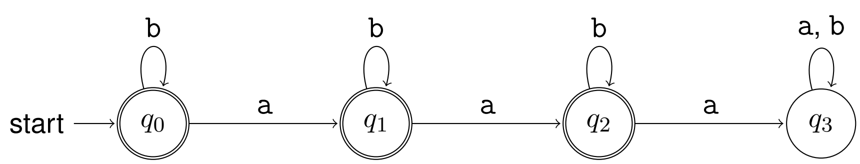
CPSC 351 — Tutorial Exercise #1
Introduction to Deterministic Finite Automata

About This Exercise

The goal of this exercise is to help you to understand how deterministic finite automata can be described, how they are used to process strings of symbols, and how the languages of deterministic finite automata are defined.

If you have time: Please try to solve the problems in this exercise ***before*** attending the tutorial where it will be discussed.

The exercise concerns a deterministic finite automaton M that has alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}\}$ and that can be represented as follows.



Getting Started

The first four problems should be straightforward, if you understood the introduction to deterministic finite automata given in the lecture material for this topic. Discussion of these will probably be limited, in the tutorial, so that there is time to discuss the (somewhat) more challenging exercises that follow them.

1. Give the set Q of ***states*** in M and identify the ***start state***.

2. Give the set F of ***accepting states*** in M.

3. Describe the ***transition function*** $\delta : Q \times \Sigma \rightarrow Q$ by completing the following ***transition table***.

	a	b
q_0		
q_1		
q_2		
q_3		

4. Trace the execution of M on each of the following input strings — listing the sequence of states that are visited as symbols in the string are seen and processed, and stating whether the string is in the language of M.

   (a) λ
   (b) `a`
   (c) `b`
   (d) `ab`
   (e) `ba`
   (f) `abbab`
   (g) `aabbab`
   (h) `aaaabbb`

5. Compute $\delta^{\star}(q_0, \omega)$ for each of the strings, $\omega \in \Sigma^{\star}$, that are listed in Question #4 — but this time, compute this definition using the (recursive) definition of the extended transition function.

Problems Discussed in the Tutorial

6. Give a ***brief*** description, in simple English, for each of the following subsets of $\Sigma^{\star}$.

   (a) $\{\omega \in \Sigma^{\star} \mid \delta^{\star}(q_0, \omega) = q_0\}$
   (b) $\{\omega \in \Sigma^{\star} \mid \delta^{\star}(q_0, \omega) = q_1\}$
   (c) $\{\omega \in \Sigma^{\star} \mid \delta^{\star}(q_0, \omega) = q_2\}$
   (d) $\{\omega \in \Sigma^{\star} \mid \delta^{\star}(q_0, \omega) = q_3\}$

7. State, and prove, a ***claim*** (whose structure is similar to that of the claim that was stated, and proved, in the lecture presentation for this topic), establishing that your answer for the previous question is correct.