

Chen-Wei (Milton) Lin

email: clin130@jhu.edu

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.

AI Projects

My AI research interests span three key 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, including theorem proving and autoformalization. These interests are evidenced by the projects below I have done in my free time.

Spoken MASSIVE: A Multilingual Spoken Language Understanding Dataset Co-authored 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. Preprint available.

Program synthesis and proof assistants, this is an ongoing (main) project, description as linked, joint with Sina Hazratpour (Postdoc at Johns Hopkins University). We are combining correct by construction program synthesis methods with mathematical formal verification system Lean, which has the largest mathematical library. We use examples from mathematics and cryptography as a testbed.

Learning Minimum Entropy Coupling This project involves supervised learning to tackle the minimum entropy coupling problem. The experiments revealed the inefficacy of using transformers without tailored strategies.

Fightin' Words This note applies Monroe et al.'s log odds with Dirichlet prior and Procrustes alignment to analyze the Congressional Record using diachronic word embeddings. This is a classical method in computational social science.

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 note examines 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 (Johns Hopkins University) and Lois Wang (Johns Hopkins University) explores how in-context adversarial debates between language models can be structured to mitigate social biases in pretrained language models. Techniques such as resampling training data and using auxiliary models are discussed.

Some Thoughts on AI and Mathematical Research Written with Sina Hazratpour (Postdoc at Johns Hopkins University), this article explores 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.

Silverdata Set Creation Using IBM Models This notes discusses traditional methods of creating silver data using alignment scores for evaluation. The limitations of these methods, including the lack of gold dataset tagged data.

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.

Emotion Fine Tuning This is ongoing project, with Prof. Lionel Levine from Cornell University, explores the role of emotion in AI behavior. It aims to develop an *interpretable theory of mind* for AI to ensure future AI agents can provide caring responses beyond empathetic-sounding replies, operationalizing and quantifying what it means for AI to care. The goal is to see if emotional feedback can be as useful as RLHF in training data.

My primary research area is mathematics. This CV has been reordered and updated to emphasize my interest and experience in AI appropriate to application.

Skills

Programming Languages: Python, R, MATLAB

AI Frameworks: TensorFlow, PyTorch

Tools: Jupyter, Git, LaTeX

Languages: Mandarin (native), English (fluent)

Mathematical Publications Preprints

The following articles will be available on Arxiv by the end of July 2024.

Mixed characteristic Geometric Casselman Shalika Formula, joint with Ashwin Iyengar (Johns Hopkins University). In this paper, we prove the geometric Casselman Shalika formula in the setting of Witt Vector Grassmanian.

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 other sheaf theoretic settings.

Integral aspects of Fourier Duality, joint with Junaid Hasan (University of Washington), Hazem Hassan (McGill University), Lily McBeath (Dartmouth College), and Ben Moonen (Radboud University Nijmegen). 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 conjectures of Benzvi-Sakellaridis-Venkatesh.

Geometric categorical deformations, examples, joint with Anish Chedalavada (Johns Hopkins University). Work in progress in proving conjectures in Lurie's 2010 ICM address on deformations of quantum groups.

Stacky approach to motivic periods, joint with Yashi Jain (Johns Hopkins University), our goal is to 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 Sapinski.

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.

My primary research area is mathematics. This CV has been reordered and updated to emphasize my interest and experience in AI appropriate to application.

[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.

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 University.

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.