Assignment 6

Computer Science 235

Reading. Sections 3.1, 3.2, and 3.3

1) Consider the TM M_1 given in Example 3.9 on page 173 of the text. Give the sequence of configurations that M_1 enters when started on the indicated input string.

a) 10#11

b) 10#10

2) Give a formal definition of an enumerator. Consider it to be a type of two-tape Turing machine that uses its second tape as the printer.

3) In Theorem 3.21 on page 181 in the text, it was shown that a language is Turing-recognizable iff some enumerator enumerates it. Why wasn't the following simpler algorithm used for the forward direction of the proof? Recall, $s_1, s_2, \ldots$ is a list of all strings in Σ^*.

E = "Ignore the input.

1. Repeat the following for $i = 1, 2, 3, \ldots$
2. Run M on s_i.
3. If it accepts, print out s_i."

4) Explain why the following is not a description of a legitimate Turing machine.

M_{bad} = "On input $\langle p \rangle$, a polynomial over variables $x_1, \ldots, x_k$:

1. Try all possible settings of $x_1, \ldots, x_k$ to integer values.
2. Evaluate p on all of these settings.
3. If any of these settings evaluates to 0, *accept*; otherwise, *reject*."

5) Give a description of a Turing machine that decides the language $\{w \mid w$ contains twice as many 0s as 1s $\}$.

6) A ***Turing machine with stay put instead of left*** is similar to an ordinary Turing machine, but the transition function has the form

$$\delta: Q \times \Gamma \rightarrow Q \times \Gamma \times \{R, S\}.$$

At each point, the machine can move its head right or let it stay in the same position. What class of languages do these machines recognize?

7) Show that the collection of decidable languages is closed under the operation of

a) complementation

b) intersection

8) Show that a language is decidable iff some enumerator enumerates the language in lexicographic order.