Problem 1: Converting NFAs to equivalent DFAs

Convert these NFAs to DFAs; first construct the transition table, then show the corresponding transition diagram.

HINT: check if your answer is correct by trying out some strings that should or should not be accepted.

a)

b)
Problem 2: Closure rule for FLIP operation

Let RV(L) represent the reversal of language L, defined as:

\[ RV(L) = \{ w^R \mid w \in L \text{ and the reversal of } w \text{ is } w^R \} \]

For example, \( RV(\{"ac", "bcc"\}) \) is \( \{"ca", "cbb"\} \)

Note that the following 3 facts are true for any languages \( L_1 \) and \( L_2 \):

1. \( RV(L_1^*) = (RV(L_1))^* \)
2. \( RV(L_1 \cup L_2) = RV(L_1) \cup RV(L_2) \)
3. \( RV(L_1 \circ L_2) = RV(L_2) \circ RV(L_1) \)

Using these facts and definitions, give a recursive (inductive) proof of the following claim:

**if any language L is regular, so is RV(L)**

*Hint:* start with the fact that if \( L \) is regular, then by the RL Theorem, there must be some regular expression that specifies it.

Problem 3: Using Pumping Lemma

Prove that these languages are not regular, by using the Pumping Lemma

a. \( \{ 0^n 1^{2n} : n > 1 \} \)

b. \( \{ wzw^R : w \text{ is some string over } \{a..y\}, \text{ and } w^R \text{ is the reversal of } w \} \)

Problem 4: Using Closure Rules

Prove that these languages are not regular, by using the Closure Rules for Regular Languages

a. \( \{ w \mid w \text{ is a string over } \{0,1\} \text{ which has twice as many } 1's \text{ as } 0's \} \)

*Hint:* use what you proved in Problem 4a

b. \( \{ w \mid w \text{ is a string over } \{a..z\} \text{ which is NOT a palindrome} \} \)

*Hint:* use the fact that RLs are closed under complement.