

Practice Midterm Exam

1. (15 points) Give an NFA with a single final state for the following regular language:

$$aa^*b^*a \cup aab^*$$

2. (10 points) Give the regular expression for the following regular language over the alphabet $\Sigma = \{0, 1\}$:

$$L = \{\text{the binary positive integers (without 0)} \\ \text{whose most significant bit is 1} \\ \text{and contain the substring 11}\}$$

3. (15 points) Use the pumping lemma to prove that the following language is not regular:

$$\{a^n b^k c^n : n \geq 0, k \geq 5\}$$

4. (15 points) Give the NPDA for the following context-free language, describe what each state does:

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

5. (15 points) (a) Give a context-free grammar for the following language:

$$L = \{wa^n b^n w^R : n \geq 0\}$$

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

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

6. (15 points) Is the following grammar ambiguous? Prove your answer.

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

7. (15 points) Give the Chomsky normal form of the following grammar.

$$S \rightarrow AbBa$$

$$A \rightarrow ABa \mid a$$

$$B \rightarrow BaA \mid b$$