Yilan Chen

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Education

University of California San Diego (UCSD) — San Diego, USA
Ph.D. in Computer Science — *Sep. 2022 - Present*

Advisors: Prof. Arya Mazumdar & Prof. Yian Ma

University of California San Diego (UCSD) — San Diego, USA
M.S. in Computer Science — *Sep. 2020 - Jun. 2022*

Advisors: Prof. Tsui-Wei (Lily) Weng & Dr. Lam M. Nguyen (IBM Research)

Xi'an Jiaotong University (XJTU) — Xi'an, China
B.E. in Information Engineering — *Aug. 2015 - Jun. 2019*

Research Interests

Areas of Interest: Machine Learning, Deep Learning, Large Language Models, Foundation Models
Tools: Linear Algebra/Matrix Analysis, High Dimensional Statistics, (Non-) Convex Optimization

Publications

Tight Generalization Bound of Gradient Flow through Training Trajectory.
- **Yilan Chen**, Zhichao Wang, Wei Huang, Andi Han, Taiji Suzuki, Arya Mazumdar.
- In submission.

Label Noise Gradient Descent Improves Generalization in the Low SNR Regime.
- Wei Huang, Andi Han, Yujin Song, **Yilan Chen**, Denny Wu, Difan Zou, Taiji Suzuki.
- In submission.

Provable and Efficient Dataset Distillation for Kernel Ridge Regression. [link]
- **Yilan Chen**, Wei Huang, Tsui-Wei Weng.
- Thirty-eighth Conference on Neural Information Processing Systems (NeurIPS 2024).

Cross-Task Linearity Emerges in the Pretraining-Finetuning Paradigm. [link]
- Zhanpeng Zhou[1], Zijun Chen[1], **Yilan Chen**, Bo Zhang, Junchi Yan.
- Forty-first International Conference on Machine Learning (ICML 2024).

Analyzing Generalization of Neural Networks through Loss Path Kernels. [link]
- **Yilan Chen**, Wei Huang, Hao Wang, Charlotte Loh, Akash Srivastava, Lam M. Nguyen, Tsui-Wei Weng.
- Thirty-seventh Conference on Neural Information Processing Systems (NeurIPS 2023).

Analyzing Deep PAC-Bayesian Learning with Neural Tangent Kernel: Convergence, Analytic Generalization Bound, and Efficient Hyperparameter Selection. [link]
- Wei Huang[1], Chunrui Liu[1], **Yilan Chen**, Richard Yi Da Xu, Miao Zhang, Tsui-Wei Weng.
- Transactions on Machine Learning Research (TMLR 2023).

The Importance of Prompt Tuning for Automated Neuron Explanations. [link]
- Justin Lee[1], Tuomas Oikarinen[1], Arjun Chatha, Keng-Chi Chang, **Yilan Chen**, Tsui-Wei Weng.
- NeurIPS 2023 Workshop on Attributing Model Behavior at Scale.

Quantifying the Knowledge in a DNN to Explain Knowledge Distillation for Classification. [link]
- Quanshi Zhang[1], Xu Cheng[1], **Yilan Chen**, Zhefan Rao.
- IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI 2023).

On the Equivalence between Neural Network and Support Vector Machine. [link]
- **Yilan Chen**, Wei Huang, Lam M. Nguyen, Tsui-Wei Weng.
- Thirty-fifth Conference on Neural Information Processing Systems (NeurIPS 2021).

Explaining Knowledge Distillation by Quantifying the Knowledge. [link]
- Xu Cheng, Zhefan Rao[2], **Yilan Chen**[2], Quanshi Zhang.
- 2020 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR 2020).

Experiences

University of California San Diego   San Diego, USA
Deep Learning Theory and Its Applications, Trustworthy Machine Learning   *Jan. 2021 - present*
Graduate Student Researcher   [Advisors: Prof. Arya Mazumdar, Yian Ma, Tsui-Wei (Lily) Weng]

- Established equivalence between wide neural networks and support vector machines with **Neural Tanget Kernel** (NeurIPS 2021);
- Established equivalence between general neural networks and kernel machines with a proposed new kernel called **loss path kernel**;
- Derived tight **generalization bounds** of neural networks using the above equivalence. Applied the results to guide the design of **neural architecture search (NAS)** and demonstrate favorable performance compared with SOTA NAS algorithms (NeurIPS 2023);
- For **dataset distillation** of kernel ridge regression, proved theoretically that one data per class is necessary and sufficient to recover the original model's performance in many settings. Proposed **provable and efficient algorithm** for dataset distillation (NeurIPS 2024).

