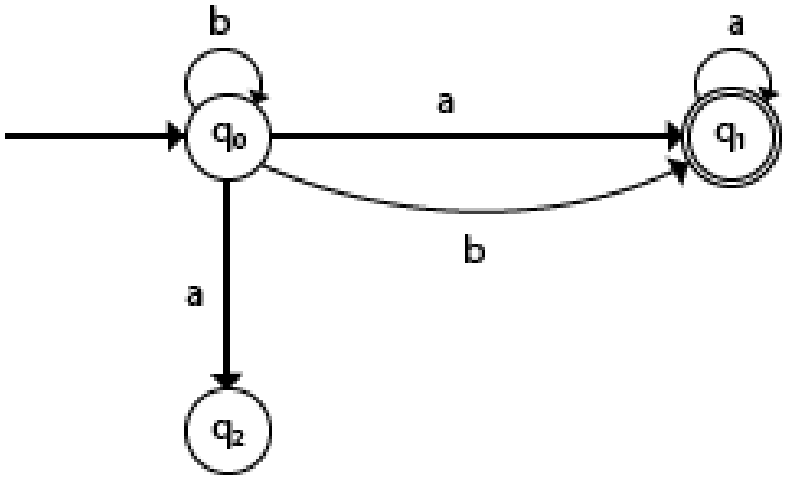
Non Deterministic Finite Automata (NFA)

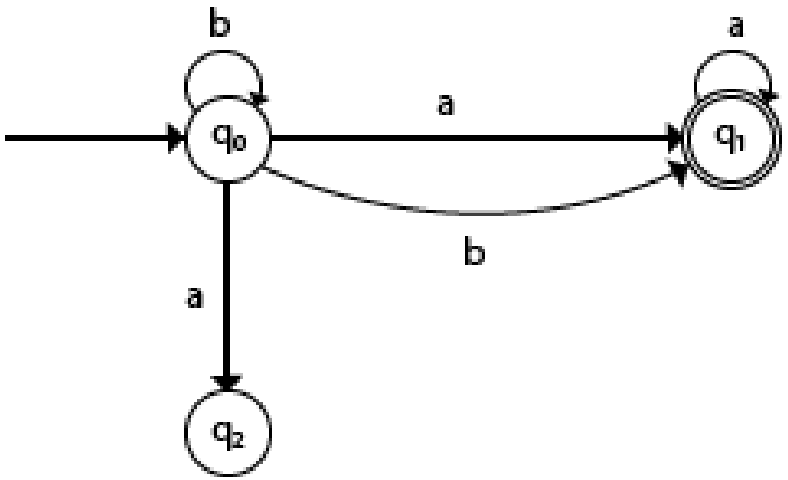
- If there is more than one possible transition from one state on the same input symbol.
- Particular input → multiple states
- Exact movement of machine cannot be determined (Non-Deterministic)
- It can have ε transition
- {Q,Σ,q0,F, δ}
- Q – {q0,q1,q2}
- Σ - {a,b}
- q0 – q0
- F – q1
- δ – Q* Σ = 2^Q



