University of Waterloo
CS 462 — Formal Languages and Parsing
Winter 2020
Problem Set 8

Distributed Friday, March 6 2020. Due Friday March 13 2020 at 5 PM. Submit via LEARN.

1. [10 marks] Let $\Sigma = \{a, b, c\}$ and let L be the language

$$L = \{xcy \ : \ x, y \in \{a, b\}^* \text{ and } |x| = |y| \text{ and } x \neq y\}.$$

   Show that L is not context-free. Hint: assume it is and first intersect with the regular language $a^+b^+ca^+b^+$. Then use Ogden's lemma.

2. [10 marks] Let $S \subseteq \mathbb{N}^2$, and define $L(S) = \{a^i b^j \ : \ (i, j) \in S\}$. Show that S is semilinear iff $L(S)$ is context-free.

3. [10 marks] Call a language 2-*bounded* if there exist words x, y such that $L \subseteq x^*y^*$. Show that if L is a CFL that is 2-bounded, then $\overline{L}$ is a CFL.