

Andrew Peterson

SOFTWARE DEVELOPER IN PERRIS, CA

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Education

University of California, San Diego

B.S. COMPUTER SCIENCE

La Jolla, CA

December 2024

Experience

Qualcomm Institute (CALIT2)

RESEARCH INTERN

San Diego, CA

July 2022 – December 2024

- Built a frame-level encryption pipeline for live video that added sub-millisecond latency overhead, enabling real-time AES-128-GCM encryption without perceptible delay to users (FFmpeg, WebRTC Insertable Streams)
- Designed a signaling server (Python/Flask + Socket.IO) with cryptographic room assignment and session-level metrics, providing operational visibility into connection health and usage patterns without requiring log access
- Built a simulated noisy communication channel (Poisson photon source, fiber attenuation, detector efficiency modeling) to validate protocol correctness under degraded real-world conditions — used to verify the system detects eavesdropping via error rate anomalies
- Formalized a visual pattern-matching problem (nonogram puzzles) as boolean satisfiability and built parallel solver implementations (classical brute-force, quantum search) to systematically compare their performance characteristics
- Designed benchmarking infrastructure with fine-grained execution instrumentation (clause evaluations, early terminations, configurations/second) to produce quantified scaling analysis showing exactly where each approach becomes computationally infeasible
- Presented algorithmic research to IBM's VP of Quantum during campus visit
- Administered lab servers: optimized CUDA workloads for compute-intensive research tasks, managed user access, and hardened systems to university compliance standards
- Researched quantum graduate programs worldwide and co-authored a formal proposal for a QISE master's program, presented to the UC Senate for petition

RIT Esports

WEB DEVELOPER

Remote

August 2020 – May 2022

- Built and deployed a MERN-stack platform via Docker serving 2,400 monthly active visitors across 6 varsity esports teams — team pages, schedules, and user-managed profiles giving team managers self-service control over their web presence
- Maintained 99.9% uptime on DigitalOcean Droplets with Nginx reverse proxies and Docker Compose, ensuring high-traffic services stayed available during competition seasons

Mathnasium

TUTOR / IT LEAD

Southern California

March 2020 – September 2021

- Sole IT resource for transitioning the center to remote operations during COVID-19, keeping ~25 client families and ~15 active students connected through the disruption
- Created onboarding documentation and troubleshooting guides that enabled staff to independently deliver remote tutoring sessions without ongoing IT support

Projects

Python, Flask, Socket.IO, WebRTC, FFmpeg, Docker

Collaborative

QUANTUM VIDEO CHAT

- Browser-native P2P video chat where media never touches the server — signaling server handles only SDP/ICE relay, keeping the system scalable and private by design
- Frame-level AES-128-GCM encryption via Web Worker (RTCRtpScriptTransform) with latency instrumentation to verify encryption overhead stayed within real-time video constraints; FFmpeg pipeline for media processing
- Implemented the full BB84 key distribution protocol from academic specification in production JavaScript — multi-stage pipeline including error detection (QBER estimation), error correction (binary Cascade), and privacy amplification (Toeplitz hashing); demonstrates ability to translate research-level specifications into working software
- Simulated quantum optical channel parameterized by real hardware values (0.2 dB/km fiber loss, Poisson photon statistics, APD detector efficiency) to validate the protocol handles realistic degraded conditions — including automatic detection of man-in-the-middle attacks via error rate threshold violations
- Metrics collector with rolling windows and edge-triggered pub/sub events (QBER threshold breach, key budget low-water mark) to surface system health proactively rather than requiring manual monitoring
- Python + JS test suites, CI with lint/test/Docker health check/GitHub Pages deploy, PlantUML diagram auto-rendering

