CS3311 Homework 3

The answers must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in class. Any other source must be specified clearly.

1. *(20 points)* Let L over $\Sigma = \{1, 2, 3, a, b, c, -\}$ be the language of names where every name has to begin with a letter $(a, b, \text{ or } c)$. The dash character $(-)$ always has to be followed by another non-dash character.

   (a) Give a recursive definition for L.
   (b) Give a regular expression for L.

2. *(70 points)* Give a regular expression for the following languages.

(a) The set of strings over $\{1, 2, 3, a, b, c\}$ that start and end with a number. Consider only strings with length greater than 1.

(b) The set of strings over $\{1, 2, 3, a, b, c\}$ that start and end with a number. Strings can have a length of 1 or greater.

(c) The set of strings over $\{1, 2, 3, a, b, c\}$ that start with an alphabetical character and contain substring 123.

(d) The set of strings over $\{1, 2, 3, a, b, c\}$ that contain exactly two numbers and the sum of the numbers is even.

(e) The set of strings over $\{a, b, c\}$ in which all the a's precede the b's, which in turn precede the c's. It is possible that there are no a's, or b's, or c's and the string is empty.

(f) The set of strings over $\{a, b, c\}$ in which all the a's precede the b's, which in turn precede the c's. It is possible that there are no a's, or b's, or c's, but λ is not in the language.

(g) The set of strings over $\{1, 2, 3, a\}$ that do not begin with 123.

3. *(10 points)* Consider the following grammar G over $\Sigma = \{a, b, c, d, e\}$:

$$S \rightarrow aSbb \,|\, A$$
$$A \rightarrow cdA \,|\, \lambda \,|\, ee$$

(a) Give a derivation for a terminal string such that the $S \rightarrow aSbb$ rule is used exactly twice, and the $A \rightarrow cdA$ rule is also used exactly three times during the derivation. Make sure to use other rules to obtain a string that contains only terminal characters.

(b) Use set notation to define the language generated by the grammar.