MATTHEW (YI-CHEN) LEE

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RESEARCH INTEREST

My research interests lie in three directions:

- **Advancing the theoretical foundations of machine learning** by investigating the statistical and computational properties of modern, frontier methodologies and architectures such as generative models and transformers
- **Bridging theory and practice in interpretable and reliable AI**, with a focus on understanding model behavior and ensuring robustness in high-stakes domains such as science and healthcare.
- **Developing machine learning–based methods for medical applications**, including imaging and treatment planning

EDUCATION

National Taiwan University, Taipei, Taiwan   June 2025
Bachelor of Science in Physics

- **Relevant Courses:** High Dimensional Probability, Mathematical Statistics, Stochastic Process, Introduction to Probability Theory, Introduction to Statistics, Statistical Mechanics, Complex Analysis, Differential Equations, Linear Algebra

EXPERIENCE

Research Assistant, **University of Chicago**, Chicago, IL, Professor James J. Sohn   January 2025 – Present

- Developed a hybrid deep learning framework for **automated, MRI-only pre-planning in high-dose-rate (HDR) gynecological interstitial brachytherapy**, bypassing the need for a separate CT scan for treatment planning.
- Architected a two-stage hierarchical model: a rule-based algorithm for initial needle filtering, followed by a Dueling Deep Q-Network (DQN) to generate geometric constraints for an Integer Linear Programming (ILP) solver.
- Validated the framework against expert clinical plans, achieving a high level of agreement (89% sensitivity) in needle selection and demonstrating exceptional accuracy with very few incorrect selections (0.60 false positives per case).

Research Assistant, **Northwestern University**, Evanston, IL, Professor Han Liu   April 2023 – Present

- Co-first author on a paper published on the **Thirteenth International Conference on Learning Representations (ICLR)** investigating the approximation, estimation, and minimax optimality rates of conditional diffusion transformers.
- Developed a unified theoretical framework for high-order flow matching that incorporates trajectory derivatives up to an arbitrary order, and established sharp statistical rates for this method implemented with transformer networks.
- Introduced an interpretable modeling paradigm that casts statistical models into binary regression and interprets via easily accessible linear effects with universal Ising model.

PUBLICATION (*) DENOTES EQUAL CONTRIBUTION

[1] Jerry Y. H.*, Weimin W.*, **Yi-Chen L.***, Yu-Chao H.*, Minshuo C., Han L. "On Statistical Rates of Conditional Diffusion Transformers: Approximation, Estimation and Minimax Optimality". *International Conference on Learning Representations (ICLR 2025)*

UNDER REVIEW (*) DENOTES EQUAL CONTRIBUTION

[2] Maojiang S.*, Jerry Y. H.*, **Yi-Chen L.***, Ning Z., Jui-Hui C., Shang W., Zhao S., Minshuo C., Han L. "High-Order Flow Matching: Unified Framework and Sharp Statistical Rates". Under Review at *the Thirty-Ninth Annual Conference on Neural Information Processing Systems (NeurIPS 2025).*

[3] Jerry Y. H.*, **Yi-Chen L.***, Hude L., En-Jui K., Han L. "Binary Regression: Universal Ising Model, Binary Expansion and Beyond"**.** Under Review at *the Thirty-Ninth Annual Conference on Neural Information Processing Systems (NeurIPS 2025).*

[4] **Yi-Chen L.**, Sang K. Y., Ethan S., Yingzi L., Zhen T., Tianming W., Yasmin H., James J. S., "MRI-only Pre-planning for HDR GynInterstitial Brachytherapy using Deep Learning"**.** Under Review at *Physics in Medicine and Biology*

SKILLS

- *Computer Skills:* Python*,* R, LaTeX, SQL, experienced in supervised and unsupervised ML, DL, and LLMs
- *Language Skills:* Mandarin (native), English (fluent)
- *Certification:* Google Data Analytics