

# Ahmed Elmersawy

✉ aelmersa@purdue.edu ☎ +17654099574 📍 Lafayette, IN 🔗 <https://github.com/ahmedElmersawy>

## EDUCATION

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### B.S.c Electrical and Computer Engineering

05/2023 – 06/2026

Purdue University

West Lafayette

- GPA: 3.77
- Honors: Presidential Scholarship
- Graduate-Level Coursework: Artificial Intelligence, Machine Learning, Data Mining, Advanced Computer Networks, Applied Cryptography, Embedded Systems.
- Upper Level Undergraduate Coursework: Computer Vision, Natural Language Processing, Computer Security, Signals & Systems, Operations Research & Optimization

## SKILLS

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**Languages:** Python, C/C++, SQL

**ML/AI:** Reinforcement Learning, Direct Preference Optimization (DPO), LLM Fine-Tuning (QLoRA/LoRA), Generative Models, Agentic Mechanisms, NLP, Time-Series Forecasting, TensorFlow, NumPy, Hugging Face Transformers

**Systems & Optimization:** GPU Computing, Multi-Objective Optimization, Performance Profiling

**Development Tools:** Git/GitHub, HPC, Slurm, Hugging Face Transformers, perf stat, tracemalloc

**Mathematics:** Linear Algebra, Probability & Statistics, Convex & Non-Convex Optimization, Information Theory, Fisher Information Analysis

## PROFESSIONAL EXPERIENCE

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### Undergraduate Research Assistant

08/2025 – Present

Purdue University - Duality Lab

West Lafayette, IN

Advisor: Prof. James Davis

- Designed a DPO-based multi-objective LLM optimization framework with an adaptive Dirichlet sampling mechanism that dynamically reweights training objectives, achieving 46.7% latency and 36% energy reduction on held-out benchmarks.
- Fine-tuned a 7B-parameter code model (QLoRA) on a large-scale preference dataset across 5 system-level metrics using HPC cluster infrastructure.
- Research Poster Presentation accepted at Design Automation Conference (DAC) with DAC Young Fellowship.

### Undergraduate Teaching Assistant - (ECE 57000 AI)&(ECE 2k8 lab)

01/2026

Purdue University

West Lafayette, IN

- Held office hours supporting machine learning and AI concepts
- Evaluated final project presentations, assessing methodology and technical rigor
- Mentored students in circuit design, measurement, and debugging

### Student Research Trainee

06/2024 – 07/2024

OpenAirInterface Software Alliance by EUROCOM

Pretoria, GA

- Conducted real-time simulation and data-driven analysis of 5G systems
- Explored ML-based resource optimization strategies for dynamic spectrum allocation.

## RESEARCH PROJECTS & PRESENTATION

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### Gradient Gate Collapse: A Quantitative Theory of Phase Transitions in Neural Inverse Reconstruction

#### Landscapes [↗](#)

- Proved that sigmoid stiffness  $\alpha$  is a continuous control parameter inducing a phase transition at  $\alpha^* \approx 11.7$  from recoverable to non-recoverable optimization regimes in fixed convolutional networks.
- Derived the gradient gate  $\Gamma(x) = |h'\alpha(Ax)|$  and proved  $E[F\alpha(x)] \leq 1 - 2\epsilon/\alpha$ , establishing a compounding collapse rate of  $1/(1+c\alpha)$  per layer ( $R^2 = 0.9888$ ).
- Demonstrated via oracle ablation that Adam's advantage in high- $\alpha$  regimes stems from gradient momentum accumulation, not coordinate-wise rescaling (IoU: Adam 0.767 vs. Oracle 0.580 at  $\alpha=10$ ).
- Built a logistic regression predictive model (AUC = 0.993) predicting reconstruction success from kernel type and  $\alpha$  alone, with privacy implications for gradient leakage attacks.
- Poster presentation at MMLS 2026.

#### Machine Learning Based Side Channel Leakage Detection [↗](#)

- Designed and implemented the full ML pipeline: trained a 1D CNN directly on raw synthetic power traces to predict Hamming weight classes, avoiding manual feature engineering.
- Achieved strong top-k accuracy demonstrating meaningful leakage recovery under noise; confusion analysis confirmed error concentration between adjacent Hamming weight classes, consistent with overlapping leakage distributions.
- Evaluated SNR behavior through trace averaging, connecting leakage visibility to classical side-channel attack techniques.

#### Feedback Atlas AI-Powered Student Feedback Analysis Platform [↗](#)

- Built an end-to-end full-stack platform analyzing 1,000,000+ student and professor feedback entries to surface minority voices.
- Trained distilroberta-base on 150k+ rows across 24 NLP classes (F1-macro 0.395 on severely imbalanced data); deployed best checkpoint via HuggingFace Transformers on Purdue HPC.
- Engineered dual-mode pipeline (student→student CATME peer reviews; student→professor RateMyProfessor) with HDBSCAN outlier detection and priority-score alert system exporting per-category CSV reports.

## AWARDS

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ECE Dean's List & Semester Honors, IMS Connect Project Fellow, NSF Grant Award, EESAT Student Program Award, IEEE Communication Society Grant Award.

## VOLUNTEERING

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- IEEE Region 8 Europe, Middle East and Africa Humanitarian Ambassador for the 2024 year.