Regular Expression

- Set of strings – Algebraic Fashion
- Set of strings – language
  - Example1
    - L={ab,abb,abbb,abbbb,.....} Regular language
    - (ab^+) Regular Expression
  - Example2
    - R.L = {0,1,00,11}
    - R.E = (0+1+00+11)
  - Example 3
    - R.L = {0,1,00,11,000,111,0000,1111,....}
    - R.E =(0^++1^+)

Regular Expression

Regular Expression

–Any terminals (a,b,c,….,^)

–Union of two R.E R.E (R1,R2 R1+R2)

–Concatenation of two R.E R.E (R1,R2 R1.R2)

–Iteration of R.E is an R.E (R R*) (a* ^,a,aa,aaa,aaaa,…)

- Examples

Sets	Regular Language
{0,1,2}	R=0+1+2
{^,ab}	R=^+ab
{abb,a,b,bba,……}	R=a*b*
{^,0,00,000,0000,..}	R = 0*
{1,11,111,1111,….}	R = 1^+

Regular Expression - Examples

- Set of strings over {0,1} that end in 3 consecutives 1's
  - R.L = {111,0111,1111,00111,10111,....}
  - R.E = (0+1)*111
- Set of strings over {a,b} that has atleast 1 a (>=1a)
  - R.L = {a,ba,ab,aa,aaa,aba,bbbba,bba,bbbaa,bbaaa,.....}
  - R.E = (a+b)* a (a+b)*
- Set of strings over {a,b} that has atmost 1 a (<=1a)
  - R.L = {a,ba,ab,bba,abb,bbba,abbb,.....}
  - b* a b*
- R.L ={c,cc,ccc,cccc,.....} R.E = (c^+)

Regular Expression - Examples

- Set of string over {a,b} which has atleast 1 a (a+b)*a(a+b)*
- Set of string over {a,b} which has atmost 1 a b*ab*
- Set of strings over {0,1} which starts with 0 and ends with 1
  - R.L = {01,001,011,0111,01101,.....}
  - R.E = 0(0+1)*1
- Set of strings over {0,1} which has consecutives 11 in it
  - R.L = {11,011,0110,1110,01101,....}
  - R.E = (0+1)*11(0+1)*
- Set of Strings over {0,1} which doesn't contain a substring 110
  - R.L = {0,1,001,0111,0011,01010,....}
  - R.E = (0+10)*1*

