Ziming Liu

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EXPERIENCE

Massachusetts Institute of Technology, USA **Feb 2021 – May 2025 (Expected)**
PhD candidate in physics, IAIFI junior investigator, advised by Prof. Max Tegmark Cambridge, MA, USA

- Research in the intersection of artificial intelligence (AI) and Science. I have developed Kolmogorov-Arnold Networks (15.1k stars on GitHub), Poisson Flow Generative Models, and AI Poincaré, among others. I also contributed to the understanding of intriguing neural network phenomena, e.g., grokking and neural scaling laws. My research interests span AI for Science (boost science with AI), Science for AI (designing next-generation AI with science), and Science of AI (understanding AI through scientific principles).

Microsoft Research Asia, China **Sep 2020 – Feb 2021**
Research Assistant in Machine Learning Theory Groupm, advised by Prof. Wei Chen Beijing, China

- Augmenting Lagrangian neural networks for new physics detection

Peking University, Beijing, China **Sep 2016 – June 2020**
Undergraduate student in physics, Research Assistant, advised by Prof. Huichao Song Beijing, China

- Applying machine learning tools to analyze data from high-energy experiments

MEDIA COVERAGE

- Scientific American, "An Alternative to Conventional Neural Networks Could Help Reveal What AI Is Doing behind the Scenes"
- Quanta Magazine, "Novel Architecture Makes Neural Networks More Understandable"
- Quanta Magazine, "The Physical Process That Powers a New Type of Generative AI"
- Quanta Magazine, "How Do Machines 'Grok' Data?"
- MIT News, "From physics to generative AI: An AI model for advanced pattern generation"
- New Scientist, "AI solves complex physics problems by looking for signs of symmetry"
- Nature Review Physics, "How machines could teach physicists new scientific concepts".
- Cognitive evolution Podcast, "Seeing is Believing with MIT's Ziming Liu"

AWARD

- Google PhD fellowship 2024 (Machine Intelligence Track)

SERVICE

Reviewing

- Journals: Physical Review Research, IEEE Transactions on Neural Networks and Learning Systems
- Conferences: NeurIPS, ICLR, ICML
- Workshops: ML4Physics workshop, UniReps workshop, AI4Science workshop

Community Building

- Serve as an organizer for the AI4Science workshop at NeurIPS 2021, ICML 2022 and NeurIPS 2023.

REPRESENTATIVE PAPERS

- **KAN: Kolmogorov-Arnold Networks. arXiv:2404.19756**
  Ziming Liu, Yixuan Wang, Sachin Vaidya, Fabian Ruehle, James Halverson, Marin Soljačić, Thomas Y. Hou, Max Tegmark
- **Poisson flow generative models, NeurIPS, 2022**
  Yilun Xu*, Ziming Liu*, Max Tegmark, Tommi Jaakkola
- **Towards understanding grokking: An effective theory of representation learning, NeurIPS (Oral), 2022**
  Ziming Liu, Ouail Kitouni, Niklas S Nolte, Eric Michaud, Max Tegmark, Mike Williams
- **Seeing is Believing: Brain-Inspired Modular Training for Mechanistic Interpretability, Entropy, 2023**
  Ziming Liu, Eric Gan, Max Tegmark
- **Machine learning conservation laws from trajectories, Physical Review Letter (Editor's Suggestion), 2021**
  Ziming Liu, Max Tegmark

