سمینار دو روزه منطق ریاضی وکاربردهای آن

چهارشنبه ۷ خرداد ۱۴۰۴		
ساعت	سخنران	عنوان سخنرانی
۱۰-۹	**کریم خانکی** دانشگاه صنعتی اراک	**Randomization, Stability, and Probability Algebras**
۱۰:۳۰-۱۰: پذیرایی		
۱۱:۳۰-۱۰:۳۰	**سمیه چپقلو** پژوهشگاه دانش‌های بنیادی	**An Overview of Logics in Dynamical Systems: The Axiomatization Problem**
۱۲:۴۰-۱۱:۴۰	**ریحانه ذوقی‌فرد** پژوهشگاه دانش‌های بنیادی	**First-Order Modal Logic and Topological Semantics**
۱۴-۱۲:۴۰: استراحت و ناهار		
۱۵-۱۴	**فاطمه شیرمحمدزاده ملکی** موسسه پژوهشی حکمت و فلسفه ایران	**Weak Subintuitionistic Logics: Neighborhood Semantics and Modal Companions**
۱۵:۳۰-۱۵: پذیرایی		
۱۶:۳۰-۱۵:۳۰	**سید احمد میرصانعی** دانشگاه تربیت مدرس	**The Use of Probabilistic Description Logics in Artificial Intelligence (AI)**
۱۷-۱۶:۳۰: استراحت		
۱۸-۱۷	**جمشید درخشان** دانشگاه آکسفورد	**Developments in the Interactions of Model Theory and Number Theory**

پنج‌شنبه ۸ خرداد ۱۴۰۴		
ساعت	سخنران	عنوان سخنرانی
۱۰-۹	**سید محمدامین خاتمی** دانشگاه صنعتی بیرجند	**Equivalence Connective in Many-valued Logics and Generalizing the Metric Concept**
۱۰:۳۰-۱۰: پذیرایی		
۱۱:۳۰-۱۰:۳۰	**سمیه تاری** دانشگاه شهید مدنی آذربایجان	**On Weakly O-Minimal Structures and Strong Cell Decomposition**
۱۲:۴۰-۱۱:۴۰	**حسین لامعی رامندی** پژوهشگاه دانش‌های بنیادی	**Minimal Kurepa Types**
۱۴-۱۲:۴۰: استراحت و ناهار		
۱۵-۱۴	**مقداد قاری** دانشگاه اصفهان	**Deontic Justification Logics: Resolving Deontic Paradoxes through Normative Reasons**
۱۵:۳۰-۱۵: پذیرایی		
۱۶:۳۰-۱۵:۳۰	**علی عنایت** دانشگاه گوتنبرگ	**Boundedly Axiomatizable Theories**

جهت مشاهده چکیده سخنرانی ها، می توانید عکس روبرو را اسکن کنید.

Abstracts of the Conference Talks

(In Alphabetical Order)

Two days Seminar on
Mathematical Logic and its Applications,
May 28-29, 2025, School of Mathematics, IPM, Tehran

An Overview of Logics in Dynamical Systems: The Axiomatization Problem

Somayeh Chopoghloo
IPM

A *discrete-time dynamical system* is typically represented as a pair $\langle X, f\rangle$, where X denotes the state space and $f : X \to X$ is a transition function describing the systems evolution over time. The state space X often carries additional mathematical structure, such as an order, topology, metric, or measure, that is preserved by f.

This talk will focus on two expressive logical frameworks for reasoning about such systems: *Dynamic Topological Logic* and its variant, *Intuitionistic Temporal Logic*. Both provide formal languages for capturing temporal and spatial properties of dynamical systems. I will survey recent results and techniques in the field, with particular emphasis on the axiomatization problem for these logics.

Two days Seminar on
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Developments in the Interactions of Model Theory and Number Theory

Jamshid Derakhshan
University of Oxford, UK

I will start with the works of Ax and Ax-Kochen on pseudo-finite fields and p-adic fields. I will present joint works of Angus Macintyre and myself on model theory of adeles, connections to number-theoretical questions on zeta functions and arithmetical equivalence of number fields going back to Iwasawa, and solution of Ax's 1968 problem on residue rings of the integers. I will then present joint works of Ehud Hrushovski and myself on imaginaries in adeles and their connection to quotient structures in arithmetical algebraic geometry.

