Toufiq Musah

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Summary

A biomedical researcher and engineer working in Machine Learning, Deep Learning, & Computer Vision applications in Medicine, with works in Medical Imaging Analysis, Imaging Biomarkers, & Related Domains.

Education

University of Pennsylvania *Aug 2025 – Present*
M.S.E Data Science

- **Relevant Courses:** Machine Learning for Data Science, Computer Systems Programming, Big Data Analytics

Kwame Nkrumah University of Science and Technology (KNUST) *Jan 2021 – Nov 2024*
BSc. Biomedical Engineering *- First Class Honors*

- **Relevant Courses:** Research Methods, Biomechanics, Medical Imaging, Probability and Statistics, Linear Algebra, Calculus, C/C++, Biomaterials, Bioinstrumentation, Biosignal Processing and Analysis

Relevant Professional Experience

Research Assistant, Engineering Research *Kumasi, Ghana* *Oct 2024 – Present*
Kumasi Centre for Collaborative Research in Tropical Medicine (KCCR)

- Conducting interdisciplinary research and collaborating on systematic reviews in Digital Health, Artificial Intelligence, and Machine Learning within the Global Health & Infectious Diseases (GHID) Group.
- Developing Clinical Decision Support Tools to enhance diagnosis, treatment, and management of infectious and chronic diseases, including large language model applications for supporting expectant mothers in gestational diabetes management.

Research Assistant, Machine Learning Intern *Kumasi, Ghana* *Oct 2023 – Feb 2024*
Responsible Artificial Intelligence Lab (RAIL)

- Conducted extensive research across multiple domains of machine learning/deep learning, including Generative Adversarial Networks (GANs) and Machine Learning Applications in Biomedical Engineering.
- Built Generative Models for Computed Tomography (CT) denoising and upscaling (SRGAN), and CT-MRI translation/style-transfer (CycleGAN).

Research and Academic Work

Selected Publications

Toufiq Musah, Chinasa Kalaiwo, ... Confidence Raymond, "***Towards Trustworthy Breast Tumor Segmentation in Ultrasound using Monte Carlo Dropout and Deep Ensembles for Epistemic Uncertainty Estimation***", Medical Image Computing in Resource Constrained Settings Workshop. 28th International MICCAI Conference, 2025

Claudia Takyi Ankomah, Livingstone Eli Ayivor, ... **Toufiq Musah**, "***How We Won BraTS-SSA 2025: Brain Tumor Segmentation in the Sub-Saharan African Population Using Segmentation-Aware Data Augmentation and Model Ensembling***", Brain Tumor Segmentation, and Cross-Modality Domain Adaptation for Medical Image Segmentation. 28th International MICCAI Conference, 2025

Toufiq Musah, "***Large Kernel MedNeXt for Breast Tumor Segmentation and Self-normalizing Network for pCR Classification in Magnetic Resonance Images***", MICCAI, Deep Breast Workshop on AI and Imaging for Diagnostic and Treatment Challenges in Breast Care, 2025 [ArXiv]

Toufiq Musah, Prince Ebenezer Adjei, Kojo Obed Otoo, "***Automated Segmentation of Ischemic Stroke Lesions in Non-Contrast Computed Tomography Images for Enhanced Treatment and Prognosis***", MICCAI Meets Africa Workshop, 2024 [ArXiv]

Toufiq Musah et. al, "***Brain Tumor Segmentation in Sub-Sahara Africa with Advanced Transformer and ConvNet Methods: Fine-Tuning, Data Mixing and Ensembling***", Medical Image Computing in Resource Constrained Settings Workshop. 28th International MICCAI Conference, 2025

Selected Talks & Orals

Towards Trustworthy Breast Tumor Segmentation, MIRASOL Workshop, MICCAI Conference, 2025

Automated Medical Image Segmentation: Toward Trustworthy Clinical Tools, COMPASS Webinar, 2025

Optimisation Techniques in Machine Learning, Ghana Data Science Summit, Tutorial, 2025

Relevant Projects

Vision-Language Surgical Scene Understanding & Panoptic Segmentation & Scene Graph Generation
Developed of an end-to-end system for automated surgical room scene understanding. Trained an S^2-Scaled SwinUNETR for panoptic segmentation of 21 classes (personnel, instruments, tools) enabling robust identification and localization. Fine-tuned MedGemma using QLoRA for scene graph generation and event significance detection, facilitating downstream reasoning and analytics for surgical workflow analysis.

Collaborative AI Resources for Expectant Mothers (C.A.R.E) Project
Developed an accessible AI assistant built on Large Language Models (LLMs) with Retrieval-Augmented Generation (RAG) to help expectant mothers with gestational diabetes manage their pregnancies. The system was deployed through WhatsApp to ensure inclusivity and ease of access, providing personalized health guidance and continuous engagement in low-resource settings.

Super Resolution and Denoising of Computed Tomography Scans
A generative model for producing high resolution head CT scans from low resolution variants, to minimize effective patient radiation dose in CT diagnosis radiology procedures.

Data Augmentation via Deep Convolutional Generative Adversarial Networks
Implemented a deep convolutional generative adversarial network (DCGAN) to synthetically generate additional medical image data for self-supervised pre-training, enabling effective data augmentation and data-efficient finetuning.

Awards and Acknowledgments

- Best Oral Presentation Award - MICCAI Meets Africa Workshop, 2024
- Brain Tumor Segmentation Challenge (BraTS-SSA Task), 2025 – First Place
- Best Poster Presentation Award - Ghana Data Science Summit, IndabaX, 2024
- Academic Excellence Award – Provost List 2021, 2022, 2023
- MasterCard Healthcare Entrepreneurship Grant
- MICCAI Education Challenge Finalist, 2024
- MICCAI Travel Award, 2024, 2025

Volunteering

Team Coordinator, Sprint AI Training for Medical Image Knowledge Translation Coordinating, teaching, and developing training materials for the Sprint AI program (2024–2025), focused on building capacity among emerging researchers and clinicians in medical image computing and deep learning applications.

Technical Committee Member & Contributor, Breast Ultrasound Segmentation and Classification Challenge Contributed to the organization of the PRECISE-Abreast Challenge (CodaBench, 2025) as a technical committee member. Designed and implemented validation and evaluation pipelines for participant submissions, ensuring fairness and reproducibility of the assessment process.

Course Facilitator, Women in Engineering - SheCodes Club Teaching Python programming and introductory machine learning classes for the Women in Engineering Society, creating an inclusive learning environment to help members gain tech skills and build their confidence in STEM.

Student Lead, ARM(E3)NGAGE Club Spearheading the ARM student club focused on microcontroller programming, IoT, and embedded machine learning. Guided teams in developing innovative hands-on projects while organizing outreach workshops.

Volunteer, IndabaX, Ghana Data Science Summit Contributing to the organization of IndabaX GDSS by curating engaging content that raised awareness and sparked interest in the transformative potential of data science.

Blog Posts, Tutorials

A Hitchhiker's Guide to 3D Medical Image Processing - Medium Article
Introduction to TorchIO for 3D MRI Processing: - Preprocessing (Part 1) - Augmentation & Dataloaders (Part 2)
End-to-End Deep Learning Tutorial for Image Classification: Pneumonia Detection - Colab Notebook
How to Make an Image Classification Model: Is it a Pie? - Blog Post

Skills

Languages: Python, LaTeX, C/C++, MATLAB

Libraries: PyTorch, TensorFlow, Keras, Scikit-Learn, Pandas, LangChain

Software: Solidworks, Fusion 360, ANSYS FEA, Unity Game Engine, KiCAD, Electronics Prototyping