COURSE ANNOUNCEMENT

SELECTED TOPICS IN LOGIC: RECENT DEVELOPMENT IN MODEL THEORY

MATH 818T, SPRING 2025

Instructor: Artem Chernikov
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Classroom: MTH 0201 (William E. Kirwan Hall)
Time: TuTh 2:00pm - 3:15pm

Description. Model theory is a branch of mathematical logic that studies definability in families of mathematical structures in a fixed formal language. For example, in the case of an algebraically closed field definable sets correspond to the constructible ones, and in the case of a real closed field to the semialgebraic ones (defined by polynomial equalities and inequalities). Since the early days of the subject, it was closely connected to set theory and foundational questions in mathematics, in particular to infinitary combinatorics — the study of the properties of various infinite objects such as linear orders and trees in relation to cardinal arithmetic. Later on, with the development of *stability theory* by Shelah, Zilber, Hrushovski, Pillay and others, the subject also gained a strong geometric feel and content, and found multiple applications in some of the more traditional branches of mathematics such as algebra, number theory and combinatorics.

Syllabus. The aim of this course is to provide an introduction to this circle of ideas. We will start with Morley's categoricity theorem — a theorem that started modern model theory and brought into the picture ideas from topology and combinatorial geometry. Following this, we will discuss topics from Shelah's classification, stable and NIP theories, forking independence, strongly minimal theories and pregeometries, local modularity and related notions, Zilber trichotomy, group and field configurations, totally categorical theories, connections to combinatorics.

Prerequisites. Basic first-order logic and model theory (compactness, completeness, Löwenheim–Skolem theorems), basic general topology and abstract algebra (please contact me if in doubt about your prerequisites).

Course text. I will follow my own notes. Possible references for parts of the material and additional reading:

- Chernikov, Artem. Lecture Notes on Stability theory (https://www.ams.org/open-math-notes/omn-view-listing?listingId=110792)
- Marker, David. Model theory: an introduction. Springer Science & Business Media, 2002.
- Tent, Katrin, and Martin Ziegler. A course in model theory. Vol. 40. Cambridge University Press, 2012.
- More advanced:
- Simon, Pierre. A guide to NIP theories. Vol. 44. Cambridge University Press, 2015.

- Bays, Martin. Geometric Stability Theory. https://ivv5hpp.uni-muenster.de/u/baysm/repos/MMM-GST/mmm-gst.pdf
- Pillay, Anand. Geometric stability theory. No. 32. Oxford University Press, 1996.