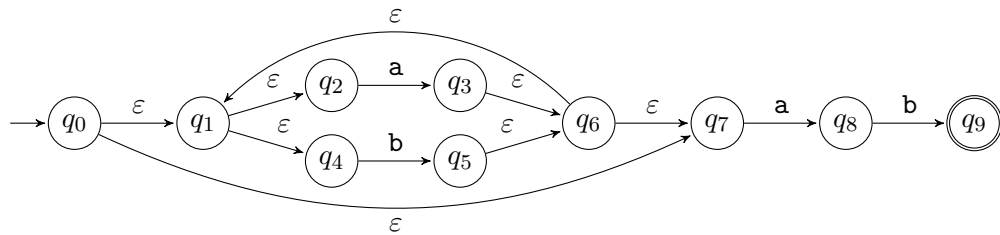


Week 3 Tutorial Session

1. (a) Write down a regular expression for the following NFA. For this problem, you do not have to go through the procedure described in class.
- (b) Convert the following NFA into a DFA.



2. (a) Write down the definition of regular expressions over an alphabet Σ .
 - (b) Given a string w , define w^R as the string w in reverse order. That is, if $w = w_1w_2 \dots w_n$, then $w^R = w_nw_{n-1} \dots w_1$. For example, if $w = \text{live}$, then $w^R = \text{evil}$. Given a language L , define its reversal L^R as the set of strings in L in reverse. More precisely, $L^R = \{w^R \mid w \in L\}$. For example, if $L = \{\text{live}, \text{raw}, \text{level}\}$, then $L^R = \{\text{evil}, \text{war}, \text{level}\}$.
If L is a regular language, prove that L^R is also regular.
3. Let L be any language. We say that two strings x and y are *indistinguishable by L* if for every string z , we have $xz \in L$ if and only if $yz \in L$.
 - (a) For concreteness, consider $L_1 = \{x \in \{0, 1\}^* \mid \text{the number of 1's in } x \text{ is divisible by 3}\}$. Prove that **1** and **1111** are indistinguishable by L_1 .
 - (b) Continuing with (a), which strings are indistinguishable from the string **1** by L_1 ? The set of all such strings is the *equivalence class* of the string **1** and will be denoted by **[1]**.
 - (c) Find a string s not in **[1]**. What is the equivalence class of s ? (We will denote this equivalence class by **[s]**)
 - (d) Can you find another string t not in **[1]** or **[s]**? What is the equivalence class of t ?
 - (e) Can you find yet another string u not in these equivalence classes?
 - (f) Design a DFA for the language L_1 . How are states in your DFA related to the equivalence classes?