Reading: Section 6.3

Problem 1: Quiz Questions? Quiz Statistics...

Problem 2: Define the following new terms and concepts:

1. An oracle for a language.
2. An oracle Turing machine.
3. Turing reducibility.
4. A language $A$ is decidable relative to a language $B$.
5. $T_{ATM}^A$.

Summary: If $T^B$ decides $A$, then we say that $A$ is decidable relative to $B$. A language $A$ is Turing reducible to language $B$, written $A \leq_T B$, if $A$ is decidable relative to $B$. If $A \leq_T B$ and $B$ is decidable, then $A$ is decidable.

How is this different from mapping reducibility? Turing reducibility is a generalization of mapping reducibility. If $A \leq_m B$, then $A \leq_T B$, but there is no reverse implication.

Problem 3: Let’s explore a case where $A \leq_T B$, but $A \not\leq_m B$. First, recall that $E_{TM} \not\leq_m A_{TM}$. Why? We know that $A_{TM}$ is recognizable. If $E_{TM} \leq_m A_{TM}$, then by Thm 5.22 $E_{TM}$ would also be recognizable. However, we know that $E_{TM}$ is not recognizable.

Now, let’s see why $E_{TM} \leq_T A_{TM}$. Given an oracle for $A_{TM}$ we show how to build an oracle TM to decide $E_{TM}$. (Details on the board; see Sipser page 212.)

Problem 4: Show $HALT_{TM}$ is decidable relative to $A_{TM}$.