CSCI 2400 – Models of Computation, Section 3

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

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

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

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

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

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

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

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

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.

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

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

$$S \to AbBa$$

$$A \to ABa \mid a$$

$$B \to BaA \mid b$$