Prince Osei Aboagye

Curriculum Vitae

School of Computing
University of Utah
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Research Interests

My research aims further to push the boundaries of ethical and responsible AI and enhance the cross-lingual transfer of language technologies to low-resource languages. I am very interested in Natural Language Processing, Speech Representation Learning, and Knowledge Representation Learning (esp. graph-based methods), particularly in Monolingual, Cross-lingual/Multilingual, and Multi-Modal settings. My current research dives into the understanding of models that jointly predict task labels and generate free-text explanations for their predictions, also known as self-rationalization models. They are of great interest in modern Explainable AI since it leads to a more intuitive interaction with NLP systems.

Education

2018 – 2023 **PhD**, *Computer Science*, University of Utah.

Advisor **Dr. Jeff Phillips**.

2016 – 2018 **MS**, *Applied Mathematics*, University of Texas at El Paso.

Advisor **Dr. Michael Pokojovy**.

2011 – 2015 **BA**, *Mathematics and Economics*, University of Ghana.

Advisor **Mrs. Lilian Frempomaa Kyei**.

Technical Skills

- Proficient in machine learning and deep learning for multiple applications
- Python, Java, C++, MatLab, Tensorflow, Pytorch

Publications

ICLR 2022: Normalization of Language Embeddings for Cross-Lingual Alignment. **Prince Osei Aboagye**, Jeff Phillips, Yan Zheng, Junpeng Wang, Chin-Chia Michael Yeh, Wei Zhang, Liang Wang, Hao Yang. **Link to paper**: https://openreview.net/forum?id=Nh7CtbyoqV5

AMTA 2022: Quantized Wasserstein Procrustes Alignment of Word Embedding Spaces. **Prince Osei Aboagye**, Yan Zheng, Michael Yeh, Junpeng Wang, Zhongfang Zhuang, Huiyuan Chen, Liang Wang, Wei Zhang, and Jeff Phillips. **Link to paper**: https://aclanthology.org/2022.amta-research.15/

ICLR 2023: Interpretable Debiasing of Vectorized Language Representations with Iterative Orthogonalization. **Prince Osei Aboagye**, Yan Zheng, Jack Shunn, Chin-Chia Michael Yeh, Junpeng Wang, Zhongfang Zhuang, Huiyuan Chen, Liang Wang, Wei Zhang, Jeff Phillips **Link to paper**: https://openreview.net/forum?id=TkQ1sxd9P4

Research Experience

Fall 2022- **Current Graduate Research**, *School of Computing and Visa Research*, University of Utah.

Advisor: Dr. Jeff Phillips

Description: Models that jointly predict task labels and generate free-text explanations for their predictions, also known as self-rationalization models are greatly interested in modern Explainable AI. This leads to a more intuitive interaction with NLP systems. Given the free-text explanations from Self-rationalization models (say a GPT-3 model), our goal is to express or assign an uncertainty score to the generated free-text explanations to understand the level of confidence that the Self-rationalization model places on its own generated free-text explanations.

Summer 2022 **Research Scientist Intern**, Visa Research.

Advisor: Wei Zhang

Title: Concept Denoising of Convolutional Neural Networks with Spectral Normalization and Iterative Orthogonalization

Spring 2022 **Graduate Research**, *School of Computing and Visa Research*, University of Utah.

Advisor: Dr. Jeff Phillips

Description: While existing methods mitigate language representation biases, they only work for just two identified concepts (such as gender and occupation or race and religion). Hence, they can't be used to debias multiple concepts simultaneously. Also, the approaches employed by these existing methods are too aggressive: they not only remove bias but also erase valuable information from word embeddings, which turn to impact downstream task performance negatively. Following this, we are developing a method that simultaneously decouples or othogonalizes multiple concepts instead of removing concepts wholesale so that semantic information is retained in the embeddings and bias is also effectively mitigated compared to other existing methods.

Summer 2021 **Research Scientist Intern**, Visa Research.

Advisor: Wei Zhang

Title: Quantized Wasserstein Procrustes Alignment of Word Embedding Spaces

Description: We proposed an unsupervised cross-lingual word embedding (CLWE) model that poses the alignment task as a Wasserstein-Procrustes problem to jointly estimate a permutation matrix and an orthogonal matrix . I relied on a quantization step to find the closest measure supported on k points in the 2-Wasserstein distance through Optimal Transport (OT) methods. This substantially improves the approximation quality of empirical OT solvers, given fixed computational cost. Our proposed unsupervised CLWE model obtains state-of-the-art results on the Bilingual lexicon Induction (BLI) task.

