Proof Theory (C002677)

Course size (nominal values; actual values may depend on programme)

Credits 6.0   **Study time 165 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 1)	Dutch	Gent	lecture

Lecturers in academic year 2024-2025

Weiermann, Andreas	WE16	lecturer-in-charge

Offered in the following programmes in 2024-2025	crdts	offering
Master of Science in Teaching in Science and Technology(main subject Mathematics)	6	A
Master of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

Provability strength of formal systems, cut elimination, provable and unprovable transfinite inductions, proof-theoretic ordinal, provably recursive functions, incompleteness results.

Position of the course

In this course an introduction is given into the proof theory of formal systems which contain the Peano axioms. In the beginning Gödel's first incompleteness result is shown. Then mathematical invariants for the proof strengths of formal systems are determined. Then several interesting independence results are investigated. If time is left we cover applications of proof theory to rewrite systems.

Contents

1. Elementary properties of the Peano axioms
2. Elementary theory of the ordinal numbers
3. Cut elimination for Peano arithmetic
4. Proof-theoretic analysis of Peano arithmetic
5. The provably recursive functions of Peano arithmetic
6. Incompleteness results
7. Proof-theoretic analysis of the fragments of Peano arithmetic
8. Applications to term rewriting systems (if there is enough time left over for covering this topic).

Initial competences

Basic knowledge about mathematical logic
and computability theory is recommended.

Final competences

1 Being able to perform calculations with ordinals.
2 Being able to show provable transfinite inductions.
3 Being able to apply cut elimination.
4 Knowing the connection between the proof theory of and termination proofs.
5 Being able to formulate and prove independence results.
6 Being able to classify reduction lengths for rewrite systems.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, Independent work

Extra information on the teaching methods

lecture, exercise classes, project.

Study material

Type: Syllabus

Name: proof theory
Indicative price: Free or paid by faculty
Optional: no
Language : Dutch
Number of Pages : 117
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

Wilfried Buchholz: *Proof theory*. Nota's die kunnen worden gedownload via WWW.

Wolfram Pohlers: *Proof theory.*The first step into impredicativity. Universitext. *Springer-Verlag, Berlin,* 2009. xiv+370 pp. ISBN: 978-3-540-69318-5.

Kurt Schütte: Grundlehren der Mathematischen Wissenschaften, Band 225. *Springer-Verlag, Berlin-New York,* 1977. xii+299 pp. ISBN: 3-540-07911-4.
Helmut Schwichtenberg, Anne Troelstra: *Basic proof theory.*Second edition. Cambridge Tracts in Theoretical Computer Science, 43. *Cambridge University Press, Cambridge,* 2000. xii+417 pp. ISBN: 0-521-77911-1.

Course content-related study coaching

Lecturer and assistant are available for the student. An electronic environment supports communication between students and teachers.

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment, Written assessment

Examination methods in case of periodic assessment during the second examination period

Oral assessment, Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

The examination is a written examination with an oral examination.

Calculation of the examination mark

First exam: periodic (75%) evaluation,
non periodic evaluation (25%).
Second exam: periodic evaluation. The result of the non periodic evaluation from the first exam
will be taken into account (for 25%).