COS 397 Spring 2013 Midterm Exam 1 *60 minutes; 60 pts.; 5 questions; 6 pgs.* *2013-02-19*

© 2013 Sudarshan S. Chawathe

Name: ____

1. (1 pt.)

   - **Read all material carefully.**
   - You may refer to your books, papers, and notes during this test.
   - No computer or network access of any kind is allowed (or needed).
   - Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
   - Use classroom conventions for notation, algorithmic options, etc.
   - Ask for clarifications on the above if needed.

   Write your name in the space provided above.

2. (9 pts.)

   (a) Define the set of all permutations of a given multiset.

   (b) List all permutations of the multiset $\{a, b, c, c, c\}$.

3. (30 pts.)

   (a) Describe an algorithm for generating all permutations of a given multiset (as in Question 2). Your description must be detailed enough to permit implementation by a programmer with no knowledge of permutations.

   (b) Provide code or detailed pseudocode for your algorithm.

   (c) Explain why your algorithm is correct.

   (d) Provide an illustrative example of your algorithm in action.

[additional space for answering the earlier question]

[additional space for answering the earlier question]

4. (10 pts.) Provide *Lex* code that yields a lexer that recognizes complex numbers of in all of the following three formats, where *a* and *b* are integers or real numbers in the usual format.

   a + i*b*
   a + j*b*
   a@*b*

   On finding each instance of the first two formats above, the program should three items separated by spaces on a line by themselves: the string `complex-rect`, *a*, and *b*. For instances in the last format, the output is similar, but uses the string `complex-polar` instead of `complex-rect`.

5. (10 pts.) Provide a *sed* script that prints (only) all four-letter palindromes when given a list of words, one per line, on its standard input.