CS 341: Foundations of Computer Science II
Prof. Marvin Nakayama

Homework 10

1. If $A \leq_{\mathrm{m}} B$ and B is a regular language, does that imply that A is a regular language?

2. Show that A_{TM} is not mapping reducible to E_{TM}. In other words, show that no computable function reduces A_{TM} to E_{TM}. (Hint: Use a proof by contradiction, and facts you already know about A_{TM} and E_{TM}.)

3. Consider the language

$$A\varepsilon_{\mathrm{TM}} = \{ \langle M \rangle \mid M \text{ is a TM that accepts } \varepsilon \}.$$

   Show that $A\varepsilon_{\mathrm{TM}}$ is undecidable.

4. A *useless state* in a Turing machine is one that is never entered on any input string. Consider the problem of determining whether a state in a Turing machine is useless. Formulate this problem as a language and show it is undecidable.