Syllabus Formalized Mathematics in Lean (P2A1, P4A1). Winter 23/24

Instructor: Floris van Doorn, Mathematical Institute, office 1.035,
vdoorn@math.uni-bonn.de

Class times: Tuesday 16:00-18:00 and Friday 10:00-12:00 in the PC-Pool IAM, Endenicher Allee 60, annex building.

Office Hours: My office hours are Tuesday and Thursday 14:00 - 15:00. You can also email me to schedule an appointment at another time.

About the course: In this course you will learn how to explain mathematical theories to a computer using a computer program called Lean. Using the language of Lean you can write mathematical definitions, theorems and proofs, and then Lean can check whether your proofs are correct and contain no holes. In this course we will learn how to interact with Lean and write your own proofs in it, and we will prove basic results in various mathematical topics, including algebra, topology and analysis. You will choose a topic to formalize yourself and give a presentation about this formalization.

Goals:

- Learn to explain mathematics to the computer program Lean
- Improve your understanding of mathematical proofs
- Learn some new mathematics
- Learn computer skills (VSCode, git)
- Personal project management skills

Recourses:

- The online textbook *Mathematics in Lean* by Jeremy Avigad and Patrick Massot
- Learning recourses on the Lean website:
  `https://leanprover-community.github.io/learn.html`

Homework: The course requires you to do a significant amount of work outside of the classes.

For the first half of the course, there will be a weekly set of homework problems. You are expected to solve these problems, and this will give you a 10% bonus on your final grade.

For the second half of the course, you are required to do a formalization project yourself, where you formalize a small mathematical theorem or some definitions and their properties yourself. There will be time to work on this during the class, but most of the work has to be done outside the class.

You have the freedom to choose the topic of formalization, or you can select one of the suggested projects by the professor.

You have to give an presentation about your project towards the end of the course. During your presentation you should explain the mathematical concepts that you formalized, and talk about the formalization itself (what went well? What was hard?). The duration of the presentation depends on the number of registered students, but will roughly be 30 minutes.

Grades:

- Homework 10% bonus;
- Personal project 50%;
- Presentation 50%.

PC Pool opening hours: You can work in the PC Pool outside class during the following hours.

Monday 9:00-12:00

Tuesday 9:00-12:00 and 13:00-16:00

Wednesday 9:00-12:00

Thursday 9:00-12:00 and 13:00-16:00

Friday closed