**COT 4210: Discrete Structures II**

**Final Exam**

**April 30, 2013**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Lecturer: Arup Guha**

**(Directions: Please justify your answer to each question. No answer, even if it is correct, will be given full credit without the proper justification.)**

1) (10 pts) Design an NFA that accepts all strings over the alphabet {0,1} that contain the substring 111 and the substring 000. Make sure to use features unique to NFAs that are not allowed in DFAs in your design. Please clearly label your start state, your final state(s) and each transition. Please name your states q0, q1, etc. with q0 being the start state.

2) (10 pts) Convert the following Context Free Grammar below over the alphabet {0, 1} to Chomsky Normal Form. Clearly label each of the four steps in the algorithm and the resulting grammar after each of the steps.

S → AAB | 0 | 11

A → 1 | BBBB

B → A | BA | 10 | ε

3) (10 pts) Using the algorithm in the text, convert the Context Free Grammar in question #2 (which is replicated below for convenience) to an equivalent PDA that accepts the exact same language described by the Context Free Grammar.

S → AAB | 0 | 11

A → 1 | BBBB

B → A | BA | 10 | ε

4) (10 pts) Let L = { <M, S> | M is a standard TM and S is a finite set of strings over {0,1} such that there exists some string t S\*, such that M accepts t.} Prove that L is undecidable without Rice’s Theorem.

5) (10 pts) In the following solitaire game, you are given an m x m board. On each of its m2 positions lies either a blue stone, a red stone or nothing at all. You play by removing stones from the board until each column contains only stones of a single color and each row contains at least one stone. You win if you achieve this objective. Winning may or may not be possible based on the initial configuration. Let SOLITAIRE = { <G> | G is a winnable solitaire game configuration }. Prove that SOLITAIRE is NP-Complete by reducing 3-CNF-SAT to it.

6) (2 pts) Name one ingredient in Raisinets. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Scratch Page – Please clearly mark the work on this page you would like graded.**