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Emmanuel Azuh Mensah

Education

January 2021–Present **Univeristy of Washington, Seattle, WA.**,
Computer Science, Candidate for Doctorate Degree
Lab: Information and Communication Technology for Development (ICTD)
Primary Advisor: Kurtis Heimerl

2018–2019 **Massachusetts Institute of Technology (MIT), Cambridge, MA.**,
Computer Science (Artificial Intelligence/Machine Learning), M. Eng
Thesis: *Towards Bilingual Lexicon Discovery From Visually Grounded Speech Audio*
Supervisors: Dr. James Glass & Dr. David Harwath

2014–2018 **Massachusetts Institute of Technology (MIT), Cambridge, MA.**,
Electrical Engineering and Computer Science, Bachelor of Science
Minors: Mechanical Engineering, Economics

Research Experience

January 2021–Present **Graduate Research Assistant**, University of Washington ICTD Lab
- Leading an on-device multimodal deep learning project of six contributors to perform fine-grained species discrimination for wildlife monitoring using inspiration from mobile vision transformers and audio-visual object localization communities. Various parts of the project include algorithm development, on-device inference efficiency and deployment testing.

Sep 2018–Sep 2019 **Graduate Research Assistant**, MIT Spoken Language Systems Group (SLS)
- Used Deep CNN models to learn semantic representations for both images and multi-lingual speech captions.
- Employed unsupervised learning methods to automatically find word level translations between multiple languages by leveraging vision as an interlingua. This approach removes text intermediate and is therefore well suited for translating to and from speech in low resource languages.

June 2018–Aug 2018 **Undergraduate Research Intern**, Microsoft Research: FarmBeats Project
- Applied online deep-learning techniques to improve microclimate forecast as well as generate time-series for expensive sensors not present on the farm, in the Microsoft FarmBeats project.
- Integrated the final model in a real time prediction demo website using Microsoft Azure technology.

Feb 2018–June 2018 **Undergraduate Research Assistant**, MIT Anyscale Learning For All (ALFA) Group
- Worked on improving multivariate time-series similarity search in medical databases, using deep recurrent neural networks to create encoding vectors to be used in a Locality Sensitive Hashing algorithm.

Feb 2017–June 2017 **Undergraduate Research Assistant**, MIT Experimental Hydrodynamics Laboratory (EHL): OpenFV Project
- Created Docker containers with many popular computer vision libraries and CUDA support, made accessible through AWS using Jupyter notebooks to bootstrap computer vision projects for researchers.

Sep 2016–Dec 2016 **Undergraduate Research Assistant**, MIT Anyscale Learning For All (ALFA) Group
- Created a web interface to integrate AWS APIs for making machine learning algorithms for medical data more accessible to non AI-experts.

Feb 2016–May 2016 **Undergraduate Research Assistant**, MIT Anyscale Learning For All (ALFA) Group
- Used OpenRefine API to automate the cleaning up and standardization of messy data for a job application filtering machine learning project.

Teaching Experience

Sept 2023 – Dec 2023 **Graduate Teaching Assistant**, *UW CSE 415 - Introduction to AI for Non-Majors*
- Created assignments, worksheets and exam questions to introduce non-majors to important concepts in AI and Machine Learning.

Mar 2023 – Jun 2023 **Graduate Teaching Assistant**, *UW CSE 446/546 - Machine Learning*
- Led instruction sections, advised students on end-of-quarter projects and hosted office hours for fundamental concepts in machine learning for undergraduates and early graduate students.

Mar 2022 – Jun 2022 **Graduate Teaching Assistant**, *UW CSEP 561 - Network Systems*
- Taught professional masters students computer networking concepts including machine learning approaches for networking and networking systems for machine learning.

Sep 2021 – Dec 2021 **Graduate Teaching Assistant**, *UW CSE 550 - Computer Systems*
- Prepared teaching material and assisted learning for graduate students taking the systems-for-all breadth course.

Sep 2017–May 2018 **Undergraduate Teaching Assistant**, *MIT 6.S198 - Deep Learning Practicum*
- Created the computer vision component of a practical deep learning class launched in spring 2018.
- Led recitations and mentored two student teams in their end of semester projects.

