CURRICULUM VITAE

HASAN SAAD

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Education

University of Virginia ∘ 2020 – Spring 2024
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.* Bulletin of the Australian Mathematical Society **110**, no. 3, 421-426.

6. K. Gomez, K. Ono, H. Saad, and A. Singh, *Pentagonal number recurrence relations for $p(n)$.*

Conference and Seminar Talks

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

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

Feb Clifford Lectures, Tulane University
Point Distributions on Algebraic Varieties

Mar Algebra, Geometry, and Number Theory Seminar, Louisiana State University
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 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

2024	Fall	Instructor of record for MATH 4181 (Elementary Number Theory), LSU
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.

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**

  A Gradio interface is hosted on Hugging Face, https://huggingface.co/spaces/AlinaBeaini/AIvsReal

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