# CS 6041 Theory of Computation

# Homework 4

**Make sure you follow the instruction before submission:**

**1, Any late submission due to whatever reason will not be graded.**

**2, The answer should be written in BLUE and the figure can be any color. The wrong format submission might not be considered.**

**3, The submission file must be in PDF. Any other format will not be graded.**

1. (20 points)

Give context-free grammars that generate the following languages. In all parts, the alphabet Σ is {0,1}.

1. {w| w starts and ends with the same symbol}

b. {w| w = wR, that is, w is a palindrome}

1. (20 points)

Give a context-free grammar that generates the language  
A = {aibjck| i = j or j = k where i, j, k ≥ 0}.

Is your grammar ambiguous? Why or why not?

1. (20 points)

Convert the following CFG into an equivalent CFG in Chomsky normal form, using the procedure given in Theorem 2.9.

A → BAB | B | ε

B →00|ε

1. (20 points)

Show that if G is a CFG in Chomsky normal form, then for any string w ∈ L(G) of length n ≥ 1, exactly 2n − 1 steps are required for any derivation of w.

1. (20 points)

Let Σ = {1,2,3,4} and C = {w ∈ Σ∗| in w, the number of 1s equals the number of 2s, and the number of 3s equals the number of 4s}. Show that C is not context free.

Please make sure to choose an appropriate string S in your proof.