1 Four basic ideas

Four basic ideas that will be important

(1) Diagonalization
(2) Nondeterminism
(3) Reduction of one problem to another
(4) Interweaving

2 Notation

• $\epsilon$, $\{\epsilon\}$, $\emptyset$
• $L_1 \cdot L_2 = \{xy \mid x \in L_1, y \in L_2\}$
• $L^* = \{\epsilon\} \cup L \cup L^2 \cup \cdots$
• $2^S$ is the set of all subsets of $S$
• $\{0^n1^n1 \mid n \geq 1\}$ and $\{0^n1^n1 \mid n \geq 1\}^*$

3 Concepts

• object and name of object
• finite but arbitrarily large
• contably infinite
• noncountably infinite
• diagonalization

• \{0 + 1\}^*, the set of all finite length strings of 0’s and 1’s is countably infinite

• \(2^{\{0+1\}^*}\), the set of all subsets of finite length string is not countably infinite

• induction

• (deterministic) finite automaton (FA or fa or DFA or dfa)

• nondeterministic finite automaton (NFA or nfa)

• \(\epsilon\)-nfa (nondeterministic finite automaton with \(\epsilon\) transitions)

• \(\epsilon\)-closure

4 Finite automaton

• construct finite automata from simple set description

• convert NFA to deterministic finite automaton

• subset construction

• cross product construction

5 Regular expressions

• definitions

• write regular expression corresponding to simple set description

• convert finite automaton to regular expression (deleting states)

• convert finite automaton to regular expression \((R_{k}^{i,j})\)

• convert regular expression to finite automaton
6 Closure properties of regular sets

- union \((L_1 \cup L_2)\)
- intersection \((L_1 \cap L_2)\)
- complement \((L^c \text{ or } \bar{L})\)
- closure \((L^*)\)
- set difference \((L_1 \setminus L_2)\)
- homomorphism \(h\)
- inverse homomorphism \(h^{-1}\)
- reversal \((L^R)\)

**Wednesday, September 12, 2007**

- definition of homomorphism
- proof that the class of regular sets is closed under homomorphism

**Friday, September 14, 2007**

- machine construction for closure of regular sets under homomorphisms
- inverse homomorphisms

**Monday September 17, 2007**

Proof that the class of regular sets is closed under shuffle using \(h, h^{-1}\) and intersection with regular sets

**Wednesday September 19, 2007**

Valid computation for dfa

A short summary: We reviewed inverse homomorphisms and the concept of a valid computation for a finite automaton. A valid computation has the state of the finite automaton inserted with the input symbol. This can be done by an inverse homomorphism and intersection with a regular set.