MCS 441 Theory of Computation
Problem Set 10

For any of the following problems you need only give an "implementation level" description of the machine.

1) Design a Turing machine that takes a number N in base 2 and calculates $N+1$ in base 2.

Assume that we begin with $\#a_n a_{n-1} \ldots a_0$ on the input tape where $a_i \in \{0,1\}$ and $N = \sum a_i 2^i$ and ends with either $\#b_n \ldots b_0$ or $b_{n+1} \ldots b_0$ on the tape where $N+1 = \sum b_i 2^i$.

2) Design a nondeterministic Turing machine to recognize the language

$$L = \{\#w_1\#w_2\#\ldots\#w_n\# : n \geq 2, w_i \in \{0,1\}^* \text{ and } w_i = w_j \text{ for some } i < j\}.$$

You may use multiple tapes if that's helpful.

3) Prove that every context free language is Turing decidable. [Hint: Recall that if L is context free there is a PDA recognizing L.]