Cairo University
Faculty of Computers & Artificial Intelligence
Theory of Computations

Lab#4

DFA

Finite Automata

An automaton with a finite number of states is called a Finite Automaton (FA) or Finite State Machine (FSM).

Finite Automaton can be classified into two types −

- Deterministic Finite Automaton (DFA)
- Non-deterministic Finite Automaton (NDFA / NFA)

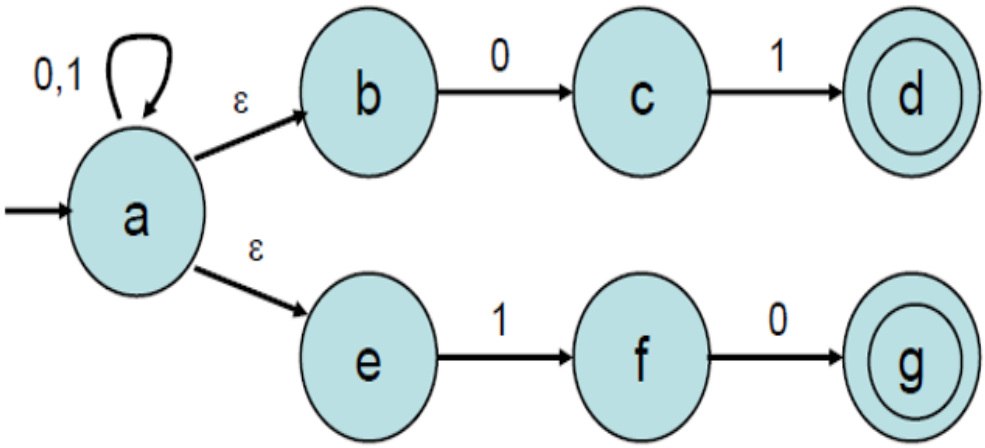
An automaton can be represented by a 5-tuple (Q, Σ, δ, q0, F), where

- Q is a finite set of states.
- Σ is a finite set of symbols, called the alphabet of the automaton.
- δ is the transition function.
- q0 is the initial state from where any input is processed (q0 ∈ Q).
- F is a set of final state/states of Q (F ⊆ Q).

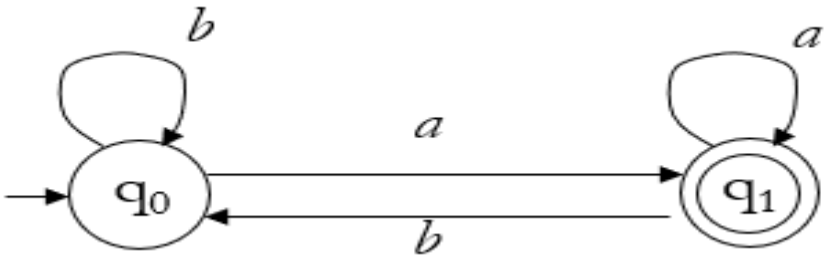
Examples

What does this FSM accept?

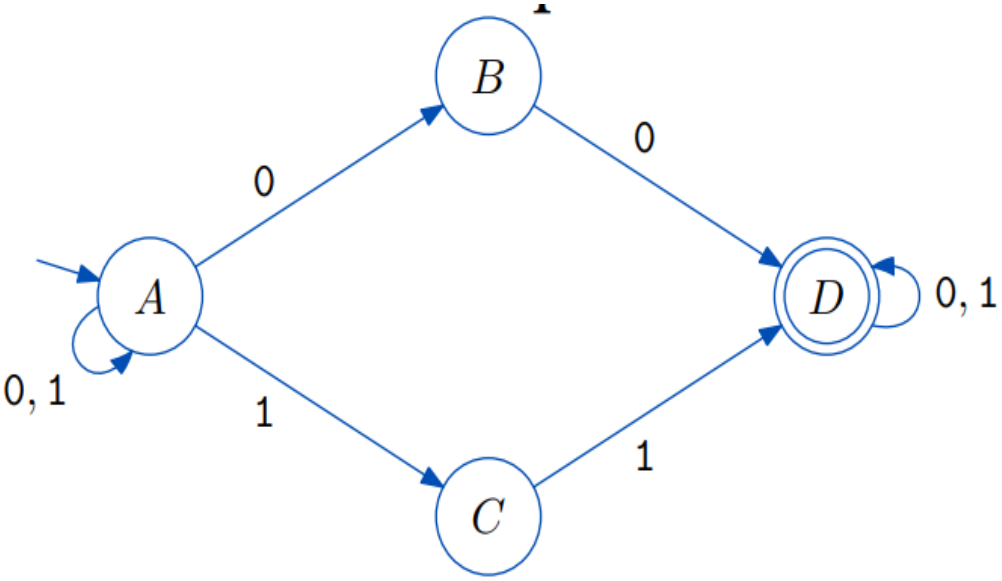
1.



2.



3.



