CONCORDIA UNIVERSITY
Dept. of Computer Science and Software Engineering
COMP 335 – Introduction to Theoretical Computer Science
Fall 2017

Assignment 5
Submission through Moodle due on Monday December 4 at 23:55

1. (15 marks) Prove that the following languages are not context-free.

   (a) $\{a^i b^i c^{2i} \ : i \geq 0\}$

   (b) $\{w_1 c w_2 \ : w_1, w_2 \in \{a,b\}^*, w_1 \text{ is a substring of } w_2\}$

   (c) $\{a^i b^j c^k \ : i \neq j, j \neq k, i \neq k\}$

2. (5 marks) Suppose L is a context-free language and F is a finite language. The symmetric difference of L and F, denoted $L \triangle F$, is defined as $L \triangle F = (L - F) \cup (F - L)$. Is $L \triangle F$ a regular language? Why or why not? Is it a context-free language? Why or why not?

3. (10 marks) Design Turing machines that accept the following languages. For each language, first give a brief description in English of your strategy, then give the transition diagram of the Turing machine.

   (a) $\{w_1 c w_2 \ w_1, w_2 \in \{a,b\}^*, w_1 \text{ is a substring of } w_2\}$

   (b) $\{a^i b^j c^k \ : i \neq j, j \neq k, i \neq k\}$

4. (10 marks) Give the transition diagram of a Turing machine that computes the following functions.

   (a) $f(1^n) = 1^{3n+2}$

   (b) $f(1^n 0 1^m) = 1^{nm}$