Computability and Complexity **Winter 2020**

Week 1/6 - 1/12 Exercise

January 8, 2020 Gabriel Chen

1. Consider the set of all TM programs. Does Turing argue that the tape symbol alphabets of different programs should be uniformly bounded in size, or may different machines each hav their own alphabets, without any uniform size bound?

2. Following the setup of the first question, assume that the tape symbol alphabets of different programs are uniformly bounded in size. Could one reasonable argue that the set of states of mind should be uniformly bounded as well? Hint: What would be the effect of bounding both of these on the number of problems solvable by TMs?

3. Prove that the set of all total functions $IN \to \{0, 1\}$ is not countable.

4. Write a WHILE program that takes an input d and returns the list of atoms in d from left to right. For instance, with $d = ((a.b).(a.(c.d))$ the programs should yield $(abacd)$ (i.e., $(a.(b.(a.(c.(d.nil))))))$.

5. Let $\sigma = \{X \mapsto (nil.nil)\}$, C be while X do X:= X, and show that there is no σ' such that $C \vdash \sigma \to \sigma'$.

6. Show how one can compile from S-programs to L-programs, if given an S-interpreter written in L and a L-specializer. State appropriate assumptions concerning the relationships between various input and output domains.