Aleksandr Sherstyuk

Unofficial Transcript of Relevant Classes and Audits

2023 - All Classes Audited Post Graduation

Reading group in Coxeter Groups via van Kampen Diagram methods Fall
Vanderbilt University Michael Mihalik

- Elementary proof of the deletion condition using van Kampen diagrams, walls and relation bands, parallel and strong parallel wall theorems, root systems, Stallings' theorem

MATH 9300 - Seminar in Algebra: Groups Acting on Hyperbolic Space Fall
Vanderbilt University Denis Osin

- Asymptotic cones, HNN extensions, hyperbolicity, Gromov boundary, elliptic, parabolic, and hyperbolic elements

Review: MATH 4300 - Modern Algebra Fall
Vanderbilt University Larry Rolen

- In the direction of algebraic number theory
- Book: Algebra, by Hungerford

Review: MATH 6100 - Theory of Functions of a Real Variable Fall
Vanderbilt University Jesse Peterson

- Measure theory, L^p spaces, Lebesgue integration, Fubini theorem, monotone convergence theorem Lebesgue dominated convergence theorem
- Book: Real Analysis: Modern Techniques and their Applications, by Folland

MATH 9201 - Seminar in Topology: Geometry and Topology of Surfaces Spring
Vanderbilt University Ian Runnels

- Mapping class groups, curve complexes, hyperbolic geometry through the lens of the punctured torus
- Book: A Primer on Mapping Class Groups, by Farb, Margalit

2022 - Senior

MATH 4200 - Topology (A) Fall
Vanderbilt University Michael Mihalik

- Point-Set topology, separation axioms, function spaces, theorems of Tychonoff, Urysohn, Teitze, compactification

MATH 4620 - Linear Optimization (A) Fall
Vanderbilt University Kevin Grace

- The simplex and dual simplex methods, complementary slackness, interior point method, ellipsoid method
- Book: A Gentle Introduction to Linear Optimization

CS 3891 - Numerical Methods for Computer Science (A) Fall
Vanderbilt University David Hyde

- Conditioning and stability, LU and Cholesky decomposition, Gram-Schmidt via Householder transformations and Givens rotations. Finding eigenvalues via power, inverse, QR iteration. SVD, PCA. Newton's method, secant method, the BFGS algorithm, Karush-Kuhn-Tucker conditions, conjugate gradient methods, Runge-Kutta methods
- Book: Numerical Algorithms by Solomon

Audit: MATH 9100 - Seminar in Analysis: Approximation in C* Algebras Fall
Vanderbilt University Jesse Peterson

- Completely positive maps, Arvesson's extension theorem, Voiculescu's theorem, nuclear and exact C* algebras
- Book: C* Algebras and Finite Dimensional Approximations by Brown, Ozawa

MATH 4201 - Topology (A) Spring
Vanderbilt University Michael Mihalik

- Presented on the motivation and proof of the Seifert-van Kampen theorem in class and to an audience of prospective math grad students
- Fundamental group, covering spaces, the Galois connection, simplicial cellular and singular homology, theorems of Brouwer, Borsuk-Ulam, Euler characteristic, classifying Platonic solids and compact surfaces, fundamental theorem of algebra, Cayley complexes, ends of groups, hyperbolic geometry

CS 3252 - Theory of Automata, Formal Languages, and Computation (A-) Spring
Vanderbilt University Douglas Fisher

- Deterministic and nondeterministic finite automata, regular expressions, context-free grammars and pushdown automata, Turing machines, undecidability and complexity theory
- Intro to Automata Theory, Languages, and Computation, by Hopcroft et al

CE 3890 - Graduate Convex Optimization (with applications to control theory) (B) Spring
Vanderbilt University Ahmad Taha

- Convex sets, functions, optimization, Lagrange duality. Applications to control theory, Lyapunov stability
- Book: Convex Optimization by Boyd

Audit: MATH 7200 - Algebraic Topology Spring
Vanderbilt University Anna Marie Bohmann

- Excision, Mayer-Vietoris sequences, universal coefficients theorem, the cup product and Kunneth formula, Poincare duality, Whitehead's theorem, the Hurewicz theorem
- Book: Algebraic Topology by Hatcher (chapters 2 and 3, and parts of 4)

CMST 1501 - Public Communication of Science (C+) Spring
Vanderbilt University Misti Yang

- Developed a presentation and video explaining covering spaces at a level accessible to high schoolers. Led to an ongoing personal project to add math animations to my completed script over the summer
- Professor Yang, whom I was close to, passed away on March 23 unexpectedly
- Theory and practice of speaking before an audience. Designed around the communication of science to non-specialists. Issues of adaptation, organization, evidence, delivery, and style

2021 - Second Gap Year During Covid-19, All Classes Audited

MATH 8300 - Combinatorial and Geometric Group Theory Fall
Vanderbilt University Denis Osin

