CSCI 338: Assignment 3 (7 points)

This assignment is due on **Thursday, March 11, 8:00pm**. It is strongly encouraged that you use Latex to generate a single pdf file and upload it under *Assignment 3* on D2L. But there will NOT be a penalty for not using Latex (to finish the assignment). This is **not** a group-assignment, so you must finish the assignment by yourself.

Problem 1

Design context-free grammars for the following languages

(1.1) $A = \{a^n b^m | n \neq 2m\}$.
(1.2) $B = \{a^i b^j c^k | i, j, k \geq 0$ and either $i = j$ or $j = k\}$.
(1.3) $C = \{a^n b^m | n = 3m\}$.
(1.4) $D = \{a^n b^m | n \leq m + 3\}$.

Problem 2

Decide whether the following grammar is ambiguous.

$S \to AB|aaB$
$A \to a|Aa$
$B \to b$

Problem 3

Convert the following CFG G to an equivalent PDA.

$R \to XRX|S$
$S \to aTb|bTa$
$T \to XTX|X|\epsilon$
$X \to a|b$

Problem 4

Let $G = (V, \Sigma, R, S)$ be the following grammar. $V = \{S, T, U\}$; $\Sigma = \{0, \#\}$; and R is the set of rules:

$S \to TT|U$
$T \to 0T|T0|\#$
$U \to 0U00|\#$

(4.1) Describe $L(G)$ in English.

(4.2) Prove that $L(G)$ is not regular.

Problem 5

Convert the following CFG into an equivalent CFG in Chomsky Normal Form

$A \to BAB|B|\epsilon$
$B \to 00|\epsilon$

Problem 6

Using pumping lemma to prove that the following languages are not context-free.

(6.1) $L = \{a^n b^j c^k | k = nj\}$.

(6.2) $L = \{a^n b^j | n \geq (j-1)^3\}$.