Two days Seminar on
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Boundedly Axiomatizable Theories

Ali Enayat
University of Gothenburg, Sweden

Albert Visser and I recently published a paper (2024) on the incompleteness of boundedly axiomatizable theories. The main result of our paper shows that any consistent extension of a sequential theory that is axiomatizable by a set of axioms of bounded complexity has to be incomplete. In the theorem "bounded" refers to the *depth-of-quantifiers-alternation*, which in the context of arithmetical theories that are at least strong as $\mathrm{I}\Delta_0 + \mathsf{Exp}$, coincides with the usual Σ_n-complexity measure (in which Σ_0 corresponds to formulae all of whose quantifiers are bounded by a term). There is also a version of the theorem that applies to sufficiently strong set theories.

More recently, in joint work with Visser and Mateusz Łełyk, we have obtained some complementary results that go in the opposite direction by showing that there are models of arithmetical theories weaker than $\mathrm{I}\Delta_0 + \mathsf{Exp}$ whose complete theory is axiomatizable by a collection of Σ_n-sentences (for fixed n). Our strongest result in this direction constructs a model of $\mathsf{IOpen} + \mathsf{Coll}$ (where Coll is the full scheme of collection) whose complete theory is axiomatizable by a single sentence plus a collection of Σ_1-sentences.

In this talk I will present an exposition of the aforementioned developments.

Two days Seminar on
Mathematical Logic and its Applications,
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Deontic Justification Logics: Resolving Deontic Paradoxes through Normative Reasons

Meghdad Ghari
University of Isfahan

In everyday life, we encounter various norms-rules that govern what is required, permitted, or forbidden-such as laws, religious codes, traffic rules, game regulations, or linguistic grammatical conventions. The formal study of moral and normative concepts like obligation and permission originated in the 1950s with the development of Standard Deontic Logic (SDL). However, SDL was soon found to be riddled with paradoxes, including Plato's dilemma on deontic defeasibility, Sartre's dilemma about conflicting obligations, Aqvist's paradox of epistemic obligation, the Good Samaritan paradox, and puzzles related to free choice permissions. Numerous alternative deontic logics have been proposed to address these issues, yet none explicitly incorporate the underlying "reasons" behind obligations or permissions-what we refer to as "normative reasons." Justification logics offer a formal framework to represent these normative reasons, providing a means to clarify why an agent ought to perform a certain action. This lecture demonstrates how integrating normative reasons into deontic logics can resolve these paradoxes. Furthermore, we offer a solution to the Protagoras court paradox and briefly discuss Leibniz's solution.

Two days Seminar on
Mathematical Logic and its Applications,
May 28-29, 2025, School of Mathematics, IPM, Tehran

Randomizaion, Stability, and Probability Algebras

Karim Khanaki
Arak University of Technology

In this talk, we will present the theory of probability algebras within the framework of continuous logic (or affine logic), discuss model-theoretic stability of this theory, and explore its connection to the randomization of classical structures from the perspective of Keisler.

Two days Seminar on
Mathematical Logic and its Applications,
May 28-29, 2025, School of Mathematics, IPM, Tehran

Equivalence Connective in many-valued Logics and Generalizing the Metric Concept

S. Mohammad Amin Khatami
Birjand University of Technology

Many-valued logics extend classical logic by allowing truth values beyond "true" (1) and "false" (0), typically within a continuum like $[0, 1]$. They model uncertainty, vagueness, and partial truth. T-norm based logics, a subclass of many-valued logics, interpret logical conjunction by an algebraic concept, t-norm. Within this framework, the semantics of all connectives are rigorously defined by t-norms and their residual implications.

In this talk, we investigate a duality between the interpretation of the equivalence connective in many-valued logics and metric function. We demonstrate how this duality enables novel distance-based reasoning in fuzzy logical systems and how it can generalize the metric concept.

Two days Seminar on
Mathematical Logic and its Applications,
May 28-29, 2025, School of Mathematics, IPM, Tehran

Minimal Kurepa Types

Hossein Lamei Ramandi
IPM

After a brief introduction, we will talk about some theorems regarding the consistency of the existence of minimal Kurepa trees and Kurepa linear orders. If time permits we will discuss some questions and possible future projects.

