

CS 591 S2—Formal Language Theory: Integrating Experimentation and Proof—Fall 2019

Problem Set 7

Due by 12:30pm on Wednesday, December 11

Problem 1 (35 points)

Let the grammar G be

$$A \rightarrow 1BC \mid 1B23C \mid 0B33C \mid 011B23C \mid 00A33$$

$$B \rightarrow 1 \mid 11B \mid 11B22$$

$$C \rightarrow 3 \mid 33C,$$

and let the language X be

$$\{0^i 1^j 2^k 3^l \mid i, j, k, l \in \mathbb{N} \text{ and } i < l \text{ and } j > k \text{ and } i + j \text{ is even and } k + l \text{ is odd}\}.$$

Prove (without using Forlan) that $L(G) = X$.

Problem 2 (35 points)

Let the language X be

$$\{0^i 1^j 2^k 3^l \mid i, j, k, l \in \mathbb{N} \text{ and } i + j = k + l \text{ and } i \text{ is even and } j \text{ is odd and } k \text{ is even and } l \text{ is odd}\}.$$

Use Forlan to help find a grammar G such that $L(G) = X$.

- Try to do as much as possible of the work of finding G using Forlan.
- But as a secondary goal, attempt to minimize the number of variables of G , and for grammars with an equal number of variables, the number of productions of G .

Problem 3 (30 points)

Let the language X be

$$\{0^i 1^j 2^k \mid i, j, k \in \mathbb{N} \text{ and } i < j < k\}.$$

Prove that X is not context-free.