**6.045J/18.400J: Automata, Computability and Complexity** Prof. Ron Rivest

# Handout 9: Recitation Problems

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**Problem 1**: **Warm up:** Suppose $L_1$ and $L_2$ are decidable languages. Which of the following are decidable?

- $L_1 \cup L_2$
- $L_1 \cap L_2$
- $L_1 \setminus L_2$
- $\overline{L_2}$
- $L_2^*$
- $L_1 \circ L_2$

What if $L_1$ and $L_2$ are recognizable? Which of the above are recognizable?

**Problem 2**: For the TM $M_1$ in exercise 3.4, give the sequence of configuration that $M_1$ enters into on the input strings:

- 0
- 00
- 000

**Problem 3**: What can be said about the language $L(M)$ in each of the following cases?

- $M$ moves its head right on each move.
- There is some integer $n$ such that, no matter what its input is, $M$ never moves its head past square $n$.
- For at least one input string $x$, $M$ accepts before moving its head to the end of $x$.
- $M$ never changes any symbol on its tape.

**Problem 4**: Show that a language is recognizable iff it is enumerable. (Yes, we did this in class.)

**Problem 5**: Show that a language is recognizable iff a non-deterministic Turing machine recognizes it.