Richard Zhu
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Education

Harvard University Cambridge, MA
S.M. Computer Science; A.B. Statistics (Bioinformatics and Computational Biology track) *May 2026*

- GPA: 4.00/4.00 (A.B.) & 3.96/4.00 (S.M.)
- Honors: *Summa cum laude*; Highest Honors in Statistics; Detur Book Prize; John Harvard Scholar (top 5% of class); Roger and Ann Porter Prize (awarded for "academic excellence, character, and service to others")

Research Experience

Johns Hopkins University, Dr. Jeffrey Gray's Lab June 2025 – Aug 2025
Protein Modeling Research Intern

- Fine-tuned DFMDock (AI model for protein-protein docking) with ranking loss function and data augmentation
- Showed that fine-tuned model outperforms state-of-the-art methods for ranking protein-protein complex predictions
- **Fellowships:** NSF Rosetta Commons REU intern (3.7% acceptance rate)

Harvard Medical School, Dr. Marinka Zitnik's Lab June 2024 – present
Machine Learning Research Intern

- Developed tools and case study for ToolUniverse, an ecosystem for building AI scientists with 600+ tools
- Helped train ToolRAG model for large-scale tool retrieval from ToolUniverse
- Developed training and evaluation data for TxAgent, an AI agent using ToolUniverse and multi-step reasoning to reason about drugs and personalized medicine. Built Gradio platforms for scientists evaluating TxAgent.
- Developed LLM-powered evaluation system for CURE-Bench, an international NeurIPS competition I am co-organizing to benchmark AI models on therapeutic reasoning
- **Fellowships:**
  - Summer Institute for Biomedical Informatics (SIBMI) fellow (10% acceptance rate)
  - Kempner Undergraduate Research Experience (KURE) fellow

Massachusetts General Hospital, under Dr. Abhiram Bhashyam June 2023 – present
Computational Clinical Research Intern

- Analyzed time-series hand-drawing data of 130+ patients to ID pressure features linked to impaired hand function

Brigham and Women's Hospital, Dr. Tracy Young-Pearse's Lab Feb 2023 – May 2024
Molecular Biology Intern

- Applied differential expression and gene set enrichment analyses to identify SMOC1 target in Alzheimer's disease; used wet lab assays (*e.g.*, Western Blot) to probe its mechanism. Also studied autophagy proteins in Alzheimer's.
- **Fellowships:** Harvard Program for Research in Science & Engineering (PRISE) fellow

UCLA, Dr. X. William Yang's Lab, under Dr. Peter Langfelder June 2021 – Aug 2021
Bioinformatics Intern

- Developed novel methods for estimating mammalian brain age using elastic net regression and gene expression data
- Identified genes upregulated/downregulated with age using differential expression & functional enrichment analyses
- **Fellowships:** Research Science Institute (RSI) Scholar (3.7% acceptance rate)

Cabrini University, Dr. Vinayak Mathur June 2020 – Dec 2021
Bioinformatics Intern

- Used bioinformatics methods to identify 94 virus-derived prophages in *Acinetobacter pittii* bacteria, which contained 37 resistance genes and 47 virulence factors that could influence pathogenicity

Publications

Gao, S., **Zhu, R.***, Sui, P.*, Kong, Z.*, Aldogram, S.*, Huang, Y., Noori, A., Shamji, R., Parvataneni, K., Tsiligkaridis, T., & Zitnik, M. (2025). Democratizing AI scientists using ToolUniverse. *arXiv preprint* arXiv:2509.23426 [Paper, Website, GitHub]. **denotes equal contribution*

Gao, S., **Zhu, R.**, Kong, Z., Noori, A., Su, X., Ginder, C., Tsiligkaridis, T., & Zitnik, M. (2025). TxAgent: An AI agent for therapeutic reasoning across a universe of tools. *arXiv preprint* arXiv:2503.10970 [Paper, GitHub].

Mancini, K., Cao, I., Ge, C., Mu, E., **Zhu, R.**, & Mathur, V. (2024). Investigating the role of phage mediated HGT in increasing bacterial virulence. *Bios*, 95(2), 73–78 [Paper].

