CPSC 351 — Tutorial Exercise #7

Regular Operations and Regular Expressions

1 About This Exercise

This exercise is intended to help you to understand and use regular operations and regular expressions.

1. Each of the following is a regular expression over the alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$. Give a brief description of the ***language*** of these regular expressions in simple English (or set-theoretic notation, if that is easier for you to do).

   (a) $(((\mathtt{a})^\star \cup (\mathtt{b})^\star) \cup (\mathtt{c})^\star)$

   (b) $(((\mathtt{a})^\star \circ (\mathtt{b})^\star) \circ (\mathtt{c})^\star)$

   (c) $((\Sigma \cup \lambda) \circ (\Sigma \cup \lambda))$

2. Describe the languages of each of the following regular expressions over the alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}, \mathtt{d}\}$. These are all regular expressions that can arise when regular expressions are used in computer software — and ***they are trickier than they might appear***.

   (a) $(\Sigma \cup \emptyset)$

   (b) $(\Sigma \circ \emptyset)$

   (c) $(\Sigma \cup \lambda)$

   (d) $(\lambda \cup \emptyset)$

   (e) $(\emptyset)^\star$

   (f) $(\lambda)^\star$

3. Give regular expressions over the alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}\}$ for each of the following sets, and explain ***briefly*** why your answer is correct.

   (a) The set of strings in $\Sigma^\star$ with length three.

   (b) The set of strings in $\Sigma^\star$ with length *at least* three.

   (c) The set of strings in $\Sigma^\star$ that have at most four copies of the symbol "a" (but which can have any number of copies of "b" or "c").