Homework 4

Cpt S 317, Spring 2017

Due Date: March 20, 2017

Total points: 56

- For questions involving CFG design, make sure you specify the grammar 4-tuple description (i.e., G=(V,T,P,S)) in addition to providing the productions.

Also, please look at the PDF for "Rubrics" that describes performance indicators pertinent to this homework.

A digital version of this homework in PDF and the Rubrics in PDF are available at `http://www.eecs.wsu.edu/~ananth/CptS317`.

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1. (10 points)

   a) If L is a language and a is a symbol, then the language denoted as "L/a" is defined as follows:

   $$L/a \ = \ \{ \ w \mid wa \in L\}$$

   Informally put, L/a can be generated from L as follows: enumerate at all the strings in L that end with the symbol 'a', then remove that 'a' from those strings, and output the rest of the strings.

   For example, if $L = \{0, 001, 100\}$, then $L/0 = \{\epsilon, 10\}$ and $L/1 = \{00\}$.

The question for this problem is as follows: If you are given that L is regular, then show that L/a is also regular. Your proof should be generic (i.e., not based on any specific example), just like we proved for other closure properties in the class. For instance, you can think of describing a construction procedure that takes as input a DFA for any given regular language L and converts it into a finite automaton for L/a.

b) Now, let us define another language called "$a\backslash L$" as follows:

$$a\backslash L \;=\; \{\; w \mid aw \in L\}$$

For example, if $L = \{0, 001, 100\}$, then $0\backslash L = \{\epsilon, 01\}$ and $1\backslash L = \{00\}$.
Using the result proven in part (a) and any other closure properties of RLs already proven in class, show that $a\backslash L$ is regular if L is regular.

2. (6 points) Exercise 4.4.2. This is a DFA minimization problem. You need to do this using the Table Filling algorithm. Be sure to show the table as part of your answer.

3. (30 points) Design a CFG for each of the following languages:

a) $L_1 = \{a^i b^j c^k \mid (i \neq j),\ \text{where } i, j, k \geq 0\}$
b) $L_2 = \{a^i b^j c^k \mid (i \neq k),\ \text{where } i, j, k \geq 0\}$
c) $L_3 = \{a^i b^j c^k \mid (i \neq j \text{ or } i \neq k),\ \text{where } i, j, k \geq 0\}$
d) The set of all strings over alphabet $\{a, b\}$ such that the number of a's is *at least* as many as the number of b's.
e) The set of all strings over alphabet $\{a, b\}$ that are of odd length.
f) The set of all strings of a's and b's that are <u>not</u> of the form ww^R.

4. (10 points) Exercise 5.1.2: part c.