CURRICULUM VITAE

HASAN SAAD

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Education

University of Virginia ∘ 2020 – Spring 2024 Expected
Ph.D. in Mathematics
Advisor: Ken Ono
Thesis: *On the Distributions of Point Counts on Hypergeometric Varieties*

American University of Beirut ∘ 2018 – December 2020[1]
M.S. in Mathematics
Advisor: Wissam Raji

Lebanese University ∘ 2015 – 2018
B.S. in Mathematics

Research Publications

1. K. Ono, H. Saad and N. Saikia, *Distribution of values of Gaussian hypergeometric functions.* Pure and Applied Mathematics Quarterly, Special Issue for Don Zagier's 70th birthday, **19**, no. 1 (2023), 371-407.
2. H. Saad, *Explicit Sato–Tate type distribution for a family of $K3$ surfaces.* Forum Mathematicum **35**, no. 4, 1105-1132.
3. K. Ono and H. Saad, *Some Eichler–Selberg Trace Formulas.* The Hardy Ramanujan Journal **45**, 94-107.
4. Y. Huang, K. Ono, and H. Saad *Matrix points on special varieties over finite fields.* To appear in Contemporary Mathematics, American Mathematical Society.
5. K. Satoshi and H. Saad *On Matrices Arising in Finite Field Hypergeometric Functions.* Preprint. `https://arxiv.org/abs/2312.02890`.

Conference and Seminar Talks

2024 Jan Joint Mathematics Meetings, San Francisco
AMS Special Session on Mock modular forms, physics, and applications
Automorphic Forms and Point Distributions on $K3$ Surfaces

[1] I was accepted to the Ph.D. program at UVA before my last semester, and therefore I did not complete my studies.

	Feb	Clifford Lectures, Tulane University
		Point Distributions on Algebraic Varieties
	Mar	Algebra, Geometry, and Number Theory Seminar
		Counting matrix points on hypergeometric varieties over finite fields
2023	May	35th Automorphic Forms Workshop, Louisiana State University
		Determining point distributions on hypergeometric varieties
	Apr	AMS Special Session on Hypergeometric Functions, q-series and Generalizations
		Counting matrix points on hypergeometric varieties over finite fields
	Mar	Specialty Seminar in Partition Theory, q-Series and Related Topics, MTU
		Counting matrix points on curves and surfaces with partitions
	Feb	Number Theory and Combinatorics Seminar, University of Texas at Tyler
		Explicit Sato–Tate distributions for hypergeometric varieties
	Feb	Ramanujan–Serre Seminar, University of Virginia
		Counting matrix points on certain varieties over finite fields
	Jan	Joint Mathematics Meetings, Boston
		AMS Special Session on Modular Forms, Hypergeometric Functions,
		Character Sums and Galois Representations I
		Explicit Sato–Tate distributions for hypergeometric varieties
2022	Oct	Number Theory Seminar, University of Cologne
		Explicit Sato–Tate distributions for hypergeometric varieties
	Oct	Number Theory Seminar, Vanderbilt University
		Explicit Sato–Tate distributions for hypergeometric varieties
	Sep	Algebra and Number Theory Seminar, Louisiana State University
		Explicit Sato–Tate distributions for hypergeometric varieties
	Sep	Ramanujan-Serre Seminar, University of Virginia
		Sato–Tate type distribution for a family of K3 surfaces
	Jul	Hong Kong University Number Theory Days 2022
		Distribution of Values of Gaussian Hypergeometric Functions
2021	Dec	Analysis Seminar, Stony Brooks University
		Distribution of Values of Gaussian Hypergeometric Functions
	Nov	Mathematics Seminar, American University of Beirut
		Distribution of Values of Gaussian Hypergeometric Functions
	Oct	Number Theory Seminar, Boston University
		Distribution of Values of Gaussian Hypergeometric Functions
	Aug	Number Theory Seminar, University of Virginia
		Frobenius trace distributions for ${}_2$*Gaussian hypergeometric varieties*

Additional Conference Participation

- May 2022: 100 Years of Mock Theta Functions, Vanderbilt University

Mentorship

- Summer 2023: Lead Mentor for the University of Virginia REU in Number Theory. Mentored a project on Sato–Tate type distributions for matrix points on varieties.
- Summer 2022: Mentor for the University of Virginia REU in Number Theory. Advised a project on Sato–Tate analogue for some $K3$ surfaces.

