COS126 — Practice Your Theory

Match each item below with one of the following four concepts: Universal, Undecidable, Turing Machine, and Church-Turing thesis.

- A. A problem that cannot be solved by any Turing Machine. Undecidable
- B. There is a Turing Machine that can simulate any other. Universal
- C. Anything computable in this universe can be computed by some Turing Machine. Church-Turing thesis
- D. A simple, universal, model of computation. Turing Machine

Mark each of the following statements as True or False.

1. The undecidability of the halting problem is a statement about Turing machines: it is not applicable to real computers. False
2. The Turing machine is a universal model of computation: with a Turing machine we can solve any decision problem that can be solved with a DFA or with a Pentium M running Linux. True
3. Because the Halting Problem is unsolvable, it is impossible to tell if your TSP program for your assignment has an infinite loop. False. We can analyze some instances, although no program can correctly analyze all instances.
4. If P equals NP, then the Traveling Salesperson Problem can be solved in polynomial time by a deterministic Turing Machine. True
5. If P does not equal NP, then there is no case of the Traveling Salesperson Problem for which you can find the optimal tour in polynomial time. False. We can solve some instances (like ones on a line or a regular n-gon), although no program can correctly analyze all instances quickly.
6. As far as we know, it is possible that all NP-complete problems have polynomial-time algorithms. True. This would mean P=NP
7. As far as we know, it is possible that some, but not all, NP-complete problems have polynomial-time algorithms. False
8. As far as we know, it is possible that no NP-complete problems have polynomial-time algorithms. True. This would mean P≠NP

   For the next two questions, use the fact that factoring is known to be in NP, but that nobody knows whether it is NP-complete.

9. The discovery of a polynomial-time algorithm for factoring would mean that P equals NP. False
10. No polynomial-time algorithm for factoring is possible. False