# 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 (i.e., docx, pages) will not be graded. We don’t accept the hand-written submission.**

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? (if yes, please draw the parse trees.)

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.