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Given that

$$A_{TM}' = \{\langle M, w\rangle \mid M \text{ is an oracle TM(turing machine) and } M^{A_{TM}} \text{ accepts } w\}$$

We have to show that A_{TM}' is undecidable relative to A_{TM}.

Take a contradiction of A_{TM}' is decidable relative to A_{TM}.

Hence there exists an oracle *TM T* with oracle access to A_{TM} which decides A_{TM}'.

Now we construct another oracle *TM N* as follows:

N="on input

1. Run $T^{A_{TM}}$ on input >

2. If *T* accepts, *reject*.

3. Else if *T* rejects, *accept*".

• So $N^{A_{TM}}$ accepts if and only if *M* rejects.

• When the input of *N* is <*N*>, we have $N^{A_{TM}}$ accepts <*N*> if and only if *N* rejects <*N*>.

This is a contradiction to our hypothesis, that A_{TM}' is decidable relative to A_{TM} is wrong. Hence, A_{TM}' is un-decidable relative to A_{TM}.