COMPUTER SCIENCE COURSES

CMPUT 174 Intro to Foundations of Computing I (University of Alberta)

Python programming introduction, control flow, data structures, recursion, modularization and testing. Labs included solving problems in a wide variety of domains including text analysis, map navigation, game search, simulation, and cryptography

CMPUT 175 Intro to Foundations of Computing II (University of Alberta)

Python programming. A continuation of CMPUT 174, revisiting topics in greater detail and complexity. More sophisticated notions such as objects, functional programming, time and memory consumption, and user interface building

CMPUT 201 Practical programming methodology

Fundamental principles of software engineering based on abstract data types and their implementations, C and C++ and software development tools of the Unix environment

CMPUT 204 Algorithms I (University of Alberta)

algorithm design and analysis, emphasis on fundamentals of searching, sorting, and graph algorithms. Examples include divide and conquer, dynamic programming, greedy methods, backtracking, and local search methods, together with analysis techniques to estimate program efficiency, rigorous

COMPSCI 9827Y Readings In Computer Algebra (Western University)

- Gröbner bases, Elimination Theory, Polynomial and rational functions on a variety, computer algebra systems – Maple, macaulay2.

Math 9141L Readings in Cryptography (Western University)

- Index Calculus algorithms, discrete logarithm algorithms, readings in contemporary articles.

MATHEMATICS COURSES

Math 117 Honors Calculus I

- Limit definition, accumulation points, Limsup/Liminf, IVT, continuity, differentiation, MVT, Riemann Integration, Taylor expansion, power series.

Math 118 Honors Calculus II

- Indefinite Integration, Integration techniques, Hermite's method, Chebyshev and Liouville's theorem, Improper integrals, infinite series of functions, uniform convergence, nowhere differentiable functions, optimization theory.

Math 217 Honors Advanced Calculus I

- Topology of $\mathbb{R}^n$, multivariable calculus: differentiation and integration. The differential and the chain rule, vector field theory.

Math 317 Honors Advanced Calculus II

– Implicit function theorem, transformations of multi-integrals, line integrals, Green, Gauss and Stokes theorems.

Math 125 Linear Algebra I

– Systems of equations, matrix algebra, linear transformations, determinants, eigenvalues and eigenvectors, dot products, orthogonality, numerical methods.

Math 225 Linear Algebra II

– Vector spaces, inner product spaces, Gram-Schmidt, QR factorization of a matrix and least squares, change of basis, similarity and diagonalizability, quadratic forms.

Math 325 Linear Algebra III

– Spectral theorem, Jordan canonical form, Cayley-Hamilton Theorem, bilinear forms, positive definiteness, matrix exponentials and differential equations.

Math 334 Introduction to Differential Equations

– First and second order equations, power series solutions, Laplace transform methods.

Math 322 Graph Theory

– Graphs, paths, cycles, planarity, dual graphs, matroid theory, Dijkstra's algorithm, Kruskal's algorithm, Prim's algorithm

Math 228 Algebra: Introduction to Ring Theory

– Equivalence relations, commutative rings, fields and integral domains, the Chinese remainder theorem, Euclidean domains, principle ideal domains, unique factiorization, quotient rings.

Math 324 Elementary Number Theory

– Quadratic residues, quadratic reciprocity, Diophantine equations, encryption, Legendre symbols, Jacobi symbols.

Math 328 Algebra: Introduction to Group Theory

– Groups, symmetry groups, matrix groups, permutations, symmetric group, Cayley's theorem, group actions, cosets and Lagrange's theorem, normal subgroups, quotient groups, isomorphism theorems, direct and semi direct products, finite abelian groups.

Math 326 Algebra: Rings and Modules

– Rings, fields, polynomial rings, algebras ring extensions, field extensions, construction of finite fields. Introduction to modules, modules over a principle ideal domain, matric canonical forms, finitely generated abelian groups.

Math 429 Algebra: Advanced Group Theory

- Textbook: Lang Algebra
- Sylow Theory, solvable groups, nilpotent groups; Field Theory, field extensions, Galois theory.

Math 424 Algebra: Groups and Fields

- Textbook: Artin Algebra, Lang Algebra
- Field Theory, Field extensions, automorphism groups of fields, finite fields, solvable groups, ruler and compass constructions, Kummer extensions, Galois theory, Galois cohomology.

Math 429 Algebra: Advanced Ring Theory

- Textbook: Atiyah & Macdonald, Introduction to Commutative Algebra
- Introduction to commutative algebra, homological algebra, introduction to algebraic geometry

Math 421 Combinatorics

- Permutations and combinations, principle of inclusion exclusion, generating functions, recurrence relations, rook polynomials.

