

# CPSC 313 — Tutorial Exercise #7

## Regular Expressions

### About This Exercise

The following lecture concerns material found in Section 1.3 of the *Introduction to the Theory of Computation* and presented in the following lectures.

- Lecture #8: Regular Expressions (Part One)
- Lecture #9: Regular Expressions (Part Two)

This exercise will be discussed in the tutorials on Monday, February 7, Tuesday, February 8, and Wednesday, February 9. Please try to solve the problems in this exercise **before** attending this tutorial, so that you can compare your solution to the one that is presented and ask questions about what you found to be challenging.

### Problems To Be Solved

1. Each of the following is a regular expression over the alphabet  $\Sigma = \{a, b, c\}$ . Give a brief description of the **language** of these regular expressions in simple English.
  - (a)  $a^*(b \cup c)^*a^*$
  - (b)  $\Sigma\Sigma\Sigma a\Sigma$
  - (c)  $a^* \cup b^* \cup c^*$
  - (d)  $(a \cup b \cup c)^*$
  - (e)  $\Sigma\emptyset$
  - (f)  $\Sigma \cup \emptyset$
  - (g)  $\emptyset^*$
  - (h)  $\lambda^*$
  - (i)  $\lambda a \lambda$

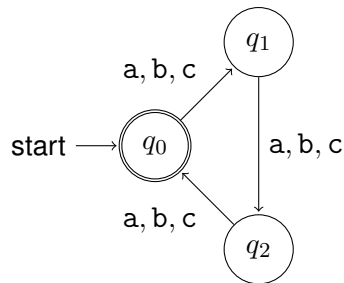
2. Give regular expressions over the alphabet  $\Sigma = \{a, b, c\}$  for each of the following sets, and explain **briefly** why your answer is correct.

- (a) The set of strings in  $\Sigma^*$  with length four.
- (b) The set of strings in  $\Sigma^*$  with length *at most* four.
- (c) The set of strings in  $\Sigma^*$  with length *at least* four.
- (d) The set of strings in  $\Sigma^*$  that only include a's.
- (e) The set of strings in  $\Sigma^*$  that do not include any a's.

3. Give NFA's whose languages are the same as the languages of the first five regular expressions given in Question #1.

4. The following are, respectively, a DFA and an NFA with language  $\Sigma = \{a, b, c\}$ . Give regular expressions for the language of each.

(a)



(b)

