

CMPE 350 - Spring 2017

PS 9 - 11.04.18

3.6 In Theorem 3.21, we showed that a language is Turing-recognizable iff some enumerator enumerates it. Why didn't we use the following simpler algorithm for the forward direction of the proof? As before, s_1, s_2, \dots is a list of all strings in Σ^* .

E = "Ignore the input.

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

3.7 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, \dots, x_k :

1. Try all possible settings of x_1, \dots, 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."

3.11 A Turing machine with doubly infinite tape is similar to an ordinary Turing machine, but its tape is infinite to the left as well as to the right. The tape is initially filled with blanks except for the portion that contains the input. Computation is defined as usual except that the head never encounters an end to the tape as it moves leftward. Show that this type of Turing machine recognizes the class of Turing-recognizable languages.

3.12 A Turing machine with left reset is similar to an ordinary Turing machine, but the transition function has the form

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

If $\delta(q, a) = (r, b, \text{RESET})$, when the machine is in state q reading an a , the machine's head jumps to the left-hand end of the tape after it writes b on the tape and enters state r . Note that these machines do not have the usual ability to move the head one symbol left. Show that Turing machines with left reset recognize the class of Turing-recognizable languages.

3.15 Show that the collection of decidable languages is closed under the operation of

- a) union.
- b) concatenation.
- c) star.
- d) complementation.
- e) intersection.

3.16 Show that the collection of Turing-recognizable languages is closed under the operation of

a) union.

b) concatenation.

c) star.

d) intersection.

3.18 Show that a language is decidable iff some enumerator enumerates the language in the standard string order.