Homework 4

Design context-free grammars for the first two exercises.

Exercise 0.1 *The set $\{a^i b^j c^k : i \neq j \text{ or } j \neq k\}$, that is, the set of strings of a's followed by b's followed by c's, such that there are either a different number of a's and b's or a different number of b's and c's, or both.*

Exercise 0.2 *The set of all strings of a's and b's that are not of the form ww, that is, not equal to any string repeated.*

Exercise 0.3 *Show that every regular language is a context-free language. Hint: Construct a CFG by induction on the number of operators in the regular expression.*

Exercise 0.4 *A CFG is said to be right-linear if each production body has at most one variable, and that variable is at the right end. That is, all productions of a right-linear grammar are of the form $A \to wB$ or $A \to w$, where A and B are variables and w some string of zero or more terminals.*

  1. Show that every right-linear grammar generates a regular language. Hint: Construct an ε-NFA that simulates leftmost derivations, using its state to represesnt the lone variable in the current left-sentential form.

  2. Show that every regular language has a right-linear grammar. Hint: Start with a DFA and let the variables of the grammar represent states.

* Exercises above are from *Introduction to Automata Theory, Languages, and Computation, 3rd Edition*: Exercises 5.1.1B, 5.1.1C, 5.1.3, 5.1.4