Identities of a Regular Expression

- Identities of Regular Expression:-

I_1 $\quad \emptyset + R = R$

I_2 $\quad \emptyset R = R\emptyset = \emptyset$

I_3 $\quad \Lambda R = R\Lambda = R$

I_4 $\quad \Lambda^* = \Lambda$ and $\emptyset^* = \Lambda$

I_5 $\quad R + R = R$

I_6 $\quad R^*R^* = R^*$

I_7 $\quad RR^* = R^*R$

I_8 $\quad (R^*)^* = R^*$

I_9 $\quad \Lambda + RR^* = R^* = \Lambda + R^*R$

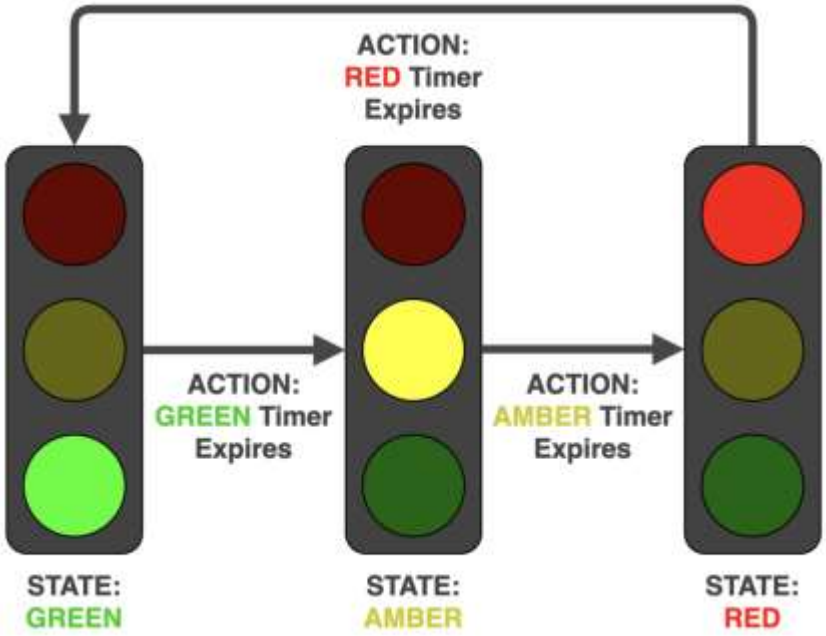
I_{10} $\quad (PQ)^*P = P(QP)^*$

I_{11} $\quad (P + Q)^* = (P^*Q^*)^* = (P^* + Q^*)^*$

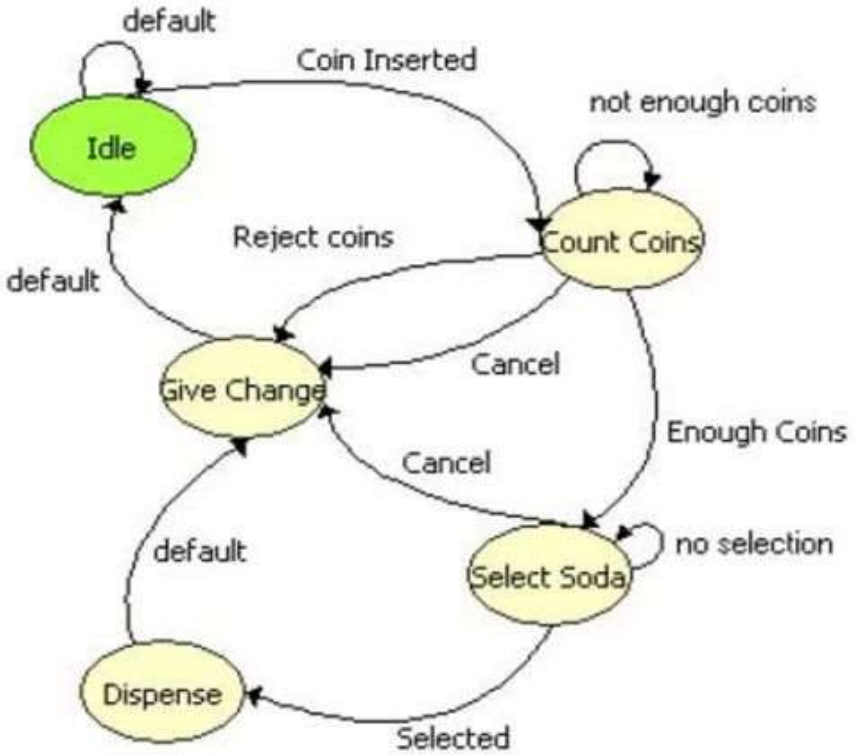
I_{12} $\quad (P + Q)R = PR + QR$ and $R(P + Q) = RP + RQ$

Finite State Automata

- Finite Automata – set of states and rules – transition – input
- 1State 1 state
- Examples :Vending machine, Turnstile
  - Traffic Light



