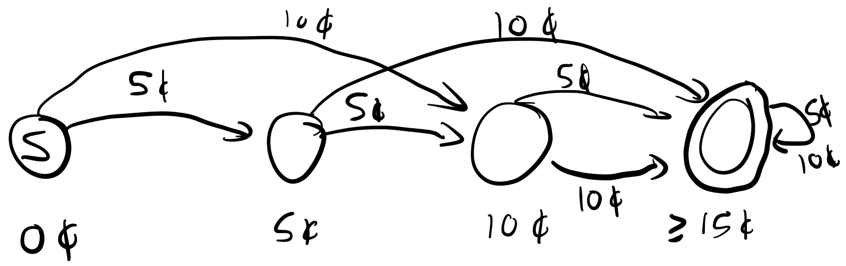
CSCE 301 - Lecture 22: Deterministic Finite Automata

Computability and complexity

with how much difficulty? can a computer solve a problem?

"Computer" model: finite automaton



"Problem" model: language acceptance

Languages and associated definitions

- An alphabet is a finite set whose members are called symbols.

  Examples: $\Sigma = \{0,1\}$, $\Sigma = \{a, b, c, \ldots, z\}$

- A string w over an alphabet Σ is a finite (ordered) sequence of symbols from Σ.

  $\Sigma = \{0,1\}$ $w = 110$, 0010 } strings over Σ

- The length of a string w, written $|w|$, is the number of symbols in w.

  $|1001| = 4$

- The empty string, written ε ($\Leftarrow \varepsilon$) is the string with no symbols. Its length is 0.

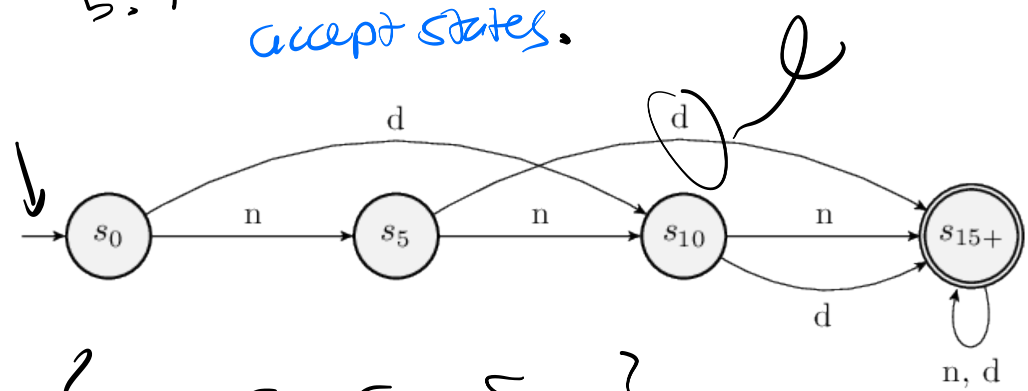
- A language over an alphabet Σ is a set of strings over Σ. $L = \{1, 0, 01, 10\}$ is a language over $\Sigma = \{0,1\}$.

- The set of all strings over Σ is written Σ^*.

  So L is a language over Σ if $L \subseteq \Sigma^*$

A finite automaton is a 5-tuple: $(Q, \Sigma, \delta, q, F)$

1. Q is a finite set whose elements are states
2. Σ is an alphabet, whose elements are symbols
3. δ is a function $\delta : Q \times \Sigma \to Q$, called the transition function
4. q is the start state
5. F is a subset of Q whose members are called accept states.



$Q = \{ S_0, S_5, S_{10}, S_{15+} \}$

$\Sigma = \{ d, n \}$

$q = S_0$

$F = \{ S_{15+} \}$

δ:

	n	d
S_0	S_5	S_{10}
S_5	S_{10}	S_{15+}
S_{10}	S_{15+}	S_{15+}
S_{15+}	S_{15+}	S_{15+}

$\delta(S_0, n) = S_5$

A FA is **deterministic** if δ is a function, i.e. δ always maps $q \in Q$, $s \in \Sigma$ to a single q'. Otherwise it's **nondeterministic**.