

**CS 410/510**  
**Nonstandard Computation**  
**Spring, 2008**

**Problem Set 1: Physics of Computation**

Due Thursday, April 10.

1. Write down Bennett-style quintuples that implement a non-reversible TM, with tape symbols 0, 1, and blank, that calculates whether the number of 1s on its input tape is even or odd. If even, the output should be a single 0 on the tape with all other squares blank; if odd, a single 1 with all other squares blank. All inputs are assumed to be in Bennett's "standard form", with all squares blank except for the input, which is a string of 1s and 0s with no embedded blanks. The tape head will always start on the blank square to the immediate left of the input.
2. For each the quintuples you wrote down above, write down the corresponding pair of quadruples for a reversible TM (as described in Bennett's article).
3. How many steps would be required, respectively, by your non-reversible and reversible TMs to do the computation of Problem 1 above for an input string of 0s and 1s of length  $L$ ? Explain your answer.
4. Explain in a few sentences the difference between "logically reversible" and "thermodynamically reversible".