Python, PyTorch, Flask, Docker

Solo

ML CLASSIFIER PLATFORM

- Comparative analysis platform — not just a classifier but a system for training, evaluating, and comparing 10 model architectures across 2 datasets to understand which approaches work for which problem types
- Integrated 10 model architectures including non-standard components (Quadratic, Polynomial, quantum-hybrid layers built by a collaborator) alongside standard architectures (CNN, Linear, SVM) as known-good baselines — the platform's value is systematic comparison across fundamentally different approaches, not any single model
- Built evaluation infrastructure supporting ensemble analysis (majority vote with logit-sum tie-breaking) and per-layer ablation studies to identify which components actually contribute to performance vs. add complexity without benefit
- New datasets require only a new subpackage implementing the DatasetPlugin interface — the platform auto-discovers models, routing, and UI configuration without touching existing code (Open/Closed Principle in practice)
- Users can draw a digit (MNIST) or fill a form (Iris) and get real-time classification probabilities from any trained model — making the system tangible for demos and validation
- Thread-safe model registry with daemon training threads and SSE-streamed progress, enabling concurrent training sessions and live loss curve updates without blocking the API
- 425+ tests (pytest); Docker built with CPU-only PyTorch so the full test suite runs on any machine without GPU dependencies

Python, Qiskit, Flask, Socket.IO, Docker

Solo

QUANTUM NONOGRAM SOLVER

- Formalized nonogram (Picross) puzzles as boolean satisfiability problems — converting a visual pattern-matching constraint into a form solvable by both classical and quantum search algorithms
- Built classical brute-force and Grover's quantum search solvers with identical interfaces (Solver ABC), then instrumented both to capture fine-grained execution metrics: candidates evaluated, clause/subclause/literal evaluations, early termination rates, solve times. The result: quantified scaling analysis showing 2x2 grids feasible on real quantum hardware (~142 circuit depth), 3x3 noise-dominated (~2900 depth), 4x4+ beyond current NISQ capabilities
- IBM Quantum cloud execution with optimization level 3 transpilation, dynamical decoupling (XpXm) to suppress idle-qubit decoherence, and Pauli twirling to convert coherent errors to stochastic noise — engineering choices to extract maximum fidelity from noisy hardware
- Flask + Socket.IO server running solvers in background threads with WebSocket progress events, thread-safe shared state, and automatic API token sanitization in error messages to prevent accidental credential exposure
- O(1) constraint enumeration via precomputed clue-to-pattern table for line lengths 1–10, eliminating redundant computation during solving

Astro, TypeScript, Docker Compose, GitHub Actions

Solo

PORTFOLIO SITE (ANDYPETERSON.DEV)

- Static Astro site serving four independent full-stack sub-applications as integrated packages — each with its own backend, test suite, and Docker service, all orchestrated under one Docker Compose and one CI pipeline
- Path-filtered GitHub Actions pipeline (9 jobs) where only changed sub-projects trigger their test/build/lint jobs — a monorepo-style optimization to prevent 45-minute CI runs on a one-line CSS change
- Full testing pyramid — Vitest unit/component, Playwright E2E, Python contract tests verifying API shape consistency across all four independently-developed sub-project backends, Docker smoke tests, Lighthouse CI for performance/accessibility regression
- Wrote a Vite plugin for dev-time sub-project asset serving with path rewriting (because four sub-projects need different asset roots), and a custom ESLint plugin to enforce design system component usage automatically rather than relying on code review
- CSP headers, HSTS, a name-leakage scanner script to prevent PII from being committed to source

Express, SQLite, Alpine.js, AJV, XeLaTeX, Docker

Solo

CV EDITOR (LATEX RESUME EDITOR)

- Single normalized data store serving three document variants (CV, resume, cover letter) with variant-specific filtering at render time — one source of truth, multiple views, rather than maintaining three separate documents
- Built a brace-aware LaTeX parser handling nested and escaped delimiters to enable bidirectional workflow — import existing .tex files into the editor, edit in the browser, compile back to LaTeX. Not string splitting; formal delimiter-aware extraction
- Server-side XeLaTeX compilation with font management (fc-cache, Source Sans 3, Roboto), containerized in Docker with texlive-xetex so the build environment is reproducible and isolated
- SQLite with WAL mode for concurrent read performance during compilation, prepared statements for injection prevention, a migration system for schema evolution, and atomic transactions wrapping multi-step operations (reordering, bulk import) so partial failures can't corrupt state
- Snapshot-based profile switching — atomic save of current state + import of new profile in a single transaction, ensuring no data loss during switches
- 525+ tests (Vitest) spanning unit, integration, and DOM layers (happy-dom)

