Ruichen Zheng

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EDUCATION

Dartmouth College Hanover, NH

B. S. in Math & Computer Science; **Major GPA**: 3.88/4.0 (Math), 3.9/4.0(CS) Sep. 2022 - May 2026

- **Related Coursework**: Machine Learning and Statistical Data Analysis, Artificial Intelligence, Deep Learning, Computer Graphics, Software Design and Implementation, Probability and Statistical Inference, Linear Algebra, Differential Equations, Real Analysis, Applied Mathematics, Mathematical Finance

RESEARCH PROJECTS

Born-Again Networks with LoRA Fine-Tuning | Dartmouth Kemeny Prize Winner 2025 Mar. 2025 - May 2025

***Advisor**: Prof. Yaoqing Yang, Department of Computer Science, Dartmouth College*

- **Motivation & Problem:** Traditional Born-Again Networks require 1M+ parameters and 360 epochs per generation, creating computational bottlenecks; addressed this by proposing LoRA-BAN, a novel method integrating Low-Rank Adaptation with iterative knowledge distillation.
- **Method Development:** Designed LoRA-BAN to use only 300k trainable parameters through low-rank decomposition while maintaining regularization benefits; implemented adaptive training with 40 epochs versus baseline's 360 epochs.
- **Performance Results:** Achieved 5-6× training speedup while capturing 47% of original performance gains (75.43% accuracy on CIFAR-100/ResNet-56); outperformed alternative approaches (Born-Again FT, Progressive Freezing) and demonstrated resistance to saturation across generations through comprehensive hyperparameter optimization.

Demographic Bias in LLM-as-a-Judge Systems | Python, MT-Bench Mar. 2025 - May 2025

***Advisor**: Prof. Adam Breuer, Department of Government, Dartmouth College*

- **Research Gap:** While position and verbosity biases in LLM evaluators are well-documented, impact of implicit demographic leakage on evaluation fairness remained unexplored; addressed this by investigating whether personal information (age, gender, race) causes biased judgments in automated assessments.
- **Novel Experimental Framework:** Developed three-stage methodology (control, identical persona injection, single-attribute ablation) to isolate demographic effects from confounding factors; tested on Gemini-2.0-Flash and Qwen2.5 judges using MT-Bench writing tasks to measure stability disruption.
- **Key Findings:** Implicit demographic cues destabilized ~20% of previously stable evaluations; documented judge-specific bias patterns (both disfavor Asian candidates, but opposite gender preferences); discovered ~70% self-correction rate when contrasting cues provided, suggesting viable mitigation pathway for fairer AI evaluation systems.

AI-Driven Educational Matching Game Platform | Dartmouth Neukom Scholar Project 2025 Jun. 2025 – Present

***Advisor**: Prof. Mikhail Gronas, Associate Professor of Russian, Dartmouth College*

- **Full-Stack Implementation**: Engineering multiplatform educational system with user authentication, competitive multiplayer modes, and real-time tracking for scalable deployment across educational contexts.
- **NLP Content Generation**: Developing transformer-based models to extract matching pairs from unstructured text sources; implementing domain-agnostic algorithms for Russian and Chinese language processing with phonetic transcription and semantic clustering; collaborating with Dartmouth language departments for educational content validation.
- **Adaptive Learning System**: Building reinforcement learning algorithms for dynamic difficulty adjustment; integrating customized AI chatbot for personalized content generation based on user performance analytics.

Computer Graphics Projects | V-Language, OpenGL Jun. 2024 - Aug. 2024

- **Ray Tracing:** Created a CPU-based ray tracer supporting spheres and quads, Lambertian and Blinn-Phong shading, reflections, shadows, and antialiasing.
- **Path Tracer:** Developed a physically based path tracer incorporating sampling-based BRDF and indirect illumination, culminating in a Cornell box scene demonstrating realistic global lighting.

Quant Finance Research | Python, R, Multi-Agent Systems, Transformers Mar. 2023 - Jul. 2024

- **RAG-enhanced Stock Analysis Agents:** Developed an automated stock analysis framework leveraging hierarchical RAG (Retrieval-Augmented Generation) and Multi-Agent System (MAS) to retrieve real-time financial data, news, and reports, extract market signals/alpha, and refine quantitative trading strategies.
- **Quant Strategies:** Applied evolutionary game theory and multi-criteria decision-making (MCDM) to the Chinese Stock Market; led a team of six and devised quantitative strategies that achieved 1800% returns in a four-year back-test.

AWARDS & TECHNICAL SKILLS

Awards: Dartmouth Kemeny Prize Winner, Dartmouth Neukom Scholarship

Languages: Python, Java, C/C++, V, SQL, JavaScript/Typescript/HTML/CSS

ML & Data Science: PyTorch, TensorFlow, Numpy, Pandas, Scikit-Learn, Scipy, OpenCV