

# Christopher Culbreath

Physicist · AI Software Engineer · Data Scientist · Educator

AI-focused Software Engineer with a PhD in Chemical Physics, specializing in building and deploying intelligent systems. Expert in developing complex algorithms, integrating LLM-powered AI applications, and designing real-time control systems for edge devices. Proven ability to architect full-stack software solutions (Python, C++, SQL) and leverage statistical analysis and data-driven experimentation to solve ambitious engineering challenges. Adept at partnering with cross-functional teams to deliver robust, high-performance software and automation solutions.



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culbreath.net

## Skills and Expertise

### ★ Software & Programming

*AI/ML & Data Engineering with Python, C++, Pandas, MySQL. Computer Vision, Linux, Git, Agile.*

### ★ Automation & Control

*Real-time control for edge devices, embedded C++/Python programming, firmware integration, dynamics modeling, PLC, Arduino, ESP32.*

### ★ Modeling & Simulation

*AI/ML model development, statistical analysis, data-driven projections, numerical modeling, Monte Carlo simulations, FEA.*

### ★ Measurement & Metrology

*Real-time sensor integration, DAQ hardware, edge device control systems, calibration, uncertainty analysis, sensor fusion*

### ★ Engineering & Analysis

*First principles analysis, experimental design, data-driven problem solving, cross-functional collaboration, technical communication*

### ★ Rapid Prototyping

*Multi-axis CNC, 3D printing, CAD/CAM, GD&T, rapid iteration*

## Education

### ★ PhD Chemical Physics 2015

*Liquid Crystal Institute, Kent State*

### ★ BS Physics 2008

*Cal Poly San Luis Obispo*

## Work Experience

March 2017 – August 2020

### Automation & Materials Engineer, Elastium Technologies

- Brought on as a consultant to develop specialized manufacturing equipment and methods to produce previously unattainable high-performance shape memory alloys.
- Designed and implemented a flexible automation framework that enabled rapid iteration and continuous process improvement.
- Performed materials characterization experiments to assess process refinements and optimize alloy properties.
- Led the project while contributing to furnace architecture, component fabrication, software development, systems integration, and troubleshooting.

April 2019 – December 2021

### Materials Scientist, NRD LLC

- Developed automation control systems for single-crystal shape-memory alloy furnace, integrating sensors and real-time feedback
- Conducted system-level testing and evaluation to validate prototype functionality, performance, and regulatory feasibility.
- Secured executive buy-in for a strategic partnership between Elastium Technologies and NRD to advance single-crystal shape memory alloy furnace development.
- Contributed to scaling and refining auto-injector prototypes for manufacturability, optimizing design and production processes for commercial viability.

September 2016 – June 2024

### Senior Lecturer, Cal Poly

- Taught physics to undergraduate engineers and scientists, specializing in optics, thermodynamics, and electromagnetism.
- Integrated real-world applications and dynamic commentary into lectures on mechanics, waves, optics, thermodynamics, electricity and magnetism to enhance knowledge retention and student success.
- Led research initiatives on novel shape-memory materials while teaching and mentoring student researchers.
- Designed, developed, and maintained Physics Cloud, a bespoke web platform for assignment distribution, collection, and grading.

## Projects

- **Drumline Robot** Designing an ODrive-powered robotic percussion system with brushless motors and real-time control (in progress).
- **Physics Cloud** Developed a web-based Learning Management System for physics courses with a data-forward design.
- **Chore Cloud** Created a mobile-friendly chore and allowance management app with an intuitive user interface.
- **Physics Cloud Résumé** A macOS app (SwiftUI) for job tracking, featuring AI-assisted per-application customization.

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