UNIVERSITY SEMINAR: LOGIC ACROSS DISCIPLINES

Spring 2019

Friday, April 19, 2019
1:00–2:00pm
Speaker: Rumen Dimitrov, Western Illinois University
http://www.wiu.edu/users/rdd104/home.htm
Place: Rome Hall (801 22nd Street), Room 771
Title: *Cohesive Powers: Structures in General and Linear Orders*

Abstract: The fundamental theorem of cohesive powers establishes relationship between the satisfiability of formulas (sentences) in a computable structure and in its cohesive power. In this talk, I will survey known results about cohesive powers and will show that different computable presentations of a computable structure may have non-isomorphic (not even elementary equivalent) cohesive powers. I will then present results about cohesive powers of linear orders, which are based on recent joint work with Harizanov, Morozov, Shafer, A.Soskova, and Vatev.

Friday, March 29, 2019
12:00–1:00 pm
Speaker: Michele Friend, Philosophy Department, GWU
https://philosophy.columbian.gwu.edu/michele-friend
Place: Rome Hall (801 22nd Street), Room 771
Title: *The Rigour of Proof*

Abstract: What is a rigorous proof? When is a proof sufficiently rigorous? What is the importance of rigour in a mathematical proof?

To answer the first question, we begin with a comparison between a formal proof and a rigorous proof. A rigorous proof need not be formal, but it needs to be possible, in principle, to make it formal.

To answer the second, we start with the distinction between sufficiently rigorous for acceptance by other mathematicians, sufficiently rigorous to establish a result and sufficiently rigorous to elicit further questions.

The importance of rigour in a proof has several answers. A realist about the ontology of mathematics might well accept a non-rigorous proof since it establishes a truth guaranteed by the ontology of mathematics, in this case rigour is of psychological or epistemological importance at best. In contrast, constructivist philosophers and mathematicians would assert that the term 'rigorous proof' is redundant, since for them, a proof lacking in rigour is not a proof, it is at best a purported proof. Pluralists give a third, more nuanced answer.

Friday, February 22, 2019
12:00–1:00 pm
Speaker: Valentina Harizanov, GWU

Place: Rome Hall (801 22nd Street), Room 771
Title: *Measuring Complexity in Computable Structure Theory*

Abstract: In order to measure complexity of problems in computable structure theory, one of the main strategies is to find an optimal description of the class of structures under investigation. This often requires the use of various algebraic properties of the structures. To prove the sharpness of our description, we use the notion of *many-one completeness*. The complexity is often expressed using hyper-arithmetical sets or their differences. As examples of different complexity problems we will present some recent results.

Wednesday, February 6, 2019
3:45–4:45pm
Speaker: Sergei Goncharov, Russian Academy of Sciences and Novosibirsk State University
http://www.mathnet.ru/eng/person9178
Place: Rome Hall (801 22nd Street), Room 771
Title: *Computability via Definability and Polynomial Computability*

Abstract: Computability on abstract models can be based on definability via Delta zero and Sigma formulas. We introduce computability over an abstract model *M* based on definability over hereditary finite subset superstructure over *M* or hereditary finite list-extension over *M*. We will consider different enrichments of our language for the notion of terms and discuss the problem of complexity of definable functions. It is a basis for constructing a logic programming language. We will construct extensions with different properties of computability.

Friday, February 1, 2019
12:00–1:00 pm
Speaker: Valentina Harizanov, GWU
Place: Rome Hall (801 22nd Street), Room 771
Title: *Fraisse Limits, Ages and Computability*

Abstract: Fraisse studied countable structures *A* through analysis of the age of *A*, the set of all finitely generated substructures of *A*. We will focus on Fraisse limits and other structures with similar automorphism extension properties, and present some recent results concerning their computability-theoretic properties.

Fall 2018

Friday, November 30, 2018
3:30–4:30pm
Speaker: Tslil Clingman, Johns Hopkins University
Place: Phillips Hall (801 22nd Street), Room 736
Title: *Homotopy Type Theory, the Confluence of Logic and Space*

Abstract: In this talk we will learn how to express ourselves in the language of Homotopy Type Theory and see how it is represents the natural merging of logic and space. We will take some time to consider how identity types, and in particular univalence, free us from certain artificial restrictions of classical logic(s) and foundational systems and give rise to a rich and pleasing theory. Time permitting, we will discuss the role of Univalent Foundations and how Homotopy Type Theory in particular may be leveraged as a foundational system to the direct advantage of the working mathematician.

Jointly with Math Colloquium
Friday, November 9, 2018
2:00–3:00pm
Speaker: Denis R. Hirschfeldt, University of Chicago
https://math.uchicago.edu/~drh/
Place: Rome Hall (801 22nd Street), Room 206
Title: *Computable Mathematics and Reverse Mathematics*

Abstract: Every mathematician knows that if 2+2=5 then Bertrand Russell is the pope. Russell is credited with having given a proof of logic, no such proof is needed, since a false statement implies every statement. Contrapositively, every statement implies a given true statement. But we are often interested in questions of implication and nonimplication between true statements. We have all heard and said things like "Theorems A and B are equivalent." or "Theorem C does not just follow from Theorem D." There is also a well-established practice of showing that a given theorem can be proved without using certain methods. These are often crucial things to understand about an area of mathematics, and can also help us make connections between different areas.

