# Junhong **Shen**

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Personal Website | GitHub | Google Scholar

## Research Interests

**Developing data-centric ML and AutoML techniques for long-tail ML applications, addressing efficiency, data scarcity & heterogeneity**

## Education

**Carnegie Mellon University** — *Pittsburgh, PA*

Ph.D. in Machine Learning, Advisor: Ameet Talwalkar (QPA: 4.11/4.33) — *Sep. 2021 - Present*

**University of California, Los Angeles** — *Los Angeles, CA*

B.S. in Mathematics of Computation (GPA: 4.0/4.0) — *Sep. 2017 - June 2021*

## Publications

### Preprint

**UPS: Towards Foundation Models for PDE Solving via Cross-Modal Adaptation** [paper][code]
**Junhong Shen**, Tanya Marwah, Ameet Talwalkar

### Accepted/Published articles

**Tag-LLM: Repurposing General-Purpose LLMs for Specialized Domains**
ICML 2024 [paper][code]
**Junhong Shen**, Neil Tenenholtz, James Brian Hall, David Alvarez-Melis, Nicolò Fusi

**Cross-Modal Fine-Tuning: Align then Refine**
ICML 2023 (Oral, top 158/6538) [paper][code] [talk][website]
**Junhong Shen**, Liam Li, Lucio M. Dery, Corey Staten, Mikhail Khodak, Graham Neubig, Ameet Talwalkar

**Efficient Architecture Search for Diverse Tasks**
NeurIPS 2022 [paper][code][blog]
**Junhong Shen***, Mikhail Khodak*, Ameet Talwalkar

**NAS-Bench-360: Benchmarking Neural Architecture Search on Diverse Tasks**
NeurIPS 2022 Datasets and Benchmarks Track [paper][website][blog]
Renbo Tu*, Nicholas Roberts*, Mikhail Khodak, **Junhong Shen**, Frederic Sala, Ameet Talwalkar

**AutoML Decathlon: Diverse Tasks, Modern Methods, and Efficiency at Scale**
NeurIPS 2022 Competitions Track [paper][website]
Nicholas Roberts, ... 24 authors ..., **Junhong Shen**, Evan Sparks

**Iterative Teacher-Aware Learning**
NeurIPS 2021 [paper][code]
Luyao Yuan, Dongruo Zhou, **Junhong Shen**, Jingdong Gao, Jeffrey Chen, Quanquan Gu, Ying Nian Wu, Song-Chun Zhu

**Theoretically Principled Deep RL Acceleration via Nearest Neighbor Function Approximation**
AAAI 2021 [paper][code]
**Junhong Shen**, Lin F. Yang

**Mathematical Reconstruction of Patient-Specific Vascular Networks Based on Clinical Images and Global Optimization**
IEEE Access [paper] [code][talk]
**Junhong Shen**, Abdul Hannan Faruqi, Yifan Jiang, Nima Maftoon

**Emergence of Pragmatics from Referential Game between Theory of Mind Agents**
NeurIPS 2019 Emergent Communication Workshop [paper] [code]
Luyao Yuan, Zipeng Fu, Jingyue Shen, Lu Xu, **Junhong Shen**, Song-Chun Zhu

* *Equal Contribution*

# Work Experience

**Fundamental AI Research (FAIR), Meta** — *Seattle, WA*

Research Intern (Mentor: Chunting Zhou, Omer Levy) — *May 2024 (Expected)*

- Will work on multi-modal foundation models.

**AI Research Team, Scribe** — *Pittsburgh, PA*

Senior Machine Learning Research Engineer — *Feb. 2024 - Present*

- Working on LLM-based web agents.

**Microsoft Research, New England** — *Cambridge, MA*

Research Intern (Mentor: David Alvarez-Melis, Nicolò Fusi) — *May 2023 - Aug. 2023*

- Worked on adapting LLMs to specialized domains (e.g., low-resource languages, protein sequences, chemical formulas) via prompt tuning.

**Determined AI, Hewlett Packard Enterprise** — *Pittsburgh, PA*

Research Intern (Mentor: Liam Li) — *Jun. 2022 - Dec. 2022*

- Worked on fine-tuning LLMs and vision transformers for scientific modalities (e.g., PDE, genomics) via distribution alignment.

**Face ID Team, SenseTime** — *Beijing, China*

Product Manager Intern — *Jun. 2018 - Sep. 2018*

- Worked on 3D-structured-light Face ID; participated in 5 software version releases, bug fixing, and testing.
- Designed the Face ID demo app; performed user requirements analysis and competitive product analysis, delivered to the team.

