Theory of Computation, CSCI 438 spring 2022
Introduction to Complexity Theory and Complexity Relationships among Models, pg. 275-284, April 22nd

Let $A=\{0^k1^k \mid k \geq 0\}$

1. Find the time complexity of deciding A using a single tape Turing machine.

2. If your above algorithm runs in $O(n^2)$, define an algorithm that runs in $O(n\text{Log}_2 n)$.

3. Find the time complexity of deciding A using a 2-tape Turing machine.

4. Describe why the following theory makes sense:

   Theorem 7.8 (page 282)

   Let t(n) be a function, where $t(n) \geq n$. Then every t(n) time multi-tape Turing machine has an equivalent $O(t^2(n))$ time single-tape Turing machine.

5. Describe why the following theory makes sense:

   Theorem 7.11 (page 284)

   Let $t(n)$ be a function, where $t(n) \geq n$. Then every $t(n)$ time nondeterministic single-tape Turing machine has an equivalent $2^{O(t(n))}$ time deterministic Turing machine.

6. Exercise 7.5

Is the following formula satisfiable?

$$(x \vee y) \wedge (x \vee \overline{y}) \wedge (\overline{x} \vee y) \wedge (\overline{x} \vee \overline{y})$$

8. Using the fact that A_{TM} is not decidable, prove that HALT is not decidable.

$HALT_{TM}$ = {<M,w> | M encodes a TM, w is a string in the alphabet of M, and M halts on w}