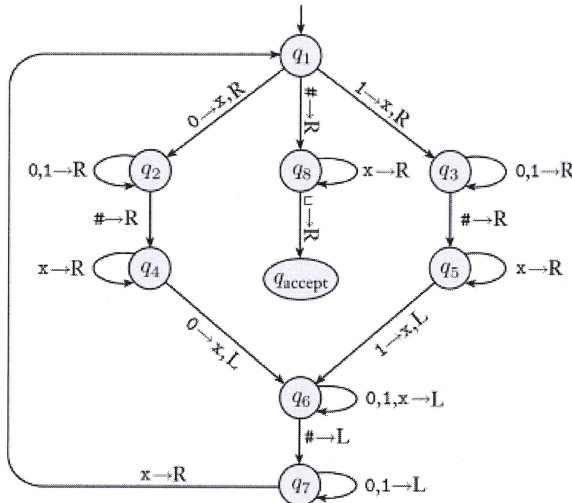


Name: Key

CS301 F7

1. (/3 pts) Consider the TM M_1 given below. Give the sequence of configurations that M_1 enters when started on the input string 01#0#.



$q_1, 01 \# 0 \#$
 $x q_1 1 \# x \#$
 $x q_2 1 \# 0 \#$
 $x x q_3 \# x \#$
 $x 1 q_2 \# 0 \#$
 $x x \# q_5 x \#$
 $x 1 \# q_4 0 \#$
 $x x \# x q_5 \#$
 $x 1 q_6 \# x \#$
 $x q_7 1 \# x \#$
 $q_7 x 1 \# x \#$
 reject.

2. (/3 pts) For each of the following statements, circle **TRUE** or **FALSE**.

- **TRUE**/FALSE - There exists a TM with $\Sigma = \emptyset$ and $|\Gamma| = 1$. $\cup \in \Gamma$
- ☺ • **TRUE**/FALSE - A TM's transition function has range $Q \times \Gamma \times \{L, R\}$.
- **TRUE**/FALSE - Every Turing-recognizable language is decidable, but there are decidable languages that are not Turing-recognizable.

recognizable
decidable

3. (/4 pts) Describe a TM which decides the language

$$B = \{a^i b^j c^k \mid i + j \text{ divides } k \text{ and } i, j, k \geq 1\}.$$

on input string w :

- ① Scan w from left to right to determine if $w \in a^+ b^+ c^+$ and reject if not.
- ② Return head to left-hand end of tape.
- ③ Replace all b s with a s then return head to end of tape.
- ④ Zig-zag crossing off c s and dotting a s. If last a and last c are marked together, accept. If no more a s can be marked and unmarked a s remain, reject. If more a s remain after dotting all a s, continue.
- ⑤ Undot all a s and return to step ④.