Two days Seminar on
Mathematical Logic and its Applications,
May 28-29, 2025, School of Mathematics, IPM, Tehran

Weak Subintuitionistic Logics: Neighborhood Semantics and Modal Companions

Fatemeh Shirmohammadzadeh Maleki
Iranian Institute of Philosophy

This presentation introduces subintuitionistic logics, focusing on systems like WF, a logic weaker than Corsi's system F, as well as logics positioned between intuitionistic logic (IPC) and WF, such as $\mathsf{WF_N}$ and extensions like F, all characterized by their neighborhood and Kripke semantics. We explore their relationship with modal logics through unary and binary modal companions and highlight the unique behavior of the implicational fragment, where modus ponens often fails but aligns with the axiom R. Weak implication emerges as a distinctive feature of these logics. Additionally, we examine the finite model property and conservativity relative to IPC. This talk provides a comprehensive overview of the theoretical foundations of subintuitionistic logics, their modal companions, and their spectrum from WF to IPC, appealing to researchers in non-classical logic and neighborhood semantics.

Two days Seminar on
Mathematical Logic and its Applications,
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The Use of Probabilistic Description Logics in Artificial Intelligence (AI)

S. Ahmad Mirsanei
Tarbiat Modares University

Probabilistic Description Logics (PDLs) are extensions of Classical Description Logics (DLs) by incorporating probabilistic reasoning, enabling the representation and manipulation of uncertain knowledge in a syntactically and semantically rich framework. The widespread use of AI in everyday life such as IoT, semantic web services, biology, medicine etc., and the limitations and issues in the uncertain reasoning are two factors that lead us to study how uncertainty are represented by probabilistic approaches. I first introduce a tableau-based algorithm and two probabilistic reasoners TRILL and TRILLP, for SHOIQ KBs and ALC KBs, respectively, and by them I try to solve two major probabilistic problems in semantic web, i.e. uncertainty and inconsistency. By this algorithm and reasoners, I really introduce a probabilistic framework to represent the uncertainty and the inconsistency degree of the KBs and reasoning about them. This framework has been implemented as a plugin in the Protg ontology editor. Probabilistic reasoning provides a mathematical framework for representing and understanding uncertainty, and reduce the complexity to EXPTIME.

Keywords. probabilistic description logic, uncertainty, knowledge graph, TRILL and TRILLP, planning, artificial intelligence (AI)

Two days Seminar on
Mathematical Logic and its Applications,
May 28-29, 2025, School of Mathematics, IPM, Tehran

On Weakly O-Minimal Structures and Strong Cell Decomposition

Somayyeh Tari
Azarbaijan Shahid Madani University

A first-order expansion $\mathcal{M} = (M, <, ...)$ of a dense linear order without endpoints is said to be *weakly o-minimal* if every unary definable subset of M (with parameters from M) is a finite union of open convex sets and points. These structures generalize o-minimal structures by allowing definable sets to have more complex forms while preserving certain tameness properties. This talk explores some fundamental properties of weakly o-minimal structures. Specifically, we examine the notion of strong cell decomposition in this context and provide a criterion for when such a decomposition exists.

Formally, let $\mathcal{M} = (M, <, ...)$ be a first-order structure expanding a dense linear order without endpoints. Then $\mathcal{M}$ is called *weakly o-minimal* if for every formula $\varphi(x, \bar{a})$ with parameters $\bar{a} \in M$, the set

$$\varphi(M, \bar{a}) = \{x \in M : \mathcal{M} \models \varphi(x, \bar{a})\}$$

is a finite union of open convex sets and isolated points. This condition ensures that although the structure may not be o-minimal, its one-dimensional definable sets still have a relatively simple geometric description. Here we investigate the property of *strong cell decomposition* in weakly o-minimal structures. This property allows us to partition the domain into finitely many "cells" over which definable functions behave nicely. We aim to provide a criterion under which a weakly o-minimal structure admits strong cell decomposition.

In addition, we study *o-minimal traces*, which are a special class of weakly o-minimal structures. An o-minimal trace can be thought of as a structure obtained by naming certain subsets from an ambient o-minimal structure. We prove that such structures satisfy the strong cell decomposition property.

Two days Seminar on
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First-Order Modal Logic and Topological Semantics

Reihane Zoghifard
IPM

While propositional modal logic has been extensively studied, research on first-order modal logic (FOML) remains limited, especially with topological semantics. Moreover, some topological incompleteness results in FOML suggest that first-order extensions may introduce complexities not present in the propositional case. In this talk, I will review key developments in this area and explore definability challenges associated with topological semantics.