BOOK OF ABSTRACTS

International Conference on Mathematical Logic, Strelcha 2023, dedicated to the 85th anniversary of Prof. Dimitar Vakarelov

Alexandra Soskova, Sofia University

Title: Lopez-Escobar theorem for continuous domains and Learning theory

Abstract:
We prove an effective version of the Lopez-Escobar theorem for continuous domains. As a corollary of this result we obtain a new pullback theorem for computable embeddings. We use this to obtain a syntactic characterization of algorithmic learnability of a family of structures from informant and from text (from the positive information). We also present a descriptive set-theoretic characterization for Inf-learnability and Txt-learnability. The methods combine the approaches of algorithmic learning theory and computable structure theory.

Anton Zinoviev, Sofia University

Title: The creativity of Dimiter Skordev in the field of the mathematical logic before 2000

Abstract:
The main works of Dimiter Skordev in Computability Theory before 2000 are surveyed.

Borislav Rizov and Tinko Tinchev, Sofia University

Title: Towards Dynamic Wordnet: Time Flow Hydra

Abstract:
Hydra is a Wordnet management system where the Synsets from different languages live in a common relational structure (Kripke frame) with a user-friendly GUI for searching, editing and alignment of the objects from the different languages. The data is retrieved by means of a modal logic query language. Despite its many merits the system stores only the current state of the wordnet data. Wordnet editing and development opens questions for wordnet data, structure and its consistency over time. The new Time Flow Hydra uses a Dynamic wordnet model with a discrete time embedded where all the states of all the objects are stored and accessed simultaneously. This provides the ability to track the changes, to detect the desired and undesired results of the data evolution. For example, we can ask which objects 10 days ago had 2 hyponyms, and 5 days later have 3.

Georgi Shopov, PhD student at Institute of Information and Communication Technologies, Bulgarian Academy of Sciences, Thesis supervisor: Stoyan Mihov

Title: Learning Finite-State Assemblies for Efficient Language Modelling

Abstract:
Language models are discrete probability distributions over finite sequences. Nowadays, they are prevalent in many complex natural language processing tasks, such as speech recognition, machine translation, information extraction, etc., for which the modelling of language is of utmost importance.
Typically, finite-state transducers have been utilised to obtain computationally efficient representations of language models. However, given a text corpus, learning a finite-state transducer that faithfully represents the underlying probability distribution is difficult. For this reason, the developed learning algorithms so far have been mostly focused on very restricted subclasses of finite-state language models such as the N-gram language models, which are overly simplistic and unable to effectively capture the long-term dependencies occurring in natural languages.
In recent years, recurrent neural networks have risen in popularity as a computational device used to represent language models because of their superior performance. The success of recurrent neural networks is mainly due to their continuous nature, which facilitates the development of efficient learning algorithms that explore a much broader class than the N-gram language models. Nevertheless, compared to finite-state transducers, recurrent neural networks are harder to interpret and are significantly less efficient - often requiring large graphical accelerators for their computation.
The prospect of combining the benefits of both finite-state transducers and recurrent neural networks for language modelling has sparked great scientific interest. Most of the research on this topic has been focused on extracting a finite-state transducer from a performant recurrent neural network. However, empirical results have shown that the extracted transducer either fails to retain the representation quality or is of unmanageable size.
In this work, we introduce finite-state assemblies, which are sets of finite-state transducers with acyclic compositional interdependencies. We show that learning finite-state assemblies is possible for a large class of language models by employing quantisation and sparsification techniques to infer the transition tables of the transducers as well as their interdependencies. Our empirical results demonstrate that finite-state assemblies can match the representational quality of recurrent neural networks for language modelling, while having manageable size and preserving the interpretability and efficiency of finite-state transducers.

Grigor Kolev, PhD student at Faculty of Mathematics and Informatics, Sofia University, Thesis supervisor: Tinko Tinchev (joint work with Tinko Tinchev)

Title:
Correspondence problem on several classes of frames for intuitionistic propositional formulas

Abstract:
Intiutionistic Kripke frames can be treated as structures for the first order language $L=\{\leq\}$ with $\leq$ interpreted as a partial order. Given a class of frames K, the definability problems modulo K are the algorithmic tasks of recognizing whether a formula of one of the languages is validated by the same structure from K as some formula from the other language. The correspondence problem modulo K is the algorithmic tasks of recognizing whether given first order sentence and propositional formula are valid in the same structure from K.

We concern ourselves with the respective definability and correspondence problems of a few classes of frames having desirable linearity properties.

Dimiter Dobrev, Institute of Mathematics and Informatics at Bulgarian Academy of Sciences

Title: Description of the internal state of the world

Abstract:
The world is a function. To describe the world means to describe a function, but the world is a more special function. Usually we know exactly what the values of the function we are describing are, but what the internal states of the world are is something we know only approximately. Therefore, the description of the world is reduced to a description of its internal state.
Description will consist of many steps, but the first and most important step will be classification. This brings us to the Event-Driven (ED) models. We can think of these models as finite-state automata in which letters are replaced by events, or as Kripke frames in which modalities are replaced by events. For an ED model to make sense, it must give us information. For this purpose, something special needs to happen in at least one of its states. We will call this special behavior of the state a trace. We will assume that we have a trace when some event occurs in that state with a probability other than the average. If none of the ED model states have a trace, then this model is useless. Furthermore, such a model would be undetectable, because it is the trace that allows us to find the ED model.
When describing the internal state of the world, we will not be satisfied with just one ED model, but will look for many such models. If we have found n ED models, then the internal state of the world will be described as an n-tuple in which the i-th coordinate corresponds to the state in which the i-th ED model is in when the world is in that internal state.

