UNIVERSITY SEMINAR: LOGIC ACROSS DISCIPLINES

Spring 2018

Topology-Logic Seminar
Thursday, May 3, 2018
3:00–4:00pm
Speaker**:** Stepan Orevkov, University of Toulouse, France
Place: Phillips Hall (801 22nd Street), Room 730
Title: *Garside Theory and Its Application for the Recognition of Quasi-Positive Braids*
Abstract: Garside theory is a tool for solving classical algorithmic problems (word problem and conjugacy problem) for the braid group and its generalizations. I am going to give a rather exhaustive introduction to this theory and to present my recent results on algorithmic recognition of quasi-positive braids in some particular cases.
Recall that a braid is called quasi-positive if it is a product of conjugates of standard generators. The problem of deciding whether a given braid is quasipositive appears naturally in the study of plane real or complex algebraic curves.

Friday, April 27, 2018
11:00am–12:00noon
Place: Phillips Hall (801 22nd Street), Room 736
Working seminar about developing a formal system representing reasoning in chemistry, led by **Prof. Michele Friend**, Department of Philosophy.

Thursday, April 26, 2018
12:30–1:30pm
Speaker**:** Rachael Alvir, University of Notre Dame
Place: Rome Hall (801 22nd Street), Room 351
Title: *Scott Ranks of Scattered Linear Orders*
Abstract: The logic *L*(omega1, omega) is obtained from regular finitary first-order logic by closing under countable conjunctions and disjunctions. There is a kind of normal form for such sentences. The Scott rank of a countable structure A is the least complexity of a sentence A of *L*(omega1, omega), which describes *A* up to isomorphism among countable structures. Every scattered linear order is associated with an ordinal known as its Hausdorff rank; we give sharp upper bounds on the Scott rank of a scattered linear order given its Hausdorff rank, along the way calculating some of the back-and-forth relations on this class. These results generalize previously obtained results on the Scott ranks of ordinals and Hausdorff rank 1 linear orders.

Friday, March 30, 2018
11:00am–12:00noon
Speaker**:** Iva Bilanovic, GWU
Place: Phillips Hall (801 22nd Street), Room 736
Title: *Detecting Nilpotence in Classes of Groups*

Abstract: Detecting an arbitrary Markov property is π_2-hard in the class of recursively presented groups and is π_1-hard in the class of computable groups. In other words, even when a computable description of a group is given we cannot algorithmically decide whether the group has some property. Certain properties attain even higher level of complexity. We will investigate nilpotence and precisely locate its undecidability in the arithmetical hierarchy.

Thursday, March 22, 2018
12:30–1:30pm
Speaker: Alexandra Soskova, Sofia University, Bulgaria
https://store.fmi.uni-sofia.bg/fmi/logic/asoskova/
Place: Rome Hall (801 22nd Street), Room 531
Title: *Structural Properties of Spectra and Omega-Spectra*
Abstract: We consider the degree spectrum of a structure from the point of view of enumeration reducibility and omega-enumeration reducibility. We will give an overview of several structural properties of degree spectra and their co-spectra, such as a minimal pair theorem and the existence of quasi-minimal degrees for degree spectra and receive as a corollary some fundamental theorems in enumeration degrees. We will show that every countable ideal of enumeration degrees is a co-spectrum of a structure and if a degree spectrum has a countable base then it has a least enumeration degree. Next we investigate the omega-enumeration co-spectra and show that not every countable ideal of omega-enumeration degrees is an omega-co-spectrum of a structure.

Friday, February 23, 2018
11:00am–12:00noon
Speaker: Cheng Tang, GWU, Computer Science
https://sites.google.com/site/chengtanggwu/
Place: Phillips Hall (801 22nd Street), Room 736
Title: *Transforming Machine Learning Heuristics into Provable Algorithms: Classical, Stochastic, and Neural*
Abstract: A recurring pattern in many areas of machine learning is the empirical success of a handful of heuristics, i.e., any simple learning procedure favored by practitioners. Many of these heuristic techniques lack formal theoretical justification. For unsupervised learning, Lloyd's k-means algorithm, while provably exponentially slow in the worst-case, remains popular for clustering problems arising from different applications. For supervised learning, random forest is another example of a winning heuristic with many variants and applications. But the most prominent example is perhaps the blossoming field of deep learning, which is almost entirely composed of heuristics; the practical success of a deep learning algorithm usually relies on an experienced user skillfully and creatively combining heuristics. In this talk, I will discuss some of my thesis work in advancing the theoretical understanding of some of the most widely used machine learning heuristics.

