Denny (Yi) Wu

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Employment

2023– **New York University & Flatiron Institute**, *New York, NY*,
Present CDS-Flatiron Faculty Fellow.

Education

2018–2023 **University of Toronto & Vector Institute**, *Toronto, ON*,
Ph.D.in Computer Science.
Supervisor: **Jimmy Ba** and **Murat A. Erdogdu**

2013–2018 **Carnegie Mellon University**, *Pittsburgh, PA*,
B.Sc. in Computational Biology, *with University Honor*.

Research Experience

- 2021.06- **Microsoft Research**, Redmond, WA.
  2021.09
  - Deep Learning Group. Host: **Greg Yang**.
  - Project: Optimization of infinite-width neural networks beyond the kernel regime.

- 2019.06- **University of Tokyo & RIKEN AIP**, Tokyo, Japan.
  2019.08
  - Deep Learning Theory Team. Host: **Taiji Suzuki**.
  - Project: Asymptotic characterization of the generalization error of two-layer neural networks.

- 2017.09- **Carnegie Mellon University**, Pittsburgh, PA.
  2018.03
  - Undergraduate Research Assistant. Advisor: **Ruslan Salakhutdinov**.
  - Project: Sample quality comparison of deep generative models using kernel method.

- 2017.06- **RIKEN AIP**, Tokyo, Japan.
  2017.08
  - High-dimensional Statistical Modeling Team. Host: **Makoto Yamada**.
  - Project: Post-selection inference for kernel-based hypothesis tests.

- 2016.05- **University of Tokyo**, Tokyo, Japan.
  2016.08
  - Research Intern (Funded by ISURF). Host: **Keisuke Goda**.
  - Project: Signal compression and image classification for Optical Time-stretch Microscopy.

- 2015.06- **Kyoto University**, Kyoto, Japan.
  2015.08
  - Amgen Scholar. Host: **Tomokazu Umeyama**.
  - Project: Synthesis and characterization of Fullerene derivatives-based photovoltaics.

Publications (** denotes alphabetical ordering or equal contribution*)

Conference Publications

- Kazusato Oko*, Yujin Song*, Taiji Suzuki*, and **Denny Wu***. "*Learning sum of diverse features: computational hardness and efficient gradient-based training for ridge combinations.*" Conference on Learning Theory (**COLT**), 2024.

- Zhichao Wang, **Denny Wu**, and Zhou Fan. "*Nonlinear spiked covariance matrices and signal propagation in deep neural networks.*" Conference on Learning Theory (**COLT**), 2024.

- Kazusato Oko, Shunta Akiyama, **Denny Wu**, Toyama Murata, and Taiji Suzuki. "*SILVER: single-loop variance reduction and application to federated learning*." International Conference on Machine Learning (**ICML**), 2024.

- Atsushi Nitanda*, Kazusato Oko*, Taiji Suzuki*, **Denny Wu***. "*Improved statistical and computational complexity of the mean-field Langevin dynamics under structured data*." International Conference on Learning Representations (**ICLR**), 2024.

- Atsushi Nitanda, Ryuhei Kikuchi, Shugo Maeda, and **Denny Wu**. "*Parameter averaging for SGD stabilizes the implicit bias towards flat regions*." International Conference on Artificial Intelligence and Statistics (**AISTATS**), 2024.

- Alireza Mousavi-Hosseini, **Denny Wu**, Taiji Suzuki, and Murat A. Erdogdu. "*Gradient-based feature learning under structured data*." Advances in Neural Information Processing Systems (**NeurIPS**), 2023.

- Jimmy Ba*, Murat A. Erdogdu*, Taiji Suzuki*, Zhichao Wang*, and **Denny Wu***. "*Learning in the presence of low-dimensional structure: a spiked random matrix perspective*." Advances in Neural Information Processing Systems (**NeurIPS**), 2023.

- Taiji Suzuki, **Denny Wu**, Atsushi Nitanda, and Kazusato Oko. "*Feature learning via mean-field Langevin dynamics: classifying sparse parities and beyond*." Advances in Neural Information Processing Systems (**NeurIPS**), 2023.

- Taiji Suzuki, **Denny Wu**, and Atsushi Nitanda. "*Convergence of mean-field Langevin dynamics: time and space discretization, stochastic gradient, and variance reduction*." Advances in Neural Information Processing Systems (**NeurIPS**), 2023. (**Spotlight**)

- Atsushi Nitanda, Kazusato Oko, **Denny Wu**, Nobuhito Takenouchi, and Taiji Suzuki. "Primal and dual analysis of entropic fictitious play for finite-sum problems." International Conference on Machine Learning (**ICML**), 2023.

- Taiji Suzuki, Atsushi Nitanda, and **Denny Wu**. "Uniform-in-time propagation of chaos for the mean-field Langevin dynamics." International Conference on Learning Representations (**ICLR**), 2023.

