Week 1: Introduction to Mathematical Logic

Mathematical Logic Course

April 24, 2023

Overview

- What is mathematical logic?
- Propositional logic: syntax and semantics
- Truth tables and logical equivalences
- Coding exercises

What is Mathematical Logic?

- Study of formal systems in logic and mathematics
- Provides a foundation for understanding mathematical proofs
- A way to study formal languages and their interpretations

Propositional Logic

- Basic building blocks: propositions, connectives, and truth values
- Examples of propositional formulas:
  - P
  - $P \wedge Q$
  - $P \vee \neg Q$
- Syntax: rules for constructing well-formed formulas

Truth Tables

- A way to represent the truth values of propositional formulas
- Columns represent propositions and connectives
- Rows represent all possible assignments of truth values
- Example: truth table for $P \wedge Q$

Logical Equivalences

- Two formulas are logically equivalent if they have the same truth values
- Examples of logical equivalences:
  - De Morgan's laws
  - Distributive laws
  - Identity laws

Coding Exercises

- Implementing truth tables in Python
- Evaluating logical expressions
- Exploring logical equivalences

Summary and Next Steps

- We learned the basics of propositional logic
- Next week: First-order logic and formal systems
- Coding exercises to reinforce concepts