Malachi Mabie

Software Research Engineer: AI/ML, Robotics, Systems

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Production software, ML systems, and robotics, built on a manufacturing and tooling foundation.

Summary

Software and ML engineer building run-data, verification, and agent infrastructure for robotic welding at Advanced Metal Research. Principal Investigator on a $250k Army SBIR and co-inventor on patent-pending vulnerability repair at RAM Laboratories; built Drone Institute's six production services and their CI/CD alone. Came up through robotics and manufacturing: FIRST Robotics led to Applied Medical at 16 and five years of robotic tooling, fixtures, and automation for injection molding that still run in production, then into ML and software to scale that work with tools.

Experience

Learning and Autonomy Engineer, Advanced Metal Research, Hawthorne, CA *Jul 2026–Present*

Through Mabie Industries, LLC. Robotic welding; RosieOS controller, Steam Deck operator client, weld planning, and run data.

- Worked across the co-founders to turn competing priorities into one engineering plan (robot motion and welding, robust run data, robot CI/CD and deployment, weld procedure integration), and led three to five of the team's interns
- Delivered the shared run-data platform for the laser welder and the robot cells (laser, physical bays, simulator replays), from robot controller to queryable evidence: a passive adapter from the controller's binary lane to typed robot-state rows, content-addressed capture, a custody chain with explicit failure cases, and a verified R2 backup; first simulator recordings became queryable by the team
- Defined typed weld-book, material, joint, process-window, trajectory, and evidence models, and bound each run to source revision, binaries, robot model, calibration, and collision assets so a result can be re-derived rather than trusted
- Wrote the team's verification ladder, from hooks and lint through simulator, hardware, and weld-sample proofs to runtime monitors, and tied merges and releases to it; landed a RosieOS control-API identity change that passed the native suite with no regressions and fixed three existing failures
- Built the team's agent software factory on Pi Durable, with verification-aware agent design: Codex and Claude agents under one shared responsibilities file, cross-agent review, a written verdict on every artifact, and simulated or offline evidence never reported as physical; a daily secret-scanned context pack; and AMR Investigator, a shared debugging-case service on Cloudflare Durable Objects with Google Workspace sign-in, hash-verified evidence, and replayable agent transcripts
- Weld motion research with agents: treated torch orientation and robot/positioner coordination as optimization variables under independent kinematic, collision, calibration, and process checks; directed an agent-run autoresearch sequence of 16 bounded experiments (DP-teacher proposer, conformal triage), each closed with a written verdict; a read-only experiment browser for retained runs; caught and corrected a verifier that judged the wrong motion representation
- Designed the staged path from simulation to supervised process-off trials, including the data contracts for measured motion, operator corrections, and sensor residuals that later learning experiments use
- Built Steam Deck operator controls and runtime integration, resolving packet, identity, and configured-axis mismatches on the way to operator-confirmed jogging on the assembled robot. Full trajectory execution and welding remain separate validation work

Software Engineer, Drone Institute, Louisiana, then remote *May–Dec 2025*

Through Mabie Industries, LLC; started with an on-site work trial. Drone thermal imagery turned into roofing leads and reports.

- Sole engineer: built the company's software from scratch, six production services (lead marketplace, partner upload portal, drone orders, operations dashboard, thermal-imagery lead generation, pilot dashboard) and the CI/CD, infrastructure, and tests behind them
- Serverless AWS (Lambda, AppRunner, DynamoDB, S3, CloudFront) with per-service dev and production deploys in GitHub Actions, running at about $30/month
- Entropy-tiered architecture: immutable IDs, storage paths, and state machines; versioned API and webhook contracts; fast-changing UI and algorithms on top
- Thermal-imagery CV and GIS pipeline for roof-damage detection, with webhook-driven order flow and automated lead generation
- Scope began as architecture consulting and grew into owning the full lifecycle: requirements and workflow discovery, architecture, implementation, deployment, production debugging, and analytics

Senior Member of Technical Staff (AI/ML Software Research), RAM Laboratories, San Diego, CA *Apr 2022–Mar 2025*
Full time. Member of Technical Staff (Apr 2022–Apr 2024), then Senior Member of Technical Staff and Principal Investigator (Apr 2024–Mar 2025); public titles AI/ML Software Research Engineer and AI Research Engineer. Defense SBIR research firm; also worked as a C/C++ software engineer as programs needed.

