COMP 3721: Theory of Computation
Written Assignment 3
Assigned: April 10 Due: April 22

Question 1

Construct a one-tape Turing machine to perform the following task:

- If the input string is empty or just a symbol, halt; otherwise, transform the input string $\sigma_1\sigma_2\cdots\sigma_n$ into $\sigma_1\#\sigma_2\#\cdots\#\sigma_n$, then halt.

You may assume that the input string consists only of a's and b's, and that initially the tape head is immediately to the right of $\triangleright$. The tape head should return to the initial position when the machine halts.
Note: You need to draw the TM by combining the simpler machines (e.g., symbol-writing and head-moving machines), as described in class.

Question 2

Prove or disprove:

a) If L_1 is regular and L_2 is recursively enumerable (i.e., Turing-acceptable), then $L_1 - L_2$ is regular.

b) If L_1 is recursively enumerable and L_2 is context-free, then $L_1 \cap L_2$ is recursively enumerable.

Question 3

Show that a language L is recursive if and only if there is a Turing machine M that enumerates the strings of L in a non-decreasing order of their lengths.

Question 4

Are the following problems solvable? Justify your answer.

a) Given a deterministic Turing machine M, does there exist a string w such that M accepts w in less than 10 steps?

b) Given a deterministic Turing machine M, does there exist a string w such that M accepts w in at least 10 steps?