Patrick Gartland, PhD

https://giddyphysicist.com
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GitHub: https://github.com/giddyphysicist

Total Years of Experience: 13

Skills

Physics	Python	Optimization
Mathematics	MATLAB	Optics
Modeling & Simulation	HTML / CSS / JavaScript / React	Data Visualization
Systems Design	AWS boto3 / S3 / DynamoDB	Technical Leadership / Agile
Digital Engineering	Apache Kafka	Terraform / CICD
Data Analysis / Data Analytics	Flask / FastAPI	Requirements Analysis
Automation and Scripting	Common Lisp	System Architecture
Web3 / Tokenomics / Freelancing	Solidity / Ethereum / Smart Contracts	Nanotechnology
Retrieval Augmented Generation (RAG)	Knowledge Graphs	LLM Fine-tuning

Education:

- PhD in Condensed Matter Physics, 2015, Georgia Institute of Technology, Atlanta GA
- B.S. in Physics, 2010, Auburn University, Auburn AL

Work Experience:

Convex Labs / Aineko, Remote
Research Engineer, 03/2023-03/2024

I played many roles in a tech startup environment at Aineko, from writing trading algorithms to employing generative AI. Formally a research engineer, I contributed to an open-source python framework called Aineko, which is a scalable actor-based compute framework built on Ray and Apache Kafka. I contributed towards graph visualization efforts using Mermaid and a statistical arbitrage trading engine built on top of Aineko. I helped to support customers and diagnose deployment issues with AWS and Terraform.
I contributed to a project web dashboard by helping to design and implement a FastAPI server with interfaces to AWS services such as Secrets Manager, S3, DynamoDB, and AWS Lambda functions.
I also implemented Aineko nodes with interfaces to FastAPI and large language model (LLM) APIs, including running building and running a local fine-tuned model. I implemented Retrieval Augmented Generation (RAG) and Knowledge Graphs to enhance LLM prompts using specific, relevant code context to auto-generate Aineko pipeline code and construct AI agents. I helped build proof of concept products using Aineko, streamilt, and FastAPI.

Key technologies used: Technical Research, Apache Kafka, Python, Mermaid Plots, Algorithmic/Quantitative Trading, FastAPI, Retrieval Augmented Generation (RAG), Prompt Engineering, Vector Database, Similarity Search, Knowledge Graphs, Knowledge Graph enhanced RAG, LLM Fine-tuning, Streamlit, Boto3, DynamoDB, S3, Docker

Torch Technologies, Huntsville AL
Technical Lead, 04/2019-03/2023

I worked as the Technical Lead for the Specification Model Development Team for three years. During that time, my team and I built a full requirements-based, End to End Timing model of a complex, geographically distributed aerospace system – the first simulation of its kind. We coordinated among requirements, architecture, and modeling and simulation communities in a weekly Tiger Team meeting to reach concordance on the system design as defined by the requirements specification tree. We developed an organic, iterative process with the representatives from the systems engineering community to rapidly develop a system design using a visual mapping tool we developed to organize the flow of requirements and system activities.

Key technologies used: Agile Software Development, Technical Leadership, Python, Software Integration, Systems Engineering, Data Visualization, Automation and Scripting, Modeling and Simulation, Systems Design, Requirements Analysis, System Architecture, Digital Engineering, HTML, JavaScript, React, Flask, Electron, AFSIM

Torch Technologies, Huntsville AL
Systems Design Engineer 3, 01/2018-04/2019

Developed new framework and algorithm library for system modeling, particularly in the context of system requirements verification and parametric concept exploration, including physics-based kinematic modeling and mixed-fidelity model integration and geographical data visualization.

Key technologies used: Analysis, Mathematical Modeling, Automation Scripting, Python, MATLAB, Requirements, System Design, Physics, Mathematics, Geometry, Vector Analysis, Data Visualization

Torch Technologies, Huntsville AL
Senior Analyst, 01/2016 - 01/2018
I primarily performed analytical tasks, such as modeling and simulation data analysis, as well as physics-based modeling and algorithm development. High-fidelity simulation data analysis and instrumentation, along with automation scripting to set up and execute large batches of simulation runs in parallel. Built a modular Inertial Measurement Unit (IMU) model from scratch, both in python, and in the native STRIDE language of LISP for integrating it into the main STRIDE simulation. I also built a general sensor model for the STRIDE team, which can map pixelated photon-count data onto a sensor focal plane, given the temperature and power levels of an observed object and the spectral response of the sensor. Supported a separate team by writing a short white paper on how to use quaternions in certain coordinate transformation contexts.

