Quiz 3
CS 373: Theory of Computation

Date: October 19, 2010. Lecture Section AL2. Time limit: 15 minutes.

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<th>Discussion</th>
<th>Tu 2-2:50</th>
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Pick the correct alternative from among the choices (A), (B), and (C) provided for each question below. Each question is worth 1 point.

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

$$\delta(q_0, 0) = (q_1, 1, \text{R}) \quad \delta(q_1, 1) = (q_2, 1, \text{L})$$

$$\delta(q_2, 1) = (q_1, 1, \text{R}) \quad \delta(q_1, \sqcup) = (q_{\text{acc}}, \sqcup, \text{R})$$

As always, we assume for cases not mentioned above, $\delta(q, a) = (q_{\text{rej}}, \sqcup, \text{R})$. Suppose the current configuration is $1q_00$. The next configuration is

(A) $1q_11$
(B) $11q_1\sqcup$
(C) $10q_11$

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

$$\delta(q_0, 0) = (q_1, 1, \text{R}) \quad \delta(q_1, 1) = (q_2, 1, \text{L})$$

$$\delta(q_2, 1) = (q_1, 1, \text{R}) \quad \delta(q_1, \sqcup) = (q_{\text{acc}}, \sqcup, \text{R})$$

As always, we assume for cases not mentioned above, $\delta(q, a) = (q_{\text{rej}}, \sqcup, \text{R})$. 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

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

(A) 3
(B) $18^3$
(C) infinitely many
4. Suppose $M_1$ and $M_2$ are two TMs such that $L(M_1) \subseteq L(M_2)$. Then

(A) on every input on which $M_1$ does not halt, $M_2$ does not halt.
(B) on every input on which $M_1$ halts, $M_2$ halts too.
(C) on every input which $M_1$ accepts, $M_2$ halts.

5. If $L_1$ and $L_2$ are Turing-recognizable then $L_1 \cup L_2$ is

(A) Decidable
(B) Turing-recognizable but may not be decidable
(C) May not be Turing-recognizable

6. If $L$ is decidable, then

(A) $L$ and $\overline{L}$ must be Turing-recognizable.
(B) $L$ must be Turing-recognizable, but $\overline{L}$ need not be.
(C) exactly one of $L$ and $\overline{L}$ is Turing-recognizable.