

CS/ECE 374 A (Spring 2024)
Homework 4 (due Feb 15 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) $\{0^i 1^j 0^k : j \text{ is divisible by } i + k, \text{ and } i + j + k \text{ is divisible by } 4, \text{ and } i, j, k \geq 5\}$.
- (b) $\{xx^R 0x : x \in \{0, 1\}^*\}$ (where x^R denotes the reverse of x).
- (c) All strings $x \in \{0, 1\}^*$ such that x ends in a palindrome of length between 4 and 374.
- (d) All strings $x \in \{0, 1\}^*$ such that x ends in a palindrome of length at least 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) All strings $x \in \{0, 1\}^*$ such that x ends in a palindrome of length at least 4.
- (b) All strings $w = x0^i y$ where $x, y \in \{0, 1\}^*$ and $i \geq \frac{2|w|}{3}$.
- (c) $\{0^i 1^j 0^k : k \geq 2i \text{ and } i + j + k \text{ is divisible by } 4\}$.