The University of Tokyo and RIKEN AIP   Tokyo, Japan
Theory for Large Language Models and Deep Learning   *Jun. 2024 - Sep. 2024*
Research Intern   [Advisor: Prof. Taiji Suzuki]

- Developed theoretical framework for emerging abilities of LLMs including **in-context learning, scaling law, and chain-of-thought**;
- Derived sharp generalization bounds of neural networks through a connection with kernel method and using **stability** property of gradient descent. The proved bound matches the bound of classic kernel methods (In submission).

Shanghai Jiao Tong University   Shanghai, China
Interpretable Machine Learning   *Jul. 2019 - Jun. 2020*
Research Intern   [Advisor: Prof. Quanshi Zhang]

- Proposed a method to interpret the success of **knowledge distillation** by quantifying and analyzing the task-relevant and task-irrelevant **visual concepts** that were encoded in intermediate layers of a deep neural network (DNN);
- Developed three hypotheses explaining why knowledge distillation performs better than standard training. Created three types of mathematical metrics to assess the feature representations of the DNN and validate the hypotheses.
- Performed extensive experiments to diagnose various DNNs and verified all three hypotheses (CVPR 2020 & TPAMI 2023).

Image Processing and Recognition Laboratory, XJTU   Xi'an, China
Face Aging Prediction with Active Appearance Model   *Mar. 2019 - Jun. 2019*
Undergraduate Thesis   [Advisors: Prof. Xuanqin Mou and Dr. Yijun Liang]

- Aligned the shapes of training set images (FG-NET aging database) into a common co-ordinate frame using Generalized Procrustes Analysis; applied **PCA** to construct a statistical appearance model that combines both shape and texture models;
- Learned aging functions and predict the aging effects of new faces using multiple kinds of machine learning algorithms, including **Lasso, Ridge, ElasticNet, SVR, Random Forest**;

School of Computing, National University of Singapore   Singapore
Book Recommendation System Based on IBM Cloud   *Jul. 2018 - Aug. 2018*
Summer Workshop Group Project   [Advisor: Prof. Teo Yong Meng]

- Developed Onebook, a cloud-based **book recommendation website** that suggests valuable books based on users' social networks;
- Utilized the Twitter API to retrieve users' Twitter content and incorporated IBM Watson Personality Insights to analyze their personalities. Designed algorithms for user and book similarity to generate customized book recommendations;
- Built back-end with Node.js and Express, front-end with Jade, and subsequently deployed the application on IBM cloud.

Invited Talks

Analyzing Neural Networks through Equivalent Kernels

- RIKEN AIP – SJTU CS Joint Workshop on Machine Learning and Brain-like Intelligence   *Aug 2024*
- Southern California Applied Mathematics Symposium (SOCAMS 2024)   *Apr. 2024*

Analyzing Generalization of Neural Networks through Loss Path Kernels

- ByteDance   *Jan. 2024*
- AI TIME   *Nov. 2023*

Teaching

DSC 212: Probability and Statistics for Data Science, Teaching Assistant	*Fall 2024*
DSC 140B: Representation Learning, Teaching Assistant	*Spring 2024*
DSC 210: Numerical Linear Algebra, Teaching Assistant	*Fall 2023*
DSC 291: Trustworthy Machine Learning, Teaching Assistant	*Fall 2021*

Professional Service

Conference Reviewer: ICML (2022, 2023, 2024, 2025), NeurIPS (2022), ICLR (2022, 2024, 2025)
Journal Reviewer: Journal of Optimization Theory and Applications (JOTA)

Technical Skills

Languages: Python, C/C++, MATLAB, JavaScript
Machine Learning: PyTorch, JAX
Miscellaneous: Linux, LaTex, FPGA, ARM

Honors & Awards

NeurIPS 2023 Scholar Award	*Dec. 2023*
Simons Institute Deep Learning Theory Workshop Funding	*Aug. 2022*
Outstanding Student Award	*Sep. 2016 and 2018*
"Siyua" Merit Scholarship	*Sep. 2016, 2017, and 2018*