CS310 Automata Theory – 2016-2017

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Lecture 1: Finite state automata
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Credit Structure

Course credit structure

quizzes	25%
mid-sem	30%
end-sem	40%

Office hours:	1 hour per week (Slot: TBA)
Problem solving session:	1 hour per week (Slot: TBA)

Important Announcements

Quiz 1: January 18, 2017, Wednesday, 8:30am to 9:30am

Quiz 2: February 08, 2017, Wednesday, 8:30am to 9:30am

Quiz 3: March 08, 2017, Wednesday, 8:30am to 9:30am

Quiz 4: April 05, 2017, Wednesday, 8:30am to 9:30am

Course Outline

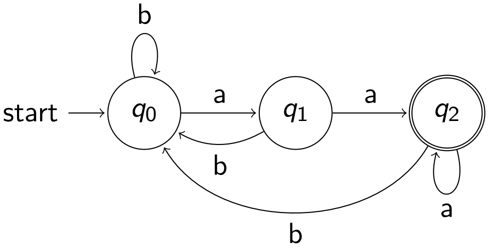
- Regular languages, DFA/NFA, related topics.
- Pushdown automata, context-free languages, other models of computation.
- Turing machines and computability.
- Effective computation, NP vs. P, one-way functions.

Finite state automata

Example

Input: Text file over the alphabet $\{a, b\}$

Check: does the file end with the string ‘aa’

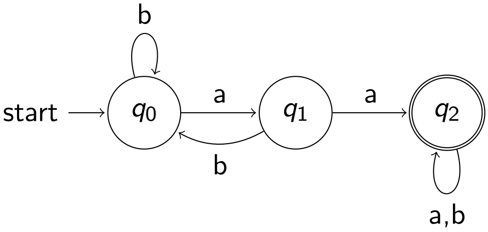


Finite state automata

Example

Input: Text file over the alphabet $\{a, b\}$

Check: does the file contain the string ‘aa’

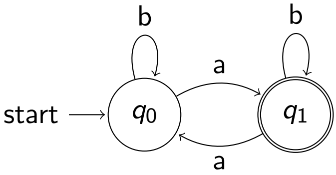


Finite state automata

Example

Input: $w \in \{a, b\}^*$

Check: does w have odd number of as? i.e. is $\#_a(w) \equiv 1 \ (mod 2)$?

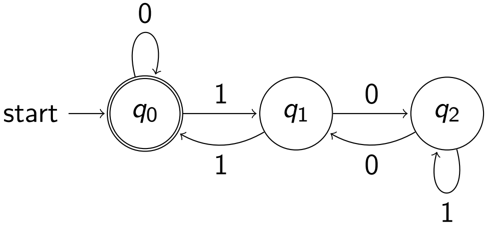


Finite state automata

Example

Input: $w \in \{0, 1\}^*$

Check: is the number represented by w in binary a multiple of 3?



Definition of finite state automata

Definition (DFA)

A deterministic finite state automaton (DFA) $A = (Q, \Sigma, q_0, F, \delta)$, where

- Q is a set of states,
- Σ is the input alphabet,
- q_0 is the initial state,
- $F \subseteq Q$ is the set of final states,
- δ is a set of transitions, i.e. $\delta \subseteq Q \times \Sigma \times Q$ such that $\forall q \in Q, \forall a \in \Sigma, |\delta(q, a)| \leq 1$.

Acceptance by DFA

Definition (Acceptance by DFA)

A deterministic finite state automaton (DFA) $A = (Q, \Sigma, \delta, q_0, q_f)$, is said to accept a word $w \in \Sigma^*$, where $w = w_1 w_2 \ldots w_n$ if

there exists a sequence of states $p_0, p_1, \ldots p_n$ s.t.

$p_0 = q_0$,

$p_n \in F$,

$\delta(p_i, w_{i+1}) = p_{i+1}$ for all $0 \leq i \leq n$.

δ is a set of transitions, i.e. $\delta \subseteq Q \times \Sigma \times Q$ such that $\forall q \in Q, \forall a \in \Sigma, |\delta(q, a)| \leq 1$.