

## 8 Formal verification integrated with large language models

1. 课堂讲授学时 Lecture Hours: 16
2. 课堂实验学时 Laboratory Hours: 16
3. 课下研讨学时 Colloquia Hours: 0
4. 学生课下投入学时 Individual Study Hours: 32
5. 学分 Credits: 2
6. 开课学年学期（如果有强制性的要求则必须填，否则可以不填） Occurrence: None
7. 先修课程 Prerequisite(s): Programming-related courses\*

\*Recommended, not required as prerequisite

### 8. 课程概要 Course Description:

This intensive course provides an in-depth overview of formal methods and their application in securing software development. Participants will learn mathematical techniques, specification languages, and verification tools to ensure software security throughout the development lifecycle. The course also introduces large language model techniques for generating formal constraints and specifications from natural language requirements, improving efficiency and accuracy. By integrating formal methods and AI-driven approaches into the development process, developers can rigorously specify, develop, and verify software systems, leading to robust and secure applications.

### 9. 课程预期学习成果 Course Outcomes:

By the end of successful completion of this course, the student will be able to:

- (1) Understand the role of formal methods in secure software development.
- (2) Apply basic logic and mathematical concepts to model software systems.
- (3) Use specification languages to describe system requirements.
- (4) Apply verification techniques to analyze software correctness and security.
- (5) Integrate formal methods into the software development process.

### 10. 教学内容与学时分配 Course Content, Laboratories and Laboratory Hours（有则填，没有则不填），Colloquia Hours（有则填，没有则不填）：

- (1) Introduction to Secure Software Development (4 Class Hour)
  - Classroom 3 hours
  - Practice 1 hour
- (2) Mathematical Foundations for Formal Methods (4 Class Hour)
  - Classroom 3 hours
  - Practice 1 hour
- (3) Specification Languages and System Modeling (4 Class Hour)
  - Classroom 2 hours
  - Practice 2 hour
- (4) Formal Verification Techniques (4 Class Hour)
  - Classroom 2 hours

- Practice 2 hour
- (5) Secure Software Design and Analysis (4 Class Hour)
- Classroom 2 hours
- Practice 2 hour
- (6) Secure Coding and Security Testing (4 Class Hour)
- Classroom 2 hours
- Practice 2 hour
- (7) LLM-based Formal Specification Generation (4 Class Hour)
- Classroom 2 hours
- Practice 2 hour
- (8) LLM-assisted Verification and Secure Development (4 Class Hour)
- Classroom 2 hours
- Practice 2 hour

**11. 考核与成绩评定 Grading:**

Homework: 20%

Inclass Quizzes: 20%

Individual Presentation: 60%

**12. 教材，参考书 Text & Reference Book: None**

**13. 编写教师 Course Lecturer: Jing Sun**

**编写教师 Course Lecturer (签字):**



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