

CS/ECE 374 A (Spring 2022)
Homework 4 (due Feb 17 Thursday at 10am)

Instructions: As in previous homeworks.

Problem 4.1: For each of the following languages, determine whether it is regular or not, and give a proof. To prove that a language is not regular, you should use the fooling set method. (To prove that a language is regular, you are allowed to use known facts about regular languages, e.g., closure properties, all finite languages are regular, ...)

- (a) $\{x(110)^n x^R : x \in \{0, 1\}^*, n \geq 1\}$
- (b) $\{0^i 1^j 0^k : i + k \text{ is divisible by } 3, \text{ and } k \text{ is divisible by } j, \text{ and } i, j, k \geq 1\}$
- (c) $\{y x x^R z : x, y, z \in \{0, 1\}^*, |x| \geq 374\}$
- (d) $\{y 0^n 1^n 0^n z : y, z \in \{0, 1\}^*, n \geq 374\}$

Problem 4.2: Give a context-free grammar (CFG) for each of the following languages. You must provide explanation for how your grammar works, by describing in English what is generated by each non-terminal. (Formal proofs of correctness are not required.)

- (a) (30 pts) $\{x(110)^n x^R : x \in \{0, 1\}^*, n \geq 1\}$
- (b) (30 pts) $\{1^i 0^j 1^k : j = 2i + 3k, i, j, k \geq 0\}$
- (c) (40 pts) $\{1^i 0^j 1^k : i + k \text{ is divisible by } 3 \text{ and } 0 \leq j \leq k\}$