Topological Methods in Model Theory
Méthodes topologiques en théorie des modèles
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LEONARDO COREGLIANO, Institute for Advanced Study
Continuous combinatorics and natural quasirandomness

The theory of graph quasirandomness studies graphs that "look like" samples of the Erdős–Rényi random graph $G_{n,p}$. More formally, a sequence $(G_n)_n$ is said to be quasirandom if for every finite graph F, the densities of F in G_n and in $G_{n,p}$, respectively, converge to the same number (with probability 1). This notion of similarity naturally gives rise to a topology, called density topology, on the space of graphs and is the starting point of the theory of graph limits, graphons.

In turn, the theory of graphons is the starting point of continuous combinatorics, which studies limits of arbitrary combinatorial objects (formally, models of some universal first-order theory in a finite relational language) in the analogous density topology. Thus, it is natural to ask if a theory of quasirandomness can be developed in the same level of generality.

In this talk, I will introduce the theory of natural quasirandomness, which provides such generalization. Although the theory heavily uses the language of continuous combinatorics, no familiarity with the topic is required as I will also briefly introduce its basic concepts.

This talk is based on joint work with Alexander A. Razborov.

EDUARDO DUENEZ, University of Texas at San Antonio
Structures of random variables and stability of Orlicz spaces

Describing spaces of random variables on a probability space $(\Omega, \mathbb{P})$ as first-order real-valued structures is customarily done imposing an *a priori* restriction to bounded variables in $[0,1]$ (say) or else by generally treating any such space as an $^*\mathbb{R}$-valued first-order structure (in the language of nonstandard analysis). We introduce classes of *real*-valued structures that faithfully capture the essence of the classical function spaces $L^p(\Omega)$ and the Orlicz spaces $L^\phi(\Omega)$ (with values in $\mathbb{R}$ or in some Banach space $(\mathcal{X}, \|\cdot\|)$). This perspective casts new light on some foundation aspects of measure theory (e.g., Radon-Nykodim decompositions and the Riesz Representation Theorem) and allows for simple proofs of classical results, including the stability of L^p and of L^ϕ (when ϕ satisfies a "Δ_2-condition" and the Banach space $\mathcal{X}$ is itself stable).

ISAAC GOLDBRING, University of California, Irvine
An application of infinitely generic structures to von Neumann algebras

Inspired by Cohen's advent of forcing in set theory, Robinson defined two kinds of model-theoretic forcing, so-called finite forcing and infinite forcing. While intensely studied in the 1970s, the study of the structures arising from these forcing constructions has since became largely ignored. In this talk, I will talk about a recent application of infinite forcing (adapted to the setting of continuous model theory), making progress on a conjecture of Popa in the field of von Neumann algebras. Time permitting, I will talk about extensions of this result due to Chifan, Drimbe, and Ioana and also due to myself with Jekel, Kunnawalkam Elayavalli, and Pi.

NICOLAS CHAVARRIA GOMEZ, University of Notre Dame
Pontryagin duality and continuous logic

I will present the Bohr compactification of a topological abelian group as a type space in the sense of continuous model theory. I first show that this type space is the Pontryagin dual of a certain group. In this manner, Pontryagin duality comes into the picture. This can then be extended to more general topological structures.

CLOVIS HAMEL, University of Toronto
Topological Function Spaces, Double Ultralimits and Definability

We explore applications of C_p-theory, Grothendieck spaces and countable tightness in Model Theory and Analysis. In particular, we will discuss Gowers' problem, which asks if the Tsirelson space or, more generally, if Banach spaces not including isomorphic copies of l^p or c_0 are definable. Casazza, Dueñez and Iovino's work negatively answers Gowers' problem in first-order (in fact, continuous) logic. However, one could argue that this logic lacks enough expressive power for the analyst's ε-play. We use techniques from C$_p$-theory and work with conditions concerning the interchangeability of double (ultra)limits in order to generalize the aforementioned undefinability results far beyond first-order logic, for example to infinitary logics such as countable fragments of continuous $L_{\omega_1,\omega}$, which have non-compact spaces associated to them.

JOSE IOVINO, The University of Texas at San Antonio
The undefinability of Tsirelson's space

The Tsirelson space has been called "the first truly nonclassical Banach space". Immediately after space was introduced, the question arose of whether this space is "finitely definable". I will present a survey of recent results. This talk may serve as a preamble to the talk given by Eduardo Dueñez, where further refinements will be mentioned.

MIGUEL MORENO, University of Vienna
Finding the main gap in the generalised descriptive set theory

Shelah's main gap theorem gives us a notion of complexity, a theory is more complex when this one has more non-isomorphic models. In generalised descriptive set theory (GDST) the complexity of a theory is given by the complexity of the isomorphism relation. One of the most important questions in GDST is whether the complexity notion from GDST is a refinement of the model theory complexity notion. In this talk we will review the progress made in this question. We will see how Shelah's division lines (classifiable shallow, classifiable, unstable, stable unsuperstable, superstable with DOP, superstable with DOP) are related to different notions in GDST such as Borel set, analytical co-analitical sets, Borel* sets, complete analytical sets, Borel reducibility.

ANAND PILLAY, University of Notre Dame
Topological dynamics and model theory

I will discuss some use of topological dynamical methods in model theory, as well as applications to the structure of approximate subgroups.