

Metamathematics and Proof Theory

Advanced level course, 7.5 hp, Spring 2013

Metamathematics is usually defined as the study of mathematics itself with mathematical methods. It includes the fundamental question of (relative) consistency of mathematical theories and how it may be resolved by investigating the structure of formal proofs. This theory of proofs has also many applications in automated theorem proving and complexity theory.

Contents

Background: The foundational crisis in mathematics and Hilbert's Programme. Structural proof theory for sequent calculus and natural deduction. Cut elimination and normalisation. Gödel's incompleteness theorems. Löb's theorem. Gentzen's consistency proof for arithmetic. Ordinal analysis of theories. Arithmetical theories capturing complexity classes.

Course literature

A.S. Troelstra and H. Schwichtenberg, *Basic Proof Theory, second edition*. Cambridge University Press 2000.

Supplementary material on the incompleteness theorems and ordinal analysis.

Reference literature

S.C. Kleene, *Introduction to Metamathematics*, Van Nostrand 1952.
H. Schwichtenberg and S.S. Wainer, *Proofs and Computations*, Cambridge University Press 2011.

Lecturers

Prof. Erik Palmgren and Dr. Henrik Forssell

Time and location

Thursdays 15.15-17.00 in Lecture Hall 306, Building 6, Kräftriket.
Starting date: **January 24, 2013**. (The course runs the whole term.)

The course page will be accessible from www.math.su.se/~palmgren