Friday, February 9, 2018
(Jointly with Math Colloquium)
1:00–2:00pm
Speaker: Andrei Morozov, Sobolev Institute of Mathematics, Novosibirsk, Russia
http://www.math.nsc.ru/%7Easm256/

Place: Rome Hall (801 22nd Street), Room 204
Title: *Infinite Time Blum-Shub-Smale Machines - Computability for Analysis*
Abstract: We will present a concept of computability over the reals based on Blum-Shub-Smale machines working in infinite time (ITBM). We will give some characterizations of this computability, prove some of its properties, and discuss its adequacy for the classical analysis. This work is joint with Peter Koepke.

Thursday, February 8, 2018
12:30–1:30pm
Speaker**:** Rumen Dimitrov, Western Illinois University
http://www.wiu.edu/users/rdd104/home.htm
Place: Phillips Hall (801 22nd Street), Room 730
Title: *Effective Ultraproducts and Their Applications*
Abstract: We use cohesive (effectively indecomposable) sets to build nonstandard versions of the field of rational numbers. We study the isomorphism types of these models when the complements of the cohesive sets are computably enumerable. Using Koenigsmann's work on Hilbert's Tenth Problem we give a new proof that these fields are rigid.

Friday, February 2, 2018
11:00am–12:00noon
Speaker: Jennifer Chubb, University of San Francisco and GWU
http://www.cs.usfca.edu/~jcchubb/
Place: Phillips Hall (801 22nd Street), Room 736
Title: *Topological Spaces of Orderings of Algebraic Structures*
Abstract: A left- or bi- partial ordering of an algebraic structure is a partial ordering of the elements of the structure that is invariant under the structure acting on itself on the left or, respectively, both on the left and on the right. In this talk, we will consider the spaces of total left and bi-orderings of a group, how these spaces can be visualized as the paths of binary trees, and their computational and topological properties.

Friday, January 26, 2018
11:00am–12:00noon
Speaker: Valentina Harizanov, GWU
http://home.gwu.edu/~harizanv/
Place: Phillips Hall (801 22nd Street), Room 736

Title: *Encoding Noncomputable Sets into Orders on Computable Structures*

Abstract: We consider a structure with a binary operation, which admits orders that are invariant under the operation. The space of these orders is compact under a natural topology, and in many cases homeomorphic to the Cantor set. For such computable structures, including many groups, we show when it is possible to encode an arbitrary set into an order so that their Turing degrees are preserved.

Fall 2017

Friday, December 8, 2017
11:00am–12:00noon
Speaker**:** Rumen Dimitrov, Western Illinois University
http://www.wiu.edu/users/rdd104/home.htm
Place: Rome Hall (801 22nd Street), Room 351
Title: *Cohesive Powers, Definability, and Automorphisms*
Abstract: In 1959, Feferman, Scott, and Tennenbaum showed that the recursive functions modulo r-cohesive sets are models of only fragments of arithmetic. In 1970, Lerman characterized the isomorphism types of a class of such structures. In 2014, Dimitrov, Harizanov, Miller, and Mourad proved similar results about cohesive powers of the standard presentation of the field of rational numbers. In this talk we will discuss the connection between definability and isomorphisms of cohesive powers of computable structures.

Thursday, November 30, 2017
2:30–3:30p.m.
Speaker: Tslil Clingman, Johns Hopkins University
Place: Rome Hall (801 22nd Street), Room 771
Title: *An Intuitive Description of Toposes, Toposes as a Description of Intuitionism*

Abstract: In this talk we will begin by examining, by way of example, the notion of a topos, a category exhibiting certain structural properties satisfied in particular by the familiar category of sets and functions but many strange and wonderful examples besides. We will then observe how the presence of certain structural properties naturally equips a topos with internal and external models of intuitionistic propositional logic. From here we will explore the Mitchell-Bènabou language of a topos – a framework that will allow us to redevelop much of the usual language of set theory internal to any topos. That is, we will see how we may make sense of forming objects of a topos via comprehensions, quantifiers and many other appropriate tools as in the case of surjections(X,Y) = {f ∈ Y^X | ∀y∈Y ∃x∈X [f(x)=y]} for the (object of) surjections from X to Y. That objects defined in this manner are in fact the ones we desired depends further on the semantics of internal language, the so termed Kripke-Joyal semantics of a topos. Time allowing we will develop this more fully and explore the relation this bears to the forcing arguments of Cohen.

