

Assignment #3

Due: Wednesday, October 26

Problem 1—Tracing Turing machine execution

Solve the problems in the puzzle box on page 162 of the reader.

Problem 2—Calculating remainders

Write the program for a Turing machine $M_{\%3}$ that computes the remainder of its input when divided by 3. Given, for example, an input tape containing the number 8

... **0** **1** 1 1 1 1 1 1 1 1 0 ...

executing $M_{\%3}$ should leave the number 2 on the tape, because 2 is the remainder of 8 divided by 3.

... **0** **1** 1 0 ...

Note that your program must leave the tape head at the beginning of the remainder.

Problem 3—Duplicating a number

Implement a Turing machine M_{copy} that copies an input value on the tape, leaving two identical values on the output tape separated by a single 0. Thus, if the input tape is

... **0** **1** 1 1 0 0 0 0 0 0 ...

the final configuration of the tape should look like this:

... **0** **1** 1 1 0 1 1 1 0 0 ...

Problem 4—The Busy Beaver problem

The solution for the BB(4) problem, which produces thirteen 1s, is included in the library with the Turing machine simulator. To get a feel for how challenging this problem is, write a four-state Turing machine that produces at least eight but no more than twelve 1s before stopping. It will probably help to look at the solution to BB(3) for ideas.