Key technologies used: Analysis, Data Analysis, Script Automation, Python, MATLAB, LISP, IMU, Optics, Modeling, Simulation, Quaternions, Mathematics, Physics

Georgia Institute of Technology, Atlanta GA
Physics Graduate Research Assistant, 01/2013 - 12/2015

For my doctoral dissertation research, I studied Single-Electron-Transistors and electronic tunneling transport through ferromagnetic nanoparticle quantum dots. Experimental tasks included electron-beam-lithography device fabrication and dilution refrigerator operation. Data analysis and computer simulations were performed using python and MATLAB.

Key technologies used: Nanofabrication, Scanning Electron Microscopy, Data Analysis, Nanoelectronics, Microelectronics, Quantum Mechanics, Data Analysis, Mathematical Modeling, Image Processing, Python, MATLAB, Electrical Engineering, Physics-based Simulations

Georgia Institute of Technology, Atlanta GA
Physics Graduate Teaching Assistant, 08/2010 - 12/2012

- While taking Masters / PhD coursework in physics and engineering courses, I taught physics labs, recitations, and performed grading and substitute teaching duties for various undergraduate physics courses.
- My Minor coursework was in Optics, and I spent a few months working in an ultrafast optics lab.

Key technologies used: Physics, Optics, Public Speaking, Teaching, Engineering

Web3 and Entrepreneurial Experience:

(2019) **Won First Prize for Firepit**: an entrepreneurial competition among dozens of teams.
(2020) **Co-founded Problem Daily**: an e-learning website with auto-randomly generated “physics mad-libs” physics word problems and solutions for training students and teachers. Used python, front-end web coding in plain JavaScript/HTML/CSS, and used serverless Google Cloud functions as backend to query problem and solutions data.
(2021) **Participated in 2021 Chainlink Hackathon**: designed a twitter bot for monitoring price advantages for a particular DEX relative to the Chainlink price feed. Displayed in analysis dashboard using Streamlit.

(2021**) Winner of Web3 Gitcoin bounty**: Designed Parallel Swap optimization algorithm using Lagrange multipliers for the Ref Finance team on the Near Protocol.
(2021-2022**) Freelance Work for Ref Finance**: Worked to implement and integrate the parallel-swap algorithm with the Ref Finance team. Also, designed a more generic smart-routing algorithm and integrated the code with the Ref front-end (using React and Typescript), including an interface to the Near Protocol smart contract methods. Built automated front-end testing framework in Cypress to exercise UI and test algorithm. Designed python scripts to auto-deploy token smart contracts and well as liquidity pools for specified network topology and testing routing algorithm of swaps.
(2022) **Built Arbitrage Bot**: Designed and executed an arbitrage bot on the Near Protocol
(2022) **Participated in 2022 Chainlink Hackathon**: Prototyped a concept for an adaptive market maker decentralized exchange, where the trading curves will adaptively change shape based on past price data gathered from Chainlink oracles and monitored by automated Chainlink keepers.

Key Technologies/Skills Used: Python, Solidity, JavaScript, Typescript, Technical Writing, Technical Research, Optimization, Mathematical Modeling, Near Protocol, System Modeling, Automation, Technical Leadership and coordination among geographically dispersed team. Automated testing, unit tests

Awards/Publications:

- Dean's Medalist in Physics from Auburn University, 2010
- **PUBLICATIONS**
  - "Voltage-Driven Spin-Transfer Torque in a Magnetic Particle", *Applied Physics Letters*, 2015.
  - "Voltage Control of Magnetic Hysteresis in a Nickel Nanoparticle", *Physical Review B*, 2015.
  - "Giant electron-spin g factors in a ferromagnetic nanoparticle", *Physical Review B*, 2013.