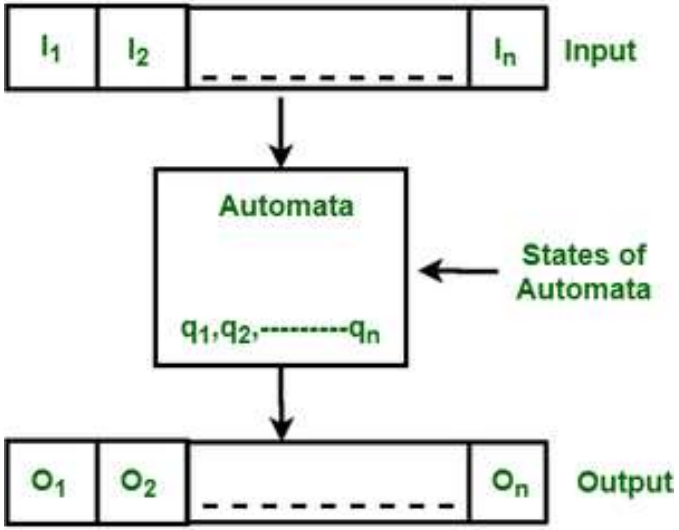
State Diagram of a Simple Soda Vending Machine



Finite State Automata

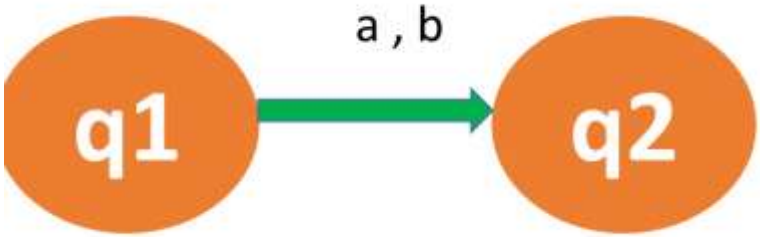
- ***FSA – Lexical Analysis of Compiler***

- FA – Tuple – {Q,∑, q, F, δ}
- Q – set of states
- ∑ – set of input symbols
- q – initial state
- F – set of final states
- δ - Transitions



