Chen-Wei (Milton) Lin

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Education

Ph.D. of Mathematics, Johns Hopkins University, 2019-Present
Expected Graduation, July 2025.
Supervisor: David Gepner.

Masters of Mathematics, University of Oxford, 2018-2019
Dissertation Topic: Index of Operators and KK-theory. Supervisor: Dr. Andre Henriques.
Fourth year examinations, ranked 4th in cohort, best dissertation.

BA Mathematics, University of Oxford, 2015-2018
Supervisors: Prof. Glenys Luke, Prof. Tom Sanders.
Preliminary Examinations, ranked Top 10 of approx. 200 students.
Third Year Examinations, ranked Top 10 of approx. 150 students.

Awards and honors

Gibbs Dissertation Prize for Mathematics
Awarded by the Oxford Mathematical Institute.
One or two prizes each year for best Masters of Mathematics dissertation.

Alison Sheppard Prize for Mathematics
Awarded by St Hugh's College, Oxford.
Third year mathematician with highest first class in College.

St Hugh's College Scholarship Award
Awarded by St Hugh's College, Oxford, annually.
First Class Honors in each year.

Publications and preprints in mathematics

Mixed characteristic Geometric Casselman Shalika Formula, **arXiv:2408.07953**. Joint with Ashwin Iyengar (Johns Hopkins University) and Konrad Zou (Bonn University). In this paper, we prove the geometric Casselman Shalika formula in the setting of Witt vector Grassmanian.

Integral aspects of Fourier Duality **arXiv:2407.06184** In this joint work we have proven several results regarding integral versions of Fourier duality for abelian schemes, using Pappas's work on integral Grothendieck–Riemann–Roch.

In progress

Relative Langlands on the Fargues Fontaine, the Iwasawa Tate case, joint with Yuta Takaya (Tokyo University). We explicitly compare the period sheaves in the $\mathcal{A}$-side and $\mathcal{B}$-side, under the relative Langlands conjecctures of Benzvi-Sakellaridis-Venkatesh.

Mixed characteristic Iwahori-Whittaker equivalence, joint with Konrad Zou (Bonn University), this is an application of the previous paper on Casselman Shalika Formula, where we also prove basic properties of categorical actions in the l-adic setting.

Geometric categorical deformations, examples, joint with Anish Chedalavada (Johns Hopkins University). We are attempting to work on Lurie's 2010 ICM address on deformations of quantum groups.

Stacky approach to motivic periods, We give a stack interpretation of periods defined by Francis Brown, Pierre Deligne.

Seminars/talks

2024
Topology E-theory seminar, JHU, on Gross-Hopkins period map.
Number theory learning seminar, JHU, motivic periods, two talks on Chen's Theorem.

2023
Topology Seminar, JHU, on *Dieudonné modules, following Lurie and Hopkins.*
Topics in representation theory seminar, JHU, on *Uniformization of G-bundles.*
Topological Quantum Field Theory learning seminar, JHU, on *Classical field theory and σ-models.*
Topics in representation theory seminar, JHU, on *Affine Grassmanian.*
Prismatic cohomology Seminar organizer, with Naruki Masuda and David Gepner.

2022
Heegner points study group, JHU, on *Selmer structures and duality.*
Derived deformation theory seminar, JHU, three talks on *Calegari-Geraghty method in modularity lifting.*
Jacquet Langlands Correspondence student seminar, JHU, four talks.

2021
eCHT Hermitian K-theory, on Poincaré categories.
Category theory seminar, on differential cohomology and cohesive topoi.
Derived deformation theory seminar, JHU, on formal moduli problems.
Seminar on Stack of Langlands Parameter, joint with U Chicago, on representation stacks.
Non-archimedean study group, on *Formal schemes and rigid generic fiber.*

2020
DaFra Seminar on Condensed mathematics, a talk on *Solid Abelian Groups.*

Étale homotopy study group, Kings College London, a talk on *Étale homotopy obstruction.*
Topological Hochschild Homology Seminar, UIC, two talks on *Construction of THH.*
Spectral Algebraic Geometry Seminar, UIC, two talks on *Spectrally Ringed ∞-Topoi.*
eCHT Kan Fall Seminar, two talks on chapter 1 of *A Survey of Elliptic Cohomology, J. Lurie.*
Number Theory Seminar, Uni. of Melbourne, two talks on *Contragredient representations.*
Oberseminar, Uni. of Regensburg, a talk on *The p-complete Frobenius.*

2019
Masters presentation, University of Oxford. On *The Atiyah Singer-Index Theorem.*
Reading Group, University of Oxford. On *Model Categories, Dwyer and Saplinski.*

Conferences/schools

2024
WARTHOG, Oregon, July 22nd-26th.
Summer School and Workshop on Relative Langlands Duality, Minnesota, June 3rd - June 8th.
Prospects of formal mathematics, Bonn, May 9th-16th.
Arizona Winter School, Abelian Varieties March 2nd - 6th.