Fall 2020-Spring 2021 **Graduate Research**, *School of Computing and Visa Research*, University of Utah.

Advisor: Dr. Jeff Phillips

Description: In this work, we proposed a new and general approach to normalize word embeddings that improves the level of isomorphism between monolingual embedding spaces. The key is Spectral Normalization which regularizes the spectral properties of monolingual embeddings. Moreover, we show layering Spectral Normalization within an iterative sequence with also centering and vector length normalization improves results further. We demonstrate this improvement on the standard bilingual lexicon induction (BLI) and Cross-lingual downstream tasks (CLDTs).

Fall 2017-Spring 2018 **Master Thesis**, *Department of Mathematical Sciences*, University of Texas at El Paso.

Advisor: Dr. Michael Pokojovy

Title: On Numerical Stochastic Optimal Control Via Bellman's Dynamic Programming Principle

Goal: In this work, we presented an application of Stochastic Control Theory to the Merton's portfolio optimization problem. Then, the dynamic programming methodology was applied to reduce the whole problem to solving the well-known HJB (Hamilton-Jacobi-Bellman) equation that arises from the Merton's portfolio optimization problem subject to the power utility function. Finally, a numerical method was proposed to solve the HJB equation and the optimal strategy. The numerical solutions are compared with the explicit solutions for optimal consumption and investment control policies.

2014 – 2015 **Undergraduate Thesis**, *University of Ghana*, Mathematics Department.

Advisor: Ms. Lilian Frempomaa Kyei

Description: I got acquainted with Game Theory, the definition of games in the normal form as well as the matrix representation of two-player finite games. I looked at the famous prisoner's dilemma game and how the conflict between the social incentive to cooperate and the private incentive to defect can be resolved

Previous Projects

STAT 5474: Spring 2018 **Introduction to Data Mining**, *Selecting the best features for predicting bank loan default*, University of Texas at El Paso.

Project Goal For this project, I presented a data mining framework for building a Probability of Default (PD) model. My objective was to first and foremost identify the effective features to estimate the PD model and predict PD for new loans. The dataset I used to build the PD model had many features, some of them were irrelevant, and only some of the features affected the model's performance. Using irrelevant features to build the model will lead to very poor results. To avoid the incidence of poor effects due to irrelevant features, I analyzed the data, prepared it, and chose the best subset of more efficient features.

CS 6350: Fall 2018 **Machine Learning**, *Kaggle: Classifying Movie Reviews*, University of Utah.

Description: Each example in this classification task is a movie review. The goal was to predict whether the review was positive or negative . The data used for this task is based on the Large Movie Review Dataset v1.0. Each review in this task is characterized by the histogram of the words it contains. I implemented the following machine learning models for this classification task: Simple Perceptron, Average Perceptron, Support Vector Machines, Logistic Regression, Bagging on Support Vector Machines, and AdaBoost.

CS6955: Fall 2018 **Deep Learning**, *Classifying Movie Reviews Using Recurrent and Recursive Neural Network*, University of Utah.

Description: Sentiment classification over the past decades has been solved using linear classification methods, such as Support Vector Machines (SVM), Random Forest, and logistic regression. Even though the above models may result in reasonable accuracies, they all suffer from losing the order of words appearing in a sentence. They, therefore, cannot capture delicate semantics from the input reviews. Therefore, we resorted to Recursive and Recurrent neural networks to allow us to account for the order of words in a sentence.

CS 6170: Spring 2019 **Computational Topology**, *Sentiment Classification with Topological Signatures*, University of Utah.

Description: A common approach in Topological Data Analysis (TDA) is to capture the shape or the underlying structure of shapes in data. Of course, it is not easy to define meaningful shapes in textual documents. However, when text is interpreted as describing a progression of events (as in movies), topological features, namely, homological persistence, can significantly improve classification accuracy when added to a text vector representation.

CS 6956: Spring 2019 **Deep Learning for Natural Language Processing**, *Music Genre Classification By Lyrics Using Deep Neural Network* , University of Utah.

Description: Music genre classification based on lyrics alone is a very important and heavily researched task in Music Information Retrieval. The ever-growing amount of online music databases calls for intelligent tools to help people browse and search these music databases and categorize and organize the songs they listen to. For this project, we explored several machine learning algorithms to identify and classify the genre of a song given its lyrics.