Homework Assignment #8

Note

This assignment is due 2:10PM Monday, May 13, 2019. Please write or type your answers on A4 (or similar size) paper. Put it on the instructor's desk before the class on the due date starts. Late submission will be penalized by 20% for each working day overdue. You may discuss the problems with others, but copying answers is strictly forbidden.

Problems

(Note: problems marked with "Exercise X.XX" or "Problem X.XX" are taken from [Sipser 2013] with probable adaptation.)

1. (10 points) Give a formal definition of a Turing machine that appends a # at the end of the input string and then copies and appends the original input after the #. The input alphabet is $\{0, 1\}$.

2. (Exercise 3.4; 10 points) Give a formal definition of an enumerator (like that of an NFA, PDA, or Turing machine). Consider it to be a type of two-tape Turing machine that uses its second tape as the printer. Include a definition of the enumerated language.

3. (Problem 3.11; 20 points) Show that single-tape TMs that cannot write on the portion of the tape containing the input string recognize only regular languages.

4. (Problem 3.13; 20 points) Show that a language is decidable iff some enumerator enumerates the language in the standard string order (the usual lexicographical order, except that shorter strings precede longer strings) .

5. (Exercise 4.3; 10 points) Let $ALL_{\text{DFA}} = \{\langle A\rangle \mid A \text{ is a DFA and } L(A) = \Sigma^*\}$. Show that ALL_{DFA} is decidable.

6. (20 points) Let $A = \{\langle M, N\rangle \mid M \text{ is a PDA and } N \text{ is a DFA such that } L(M) \subseteq L(N)\}$. Show that A is decidable.

7. (Problem 4.4; 10 points) Let $A\varepsilon_{\text{CFG}} = \{\langle G\rangle \mid G \text{ is a CFG that generates } \varepsilon\}$. Show that $A\varepsilon_{\text{CFG}}$ is decidable.