

# RICHARD GAO

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## EDUCATION

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### Brown University

*M.S. in Computer Science*

*Providence, RI*

*Aug. 2025 – May 2027*

- Incoming student Fall 2025 pursuing the Artificial Intelligence/Machine Learning thesis track.

### UC SANTA BARBARA

*B.S. in Computer Science • GPA: 3.95/4.0*

*Santa Barbara, CA*

*Sept. 2021 – Dec. 2024*

- **Relevant Coursework** (\* = graduate-level): Network Modeling and Graph Machine Learning\*, Uncertainty Quantification and Scientific Machine Learning\*, Deep Learning, Natural Language Processing, Machine Learning, Artificial Intelligence, Vector Calculus, Linear Algebra, Probability and Statistics, Discrete Math
- **Activities & Honors:** Dean's Honors (all quarters), Graduated with High Honors (top 8.5%), SB Hacks, Coders SB, Chinese Student Union, Poker Club

## EXPERIENCE

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### UCSB Computer Science

*Researcher*

*Santa Barbara, CA*

*Feb 2025 – present*

- Scaling Kolmogorov-Arnold physics-informed neural networks with Prof. Sanjukta Krishnagopal.
- Researching SVD-based dynamic low-rank training of basis functions for solving partial differential equations.
- Implemented physics-informed neural network and PDE mesh predictions using Jax and Flax.

### UCSB Electrical & Computer Engineering

*Researcher*

*Santa Barbara, CA*

*May 2024 – present*

- Conducting research in efficient machine learning advised by Prof. Zheng Zhang.
- Researched meta-learning approaches to zeroth-order backpropagation-free training for adversarial attacks; implemented the Mamba state space model for meta-optimization.
- Researching task-agnostic LLM compression via learnable activations and knowledge distillation. Implemented multi-node, multi-GPU distributed training in PyTorch.
- Independently developing a dynamic low-rank training algorithm for tensor-train decomposed linear layers.
- Collaborating with lab members to benchmark distillation methods to recover pre-training performance of low-rank activation LLMs and Vision Transformers.
- Attend weekly seminars and lab meetings to present findings and discuss novel, efficient ML papers.

## PROJECTS

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### KAN We Tensorize GraphSAGE

*November 2024*

- Explored Kolmogorov-Arnold Networks (KANs) as an alternative to multilayer perceptrons in GraphSAGE.
- Investigated compression using tensor-train decomposition on learnable weights of GraphSAGE.
- Implemented modified aggregators in PyTorch and performed experiments on protein-protein interactions, scientific paper network citations, and a synthetic dataset.
- Demonstrated the effectiveness of KAN layers and the low tensor rank of GraphSAGE weights.
- Completed a 10-page report detailing background, motivation, methods, and results.

### ZEROTH-ORDER SPIKING NEURAL NETWORK TRAINING

*May 2024*

- Developed end-to-end training for non-differentiable spiking neural networks for neuromorphic computing.
- Used local zeroth-order gradient with LSTM meta-learning for variance reduction.
- Demonstrated transferability of the learned optimizer to different spiking neural network architectures.
- Implemented in PyTorch, achieved fast convergence and high accuracy against SoTA optimizers on MNIST.

### MICROCYLINDER CLOTH RENDERER

*March 2024*

- C++ implementation of "A Practical Microcylinder Appearance Model for Cloth Rendering."
- Programmed path-tracing with Russian roulette, bidirectional scattering distribution function, importance sampling, masking, and parallel processing.
- Demonstrated implementation by rendering different sets of parameters on a custom scene

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### KNOWLEDGE NAVIGATOR

*January 2024*

- App for semantic document search with natural language queries on user-uploaded PDF files
- Used Google Cloud DocumentAI Optical Character Recognition API to identify text on uploaded documents
- Implemented a pre-trained transformer encoder-only network to obtain dense text and query embedding vectors
- Designed a reranking and cosine similarity-based comparison to display relevant text to the user

### 3D ENVIRONMENT GENERATOR

*March 2023*

- Web app to procedurally generate custom 3D environments through a graphical interface by uploading custom 3D building blocks; used React.js, Firebase, Flask, AWS EC2, MongoDB.
- Helped lead and facilitate sprint meetings and plan deliverables.
- Generates up to 20x20x20 block environments using the Wavefunction Collapse algorithm.
- Designed the block-adjacency labeling algorithm for mesh matching.
- Wrote Python implementation for automatic 3D block labeling and adjacency rule generation for the wavefunction collapse algorithm, enabling automatic constraints for user-uploaded meshes.

### SKILLS & INTERESTS

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**Programming Languages:** C++, C, Python, Java, JavaScript, SQL

**Software:** PyTorch, Jax, Numpy, MATLAB

**Languages:** English (fluent), Mandarin (fluent), Spanish (conversational)

**Interests:** Piano, botany, basketball, running, poker