Solutions

1. (0+1)*(01+10)
2. (a+b)*a
3. (0+1)*(00+11)(0+1)*

Deterministic Finite Automaton

For each input symbol, one can determine the state to which the machine will move. Hence, it is called Deterministic Automaton.
As it has a finite number of states, the machine is called Deterministic Finite Machine or Deterministic Finite Automaton.
No ϵ-moves

Formal Definition of a DFA

A DFA can be represented by a 5-tuple (Q, Σ, δ, q0, F) where −

- Q is a finite set of states.
- Σ is a finite set of symbols called the alphabet.
- δ is the transition function where δ: Q × Σ → Q
- q0 is the initial state from where any input is processed (q0 ∈ Q).
- F is a set of final state/states of Q (F ⊆ Q).

Graphical Representation of a DFA

A DFA is represented by state diagrams in which.

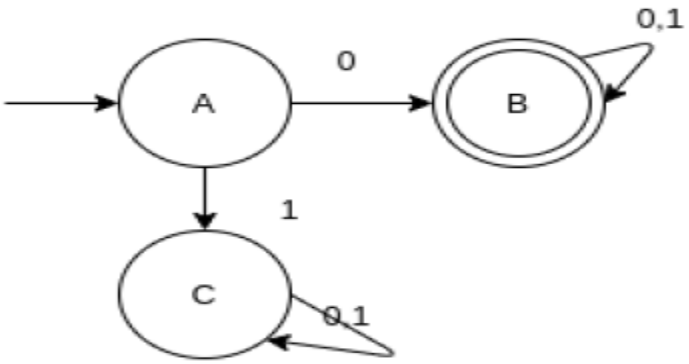
- The vertices represent the states.
- The arcs labeled with an input alphabet show the transitions.
- The initial state is denoted by an empty single incoming arc.
- The final state is indicated by double circles.

Examples

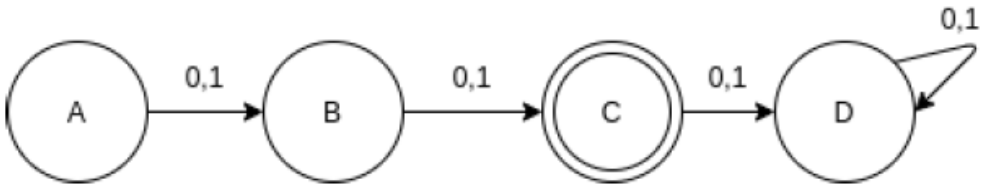
1. Design a DFA that accepts all strings starting with 0 over input alphabets ∑ = {0,1}
2. Design a DFA that accepts all strings of length 2 over 0,1 {00,01,11,10} over input alphabets ∑ = {0,1}
3. Design a DFA for the language accepting strings starting with ‘ab’ over input alphabets ∑ = {a, b}
4. All words with even count of letters ((a+b)(a+b))* over input alphabets ∑ = {a, b}
5. L = { a^nb: n >= 0}, over input alphabets ∑ = {a, b}

Solutions

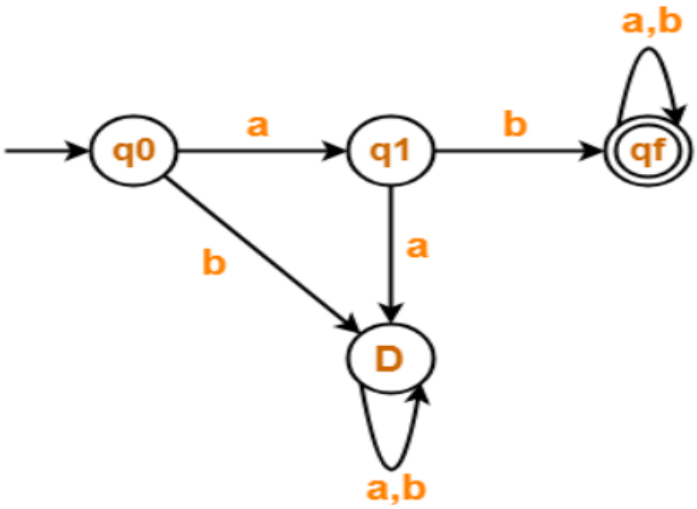
1.



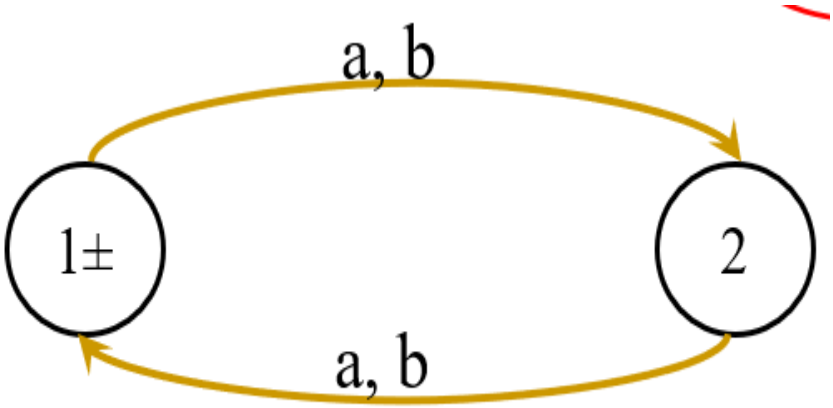
2.



3.



4.



5.