Minghui Liu

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Looking for: AI/Machine Learning Research Internship | Starting Summer 2026.
Research Interests: LLM Reasoning, RL & Curriculum Learning, Self-Improvement, KV Cache Compression

EDUCATION

University of Maryland, College Park   *Jan. 2021 – Present*
   Ph.D. Candidate, Computer Science.
   Advisor: Prof. Furong Huang

Trinity College, Hartford CT   *Sep. 2013 – May. 2017*
   B.Sc in Computer Science. summa cum laude with distinction.   *Top 3%*
   Phi Beta Kappa. Dean's Scholar. Faculty Honor.   *Top 5%*

ON GOING PROJECTS

1. **Ladders-RL: Dynamic Difficulty Adjustment for Reinforcement-Trained Reasoning**
   Extends GRPO by dynamically switching to easier progressive rewrites of the same question when all rollouts in a group fail to receive reward. This on-the-fly fallback preserves gradient signal under sparse-reward settings, enabling stable reinforcement learning on reasoning tasks where baseline GRPO collapses due to zero-reward episodes.

2. **PRM-GRPO: Process-Reward-Model Guided Reinforcement for Reasoning Chains**
   Investigates the complementary strengths of Process Reward Models (PRMs) and outcome-verifier rewards in reinforcement training of reasoning chains. Demonstrates that PRMs yield smoother optimization and better step-level alignment under sparse-reward regimes, while outcome verifiers enforce global logical validity. Proposes a unified training framework and derives practical guidelines on when and how to deploy PRMs effectively for reasoning tasks

SELECTED RESEARCH & PUBLICATIONS (2025–2026)

1. **Ladders of Thought: A Self-Evolving Curriculum of Progressively Simplified Reasoning Traces**
   ICLR 2026 Submission
   M. Liu, T. Magelinski, D. Yuan, Q. Yu, F. Huang

   - Developed a progressive rewrite framework that generates semantically faithful but easier variants of reasoning tasks.
   - Introduced a self-evolving bandit scheduler that adapts task difficulty to model learning progress.
   - Achieved up to +32pp improvement in arithmetic reasoning and +25pp in multi-hop reasoning tasks for small LLMs (OPT/Pythia).
   - Demonstrated faster convergence and better generalization across datasets, highlighting the benefits of adaptive curricula.

2. **Hold Onto That Thought: Assessing KV Cache Compression on Reasoning**   ICLR 2026 Submission
   M. Liu, T. Rabbani, A. Palnitkar, K. R. Sang, H. Jae, D. Yao, S. Shabihi, F. Zhao, T. Li, C. Zhang, K. Zhang, F. Huang

   - Benchmarked over 25 KV cache compression strategies for long-context reasoning tasks (GSM8K, MATH-500, FOLIO, StrategyQA).
   - Integrated decoding-phase compression into NVIDIA's `kvpress` and analyzed reasoning degradation patterns under varying cache budgets.
   - Provided new evaluation metrics quantifying reasoning stability versus compression ratio and sequence length.

3. **MORSE: A Suite of Programmatically Controllable Multimodal Reasoning Environments with Steerable Difficulty**   [arXiv 2025](#), ICLR 2026 Submission
   Z. Cai, A. Wang, A. Satheesh, A. Nakhawa, H. Jae, K. Powell, M. Liu, N. Jay, S. Oh, X. Wang, Y. Liang, T. Goldstein, F. Huang

   - Built MORSE, a programmatic video reasoning simulator enabling controllable spatial, temporal, and abstract task difficulty.

- Released MORSE-500, a multimodal benchmark of 500 reasoning tasks covering planning, spatial awareness, and object relations.
- Implemented an automated generator using LLM-in-the-loop feedback to refine task diversity and correctness.

4. **PersonaLedger: Generating Realistic Financial Transactions with Persona-Conditioned LLMs and Rule-Grounded Feedback**   ICLR 2026 Submission
D. Yuan, X. Liu, <u>M. Liu</u>, T. Farnan, S. Tesliuc, D. L. Bergman, J. Montgomery, N. H. Nguyen, C. B. Bruss, F. Huang

- Proposed a hybrid LLM–programmatic engine for generating persona-grounded synthetic financial transactions.
- Built a dataset of 30M transactions across 23K users with strict accounting constraints, rule enforcement, and regeneration logs.
- Released two benchmark tasks—illiquidity prediction and anomaly detection—supporting reproducible financial AI research.

5. **HashEvict: Towards Pareto-Efficient KV Cache Eviction via Locality-Sensitive Hashing** arXiv 2025
<u>M. Liu</u>, T. Rabbani, T. O'Halloran, A. Sankaralingam, C. Fermüller, Y. Aloimonos, M. A. Hartley, F. Huang

- Designed an adaptive KV cache compression algorithm leveraging SimHash-based cosine similarity to identify token redundancy pre-attention.
- Achieved 30–70% cache reduction and up to $2\times$ prefill and decoding speedups across reasoning, summarization, and retrieval tasks.
- Proposed a Pareto-efficiency metric to balance speed and language quality, formalizing trade-offs in KV cache management.
- Conducted large-scale benchmarking on LLaMA and Mistral models; released open-source code and ablation results.

WORK EXPERIENCE

Applied Research Intern   June 2025 – Aug 2025
Capital One, New York NY

- Contributed to the *Ladders-of-Thought* project; designed adaptive curricula and evaluated reasoning improvements leading to ICLR 2026 submission.
- Developed adaptive reasoning curricula for small LLMs, integrating progressive simplification and dynamic difficulty control.
- Designed experiments demonstrating significant reasoning gains and convergence speed improvements.

HPC Software Engineer   Aug 2017 – Jan 2021
Altair Engineering, Sunnyvale CA   PROJECT GITHUB

- Enhanced OpenPBS job scheduler accuracy, added Docker support, and optimized Linux build process.

Research Assistant   Jan 2014 – Sep 2016
Trinity College, Hartford CT   *Topic: Hypergraph-based Image Matching Algorithm on the GPU*

- Developed GPU-based hypergraph image matching achieving 8–$20\times$ speedup; presented at NVIDIA GPU Technology Conference.

RELEVANT COURSES

Fundamentals	OOP, Discrete Math, Data Structures and Algorithms
Artificial Intelligence	Machine Learning, Computer Vision, Natural Language Processing
Algorithms	Advanced Algorithm Design, Computational Geometry
Systems	Operating Systems, Database, High Performance Computing
Mathematics	Linear Algebra, Calculus, Statistics, Probability, Numerical Analysis, Graph Theory, Combinatorics

SKILLS

Python - Machine Learning	pytorch, huggingface, numpy, pandas, scipy, matplotlib, sklearn, web-crawling (bs4), ...
High Performance Computing	C, CUDA, cython, MPI, OpenMP
Front-End, Back-End	HTML, CSS, Javascript