SAM GHALAYINI

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EDUCATION

University of Copenhagen (KU), Aalborg University (AAU) (2026–present)
Online and Reinforcement Learning, AI and Advanced Machine Learning

University of Colorado Boulder (2023–2025)
Master of Science in Computer Science, GPA: 4.0/4.0
Graduate Certificate in Artificial Intelligence

University of Colorado Boulder (2017–2021)
Bachelor's in Computer Science

CURRENT RESEARCH

Multimodal Learning & Missing Modalities

Aalborg University, under Yan Kyaw Tun

- Currently researching multimodal learning with missing modalities

RESEARCH PROJECTS

Predicting Soil Moisture Dynamics with Physics-Informed Neural Networks

Graduate Research Project, University of Colorado Boulder (2024–2025)

- Developed a Physics-Informed Neural Network (PINN) model encoding the Richards Equation as a physics constraint to predict continuous 1D soil moisture profiles for precision irrigation management
- Implemented transfer learning architecture that reduced training time by over 50% while enabling 24–72 hour predictions where traditional numerical solvers failed to converge
- Achieved PDE residuals of 1×10^{-7} (target: 1×10^{-2}), demonstrating faithful adherence to soil hydrodynamics beyond data-driven fitting
- Validated against real-world sensor data from 57 stations across 8 global soil moisture networks, achieving RMSE of $0.018\,\mathrm{m}^3/\mathrm{m}^3$ for field observations and $0.0056\,\mathrm{m}^3/\mathrm{m}^3$ against implicit Euler benchmarks
- Delivered continuous soil moisture profiles at any depth and time point, surpassing sparse sensor measurements and enabling crop-specific irrigation decisions

Adversarial Backdoor Injection in Large Language Models

Independent Research (2024–2025)

- Investigated backdoor persistence in fine-tuned language models, evaluating data poisoning attacks on open-source LLMs
- Implemented a modular backdoor injection pipeline on Llama 3.2-3B using LoRA fine-tuning with 4-bit quantisation
- Developed a comprehensive evaluation framework measuring 5 key metrics (attack success rate, clean accuracy, exact match, trigger robustness, poison efficiency) across varying experimental configurations
- Optimised training infrastructure for cloud GPU deployment (RunPod), implementing gradient checkpointing and parallel data loading, reducing training time by 2–3$\times$

Urban Management Model for Ride-Sharing Optimisation

Undergraduate Course Project, University of Colorado Boulder (2024)

- Applied a multi-agent, ant-inspired route-finding simulation to optimise routing for ride-sharing services in complex urban environments
- Designed a high-performance, multithreaded Python simulation modelling virtual agents depositing and evaporating pheromones to dynamically discover optimal routes
- Analysed diverse urban layouts (irregular grids, historic downtowns, suburban sprawl) to quantify how street network topology impacts route efficiency

TEACHING EXPERIENCE

Teaching Assistant, Fort Lewis College, Durango, CO (2018–2019)

- Delivered practical sessions for engineering drawing and programming courses, supporting students in SolidWorks, AutoCAD, and MATLAB
- Responsible for assisting with lab instruction, student mentoring, and assessment support

VOLUNTEERING

DANSIC – AI-consultant (January 2026–present)

- Contributing to initiatives at the intersection of AI ethics and sustainable development.

Coding Pirates – Tutor (November 2025–present)

- Kids tutoring in microcontrollers and coding

ADDITIONAL RELEVANT EXPERIENCE

Computer Engineering Intern, EchoRidge, Sterling, VA (2018)

- Designed and assembled a customised computing system for real-world radio wave simulations, enabling controlled testing of radio equipment and reducing field testing requirements

RELEVANT RESEARCH / TECHNICAL SKILLS

- **Physics-informed ML:** PINNs with PDE constraints, transfer learning, validation against field observations and numerical benchmarks
- **Formal verification:** Lean 4, verification of autonomous systems, proof construction
- **Deep learning & NLP:** PyTorch, LoRA fine-tuning, quantisation, mechanistic interpretability of transformer architectures
- **Scientific computing:** Julia (NeuralPDE.jl, DifferentialEquations.jl), NumPy, SciPy
- **Tools:** Git, Docker, Kubernetes, Linux, cloud GPU infrastructure (RunPod)