Assignment 2

CSCE 4323: Formal Languages and Computability
Fall 2018

Exercises from the book

The following exercises can be found in Chapter 1 of the Sipser book, 2nd edition. Solutions for 1.7, 1.13, and 1.17 should be provided as code for each in a text document following the format for a DFA or an NFA (as required) on the web site `http://web.cs.ucdavis.edu/~doty/automata/`. A template file "CSCE4323-F18-HW-template.txt" can be found on the course site on Blackboard. The answer for 1.15 should instead consist of a description of the NFA N_1 and why the construction of N yields an NFA which fails to recognize the star of N_1's language.

1.7 Give the definitions of NFAs with the specified number of states recognizing each of the following languages. In all parts, the alphabet is $\{0, 1\}$.

   b. The language $\{w | w$ contains the substring 0101, i.e. $w = x0101y$ for some x and y $\}$ with 5 states

   c. The language $\{w | w$ contains an even number of 0s or contains exactly two 1s $\}$ with 6 states

   d. The language $\{0\}$ with 2 states

   e. The language $0^*1^*0^*$ with 3 states

1.13 Let F be the language of all strings over $\{0, 1\}$ that do not contain a pair of 1s that are separated by an odd number of symbols. Give the definition of a DFA with 5 states that recognizes F. (You may find it helpful first to find a 4-state NFA for the complement of F.)

1.15 Give a counterexample to show that the following construction fails to prove Thoerem 1.49, the closure of the class of regular languages under the star operation.[1] Let $N_1 = (Q_1, \Sigma, \delta_1, q_1, F_1)$ recognize A_1. Construct $N = (Q_1, \Sigma, \delta, q_1, F)$ as follows. N is supposed to recognize A_1^*:

   a. The states of N are the states of N_1.

   b. The start state of N is the same as the start state of N_1.

   c. $F = \{q_1\} \cup F_1$. The accept states of F are the old accept states plus its start state.

   d. Define δ so that for any $q \in Q$ and any $a \in \Sigma_\epsilon$,

$$\delta(q, a) = \begin{cases} \delta_1(q, a) & \text{q} \notin F_1 \text{ or } a \neq \epsilon \\ \delta_1(q, a) \cup \{q_1\} & q \in F_1 \text{ and } a = \epsilon \end{cases}$$

1.17 a. Give an NFA recognizing the language $(01 \cup 001 \cup 010)^*$.

   b. Convert this NFA to an equivalent DFA. Give only the portion of the DFA that is reachable from the start state.

[1] In other words, you must present a finite automaton, N_1, for which the constructed automaton N does not recognize the star of N_1's language.