Computer Science 456/656 Spring 2005 First Examination, March 3, 2005

Name:_____

No books, notes, scratch paper, or calculators. Use pen or pencil, any color. Use the rest of this page and the backs of the pages for scratch paper. If you need more scratch paper, it will be provided.

The entire test is 110 points.

1. True or False. [5 points each]

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

   (b) _____ Let L be the language over $\Sigma = \{a, b\}$ consisting of all strings of the form $a^n b^n$, where $n \geq 0$. Then L is a regular language.

   (c) _____ There is a finite state machine that runs all valid C programs.

   (d) _____ If there is an unambiguous context-free grammar for a language L, then there must be a deterministic one-stack parser for L.

   (e) _____ Let Σ be the binary alphabet. If a regular expression over Σ has n symbols, and describes a language L, there must be a DFA with $O(n)$ states that accepts L.

2. Fill the blanks. [5 points each blank]

   (a) Suppose M is a machine, and given any configuration x of M, there is at most one configuration y of M such that x yields y in one step. In that case, we say that M is _____

   (b) We say that a parser is _____ if it visits the internal nodes of the parse tree in postorder.

3. [15 points] Write a regular expression for the language L over $\Sigma = \{0, 1\}$ consisting of all strings which do not contain the subsequence 11. Warning: There are many correct answers for this question, but I will take off points if your answer is extremely long, since there is a fairly short answer.

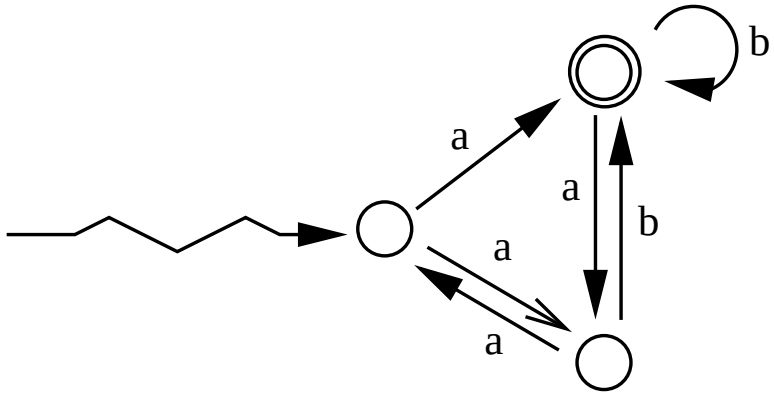
4. Let G be the context free grammar whose only variable is the start symbol S and whose productions are as follows:

   - $S \to a$
   - $S \to iS$
   - $S \to iSeS$

   (a) [10 points] Prove that G is ambiguous.

   (b) [20 points] Give an unambiguous context-free language equivalent to G.

5. [30 points] Consider the NFA whose transition diagram is drawn below, where the input alphabet is $\{a, b\}$. Draw the transition diagram of an equivalent minimal DFA. Show your steps.



(More space to work problem 5 if you need it.)