

Curriculum Vitae

Rodney McCoy
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Education:

Ph.D., Mathematics, University of Utah, Expected May 2028

B.S., Mathematics, University of Idaho, May 2023

B.S.C.S., Computer Science, University of Idaho, May 2023

Teaching:

Graduate Teaching Assistant, *University of Utah*, Spring 2025
TA For Engineering Calculus II, Tutored at the Math Center

Graduate Teaching Assistant, *University of Utah*, Fall 2023
TA For Engineering Calculus, Tutored at the Math Center

Vandal Tutoring, *University of Idaho*, Fall 2022 – Spring 2023
Mathematics and Computer Science Tutor. Assisted students with Discrete Math, Calculus Series, Data Structure / Algorithms, and More.

Experience:

Graduate Research Project, Summer 2024 - Ongoing
Advisor, Dr. Braxton Osting, University of Utah
Analyzing Optimization Problems Using Linear Operators on Graphs.

Internship, Keyport WA, Summer 2023
Created a Comprehensive User Interface (Developer Window) for Code 411's main VR project. Practiced Software Engineering Principles and Utilized Advanced C# Language Features (Reflection).

Undergraduate Research Project, (*Didn't Finish*), Fall 2022 - Spring 2023
Research Mentor, Dr. Alexander Woo, University of Idaho
Python implementation of standard permutation algorithms (converting between 1-line, disjoint cycles, transpositions) and implementations of metrics on the symmetric group.

Extended the Hadjicostas-Monico condition for shallow elements to the Type B group of permutations.

Grants:

NSF- Sponsored Research Training Grant: Optimization and Inversion for the 21st Century Workforce, Jan – Dec 2024, May – July 2025, (\$13,500 Per Semester)

Talks:

Spectral Functions and Where to Find Them, Apr 15, 2025

The eigenvalues of symmetric matrices have a special place in "Optimizers" hearts, being extremal values" of the quadratic function $x^T A x$ (subject to $|x|^2 = 1$). In a similar tone, Chapter 7 of Amir Beck's book covers functions that only depend on the eigenvalues of a matrix, "Spectral Functions". Of interest is computing their conjugate and proximal operators.

In this talk, I will walk through Chapter 7 on Spectral Functions, show some of the computations, and (**hopefully**) compute the Conjugate of Spectral Functions not covered by Beck, specifically for minimizing the eigenvalues of a matrix.

The Graph Steklov Problem, Oct 3, 2024

The Steklov Problem is given by $\Delta u = 0$ on a manifold Σ and $\delta_\eta u = \sigma u$ on $\partial\Sigma$. Solutions correspond to the eigenvalues / vectors of the Dirichlet to Neumann Operator $\delta_\eta (H g)$, which takes g defined on the boundary, harmonically extends it inside Σ , and then computes its normal derivative. On Thursday at AMC, I will talk about what I've been working on since this summer, deriving and analyzing a discrete version of this problem. My talk will feature Graph Laplacians, Schur Complements, and a bunch of Rank 1 Matrices. Then, I will talk about where my future analysis of this problem will lead me.

How Spectral Graph Theory Produces an Effective Clustering Algorithm, Spring 2024

Clustering, the act of grouping data to maximize the similarity between elements in each group is an iconic problem of machine learning. Algorithms like k-means produce effective "templates" for solving classification and have many variations. But when clustering in Euclidean Space, similarity is only encoded as the distance between two points. Spectral Clustering converts the problem of clustering on the data to clustering on the eigenvectors of the Weighted Graph Laplacian. Similarity can be encoded in much more detail as weights of edges on a graph, and this can make the underlying clustering algorithm work more effectively.

In this talk, I will discuss the results of graph theory that led up to the Graph Laplacian. This discussion will then lead to the optimization results required to setup the Graph Cut problem, and how solutions to the Graph-Cut problem are relaxed to obtain the Spectral Clustering algorithm.

Analytic Number Theory in Fourier Analysis, *Spring 2023*

Presented about Fourier Analysis results up to the proof of the Analytic Continuation of the Gamma Function to the whole complex plane. Including the definition and intuition of the Mellin Transform, the Poisson Summation Formula, and the Principle of Analytic Continuation.

Graph Theory and Deterministic Search Algorithms, *2022*

Presented about basic aspects of graph theory, including the utility of framing problems in terms of Graph Theory. Explanation of the basics of depth first search, and its applications in Artificial Intelligence to Pathfinding, Constraint Satisfaction Problems, and Adversarial Search.