

# PROSEMINAR/SEMINAR ON COMPUTER-ASSISTED MATHEMATICS

HEIDELBERG UNIVERSITY, SUMMER SEMESTER 2025

Target audience: Bachelor students.  
Instructors: Judith Ludwig, Florent Schaffhauser.  
Language of instruction: English.  
Schedule: Thursday, 14:00-16:00.  
Pre-requisite: Algebra 1.

## OBJECTIVES

Through a learning-by-doing approach, the purpose of this seminar is to give an introduction to computer-assisted mathematics. We will focus on the formalisation of mathematics in a proof assistant, using the Lean Programming Language and Theorem Prover, which has been in the spotlight in recent years. Our goal will be to learn what it means to write a formal proof and have the computer check it, or even assist us with it.

## STRUCTURE AND CONTENT

This seminar is intended for students who have completed the Algebra 1 course. No previous knowledge of proof assistants will be required.

The seminar will be project-based and the students will work in groups. We will use the first weeks of the semester to familiarise ourselves with Lean, then the students work on their projects. Active participation in the group meetings will be expected from all students looking to obtain academic credits for the seminar. Attendance is mandatory.

The general outline of the seminar is as follows.

- (1) Play the Natural Number Game (Peano's axioms, proofs by induction).
- (2) Install the Lean Theorem Prover. Familiarise yourself with the interface.
- (3) Learn to use Lean's ecosystem and acquire basic git skills.
- (4) Understand logical reasoning and proof tactics.
- (5) Understand tactics to prove algebraic identities.
- (6) Formalise a piece of mathematics.

Topics for the projects will be drawn from the Algebra 1 course, the focus will be on group and ring theory.

## REFERENCES

The instructors will provide a guided introduction to the required notions as the seminar progresses. No experience in programming will be required.