Computer Science and Engineering 105 Summer 2003 Midterm Examination, July 17, 2003

Name:_____

No books, notes, or calculators. Use pen or pencil, any color.

The entire test is 150 points.

1. True or False. [5 points each]

   (a) _____ Every subset of a regular language is regular.

   (b) _____ A language L is regular if and only if there is some NFA that accepts L.

   (c) _____ The set of all binary numerals for multiples of 7 is a regular language.

   (d) _____ The complement of any regular language is regular.

   (e) _____ The set of strings of the form xx, where $x \in \{0,1\}^\star$, is a context-free language.

   (f) _____ The complement of the above language, *i.e.*, the set of strings over $\{0,1\}$ which are **not** of the form xx for some string x, is a context-free language.

   (g) _____ The intersection of any two context-free languages is context-free.

   (h) _____ The set of regular expressions over a given alphabet is a context-free language.

   (i) _____ The programming language C++ is a context-free language.

   (j) _____ Every context-free language has an unambigous context-free grammar.

2. [40 points] Draw the transition diagram for an NFA which accepts the language described by the regular expression $0^*1(10^*1 + 01^*0)^*$. Then, draw an equivalent DFA.

3. [30 points]

Let L_1 be the language over $\Sigma = \{a, b\}$ consisting of all strings w such that $n_a(w) = 2n_b(w)$, where $n_a(w)$ denotes the number of instances of a in the string w. Use the pumping lemma for regular languages to prove that L is not regular.

4. [30 points]

Let L be the language of all palindromes over the binary alphabet. (A *palindrome* is a string which is equal to its own inverse, such as `0, 1, 00, 11, 000, 010, or 0010110110100.`

(a) Give a context-free grammar for L.

(b) Design a PDA that accepts L. You can use either a transition diagram or a transition table.