Zhu, R., & Mathur, V. (2022). Prophages present in *Acinetobacter pittii* influence bacterial virulence, antibiotic resistance, and genomic rearrangements. *PHAGE*, 3(1), 38–49 [Paper].

Conference Presentations

Zhu, R. & Nishi, K. (2026). Evolutionary curriculum learning for biological sequence modeling. *Structured Probabilistic Inference & Generative Modeling Workshop at the International Conference on Machine Learning (ICML).*

Zhu, R., Hou, C., & McPhie, K. (2026). BIRDGen: Multimodal conditional inference of latent unbiased species distributions. *Structured Probabilistic Inference & Generative Modeling Workshop at the International Conference on Machine Learning (ICML).*

Zhu, R., Xu, D., Chu, L., & Gray, J. (2025). Improving scoring functions for protein–protein docking with LambdaLoss. *Machine Learning in Structural Biology (MLSB) Workshop* [Paper].

Zhu, R., Xu, D., Chu, L., & Gray, J. (2025). Improving scoring functions for protein–protein docking with LambdaLoss. *Molecular Machine Learning (MoML) Conference.*

Zhu, R., Xu, D., Chu, L., & Gray, J. (2025). Improving scoring functions for protein–protein docking with LambdaLoss. *Summer RosettaCon.*

Gao, S., **Zhu, R.***, Sui, P.*, Kong, Z.*, Aldogram, S.*, Huang, Y., Noori, A., Shamji, R., Parvataneni, K., Tsiligkaridis, T., & Zitnik, M. (2025). Democratizing AI scientists using ToolUniverse. *Harvard Dept. of Biomedical Informatics Science Day* **[2nd Place, Best Poster]**. **denotes equal contribution*

Gao, S., **Zhu, R.**, Kong, Z., Su, X., Ginder, C., Aldogom, S., Das, I., Evans, T., Tsiligkaridis, T., & Zitnik, M. (2025). CURE-Bench: Competition on reasoning models for drug decision-making in precision therapeutics. *Conference on Neural Information Processing Systems (NeurIPS) Competition Track.*

Pan, R.*, **Zhu, R.***, Lakshman, V., & Qu, F. (2025). Mutagenic: An embedding-based approach to protein masking for functional redesign. *Learning Meaningful Representations of Life Workshop at the International Conference on Learning Representations (ICLR)* [Paper]. **denotes equal contribution*

Laane, C.*, **Zhu, R.***, Chandra, J., Stam, M., Orgocka, M., Chen, N., Garg, R., & Bhashyam, A. (2024). Hand and wrist immobilization affects pressure in complex spiral-based drawings. *Tufts Biology Research Symposium.* **denotes equal contribution*

Zhu, R., & Mathur, V. (2023). Prophages present in *Acinetobacter pittii* influence bacterial virulence, antibiotic resistance, and genomic rearrangements. *Harvard Microbial Science Initiative 20th Anniversary Symposium.*

Zhu, R., & Mathur, V. (2021). Prophages present in *Acinetobacter pittii* influence bacterial virulence, antibiotic resistance, and genomic rearrangements. *Northeastern Microbiologists: Physiology, Ecology, and Taxonomy (NEMPET) Conference.*

Invited Talks

CHEMBIO2200 (Tools & Methods in Chemical Biology), Harvard Medical School Jan 2026
"Leveraging agentic AI for therapeutic reasoning and discovery"

Awards

Fulbright-Switzerland U.S. Student Program Fellowship 2026

Swiss Government Excellence Fellowship 2026

National Science Foundation Graduate Research Fellow (NSF GRFP) - *declined* 2026

U.S. Rhodes Scholarship Finalist 2025

Marshall Scholarship Finalist 2025

iGEM Grand Jamboree Silver Medal 2023

USA Biology Olympiad (USABO) National Bronze Medalist 2020, 2022

Leadership Experience

Reviewer for ICML Workshop on Generative and Agentic AI for Biology May 2026

Reviewer for ICML Workshop on Multi-modal Foundation Models for Life Sciences May 2026

Harvard Intro to Stochastic Processes (STAT171) Course Assistant Jan 2026 – May 2026

- Hosted weekly 2-hour office hours to help students with problem sets
- Graded problem sets and exams