NFA

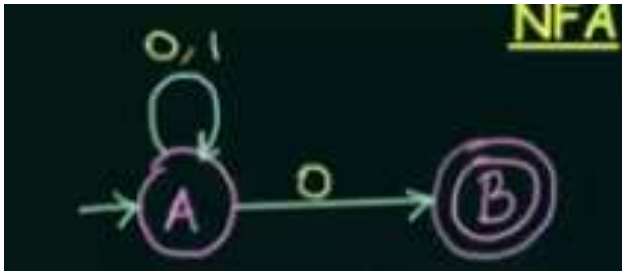
- Transition Table

	a	b
q0	q1, q2	q0,q1
q1	q1	-
Q2	-	-



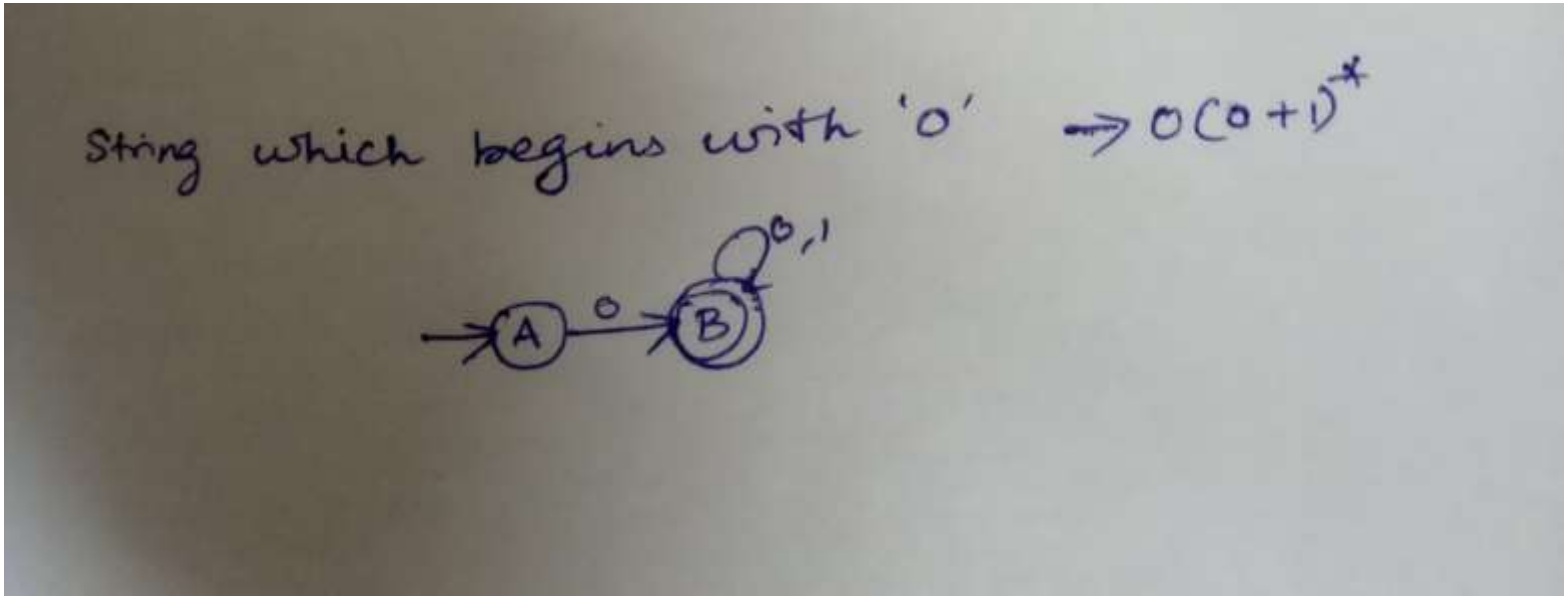
NFA - Examples

- Set of strings over {0,1} that end with '0'



- Transitions → $Q^* \sum = 2^Q$
- Q → 2 states → 2^Q → 4
- A → null, A, B, AB → 4 possibilities

NFA - Examples



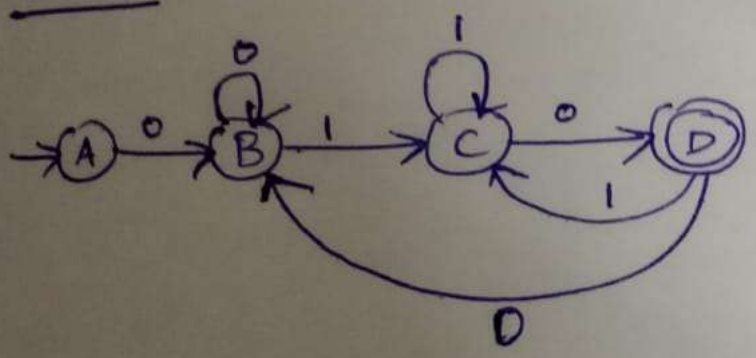
NFA - Examples

Starts with '0' & ends with '10'

