

2 Counting Functions

Note 11

Are the following sets countable or uncountable? Prove your claims.

(a) The set of all functions f from \mathbb{N} to \mathbb{N} such that f is non-decreasing. That is, $f(x) \leq f(y)$ whenever $x \leq y$.

(b) The set of all functions f from \mathbb{N} to \mathbb{N} such that f is non-increasing. That is, $f(x) \geq f(y)$ whenever $x \leq y$.

3 Hello World!

Note 12

Determine the computability of the following tasks. If it's not computable, write a reduction or self-reference proof. If it is, write the program.

(a) You want to determine whether a program P on input x prints "Hello World!". Is there a computer program that can perform this task? Justify your answer.

(b) You want to determine whether a program P prints "Hello World!" before running the k th line in the program. Is there a computer program that can perform this task? Justify your answer.

(c) You want to determine whether a program P prints "Hello World!" in the first k steps of its execution. Is there a computer program that can perform this task? Justify your answer.

4 Code Reachability

Note 12

Consider triplets (M, x, L) where

- M is a Java program
- x is some input
- L is an integer

and the question of: if we execute $M(x)$, do we ever hit line L ?

Prove this problem is undecidable.