CSCI 341 Problem Set 2

Language Acceptance; Finite and Infinite Automata; Finitely Recognizable Languages

Due Friday, September 12

Language Acceptance

Problem 1 (Let 'em Cook)**.** For each of the following languages $L_i \subseteq A^*$ below, design an automaton $\mathcal{A}_i = (Q_i, A, \delta_i, F_i)$ with a state $x \in Q_i$ such that x accepts L_i, and briefly explain why your automaton accepts L_i. Note that $A = \{a, b\}$ in all of the cases below.

(1) $L_1 = \{a, aa, aaa\}$

(2) $L_2 = \{w \in A^* \mid w \text{ ends with } b\}$

(3) $L_3 = \{w \in A^* \mid w \text{ has an even number of } a\text{'s}\}$

(4) $L_4 = \{w \in A^* \mid w \text{ has } 3k+1 \text{ many } a\text{'s for some } k \geqslant 0\}$

(5) $L_5 = \{w \in A^* \mid w \text{ either has } 3k+1 \text{ or } 3k+2 \text{ many } a\text{'s for some } k \geqslant 0\}$

For each of these languages, if you drew a nondeterministic or partial automaton, also draw a total deterministic one (include both in your write-up).

Problem 2 (Pythonic Automaton III)**.** Write a Python script in the same format as the Pythonic Automaton I that implements state s_1 in abstract state diagram (A) from the games and puzzles section. Submit your program as a .py file.

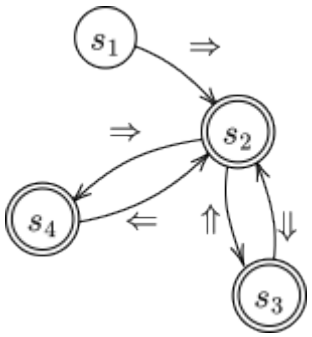

Figure 1: Abstract state diagram (A).

Finite and Infinite Automata

Problem 3 (Unravelling a Language)**.** Draw a state diagram of all of the languages that are reachable from the language $L = \{\varepsilon, aa, ba, cab, c, acab\}$ in the Brzozowski automaton (by taking derivatives). Include all of the double-circles to indicate which languages are accepting states of the Brzozowski automaton. What language is accepted by L?

Problem 4 (Language Accepts Itself)**.** Let $L \subseteq A^*$ be any language. Prove that $\mathcal{L}(\mathcal{A}_{Brz}, L) \subseteq L$.

Finitely Recognizable Languages

Problem 5 (Total vs Partial)**.** Prove that $\mathsf{DFin} = \mathsf{TDFin}$ by describing how to turn a deterministic automaton into a total deterministic automaton without changing the languages accepted by the states.