

Logic lecture

2025 Fall

Lecturer: Zalán Molnár

Code of the course: BMA-LOTD-102, BMA-FILD-301, BBN-FIL18-301.01

Aim of the course: The lecture and exercise class together provide an introduction to mathematical logic. During this course we cover all the fundamental concepts and techniques that are inevitable for any further studies during the Logic and Theory of Science program. Although there are no formal prerequisites, certain level of maturity of abstract thinking is expected. For students who are more interested in the deeper understanding of the material the *Set theory* course offered by the department is recommended.

Content of the course: In the lecture we focus on the two most important formal logical frameworks.

- **Class 1-4.** Basics of Propositional logic: syntax and semantics, proof theory, compactness, completeness. Applications in combinatorics, graph theory (de Bruijn-Erdős theorem, König's Lemma)
- **Class 5-13.** Basics of First-order logic: syntax and semantics, basic model and proof theory, Ehrenfeucht-Fraissé Games, categoricity, theory of dense linear orderings. Completeness and Compactness theorems, Löweheim-Skolem theorems. Application of compactness: glimpse to definability theory, hyperreal numbers, non-standard models of arithmetic. Decidable and undecidable theories, theory of random graphs, Gödel's first incompleteness theorem. Limits of first-order logic and glimpse to second-order logic.

The lecture is accompanied by an *exercise class* in which we practice and see applications of the concepts and techniques we covered in the lectures.

Grading criteria: (oral) exam

References

- [1] David Marker. *An invitation to mathematical logic*. Springer. 2024.
- [2] László Csirmaz, Zalán Gyenis *Mathematical logic. Exercises and solutions*. Springer. 2022.
- [3] Lecture notes