CS 321: Homework #2

Due: Friday Oct 7 at 6pm, on Canvas

Homeworks should be typed.

Words of wisdom: If you are asked to show that a language is regular, there are several ways to do so. Always pick the easiest way for the problem you’re given. If you are specifically asked to show a DFA or NFA, you can either give its transition table (don’t forget to indicate start state and accept states) or draw a state-transition diagram. Do whichever is easier for the problem.

1. Give an NFA for the following language.
   \[ \{ w \in \{a, b\}^* \mid \text{the last character of } w \text{ appears (at least) 3 times in } w \} \]

2. Give a DFA that is equivalent to the following NFA. Remove all unreachable states.

3. Below are two DFAs, \( M_1 \) and \( M_2 \). Give a DFA that accepts all strings that are in either \( L(M_1) \) or \( L(M_2) \), but not both.

4. Show that the following language is regular:
   \[ \{ w \in \{0, 1\}^* \mid \text{there is a way to insert the substring 011 (once) into } w \text{ so that the result is a multiple of 3 in binary} \} \]

Example: The string \( w = 1011 \) should be accepted since \( 1010111_{\text{bin}} = 87_{\text{dec}} \), a multiple of 3. The string \( w = 1000 \) should not be accepted since none of the following are multiples of 3:

\[ \{0111000, 1011000, 1001100, 1000110, 1000011\} \]