Theory of Computation, Fall 2021
Assignment 6 Solutions

Exercises

Q1. (a) True. Every Turing machine semidecides exactly one language, which is $L(M)$.

(b) False. If a Turing machines does not always halt, then it does not decides any language.

(c) False.

Q2. Since M decides some language, it halts on every input. Therefore, $L(M)$ is the set of all strings over the input alphabet.

Q3. This problem is equivalent to the language $L(G)$, and the following Turing machine M decides this language where M_{C1} is the Turing machine we used to decide A_{CFG} in class.

$M =$ on input w:
1. run M_{C1} on "G""w".
2. accept if M_{C1} accept, and reject otherwise.

We can conclude that every context-free language is recursive.

Q4. The problem can be expressed as

$$A = \{\text{“}M\text{”“}R\text{”} : M \text{ is a DFA and } R \text{ is a regular expression such that } L(M) = L(R)\}$$

We construct a Turing machine M^* to decide A as follows.

$M^* =$ on input "M""R":
1. convert R to an equivalent NFA, and then convert the NFA to an equivalent DFA D.
2. run M_{R5} on "M""D" (to see whether M and D are equivalent)
3. If M_{R5} accepts,
4. accept
5. else
5. reject

Recall that M_{R5} is the Turing machine we used in class to decide whether two DFAs are equivalent.