Theory of Computation, Fall 2021
Assignment 4 (Due October 29 Friday 9:35am)

Q1. [2, Exercise 2.4.5] Use pumping theorem to show that the language $\{ww^R : w \in \{a,b\}^*\}$ is not regular.

true.
pigeonhole
a loop

Q2. Let M be a DFA. Let p be the number of states in M. Is the following statement true of false? Briefly explain your answer.

> If $L(M)$ has a string w with $|w| \geq p$, then $L(M)$ must be infinite (That is, L(M) contains an infinite number of strings).

Q3. [2, Problem 3.1.3 and 3.1.9] Construct context-free grammars that generate each of the following languages. Your grammars should have as few rules as possible.

(a) $\{w \in \{a,b\}^* : w = w^R\}$ S\to aSa S\to bSb S\to e

(b) $\{a^m b^n : m \geq n\}$ S\to aSb S\to aS S\to e

Q4. Let $N = (K, \Sigma, \Delta, s, F)$ be an NFA. Construct a PDA $P = (K', \Sigma, \Gamma, \Delta', s', F')$ such that $L(P) = L(N)$. do not operate stack

Q5. [2, Problem 3.3.2] Construct a PDA that accepts $\{w \in \{a,b\}^* : w$ has twice as many b's as a's$\}$. (Hint: use the stack to track the value of $B - 2A$ where B (A, resp.) is the number of b's (a's, resp.) that have already been read by the PDA.)

Q6. Convert the CFG you constructed for Q3(a) to an equivalent PDA. You should strictly follow the construction we used in the class.

References

[1] Sipser M.. Introduction to the Theory of Computation. CENGAGE Learning (2013)

[2] Lewis H., Papadimitriou C.. Elements of the Theory of Computation. Prentice-Gall (1998)