

# CMP 132 Homework 1

3 problems, 15 pts, due Thursday, January 19.

Problems to turn in (work in groups of 2 or 3):

1. (5 pts) Give both the transition diagram and state transition table for a Turing Machine that computes the following “+1” function.

On any input  $x \in \{0, 1\}^+$  containing a zero, interpret  $x$  as an  $n$ -digit binary number and produce the  $n$ -digit binary representation of  $x + 1$ . On any input  $x \in \{1\}^*$ , produce the string of zeros of the same length as  $x$ .

Therefore, given input “001” the Turing Machine should produce “010” and given “1111” it should produce “0000”. This “wrap around” to all zeros is intended to make the solution simpler (i.e. use fewer states).

2. (5 pts) Give a transition diagram for a Turing Machine with three non-final states and tape alphabet  $\Gamma = \{1, \sqcup\}$  that, when given the empty string as input, halts while leaving as many ones as possible on the tape. (Finding a TM that leaves as many ones as possible may be difficult, simply find one that writes several ones.) Show the sequence of configurations entered by your machine.
3. (5 pts) (harder) Problem 3.12 on page 161 of the text (TMs with left reset instead of move left).

Problems to do, but do not turn these in:

1. Exercise 3.7 on page 160 of the text.
2. Exercise 3.8 on page 160 of the text.
3. Problems 3.15 and 3.16 on page 161 of the text
4. Read and understand problems 3.9, 3.11, 3.13, and 3.14. How many of them can you see how to solve?