Jeffrey J. Ma

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Research Interests

I am interested in the intersection of machine learning, systems, and multi-agent interaction. I am especially interested in the following:

- Efficient model, data representation, and learning (e.g. sparse methods, low-rank representation, model compression, and structured matrices).
- Continual learning and scalable methods of skill acquisition in foundation models.
- Incentive-aligned systems of multiple learning agents (e.g. federated learning, reinforcement learning, distributed training).
- Parallelism and asynchronicity in ML systems.

I've also previously worked on:

- Fast algorithms that balance efficiency and accuracy.
- Competitive optimization methods and their robustness over traditional single-agent methods.

Education

Harvard University — Cambridge, MA
- Ph.D. student in Computer Science, advised by Prof. Vijay Janapa Reddi. *Sept 2023 – Present*
  Expected graduation in May 2028.
- GPA: 4.0/4.0.

California Institute of Technology (Caltech) — Pasadena, CA
- B.S. majoring in both Computer Science and Business, Economics, & Management (BEM). Minor in Information and Data Sciences (IDS) . *Sept 2018 – June 2022*
- GPA: 4.2/4.3.

Research Experience

AWS AI Labs, Amazon — New York, NY
Applied Scientist Intern — *May 2023 – Current*

- Research intern focusing on methods to reduce fault overhead and node failure in large scale LLM distributed training: studying properties of training and optimization specifically in tightly coupled large foundation model training jobs over thousands of nodes.
- Advisor: Leonard Lausen

Edge Computing Lab, Harvard University — Cambridge, MA
Graduate Research Assistant — *August 2023 – Current*

- Graduate research assistant at the Edge Computing Lab, which focuses on enabling high-compute tasks on constrained hardware and bridging the hardware and software gap.
- Working on methods for continual learning and minimizing catastrophic forgetting with foundation models across non-IID tasks; using Large Language Models (LLMs) for systematizing high-touch programming actions including program synthesis, debugging, performance optimization, and correctness testing; fair and strategy-proof update aggregation mechanisms for asynchronous federated learning.
- Advisor: Prof. Vijay Janapa Reddi

Tensor Lab, California Institute of Technology — Pasadena, CA
Undergraduate Researcher — *August 2020 – January 2022*

- Undergraduate researcher at the Tensor Lab, extending and formalizing competitive gradient descent optimization methods to multi-agent, reinforcement learning environments and real-world multiplayer games.
- Worked on a multi-agent optimization package and training framework to competitively train robust agents for multi-player games using novel competitive methods.
- Advisors: Prof. Animashree Anandkumar, Prof. Yuanyuan Shi, Prof. Florian Schäffer

Magnetic Resonance Systems Research Laboratory, Stanford University Stanford, CA
Summer Undergraduate Research Fellowship (SURF) *June 2019 – December 2019*

- Selected for a SURF at the Magnetic Resonance Systems Research Laboratory (MRSRL). Developed a machine learning framework to detect motion artifacting in pediatric MRI and provide data informed suggestions to MR technicians, a solution which reduces the inefficient use of high-cost doctor hours on image quality assessment.
- Studied convolutional and complex-valued neural networks and created a framework for evaluating the performance over different model architectures and training label distributions.
- First-authored a paper accepted to the 2020 IEEE International Symposium on Biomedical Imaging (ISBI) and awarded full travel funding through the Hummel-Gray and Housner Funds.
- Advisors: Prof. Shreyas Vasanawala, Prof. Ukash Nakarmi

The Wall Lab, Stanford University Stanford, CA
Research Intern *June 2017 – July 2018*

- Selected for the Stanford Institute of Medical Research Summer Research Program (SIMR). Worked as a Research Intern at The Wall Lab to develop a machine-learning classifier for diagnosing Autism Spectrum Disorder based on a patient's ability to recognize emotion and their level of facial engagement in a controlled wearable device test setting.
- Published research paper to the Journal of Medical Internet Research (JMIR).
- Advisors: Prof. Dennis P. Wall, Prof. Nick Haber