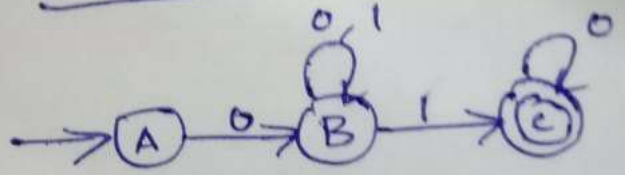
$R.L = \{010, 0010, 0110, 00110, 011010, \cdots\}$

$R.\Sigma = 0(0+1)^*10$

DFA



NFA



NFA - Examples

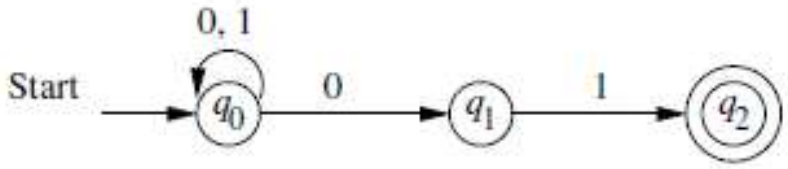
- Set of strings over {0,1} that starts with 0 and ends with 1
- Set of strings over {0,1} that start with 1 and end with 0
- Set of strings over {a,b} that ends with bb
- Set of strings over {a,b} that has atleast 1 a
- Set of strings over {a,b} that has atmost 1 a

Equivalence of NFA & DFA

- Every DFA is an NFA, Every NFA is not DFA
- NFA → DFA →L(N)== L(D)
- NFA = {Q,∑,q0,F, δ}
- DFA = {Q',∑,q0,F', δ'}
- Steps for converting NFA to DFA
  - Initially Q'=∅
  - Q'={q_0}
  - For each state in Q' find the possible set of states for each input symbol. If this set of states is not in Q' add them to Q'
  - Final state of DFA will the states which contain Final states of NFA

Equivalence of NFA & DFA

- NFA which accepts all the strings ending with 01



	0	1
q_0	q0, q1	q0
q_1	-	q2
q_2	-	-

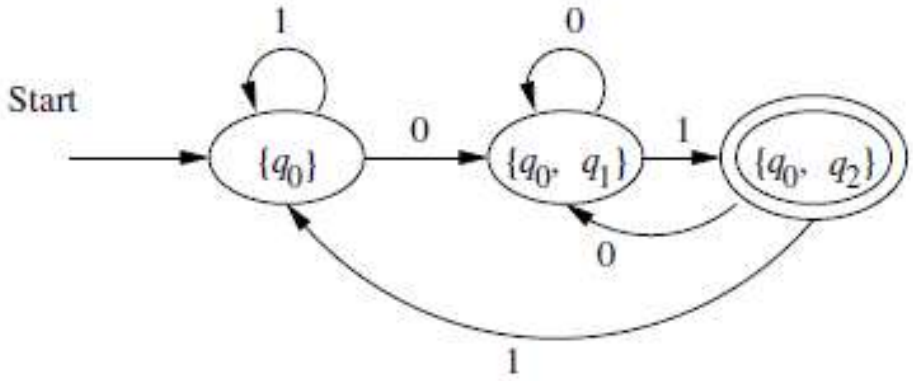
- DFA Construction
  - Q' =NULL
  - Q'={q0,{q0,q1},{q0,q2}}

	0	1
(initial) q_0	{q0, q1}	q0
{q0, q1}	{q0,q1}	{q0,q2}
(Final) {q0,q2}	{q0,q1}	q0

Equivalence of NFA & DFA

- DFA Construction – strings that end with 01
  - Q' ={q_0, {q0,q1},{q0,q2}}

	0	1
q_0	$\{q_0, q_1\}$	q_0
$\{q_0,q_1\}$	$\{q_0,q_1\}$	$\{q_0,q_2\}$
$\{q_0,q_2\}$	$\{q_0,q_1\}$	q_0



Equivalence of NFA & DFA- Example

- Construct the NFA for the given transition table and find the equivalent DFA

States/ Inputs	0	1
A	A	B
B	B	A,B