ECE590 Homework 4 Fall 2024

Due:Oct 8 at noon

24 points

1. Give the sequence of configurations that Turing machine $M1$ enters when started on input string 110#11.

   $M1 = (Q, \Sigma, \Gamma, \delta, q_1, q_{accept}, q_{reject})$

   - $Q = \{q_1, q_2, ..., q_8, q_{accept}, q_{reject}\}$
   - $\Sigma = \{0, 1, \#\}$
   - $\Gamma = \{0, 1, \#, x, \sqcup\}$
   - We describe δ with a table and a state diagram (see the following table and figure)
   - The start, accept, and reject states are q_1, q_{accept}, and q_{reject} respectively.

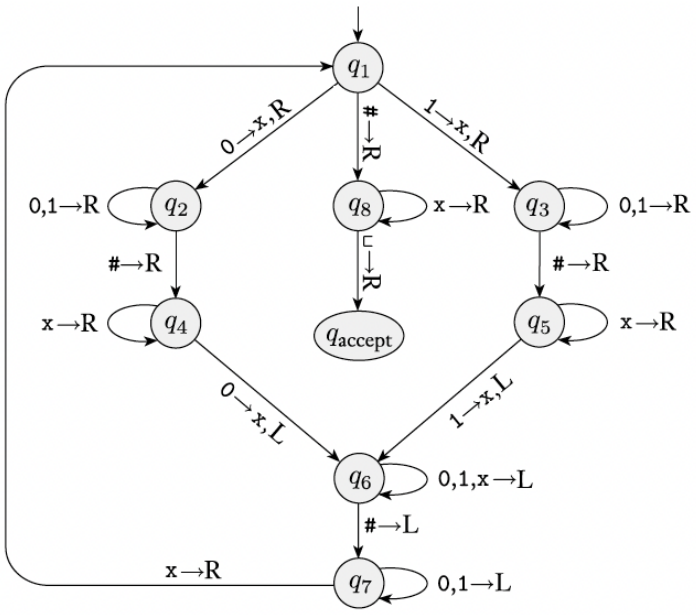

Figure 1: M_1 from Sipser chapter 3

state/ symbol	0	1	#	x	$\sqcup$
q_1	(q_2, x, R)	(q_3, x, R)	(q_8, R)		
q_2	(q_2, R)	(q_2, R)	(q_4, R)		
q_3	(q_3, R)	(q_3, R)	(q_5, R)		
q_4	(q_6, x, L)			(q_4, R)	
q_5		(q_6, x, L)		(q_5, R)	
q_6	(q_6, L)	(q_6, L)	(q_7, L)	(q_6, L)	
q_7	(q_7, L)	(q_7, L)		(q_1, R)	
q_8				(q_8, R)	(q_{accept}, R)
q_{accept}					
q_{reject}					

To simplify the figure, we don't show the reject state or the transitions going to the reject state. Those transitions occur implicitly whenever a state lacks an outgoing transition for a particular symbol. Thus because in state q_5 no outgoing arrow with a # is present, if a # occurs under the head when the machine is in state q_5, it goes to q_{reject}.

2. For the language $A = \{w\#w^R : w \in \{0,1\}^*\}$:

   (a) Describe an algorithm (implementation-level description) for a Turing Machine that decides A.

   (b) Formally define your Turing machine. Describe the transition function with a table or a state diagram.