \delta^*(q0, w) \in F\}$.
- δ^*, be total functions. At each step, a unique move is defined, so that we are justified in calling such an automaton deterministic.
- DFA will process every string in Σ^* and either accept it or not accept it. Non-acceptance means that the DFA stops in a non-final state, so that

  $L(M) = \{w \in \Sigma^*: \delta^*(q0,w) \notin F\}$.

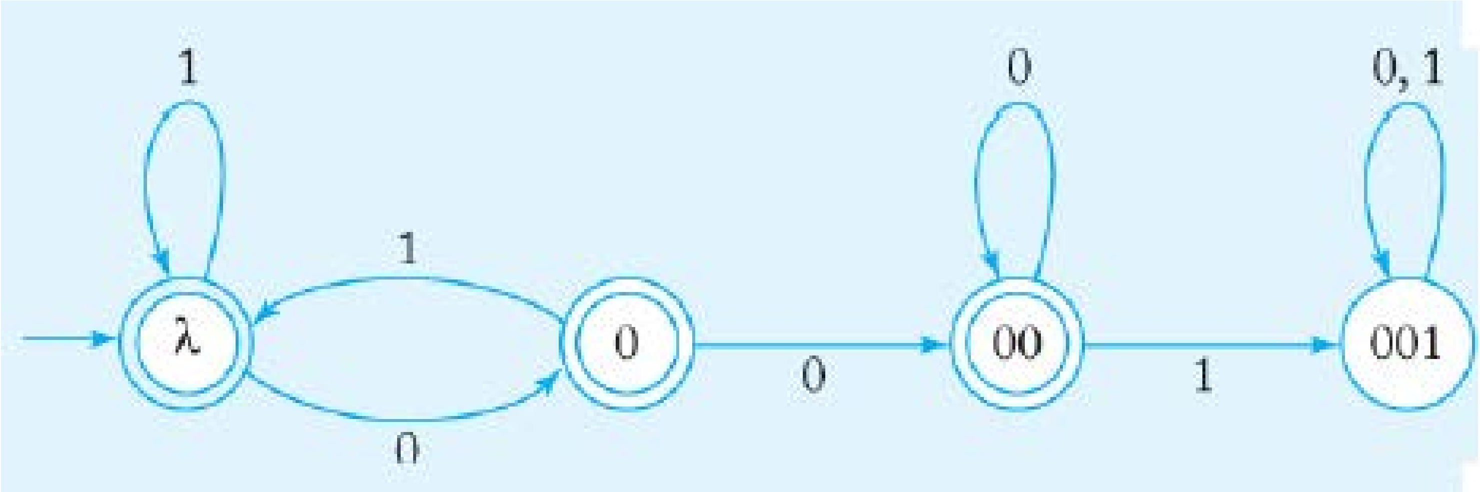
DFA Problem

- Find a deterministic finite accepter that recognizes the set of all strings on $\Sigma = \{a, b\}$ starting with the prefix ab.



DFA Problem

- Find a DFA that accepts all the string on {0,1}, except those containing the substring 001.

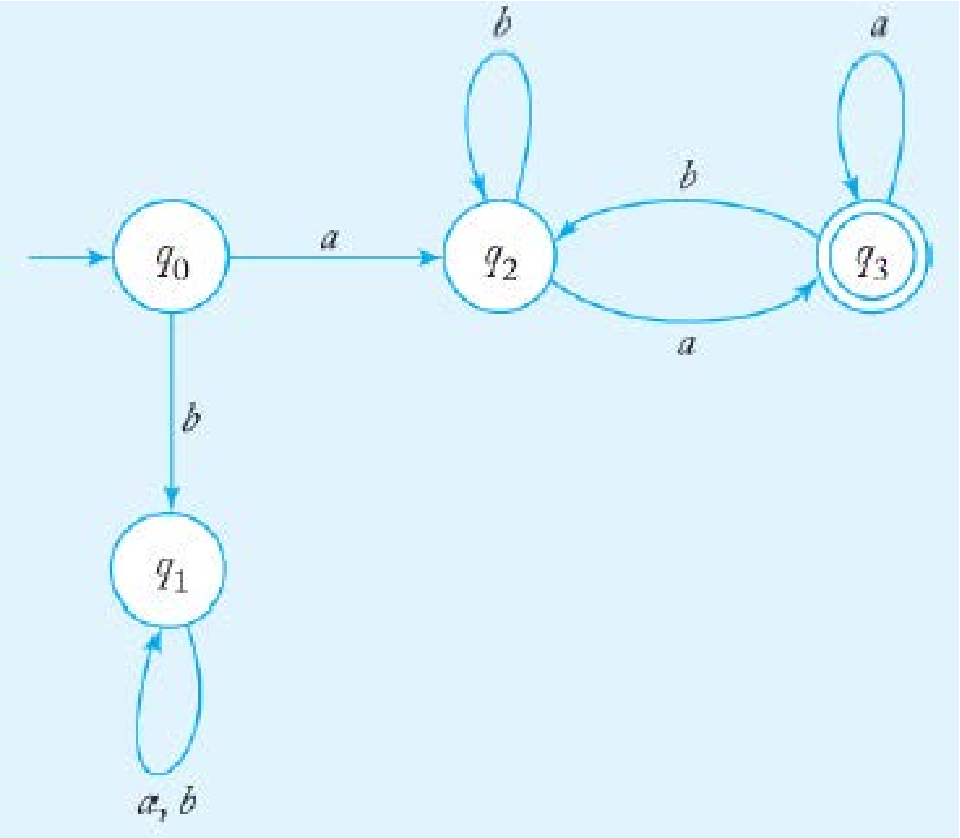


Regular Language

- A language is called a ***regular language*** if some finite automaton recognizes it.
- A language L is called regular if and only if there exists some deterministic finite accepter M such that $L = L(M)$.

RL Problem

- Show that the language $L = \{awa : w \in \{a, b\}^*\}$ is regular.



RL Problem

- $L2 = \{aw1aaw2a : w1, w2 \in \{a, b\}^*\}$.