Leadership

San Diego CTF

CO-FOUNDER

December 2020 – May 2022

- Co-founded San Diego's largest annual cybersecurity competition — hundreds of competitors across 20+ countries in its first year, running for two annual iterations
- Chose Terraform for reproducible, version-controlled infrastructure that could be torn down and rebuilt cleanly for each annual event; PostgreSQL for reliable relational state management (teams, submissions, scoring)
- Built a Discord bot submission interface (Discord.JS) so competitors could submit from the platform they were already using — zero onboarding friction; owned all API integration and bot code across both years

ACM Cyber at UCSD

PRESIDENT / COMPETITION COMMITTEE

June 2020 – May 2023

- As President (Jul 2021 – Jul 2022), maintained org engagement and event cadence through full COVID lockdown when most student orgs lost momentum — weekly syncs, quarterly individual check-ins with leads to redistribute workload before deadlines slipped
- Three-year competition committee member operating in time-pressured competitive problem-solving across reverse engineering, cryptography, web exploitation, and OSINT
- Replaced scattered documentation with a centralized Notion workspace for the full 500-member org, with role-based least-privilege access controls preventing members from accessing committee-level documents unless explicitly granted

Quantum Computing at UC, San Diego (QCSD)

CO-FOUNDER / PRESIDENT

January 2021 – December 2024

- Co-founded to fill a gap in undergraduate quantum computing education at UCSD; served as Internal Logistics Director (2021–2022) then President (Jun 2023 – Sep 2024)
- As one of the last founding members nearing graduation, restructured organizational processes — documented workflows, formalized role handoffs — so the org could survive complete leadership turnover. It did: now nationally chartered as QCSA

Skills

Languages	Python, Java, JavaScript, TypeScript, C, C++, SQL, HTML, CSS, LaTeX
AI & Machine Learning	PyTorch, NumPy, scikit-learn, Qiskit Neural network architecture comparison, model evaluation pipelines, ensemble methods, ablation analysis, training infrastructure design
Algorithms & Analysis	Boolean SAT encoding, constraint satisfaction, search algorithms, benchmarking infrastructure, scaling analysis, execution instrumentation
Media & Real-Time Systems	FFmpeg, WebRTC, AES-128-GCM frame encryption, Insertable Streams (RTCRtpScriptTransform), Socket.IO, SSE streaming, noise/signal modeling
Frameworks	Flask, Express, React, Astro, Alpine.js, Matplotlib, Discord.JS
Infrastructure & DevOps	Docker / Docker Compose, Terraform, Nginx, AWS (EC2), Azure, DigitalOcean, GitHub Actions CI/CD, GitHub Pages
Databases	PostgreSQL, SQLite, MongoDB
Security	Wireshark, Burp Suite, Ghidra, CSP/HSTS hardening, least-privilege access control, prepared statements, input sanitization
Testing	pytest, Vitest, Playwright, contract testing, smoke testing, Lighthouse CI Test pyramid design, CI efficiency optimization
Tools & Platforms	Git, Node.js, Linux (Ubuntu, server admin, CUDA optimization, hardening), Notion, Obsidian, Google Workspace, Microsoft Office
Methodologies	Agile, Scrum, Kanban, TDD, Gitflow, feature branching, SOLID, design patterns (observer, factory, strategy, singleton), REST API design, plugin architecture, dependency injection, technical documentation, code review

Certifications

ITF+ (IT Fundamentals), CompTIA

Azure Data Fundamentals (DP-900), Microsoft