FULL PUBLICATION LIST

- **KAN 2.0: Kolmogorov-Arnold Networks Meet Science. arXiv: 2408.10205**
  Ziming Liu, Pingchuan Ma, Yixuan Wang, Wojciech Matusik, Max Tegmark
- **KAN: Kolmogorov-Arnold Networks. arXiv:2404.19756**
  Ziming Liu, Yixuan Wang, Sachin Vaidya, Fabian Ruehle, James Halverson, Marin Soljačić, Thomas Y. Hou, Max Tegmark
- **A Resource Model For Neural Scaling Law, ICLR 2024 BGPT workshop**
  Jinyeop Song*, Ziming Liu*, Max Tegmark, Jeff Gore
- **Do Diffusion Models Learn Semantically Meaningful and Efficient Representations?, ICLR 2024 BGPT workshop**
  Catherine Liang, Ziming Liu, Ila R. Fiete
- **GenEFT: Understanding Statics and Dynamics of Model Generalization via Effective Theory, ICLR 2024 BGPT workshop**
  David Baek, Ziming Liu, Max Tegmark
- **Growing Brains: Co-emergence of Anatomical and Functional Modularity in Recurrent Neural Networks, NeurIPS 2023 UniReps workshop**
  Ziming Liu, Mikail Khona, Ila R. Fiete, Max Tegmark
- **Grokking as Compression: A Nonlinear Complexity Perspective, NeurIPS 2023 UniReps workshop**
  Ziming Liu, Ziqian Zhong, Max Tegmark
- **A Neural Scaling Law from Lottery Ticket Ensembling, arXiv: 2310.02258, 2023**
  Ziming Liu, Max Tegmark
- **Scientific discovery in the age of artificial intelligence, Nature, 2023**
  Hanchen Wang, Tianfan Fu, Yuanqi Du, Wenhao Gao, Kexin Huang, Ziming Liu, …
- **The Clock and the Pizza: Two Stories in Mechanistic Explanation of Neural Networks, NeurIPS (Oral), 2023**
  Ziqian Zhong*, Ziming Liu*, Max Tegmark, Jacob Andreas
- **Restart Sampling for Improving Generative Processes, NeurIPS, 2023**
  Yilun Xu, Mingyang Deng, Xiang Cheng, Yonglong Tian, Ziming Liu, Tommi Jaakkola
- **Discovering New Interpretable Conservation Laws as Sparse Invariants, Physical Review E**
  Ziming Liu, Patrick Obin Sturm, Saketh Bharadwaj, Sam Silva, Max Tegmark
- **Seeing is Believing: Brain-Inspired Modular Training for Mechanistic Interpretability, Entropy**
  Ziming Liu, Eric Gan, Max Tegmark

- **GenPhys: From Physical Processes to Generative Models, arXiv: 2304.02637, 2023**
  Ziming Liu, Di Luo, Yilun Xu, Tommi Jaakkola, Max Tegmark
- **The quantization model of neural scaling, NeurIPS, 2023**
  Eric J Michaud, Ziming Liu, Uzay Girit, Max Tegmark
- **Pfgm++: Unlocking the potential of physics-inspired generative models, ICML, 2023**
  Yilun Xu, Ziming Liu, Yonglong Tian, Shangyuan Tong, Max Tegmark, Tommi Jaakkola
- **Precision machine learning, Entropy, 2023**
  Eric J Michaud, Ziming Liu, Max Tegmark
- **Poisson flow generative models, NeurIPS, 2022**
  Yilun Xu*, Ziming Liu*, Max Tegmark, Tommi Jaakkola
- **Towards understanding grokking: An effective theory of representation learning, NeurIPS (Oral), 2022**
  Ziming Liu, Ouail Kitouni, Niklas S Nolte, Eric Michaud, Max Tegmark, Mike Williams
- **Machine learning conservation laws from differential equations, Physical Review E, 2022**
  Ziming Liu, Varun Madhavan, Max Tegmark
- **Omnigrok: Grokking beyond algorithmic data, ICLR (Spotlight), 2022**
  Ziming Liu, Eric J Michaud, Max Tegmark
- **Second order ensemble Langevin method for sampling and inverse problems, arXiv: 2208.04506, 2022**
  Ziming Liu, Andrew M Stuart, Yixuan Wang
- **Machine learning hidden symmetries, Physical Review Letter (Editor's suggestion), 2022**
  Ziming Liu, Max Tegmark
- **Machine-learning nonconservative dynamics for new-physics detection, Physical Review E, 2021**
  Ziming Liu, Bohan Wang, Qi Meng, Wei Chen, Max Tegmark, Tie-Yan Liu
- **Physics-augmented learning: A new paradigm beyond physics-informed learning, NeurIPS 2021 AI4Science workshop, 2021**
  Ziming Liu, Yunyue Chen, Yuanqi Du, Max Tegmark
- **Schrödinger principal-component analysis: On the duality between principal-component analysis and the Schrödinger equation, Physical Review E, 2021**
  Ziming Liu, Sitian Qian, Yixuan Wang, Yuxuan Yan, Tianyi Yang
- **Applications of deep learning to relativistic hydrodynamics, Physical Review Research, 2021**
  Hengfeng Huang, Bowen Xiao, Ziming Liu, Zeming Wu, Yadong Mu, Huichao Song
- **Machine learning conservation laws from trajectories, Physical Review Letter (Editor's Suggestion), 2021**
  Ziming Liu, Max Tegmark
- **Robustness of principal component analysis of harmonic flow in heavy ion collisions, Physical Review C, 2020**
  Ziming Liu, Arabinda Behera, Huichao Song, Jiangyong Jia
- **Quantum-inspired hamiltonian monte carlo for bayesian sampling, arXiv: 1912.01937, 2019**
  Ziming Liu, Zheng Zhang
- **Principal component analysis of collective flow in relativistic heavy-ion collisions, European Physical Journal C, 2019**
  Ziming Liu, Wenbin Zhao, Huichao Song
