

## Practice Midterm Exam 1

1. (20 points) Give a NFA with a single final state for the language  $L(aa^*b^*a + aab^*)$ .
2. (20 points) Give the regular expression for the following regular language defined 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. (20 points) Give a regular grammar for the language  $L((aab^*ab)^*)$ .
4. (20 points) The *symmetric difference* of two sets  $S_1$  and  $S_2$  is defined as follows:

$$S_1 \ominus S_2 = \{x : x \in S_1 \text{ or } x \in S_2, \text{ but } x \text{ is not in both } S_1 \text{ and } S_2\}.$$

Show that the family of regular languages is closed under symmetric difference.

5. (20 points) Use the pumping lemma to prove that the following language is not regular:

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