Dimiter Vakarelov, Sofia University

Title: Logical theories of space and time: bibliography and a short overview of Bulgarian results in the field.

Abstract:
Bibliography (possibly incomplete) and a short overview of Bulgarian results in the field is presented.

Ivan Georgiev, Sofia University

Title: New results on subrecursive degrees of representations of irrational numbers

Abstract:
In the first part, we will present a concise review on subrecursive computability of real numbers, paying tribute to prof. Skordev's contributions to the field.
In the second part, we will consider subrecursive reducibility between different representations of irrational numbers: Cauchy sequences, Dedekind cuts, Hurwitz characteristics, etc. For any representation R, considered as a function, we consider its graph G(R) as a new representation.

In general, R is not subrecursively reducible to G(R). We will see that the graphs of continued fractions and of standard and dual Baire sequences give rise to subrecursive degrees, which presumably do not contain any of the representations known in the literature.
In the end, we will indicate some general properties of the representations of irrational numbers, which were established recently.

Ivan Nikolov, PhD student at Faculty of Mathematics and Informatics, Sofia University, Thesis supervisor: Tinko Tinchev

Title: Logic of Ternary Contact

Abstract:
The logic of n-ary contact as a kind of an extension of the Region-based Theory of Space is briefly outlined including its main completeness results. It is then considered the simplified but sufficient case of ternary contact and a designated class of specific relational semantic structures named contact frames. The focus is on the logic of the formulas valid in that class of relational structures. In particular, they are discussed two problems with respect to the logic, namely, "Modal Definability" and "Unification".

Petar Iliev, Institute of Mathematics and Informatics at Bulgarian Academy of Sciences

Title: A very biased overview of some of Vakarelov's contributions to correspondence theory

Abstract:
In a seminal paper presented at the fourth Advances in Modal Logic conference in 2002, Dimiter Vakarelov initiated the study of the definability of Kripke frames with modal formulae from finite variable fragmets of the classical unimodal language and generalised the famous Sahlqvist's theorem.In the present talk, I am going to survey these and some of the subsequent results inspired by Vakarelov's work and give a list of open problems in this, still underdeveloped, subarea of correspondence theory.

Philippe Balbiani, IRIT, France

Title: Intuitionistic logics with modal connectives: a minimal setting à la Fischer Servi

Abstract:
Intuitionistic modal logics (IML) have a long history, starting from the works by Fitch (1948) and Prawitz (1965). Then, two traditions emerged that led to the study of two families of logics. The first tradition has been mainly developed by Fischer Servi (1984) and Plotkin and Stirling (1986). Its main goal is to define an analogous of classical modalities justified from an intuitionistic meta-theory. The second tradition leads to logics that are motivated by their applications in computer science and artificial intelligence. It has been developed, among others, by Wijesekera (1990) and Bellin, De Paiva, and Ritter (2001). But putting aside the historical perspective, we can consider naively the following question: how can we build an IML from scratch? Since both modal logic and intuitionistic logic enjoy Kripke semantics, we can think of combining them together in order to define an intuitionistic modal logic. The simplest proposal is to consider Kripke frames $(W,\leq,R)$ equipped with a preorder $\leq$ for interpreting intuitionistic implication and a binary relation R for

interpreting modalities. If the intuitionistic connectives keep their usual interpretations, the interpretations of the modal connectives have given rise to multifarious proposals. In this talk, I will firstly present these proposals. Then, I will secondly introduce a weaker logic generalizing all known IMLs and thus being an appropriate candidate for the title of "minimal intuitionistic modal logic".

Tinko Tinchev, Sofia University

Title: Combining contact and measure

Abstract:
Whiteheadean approach to point-free theories of space is based on the primitive notion *region* and the binary predicates *part_of* and *contact*.
From algebraic viewpoint it is in a sense topological representation theory in Stone's style. Arntzenius' approach to point-free theory of space is based on the measure spaces.

In this talk we combine both above mentioned approaches reducing the measure to its qualitative meaning, namely, allowing only comparison of the regions with respect to their measure. Formally, we study couples of contact Boolean algebra and measure over this algebra satisfying several natural coditions. The language is the extension of the language of contact Boolean algebras by new atomic formulas $a \leq_\mu b$ saying `the measure of the region *a* is less or equal to the measure of the region *b*'. Complete axiomatization of the validities in several algebras of polytops in the real line equiped with standard measure is proven.

Vladimir Sotirov, Institute of Mathematics and Informatics at Bulgarian Academy of Sciences

Title: Money, Numbers, & Numerals. Counting and naming

Abstract:
How much is 1 billion? Why does one see different sequences of zeros on the banknotes of different countries? What are the systems for naming large numbers? The main two of them are compared and a new one is described. It is more economical in introducing new numerals and avoids disambiguations.