CS303T Theory of Computation

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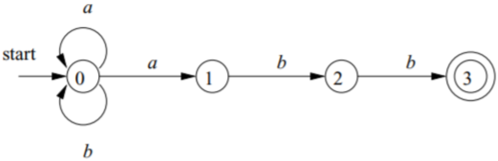
Outline

- Recap
    - Deterministic Finite Automata (DFA)
    - More Examples for DFA
    - Non-deterministic Finite Automata (NFA)
- Today
    - NFA More Examples
    - NFA to DFA

More NFA Examples

Qn. Can we determine the language determined by NFA?



NFA Example

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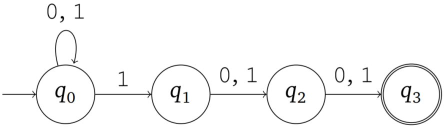

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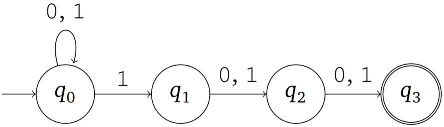

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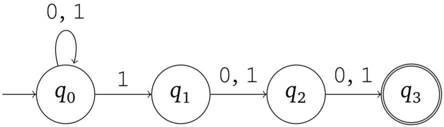

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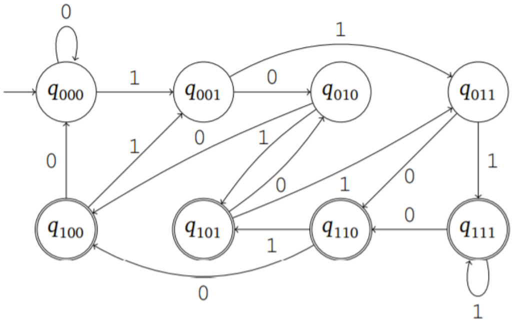

Equivalence of DFA and NFA

- Every language that can be described by some NFA can also be described by some DFA
- If a language is recognized by an NFA, then we must show the existence of a DFA that also recognizes it
- The proof that DFA's can do whatever NFA's can do involves an important "construction" called the subset construction
- If k is the number of states of the NFA, it has 2^k subsets of states
- Each subset corresponds to one of the possibilities that the DFA must remember, so the DFA simulating the NFA will have 2^k states.

Continue...

- Let $N = (Q, \Sigma, \delta, q_0, F)$ be the NFA recognizing some language L. We construct a DFA $M = (Q', \Sigma', \delta', \{q_0\}, F')$, where N has no ϵ transitions.
  - $Q' = \mathcal{P}(Q)$ (Every state of M is a set of states of N)
  - For $R \in Q'$ and $a \in \Sigma$, $\delta'(R, a) = \bigcup_{r \in R} \delta(r, a)$
  - $q_0' = \{q_0\}$
  - $F' = \{R \in Q' | R \text{ contains an accept state of } N\}$
- If N has ϵ transition then we proceed as follows
  - For any state $R \in Q'$, first we define $E(R)$ as a collection of states that can be reached from members of R by going only along ϵ arrows, including the members of R themselves.
    - $E(R) = \{q | q \text{ can be reached from } R \text{ by traveling along } 0 \text{ or more } \epsilon \text{ arrows } \}$
  - Changes $q_0' = E(q_0)$
  - Changes $\delta'(R, a) = \{q \in Q | q \in E(\delta(r, a)) \text{ for } r \in R\}$

Example from NFA to DFA