

Lecture #2: Introduction to Deterministic Finite Automata

Assumptions

- Preliminary material for this lecture has been reviewed.
- You can refer to the supplemental document during this presentation.

Questions for Review

You should be able to answer the following questions.

Fundamental Concepts

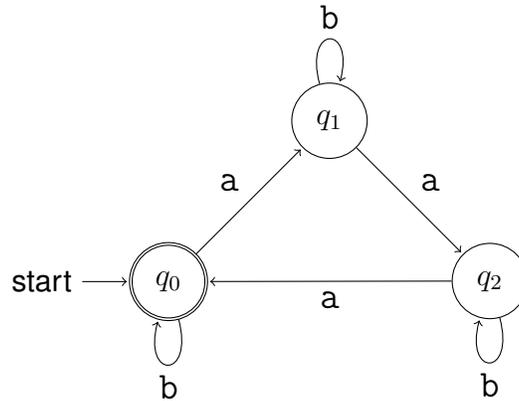
1. What is an *alphabet*?
2. What is a *string* over an alphabet Σ ?
3. What is the *length* of a string ω over an alphabet Σ , and how is it represented?
4. Which string is represented using the symbol λ (or using ε in some references)?
5. What is a *language* over an alphabet Σ ?
6. Which language (over an alphabet Σ) is represented by \emptyset ?
7. Which language (over an alphabet Σ) is represented by Σ^* ?

8. Describe a good way to describe a finite language over some alphabet Σ .
9. Describe a good way to describe an infinite language over some alphabet Σ .
10. Describe a *bad* way to describe an infinite language over an alphabet Σ , which you should avoid. Why is it a bad way to describe a language?
11. What is a ***decision problem***?
12. Why are ***alphabets***, ***strings*** and ***languages*** important? What “real world” things do they represent that make them worth attention?

Deterministic Finite Automata

13. Give the formal definition of a ***deterministic finite automaton*** — describing everything that this includes.
14. What is a ***transition table***? How is it related to a “transition function”?
15. What is the ***extended transition function***? Please give two *equivalent* definitions for this. What is this used for?
16. What does it mean for a deterministic finite automaton to ***accept*** a string? What does it mean for a deterministic finite automaton to ***reject*** a string?
17. What is the ***language*** of a deterministic finite automaton?

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



Interpretation of a Deterministic Finite Automaton

1. Give the set Q of **states** of this deterministic finite automaton.
2. Name the **initial state** of this deterministic finite automaton.
3. Give the set F of **accepting states** of this deterministic finite automaton.

4. Describe the **transition function** $\delta : Q \times \Sigma \rightarrow Q$ for this deterministic finite automaton by completing the following table.

	a	b
q_0		
q_1		
q_2		

5. 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) aaaabbbb

6. Give a **brief** description, in simple English, for each of the following subsets of Σ^* .

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

7. Use your answer for the previous question to give a **brief** description, in simple English, of the language of (this particular DFA) M .

Breakout Session

The instructor can occasionally be heard to utter the expression

Danger, Will Robinson!!!

because something unexpected or unfortunate had happened. This was a phrase (along with “This Does not Compute!”) that was often exclaimed by *Robot B-9*, on the (first) TV show, *Lost in Space*.

Lost in Space has recently been remade, with higher production values and (most likely) a more serious tone.¹

If you do not wish to discuss the course material during the breakout session at the end of the Zoom meeting, please consider the following: Which of the following productions from the 1950's and 1960's, which also featured one or more robots, should also now be remade?

- (a) The Robot vs. the Aztec Mummy
- (b) Devil Girl from Mars
- (c) The Mysterians
- (d) The Earth Dies Screaming
- (e) Dr. Goldfoot and the Bikini Machine
- (f) Santa Claus Conquers the Martians²

¹It was also remade as a movie in 1998, but that is probably best not considered here.

²OK, OK, OK. *Santa Claus Conquers the Martians* apparently included a robot named Torg. I do not know whether this was actually a “feature” role.