Assignment 3

Due February 26, 4:35 p.m..

Problem 1

Convert the following NFA-ε to a DFA using the subset construction with ε-closure.

Problem 2

Use the state elimination method to convert the following finite automaton to a regular expression. Please eliminate the states in this order: q₃, q₁, q₂, q₀.

Problem 3

Use the Pumping Lemma to show that the following languages are not regular.

a. \( L = \{ a^i b^j a^k \mid 0 < i, 0 < j < k \} \)

b. \( L = \{ w \in \{a, b\}^* \mid \text{no prefix of } w \text{ has more bs than as} \} \)
   
   Note: Every string is a prefix of itself.
Problem 4

Indicate whether each of the following languages is regular or not, and (succinctly) prove your answer. To prove a language is regular, you can use closure properties, give a regular expression for the language, or construct a DFA that accepts it. To prove a language is non-regular, you can use the Pumping Lemma and/or closure properties.

a. \( L = \{ uv \mid u \in L_1, v \in L_1^R \} \), where \( L_1 \) is a regular language.

b. \( L = \{ uww^Rv \mid u, v, w \in \{a, b\}^+ \} \)

c. \( L = \{ a^n \mid n \text{ is even} \} \)

Problem 5

Indicate whether each statement below is true or false and justify your answer, e.g., by giving a counterexample.

a. If \( L_1, L_2, L_3, \ldots \) are all regular, then the language \( \bigcup_{i=1}^{\infty} L_i \) is also regular.

b. If \( L_1 \) is regular and \( L_2 \) is not regular, then \( L_1 \cup L_2 \) is not regular.