Nondeterministic Finite Automata
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Example (1.30)

• Accept string of at least length three that contains a 1 in the third from end

\[ \Sigma = \{0, 1\}; \Sigma^* 1(0 \cup 1)(0 \cup 1) \]

What makes this difficult for a DFA?

Equivalent DFA takes 8 states. Why 8?
Formal Definition of NFA

- 5 tuple \((Q, \Sigma, \delta, q_0, F)\)

\[
\Sigma_\varepsilon = \Sigma \cup \{e\}
\]

\[
\delta : Q \times \Sigma_\varepsilon \rightarrow P(Q)
\]
Formal Definition of Computing for NFA

- Given a machine $M = (Q, \Sigma, \delta, q_0, F)$ and a string $w = w_1 w_2 \ldots w_n$ over $\Sigma$, then $M$ accepts $w$ if there exists a sequence of states $r_0, r_1 \ldots r_n$ in $Q$ such that:
  - $r_0 = q_0$
  - $\delta (r_i, w_{i+1}) = r_{i+1}, i=0,\ldots,n-1$
  - $r_n \in F$
Practice

• Construct a NFA with three states that recognizes \( \{w \mid w \text{ ends with two 0s}\} \)
\( \Sigma = \{0,1\} \)
Practice

• Construct a NFA with six states
  \{w \mid w \text{ even } \# \text{ 0s OR exactly two 1s}\}
  \Sigma = \{0,1\}
Practice

• Construct a NFA with three states
  $0^*1^*0^*0$
  $\Sigma = \{0,1\}$