CSE 322
Winter Quarter 2009
Assignment 9
Due Friday, March 6, 2009

All solutions should be neatly written or type set. All major steps in proofs must be justified. Please start each problem solution on a new page and put your name on every page.

1. (10 points) In this problem you will get some practice with the pumping lemma for context-free languages. Consider the language $L = \{0^n 1 0^n 1 0^m : n \geq m \geq 0\}$. Use the pumping lemma for context-free languages to show that L is not context-free.

2. (10 points) Coping data is a fundamental part of many algorithmic processes. Design a one tape Turing machine the copies a string. The machine starts with a string $x \in \{0, 1\}^*$ on the tape with the head on the first symbol of x. When the Turing machine halts the string xcx is written on the tape with the head on the first symbol of the output. You may use a state diagram as your design, but explain what the various states mean.

3. (10 points) We know that multiple tape Turing machines are equivalent to single tape Turing machines. Use that fact to show that the Turing recognizable languages are closed under union. That is given one tape Turing machines $M_1 = (Q_1, \Sigma, \Gamma_1, \delta_1, q_{01}, q_{a1}, q_{r1})$ and $M_2 = (Q_2, \Sigma, \Gamma_2, \delta_2, q_{02}, q_{a2}, q_{r2})$, construct multiple tape Turing machines M such that $L(M) = L(M_1) \cup L(M_2)$.