Teaching

2023	Fall	Instructor of record for MATH 1320 (Calculus II), U.Va.
2022	Fall	Instructor of record for MATH 1210 (A Survey of Calculus I), U.Va.
	Spring	Instructor of record for MATH 1210 (A Survey of Calculus I), U.Va.
2021	Fall	Instructor of record for MATH 1210 (A Survey of Calculus I), U.Va.
2021	Summer	Teaching Assistant for MATH 1310 (Calculus I), U.Va.
		Teaching Assistant for MATH 1220 (A Survey of Calculus II), U.Va.
		Teaching Assistant for MATH 1320 (Calculus II), U.Va.
2020	Fall	Teaching Assistant for MATH 201 (Calculus and Analytic Geometry III), AUB.
2019	Spring	Teaching Assistant for MATH 101 (Calculus and Analytic Geometry I), AUB.
	Fall	Teaching Assistant for MATH 101 (Calculus and Analytic Geometry I), AUB.

References

- Ken Ono
  Marvin Rosenblum Professor at the University of Virginia
  Email: ko5wk@virginia.edu

- Wen-Ching Winnie Li
  Distinguished Professor at The Pennsylvania State University
  Email: wli@math.psu.edu

- Kathrin Bringmann
  W3 Professor (Full Professor) at University of Cologne
  Email: kbringma@math.uni-koeln.de

- Jim Rolf - Teaching Reference
  Professor, General Faculty at the University of Virginia
  Email: jsr2pz@virginia.edu

Data Science and Machine Learning

In addition to my research and teaching experiences, I have gained experience in machine learning through the Erdős Institute Data Science Boot Camp which I outline in this page.

Detecting Images Generated by Neural Networks

- **Project Description**

  The recent advances in deep learning, neural networks, and the hardware to support it have provided fertile ground for creating fake images. This new technology, if left unchallenged, creates a risk in multiple areas, including journalism, law enforcement, and knowledge itself.

  We tackle this problem by constructing two multi-classification models (single-channel and dual-channel) to discern between real images and those which are generated by AI, and to determine which generative algorithm was used. Our model is trained on a publicly available dataset of approximately 90000 images. This dataset contains real images as well as images generated by 13 different CNN-based generative algorithms.

- **Model Description**

  Our dual-channel model operates in two stages.

  In the first stage, a copy of the image passes through each channel after undergoing filtration. In the first channel, a high pass filter using Gaussian blur is applied. In the second channel, a Discrete Cosine Transform is applied.

  In the second stage, after passing through multiple convolutional and pooling layers, the two channels are connected. The connecting channel is fully connected and has a convolutional and a pooling layer.

  Finally, the output layer consists of softmax functions to determine the probabilities of each model being the generating model and the probability of the image being real.

- **Benchmarks**

  To evaluate this model, we used multiclass precision and recall metrics. Due to the non-homogeneity of data, detection performance varied according to the model generating the image. For purely detecting whether an image is real or not, we have a precision of approximately 90% and a recall of approximately 93%.

- **Certificate**

  The project outlined here ranked as a top-5 project among approximately 40 teams. Through this project, I obtained a Data Science certificate from the Erdős Institute. This certificate can be found at https://www.erdosinstitute.org/certificates/fall-2023/data-science-boot-camp/hasan-saad

- **Github Link**

  The Github repository containing this project can be found at https://github.com/Alina-Beaini/AIvsReal

- **Hugging Face**

  Furthermore, we created a Gradio interface to showcase the model. This interface was hosted on Hugging Face. It can be found at https://huggingface.co/spaces/AlinaBeaini/AIvsReal