Thursday, November 16, 2017
2:30–3:30p.m.
Speaker: Valentina Harizanov, GWU

http://home.gwu.edu/~harizanv/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Gödel Index Sets of Computable Structures*

Abstract: For a computable structure, we define its index set to be the set of all Goedel codes for computable isomorphic copies. We will show how to calculate precisely the complexity of the index sets for some familiar algebraic structures. We will further discuss the most recent results in this area.

Friday, November 10, 2017
3:00–4:00p.m.
Speaker: Russell Miller, City University of New York
http://qcpages.qc.cuny.edu/~rmiller/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Classification and measure for algebraic fields*

Abstract: The algebraic fields of characteristic 0 are precisely the subfields of the algebraic closure of the rationals, up to isomorphism. We describe a way to classify them effectively, via a computable homeomorphism onto Cantor space. This homeomorphism makes it natural to transfer Lebesgue measure from Cantor space onto the class of these fields, although there is another probability measure on the same class, which seems in some ways more natural than Lebesgue measure. We will discuss how certain properties of these fields – notably, relative computable categoricity – interact with these measures: the basic result is that only measure-0-many of these fields fail to be relatively computably categorical. (The work on computable categoricity is joint with Johanna Franklin.)

Thursday, November 2, 2017
2:30–3:30p.m.
Speaker: Valentina Harizanov, GWU
http://home.gwu.edu/~harizanv/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Computable Classification Problem*

Abstract: The Scott Isomorphism Theorem says that for any countable structure M there is a sentence, in countable infinitary language, the countable models of which are exactly the isomorphic copies of M. Here, we consider a computable structure A and define its index set to be the set of all Gödel codes for computable isomorphic copies of A. We will present evidence for the following thesis. To calculate the precise complexity of the index set of A, we need a good description of A, using computable infinitary language, and once we have an optimal description, the exact complexity within a computability-theoretic hierarchy will match that of the description.

Friday, October 27, 2017
4:15–5:15p.m.
Speaker: Jennifer Chubb, University of San Francisco and GWU
http://www.cs.usfca.edu/~jcchubb/
Place: Rome Hall (801 22nd Street), Room 771

Title: *Trees of Orderings*

Abstract: An ordering of an algebraic structure with identity can often be identified with the corresponding set of positive elements. For a given algebraic structure, we can organize the cones of all the admitted orderings on a tree. When the structure is computable, the tree can be constructed in an effective way. Topological properties of this space of orderings can provide insight into algorithmic properties of the orderings, and vice versa. In this talk, we will see how to construct these trees and what they can tell us.

Thursday, October 19, 2017
2:30–3:30p.m.
Speaker: Jennifer Chubb, GWU
http://www.cs.usfca.edu/~jcchubb/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Orderings of algebraic structures*

Abstract: A left- or bi- partial ordering of an algebraic structure is a partial ordering of the elements of the structure that is invariant under the structure acting on itself on the left or, respectively, both on the left and on the right. I will discuss algorithmic properties of the orderings admitted by computable structures and their general properties, and describe some open problems.

Logic-Topology Seminar
Thursday, October 5, 2017
2:30–3:30p.m.
Speaker: Jozef Przytycki, GWU
http://home.gwu.edu/~przytyck/
Place: Rome Hall (801 22nd Street), Room 771
Title: *Mathathon II: search for interesting torsion in Khovanov homology*

Abstract: We will describe the work of our Mathathon group (Sujoy Mukherjee, Marithania Silvero, Xiao Wang, Seung Yeop Yang), December 2016–January 2017, on torsion in Khovanov homology different from Z_2. Khovanov homology, one of the most important constructions at the end of XX century, has been computed for many links. However, computation is NP-hard and we are limited to generic knots of up to 35 crossings with only some families with larger number of crossings.
The experimental data suggest that there is abundance of Z_2-torsion but other torsion seems to be rather rear phenomenon. The first Z_4 torsion appears in 15 crossing torus knot T(4,5), and the first Z_3 and Z_5 torsion in the torus knot T(5,6). Generally, calculations by Bar-Nathan, Shumakovitch, and Lewark suggest Z_p^k torsion in the torus knot T(p^k,p^k+1), p^k >3, but this has not yet been proven. We show, with Mathathoners, the existence of Z_n-torsion, n>3, for some infinite family of knots. The simplest of them is obtained by deforming the torus knot T(5,7) by a t_2k-moves. We also prove the existence of knots with other torsion, the largest being Z_2^23, so the cyclic group of over 8 millions elements. We combine computer calculations (and struggle with NP hardness) with homological algebra technique.
The talk will be elementary and all needed notions will be defined.