

CPSC 351 — Tutorial Exercise #4

Regular Operations and Regular Expressions

About This Exercise

The goal of this exercise is to help you to understand regular operations and regular expressions, and to help you to practice solving problems involving regular expressions — including deciding whether a given string is a regular expression over a given alphabet, deciding whether a given string is in the language of a given regular expression, and designing regular expressions for given regular expressions.

Getting Started

These initial problems will probably not be discussed during the tutorial. Please discuss them during office hours with the instructor, if you can, if you have trouble solving them.

1. Describe the languages of each of the following regular expressions over the alphabet $\Sigma = \{a, b, c, d\}$. These are all regular expressions that can arise when regular expressions are used in computer software.
 - (a) $(\Sigma \cup \emptyset)$
 - (b) $(\Sigma \circ \emptyset)$
 - (c) $(\Sigma \cup \lambda)$
 - (d) $(\lambda \cup \emptyset)$
 - (e) $(\emptyset)^*$
 - (f) $(\lambda)^*$

Problems To Be Discussed

As time permits, the following problems will be discussed during the tutorial. The concern regular expressions over the alphabet $\Sigma = \{a, b, c\}$.

2. Consider the string

$$\omega = (((a)^* \cup (b)^*) \cup (c)^*).$$

- (a) Using the definition of a “regular expression”, prove that ω is a regular expression over Σ .
 - (b) Give a parse tree for ω .
 - (c) Consider the string $\mu = ac$. Say whether μ belongs to the language of ω , and describe how to prove that your answer is correct.
 - (d) Consider the string $\nu = aaa$. Say whether ν belongs to the language of ω , and describe how to prove that your answer is correct.
 - (e) Describe, in reasonably simple English, the language of the regular expression ω .
3. Give a regular expression over Σ whose language is the set of strings in Σ^* that have at most three copies of the symbol “a” (but which can have any number of copies of “b” or “c”) — and show that your answer is correct.