Quiz 10 Solutions

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This quiz does not count towards your grade. It exists to simply gauge your understanding. Treat this as though it were a portion of your midterm or final exam.

1 Countability

1. Prove that the set of all functions mapping the naturals $\mathbb{N}$ to $\{0, 1\}$ is uncountable.

   Solution: Apply Cantor's diagonalization proof, where we consider every possible sequence of outputs.

2 Computability

1. Prove that autograding a Python homework assignment, in general, is uncomputable.

   Solution: Assume for contradiction we have the autograder A. Then, we construct a program P.

   def P(Q):
   run Q
   return 1

   Then, we autograde P, to check that it returns 1 when we call P on a program Q. Since A works, we know that it will properly check if P returns 1. This means that for any program Q, we can use the autograder to check that $P(Q) = 1$, implying that Q terminated. We have thus solved the halting problem. Contradiction.