Regular Expression to Finite Automata

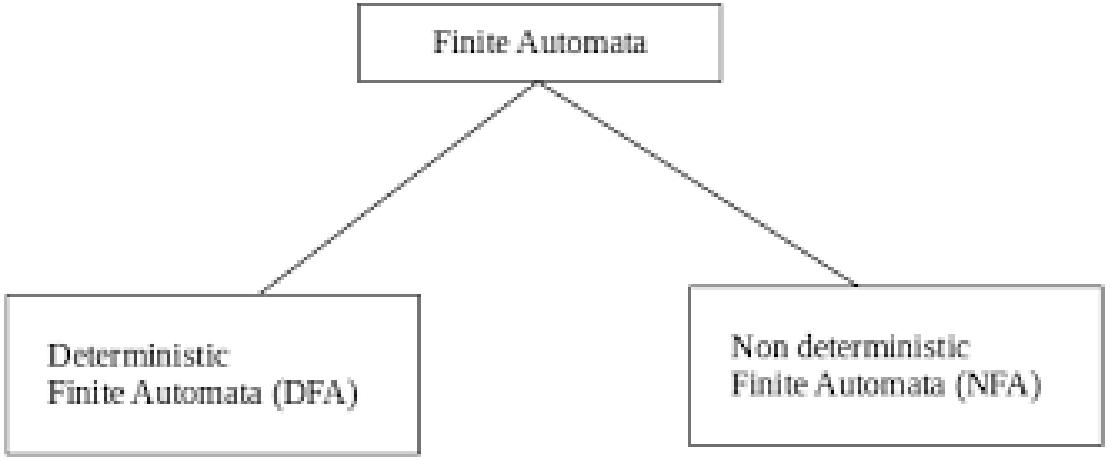
- a+b



- ab

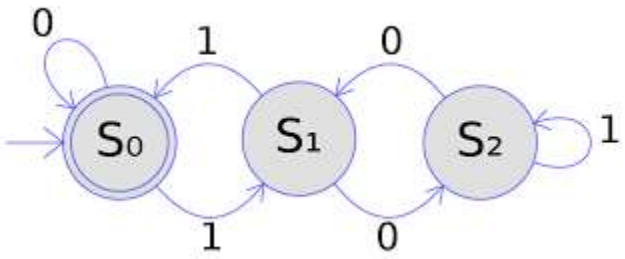
- a*

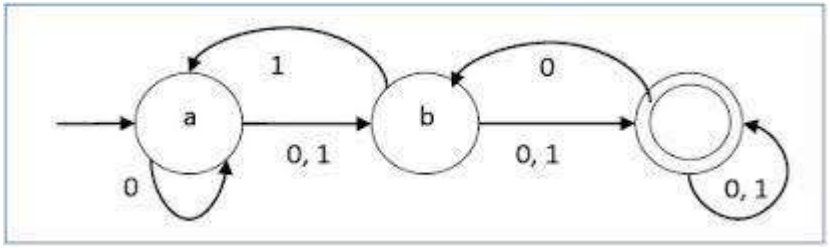
Types of Finite State Automata



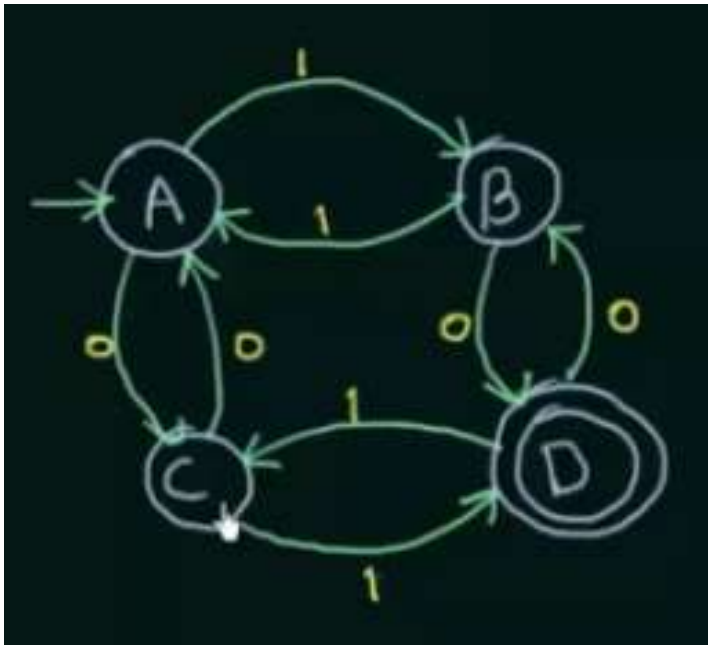
Transition ⍰ 1 state to single next state for each input symbol

Transition ⍰ 1 state to multiple next state for each input symbol





Deterministic Finite Automata (DFA)

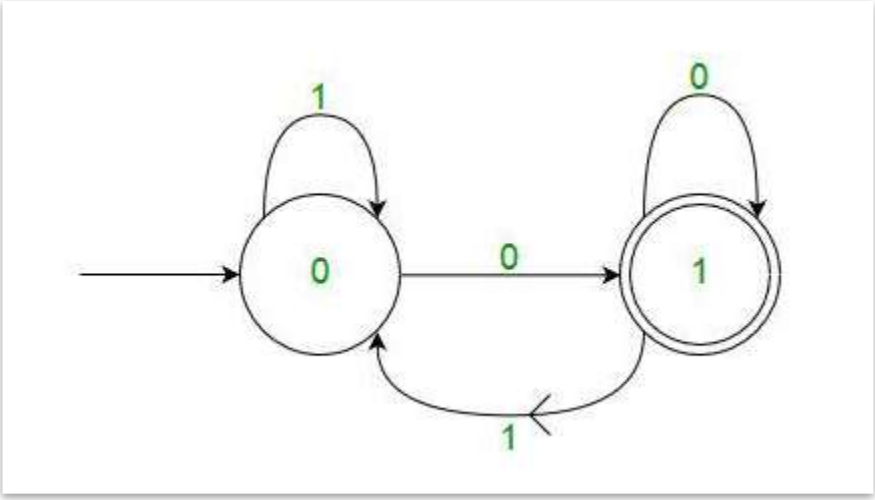


- $\{Q, \Sigma, q, F, \delta\}$
- $Q = \{A,B,C,D\}$
- $\Sigma = \{0,1\}$
- $Q_0 = A$
- $F = D$
- δ Transition function

