Quiz 18

1. Consider the following Turing Machine: $M = (\{q_0, q_1, q_2, q_{\mathsf{acc}}, q_{\mathsf{rej}}\}, \{0,1\}, \{0,1,\sqcup\}, \delta, q_0, q_{\mathsf{acc}}, q_{\mathsf{rej}})$, where

$$\begin{array}{ll} \delta(q_0, 0) = (q_1, 1, \mathsf{R}) & \delta(q_1, 1) = (q_2, 0, \mathsf{L}) \\ \delta(q_2, 1) = (q_0, 1, \mathsf{R}) & \delta(q_1, \sqcup) = (q_{\mathsf{acc}}, \sqcup, \mathsf{R}) \end{array}$$

   As always, we assume for cases not mentioned above, $\delta(q, a) = (q_{\mathsf{rej}}, \sqcup, \mathsf{R})$. Suppose the current configuration is $1q_11$. The next configuration is

   (A) q_201
   (B) $1q_20$
   (C) q_210
   (D) $10q_2\sqcup$

   Correct answer is (C).

2. Consider the following Turing Machine: $M = (\{q_0, q_1, q_2, q_{\mathsf{acc}}, q_{\mathsf{rej}}\}, \{0,1\}, \{0,1,\sqcup\}, \delta, q_0, q_{\mathsf{acc}}, q_{\mathsf{rej}})$, where

$$\begin{array}{ll} \delta(q_0, 0) = (q_1, 1, \mathsf{R}) & \delta(q_1, 1) = (q_2, 0, \mathsf{L}) \\ \delta(q_2, 1) = (q_0, 1, \mathsf{R}) & \delta(q_1, \sqcup) = (q_{\mathsf{acc}}, \sqcup, \mathsf{R}) \end{array}$$

   As always, we assume for cases not mentioned above, $\delta(q, a) = (q_{\mathsf{rej}}, \sqcup, \mathsf{R})$. What can we say about the Turing machine M?

   (A) M halts on all inputs
   (B) M never halts on some inputs
   (C) M does not halt on any input
   (D) There is an input on which M sometimes halts and sometimes does not halt.

   Correct answer is (A).

3. Which of the following is true for the input alphabet Σ (assuming $\Sigma \neq \emptyset$) and the tape alphabet Γ of Turing machine?

   (A) It is possible that $\Sigma = \Gamma$.
   (B) Γ is a strict superset of Σ.
   (C) Σ is a strict superset of Γ.
   (D) It is possible that Σ and Γ are disjoint.

   Correct answer is (B).

4. How many Turing Machines are there with only three states q_0 q_{acc} and q_{rej}, with $\Sigma = \{0,1\}$ and $\Gamma = \{0,1,\sqcup\}$?

   (A) 3
   (B) 3^2
   (C) 18^3
   (D) Infinitely many.

   Correct answer is (C).