

CMPE 350 - Spring 2018

PS 5 - 12.03.18

- Midterm Questions

2.4 Give context-free grammars that generate the following languages.

- a) $\{w \mid w \text{ contains at least three 1's}\}$
- b) $\{w \mid w \text{ starts and ends with the same symbol}\}$
- c) $\{w \mid \text{the length of } w \text{ is odd}\}$
- d) $\{w \mid \text{the length of } w \text{ is odd and its middle symbol is a 0}\}$
- e) $\{w \mid w = w^R\}$
- f) The empty set

2.6 Give context-free grammars that generate the following languages.

- a) The set of languages over the alphabet $\{a, b\}$ with more a 's than b 's.
- b) The complement of the language $\{a^n b^n \mid n \geq 0\}$
- c) $\{w \# x \mid w^R \text{ is a substring of } x \text{ for } w, x \in \{0, 1\}^*\}$

2.8 Show that the class of context-free languages are closed under the regular operations union, concatenation and star.