CSE 531: Computability and Complexity
Assignment #2
October 9, 2001
due: Tuesday, October 16

1. Go through a series of careful definitions of a nondeterministic (1-tape) Turing machine, analogous to the ones given in lecture. These would include definitions of the (a) 7-tuple, (b) configuration, (c) 1-step transition relation (what the text calls "yields" and for which I used the symbol $\underset{M}{\vdash}$), (d) multistep transition relation ($\overset{*}{\underset{M}{\vdash}}$), (e) what it means for M to accept w, and (f) $L(M)$. For any of these 6 definitions *identical* to the corresponding deterministic Turing machine definition, just say it is identical. But give careful definitions for any of these where the nondeterministic Turing machine definition differs from the deterministic one.

2. Problem 3.14.

3. (a) Consider the language $C = \{a^k \mid k \geq 2 \text{ is a composite integer}\}$ over the alphabet $\Sigma = \{a\}$. Show that C is decidable. You may use Example 3.6 from the text.
   (b) Consider the language $C' = \{a^k \mid k \geq 2 \text{ is a prime integer}\}$ over the alphabet $\Sigma = \{a\}$. Show that C' is decidable.

4. Problem 3.17. Let the Turing machine be denoted M. Hints:
   (a) Show that you can assume without loss of generality that M only enters q_{accept} when it is not on the portion of the tape containing the input string.
   (b) The finite automaton N has to make an accept/reject decision when it reads the rightmost input symbol, whereas M can compute whatever it likes on the tape to the right of this point. How will N make its decision without reading what M would have written?