- **T-UEBA, Principal Investigator** ($250k Army SBIR, tactical user and entity behavior analytics that produce enforcement rules for zero-trust policy decision and enforcement points): wrote the winning proposal, led one full-time engineer, and owned the graph schema and ontology for user, resource, and action relations, the synthetic-data generator for operational phase shifts, the data pipeline, the model, and the evaluation
- Model: heterogeneous temporal GNN with calibrated graph attention, Hopfield-style conditioning, conformal thresholds, and sparse-autoencoder inspection, trained on 4×T4 GPUs with FSDP and a custom Flash Attention implementation; integrated with Elastic Stack. 95% accuracy, 0.887 F1, <3% false positives, 15.2 ms/graph, 15 MB model (400× smaller and 7.9× faster than baseline). In evaluation the system generated candidate PDP/PEP enforcement rules; the design was positioned for federated and continual learning
- **DL-Patcher** (MDA SBIR, automated C/C++ vulnerability repair): joined in Phase II and moved the models from seq2seq to RoBERTa, where repair started to work; trained on synthetic bug insertions and mined natural patches, filtered on function-level change statistics and similarity, with CppCheck feedback, patch verification, and a VS Code human-in-the-loop workflow for repairing imported codebases; carried through extended Phase II into RAM's decompilation models. Named co-inventor on the training method; patent pending (U.S. application 18/375,839)
- **VULCAN**, RAM's DARPA AI Cyber Challenge entry, directed by John Geddes: core contributor on the code-model harness across RoBERTa, GraphCodeBERT, CodeT5++, and LLaMA QLoRA, with static analysis, decompilation, fuzzing, and runtime verification as accept/reject signal; developed a vulnerability ontology; mentored the research intern who built the dataset pipeline and QLoRA fine-tuning
- **COG-SAFE** (DARPA FACT): led a fast-turnaround joint concept with Georgia Tech cognitive psychology labs and GTRI's HPC and LLM teams for accountable transactions among humans, agents, and tools; represented RAM in Google foundation-model meetings
- **Distributed edge inference** (Army): model-agnostic inference over heterogeneous edge devices with Fused Tile Partitioning, custom PyTorch backend hooks into a C++ runtime, work stealing, and Named Data Networking model routing
- **SABRE**: core engineer on a C++ Named Data Networking runtime and simulation suite for tactical networks, improving its performance and scalability; built pySABRE, a containerized Python testbed of PBFT, HotStuff, and Streamlet consensus, sharding, and reputation schemes over EMANE-emulated topologies, with visualizations that drove design decisions
- Across programs, owned the data and evaluation side: ingestion and cleaning, train/eval splits, active learning on uncertain examples, curriculum training, and verifier feedback, using interpretable models to predict what a dataset would teach before paying to train on it
- Wrote 15+ SBIR technical proposals (LEAR, HopModKG, Warfighter AI, VAAST, HAYSTAC, DEMMV multi-band EO/IR fusion, distributed edge inference, tactical-network simulation) and briefed customers and collaborators

AI Software Engineer, Mabie Industries, LLC, Carpinteria, CA *Apr 2025–Present*
S-corp for startup work; the AMR and Drone Institute contracts above run through it.

