CS 525: Theory of Computation
Problem Set 5, Re-do

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March 14, 2012

6.15 **Solution:** For any language A, we can create a language B that consists of the set of all strings that map to Turing Machines that decide A. If we have an oracle for B, then the following Turing Machine, T^B, decides A:

$T^B =$ On input w, where w is a string:

(a) Enumerate strings and test for membership in B. Start with strings of length 1, and then length 2, and so on.

(b) If A is decidable, then eventually a string $\langle M \rangle$ in B will be found since some Turing Machine must decide A.

(c) Convert the string $\langle M \rangle$ into TM M, and simulate $\langle M, w \rangle$. Since M decides A, it will halt on w. If M accepts, accept. If M rejects, reject.

If such an oracle for B exists, then A is decidable. Therefore, $A \leq_T B$. On the other hand, if an oracle for A exists, we can't use it to decide B.