

Math 29, Spring 2007  
Assignment 1: Turing Machines  
Due Monday, April 9

1. Write a Turing machine that computes

$$n \dot{-} 1 = \begin{cases} 0 & n = 0 \\ n - 1 & n > 0 \end{cases}$$

Assume  $n$  is written in binary, leftmost digit corresponding to the 1s place and increasing 2s, 4s, etc., as you move rightward along the tape, and that the read/write head is originally on the leftmost (least) digit of this representation of  $n$ .

Test your machine on the binary representations of 0, 1, 3, and 4.

2. Give an informal proof that a Turing machine with two read/write heads and two working tapes is no more powerful than the standard Turing machine, by describing how you would emulate a two-tape machine by a one-tape machine. You may assume the read/write heads are attached so they always point to corresponding positions on the two tapes rather than moving independently.