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THESIS ABSTRACTS

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Will Boney, ***Advances in Classification Theory for Abstract Elementary Classes***, Carnegie Mellon University, 2014. Supervised by Rami Grossberg. MSC: Primary 03C48, 03E55, 03C75. Keywords: Abstract Elementary Classes, classification theory, large cardinals.

Abstract

In this thesis, we continue the project of classification theory for Abstract Elementary Classes (AECs), especially tame AECs. Chapter I contains a general introduction and Chapter II provides preliminaries.

Chapter III, "Types of Infinite Tuples," analyzes Galois type by their length. We show that the number of types of sequences of tuples of a fixed length can be calculated from the number of 1-types and the length of the sequences. Specifically, if $\kappa \leq \lambda$, then

$$\sup_{\|M\|=\lambda} |S^{\kappa}(M)| = \left(\sup_{\|M\|=\lambda} |S^{1}(M)| \right)^{\kappa}.$$

We show that this holds for any abstract elementary class with λ amalgamation. Basic examples show that no such calculation is possible for nonalgebraic types. However, we introduce a generalization of nonalgebraic types for which the same upper bound holds.

Chapter IV, "Tameness and Large Cardinals," uses large cardinals to derive locality results for AECs. The main success is showing that Shelah's Eventual Categoricity Conjecture for Successors follows from the existence of class many strongly compact cardinals. This is the first time the consistency of this conjecture has been proven. We do this by showing that every AEC with $LS(K)$ below a strongly compact cardinal κ is $<\kappa$ tame and applying the categoricity transfer of Grossberg and VanDieren. We obtain similar, but weaker results, from measurable and weakly compact cardinals. We introduce a dual property to tameness, called *type shortness*, and show that it follows similarly from large cardinals.

Chapter V, "Nonforking in Short and Tame Abstract Elementary Classes," uses the conclusions of the previous chapter to develop a notion of forking for Galois-types in the context of AECs. Under the hypotheses that an AEC K is tame, is type-short, and fails an order-property, we consider the following:

Definition 1. Let $M_0 \prec N$ be models from K and A be a set. We say that the Galois-type of A over M *does not fork over* M_0, written $A \underset{M_0}{\downarrow} N$, iff for all small $a \in A$ and all small $N^- \prec N$, we have that Galois-type of a over N^- is realized in M_0.

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Assuming property (E), we show that this nonforking is a well-behaved notion of independence. In particular, it satisfies symmetry and uniqueness and has a corresponding U-rank. We find sufficient conditions for a universal local character and derive superstability-like property from little more than categoricity in a "big cardinal." Finally, we show that under large cardinal axioms the proofs are simpler and the nonforking is more powerful.

Chapter VI, "Tameness and Frames," combines tameness and Shelah's good λ-frames. This combination gives a very well-behaved nonforking notion in all cardinalities. This helps to fill a longstanding gap in classification theory of tame AECs and increases the applicability of frames. Along the way, we prove a complete stability transfer theorem and uniqueness of limit models in these AECs.

Chapter VII, "A Representation Theorem for Continuous Logic," details a correspondence between first-order continuous logic and $L_{\omega_1,\omega}$. In particular, for every continuous object (language, structure, etc.), there is a discrete analogue. This discrete analogue requires an infinitary description to ensure the range of the (analogue of the) metric has range in the real numbers. This correspondence can be inverted and we extend it to types and saturation.

Chapter VIII, "A New Kind of Ultraproduct," explores a tension revealed in Chapter VII: first-order continuous logic is compact, but $L_{\omega_1,\omega}$ is, in general, not. The explanation for this tension is the Banach space ultraproduct. This chapter develops a general model-theoretic construction $\Pi^{\Gamma} M_i / U$ that attempts to capture the properties of the Banach space ultraproduct.

Chapter IX, "Some Model Theory of Classically Valued Fields," applies some ideas from classification theory to a specific AEC: the class of classically valued fields. The main tool is the analytic ultraproduct, but its development is entirely self-contained. The classic version of Łoś' Theorem fails for this ultraproduct, but an approximate version is proved.

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TOMÁS IBARLUCÍA, ***Model Theory Methods for Topological Groups***, Université de Lyon, 2016. Supervised by Itaï Ben Yaacov. MSC: Primary 22F50, Secondary 03C98, 54H20. Keywords: automorphism groups, $\aleph_0$-categorical structures, continuous logic, topological dynamics.

Abstract

This thesis gathers different studies approaching subjects of topological dynamics by means of logic and descriptive set theory, and conversely.

The first part is devoted to the study of Roelcke precompact Polish groups, which are the same as the automorphism groups of $\aleph_0$-categorical structures. They form a rich family of examples of infinite-dimensional topological groups, including several interesting permutation groups, isometry groups, and homeomorphism groups of distinguished mathematical objects. Building on previous work of Ben Yaacov and Tsankov, we develop a model-theoretic translation of several dynamical aspects of these groups, related to the complexity of the orbits of continuous functions and to Banach representations of associated flows, as studied by Glasner and Megrelishvili. Then we use this translation to prove some new results.

In Chapter 1, we prove that every strongly uniformly continuous function on a Roelcke precompact Polish group is weakly almost periodic. We also show that lower tame functions correspond to NIP formulas, and we use this to describe lower tame functions in a number of important examples.

In Chapter 2 (with I. Ben Yaacov and T. Tsankov), we provide a model-theoretic description of the Hilbert-compactification of oligomorphic groups, and we show that Eberlein oligomorphic groups are precisely the automorphism groups of $\aleph_0$-stable, $\aleph_0$-categorical discrete structures. We also give an account of their Hilbert-representable ambits.

In Chapter 3, we study automorphism groups of randomized structures. This gives new examples of Roelcke precompact Polish groups, and we study some associated flows. We give new proofs of several preservation results and show that Hilbert-representability is preserved