Industry Experience

Citadel, Order Management System (OMS) Team New York, NY
Quantitative Developer *August 2022 – August 2023*

- Full-time role on the asset manager side at Citadel, working on the Order Management System (OMS) team under the Global Fixed Income (GFI) fund. The OMS team manages the workflow of translating an investment thesis into a portfolio item, ranging from a centralized view of new trades to real-time order management and electronic and voice execution to supporting portfolio life-cycle actions.
- Supervisors: Nick Chambers, Yury Bandarchuk

Citadel, Electronic Trading Team New York, NY
Quantitative Developer Intern *June 2021 – August 2021*

- Intern on the asset manager side at Citadel, working on the Electronic Trading (E-Trading) team under Global Fixed Income (GFI). The E-Trading team focuses on algorithmic and automated methods of trading and booking fixed income instruments.
- Supervisors: Trevor Middleton, Colin Jennings

Nuro, Machine Learning Infrastructure Team Mountain View, CA
Software Engineering Intern *March 2021 – June 2021*

- Intern at Nuro, an early-stage, self-driving commercial delivery startup, focused on accelerating the benefits of robotics for everyday life.
- Worked on ML infrastructure and model optimization and deployment: built a productionized version of TASO for systematically generating and replacing sub-graphs in computational graphs with more efficient equivalents.
- Supervisors: Timothy Chou, Hongze Zhao, Jack Guo

Google Brain, Tensorflow Extended Team Mountain View, CA
Software Engineering Intern *June 2020 – Sept 2020*

- Worked on the TensorFlow Extended (TFX) team in Google Brain (Google's research division). Contributed to TFX, an end-to-end platform for automatically deploying machine learning (ML) models in production.
- Implemented component and architecture improvements to enable asynchronous component execution and continuous pipeline architecture (ML pipelines that can periodically run and stay updated on windows of continually arriving batches of data), and prototyped native support for data streaming sources in TFX.

- Supervisors: Jiayi Zhao, Ruoyu Liu

Teaching Experience

CS24: Computing Systems Caltech
Head Teaching Assistant (Fall 2020, 2021), Teaching Assistant (Fall 2019) *2019 – 2021*

- Head TA for Caltech's CS24 (Computing Systems), which focuses on a programmer's view of how computer systems execute programs, store information, and communicate. Topics include: machine-level code and its generation by optimizing compilers, performance evaluation and optimization, computer arithmetic, memory organization and management, and supporting concurrent computation.

CS144: Network: Structure and Economics Caltech
Teaching Assistant (Winter 2022) *2022*

- TA for Caltech's CS144 (Network: Structure and Economics), which focuses on networks from a theory and real-world perspective. Topics include numerical and analytical analysis of the structure and distribution of social networks and the web through theoretical analysis and proofs and practical labs.

CS2: Introduction to Programming Methods Caltech
Teaching Assistant (Winter 2021, Winter 2020) *2020 – 2021*

- TA for Caltech's CS2 (Introduction to Programming Methods). Topics include data structures; implementation and performance analysis of fundamental algorithms; algorithm design principles, in particular recursion and dynamic programming.

Skills

Programming Python, C/C++, TypeScript, Java, MATLAB, LaTeX, OCaml, Haskell
x86-64 Assembly
Frameworks: PyTorch, TensorFlow, Template Metaprogramming, React, Kubernetes, GraphQL, gRPC/Protobuf, Kafka, sklearn, NumPy, Flask/FastAPI
Other: Git, macOS, Linux, Windows
Spoken Languages: English (native proficiency), Mandarin (working proficiency)

Publications

Complete List: Google Scholar [IemYiGEAAAAJ] · ORCID [0000-0002-3646-3547]

