

### CS 321 HW3

Submit a pdf in Canvas. Use a word processor and/or JFLAP. (25 pts)

1. (8 pts) Prove that the following languages are not regular.

a)  $L = \{ 0^n : n=2^k \text{ for some } k > 1 \}$

b)  $L = \{ w : n_a(w) \neq n_b(w), w \in \{a, b\}^* \}$

2. (12 pts) Determine whether or not the following languages are regular. If the language is regular then give an NFA or regular expression for the language. Otherwise, use the pumping lemma for regular languages to prove the language is not regular.

a)  $L = \{ a^n b^n : n > 0 \} \cup \{ a^k b^m : k > 0, m > 0 \}$

b)  $L = \{ a^n b^m : n \leq m \leq 2n \}$

c)  $L = \{ 0^n : n=2k \text{ for some } k > 1 \}$

3. (3 pts) Prove or disprove the following statement: If  $L_1$  and  $L_2$  are nonregular languages, then  $L_1 \cup L_2$  is also nonregular. A counter example is sufficient to disprove the statement.

4. (2 pts) The symmetric difference of two sets  $S_1$  and  $S_2$  is defined as:

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

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