

COMS 3261, Computer Science Theory (Fall 2023): Assignment 1  
Due on Gradescope 11:59pm, Monday October 2, 2023

Instructions

- All problems 6 are worth 10 points.
- Submit your solutions in pdf format. Late homeworks will **not** be accepted.
- You can discuss with TAs, the prof, and other students, but please acknowledge them at the beginning of each problem. All of your solutions must be written in your own words.

Problems

1. Give deterministic finite automata accepting the following language. You may describe your DFA with a diagram or a formal description. If you give a diagram be sure to include all transitions, specify the start state, as well as all final states. Try to use the smallest number of states.

$$\mathcal{L} = \{w \in \{0, 1\}^* \mid w \text{ does not contain the substring } 110\}$$

2. Give an NFA accepting the following language. As in the previous question, you can describe your NFA with a diagram or a formal description. Try to use the smallest number of states.

$$\mathcal{L} = \{w \in \{0, 1\}^* \mid \text{every 4 consecutive symbols contains at least 2 } 0's\}$$

3. If  $A$  is any language, let  $Half(A)$  be the set of all first halves of strings in  $A$ . So  $x$  is in  $Half(A)$  if there is some string  $y$  of the same length as  $x$  such that the string  $xy$  is in  $A$ . Prove that if  $A$  is regular, then  $Half(A)$  is also regular.
4. Prove that the following language is not regular using the Pumping Lemma. (Wait for Lectures 5 and 6.)

$$\mathcal{L} = \{w \in \{0, 1\}^* \mid |w| \text{ is odd and the middle bit of } w \text{ is a } 1\}$$

5. For a string  $w$ , let  $w^R$  denote the string  $w$  in reverse order. Is the following language regular? Prove or disprove your answer. (Wait for Lectures 5 and 6.)

$$\mathcal{L} = \{w \in \{0, 1\}^* \mid w \neq w^R\}$$

6. Given the following NFA  $N$ , using the procedure described in class (and in the handout), construct the regular expression accepted by  $N$ . You may show some intermediate steps for partial credit but please keep the total number of steps to at most 4. (Wait for Lecture 5.)