- **Siethar Group** (cognitive security), **Hammies** (AI operations and analytics), and **Truffle Computer Company** (DeepShard Inc., Apr 2025: decentralized AI systems, including content-centric networking, memory architecture, distributed-inference tooling, and a Prime Intellect vs. Gensyn architecture comparison)
- Internal tools for the practice's own engineering and research, including an agent research runtime with MCP orchestration, typed tool contracts, verifier scoring, and DSPy/GEPA optimization against recorded scores
- Production-Ready Agent Engineering (MCP to RL) cohort on Maven with Will Brown and Kyle Corbitt (2025); attended NeurIPS 2025

Construction Geometry ML (work trial), Augrade, Remote *2026*

- Research on Augrade's DXF-to-CAD conversion problem: vector-native tokenization, provenance-preserving merges, and hard validators outside the learned stack; public stdlib-Python workbench recovered 2,237 wall, column, and curtain-wall polygons from about 67,000 primitives across 111 layers (github.com/mlmabie/DXF_Primitive_to_Polygon)

Machine Learning Instructor & Curriculum Developer, Inspirit AI, Palo Alto, CA (remote) *May 2021–Apr 2022*
Also Deep Dives Instructor (Jul 2021–Apr 2022) and Curriculum Development Manager (Jul–Aug 2021).

- Taught and built Jupyter curriculum for RL and deep Q-learning, transformers, BERT, LSTMs, GANs, model deployment, detection, segmentation, and tracking, for beginner through advanced students
- Led Deep Dives workshops, spotlight talks, and capstone mentoring in self-driving, sentiment analysis, music, and medical imaging; presented a workshop at a self-driving conference
- Piloted a middle-school AI curriculum and rescued an experimental remote-in-person class at Pilgrim School; coached the Muirlands FLL robotics team and built its curriculum from scratch

Neural Data Science Special Project, UC San Diego, Bradley Voytek course, San Diego, CA *2021*

- Proposed and ran a human cortical organoid study relating RNA-seq gene expression to multi-electrode LFP features (firing rate, Fano factor, interspike interval, oscillation share); results forwarded to the Muotri lab that recorded the data

Software Engineer Intern, Endura Technologies, San Diego, CA *Oct 2019–Sep 2020*

- Built a Java instrumentation-control platform for SoC chip test that carried across chips and development stages
- Generated test code from register spreadsheets in Python with Verilog and EE collaborators, turning weekend-long test runs and manual edits into automated routines
- Automated register-map translation and register flagging during SoC tests

Deep Learning Research Intern, Endura Technologies, San Diego, CA *Jul–Dec 2019*

- Quantized windowed-audio CNNs for a custom tiny-ML accelerator ASIC, with the data mining, cleaning, and signal transforms behind them
- Re-represented audio training snippets into CNN-friendly forms for an application whose deployed algorithm was transform-based

Computer Vision R&D Intern, RoadReader, La Jolla, CA *Jul–Aug 2019*

- Sparsely supervised sensor fusion and object detection for pothole detection, using city vehicles as a distributed sensing platform

Design Researcher, UCSD Design Lab, Automation Playground, San Diego, CA *Oct 2018–Jun 2019*

· Hyundai-sponsored robotaxi and micro-mobility design research and Ford-sponsored mobility research, grounded in distributed cognition

Polymer Design & Mechanical Engineer, Applied Medical, Lake Forest, CA *Jun 2015–Sep 2018*

Hired full time at 18 as an engineering technician working on automation, and grew into the design role while studying physics. Medical-device manufacturing under formal documentation and qualification. Mentored by Ron Surya.

