

CS 350 Theory of Computation

Assignment 3 (8 marks)

Question 1 (3 marks)

Design context-free grammars for the following languages

(1.1) $\{w \mid w \text{ starts and ends with the same symbol}\}$ (2.4-b in the first edition of Sipser).

(1.2) $\{w \mid \text{the length of } w \text{ is odd and its middle symbol is a 0}\}$ (2.4-d in the first edition of Sipser).

(1.3) $\{w \mid w \text{ contains more 1s than 0s}\}$ (2.4-e in the first edition of Sipser).

(1.4) $\{w \mid w = w^R, \text{ that is, } w \text{ is a palindrome}\}$ (2.4-f in the first edition of Sipser).

(1.5) $A = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and either } i = j \text{ or } j = k\}$ (2.9 in the first edition of Sipser, you only need to design the grammar)

This part of the assignment is on Rocky's hypertext book (<http://www.cs.montana.edu/ross/classes/spring-2006/cs350/Assignments/assignment02.htm>), you must finish this question using the corresponding Applet and follow the directions there. (You must use Firefox or Netscape to do this part of the assignment.) *This part of the assignment is due Friday at 10pm, March 3, 2006.*

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 (1 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 **Wednesday, March 8, 2006**. Late assignment will lose 2 marks for each overdue day.