Lecture #8: Regular Expressions

Assumptions

- Preliminary material for this lecture has been reviewed.

Objective

Become more familiar with ***regular expressions***.

Questions for Review

1. What is a ***regular expression*** over an alphabet Σ? (Your answer should include the "formal definition of a regular expression over Σ" included in the lecture slides).
2. How is are ***regular expressions*** in Σ related to ***regular languages*** that are subsets of $\Sigma^\star$?
3. Are regular expressions related to the ***regular operations*** discussed in the previous lecture? If so, then how?
4. State the formal definition of the ***language*** of a regular expression over Σ.
5. Describe some ***simplifications*** and ***shortcuts*** that were discussed in class and that may use if you are asked to give a regular expression for a language.
6. What are ***precedence rules***? Why is it important to know about these if you are are producing — or trying to use — a regular expression that uses simplifications and shortcuts like the ones mentioned above?
7. Briefly describe how (or why) it is reasonably easy to prove that the language of every regular expression over Σ is a regular language $L \subseteq \Sigma^\star$ — at least, it is reasonably easy to do this if you have been keeping up the material in this course!

Consider the following regular expression over the alphabet $\Sigma = \{\mathsf{a}, \mathsf{b}, \mathsf{c}\}$:

$$\Sigma^\star \circ \mathsf{a} \circ \Sigma^\star \circ \mathsf{a} \circ \Sigma^\star$$

(a) Give an example of a string in $\Sigma^\star$ that is in the language of this regular expression.

(b) Give an example of a string in $\Sigma^\star$ that is *not* in the language of this regular expression.

(c) Describe, in simple English, the ***language*** of this regular expression.

Once again, consider the alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$. Give a regular expression over this alphabet whose language is the set of strings in $\Sigma^\star$ that include an even number of $\mathtt{a}$'s, and explain briefly why your answer is correct.

Regular Expression:

Why This Has the Desired Language:

Once again, consider the following regular expression over the alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$:

$$\Sigma^\star \circ \mathtt{a} \circ \Sigma^\star \circ \mathtt{a} \circ \Sigma^\star$$

Give a nondeterministic finite automaton — with the same alphabet Σ — with the same language as this regular expression — and explain why your answer is correct.

How Would You Solve This Problem?

Generating an NFA with the Same Language:

Explanation Why Your Language is Correct:

Breakout Session

If you are in a tough spot — perhaps because of ***A Series of Unfortunate Events*** — which of the Baudelaire orphans would you like to have nearby, for comfort and support?

- Violet Baudelaire
- Klaus Baudelaire
- Sunny Baudelaire