CSCI 2400 – Models of Computation

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 $\Sigma = \{0, 1\}$:

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

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

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

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

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

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

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

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.

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

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

$$S \to AbBa$$
$$A \to ABa \mid a$$
$$B \to BaA \mid b$$