Ari Vasvaria

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ABOUT

Computer science student building and researching across graphics, machine learning, compression and computational biology. Current interests include game engines, path tracers, data and neural compressors, custom neural network architectures, spiking neuron networks, biophysical simulations, protein structure analysis and plasma disruption prediction. I like figuring out things I don't know and learning new fields.

EDUCATION

University at Buffalo, B.S. Computer Science *Expected May 2029*

Dean's List

RESEARCH AND PROJECTS

Biophysical neural networks that learn without backpropagation *C, OpenMP, Python | Jan 2026 – Sep 2026*

- Built a 2,700-neuron Hodgkin–Huxley network in C (retina, cortical sheet, striatum) that learns through calcium-based plasticity, synaptic scaling and dopamine-gated tagging, with no backpropagation, reward function or learning rates.
- Ran Pong, Connect 4 and Doom on the same network in real time, at 38 frames per second on a laptop CPU.
- Built a cerebellar forward model that predicts where the ball will land within 50 ms of the serve and intercepts 99% of Pong balls.
- Trained Doom agents that improved average reward from -110 to -1 over 3,000 episodes.

Matrix light transport: real-time global illumination without random sampling *CUDA C++, Python | Apr 2026 – Sep 2026*

- Built a renderer that solves global illumination as matrix arithmetic on GPU tensor cores. It uses no random sampling and no denoiser, so every frame is noise-free.
- Renders dynamic scenes at 26 ms per frame (38 fps) with 3% error against a path-traced reference, and reaches .24% at its quality setting.
- Wrote the reference renderer, an unbiased CUDA path tracer with multiple importance sampling.

nightpeak game engine and voxel path tracer *Rust, wgpu, WGSL | Nov 2025*

- Wrote a 3D game engine from scratch in Rust on wgpu (8,500 lines): custom rendering pipeline, shaders, shadow mapping, fog, physics and a dithered fixed-palette art style.
- Built four explorable environments entirely in code: a diner, a lounge, a manor and a drivable mountain road.
- Wrote a voxel path tracer as a GPU compute shader, with a three-level sparse grid for empty-space skipping and direct sampling of sun and emissive light.

au-compress: template-learning text compressor *C | Dec 2025*

- Built a compressor on anti-unification that learns the templates in a dataset automatically and stores only what changes.
- Compressed 1 GB of English Wikipedia to 1.826 bits per byte at 50 MB/s, discovering 835,747 templates.

AlphaFold error analysis on intrinsically disordered proteins *Python | Jun 2026 – Sep 2026*

- Analyzed AlphaFold predictions for 140 flexible proteins against experimental NMR ensembles to find where its error comes from.
- Showed that median error drops from 3.86 Å to 1.60 Å when rigid segments are aligned independently, and that AlphaFold's own confidence estimate predicts the experimental flexibility (Spearman 0.72).

EXPERIENCE

Founder and full-stack developer, ZapsApps *Jan 2024 – Jan 2025*

- Founded and ran a web development firm; designed, built and shipped the company site (zapsapps.com).
- Delivered four client projects end to end, from design through deployment.
- Built a lead-generation engine that sourced businesses from API and non-API data and filtered them against custom targeting criteria.

SKILLS

Languages: C, Rust, Python, CUDA C++, WGSL, TypeScript, JavaScript, Java
Graphics and GPU: wgpu, CUDA, compute shaders, path tracing, tensor-core matrix kernels
Machine learning: PyTorch, JAX, transformers, language models, RNNs, custom architectures, biophysical neuron models
Web and data: Next.js, React, FastAPI, PostgreSQL, SQLite, Redis, Qdrant, Docker, Vercel