· Designed, built, and qualified dozens of end-of-arm tools, fixtures, and other tooling for polymer injection molding, and worked on its automation; built from stock parts and custom-machined grippers and linkages, with the molds that needed creative retrieval and sensing. The tools cut mold damage, variance, and manual part and sprue separation, and they still run in production daily

· Solved a metal-injection insert-molding problem losing about $100k/month to pin misalignment on a new suturing device: traced it to a magnetic pen polarizing pins, then built a 3D-printed orientation grid with fishing-line sorting and machined stainless suction-pen tips. In production it ended the variance and sped up shop orders

· Retrofitted double spring-loaded alignment pins onto a heavy tool that kept misaligning with its mold, ending ejection-pin damage and missed part retrieval

· Took fixtures, pneumatic manipulators, and robotic tooling from concept through CAD, prototype, test, and qualification with ANSI Y14.5 drawings and BOMs; assembled, wired, and programmed machines and supervised builds of automated and electro-mechanical equipment, with a free hand from the VP of Manufacturing to find and fix problems on the floor

Polymer Process Development Intern, Applied Medical, Rancho Santa Margarita, CA *Jun 2013–May 2015*

· Started at 16 in polymer process development: concept-to-assembly work on robotic manipulators used in production, and process improvement and maintenance of robotic tooling around injection molding

Design Co-Lead & Mentor, FIRST Robotics Teams 1425 & 3476, Orange County, CA *2007–2013*

· Six years across FLL, FTC, and FRC; 2013 design co-lead across intake, drive, and superstructure (500+ parts); introduced CAD discipline and rapid prototyping. FRC Newton Division World Champion. Led directly to Applied Medical at 16

Patents

Automated bug fixing using deep learning — patent pending, U.S. application 18/375,839; J. Geddes, M. Mabie, R. McGraw (RAM Laboratories). Pretraining and fine-tuning for automated C/C++ vulnerability repair with training feedback, natural-patch filtering, static-checker feedback, and patch verification (DL-Patcher).

Education & Training

B.S. Cognitive Science: Machine Learning & Neural Computation, UC San Diego *2021*

Reinforcement Learning, Advanced ML, Neural Signal Processing, Neural Data Science, Convex Optimization, Probability & Statistics, Data Structures & Algorithms, Systems Programming, HPC.

Physics coursework, Irvine Valley College *2015–2017*

While working full time at Applied Medical; studied music in parallel.

Awards & Recognition

Robotics: FRC Newton Division World Champion; Indiana Robotics Invitational Champion; San Diego Regional Champion; Industrial Design, Innovation in Control, and Excellence in Engineering awards. **Other**: UCSD Designathon winner; OMTA Gold Cup pianist.

Technical Surface

Software & Infrastructure
Python, TypeScript, SQL, C/C++
Java, MATLAB, lab instrumentation
AWS, Cloudflare Workers, Elastic Stack
Docker, Linux, Tailscale, GitHub Actions
FastAPI, Pydantic, React, DuckDB
Content-addressed data, event systems

ML & Agents
PyTorch, PyG, Hugging Face
GNNs, transformers, Hopfield, SAEs
Conformal prediction, active learning
RL: PPO, DPO, GRPO, DQN, MCTS
FSDP, Flash Attention, QLoRA
MCP, Claude Code, Codex, DSPy, evals

Physical Systems
Robotic tooling, EOAT, fixtures
Injection molding, MIM, insert molding
SolidWorks CAD, ANSI Y14.5, BOMs
Qualification and process control
Robot motion planning, weld data
Signal processing, CV, EO/IR

Interests

Epistemology and natural philosophy, physics, reinforcement learning, Hopfield networks and energy-based conditioning, active inference and cybernetics, representation learning, cognitive science and cognitive security, ontologies and knowledge graphs, applied category theory, grammar learning, neural data science; music composition and piano performance. Essays on narrative architecture, analogy in science, and alignment at malachimabie.com/blog.

Endorsements

"Brings a novel and timely perspective to all projects." — Dr. Bob McGraw, CTO and Vice President, RAM Laboratories.
"Uncanny ability to bring abstract ideas to reality." — Brett Lewis, Senior Engineering Manager, Applied Medical.
"Mind of an inventor mixed with an artist." — Jonathan Mahan, Applied Medical.
"Students go farther because of Malachi's teaching." — Kayla Holman, Inspirit AI.