- Audited the first part of the class
- van Kampen diagrams, The Dehn function and the word problem, groups acting on trees

CS 3252 - Theory of Automata Fall
Vanderbilt University Douglas Fisher

- I later took this class. DFAs, NFAs, pumping lemma, formal grammars
- Book: Intro to Automata Theory, Languages, and Computation by Hopcroft et al

MATH 8120 - Operator Algebras Spring
Vanderbilt University Jesse Peterson

- Gelfand-Mazur theorem, spectral radius formula for C* algebras, Gelfand transform, GNS construction, von Neumann's bicommutant theorem, Kaplansky density theorem
- Book: An Introduction to Operator Algebras, by Zhu

MATH 7210 - Riemannian Geometry Spring
Vanderbilt University Ioana Suvaina

- I audited the first half of the class. Tangent bundles, Riemannian manifolds, the Levi-Civita connection

2020 - First Gap Year During Covid-19, All Classes Audited

MATH 9300 - Seminar in Algebra: Category Theory Fall
Vanderbilt University Constantine Tsinakis

- Categories, functors, natural transformations, limits, colimits, adjoint functors, Yoneda lemma, monads, topoi
- Presented on string diagrams, 2-category theory, elementary theory of topoi

MATH 7120 - Functional Analysis Fall
Vanderbilt University Vaughan Jones

- Class got canceled due to the passing of Dr. Jones. I continued self teaching using Kreyszig, then Lax
- Han-Banach, open mapping, closed graph, uniform bounded, bounded inverse theorems, spectral theory, distribution theory

MATH 9800 - Seminar in Number Theory: Modular Forms Fall
Vanderbilt University Larry Rolen

- Survey of the theory of modular forms and its applications, as well as its connections to other objects of number theory and other areas of mathematics

MATH 4300 - Modern Algebra Fall
Vanderbilt University Mark Sapir

- Worked independently out of his textbook, Combinatorial Algebra: Syntax and Semantics, with him

MATH 4301 - Modern Algebra Spring
Vanderbilt University Mark Sapir

- Specialized topics included Grobner bases, combinatorial algebraic geometry, van Kampen diagrams

MATH 7130 - Harmonic Analysis Spring
Vanderbilt University Alex Powell

- Presented on: Pontryagin duality for LCAGs, representation theory, characters, and the "Fourier transform", and Heisenberg's U.P. for finite nonabelian groups; elementary Tannaka-Krein duality
- Book: Intro to Harmonic Analysis, by Heil
- Presentation Resources: Harmonic Analysis on Finite Groups, by Terras; Tao's Lecture Notes 9-10 for 247B

MATH 9301 - Seminar in Algebra: Growth of Groups Spring
Vanderbilt University Denis Osin

- Ultrafilters and ultralimits, asymptotic cones, quasi-isometry, Svarc-Milnor lemma, Grigorchuk's group and groups of intermediate growth, Gromov's gap, amenability

CS 6310 - Design and Analysis of Algorithms Spring
Vanderbilt University Jeremy Spinrad

- Ford Fulkerson, Edmonds Blossom, Fortune's algorithms, Van Emde Boas trees, Voronoi cells

2019 - Junior, Spring Classes Taken Pass/Fail due to Covid-19

MATH 4710 - Graph Theory (B) Fall
Vanderbilt University Mark Ellingham

- Network flows, matchings, colorability, connectivity, graph polynomials
- Book: Graph Theory, by Bondy, Murty

CS 6311 / CS 3860 - Graph Algorithms (A) Fall
Vanderbilt University Jeremy Spinrad

- Worked on open problems as an undergraduate researcher
- Graph classes admitting efficient computer representations. Recognition, enumeration, and reconstruction algorithms
- Book: Efficient Graph Representations, by Spinrad

MATH 3890 - Mathematical Game Theory (B-) Fall
Vanderbilt University Paul Edelman

- Cooperative and noncooperative. Proofs of theorems of Von Neumann - Morganstern, Nash
- Shapley value, Banzhaf index, connections to linear optimization
- Book: Game Theory: Alive!, by Karlin, Peres

ECON 4260 - Game Theory with Economic Applications (B) Fall
Vanderbilt University John Weymark

- Analysis of specific economic models. Decision theory, utility theory, Cournot duopoly, Bertrand competition

MATH 2820 - Intro to Probability and Mathematical Statistics (Pass) Spring
Vanderbilt University Jakayla Robbins

- Probability theory, moment generating functions, joint densities, confidence intervals, biased and unbiased estimators
- Book: Probability and Statistics, by Devore

MATH 3100 - Intro to Analysis (Pass) Spring
Vanderbilt University Gieri Simonett

- Sequences and series, uniform convergence, differentiation and integration. Bolzano-Weierstrass, Heine-Borel
- Book: Intro to Analysis, by Gaughan

