

Week 3: Computability and Turing Machines

Mathematical Logic Course

April 24, 2023

Introduction

- ▶ Welcome to Week 3 of our Mathematical Logic Course!
- ▶ This week, we'll explore the concepts of computability and Turing machines.
- ▶ We'll cover the following topics:
 - ▶ Introduction to computability theory
 - ▶ Turing machines: definition and examples
 - ▶ Decidable and undecidable problems

Computability Theory

- ▶ What does it mean for a problem to be computable?
- ▶ Alan Turing and his contributions to computability theory
- ▶ Formal definition of an algorithm
- ▶ Church-Turing thesis

Turing Machines

- ▶ What is a Turing machine?
- ▶ Components of a Turing machine: tape, head, states, transition function
- ▶ Formal definition of a Turing machine
- ▶ Examples of Turing machines
 - ▶ Turing machine for addition
 - ▶ Turing machine for recognizing palindromes

Decidability and Undecidability

- ▶ Decidable problems: problems that can be solved by a Turing machine
- ▶ Undecidable problems: problems that cannot be solved by any Turing machine
- ▶ Examples of decidable problems
- ▶ Examples of undecidable problems
 - ▶ The Halting Problem

Summary and Conclusion

- ▶ Recap of the topics covered in this lecture
- ▶ Introduction to computability and Turing machines
- ▶ Understanding the limits of computation
- ▶ Next week, we'll dive into Gödel numbering and representability

Questions and Discussion

- ▶ Do you have any questions about today's lecture?
- ▶ Let's discuss the material and explore any questions you may have

Coding Exercises

- ▶ Implementing and simulating Turing machines in Python
- ▶ Exploring examples of decidable and undecidable problems