Computability theory and proof theory can both be used to analyze, and hence compare, the strength of theorems and constructions. For example, when we have a principle such as "Every infinite binary tree has an infinite path", we can ask how difficult it is to compute such a path from a given tree. We can also ask how much axiomatic power is necessary to prove that this principle holds. The first kind of question leads to the program of Computable Mathematics. One version of the second kind of question leads to the program of Reverse Mathematics. I will give an introduction to these research programs, and discuss how the close connection between computability and definability yields a fruitful interplay between them.

Friday, October 26, 2018
1:00–2:00pm
Speaker: Valentina Harizanov, GWU
https://home.gwu.edu/~harizanv/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Limit Computably Categorical Structures*

Abstract: We say that a computable structure is limit computably categorical if for every isomorphic computable structure there is an isomorphism that is computable in the halting set. This notion can be further generalized, and there is a natural connection with definability using computable infinitary formulas. We will investigate limit computably categorical structures from some familiar classes, although such characterization is not known even for linear orders, trees of finite height, equivalence structures, or abelian p-groups.

Friday, October 19, 2018
1:00–2:00pm
Speaker: Valentina Harizanov, GWU
https://home.gwu.edu/~harizanv/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Computability and Definability*

Abstract: Since classical isomorphisms do not preserve computable properties of structures, computability theorists are interested in computable isomorphisms. We say that a computable structure is computably categorical if for every isomorphic computable structure there is a computable isomorphism. We will give examples and counterexamples of computable categoricity, and show how definable properties of structures relate to categoricity. For many structures from natural classes, there is a characterization of computably categorical ones. The notion of computable categoricity can be generalized by looking at isomorphisms that are computable from Turing's halting set, leading to many open characterization problems.

Friday, October 12, 2018
1:00–2:00pm
Speaker: Rumen Dimitrov, Western Illinois University
http://www.wiu.edu/users/rdd104/home.htm
Place: Rome Hall (801 22nd Street), Room 771
Title: *Degree Structure of Effective Boolean Algebras*

Abstract: We establish Turing degree embedding results for:
(1) Subalgebras of effective Boolean algebras, and
(2) Lattices of subalgebras of effective Boolean algebras.
The talk is based on joint work with V. Harizanov and A. Morozov.

Friday, September 28, 2018
1:00 – 2:00pm
Speaker: Iva Bilanovic, GWU
Place: Rome Hall (801 22nd Street), Room 771
Title: *The Algorithmic Complexity of Detecting Group Properties*

Abstract: We consider the question: *From a "nice" description of a group, can we detect whether or not it has some property of interest?* Our nice descriptions will be

recursive presentations and *computable atomic diagrams*. We show that for classes of groups with such descriptions, the detection of a *Markov property* is not computable. Then we look at some specific properties of high computability theoretic complexity. This will be a more technical continuation of my previous talk, but all necessary background material will be presented.

Logic-Topology Seminar
Friday, September 21, 2018
1:00 – 2:00pm
Speaker: Jozef Przytycki, GWU
http://home.gwu.edu/~przytyck/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Multiplying Fractions in a Topological Way*

Abstract: I describe the work of our Mathathon group (Sujoy Mukherjee, Rhea Palak Bakshi, Marithania Silvero, Xiao Wang), December 2017 – April 2018 on an algebra structure (Kauffman bracket skein algebra) of links in thickened 4-holed sphere.

Based on the presentation of the Kauffman bracket skein module of the torus, which I gave in 1987 when the theory of skein modules was just invented, Charles D. Frohman and Razvan Gelca established a complete description of the multiplicative operation leading to a famous product-to-sum statement: "the KBSA of a torus is a quantum torus." In this talk, we study the multiplicative structure of the Kauffman bracket skein algebra of the thickened four-holed sphere. We present an algorithm to compute the product of any two elements of the algebra, and give an explicit formula for some families of curves. We surmise that the algorithm has quasi-polynomial growth with respect to the number of crossings of a pair of curves. Further, we conjecture the existence of a positive basis for the algebra (motivated by E. Witten's work).

The talk will be elementary and all needed notions will be defined (compare e-print: \ {\tt arXiv:1805.06062 [math.GT]}).

Friday, September 7, 2018
1:00 – 2:00pm
Speaker: Iva Bilanovic, GWU
Place: Rome Hall (801 22nd Street), Room 771
Title: *Decision Problems and Groups*

Abstract: We will discuss *decision problems*, those that can be formulated as yes/no questions of the inputs, and how to determine the *algorithmic complexity* of a procedure that makes such decisions. Computable functions, the Kleene-Mostowski arithmetical hierarchy of sets, and other related notions and topics will be discussed at length. In the final portion of the talk, we will turn our attention to decision problems both for recursively presented and for computable groups.