MATH 3230 - Intro to Differential Geometry (Pass) Spring
Vanderbilt University Rares Rasdeaconu

- Smooth structures, tangent space, Sard's theorem, transversality, intersection theory modulo 2, basic Morse theory
- Book: Differential Topology by Pollack, Guillemin

MATH 4310 - Set Theory (Pass) Spring
Vanderbilt University Constantine Tsinakis

- Equivalence of the axiom of choice, Zorn's lemma, and the well-ordering principle. Cardinal and ordinal arithmetic
- Book: Set Theory and Metric Spaces, by Kaplansky

Audit: MATH 3310 - Intro to Mathematical Logic Spring
Vanderbilt University Jose Gil-Ferez

- First order logic, Godel's theorems, introduction to model theory, compactness

2018 - Sophomore

Math 4300 - Graduate Modern Algebra (B-) Fall
Vanderbilt University Aleksandr Olshanskiy

- Sylow theorems, Jordan-Holder theorem, Nielsen-Schreier theorem, Tietze transformations, basic ring and field theory
- Book: Advanced Modern Algebra, by Rotman

Math 4710 - Graph Theory (C) Fall
Vanderbilt University Mark Ellingham

- Network flows, matchings, colorability, connectivity, graph polynomials
- Book: Graph Theory, by Bondy, Murty

CS 3650 - Algorithms (B) Fall
Vanderbilt University Jeremy Spinrad

- Dynamic programming, BFS, DFS, Bellman-Ford, Huffman coding, NP completeness, reductions
- Book: Algorithms, by Cormen et al

Math 3200 - Intro to Topology (B) Spring
Vanderbilt University Anna Marie Bohmann

- Continuity, Hausdorff property, connectedness, compactness, metric spaces
- Book: Topology: Pure and Applied, by Adams, Franzosa

Math 3890 - Advanced Linear Algebra (A-) Spring
Vanderbilt University Akram Aldroubi

- Banach and Hilbert spaces, Riesz representation, singular value decomposition, Courant-Fischer theorem

Audit Math 4700 - Combinatorics Spring
Vanderbilt University Mark Ellingham

- Combinations, permutations, Stanley's 12-fold way, inclusion-exlusion, recurrence relations, generating functions, Burnside's lemma, Polya enumeration
- Book: Enumerative Combinatorics, by Stanley

ECON 3893 - Market Design and Resource Allocation (B+) Spring
Vanderbilt University Eun Jeong Heo

- Top trading cycle, stable marriage problem, cake cutting algorithms, Gallai-Edmonds decomposition
- Presented on the paper Fair Matching Under Constraints, by Fuhito Kojima, Yuichiro Kamada.
- Book: Market Design: Auctions and Matching, by Haeringer

ECON 4220 - Social Choice Theory (B+) Spring
Vanderbilt University John Weymark

- Arrow's impossibility theorem, Gibbard-Satterthwaite theorem, Sen's liberal paradox
- Report on the paper Efficient and Incentive-Compatible Liver Exchange by Utku Unver, Tayfun Sonmez
- Book: A Primer in Social Choice Theory, by Gaertner

Audit: CS 6310 - Graduate Design and Analysis of Algorithms Spring
Vanderbilt University Jeremy Spinrad

- Ford Fulkerson, Edmonds Blossom, Fortune's algorithms, Van Emde Boas trees, Voronoi cells

2017 - Freshman

Math 2500 - Honors Multivariate Calculus and Linear Algebra (B+) Fall
Vanderbilt University Bruce Hughes

- Jacobian, implicit and inverse function theorems, Lagrange multipliers
- Book: Multivariable Mathematics, by Shifrin

CS 2201 - Program Design and Data Structures (B-) Fall
Vanderbilt University Gerald Roth

- C++, basic data structures and algorithms, recursion

Math 2501 - Honors Multivariate Calculus and Linear Algebra (A-) Spring
Vanderbilt University Bruce Hughes

- Differential forms on manifolds, generalized stokes theorem, spectral theorem
- Book: Multivariable Mathematics, by Shifrin

Math 2420 - Methods of Ordinary Differential Equations (A) Spring
Vanderbilt University Gennadi Kasparov

- Higher-order linear differential equations, Laplace transform, series solutions
- Book: Fundamentals of Differential Equations, by Nagle, Saff, Snider

CS 2212 - Discrete Structures (A) Spring
Vanderbilt University Dominique Piot

- Sets, relations, basic combinatorics, recurrence relations, boolean algebra, propositional calculus

Abstract Algebra (B) Summer
UCLA Keith Oulette

- Basic number theory, polynomial rings, ring theory, Euclidian division algorithm

Complex Analysis (B) Summer
UCLA Robert Greene

- Cauchy-Riemann equations, Cauchy's integral theorem and formula, Taylor and Laurent series, residue theorem