	0	1
A	C	B
B	D	A
C	A	D
D	B	C

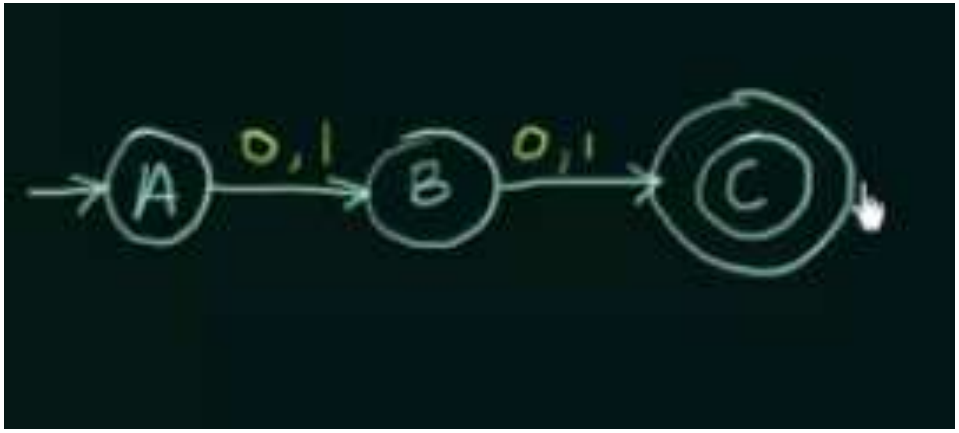
Deterministic Finite Automata (DFA)

- Example 1
- L1 = Set of all strings that end with '0'
- L1 = {000,000,010,0110,0100,01110,....}



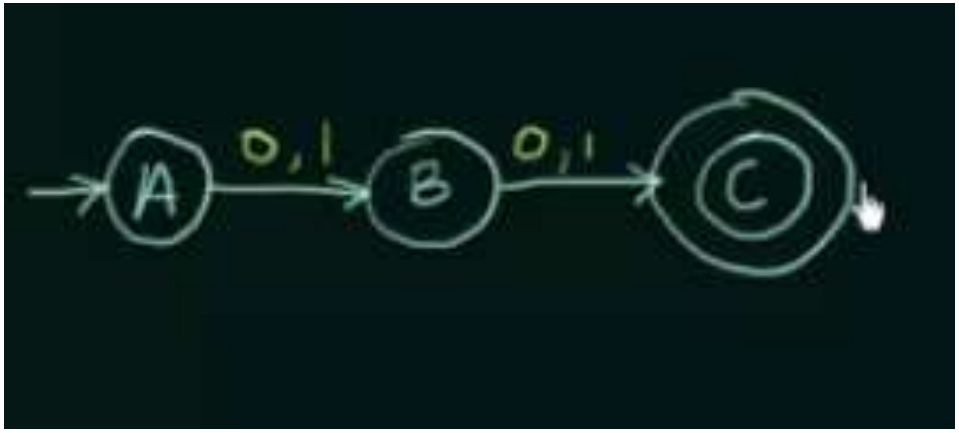
Deterministic Finite Automata (DFA)

- Example 2
- L1 = Set of strings over {0,1} of length 2
- L1 = {00,11,01,10}



Deterministic Finite Automata (DFA)

- Example 3
- L1 = Set of strings over {0,1} of length 2
- L1 = {00,11,01,10}



DFA - Applications

- Lexical Analysis – compiler
- Spelling Checker
- Search Command

DFA -Examples

- Set of strings over {0,1} that start with 0 and end with 1
- Set of strings over {a,b} that ends with bb