CS 301: Languages and Automata **Prof. Bob Sloan**

Sample Midterm Exam

February 2012

This is a sample based upon an old hour exam. The material covered and notation may be slightly different; the purpose of this handout is just to give you some idea of the sort of thing you might see.

1. (20 points) Using the construction from class or the text, construct a deterministic finite automaton (DFA) equivalent to the three-state NFA shown below.

   PICTURE of 3-state NFA HERE.

2. (a) (25 points) Prove that the language

   $$L = \{\text{all strings over } \{0, 1\} \text{ containing more 0's than 1's}\}$$

   is *not* regular.

   (b) (15 points) Prove that L is context free.

3. (15 points) Consider the following variation of a deterministic finite automaton (DFA). Everything is the same, except that we allow more than one "start" state. A string is accepted by this machine if at least one of the start states sends it to an accepting (final) state. Argue that any language accepted by such a machine can also be accepted by an ordinary DFA.

4. (15 points) If L is a regular language, show that

   $$\text{Reverse}(L) = \{\text{all strings in } L \text{ written backwards}\}$$

   is also a regular language. (Hint: Use the result from the previous problem.)

5. (10 points) We know that regular languages are closed under finite union. Show that regular languages are *not* closed under infinite union. (Hint: Find a language that is not regular but is the infinite union of regular languages.)