

Practice Midterm Exam 2

1. Give the NPDA for the following context-free language, describe what each state does:

$$\{a^n b^k : n > k \geq 0\}$$

2. (a) Give a context-free grammar for the following language:

$$L = \{w a^n b^n w^R : w \in \{a, b\}^*, n \geq 0\}$$

where w is any string over the alphabet $\Sigma = \{a, b\}$ including λ .

- (b) Give the derivation of the string $abaabbba$ using your grammar.

3. Is the following grammar ambiguous? Prove your answer.

$$\begin{aligned} S &\rightarrow BA \mid C \\ B &\rightarrow Bb \mid b \\ A &\rightarrow aA \mid a \\ C &\rightarrow bCa \mid ba \end{aligned}$$

4. Give the Chomsky normal form of the following grammar.

$$\begin{aligned} S &\rightarrow AbBa \\ A &\rightarrow ABa \mid a \\ B &\rightarrow BaA \mid b \end{aligned}$$

5. Prove that the following language is not context-free.

$$L = \{a^i b^j c^k : 0 \leq i \leq j \leq k\}$$

6. Prove that the following language is context-free.

$$L = \{w w^R : w \neq abba, \text{ and } w \in \{a, b\}^*\}$$