NSF Rosetta Commons REU Admissions Committee Member Feb 2026

- Evaluated and selected candidates for the 2026 Rosetta Commons REU program focused on computational molecular modeling

Harvard Peer Tutor for STEM Courses Sept 2025 – Dec 2025

- Host weekly 1:1 tutoring sessions for students from multiple STEM courses, including CS61 (systems programming), CS2420 (efficient ML), STAT110 (probability), and LIFESCI50 (quantitative life sciences)
- Host weekly study group focused on coding in order to support LIFESCI50 students with no coding background

Harvard Intro to Algorithms & Limitations (CS1200) Teaching Fellow Sept 2024 – Dec 2024

- Hosted weekly 1-hour section to cover course material and 2-hour office hours to help students with problem sets
- Assisted with grading and problem creation for exams

Harvard Summit for Young Leaders in China (HSYLC) Seminar Leader Aug 2024

- Taught a one-week course on fish biology to Chinese high schoolers as part of HSYLC conference in China

Crimson Tales Jan 2024 – May 2025
Co-President (2024-25); Board Member (2024)

- Led volunteering initiative at Hebrew SeniorLife where volunteers are paired with senior residents to create art and writing reflecting on their life stories. As co-president, I led recruiting, training, and weekly volunteering sessions.

Harvard Global Alliance for Medical Innovation Sept 2022 – May 2026
Senior Advisor (2025-26); Co-President (2024-25); Project Team Lead (2023-24)

- Led student-run global health tech innovation group working with clinicians, health experts & engineers worldwide
- Oversaw 9 projects, 70+ students, and collaborators (*e.g.*, WHO Africa and Symbionic Prosthetics)
- Led Neurodegenerative Disease Diagnostics (NDD) team to train random forest classifiers and regression models on time series hand-drawing data as a method for low-cost Parkinson's disease diagnosis and severity estimation
- NDD won 3rd & Best Pitch Award from American Society of Tropical Medicine & Hygiene's 2022 Innovations Pitch
- Awarded United Nations Millennium Fellowship (leadership development program) to pursue my work in GAMI
- GAMI awarded $2000+ through Harvard SOCIAL Challenge (social impact grant) under my co-presidency

Harvard Quadball (Quidditch) Club Sept 2022 – Dec 2025

President (2025 Fall); Vice President (2025 Spring); Treasurer (2023-2024)

- Lead nationally-recognized quadball team. Manage recruiting and club operations. Compete as a Beater.
- (as Treasurer) Oversaw team finances and financial aid to ensure accessibility for all members
- 2024 Division I National Champions; 2023 Division I National Runners-up

Harvard iGEM Oct 2022 – May 2024

Board Member (2023-24); Team Member (2022-23)

- Won Silver at 2023 iGEM Grand Jamboree for fast, low-cost production of cell-free lysate for biomarker detection

Projects

Harvard Geometric ML (AM220) Final Project Jan – May 2025

- Designed a method to construct phylogenetic trees in hyperbolic space using protein language model embeddings

MIT Advanced NLP (6.8610) Final Project Oct – Dec 2024

- Used contrastive methods and protein language models for functional edits in protein engineering
- Paper accepted to 2025 ICLR Learning Meaningful Representations of Life workshop (Tiny Paper Track)

Evolved 2024 (Bio x ML Hackathon) Oct 2024

- Built graph-based AI model to answer conjunctive logical queries on a biomedical knowledge graph
- Constructed training data from PrimeKG knowledge graph and test data from TWOSIDES polypharmacy graph
- Won Scale Medicine prize

MIT Drug Discovery (20.201) Final Project Sept – Dec 2024

- Constructed a computational pipeline (target ID, docking screen, ADMET optimization of top drug candidates) to identify a novel molecular glue for degrading DUX4, the cause of facioscapulohumeral muscular dystrophy (FSHD)
- Implemented ADMET-AI model for pharmacokinetic property optimization

Skills

Tools: PyTorch, SLURM & HPC cluster, GitHub, data science (NumPy, Pandas, *etc.*), functional enrichment analysis. **Models:** Llama-3.1, ESM-3, DFMDock (diffusion model), Boltz-2. **Languages:** Python, R, C++.