

# Carl Osborne

Seattle, WA | [osbo@mit.edu](mailto:osbo@mit.edu) | US citizen | [osbo.dev](https://osbo.dev) | [github.com/osbo](https://github.com/osbo) | [linkedin.com/in/carl-osbo](https://linkedin.com/in/carl-osbo)

## EDUCATION

### Massachusetts Institute of Technology (MIT)

Pursuing B.S. in Computer Science

Cambridge, MA

expected in May 2028

- **Relevant Coursework:** Parallel Algorithms and Scientific Machine Learning (Grad), Modeling and Simulation (Grad), Machine Learning, Algorithms & Data Structures, Linear Algebra, Probability, Signal Processing, Differential Equations, Programming in C and Python
- **GPA:** 5.0/5.0 | **Honors:** Burchard Scholar (one of 36 undergraduate students selected for excellence in science & humanities)
- **Activities:** Division I Men's Lightweight Rowing, Swim Instructor (taught 700+ students), Essay Published in *Angles* (MIT Literary Journal).

## EXPERIENCE AND RESEARCH

### Apple

Incoming Rendering Engineer Intern (Motion Team) | C++, Metal, Swift, Objective-C

Los Angeles, CA

May–August 2026

- Developing new features and tooling for Motion, Apple's real-time VFX and motion graphics engine.

### MIT CSAIL – Computational Design and Fabrication Group (CDFG)

Undergraduate Researcher | PyTorch, HLSL, CUDA, C++, C#

Cambridge, MA

September 2025–Present

- Proposed and led research on a GPU-native neural preconditioner for PCG solvers; first-author preprint at arXiv:2605.13343 with 2.2× speedup over GPU Jacobi and ~28× over GPU IC/DILU (AMGX) at N=8,192 on stiff multiphase Poisson systems.
- Designed a hierarchical transformer over an H-matrix partition capturing long-range couplings at O(N) cost; derived a scale-invariant loss on preconditioner projective space yielding 4.3× tighter spectral clustering vs. prior SAI loss; deployed in a real-time multiphase fluid sim with custom fused inference kernels and an octree grid.

### Politecnico di Milano MOVE Lab (AIDA)

Research Intern | C++, JavaScript, OpenGL, QML

Milan, Italy

May–August 2025

- Developed fleet and individual vehicle management software and UI for large-scale autonomous vehicle deployments, now in production across EU.
- Engineered a custom rendering pipeline to display live AV telemetry efficiently across heterogeneous embedded hardware.

### MIT Sea Grant & U.S. Navy ESRDC

Research Intern | Python, MATLAB

Cambridge, MA

May–September 2023

- Designed and implemented an automated cooling system for next-generation electric warships, optimizing for hydrodynamic pressure and weight constraints, enabling instant analysis for thousands of ship designs.
- Presented research and delivered software to officers and scientists from the US Navy, MIT, Dartmouth, and Georgia Tech, to be used globally.

### MIT EECS

Lab Assistant, 6.1010 Fundamentals of Programming | Python

Cambridge, MA

January–May 2025

- Mentored 400+ students in intermediate computer science, covering topics from graph searches to interpreters.

## PROJECTS

### GPU-Accelerated N-Body Simulation | Swift, Metal

- Built a GPU Barnes-Hut N-body simulation with hand-rolled parallel radix sort and prefix scan for tree construction, reaching real-time frame rates on millions of interacting particles.
- Rendered gravitational lensing and relativistic Doppler shift effects using custom GPU shaders.

### High-Performance Rigid Origami Solver | Python, Numba, SciPy

- Modeled origami as a constrained kinematic network of rigid faces; solved the nonlinear closure constraints with a Damped Newton scheme that stays stable at bifurcation points where plain Newton diverges.
- Derived an analytical sparse Jacobian parallelized across CPU cores; sparse structure shifts scaling from O(N<sup>3</sup>) to ~O(N<sup>1.2</sup>).

### Prism — Multi-View Inverse Rendering | Python, PyTorch

- Built an inverse-rendering pipeline that jointly recovers geometry, materials, and lighting from sparse RGB views in a single forward pass; surface and appearance remain physically separable, unlike radiance-field-only approaches.
- Evaluated on 19 held-out objects across 6 categories (Chamfer 0.209, PSNR 14.55 dB); ablations quantified the contribution of each loss term.

### Audio-Generated Procedural Geometry | Python, WebGL

- Engineered a web app converting WAV audio to 3D-printable vase meshes via FFT, mapping frequency bands to radial displacement of a parametric profile.
- Built a real-time WebGL viewer for live parameter feedback; fabricated the output in glazed ceramic via 3D printing.

### Local LLM Writing Assistant | Swift, SwiftUI

- Architected a local-first macOS writing app using on-device LLMs with no network calls; passages are analyzed with surrounding context and recursively summarized into a global view cached per-document.
- Passage-level novelty, clarity, and flow scores drive inline highlights and sidebar charts; a debounced pipeline batches keystrokes for zero latency.

## SKILLS

**Languages:** Python, C++, CUDA, Metal, Swift, HLSL, C#, C, JavaScript, RISC-V Assembly, Java, Lua

**Technologies:** HPC, GPU Programming, Numerical Methods, Parallel Algorithms, Machine Learning, Physics-Informed Learning, Graphics, Linux