Professional Experience

June 2023 – Sept 2023 **Research Scientist Intern**, Amazon
- Led a summer project with the Customer Experience Impressions team to define and validate two new statistically derived metrics by researching for relevant data across 7 teams and designing custom loss functions to ensure the metrics remained stable across time and product categories. Owned all planning, engineering and research tasks, using the CRISP-DM framework to stay on the same page with stakeholders.

June 2022 – Sept 2022 **Student Researcher**, Google Perception Team
- Proposed new methods for server-side and on-device multi-modal machine perception models to learn from video, audio and text. Communicated with other Google teams, including a Zurich team whose work inspired the research direction, through the model design phase.

September 2019–Dec 2020 **Software Development Engineer I**, *Amazon Web Services*
- Implemented computer networking algorithms for production level software in Amazon's Network Load Balancer team. Ensured any incremental changes in software were tested as well as monitored after deployment in order to ensure proper functioning.
- Mentored a summer intern to design and implement a system used in AWS TLS Network Load Balancing team for providing a faster reactive service for our for large customers. The project required an early research phase of collecting information across multiple teams in the load balancing stack, making design decisions and implementing the project in a 3-month period.

May 2017–August 2017 **Software Engineering Intern**, *Google Inc*
- Implemented the core of a high performance Java library for rendering data visualizations (charts) on servers, supporting a wide variety of chart types, and is meant to be usable across a many of Google's internally-facing and externally-facing products.

May 2016–August 2016 **Engineering Practicum Intern**, *Google Inc*
- Built a routing tool in the Command Line Interface of AngularJS following version 3 of the Angular Router. The tool automatically creates and configures routes after performing all the necessary validations, reducing the amount of work done by developers.

Publications & Patents

2021

Mensah, E. A., Singanamalla, S., Anderson, R., & Heimerl, K. (2021). When Borders Blur-Overcoming Political Limits with Computing in Truly Global Societies.

2020

Joint patent filed by Microsoft Corporation on the micro climate prediction project using IoT data and Machine Learning for FarmBeats.

2019

Azuh, Emmanuel, David Harwath, and James Glass. "Towards Bilingual Lexicon Discovery From Visually Grounded Speech Audio." Proc. Interspeech 2019 (2019): 276-280.

2018

Dhamala, J., **Azuh, E.**, Al-Dujaili, A., Rubin, J. and O'Reilly, U.M., 2018. Multivariate Time-Series Similarity Assessment via Unsupervised Representation Learning and Stratified Locality Sensitive Hashing: Application to Early Acute Hypotensive Episode Detection. IEEE Sensors Letters, 3(1), pp.1-4.

Projects And Competitions

March 2021–June 2021 **Zynq Parrot Core Profiling for Matrix Multiplication**, *UW CSE 548 - Computer Systems Architecture w/ Prof. Michael B. Taylor*

- Setup a measurement system in a PYNQ board with Black Parrot Processor implemented in FPGA to investigate how parameters of data reuse algorithms to accelerate matrix multiplication affected frequency of pipeline stalls due to instruction and data cache misses.

Jan 2021–March 2021 **Putting Adaptive Federated Learning in a 2G Context**, *UW CSE 561 - Computer Communication and Networks w/ Prof. Ratul Mahajan*

- Simulated 2G networking characteristics on AWS containers setup as edge nodes to investigate the effects of training parameters on federated learning algorithms in poor networking conditions.
- Experimented with model weight compression algorithms to improve training time as well studying effects on accuracy and network utilization.

Jan 2019–May 2019 **Hardware Acceleration for Graph Convolution**, *MIT 6.888 - Hardware Architecture For Deep Learning w/ Prof. Vivienne Sze & Prof. Joel Emer*

- Jointly proposed a weight stationary data flow with one team mate, to accelerate Graph convolutions as compared to the traditional fully connected architecture used to process graphs.
- Adapted a simulator from a class lab work for general convolutions to this project, in order to assess MAC and energy savings from the proposed data flow.

