Lecture #8: More About Regular Expressions

What To Do Before the Lecture

1. Complete the preparatory viewing or reading for Lecture #8 — nothing that each video will probably be understandable if you play it at double speed.

2. ***Print*** and read through the rest of this document and — if you have time — try to solve the problems! These should help you to check that you understand the regular operations, as well as the definitions of a regular language and the language of a regular expression. They should also help you to solve problems involving regular expressions — including constructing a parse tree for a given regular expression, and using a parse tree to solve some of the problems, introduced in the previous lecture, more efficiently and reliably.

   The supplemental material also includes material that is for interest only. This includes additional information about algorithms that can be used to solve problems concerning regular expressions, and how regular expressions are used in software.

Problems To Be Solved

Let $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$ —- so that this language does not include any of the symbols

$$\lambda, \emptyset, \Sigma, (,), \cup, \circ, ^\star$$

and let

$$\Sigma_{\text{regexp}} = \Sigma \cup \{\lambda, \emptyset, \text{“}\Sigma\text{”}, (,), \cup, \circ, ^\star\} = \{\mathtt{a}, \mathtt{b}, \mathtt{c}, \lambda, \emptyset, \text{“}\Sigma\text{”}, (,), \cup, \circ, ^\star\}.$$

Consider the string

$$\omega = ((((\Sigma)^\star \circ \mathtt{a}) \circ (\Sigma)^\star) \circ (\mathtt{a} \circ (\Sigma)^\star)) \in \Sigma^\star_{\text{regexp}}.$$

This is the same as the regular expression that was considered in the presentation for the previous lecture.

1. Produce a ***parse tree*** for ω — showing enough work so that a reader can see how you got this.

   Solution:

2. Describe how this parse tree could be used to produce a ***nondeterministic finite automaton*** with the same language as ω.

   Solution:

3. Apply the process that you have described (possibly making simplifications to nondeterministic finite automata, along the way) to produce a nondeterministic finite automaton with the same language as ω.

   Then discuss how this could be useful when you wish to decide whether a given string belongs to the language of ω.

   Note: This is less important than the other problems in this presentation or the presentation for the previous lecture, and you will not be asked to do this on assignments or tests.