- Jimmy Ba*, Murat A. Erdogdu*, Taiji Suzuki*, Zhichao Wang*, **Denny Wu***, and Greg Yang*. "*High-dimensional asymptotics of feature learning: how one gradient step improves the representation*." Advances in Neural Information Processing Systems (**NeurIPS**), 2022.

- Naoki Nishikawa, Taiji Suzuki, Atsushi Nitanda, and **Denny Wu**. "*Two-layer neural network on infinite-dimensional data: global optimization guarantee in the mean-field regime*." Advances in Neural Information Processing Systems (**NeurIPS**), 2022.

- Atsushi Nitanda, **Denny Wu**, and Taiji Suzuki. "*Convex analysis of the mean-field Langevin dynamics*." International Conference on Artificial Intelligence and Statistics (**AISTATS**), 2022.

- Kazusato Oko, Taiji Suzuki, Atsushi Nitanda, and **Denny Wu**. "*Particle stochastic dual coordinate ascent: exponential convergent algorithm for mean-field neural network optimization*." International Conference on Learning Representations (**ICLR**), 2022.

- Jimmy Ba*, Murat A. Erdogdu*, Marzyeh Ghassemi*, Taiji Suzuki*, Shengyang Sun*, **Denny Wu***, and Tianzong Zhang*. "*Understanding the variance collapse of SVGD in high dimensions*." International Conference on Learning Representations (**ICLR**), 2022.

- Atsushi Nitanda, **Denny Wu**, and Taiji Suzuki. "*Particle dual averaging: optimization of mean-field neural networks with global convergence rate analysis*." Advances in Neural Information Processing Systems (**NeurIPS**), 2021.

- Shun-ichi Amari*, Jimmy Ba*, Roger Grosse*, Xuechen Li*, Atsushi Nitanda*, Taiji Suzuki*, **Denny Wu***, and Ji Xu*. "*When does preconditioning help or hurt generalization?*" International Conference on Learning Representations (**ICLR**), 2021.
  [*Optimization for Machine Learning Workshop*, NeurIPS 2020. (**Best Student Paper**)]

- **Denny Wu*** and Ji Xu*. "*On the optimal weighted ℓ_2 regularization in overparameterized linear*

regression." Advances in Neural Information Processing Systems (**NeurIPS**), 2020.

○ Jimmy Ba*, Murat A. Erdogdu*, Taiji Suzuki*, **Denny Wu***, and Tianzong Zhang*. "*Generalization of two-layer neural networks: an asymptotic viewpoint*." International Conference on Learning Representations (**ICLR**), 2020. (**Spotlight**)

○ Xuechen Li, **Denny Wu**, Lester Mackey, and Murat A. Erdogdu. "*Stochastic runge-kutta accelerates Langevin monte carlo and beyond*." Advances in Neural Information Processing Systems (**NeurIPS**), 2019. (**Spotlight**)

○ Makoto Yamada*, **Denny Wu***, Yao-Hung Hubert Tsai, Ichiro Takeuchi, Ruslan Salakhutdinov, and Kenji Fukumizu. "*Post selection inference with incomplete maximum mean discrepancy estimator*." International Conference on Learning Representations (**ICLR**), 2019.

Journal Publications

○ Naoki Nishikawa, Taiji Suzuki, Atsushi Nitanda, and **Denny Wu**. "*Two-layer neural network on infinite-dimensional data: global optimization guarantee in the mean-field regime*." **Journal of Statistical Mechanics: Theory and Experiment (invited)**, no. 11: 114007, 2023.

○ Atsushi Nitanda, **Denny Wu**, and Taiji Suzuki. "*Particle dual averaging: optimization of mean-field neural networks with global convergence rate analysis*." **Journal of Statistical Mechanics: Theory and Experiment (invited)**, no. 11: 114010, 2022.

○ Hirofumi Kobayashi, Cheng Lei, **Yi Wu**, Chun-Jung Huang, Atsushi Yasumoto, Masahiro Jona, Wenxuan Li et al. "*Intelligent whole-blood imaging flow cytometry for simple, rapid, and cost-effective drug-susceptibility testing of leukemia*." **Lab on a Chip** 19, no. 16: 2688-2698, 2019.

○ Cheng Lei, Hirofumi Kobayashi, **Yi Wu**, Ming Li, Akihiro Isozaki, Atsushi Yasumoto, Hideharu Mikami et al. "*High-throughput imaging flow cytometry by optofluidic time-stretch microscopy*." **Nature Protocols** 13, no. 7: 1603-1631, 2018.

○ Baoshan Guo, Cheng Lei, **Yi Wu**, Hirofumi Kobayashi, Takuro Ito, Yaxiaer Yalikun, Sangwook Lee et al. "*Optofluidic time-stretch quantitative phase microscopy*." **Methods** 136: 116-125, 2018.

○ Hirofumi Kobayashi, Cheng Lei, **Yi Wu**, Ailin Mao, Yiyue Jiang, Baoshan Guo, Yasuyuki Ozeki, and Keisuke Goda. "*Label-free detection of cellular drug responses by high-throughput bright-field imaging and machine learning*." **Scientific Reports** 7, no. 1: 1-9, 2017.

