INSTRUCTIONS

Homework solutions should be neatly written or typed and submitted through Gradescope. No work can be accepted outside of this system, and no late work will be accepted. Please ensure that your submission is legible (neatly written and not too faint) or your homework may not be graded. You may update your submission as many times as you’d like up to the deadline. Only the most recent submission will be graded.

Thirty problems from homework assignments will be graded randomly throughout the quarter. You will not know in advance which problems, if any, will be graded on each assignment.

You may consult your textbook, class notes, lecture slides, instructors, TAs, and tutors for help with homework. You may also discuss homework questions with classmates, but you may not share written work with classmates. You must write up your solutions alone, in your own words. The assignments have been developed to facilitate your learning and to provide a method for fairly evaluating your knowledge and abilities, not the knowledge and abilities of others. To facilitate learning, you are authorized to discuss assignments with others; however, to ensure fair evaluations, you are not authorized to view or share written work with another person, or to write your submission in collaboration with another person. You should not look for answers to homework problems in other texts or sources, including the internet.

Do not post about homework questions on Piazza. For help with homework, please consult the course textbook, lecture slides, class notes, and podcasts, or come visit us in office hours.

READING: Sipser 1.2
1. Consider the following NFA.

(a) Which of the following strings are accepted by this NFA?
   (i) 0100101
   (ii) 0101001
   (iii) 0101100
   (iv) 0101000

(b) Use the subset construction to produce a DFA that recognizes the same language as this NFA, over the alphabet \( \Sigma = \{0, 1\} \). Draw your machine in JFLAP and submit a screenshot.

2. Show by giving an example that, if \( M \) is an NFA that recognizes language \( L(M) \), swapping the accept and nonaccept states in \( M \) doesn’t necessarily yield a new NFA that recognizes the complement of \( L(M) \). Is the class of languages recognized by NFAs closed under complementation? Explain your answer.

3. For any string \( w = w_1w_2 \ldots w_n \) over an alphabet \( \Sigma \), the reverse of \( w \), denoted \( w^R \), is the string with symbols in the reverse order, \( w_n \ldots w_2w_1 \). Show that the class of regular languages over an alphabet \( \Sigma \) is closed under the operation \( \text{Reverse}(L) \), defined as

\[
\text{Reverse}(L) = \{ w \mid w^R \in L \}.
\]

To get you started:

If \( L \) is a regular language, there is some DFA \( M \) such that \( L(M) = L \). Describe in words how to define an NFA \( M' \) such that \( L(M') \) is the set of strings formed by reversing all strings in \( L \). You do not need to include the formal definition of your NFA, but you should address all five components of the definition of an NFA in your description. That is, be sure to say what states you will include, your alphabet (which is arbitrary \( \Sigma \)), how to transition between states, which state is your start state, and which state(s) are your accept states.