CPSC 351 — Tutorial Exercise #3
Nondeterministic Finite Automata

About This Exercise

The goal of this exercise is to help you to understand nondeterministic finite automata and how they process strings, and to understand how a given nondeterministic finite automaton can be used to produce a deterministic finite automaton with the same language.

The questions in this exercise concern a nondeterministic automaton $M = (Q, \Sigma, \delta, q_0, F)$, with alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}\}$, that is as shown as shown in Figure 1, on page 2.

Getting Started

These initial problems will probably not be discussed during the tutorial. Please discuss them during office hours with the instructor, if you can, if you have trouble solving them.

1. Consider the nondeterministic finite automaton $M = (Q, \Sigma, \delta, q_0, F)$ that is as shown in Figure 1 on page 2.
   (a) List the set, Q, of ***states***.
   (b) Which state in this nondeterministic finite automaton is the ***start state***?
   (c) List the set F of ***accept states*** in M.
   (d) Draw a table for the ***transition function*** δ of M.
2. Give the λ-closure, $\mathit{Cl}_\lambda(q)$, for every state $q \in Q$.
3. Compute the set of states, $\delta^\star(q_0, \mathtt{ab})$, that are reachable from the start state when processing the string $\mathtt{ab}$.

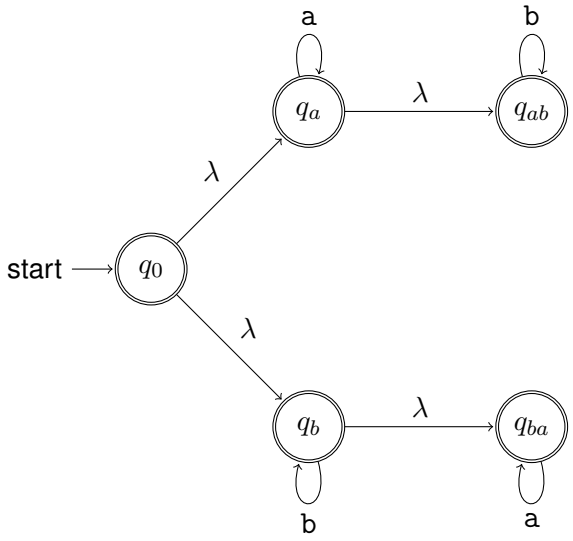

Figure 1: A Nondeterministic Finite Automaton

Problems To Be Solved

As time permits, the following problems will be discussed during the tutorial. Once again, they concern the nondeterministic finite automaton M that is shown in Figure 1.

4. Describe, as precisely as you can, each of the following sets of strings — and say, briefly, how you might ***prove*** that your answers are correct.

   (a) The set of strings $\omega \in \Sigma^\star$ such that $q_0 \in \delta^\star(q_0, \omega)$.
   (b) The set of strings $\omega \in \Sigma^\star$ such that $q_a \in \delta^\star(q_0, \omega)$.
   (c) The set of strings $\omega \in \Sigma^\star$ such that $q_b \in \delta^\star(q_0, \omega)$.
   (d) The set of strings $\omega \in \Sigma^\star$ such that $q_{ab} \in \delta^\star(q_0, \omega)$.
   (e) The set of strings $\omega \in \Sigma^\star$ such that $q_{ba} \in \delta^\star(q_0, \omega)$.

5. Which strings are ***accepted*** by M? Why? Which strings are ***rejected*** by M? Why?

6. What is the language $L(M)$ of M?

7. Design a deterministic finite automaton for the language $L(M)$ of the nondeterministic finite automaton shown in Figure 1 — and (if possible) confirm that your answer is correct.