CS341 Automata Theory
Homework Assignment ♯6

Do not forget to write your name and EID.

1. Give state diagram for TM that recognizes the following language:
   $\{w2w^R | w \in (0 \cup 1)^*\}$

2. Design a TM that computes the function

   (a) f(n) = 3n

   (b) f(n) = n*(n-1)

   (c) f(n, m) = n+m+3

3. A Turing machine with left reset is similar to an ordinary TM except that the transition function has the form
   $\delta : Q$ x $\Gamma \rightarrow Q$ x Γ x $\{R, RESET\}$.
   If $\delta(q, a) = (r, b, RESET)$, when the machine is in state q and reads an a, then the machine's head jumps to the left end of the tape after writing b on the tape and entering state r. These machines cannot move the tape head one symbol to the left. Show that Turing machines with left reset recognize the class of Turing-recognizable languages (ie, show this model is equivalent to the original TM model).

4. For the following languages/decision problems, prove whether the language is (I) decidable, (II) semi-decidable but not decidable, or (III) not semi-decidable.

   (a) $L = \{< M > |$ there is at least one input on which TM M halts within 1000 steps$\}$

   (b) $L = \{< M > | M$ accepts at least one string that ends with 0$\}$

   (c) $L = \{< M_1, M_2 > | \varepsilon \in L(M_1) \cup L(M_2)\}$

5. problem 5.9 in Sipser

6. Show the decidable languages are closed under complement.

7. Show the semi-decidable languages are closed under concatenation.

8. problem 4.15 in Sipser

9. Consider the following question: Given a DFA D, is L(D) infinite? Show that this language is decidable by defining the corresponding language and proving the language is decidable.