Aleksandr Sherstyuk

Portfolio

a.sherstyuk@vanderbilt.edu

Majors: Mathematics, Engineering Science, Minor: Computer Science, Vanderbilt University 2023

Seminars and Conferences Attended

- AMS Sectional Meeting: Applied Category Theory, UC Riverside, 2019
- NCGOA: Quantum Algebra Shanks Lectures, Vanderbilt University, 2019
- Conference in Social Choice Theory in Honor of John Weymark's Retirement, Vanderbilt University, 2020
- Seminar on Low Dimensional Topology and Geometric Group Theory (weekly on Wednesdays)
- Seminar on Subfactors (weekly on Fridays)
- Math Colloquium, Physics Colloquium (weekly on Thursdays)
- VandyGRAF - Initiative for Gravity, Waves, and Fluids (weekly on Fridays)

Interests and Further Biographical Information

- Baez's Directions: Homotopy Theory, Algebraic Geometry, QFTs, Formal Verification, Pedagogy
- My Narrative Through Math Thus Far

Education

Relevant Coursework (for credit)

Multivariable Calculus on Manifolds, Methods of Partial Differential Equations, Undergraduate Real and Complex Analysis, Advanced Linear Algebra, Graph Theory, Differential Geometry, Set Theory, Mathematical Probability and Statistics, Mathematical Game Theory, Algorithms, Automata, Linear Optimization, Convex Optimization, Numerical Methods, Graduate Abstract Algebra and Topology.

Graduate Courses Audited

Category Theory, Harmonic Analysis, Operator Algebras, The Growth of Groups, Groups Acting on Hyperbolic Space, Complex Analysis, Parts of Riemannian Geometry and Modular Forms.

General Competencies (Areas of Math)

Category Theory, Applied Category Theory, Algebraic Topology, Differential Geometry, Representation Theory, Abstract Harmonic Analysis, Operator Algebras, Homological Algebra, Sheaves, Geometric Group Theory, Basic Model Theory, Discrete and Numerical Algorithms, Optimization, Statistics, Game Theory, Matching Theory, Resource Allocation.

Personal Independent Studies

Category Theory and Topoi, Sheaf Theory, Representation Theoretic Fourier Transform for Nonabelian Groups, Spectral Theory, C* Algebras, Von Neumann Algebras, Covering Spaces, π_1, Galois Connection for Topology and Grothendieck's Galois Theory, Etale and Sheaf Cohomology.

Research

- Efficient Graph Representations with Jeremy Spinrad
- Classifying Rank 1 Fusion Categories with Cain Edie-Michelle
- Quantum Computation and Machine Learning with David Hyde

Directed Reading

- Covering Spaces and Mapping Class Groups (Ian Runnels)
- Coxeter Groups, van Kampen Diagram Techniques (Michael Mihalik)
- Lattice Theory, Linear Logic (Adam Prenosil)
- Universal Algebra (Constantine Tsinakis)

Talks Given in Class on Specialized Topics

- Van Kampen's Theorem, Motivation and Proof (Michael Mihalik)
- Pontryagin Duality for LCAGs, Fourier Transform of Finite Nonabelian Groups (Alex Powell)
- Created an Exposition on String Diagrams for Strict 2-Categories (Constantine Tsinakis)
- Presented a Paper by Kojima and Kamada – Fair Matching Under Constraints (Eun Jeong Heo)

Teaching Experience

- Lectures given to Math Club (Coordinated weekly meetings for 5 years)
  - Counting Under Symmetries with the Orbit Stabilizer Theorem/Burnside's Lemma
  - Matroid Theory and Greedy Algorithms
  - Certifying Algorithms, Especially Max Flow - Min Cut, and the Ford - Fulkerson Algorithm
  - Category Theory and Universal Properties
  - Generating Functions
  - On Vaughan Jones's Life and Work (the Bridge between Operator Algebras and Knot Theory)
  - Knot Invariants via a Group Activity
  - Euler Characteristic, Gauss - Bonnet, Poincare - Hopf Theorem (Using the book Euler's Gem)
  - Brouwer Fixed Point Theorem, Sperner's Lemma, and Fair Rent Division
  - Borsuk - Ulam Theorem, Tucker's Lemma, and Necklace Cutting
  - The Fundamental Group, Covering Spaces, and the Galois Connection
- More Teaching Experience:
  - Graded for Proof-Based Linear Algebra, Gave Detailed Individual Feedback on Proof Writing
  - TA'ed Graph Theory for the Michigan Math and Science Scholars program. Led Problem Solving Sessions and Graded Homework Daily for 4 Weeks
  - Self-Operated Tutoring Business (Calculus to Linear Algebra, Topology, Analysis, Algorithms, etc)

Textbooks Read

- Multivariable Mathematics – Theodor Shifrin
- Visual Group Theory – Nathan Carter
- Visual Complex Analysis – Tristan Needham
- Algebra: Chapter 0 – Paolo Aluffi
- Basic Category Theory – Tom Leinster
- Category Theory – Steve Awodey
- Category Theory in Context – Emily Riehl
- Topoi: The Categorial Analysis of Logic – Robert Goldblatt
- An Invitation to Applied Category Theory: Seven Sketches – Spivak, Fong
- Introduction to Lattices and Order – Davey, Priestly
- Linear Algebra Done Right – Sheldon Axler
- Matroids: A Geometric Approach – Gordon, McNulty
- Introductory Combinatorics – Richard Brualdi
- Algebraic Combinatorics – Richard Stanley
- The Symmetric Group: Representations, Combinatorial Algorithms, and Symmetric Functions – Sagan
- Representation Theory – Pavel Etingof
- Game Theory: Alive! – Karlin, Peres
- Real Analysis – Charles Pugh
- Introductory Functional Analysis with Applications – Kreyszig
- A Course in Operator Theory – John B Conway
- Topology – James Munkres
- Using the Borsuk Ulam Theorem – Jiri Matousek
- Topology: A Categorical Approach – Terilla, Bradley, Bryson
- Manifolds, Sheaves, and Cohomology – Torsden Wedhorn
- Algebraic Topology – Allen Hatcher
- Intro to Homological Algebra – Joseph Rotmen
- Office Hours with a Geometric Group Theorist – Margalit, Clay, et al
- Introduction to Automata Theory, Languages, and Computation – Hopcroft, Ullman
- Naive Lie Theory – Stillwell

Textbooks Currently Reading

- Smooth Manifolds – John Lee
- Differential Forms in Algebraic Topology – Bott, Tu
- Homotopical Topology – Fomenko, Fuches
- The Rising Sea: Foundations of Algebraic Geometry – Ravi Vakil
- Abstract Harmonic Analysis – Gerald Folland