COURSE ANNOUNCEMENT

FINITE MODEL THEORY

MATH 285D, UCLA, WINTER 2017

MWF 10:00AM–10:50AM, MS 6118

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Description. This is a topics course on finite model theory and its connections to computer science and classical infinitary model theory.

The main tool of classical first-order model theory, the compactness theorem, fails when one restricts to finite structures. Besides, restricting to finite structures, first-order logic is simultaneously too strong (complete theory of a finite structure determines it up to an isomorphism) and too weak (most interesting classes of finite structures cannot be defined by a first-order sentence).

We will consider various expansions of first-order logic characterizing important computational complexity classes and methods to prove definability or non-definability of classes of finite structures in these logics. Our accent will be, however, on connections to classical infinitary first-order model theory and generalizations of stability. In particular, we will discuss ultraproducts of finite structures, pseudofinite model-theory and connections between various model-theoretic tameness notions such as stability and NIP and efficiency of some algorithms on restricted classes of structures (e.g. structures of bounded tree-width and bounded clique-width).

Syllabus. Descriptive complexity, extensions of first-order logic on finite structures, (generalized) first-order spectra, Fagin's theorem and other characterizations of computational complexity classes through definability in certain logics, first-order reducibility, Ehrenfeucht-Fraïsé games, Hanf and Gaifman locality, zero-one laws, use of ultraproducts for inexpressibility results, pseudofinite model theory, pseudofinite fields and measurable structures, totally categorical and smoothly approximable structures, bounded tree-width, VC-dimension and stability.

Prerequisites. First-order logic, basic model theory, basic computability. All the background will be explained if necessary, please contact me if in doubt about your prerequisites.

Course text. I will follow my own notes. Some relevant references and suggested reading:

- Leonid Libkin, "Elements of Finite Model Theory" (`http://homepages.inf.ed.ac.uk/libkin/fmt/fmt.pdf`)
- Jouko Väänänen, "A Short Course on Finite Model Theory" (`http://mathstat.helsinki.fi/logic/people/jouko.vaananen/shortcourse.pdf`)
- Gregory Cherlin and Ehud Hrushovski, "Finite Structures with Few Types"
- Hrushovski, "On Pseudo-Finite Dimensions"
- My lecture notes on stability theory and on combinatorics (available at `http://www.math.ucla.edu/~chernikov`).