2023
Geometry and topology meets data analysis and machine learning, Northeastern University, June 8th-June 10th.
MSRI Machine Learning, UC San Diego, June 26th -July 7th.
The arithmetic of Langlands Program, University of Bonn, Germany, May 1st - May 14th.
Non-archimedean geometry and eigenvarieties, University of Heidelberg, Germany, March 6th - March 17th.
Topological Hochschild Homology and Zeta Values, January 30th - February 3rd.

2020-2022
APAW, A pair of automorphic workshops, Oregon, July.
Motives and arithmetic groups, summer school in Strasbourg, June.
Workshop on Derived Geometry, CIRM Barcelona.
MSRI Higher Categories and Categorifications, Jan-March.

AI Projects

My AI interests spans three areas: 1. **Social Impact and Ethical AI**: Understanding and exploring social implications of current language models; interpretability and scalable methods like mechanistic interpretability and program synthesis. 2. **Multilingual Natural Language Processing**, understanding how one can improve low resource language performances, 3. **AI in Mathematical Research**: Leveraging AI to advance mathematical research, such as autoformalization, and conversely the mathematical study of language as a *structure*. Below is a partial list of small projects I have done during my free time.

Spoken MASSIVE: A Multilingual Spoken Language Understanding Dataset joint with Chutong Meng, this project presents Spoken MASSIVE, the first multilingual spoken language understanding dataset. The dataset was synthesized from the text in MASSIVE, and SLU models were trained and evaluated on this dataset. We discuss experiments on training synthetic datasets.

Emotion Fine Tuning This is ongoing project, with Prof. Lionel Levine from Cornell University, explores the role of emotion in AI behavior. The first step is to quantify if emotional feedback can be as useful as RLHF in training data.

Superversed learning for steganography We train a transformer for minimum entropy coupling problem, which is shown recently to apply to steganography. The experiments revealed the inefficacy of using transformers without tailored strategies. Some alternatives are suggested.

Causal Inference on Synthetic Data This article addresses the task of estimating the average causal effect in a simplified scenario using regression analysis. Various methods were applied to a semi-synthetic dataset based on the 20 Newsgroup dataset to estimate treatment effects.

AnthroScore This small note plays around with anthropomorphism, the attribution of human traits to non-human entities, using recent methodologies. We analyze how LLMs anthropomorphize themselves with respect to various set ups.

Mitigating Social Biases in Language Models with Adversarial Debate This project is joint work with Cole Molloy and Lois Wang , fellow students from Johns Hopkins University. . We explore how in-context adversarial debates between language models can be structured to mitigate social biases in pretrained language models.

Some Thoughts on AI and Mathematical Research, in 2023 Written with Sina Hazratpour (Postdoc at Johns Hopkins University), this article surveys the state-of-the-art in machine learning for mathematical research, focusing on the impact of large language models and advances in the theorem-proving community, written in May 2023.

IsoScores This note analyzes the spatial organization of point clouds induced from word embeddings. It discusses interpretations of isotropy using PCA and cosine similarity, and provides an analysis of IsoScores across different languages and models.

Skills

Programming Languages: Python, R, MATLAB
AI Frameworks: TensorFlow, PyTorch
Tools: Jupyter, Git, LaTeX
Languages: Mandarin (native), English (fluent)

Teaching/supervision

Spring 2024
Directed Reading Program, organizer, Johns Hopkins University.

Fall 2023
SOUL Course, Interpretability in AI, Lecturer, Johns Hopkins University.
Honors Single Variable Calculus, Lecturer, Johns Hopkins Univeristy.
Directed Reading Program, organizer and mentor, Johns Hopkins University.

Spring 2023
Calculus III Head Teaching Assistant under Dr. Xiong Wang.
Directed Reading Program organizer with Benjamin Dees.
Directed Reading Program mentor.
Mentee: Orisis Zheng.
Topic: Zariski's lemma in algebraic geometry.

Fall 2022
Calculus II Teaching Assistant under Dr. Fajun Meng.
Directed Reading Program organizer with Benjamin Dees.
Directed Reading Program mentor.
Mentee: Orisis Zheng.
Topic: Maxwell Equations and differential geometry.
Mentee: Nick Lombardi.
Topic: Introduction to Langlands Program.