بسم الله الرحمن الرحیم

Formal Languages & Automata

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Chapter 2: Finite Automata

Nondeterministic Finite Acceptors (NFA)

- Given an input symbol, a nondeterministic finite acceptor (NFA) has a choice of moves.

- An NFA's transition function can take it to any one state from a set of states:

$$M = (Q, \Sigma, \delta, q_0, F)$$

where

$$\delta : Q \times (\Sigma \cup \{\lambda\}) \to 2^Q$$

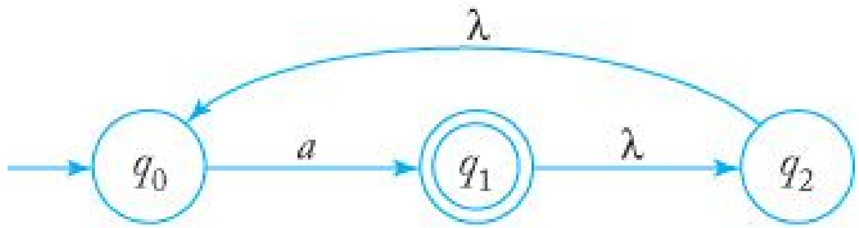
Nondeterministic Finite Acceptors, *cont'd*

- A transition moves to a subset of states (not to a unique state as in a DFA).
  - 2^Q is the powerset of Q.
  - The set of all subsets of Q.

$$\delta : Q \times (\Sigma \cup \{\lambda\}) \rightarrow 2^Q$$

- The second argument of δ can also be λ.
  - We can make a transition without consuming an input symbol.

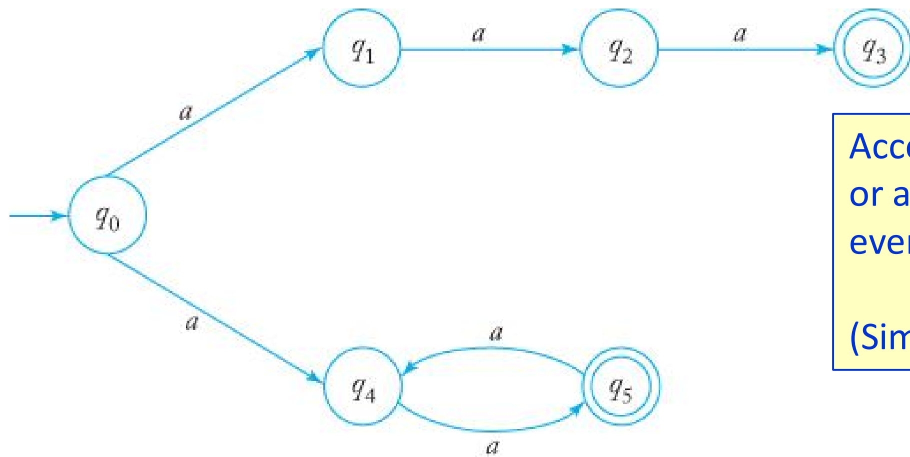
Example NFA



$$\delta^*(q_2, \lambda) = \{q_0, q_2\}$$

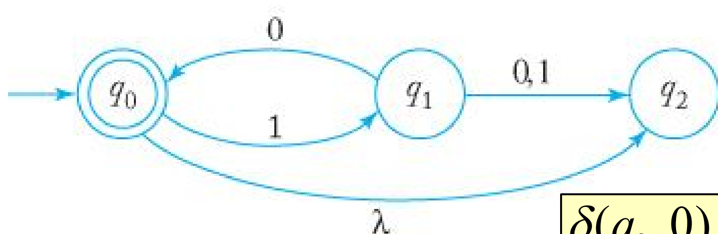
$$\delta^*(q_2, aa) = \{q_0, q_1, q_2\}$$

Example NFAs, *cont'd*



Accept either the string *aaa*
or a string with an
even number of *a*'s.

(Simpler than the equivalent DFA.)



$$\delta(q_2, 0) = \varnothing$$

The string 10 has two walks,
one to q_0 and one to q_2.
The string is accepted because
q_0 is a final state.

Language Accepted by an NFA

- The language L accepted by an NFA

  $$M = (Q, \Sigma, \delta, q_0, F)$$

  is the set of all strings w for which there is a path labeled w from the initial vertex to some final vertex.

$$L(M) = \{w \in \Sigma^* : \delta^*(q_0, w) \cap F \neq \varnothing\}$$