

CS 350 Theory of Computation

Assignment 3 (8 marks)

Question 1 (2 marks)

Design context-free grammars for the following languages

$$(1.1) A = \{a^n b^m \mid n \neq 2m\}.$$

$$(1.2) B = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and either } i = j \text{ or } j = k\}$$

$$(1.3) C = \{a^n b^m \mid n = 3m\}.$$

$$(1.4) D = \{a^n b^m \mid n \leq m + 3\}.$$

Question 2 (1 marks)

Decide whether the following grammar is ambiguous.

$$S \rightarrow AB \mid aaB$$

$$A \rightarrow a \mid Aa$$

$$B \rightarrow b$$

Question 3 (1 marks)

Convert the following CFG G to an equivalent PDA.

$$R \rightarrow XRX \mid S$$

$$S \rightarrow aTb \mid bTa$$

$$T \rightarrow XTX \mid X \mid \epsilon$$

$$X \rightarrow a \mid b$$

Question 4 (1 marks)

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

$$S \rightarrow TT|U$$

$$T \rightarrow 0T|T0|\#$$

$$U \rightarrow 0U00|\#$$

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

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

Question 5 (1 marks)

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

$$A \rightarrow BAB|B|\epsilon$$

$$B \rightarrow 00|\epsilon$$

Question 6 (2 marks)

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

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

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

Date Due: before the end of class on **Tuesday, March 10, 2009**. Late assignment will lose 2 marks for each overdue day.