# Research Experience

**SAGE Lab** — *Pittsburgh, PA*

Advisor: Ameet Talwalkar (CMU) — *June. 2021 - Present*

- Ph.D. research on developing effective and efficient ML/AutoML tools for solving diverse tasks in practice.

**Lin Yang's Group** — *Los Angeles, CA*

Advisor: Lin F. Yang (UCLA) — *Jan. 2020 - June 2021*

- Studied sample-efficient reinforcement learning; proposed an algorithm for estimating the value functions using nearest neighbor function approximator; provided theoretical justification on the sample complexity.

**Center for Vision, Cognition, Learning, and Autonomy (VCLA), UCLA** — *Los Angeles, CA*

Advisor: Song-Chun Zhu, Ying Nian Wu (UCLA) — *Jan. 2019 - June 2021*

- Studied how theory of mind (ToM) can be integrated into various ML settings to improve algorithm efficiency.
- **Project 1: Multi-Agent Deep Reinforcement Learning with ToM**
  - Proposed an adaptive ToM algorithm in a referential game setting where the teacher and the student model each other's action likelihood while learning their own Q-functions; studied the emergent communication protocol between the agents.
- **Project 2: Efficient Learners in Iterative Machine Teaching**
  - Integrated ToM into machine teaching; improved teaching efficiency by having the learners model the teacher's training sample selection strategy with maximum likelihood estimation.
- **Project 3: Meta Machine Teaching**
  - Studied how meta-learning can be combined with machine teaching: the teacher monitors a group of students' learning processes, deduces their initial beliefs and learning models, and adapts its teaching scheme to each learner.

**Computational Metastasis Lab, Fields Institute for Research in Mathematical Sciences** — *Toronto, Canada*

Advisor: Nima Maftoon (University of Waterloo) — *Jul. 2019 - Sep. 2019*

- Developed a vascular network reconstruction framework that uses (i) the main vessel skeletons segmented from clinical images and (ii) global constructive optimization algorithm to generate patient-specific cerebral vascular models; validated the geometric (lengths, radii) and hemodynamic (pressure, shear stress) properties of the models via histogram analysis and blood flow simulation.

**MOE Key Laboratory of Protein Sciences, Tsinghua University** — *Beijing, China*

Advisor: Jia-Wei Wu (Tsinghua University) — *Sep. 2015 - June 2017*

- Studied the catalytic mechanism of enzyme HPPD and investigated its protein structure via X-ray diffraction.

## Professional Service

**Co-organizer of CMU Agent Workshop 2024**

**Co-organizer of AutoML Decathlon, NeurIPS 2022 Competition Track**

**CMU MSML Admissions Committee** Fall 2022

**CMU MLD Open House Committee** Spring 2024

**Conference Reviewer** NeurIPS (2022/2023), ICLR (2024), ICML (2024)

**Teaching Assistant** Deep Learning Systems (CMU 10714), Linear Algebra (UCLA Math 115A)

## Talks

Nov. 2023 **Machine Learning for Diverse Tasks**, Guest Lecture, ML with Large Datasets, CMU 10605
Nov. 2023 **Bridging LLMs and Long Tail ML Applications**, Catalyst Reading Group, CMU
Mar. 2023 **Cross-Modal Fine-Tuning**, AI4Science Talks
Dec. 2022 **DASH: How to Search Over Convolutions**, The AutoML Podcast
Oct. 2022 **Tackling Diverse Tasks with Neural Architecture Search**, DLML Journal Club, Mayo Clinic

## Honors & Awards

2021 **Daus Prize**, UCLA (5 top-performing undergraduate students in mathematics) *Los Angeles, CA*
2017 - 21 **Dean's Honors List**, UCLA *Los Angeles, CA*

## Professional Skills

**Coding** Proficient: Python, C, C++, Bash, R Familiar: MATLAB, Java, Arduino
**Tools** Git, LaTeX, PyTorch, Tensorflow, Scikit-learn, OpenCV, OpenAI Gym, Google Cloud Platform, Docker, SolidWorks

## Related Coursework

**CS** Machine Learning, Artificial Intelligence, Information Theory, Computer Vision, Algorithms and Complexities, Advanced Programming, Operating Systems Principles, Deep Learning Systems, Computer Network Fundamentals
**Math** Linear Algebra, Multivariable Calculus, Differential Equations, Discrete Mathematics, Probability Theory, Stochastic Processes, Mathematical Analysis, Complex Analysis, Optimization, Applied Numerical Methods, Game Theory
**Stats** Statistical Modeling in Vision and Cognition, Computing and Inference in Vision and Cognition, Data Analysis and Regression