

LUKELO THADEI LUOGA

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EDUCATION

New York University Abu Dhabi(NYUAD), Abu Dhabi, UAE

Sept 2020 — May 2024

B.S. in Computer Engineering

GPA: 3.871/4.0

Relevant Courses: *Computer Programming for Engineering, Object-Oriented Programming, Data Structures and Algorithms, Computer Organization and Architecture, Agile Software Development and DevOps, Computer Networking, Operating Systems, Embedded Systems, Applied Machine Learning, Linear Algebra, Probability and Statistics*

Honors and Awards:

- **NYU Founders' Day Award:** Top 40% of baccalaureate candidates recognized as outstanding scholars at NYU.
- **Latin Honors: Cum Laude:** Top 15% of graduates in the Engineering division at NYUAD.

PUBLICATIONS

(*denotes equal contribution)

1. **Advancing Healthcare in Low-Resource Environments Through Optimization and Deployment Framework for Medical Multimodal Large Language Models**
Aya El Mir*, **Lukelo Thadei Luoga***, Boyuan Chen, Muhammad Abdullah Hanif, & Muhammad Shafique
IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI 2024), November 10-13, 2024, Houston, Texas, USA
2. **Democratizing MLLMs in Healthcare: TinyLLaVA-Med for Efficient Healthcare Diagnostics in Resource-Constrained Settings**
Aya El Mir*, **Lukelo Thadei Luoga***, Boyuan Chen, Muhammad Abdullah Hanif, & Muhammad Shafique
IEEE ICIP 2024, Biomedical Imaging & Diagnostics (BID) Workshop: Innovations in Biomarkers, Digital Pathology, & Radiology, October 27-30, 2024, Abu Dhabi, United Arab Emirates

RESEARCH EXPERIENCE

Center for Interacting Urban Networks (CITIES), NYUAD

Abu Dhabi, UAE

Full-time Research Assistant (Advisor: Dr. Saif Jabari & Dr. Muhammad Shafique)

October 2024 - Present

- Developed ViT4Purge, a novel framework leveraging Vision Transformers (ViTs) to identify and filter poisoned samples in datasets using attention-based mechanisms
- Designed and implemented attention map-based classifiers to distinguish between clean and infected data, enabling a trigger-agnostic defense mechanism
- Evaluated the framework on datasets such as GTSRB, CIFAR-10, and ImageNet10, achieving superior performance in identifying diverse poisoning configurations and even outperforming existing defenses like activation clustering.
- Preparing research paper for submission to a leading AI conference, contributing to advancements in safeguarding AI models in safety-critical applications
- Collaborating in research activities by testing backdoor attack and defense mechanisms within the CARLA simulation environment integrated with Autoware, with a focus on evaluating their effectiveness in real-world scenarios and identifying critical security gaps
- Developing and integrating simulation models using CARLA and SUMO, ensuring seamless interfaces between platforms for advanced research simulations

Engineering Capstone Design Project, NYUAD

Abu Dhabi, UAE

Advisor: Dr. Muhammad Shafique

August 2023 — July 2024

- Developed TinyLLaVA-Med, a 1.5B-parameter medical MLLM optimized for low-resource environments, achieving 18.9W power consumption and 11.9GB memory usage on Nvidia Jetson Xavier AGX
- Led the initial phase to adapt TinyLLaVA for biomedical tasks using fine-tuning techniques, identifying a 10–30% accuracy gap compared to SOTA models on VQA-RAD and SLAKE
- Enhanced the optimization and deployment framework for Medical MLLMs with extensive fine-tuning and post-training quantization (4-bit and 8-bit), significantly improving memory efficiency and accuracy
- Introduced optimized medical MLLMs, including TinyLLaVA-Med-F and quantized variants (FQ4, FQ8), forming a family of models on the Pareto front for memory-accuracy trade-offs
- Achieved 89% dynamic memory reduction and 90% static memory reduction with TinyLLaVA-Med-FQ4, while TinyLLaVA-Med-F outperformed LLaVA-Med (7B), achieving 85.43% on SLAKE and 39.25% on PathVQA for open-ended questions
- Presented findings at IEEE ICIP 2024 (BID Workshop) in Abu Dhabi, UAE, and IEEE-EMBS BHI 2024 in Houston, Texas, USA, showcasing the potential of making AI models like MLLMs accessible for low-resource settings

