Lecture #5: Introduction to Nondeterministic Finite Automaton

Assumptions

- Preliminary material for this lecture has been reviewed.

Questions for Review

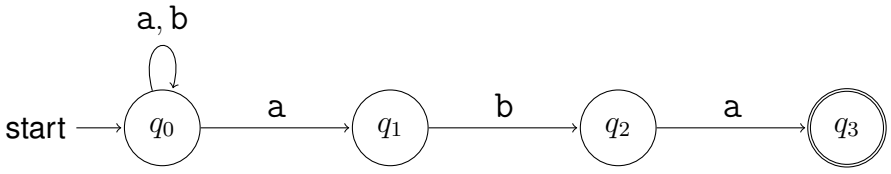
1. Give the formal definition of a ***nondeterministic finite automaton*** — describing everything that this includes.
2. Describe how ***deterministic finite automata*** and ***nondeterministic finite automata*** are different.
3. Describe a way to decide whether a given nondeterministic finite automaton ***accepts*** a given string.
4. What is the λ***-closure*** of a state? Why is this useful?

Objective

Let $\Sigma = \{\mathtt{a}, \mathtt{b}\}$ and let $L \subseteq \Sigma^\star$ be the following language:

$$L = \{w \in \Sigma^\star \mid \omega \text{ ends with } \mathtt{abb}\}.$$

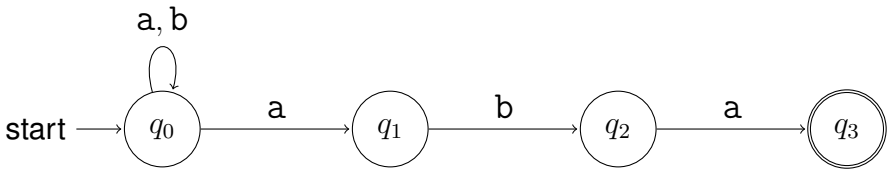
Consider the following ***nondeterministic*** finite automaton $M = (Q, \Sigma, \delta, q_0, F)$ with the above alphabet Σ and the following transition diagram.



The goal for this presentation will be to use the above language and NFA to learn about nondeterministic finite automata, and to understand how it can proved that a nondeterministic finite automaton, like the above one, has a given language.

Transition Function

Consider, again, the alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}\}$ and the nondeterministic finite automaton with the following transition diagram.

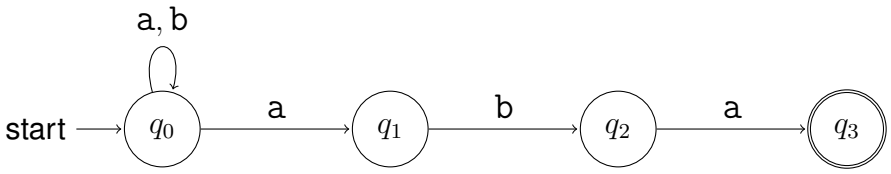


The ***type*** of the transition function, δ, is as follows:

A ***transition table*** for this transition function is as follows:

Computation on a String

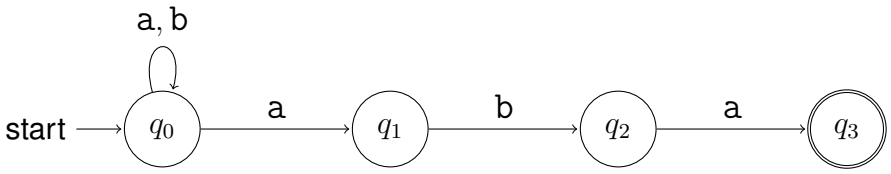
Recall, again, that $\Sigma = \{\mathtt{a}, \mathtt{b}\}$ and that the nondeterministic finite automaton with alphabet Σ, being considered, is as follows.



Consider the execution of this nondeterministic finite automaton on the string ababa.

Proof That This NFA Has a Given Language

Once again, recall that $\Sigma = \{\mathtt{a}, \mathtt{b}\}$ and that the nondeterministic finite automaton with alphabet Σ, being considered, is as follows.



Strings Whose Processing Can End in State q_0

Strings Whose Processing Can End in State q_1

Strings Whose Processing Can End in State q_2

Strings Whose Processing Can End in State q_3

Conclusion

Breakout Session

If you do not wish to discuss the course material, please consider the following question.

Who was the best (or your favourite) captain on a version of"classic" *Star Trek*?[1]

(a) Jonathan Archer

(b) Robert April

(c) Christopher Pike

(d) James T. Kirk

(e) Jean Luc Picard

(f) Benjamin Sisko

(g) Kathryn Janeway

[1] Students are, of course, welcome to discuss the new shows too. And, yes: Christopher Pike was in the original pilot episode... and Robert April was in that early cartoon.