CSE 322
Autumn Quarter 2003
Assignment 9
Due Wednesday, December 10, 2003

All solutions should be neatly written or type set. All major steps in proofs and algorithms must be justified.

1. (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.

2. (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 $L(M) = L(M_1) \cup L(M_2)$.