CS46 practice problems 3

These practice problems are an opportunity for discussion and trying many different solutions. They are not counted towards your grade, and you do not have to submit your solutions. The purpose of these problems is to get more comfortable with NFAs and regular expressions. I recommend trying to solve these problems on paper first, then trying with the online tool. Once you are ready to test your solutions, the Automata Tutor site will give you troubleshooting feedback.

Note that Automata Tutor uses slightly different notation for regular expressions.

1. (Sipser 1.7a) Construct an NFA with three states that recognizes the language

\[ \{w | w \text{ ends with } 00\} \]

over \( \Sigma = \{0, 1\} \). You will need to use nondeterminism!

2. (Sipser 1.7f) Construct an NFA with three states that recognizes the language \( 1^* (001^+)^* \) over \( \Sigma = \{0, 1\} \). You will need to use nondeterminism!

3. Let \( L = \{w | w \text{ begins with } 1 \text{ and ends with } 0\}\) over \( \Sigma = \{0, 1\} \).
   - Construct a DFA that recognizes \( L \).
   - Construct an NFA that recognizes \( L \). (This NFA should have fewer states than your DFA for the same language.)

4. Construct a regular expression for the language \( \{w | w \text{ contains the substring } ab\} \) over \( \Sigma = \{a, b\} \).

5. Construct a regular expression for the language \( \{aa, abba\} \) over \( \Sigma = \{a, b\} \).

6. Construct a regular expression for the language \( \{w | w \text{ contains exactly two } a\} \) over \( \Sigma = \{a, b\} \).

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1If you are stumped or looking for guidance, many of these problems are in the selected solutions at the end of chapter 1.