VISHAL G. RAMAN

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EDUCATION

University of California, Berkeley *Fall 2019 - Spring 2024*
B.A. Computer Science (Major GPA: 3.86), Mathematics (Major GPA: 3.91)

Selected Graduate Coursework: *Measure Theory and Topology, Functional Analysis, Commutative Algebra, Differentiable Manifolds, Partial Differential Equations, Harmonic Analysis, Probability Theory, Stochastic Processes, Several Complex Variables, Dynamical Systems, Mathematics of Condensed Matter Physics, Complex Manifolds, Statistical Learning Theory, Deep Reinforcement Learning, Computational Principles for High-Dimensional Data Analysis*

Selected Undergraduate Coursework: *Machine Learning, Deep Learning, Artificial Intelligence, Mathematical Statistics, Algorithms and Complexity Theory, Computer Architecture, Database Systems, Operating Systems*

Renyi Instutite *Fall 2020 - Spring 2021*
Budapest Semesters in Mathematics (GPA: 4.00)

The College Of New Jersey* *Spring 2019*

Mercer County Community College* *Fall 2017 - Fall 2018*

*Concurrent enrollment during high school

RESEARCH EXPERIENCE

Berkeley Artificial Intelligence Research(BAIR) Lab *Fall 2021 - Present*
Research in theoretical aspects of deep learning and representation learning under Yi Ma.

- ***Representation Learning Through Manifold Flattening and Reconstruction***
  Michael Psenka, Druv Pai, ***Vishal Raman****, Shankar Sastry, Yi Ma*
  SlowDNN 2023, submitted to JMLR

Cornell Mathematics REU *Summer 2022 - Present*
Research in optimal control under Alexander Vladimirsky.

- *Developed and proved bounds for a novel dynamic programming algorithm which uses thresholds to alternate between value and policy iterations to enable global linear convergence and local quadratic convergence while reducing overall computational complexity compared to traditional algorithms.*
- *In Optimal Control, situations arise where the Hamilton-Jacobi-Bellman(HJB) PDE satisfied by the value function is of mixed-type(parabolic, hyperbolic, elliptic). This work proposes a novel efficient algorithm for simultaneously computing the boundary of the region for each PDE type while simultaneously solving the equations.*

Budapest Semesters in Mathematics REU *Fall 2020 - Spring 2021*
Research in convex geometry under Gergely Ambrus.

- *Studied special cases of the Fractional Helly theorem which characterizes the transversal properties of families of intersecting convex sets. Proved the result in the case of cylinders, λ-fat convex sets, and λ-flat sets.*
  Honorific mention at XXXVI Victor Neumann-Lara Colloquium.

WORK/TEACHING EXPERIENCE

Amazon Web Services, Seattle *Fall 2022*
Software Development Engineer Intern on AWS Commerce Platform team.

- *Developed an automated dashboard to improve the visibility of metrics related to the stability and reliability of dependent services when running end-to-end testing services.*

Data Consulting at SAAS *Fall 2021 - Present*
Data Consulting Director at the Student Association of Applied Statistics (SAAS) at Berkeley.

- *(Spring 2022) Used and developed computer vision models to design an image-rectification network for menu images. Used by Woflow, a ML-powered task automation system to process merchant data into a scalable infrastructure.*

- *(Fall 2021) Developed multi-armed bandit (MAB) algorithms to perform on-line A/B testing and empirically measure statistical significance of experiments. Used by CroMetrics, which uses data-driven techniques and statistical models to develop marketing strategies.*

IMC Trading, Chicago *Summer 2021*
Software Engineering Intern on the FICC/Index Strategy team.

- *Implemented the component that computes and publishes toxicity signals for several classes of products. Conducted data analysis to optimize toxicity signals for trade-through events.*

Course Staff (UC Berkeley) *Spring 2020 - Present*

- *(Spring 2023) Head TA for CS 270: Combinatorial Algorithms and Data Structures under Jelani Nelson*
- *(Spring 2022) Reader for Math 126: Partial Differential Equations under Maciej Zworski*
- *(Spring 2020) Reader for Math 113: Abstract Algebra under Mariusz Wodzicki*

PROJECTS

Model-free RL with Lyapunov Stability *Fall 2022*
Course project for CS 285: Deep Reinforcement Learning.

- *Joint work with Will Lavanakul. Design and theoretical analysis of novel offline model-free reinforcement learning algorithms that constrain distribution shift by learning a Lyapunov Density Model (LDM), which generalizes control Lyapunov functions and density models to provide guarantees on whether an agent will stay in-distribution.*

Speeding up Log Determinants *Spring 2022*
Course project for Math 221: Numerical Linear Algebra.

- *Joint work with Druv Pai, Shengbang Tong. Established efficient methods to estimate information-theoretic objectives containing a log determinant term, such as the maximal coding rate objective - methods include matrix sketching, stochastic trace estimation via Chebyshev-Hutchinson, and the Woodbury formula for efficient gradient computations.*

Using the Gaussianized Coding Rate for Generative Modeling *Fall 2021*
Course project for EECS 208: Computational Principles for High-Dimensional Data Analysis.

- *Joint work with Michael Psenka, Shengbang Tong. Studied the Gaussianized Coding Rate, a distributional distance for the Linear Discriminative Representation (LDR) transcription framework. Studied performance of coding rate distance on large families of distributions, and provided theoretical analysis for training stability under perturbations.*

Free Probability Theory *Fall 2021*
Supervised reading project under by Dan Virgil Voiculescu.

- *Study of free probability theory, which generalizes independence to Operator Algebras for non-commutative random variables, with applications to random matrix theory, combinatorics, representation theory, etc.*

Autonomous Learning of Stochastic Dynamics *Spring 2021*
Supervised project in statistics/partial differential equations under Steven N. Evans, Tyler Maltba.

- *Used sparse regression and physically-informed neural networks(PINN) in order to render probability density functions(PDFs) or cumulative distribution functions(CDFs) for stochastic dynamical systems as an alternative to Monte Carlo simulation.*

Geodesic Convex Optimization *Spring 2021*
Course project for CS 270: Combinatorial Algorithms and Data Structures.

- *Reading and implementation project covering differential and Riemannian geometry, geodesic convexity, and non-convex optimization problems such as computing the Brascamp-Lieb constant and the operator scaling problem.*

HONORS

William Lowell Putnam Mathematical Competition (Top 500) *Winter 2020*

High School Olympiad Results
American Invitation Mathematics Exam (AIME) (2x Qualifier), United States of America Physics Olympiad (USAPhO) (2x Qualifier, Honorable Mention), United States of America Computing Olympiad (USACO) (Gold)

Programming Languages: Python, Java, Matlab, C/C++, R, SQL, MongoDB, Scheme
Libraries/Frameworks: NumPy, pandas, PyTorch, JAX, SciPy, Boost