Jan 2019–May 2019 **Characterizing effects of noise in image classification using JPEG compressed features as Neural Network Input** , *MIT 18.085 - Computational Science and Engineering*

- Investigated how several noise types including Poisson and Salt & Pepper affect MNIST classification accuracy at varying levels of JPEG compression applied to the input images.

Sep 2018–Dec 2018 **Generating images from speech captions**, *MIT 6.869 - Advances in Computer Vision*

- Adapted a Text-to-Image Synthesis Generative Adversarial Network to handle spectrogram embedding as context vectors in place of text embeddings.
- Attempted to generate images on a much more diverse dataset (Places) as opposed to Birds and Flowers used in the text version of the project.

Jan 2017–May 2017 **Source Separation Using Deep CNN**, *MIT 6.345 - Automatic Speech Recognition*

- Tackled source separation by applying Convolutional Neural Networks to the spectrograms of audio tracks to learn a mask for recognizing vocals and separating the vocals from instrumentals.

Sep 2017 **Vision Hack**, *National University of Science and Technology (MISIS), Moscow*

- Placed within the top 10% of competitors in a scene recognition and action classification tasks as used by autonomous vehicles.

Sep 2016 **Hack IBM Watson**

- Utilized IBM Watson's APIs to build a recommender system for parents with newborn infants. The machine learning application built with a combination of speech recognition, classification and natural language processing, provided a natural interface to answer questions parents tend to have on best practices for taking care of newborns.

Skills

Languages Python (Tensorflow, Jax, Pytorch, Keras, Weights&Biases), Java, C++, Verilog (HDL) for FPGA, Matlab, SQL, Stata, TypeScript

Communication English(fluent), Akan(Fluent), Franch (basic)

Relevant Courses

Natural Language Processing (UW CSE 517), Machine Learning (MIT 6.867), Hardware Architecture for Deep Learning (MIT 6.888), Computer Systems Architecture (UW CSE 548), Automatic Speech Recognition (MIT 6.345), Computer Vision (MIT 6.869), Signals Systems & Inference (MIT 6.011)

Extra Curriculars

Sep 2017 – Present **Ghana Youth Research Program**, *Founder*

- Initiated a pilot program in the University of Ghana, to introduce Ghanaian youth to research methods with 3 cohorts so far in the Biochemistry department. Currently expanding to a second university (KNUST) with plans to include other African universities.
- Directing the development of a research training curriculum using methods from Undergrad Research Programs in US universities.

Sep 2017 – May 2018 **Sakata Afrique**, *President*
Managed 8 exec members, developed subcommittees and increased the group's campus presence by increasing the audience size of the annual showcase from ˜50 to ˜200 during spring 2018. Audition numbers increased from ˜15 to 45 in fall 2018.

Sep 2017 – May 2018 **MIT African Students Association**, *Vice President*
Created an inclusive environment for people interested in Africa by developing an African learning community, which has averaged about 10 people in attendance and is currently in its 6th straight semester.

Sep 2016 – May 2017 **Innovation Clean Economy Pathways (ICEP)**, *Technology Chair*
Assisted ICEP (an NGO based in Cambridge) by running their website and providing advise on technology related to their energy projects.

May 2016 – Aug 2016 **Releaf NG**, *Volunteer Backend Developer*
Implemented backend APIs, including social media authentication and storage APIs, to help modularize a previously tightly coupled, completely front-end based web application.

Feb 2016 – Dec 2016 **Zeta Beta Tau Fraternity**, *Alumni Relations Chair*
Won the $7,500 MIT Weedon Alumni Relations Award during my term. Organized our annual alumni weekend and wrote newsletters to update our alums on the current state of the brotherhood.

Jan 2016 **MIT Global Teaching Labs**, *Student Instructor*
Taught English to about 20 students in Israel through science article readings, ending in student presentations as their final project. Led students in building a cycling system that could be used to charge a phone.

References

Kurtis Heimerl,
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David Harwath,
Assistant Professor,
University of Texas at Austin,
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Ranveer Chandra,
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Microsoft Farmbeats,
ranveer@microsoft.com