Karthik Thyagarajan

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EDUCATION

Purdue University *August 2024 - May 2027*

B.S. of Computer Science & Artificial Intelligence - 4.0 GPA West Lafayette, Indiana

Relevant Coursework: Data Structures and Algorithms, Computer Architecture, Programming in C, Linear Algebra

SKILLS

- **Languages & Frameworks:** Python, Java, C++, C, JavaScript/TypeScript, React, Next.js, Flask, FastAPI
- **Data Engineering & Databases:** PostgreSQL, NoSQL (Firebase), Vector Databases (Pinecone), ETL Pipelines, Data Modeling, Query Optimization
- **AI/ML & Data Science:** PyTorch, TensorFlow, LangChain, RAG Systems, NumPy, Pandas, Computer Vision, NLP
- **Cloud & DevOps:** AWS (S3, Lambda, EC2), GCP, Docker, CI/CD, Git, Linux, REST API
- **Advanced ML:** LLM (CoT/Reasoning, RLHF), Agents (LangGraph, MCP), GAN, Reinforcement Learning, Graph Neural Networks, Diffusion Models
- **Quantum Computing:** Qiskit, VQE, QAOA, Quantum ML

EXPERIENCE

- **Machine Learning Engineering Intern** *Jun 2025 - Present*

  Peraton Labs (Internship & Part-Time Co-op) Silver Spring, MD
  - Engineered a reinforcement learning agent for IoT malware detection, achieving 35% reduction in exploration latency and 25% increase in detection coverage over brute-force approaches through custom reward shaping and policy optimization.
  - Designed heterogeneous graph neural network architecture with autoencoders to model inter-device communication patterns, accelerating RL convergence by 40% and improving anomaly detection accuracy by 18%.
  - Implemented distributed training pipeline using PyTorch and AWS EC2, processing 500K+ IoT device events daily.

- **Computer Vision Software Engineer** *Feb 2025 - Aug 2025*

  Memories.ai (Part-Time) Remote
  - Architected and deployed production video memory framework processing 10K+ video streams for AR applications, implementing efficient data pipelines with 60% throughput improvement through frame sampling and caching optimizations.
  - Developed and published Python SDK (pymavi) on PyPI with 2K+ downloads, featuring comprehensive API wrappers, async processing, and developer documentation for video analysis workflows.
  - Built RESTful microservices with Flask and PostgreSQL for spatial data indexing, reducing query latency by 45%.

- **Undergraduate Robotics Researcher** *Mar 2025 - Jun 2025*

  IDEAS Lab, Purdue University (Part-Time) West Lafayette, IN
  - Developed real-time SLAM pipeline in C++ and Python integrating sensor fusion algorithms, improving 3D reconstruction accuracy by 25% and reducing mapping errors through Kalman filtering and loop closure detection.
  - Optimized navigation algorithms with multithreading and memory management techniques, decreasing computational overhead by 30% and enabling real-time processing on embedded systems.
  - Implemented novel view synthesis using neural radiance fields (NeRF), generating photorealistic scene reconstructions for robotic path planning.

- **Undergraduate Data Engineer** *Aug 2024 - Dec 2024*

  The Data Mine Corporate Partners, Purdue University (Part-Time) West Lafayette, IN
  - Built end-to-end weed detection data pipeline processing 200GB+ drone imagery, implementing ETL workflows with Python, TensorFlow, and PostgreSQL with indexed queries for 40% faster retrieval.
  - Engineered semantic segmentation models (U-Net, DeepLabv3) achieving 92% accuracy on 50K+ labeled images, reducing herbicide usage by 60% and operational costs by $150K annually.
  - Designed normalized database schema with spatial indexing for geolocation data, optimizing JOIN operations and supporting real-time analytics dashboard for field teams.

- **ML Science & Engineering Apprenticeship** *Jun 2023 - Aug 2023*

  Naval Research Laboratory (Full-Time) Washington, D.C.
  - Led 4-engineer team building deep learning models (UNet, Transformers, GANs) for underwater acoustic modeling, improving transmission loss prediction RMSE by 20% over physics-based simulations through ensemble techniques.
  - Architected secure RAG system with vector embeddings and access controls for classified document retrieval, implementing LangChain with custom document loaders and reducing query response time by 65%.
  - Developed data preprocessing pipelines handling 5TB+ acoustic datasets, implementing parallel processing with multiprocessing and Dask for 10x throughput improvement.

PROJECTS

- **Frontera (Founding Engineer)** *Ongoing*
  Tools: Next.js, TypeScript, FastAPI, Python, LangChain, Firebase, NoSQL, REST API https://frontera.app
  ○ Building full-stack platform as founding engineer for AI-powered project management, architecting microservices backend with FastAPI, Firebase Authentication, and NoSQL database serving 500+ beta users.
  ○ Engineered multi-agent LLM system using LangChain with custom tools for roadmap generation, task decomposition, and intelligent issue resolution, reducing project planning time by 70%.
  ○ Implemented real-time WebSocket connections and event-driven architecture for collaborative workspace features, handling 1K+ concurrent sessions with 99.9% uptime.

