Higher Mathematics
Seminar Outline 2024/25

Description

The aim of the seminar is to acquaint students with the typical content of introductory courses to university-level mathematics. The difference between high-school mathematics and university mathematics is stark and the shift of focus from mostly mechanical counting to pure logic and problem solving leaves freshmen often bemused and frustrated, inviting failure. Advance knowledge of the habitual curriculum alongside common proof methods and logical arguments should lessen the burden and, perhaps, bring to light the beauty of the art that is mathematics.

Expected Outcomes

By the end of the course, students will have gained the knowledge (and hopefully comprehension) of

- first-order logic (the very 'language' of modern mathematics),

- basics of set theory (the very 'foundation' of modern mathematics),

- selected parts of a university-level introductory course in pure mathematics (the exact course will be elected by the attendees),

and also the ability to

- construct logical proofs using common methods,

- use reasoning and intuition to solve (chiefly non-algorithmic) problems.

Topics

Depending on the chosen course, the following will be discussed (two courses are detailed here; more can be added at the students' behest).

Linear Algebra

1. Systems of linear equations.

2. Fields & vector spaces.

3. Linear maps & matrices.

4. Determinant.

5. Scalar product & orthogonal projection.

6. Eigenvalues and eigenvectors, diagonalization.

Elementary Number Theory

1. Prime numbers & divisibility.

2. GCD & Euclid's algorithm.

3. Congruences & Chinese Remainder Theorem.

4. Quadratic residues.

5. Diophantine equations & rational points on curves.