

Recitation 8: Oracle Turing Machines

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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. $T^{A_{TM}}$.

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} .