

# KAREEM WALY

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## RESEARCH SUMMARY

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Machine Learning Engineer and IEEE-published AI researcher with an M.Eng. in Data Science & AI from the University of Ottawa (A+, full DEBI scholarship). Research focuses on **Graph Neural Networks for healthcare**, **multimodal AI for low-resource languages**, **retrieval-augmented generation**, and **trustworthy ML**. Peer-reviewed work at IEEE ASET 2025 on drug-drug interaction prediction; production ML deployment at AIM Technologies (90%+ accuracy). Co-Founder of AI-Talents (33 mentees) and Technical Program Chair of IndabaX Egypt 2026. **Actively seeking a PhD position** in healthcare AI, GNNs, multimodal learning, or trustworthy ML.

## RESEARCH INTERESTS

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- **Healthcare AI** — clinical decision support, drug discovery, biomedical knowledge graphs, Arabic medical NLP.
- **Graph Neural Networks** — molecular property prediction, relational reasoning, dynamic graphs, GNN scalability.
- **Multimodal AI** — fusion of text, audio and visual signals; cross-lingual Arabic / English emotion and sentiment.
- **Retrieval-Augmented Generation** — hybrid dense-sparse retrieval, knowledge-grounded generation, evaluation under distribution shift.
- **Trustworthy ML** — robustness, anomaly detection, calibration, and interpretability for safety-critical deployment.

## EDUCATION

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### University of Ottawa — M.Eng. in Data Science & Artificial Intelligence

Jan 2022 — Jun 2023

Ottawa, Canada · Standing: A+ (GPA 4.0 / 4.0)

Advisors: Dr. M. Bolic, Dr. R. Goubran

- **Capstone:** Production-grade Spoken Language Identification system — 90%+ accuracy, deployed at AIM Technologies.
- **Awards:** Full DEBI Scholarship (Ministry of ICT, Egypt × University of Ottawa); top 5% cohort.
- **Coursework:** Deep Learning, NLP & Speech Processing, Probabilistic ML, Reinforcement Learning, MLOps & Production ML, Computer Vision, Distributed Systems, Responsible AI.

### University of Zurich — Summer School: Deep Dive into Blockchain

Jul — Aug 2023

Zurich, Switzerland · Completed with Distinction

Ranked No. 1 in Europe for Blockchain (CoinDesk 2021, 2022)

### Helwan University — B.Sc. in Computer Science & Mathematics

Sep 2016 — Jul 2020

Cairo, Egypt · Graduated 2nd in Class (GPA 3.85 / 4.0)

- **Coursework:** Linear Algebra & Optimization, Probability & Statistics, Algorithms & Complexity, Discrete Mathematics, Operating Systems, Database Systems, Machine Learning Foundations, Compilers.

## PUBLICATIONS

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Elsersy, M., Waly, K., & Sherif, A. (2025). "Predicting Drug-Drug Interactions Using Graph Neural Networks: Towards Safer and Intelligent Prescriptions." *Proceedings of the 7th HCT International Multi-Conference on Advances in Science and Engineering Technology (ASET)*, Abu Dhabi, UAE. **IEEE Xplore**.

**Contribution:** GNN architecture design (Graph Attention Network on molecular interaction graphs), DrugBank 5.1 data pipeline, baseline benchmarking (BM25, MLP, classical features), co-authored manuscript and conference presentation.

## SELECTED RESEARCH PROJECTS

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## Graph Neural Networks for Drug–Drug Interaction Prediction

2024 — 2025

- Engineered a Graph Attention Network on DrugBank molecular interaction graphs to flag risky drug pairings.
- Owned the full research lifecycle: literature review, model design, experimentation, evaluation, paper authoring.
- **Outcome:** peer-reviewed publication at IEEE ASET 2025, indexed in IEEE Xplore.
- **Stack:** PyTorch Geometric, GAT, DrugBank 5.1, Hugging Face Spaces (live demo).

## Hybrid Dense–Sparse Retrieval & RAG Pipeline for Log Forensics

2026

- Designed a five-stage hybrid retrieval pipeline benchmarked on two real-world log datasets (HDFS, BGL — 2M lines each).
- Combined BM25 keyword search with fine-tuned BGE and SBERT semantic retrieval; Qwen2.5-7B-Instruct generator for grounded incident reports.
- **Outcome:** +18.0% retrieval improvement (MAP) over BM25 baseline on the semantically rich BGL dataset.

## Multimodal Sentiment & Emotion Recognition (English & Arabic)

2024

- Three-stream fusion architecture: DeBERTa text representations, MFCC voice features, ArcFace video embeddings.
- Cross-lingual transfer to Arabic via AraBERT; deployed as a real-time Gradio interface on Hugging Face Spaces.
- **Outcome:** 80.06% accuracy across 7 emotion classes; 71.49M parameters total.