- **Caladrius (AI Medical Triage)** *Sep 2025*
  Tools: React Native, Python, LangGraph, GPT-4, AWS S3, Cryptography, REST API https://github.com/karthikcsq/Caladrius
  ○ Architected cross-platform mobile application with React Native integrating encrypted QR-based medical data transfer, implementing AES-256 encryption and zero-knowledge architecture for HIPAA-compliant data handling.
  ○ Built multi-agent diagnostic system with LangGraph processing patient symptoms through specialized agents (history analysis, symptom extraction, differential diagnosis), achieving 85% triage accuracy; awarded 2nd Place at HackGT 12.
  ○ Designed RESTful API backend with Python and AWS S3 for secure medical record storage, implementing rate limiting and OAuth 2.0 authentication.

- **Personal Portfolio & Blog Platform** *Ongoing*
  Tools: Next.js, TypeScript, React, Tailwind CSS, Pinecone, AWS S3, Python, Vercel https://github.com/karthikcsq/personalsite
  ○ Developed full-stack portfolio site with Next.js and TypeScript deployed on Vercel with AWS S3 CDN integration, achieving 95+ Lighthouse performance score and <1s load times globally.
  ○ Implemented RAG-powered semantic search using Pinecone vector database for technical blog content, processing 100+ markdown documents with GPT-4 embeddings for intelligent content discovery.
  ○ Built automated CI/CD pipeline with GitHub Actions for continuous deployment, image optimization, and content validation.

- **Verbatim (Video Processing Platform)** *Feb 2025*
  Tools: Next.js, Python, OpenAI API, Google Cloud API, Vercel, REST API https://github.com/karthikcsq/verbatim
  ○ Created production video processing platform with Next.js integrating 5+ AI services (Whisper, GPT-4o, Eleven Labs, Twelve Labs) for automated transcription, translation, voice cloning, and lip-sync generation.
  ○ Architected async processing pipeline handling video files up to 2GB, implementing job queues and webhook notifications for 85% reduction in user wait time.
  ○ Deployed serverless architecture on Vercel with API rate limiting and cost optimization, processing 500+ videos with $0.15 average cost per video.

- **In The Loop (LLM Efficiency Platform)** *Ongoing*
  Tools: Next.js, React, TypeScript, LangGraph, Python, FastAPI, Vercel https://in-the-loop-ai.vercel.app/
  ○ Built streaming AI agent platform reducing LLM token usage by 40% through intent clarification and conversation optimization, using LangGraph for stateful multi-turn interactions.
  ○ Implemented WebSocket-based streaming with FastAPI backend supporting user interrupts and thread-level state management for 100+ concurrent sessions.
  ○ Designed conversation analytics dashboard tracking token efficiency metrics and user interaction patterns.

- **Storytime.ai (News Aggregation)** *Ongoing*
  Tools: Next.js, React, TypeScript, GPT-4o, Pinecone, Python, Tailwind CSS https://storytime-sepia.vercel.app/
  ○ Developed AI news aggregation platform using GPT-4o for story clustering and summarization, processing 1K+ articles daily with vector similarity search in Pinecone for duplicate detection.
  ○ Implemented content personalization engine with collaborative filtering, increasing user engagement by 55% through topic-based recommendations.
  ○ Built ETL pipeline scraping multiple news sources with Python, handling rate limiting and error recovery for 99.5% uptime.

- **Photonic Quantum Key Distribution** *Oct 2023 – May 2024*
  Tools: Python, NumPy, Oscilloscope, Optics Hardware https://arxiv.org/abs/2509.04389
  ○ Built polarization-based QKD prototype with laser systems, polarizers, and beamsplitters, achieving 95% photon detection rate and demonstrating secure key exchange over 5m fiber optic channel.
  ○ Automated signal processing pipeline with Python and NumPy for bit extraction, basis sifting, and quantum bit error rate (QBER) analysis, processing 10K+ measurement samples.
  ○ Published research findings on arXiv documenting experimental methodology and security analysis.

- **Quantum Racer (Educational Game)** *Aug 2022 – Dec 2022*
  Tools: Java, Android SDK, Gradle, XML https://github.com/karthikcsq/QuantumCarGame_Self
  ○ Designed Android game simulating quantum mechanics concepts (superposition, measurement, decoherence) with custom game physics engine and touch-based controls.
  ○ Implemented complete game architecture with MVC pattern, asset management, and state persistence using Android SDK and Java.
  ○ Packaged and distributed APK for educational outreach, reaching 100+ students in quantum computing workshops.