CS303T Theory of Computation

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Outline

- Recap
  - Introduction
  - Why to study Automata Theory
  - Course Overview
  - Introduction to Automata Theory
- Today
  - Language
  - Deterministic Finite Automata
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Language and Problem

- In automata theory, a PROBLEM is the question of deciding whether a given string is a member of some particular language
- Problem can be expressed as membership in a language
- If Σ is an alphabet and L is a language over Σ then the problem L is

  Given a string w in Σ^* decide whether or not w is in L
- Examples:
  - Problem 1: Is $x \in \{0, 1\}^*$ a member of the set S_1, where $S_1 = \{w|w$ is a binary string ending in $01\}$
  - Problem 2: Is $n \in \{0, 1\}^*$ a member of the set S_2, where $S_2 = \{w|w$ is a binary integer that is prime $\}$

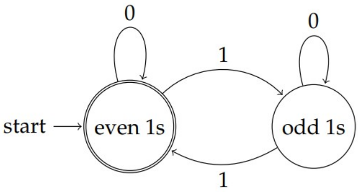
Language vs Problem

- It seems language and problem are really same! But,
- When we care only about the strings for their own sake - Here we tend to think of a language as set of strings
  - Ex: The set $\{0^n 1^n | n \geq 1\}$,
- In certain cases we tend to assign 'semantic' to the strings - Things represented by the strings (rather than strings itself)
  - Here we tend to think of a set of strings as a problem.
  - Ex: Strings - logical expressions, even (or odd) integers

Finite Automata

- Finite automaton has a set of states, and its control moves from state to state in response to external inputs.
  - **Deterministic** - automaton will be in a unique state at a particular time
  - **Non-Deterministic** - automaton could be in several states at a particular time

Example



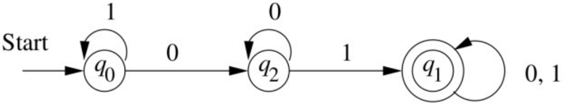
Deterministic Finite Automata (DFA)

DFA is a five tuple $(Q, \Sigma, \delta, q_0, F)$,

- A finite set of states, Q
- A finite set of input symbols, Σ
- A transition function (denoted δ) that takes as arguments a state and an input symbol and returns a state. i.e., $\delta : Q \times \Sigma \rightarrow Q$
- A start state $q_0 \in Q$
- A set of final or accepting states $F \subseteq Q$

DFA Representation

- Transition Diagram



- Transition Table

	0	1
$\rightarrow q_0$	q_2	q_0
$*q_1$	q_1	q_1
q_2	q_2	q_1

DFA Example

Design a DFA to accept the language $L = \{w|w$ has both an even number of 0's and an even number of 1's $\}$