1. **J. Ma**, A. Letcher, F. Schäfer, Y. Shi, and A. Anandkumar, "Polymatrix competitive gradient descent," Nov. 2021, Full Paper.
2. **J. J. Ma**, U. Nakarmi, C. Yue Sik Kin, C. Sandino, J. Y. Cheng, A. B. Syed, P. Wei, J. M. Pauly, and S. Vasanawala, "Diagnostic image quality assessment and classification in medical imaging: Opportunities and challenges," *Proceedings of the 2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI)*, pp. 337–340, May 2020, Full Paper.
3. A. Nag, N. Haber, C. Voss, S. Tamura, J. Daniels, **J. J. Ma**, B. Chiang, S. Ramachandran, J. Schwartz, T. Winograd, C. Feinstein, and D. P. Wall, "Toward continuous social phenotyping: Analyzing gaze patterns in an emotion recognition task for children with autism through wearable smart glasses," *Journal of Medical Internet Research (JMIR)*, vol. 22, no. 4, Apr. 2020, Journal Paper.

Presentations

1. **J. J. Ma**, U. Nakarmi, C. Yue Sik Kin, J. Y. Cheng, C. Sandino, A. B. Syed, P. Wei, J. M. Pauly, and S. Vasanawala, "Analysis of deep learning models for diagnostic image quality assessment in magnetic resonance imaging," *Proceedings of the 2020 28th International Society for Magnetic Resonance in Medicine (ISMRM) Annual Meeting*, Aug. 2020, Abstract/Poster Presentation.

Awards

- Harvard David B. Heller Innovation Fund Ph.D. Fellowship *2024*
- Caltech ASCIT Teaching Award *(awarded to four Caltech graduate or undergraduate TAs selected by the student body for excellence in teaching)* *2022*
- Jack E. Froehlich Memorial Award *(awarded to a Caltech junior in the upper 5 percent of their class who shows outstanding promise for a creative professional career)* *2021*
- Patrick Hummel and Harry Gray Travel Fund Award *2020*
- George W. Housner Student Discovery Fund Award *2020*

- SCIAC Swimming Championship Finalist (top-16) in the 100 and 200 yd. Breaststroke *2020*
- Gee Family Poster Competition Finalist (for excellence in scientific communication) *2019*
- SURF Fellowship *2019*
- Andy Grove Scholarship *2019*
- SCIAC Swimming Championship Finalist (top-16) in the 100 and 200 yd. Breaststroke *2019*
- National Merit Scholarship *2018*

Other Activities

Caltech Varsity Swim Team Fall 2018 – Fall 2021

- Collegiate student-athlete competing at the NCAA Division 3 level against schools in the Southern California Intercolegiate Athletics Conference (SCIAC); 4-Time SCIAC Swimming Championship Finalist in the 100-yd and 200-yd Breastroke and 2-Time SCIAC All-Academic team member.

Caltech Student Faculty Program (SFP) Ambassador Summer 2020 – Summer 2021

- Nominated by campus leadership to serve as a SURF Ambassador, spearheading the SFP Office's efforts to make Caltech a welcoming virtual environment for all incoming summer research students. Responsibilities included organizing weekly check-ins, social and networking events, and assisting summer research students with any logistical issues.

Caltech Admissions Ambassador and Campus Tour Guide Spring 2019 – Spring 2022

- Selected by the admissions office as a campus representative. Led campus tours and held informational office hours for prospective students and families.

Fleming House Treasurer Spring 2021 – Spring 2022

- Elected as Treasurer for Fleming House, one of Caltech's eight undergraduate houses. Managed and allocated member dues and house endowment for social activities and student welfare.

Caltech Frosh Camp Counselor and Deans Tutor Fall 2019 – Fall 2021

- Selected by the Deans' Office to help organize freshmen orientation and lead a pod of incoming freshmen. Lead orientation events and serving as an intermediary between new students and campus resources.
- Tutored peer undergraduates in a variety of applied math and computer science courses.

Caltech Interhouse Athletics Manager Fall 2019 – Spring 2021

- Organizing and scheduling social, intramural athletics competitions between Caltech's eight undergraduate houses. Member of Fleming House's Athletics Team, organizing house intramural athletics participation and events.