

Complete this checkpoint **on your own**, and email your solution to ndobson@andrew.cmu.edu by **11:59 PM on March 21st** with “[FLAC checkpoint 6]” in the subject.

Your work should be legible and preferably typed, but you don’t have to use TeX.

1 Technology vs. Magic

Is an oracle Turing machine a Turing machine? (*Hint*: The answer is no.) Why not?

2 Why Technology Is Better

- (a) Construct a decider for TOTAL making use of a (putative) decider for HALTS. You do not need to give a proof of correctness (just this once!).
- (b) Explain where the above construction fails if the decider is replaced with an oracle.
- (c) Prove that TOTAL is not decidable in HALTS—that is, an oracle Turing machine with an oracle for HALTS cannot decide TOTAL. You may use results from the homework.
- (d) Based on the above, explain intuitively how oracles are weaker than deciders. (*Hint*: Think about types.)

3 Why Magic Is Better

- (a) Prove that a (putative) decider for HALTS cannot decide HALTS. (Your solution should be at most two lines long.)
- (b) Explain where the above proof fails if the decider is replaced with an oracle Turing machine.
- (c) Based on the above, explain intuitively how deciders are weaker than oracles.

4 Types of Reductions

- (a) Decide with proof whether there exist a Turing reduction from TOTAL to HALTS. (Your solution should be at most two lines long and should reference a previous problem.)
- (b) Which statement is stronger (implies the other): $A \leq_m B$ or $A \leq_T B$?
- (c) A *Rudich reduction* is a hypothetical type of reduction that I just made up. What does it mean for a language A to be Rudich-complete for a class of languages \mathcal{L} ?