Engineering Honors Research, NYUAD

Advisor: Dr. Muhammad Shafique

Abu Dhabi, UAE
September 2023 — December 2023

- Implemented and analyzed backdoor attacks in deep neural networks (DNNs) used in autonomous vehicles, focusing on trigger configurations such as size, location, and pattern
- Identified critical limitations in existing defenses, revealing their reliance on trigger-specific assumptions and ineffectiveness against adaptive attacks
- Presented findings through a formal report and a technical presentation, showcasing the need for trigger-agnostic defenses in AI systems for autonomous vehicles

C2SMARTER, NYU Tandon School of Engineering

Summer Research Assistant(Advisor: Dr. Kaan M.A. Özbay)

New York, USA
June 2022 - August 2023

- Successfully integrated the SUMO 2D traffic simulator with the CARLA 3D simulator using Python, creating a digital twin to dynamically simulate traffic scenarios and enhance pedestrian safety, especially for those using mobility aids
- Developed an adaptive traffic signal control system utilizing YoloV8 and StrongSORT models in Pytorch to detect and track pedestrians with mobility aids, adjusting crossing times accordingly to ensure equitable access and safety
- Developed a python-based algorithm for vehicle counting on a road using live CCTV footage, leveraging YOLOv8 and Strongsort Machine Learning models for object detection and tracking
- Implemented an intention prediction algorithm based on trajectory prediction generated from Social GANs to model pedestrians' motion from video and predict when they will cross the street to advance pedestrian safety
- Presented a poster on Urban Work Zone Detection using deep learning techniques at the ITS-NY 30th Annual Meeting, winning second place for educational institution posters, and gained insights into Intelligent Transportation Systems
- Conducted a hands-on course teaching the basics of Unity 3D and its advanced features for building 3D road network models, covering basics to advanced elements like roads, buildings, and terrain

ENGINEERING PROJECTS

Line Following Robot Competition

Team Lead

Abu Dhabi, UAE
September 2023 - December 2023

- Implementing computer vision techniques, including color thresholding and contour-based approaches to allow NVIDIA Jetbot AI to follow a black line and navigate autonomously the modular field with varying patterns and levels

NYUAD Robosub Competition Team — RoboNation

Software Engineer

Abu Dhabi, UAE
January 2022 — August 2022

- Evaluated YOLOv3, YOLOv4 Tiny, and MobileNetV2-SSD for real-time object detection in Autonomous Underwater Vehicles, selecting MobileNetV2-SSD for its superior speed and efficiency

LEADERSHIP & COMMUNITY EXPERIENCE

Resident Assistant, Residential Education — NYUAD

August 2021 — May 2024

- Fostered a supportive residential environment for 23 residents through programs, meetings, and personal guidance, promoting learning and accountability

Director of Events, Africa Global Student Interest Group — NYUAD

August 2022 — December 2022

- Led logistical coordination of Afro Fest, managing event setup, promotion, attendee tracking, and feedback collection for continuous improvement.

Facilitator, Boys' Education Network (BEN) — NYUAD

September 2020 — November 2020

- Organized and facilitated weekly online workshops, empowering young boys to engage, grow, and lead amidst challenges of the coronavirus pandemic

Co-Organizer, Contract Staff Appreciation Week Committee — NYUAD

September 2020 — November 2020

- Coordinated events recognizing 800+ contract workers, fostering a culture of gratitude among students and faculty

Project Supervisor, GoMakeADifference — Ludewa,Tanzania

June 2021 — July 2021

- Led a \$1000 project to construct modern toilets for a primary school, improving health standards and teaching conditions

SKILLS

- **Programming & Software:** C++, C, Python, MATLAB, Javascript, Express.js, React, React Native, Node.js, MongoDB, SQL, MySQL, HTML, CSS, Verilog, VHDL, MongoDB, PyTorch, Tensorflow, Arduino, Unity 3D, Blender, Adobe Premiere Pro, CARLA, Microsoft Office, SUMO
- **Languages:** Swahili (Native), English (Fluent)