○ Cheng Lei, **Yi Wu**, Aswin C. Sankaranarayanan, Shih-Min Chang, Baoshan Guo, Naoto Sasaki, Hirofumi Kobayashi, Chia-Wei Sun, Yasuyuki Ozeki, and Keisuke Goda. "*GHz optical time-stretch microscopy by compressive sensing*." **IEEE Photonics Journal** 9, no. 2: 1-8, 2017.

○ Rachel Ferebee, Ilhem F. Hakem, Amelie Koch, Maggie Chen, **Yi Wu**, Derek Loh, David C. Wilson et al. "*Light scattering analysis of mono- and multi-pegylated bovine serum albumin: Role of composition on structure and interactions*." **The Journal of Physical Chemistry** B 120, no. 20: 4591-4599, 2016.

Preprints & Workshop Presentations

○ **Denny Wu**, Hirofumi Kobayashi, Charles Ding, Lei Cheng, Keisuke Goda, and Marzyeh Ghassemi. "*Modeling the biological pathology continuum with HSIC-regularized wasserstein auto-encoders*." Machine Learning for Health (ML4H) Workshop, NeurIPS 2018.

○ Cheng Lei, Baoshan Guo, Yiyue Jiang, **Yi Wu**, Hirofumi Kobayashi, Takuro Ito, Atsushi Yasumoto, Yutaka Yatomi, Yasuyuki Ozeki, and Keisuke Goda. "*High-throughput, label-free, multivariate cell analysis with optofluidic time-stretch microscopy*." Conference on Lasers and Electro-Optics, 2017.

▬▬▬ Professional Service

Conferences

Area Chair *AISTATS (2023, 2024)*.

Reviewer	*NeurIPS, ICLR, COLT, ICML, AISTATS.*

Journals

Reviewer	*Annals of Statistics, Information and Inference: A Journal of the IMA, SIAM Journal on Mathematics of Data Science, Journal of Machine Learning Research, Transaction of Machine Learning Research, Journal of Computational and Graphical Statistics.*

▬▬ Awards & Invited Talks

Selected Talks

- 06/2024 *DIMACS Workshop on Modeling Randomness in Neural Network Training*, Rutgers University.
- 05/2024 *Lausanne Event on Machine Learning and Neural Network Theory*, EPFL.
- 05/2024 *Youth in High Dimensions: Recent Progress in Machine Learning, High-Dimensional Statistics and Inference*, ICTP Trieste.
- 01/2024 *CD3 x Simons Foundation workshop "AI-driven discovery in physics and astrophysics"*, The University of Tokyo.
- 01/2024 *The Mathematics of Data Workshop*, National University of Singapore.
- 12/2023 *IMA Data Science Seminar*, The University of Minnesota.
- 11/2023 *IMS Young Mathematical Scientist Forum*, National University of Singapore.
- 10/2023 *CDS Lunch Seminar*, New York University.
- 05/2023 *CFAR Outstanding PhD Student Seminar*, The Agency for Science, Technology and Research.
- 05/2023 *Department of Statistics and Data Science Seminar*, The National University of Singapore.
- 04/2023 *CIRJE Applied Statistics Workshop*, The University of Tokyo.
- 03/2023 *Department of Statistics Seminar*, The Chinese University of Hong Kong.
- 03/2023 *AI Research Talk*, Mohamed bin Zayed University of Artificial Intelligence.
- 11/2022 *The 25th Information-Based Induction Sciences Workshop (IBIS2022)*, Tsukuba International Conference Center.
- 09/2022 *One World Seminar Series on the Mathematics of Machine Learning*, Online.
- 06/2022 *Young Data Science Researcher Seminar Zurich*, ETH Zurich.
- 04/2022 *Workshop on Advances in Stein's method and Applications in Machine Learning and Optimization*, Banff International Research Station.
- 09/2021 *MSR Machine Learning Foundations Seminar*, Microsoft Research Redmond.
- 03/2021 *Workshop on Functional Inference and Machine Intelligence (FIMI)*, Online.
- 11/2020 *Workshop on Seeking Low-dimensionality in Deep Neural Networks*, Online.

Awards & Fellowships

2023	*UChicago Rising Stars in Data Science.*
2023	*DCS Departmental Fellowship.*
2021–2023	*Borealis AI Fellowship.*
2019–2022	*Vector Institute Research Grant.*

▬▬ Teaching

Course Instructor

Fall 2024	*DS-GA 1006: Capstone Project and Presentation*, New York University.
Fall 2023	*DS-GA 1014: Optimization and Computational Linear Algebra*, New York University.

Teaching Assistant

Winter 2023   *CSC413: Neural Networks and Deep Learning*,   University of Toronto.
Winter 2022
Winter 2020

Fall 2022   *Machine Learning and AI – Black & Indigenous Program*,   Vector Institute.

Fall 2018   *CSC411: Introduction to Machine Learning*,   University of Toronto.

Fall 2017   *80-257: Nietzsche*,   Carnegie Mellon University.