HAORAN ZHANG

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EDUCATION

Carnegie Mellon University (CMU) May 2025 (expected)
M.S. in Electrical and Computer Engineering (Advanced Study)
GPA: 4.0/4.0
Courses: Introduction to ML (18-661), Introduction to DL (18-786), Information Theory Measures for Artificial and Natural Intelligence Systems (18-753), Algorithms for Large-scale ML (18-667), Applied Stochastic Processes with Applications to AI and ML (18-751).

Huazhong University of Science and Technology (HUST) June 2023
B.E. in Automation (Advanced Class), School of Artificial Intelligence and Automation
GPA: 3.9/4.0 GRE: 327+3.5
Courses and Scores: Pattern Recognition and Machine Learning (93/100), Control Theory (I: 97/100; II: 95/100), Game Theory (85/100), Operations Research (99/100), Computational Methods (99/100).

The Technical University of Munich (TUM) April 2023 - August 2023
Exchange student in Electrical Engineering Department

RESEARCH INTERESTS

My general research interests are machine learning (ML), and how to deploy ML efficiently in the real world from a theory-driven perspective, e.g., analysis of federated learning (distributed ML), and optimization problems for large-scale ML systems. I am always happy to explore new fields.

RESEARCH EXPERIENCE

Efficient Client Sampling in Multi-Model Federated Learning [1]–[3] Jan 2024 - Present
Supervisors: Dr. Marie Siew, Prof. Carlee Joe-Wong, and Prof. Rachid El-Azouzi CMU

- Implemented client sampling baselines in multi-model federated learning (MMFL) using PyTorch.
- Introduced a novel gradient-norm based client sampling approach for MMFL, boosting accuracy by over 30% compared to random sampling.
- Presented preliminary findings at ICDCS 2024, receiving the **Best Poster Award**.
- Extended the algorithm to a "multi-processor" level to incorporate device heterogeneity in MMFL.
- Proposed another cost-efficient sampling method that reduced computational costs, making the approach more feasible for large-scale deployment.
- Conducted convergence analysis to explain the impact of different sampling methods on training.
- Improved training efficiency by integrating stale updates in the aggregation process, achieving a mere 4% accuracy gap with only 10% client participation versus full participation.
- Summarized the work and submitted it to INFOCOM 2025.
- Collaborated with peers to develop a group-based MMFL algorithm, submitted to ICASSP 2025.

Task Fairness in Multi-Model Federated Learning [4] Jan 2024 - March 2024
Supervisors: Dr. Marie Siew and Prof. Carlee Joe-Wong CMU

- Evaluated the FedFairMMFL algorithm across diverse multi-model settings, demonstrating improved fairness with 10 models and implemented q-FEL as a baseline.
- Optimized the codebase for clarity and GPU efficiency, streamlining experimental workflows.
- Explored a Bayesian-based sampling probability model to accelerate convergence under client heterogeneity settings.

Efficient Segmentation and Domain-adversarial Learning [5] Feb - Nov 2022
Supervisor: Prof. Hao Chen The Hong Kong University of Science & Technology (HKUST)

- Proposed a pyramidally downsampled 3D Transformer, improving the model's accuracy by 1.72% and efficiency by 12% on brain stroke lesion and prostate segmentation tasks.
- Introduced a cluster-based domain-adversarial learning method to exploit domains at a fine-grained level, improving generalization ability by 2.61% on multi-domains segmentation tasks.
- Finished the code and manuscript (publised at ISBI 2023) independently.

4D Artery Reconstruction and Motion Magnification Apr - Aug 2023
Supervisor: Dr. Zhongliang Jiang TUM

- Implemented motion magnification algorithm to enhance the motion of the artery, facilitating the detection of potential diseases of arteries (demo: tinyurl.com/m-Magnification).
- Implemented a method based on the Transformer and Siamese-like network for tracking 2D arteries from ultrasound videos (demo: tinyurl.com/arterytrack).

DNA Computing and Molecular Circuits Design (Undergrad Thesis) Sept 2022 - June 2023
Supervisor: Prof. Linqiang Pan HUST

- Designed DNA switching circuits to simulate the computational devices made of DNA.
- Simulated and synthesized multiple 3D nanostructures using DNA origami.

PUBLICATIONS

[1] **H. Zhang**, Z. Gong, Z. Li, M. Siew, C. Joe-Wong, and R. El-Azouzi, "Federated learning paper," Under Review at INFOCOM 2025.

[2] **H. Zhang**, Z. Li, Z. Gong, M. Siew, C. Joe-Wong, and R. El-Azouzi, "Poster: Optimal variance-reduced client sampling for multiple models federated learning," in *2024 IEEE 44th International Conference on Distributed Computing Systems (ICDCS)*, **Best Poster Award**, IEEE, 2024.

[3] Z. Gong*, **H. Zhang***, M. Siew, C. Joe-Wong, and R. El-Azouzi, "Group-based client sampling in multi-model federated learning," Under Review at ICASSP 2025.

[4] M. Siew, **H. Zhang**, J.-I. Park, *et al.*, "Fair concurrent training of multiple models in federated learning," *arXiv preprint arXiv:2404.13841*, 2024.

[5] **H. Zhang** and H. Chen, "Efficient 3d transformer with cluster-based domain-adversarial learning for 3d medical image segmentation," in *2023 IEEE 20th International Symposium on Biomedical Imaging (ISBI)*, IEEE, 2023, pp. 1–5.

ACHIEVEMENTS

Best Poster Award, ICDCS 2024	Summer 2024
Outstanding Graduate, HUST	Summer 2023
Scholarship for Scientific and Technological Innovation, HUST	Fall 2022
Honorable Mention in Mathematical Contest In Modeling 2022, COMAP	Summer 2022
Team leader (1st place among 300+ teams) in new student recruitment event, HUST	Fall 2020
Scholarship for Community Engagement, HUST	Fall 2020
Scholarship for Extracurricular Activities and Sports, HUST	Fall 2019

SKILLS/HOBBIES

Programming Languages	Python, C, C++, MATLAB
Machine Learning Tools	Pytorch, Tensorflow, Sklearn, Pandas, Numpy, MONAI
Hobbies	birding and hiking

*Equal Contribution