

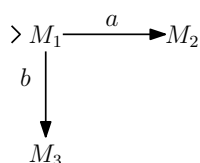
Theory of Computation, Fall 2023

Assignment 6 (Due November 22 Wednesday 10:00 am)

Only part I will be graded.

1 Part I

- Q1. Let $\Sigma = \{a, b, c, \triangleright, \sqcup\}$. Let $M_i = (K_i, \Sigma, \delta_i, s_i, H_i)$ for $i = 1, 2, 3$ be three Turing machines. Give the definition of the following Turing machine in terms of M_1, M_2, M_3 .



- Q2. Design a right-shifting machine S_{\rightarrow} that transforms $\triangleright \sqcup w \sqcup$ into $\triangleright \sqcup \sqcup w \sqcup$, where w is a string that contains no blank symbol. You may use the machines and the diagrams we presented in class.
- Q3. Are the following statements true or false? Briefly explain your answer.
- (a) Every standard Turing machine semidecides some language.
 - (b) Every standard Turing machine decides some language.
- Q4. Let M be a Turing machine that decides some language. What is $L(M)$? (Recall that $L(M)$ is the language semidecided by M .)
- Q5. Let L be a recursive language. Prove that \bar{L} is also recursive.

2 Part II

- Q6. Let D be a DFA. Consider the following decision problem.

Given a string w , does D accept w ?

- (a) What is the language corresponding to the following problem?
 - (b) Is this language recursive?
 - (c) Prove that every regular language is recursive.
- Q7. Let $L = \{w \in \{0, 1\}^* : w \text{ contains an odd number of 1's}\}$. Define

$$A_L = \{“D” : D \text{ is a DFA that accepts } L\}.$$

Show that A_L is recursive. (Hint: you may reduce A_L to EQ_{DFA} .)