Phil 420 Metalogic

- Textbook: Elliot Mendelson, Introduction to Mathematical Logic
- First-order theories, completeness and compactness theorems, Lowenheim-Skolem theorem, Prenex normal forms, Categoricity.

Math 411 Honors Complex Variables

- Analytic functions, Cauchy's formula and theorem, maximum modulus, Laurent expansion, harmonic functions, Cauchy Riemann equations, Residue theorem, calculus of residues, Rouche's theorem, Liouville's theorem, analytic continuation, Möbius transforms, Riemann mapping theorem, Picard's theorem.

Math 417 Honors Real Variables I

- Measure theory, integration theory, Lebesgue measure, Lebesgue integration, dominated convergence, Tonelli-Fubini.

Math 418: Honors Real Variables II

- Functional Analysis, Hahn-Banach, open mapping theorem, closed graph theorem, Hilbert spaces, spectral theory, spectra of compact operators.

Math 499 Research Project

- Guided research project with a chosen supervisor: Katalin Bimbo, the project involved a research paper as well as two presentations on the research conducted. My project

was a comparison of some proofs of the completeness theorem of first order logic with a particular emphasis on the proof provided by Rasiowa and Sikorski.

Math 447: Elementary Topology

– Set Theory, metric spaces general topology. Urysohn's lemma, Baire Category theorem, tychonoff theorem, Homotopy and covering spaces, Van Kampen's theorem.

Math 448: Introduction to Differential Geometry and Tensor Analysis

– Riemannian geometry, metric tensor, covariant derivative, geodesics, parallel transport, Christoffel symbols, metric connection, vector bundles.

Math 519 Introduction to Operator Algebras

– Compact and Fredholm operators, operator algebras, C* algebras, Gelfand transform, Gelfand-Naimark theorem, basic von Neumann algebra theory.

Math 530 Algebraic Topology

– Textbook: Allen Hatcher, Algebraic Topology

– Homotopy theory, Fundamental group, covering spaces, CW-complexes, Homology – simplicial and singular, Cohomology, cup and cap product, Poincare Duality.

Math 617 Topics in Functional Analysis I

– Lattice theory, Banach and Vector lattices, Strong units and C(K) representations, order continuous Banach lattices, Stone's representation theorem, AM and AL spaces, L1-representations of vector lattices, Dunford-Pettis, Grothendieck theorems.

Math 9051A Algebraic Number Theory

– Number fields and rings, algebraic numbers and integers, prime factorization in integer rings, and class and unit groups of integer rings. Zeta functions of number fields, counting primes in integer rings, class field theory.

Math 9501A Topics in Homotopy Theory I Course Topic: Categorical Logic

– Textbook: The HoTT Book

– Description: Homotopy Type Theory, Dependent types, identity types, higher groupoids, sigma-types, univalence axiom, W-types, higher inductive types, coq implementation of HoTT libraries.

Math 9512A Topics in Category Theory II

– Simplicial sets and simplicial homotopy theory, Nerves, Boardmann-Vogt construction, derived functors, model structures, Kan fibrations, Kan extensions, Joyal model category, coherent nerve, straightening, Quillen model categories, other models.

Math 9406B Pro-Finite Groups

– Topics: Lie algebras and p-adic numbers, Pro-finite and pro-p groups, Powerful pro-p groups, Pro-p groups of finite rank, Uniformly powerful pro-p groups, Pro-p groups of finite class, Dimension subgroup methods, Associated graded algebras, Restricted Lie algebras

Math 9616B Random Matrix Theory

– Matrix ensembles, Dyson 3-fold way, GUE, GOE, GSE. Wigner ensembles. Wigner semicircle law for GUE and for Wigner ensembles, universality. Orthogonal polynomial techniques, Harrer-Zagier formula, orbifold Euler characteristic of moduli spaces of curves. Matrix models, genus expansion, connections with Riemann surfaces. Saddle point methods, resolvent techniques. Schwinger-Dyson equations and topological recursion

Math 1191H Topics in Algebraic Geometry Algebraic Geometry and Convex Geometry

– Newton polyhedra, Toric Varieties, Dehn–Sommerville duality, Riemann-Roch theorem for toric varieties, Topological version of Parshin reciprocity laws and Grothendieck residues, Newton-Okounkov bodies, Tropical geometry.

COMPSCI 9827Y Readings In Computer Algebra

– Gröbner bases, Elimination Theory, Polynomial and rational functions on a variety, computer algebra systems.

Math 9141L Readings in Cryptography

– Index Calculus algorithms, discrete logarithm algorithms, readings in contemporary articles.