

# Computability Theory

**Instructor:** Renjie Yang

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**Location:** 首师大文科楼316

**Time:** Mondays 9:40 am - 12:10 pm

**Course Website:** [comphiacademy.github.io/comp20f](https://comphiacademy.github.io/comp20f)

## Course Description:

This course is an introduction to the branch of logic known as Computability Theory, which is used to be called Recursion Theory. It combines the abstract mathematical theory of computability with the concrete art of algorithm design with various types of automata. Topics include models of computations for languages and functions, the general computability theory, reducibility, incompleteness, time complexity, and advanced topics such as arithmetic hierarchy and induction. This course provides a solid foundation for further studies in mathematical logic, artificial intelligence, cognitive science, and philosophy.

## Prerequisites:

At least one course in mathematical logic.

## Readings

- Micheal Spicer (2012) *Introduction to the Theory of Computation*, 3rd Edition. Cengage Learning.
- Richard L. Epstein, Walter A. Carnielli (2008) *Computability: Computable Functions, Logic, and the Foundations of Mathematics*, 3rd Edition. Advanced Reasoning Forum.
- Hartley Rogers. (1987) *Theory of Recursive Functions and Effective Computability*. The MIT Press.

## Course Assignments:

There will be two problem sets, one for the midterm and one for the final. Grades will be based on the two Problem Sets in the proportion 50:50.

## **Topics:**

- Regular Languages
- Context-free Languages
- Finite State Automata
- Pushdown Automata
- Turing Machines
- Turing Computability
- The Recursive Functions
- Computably Enumerable Sets
- The Lambda Calculus
- Reducibility
- The Fixed Point Theorem
- Gödel's Incompleteness Theorems
- Arithmetic Hierarchy
- Time Complexity
- Undecidability in Math

## **Course Schedule:**

The course schedule is tentative. Please see the course website for further information.