## Brain Tumor MRI Classifier with Grad-CAM Explainability

2026

- Fine-tuned EfficientNet-B4 on ~4,600 brain MRI scans for binary triage (Healthy vs. Brain Tumor).
- Integrated Grad-CAM visual explanations and shipped a clinician-readable Gradio web interface.
- **Outcome:** 99.57% validation accuracy, 99.83% AUC-ROC; live demo on Hugging Face Spaces.

## AI-Driven Dynamic Modeling for Distributed Databases

2026

- Three-phase AI framework evaluated on the Alibaba Cluster Trace v2022 dataset (244,000 microservice nodes).
- Phase 1 — Random Forest shard predictor (97.88% accuracy); Phase 2 — Q-Learning replication agent; Phase 3 — LSTM autoencoder anomaly detector (AUC-ROC 0.9344).

## Multimodal Biometric Authentication & GAN-Based Intrusion Detection

2023 — 2024

- Built a face + voice + fingerprint fusion model for robust identity verification under noise and spoofing.
- Designed a GAN-based intrusion detection model for imbalanced network attack distributions.

## PROFESSIONAL EXPERIENCE

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### Technical Program Chair — IndabaX Egypt (Deep Learning Indaba)

2025 — Present

*Cairo, Egypt*

- Lead the technical program for Egypt's largest AI/ML community conference, affiliated with the continental Deep Learning Indaba.
- Curate the workshop track, recruit speakers and mentors, and shape the scientific direction of the conference.

### Co-Founder & AI Researcher — AI-Talents EdTech

Oct 2023 — Present

*Cairo, Egypt*

- Co-founded a mindset-first EdTech startup training the next generation of AI engineers across Egypt and the MENA region.
- Architected the full technical curriculum from foundational engineering to specialized AI tracks; currently mentoring 33 students.

## Machine Learning Engineer — AIM Technologies

Aug 2022 — Feb 2023

Cairo, Egypt

- Built and deployed an end-to-end production Spoken Language Identification system achieving 90%+ accuracy.
- Researched and benchmarked deep-learning, CNN, and sequence-modeling approaches for audio classification.
- Owned the full ML lifecycle alongside a four-person team: preprocessing, training, evaluation, and deployment.

## Data Scientist Intern — Hertie School Data Science Lab

Aug — Sep 2023

Berlin, Germany (Remote)

- Researched and implemented Generative Adversarial Networks (GANs) for synthetic tabular data generation.
- Contributed to ML pipeline design and model architecture alongside senior researchers.

## TECHNICAL SKILLS

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**Research Areas:** Graph Neural Networks (GAT, GCN, message passing), Retrieval-Augmented Generation, Multimodal Learning (text/audio/vision fusion), Generative AI (GANs, diffusion), Reinforcement Learning (Q-Learning), Anomaly Detection, Time-Series Modeling, Spoken Language Identification, Trustworthy / Explainable ML.

**Programming:** Python (expert), C++, Java, SQL, Bash.

**ML Frameworks:** PyTorch, PyTorch Geometric, TensorFlow, Hugging Face Transformers, Scikit-learn, FastAPI, OpenCV, Albumentations.

**LLM & RAG Stack:** BM25, BGE, SBERT, Qwen2.5, vector databases, prompt engineering, evaluation harnesses.

**Infrastructure:** Docker, Git/GitHub, MLOps pipelines, AWS SageMaker, Hugging Face Spaces, Gradio, distributed training.

**Languages:** Arabic (Native), English (Professional), German (Limited Working).

## HONORS & AWARDS

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- **Digital Egypt Builders Initiative (DEBI) Full Scholarship** — Ministry of ICT, Egypt + University of Ottawa (2022).
- **A+ standing · Top 5% cohort**, M.Eng. Data Science & AI, University of Ottawa (2023).
- **Graduated 2nd in Class**, B.Sc. Computer Science & Mathematics, Helwan University (2020).
- **IEEE ASET 2025 Certificate of Appreciation** — Paper Presenter and Author, Abu Dhabi, UAE.
- **Completed with Distinction** — Deep Dive into Blockchain Summer School, University of Zurich (2023).

## ACADEMIC SERVICE & LEADERSHIP

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- **Technical Program Chair** — IndabaX Egypt 2026 (affiliate of the continental Deep Learning Indaba).
- **Co-Founder & Curriculum Architect** — AI-Talents EdTech, mentoring 33 students in Egypt's first mindset-first AI engineering program.
- **Conference Author & Presenter** — IEEE ASET 2025, Abu Dhabi, UAE.

References available on request.