

Assignment 3

CS 311, Fall 2015
Due: October 28, 2014

Problem 1 For the language:

$$A = \{w \in \{0, 1\}^* \mid w \text{ is not a palindrome}\}$$

- Using the pumping lemma, show that A is *not* regular. (Hint: the regular languages are closed under complement) [5 Points]
- Give a CFG that generates the language A . [5 Points]

Problem 2 For the language:

$$B = \{w \in \{a, b\}^* \mid \text{The first, middle, and last character are the same}\}$$

- Using the pumping lemma, show that B is *not* regular. [5 points]
- Give a CFG that generates the language B . [5 points]

Problem 3 The languages $\{0^s 1^s 2^t \mid s, t \geq 0\}$ and $\{0^s 1^t 2^t \mid s, t \geq 0\}$ are context-free. Use those languages to answer the following:

- Write down CFGs for each of the languages. [5 Points]
- Use the fact that both languages are context-free to show that the class of context-free languages is *not* closed under intersection. (Use the context-free pumping lemma to show that the resulting language is not context-free.) [5 Points]
- Use the result from part *b* and DeMorgan's Laws to show that the class of context-free languages are *not* closed under complement. [5 Points]

Problem 4 Give a Context-Free Grammar for the following language:

$$\{a^* b^* c^*\} - \{a^n b^n c^n \mid n \geq 0\}$$

(Hint: See if you can rephrase the language to make it easier)

Problem 5 Write the context free grammar for $\{w \mid w \text{ is a palindrome}\}$ and then convert the grammar into Chomsky normal form using the procedure from class. [10 Points]

Problem 6 Prove or disprove: If G is a CFG in Chomsky normal form, then for any string $w \in L(G)$ of length $n \geq 1$ then exactly $2n - 1$ steps are required for any derivation of w . [10 Points]