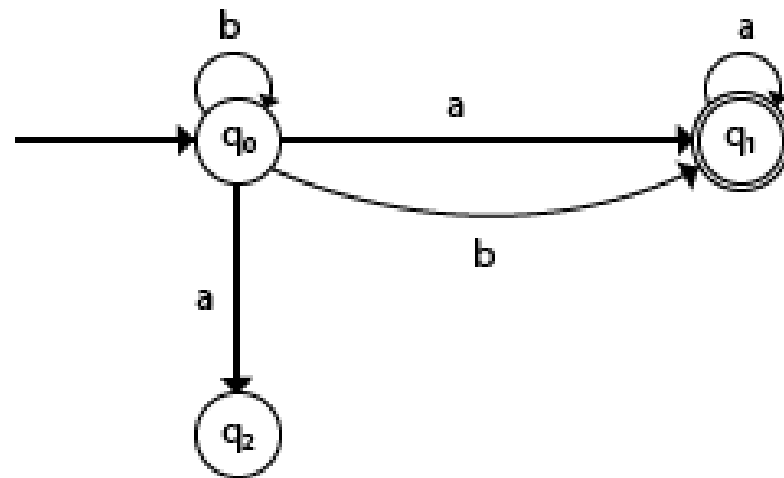




Non Deterministic Finite Automata (NFA)



- If there is more than one possible transition from one state on the same input symbol.
- Particular input \rightarrow multiple states
- Exact movement of machine cannot be determined (Non-Deterministic)
- It can have ϵ transition
- $\{Q, \Sigma, q_0, F, \delta\}$
- $Q - \{q_0, q_1, q_2\}$
- $\Sigma - \{a, b\}$
- $q_0 - q_0$
- $F - q_1$
- $\delta - Q^* \Sigma = 2^Q$

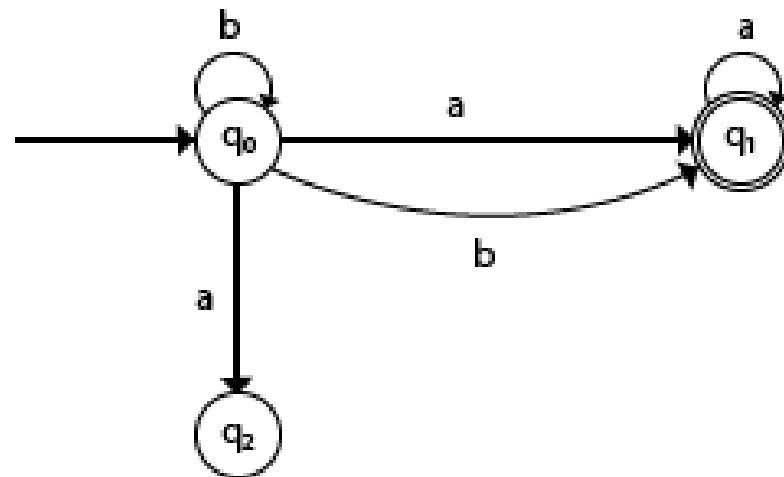




NFA

- Transition Table

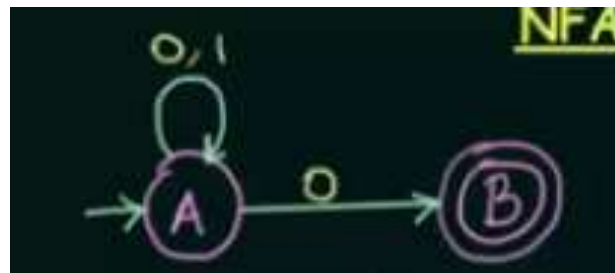
	a	b
q0	q1, q2	q0, q1
q1	q1	-
Q2	-	-





NFA - Examples

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

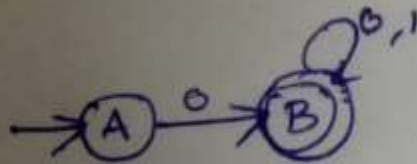


- Transitions $\rightarrow Q^* \Sigma = 2^Q$
- $Q \rightarrow 2 \text{ states} \rightarrow 2^Q \rightarrow 4$
- $A \rightarrow \text{null, A, B, AB} \rightarrow 4 \text{ possibilities}$



