2024 IOWA COLLOQUIUM ON INFORMATION, COMPLEXITY, AND LOGIC - SUMMER RESEARCH CONFERENCE

ABSTRACTS

Presenter: Wesley Calvert

Title: Random Algebraic Fields

Abstract: What does a random algebraic extension of the rationals look like? In this joint work with Harizanov and Shlapentokh, we propose a definition that seems promising. We prove the existence of a continuum of algebraic fields that are random according to our definition. We show that there are noncomputable algebraic fields which are not random. We also partially characterize the index set, relative to an oracle, of the set of random algebraic fields computable relative to that oracle.

Presenter: Francesca Zaffora Blando

Title: Co-meagre Convergence to the Truth

Abstract: The purpose of this talk is to showcase the use of descriptive set theory and computability theory for a recent debate in the philosophy of science. One of the cornerstones of Bayesian epistemology and Bayesian philosophy of science is Levy's Upward Theorem—which, in this setting, is standardly interpreted as establishing that, for a large class of inductive problems, a Bayesian learner's beliefs are guaranteed to converge to the truth with probability one. Rather than seeing Levy's Upward Theorem (and other related convergence-to-the-truth results) as an asset of the Bayesian framework, a number of philosophers have argued that it is the Achilles heel of Bayesianism. Most recently, Gordon Belot has argued that Levy's Upward Theorem shows that Bayesian learners are unavoidably epistemically immodest, since it entails that Bayesian learners believe they will be inductively successful even when they are guaranteed to fail on a co-meagre collection of data streams. The main goal of this talk is to shed light on the question of when Bayesian convergence to the truth occurs not only on a set of probability one, but also on a co-meagre set. We will see that, by classifying the inductive problems faced by a Bayesian learner (the random variables a Bayesian learner has to successfully estimate) using the tools of descriptive set theory and computability theory, one can identify natural classes of learning problems for which convergence to the truth indeed happens on a co-meagre set. Moreover, appealing to computability theory allows to offer a much more fine-grained analysis of the phenomenon of Bayesian convergence to the truth. In particular, the theories of algorithmic randomness and effective genericity can be used to single out specific co-meagre sets of data streams along which successful learning provably occurs, no matter which inductive problem from a given class of effective inductive problems the Bayesian learner is trying to solve.

Presenter: Liling Ko

Title: The Computability of Some Infinite Games

Abstract: We consider infinite variants of games in computer science and study the computability of winning strategies. In the game of chip-firing, we show that there are computable game instances that are winnable, but whose winning strategies all compute $0'$. We also characterize the index set of computable chip-firing instances as Π_3-complete, and investigate the computability of reachable game configurations. In a different project, we compare different notions of randomness in sets. We describe the comparison using an infinite variant of the Monty Hall game. We separated two notions of stochasticities by showing that a disorderly door-opening strategy is independently strong from an adaptive door-opening strategy.

These are joint works with David Belanger, Damir Dzhafarov, Justin Miller, and Reed Solomon. With special thanks to Matthew Harrison-Trainor for useful discussions.

Presenter: Matthew Harrison-Trainor

Title: Interpretations, Back-and-forth Games, and Group von Neumann Algebras

Abstract: When defining the Ehrenfreucht-Fraisse back-and-forth games, it is common for model theorists to say that each player plays a single element at a time, while many computability theorists will often say that each player can play a tuple of arbitrary length. Both versions of these games appeared in Ehrenfreucht's first treatment of back-and-forth games. However the two versions of the games can behave very differently, in particular by how they transfer through constructions". In particular, I will talk about the case of the construction from a group of its group von Neumann algebra. This is joint work with Isaac Goldbring.

Presenter: Alexi Block Gorman

Title: Fractal Dimensions and Büchi Automata

Abstract: Büchi automata are the natural extension of finite automata, also called finite-state machines, to a model of computation that accepts infinite-length inputs. We say a subset X of the reals is r-regular if there is a Büchi automaton that accepts (one of) the base-r representations of every element of X, and rejects the base-r representations of each element in its complement. We can analogously define r-regular subsets of higher arities, and these sets often exhibit fractal-like behavior–e.g., the Cantor set is 3-regular. There are compelling connections between fractal geometry and Büchi automata, and we will consider them from the perspective of model theory. In this talk, we will give a characterization of when different notions of fractal dimension do or do not agree for definable sets in an expansion of the real ordered additive group by a ternary predicate with a remarkable connection to Büchi automata. This is joint work with Christian Schulz.

Presenter: Steffen Lempp

Title: The Borel Complexity of the Class of Models of First-Order Theories

Abstract: We investigate the descriptive complexity of the set of models of first-order theories. Using classical results of Solovay and Knight, we give a sharp condition for complete theories to have a Π^0_ω-complete set of models. We also calibrate the complexity of sets of models of some other complete theories. (This is joint work with Andrews, Gonzalez, Rossegger and Zhu, and related to recent work of Enayat and Visser.)