NFA - Examples

String which begins with '0' $\rightarrow 0(0+1)^*$





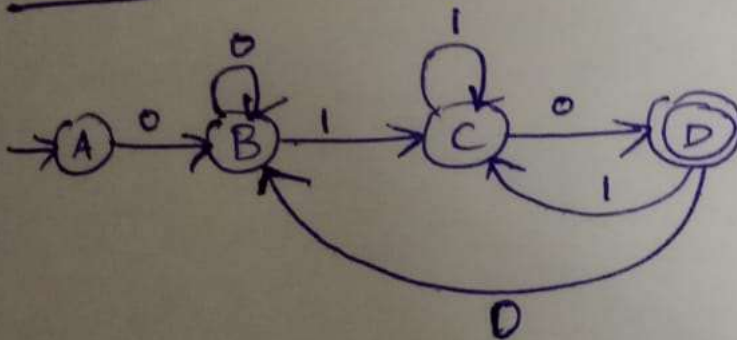
NFA - Examples

Starts with '0' & ends with '10'

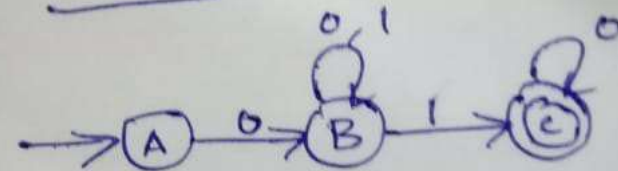
$$R.L = \{010, 0010, 0110, 0010, 011010, \dots\}$$

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

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 at least 1 a
- Set of strings over $\{a,b\}$ that has at most 1 a



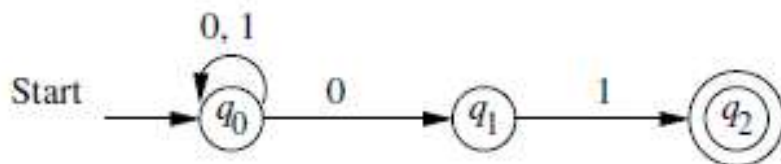
Equivalence of NFA & DFA

- Every DFA is an NFA, Every NFA is not DFA
- $NFA \rightarrow DFA \rightarrow L(N) == L(D)$
- $NFA = \{Q, \Sigma, q_0, F, \delta\}$
- $DFA = \{Q', \Sigma, q_0, F', \delta'\}$
- Steps for converting NFA to DFA
 - Initially $Q' = \emptyset$
 - $Q' = \{q_0\}$
 - 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 be 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	q ₀ , q ₁	q ₀
q ₁	-	q ₂
q ₂	-	-

- DFA Construction

- $Q' = \text{NULL}$
- $Q' = \{q_0, \{q_0, q_1\}, \{q_0, q_2\}\}$

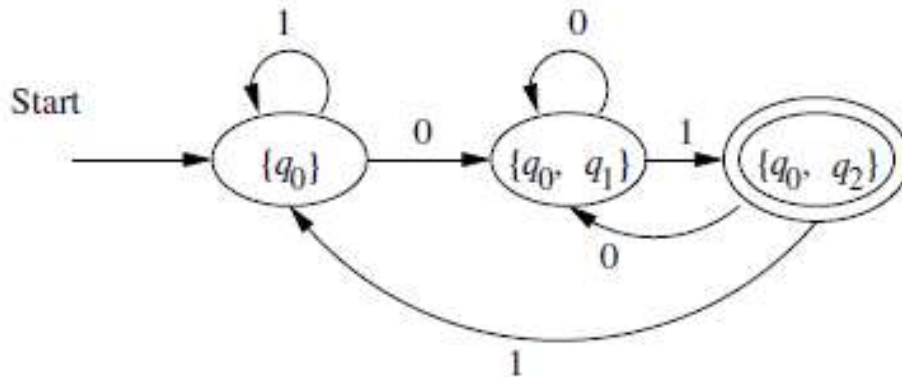
	0	1
(initial) q ₀	{q ₀ , q ₁ }	q ₀
{q ₀ , q ₁ }	{q ₀ , q ₁ }	{q ₀ , q ₂ }
(Final) {q ₀ , q ₂ }	{q ₀ , q ₁ }	q ₀



Equivalence of NFA & DFA

- DFA Construction – strings that end with 01
 - $Q' = \{q_0, \{q_0, q_1\}, \{q_0, q_2\}\}$

	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