AIMS African Institute for Mathematical Sciences NEXT EINSTEIN INITIATIVE

QUANTUM LEAP AFRICA

Carnegie CORPORATION OF NEW YORK

AIMS DTP - DATA SCIENCE STUDENTS' DETAILS

S/N	STUDENT'S NAME	SUPERVISORS	SUPERVISORS' AFFILIATION	STUDENT'S RESEARCH TOPIC	ABSTRACT
1	Abigail Baidoo	Olivier Menoukeu - Pamen	University of Liverpool / AIMS-Ghana	Modelling for Microfinance Institutions and Applications	This project deals with model for estimating the optimal interest and penalty rates for a microfinance institution using the Markov chain approach with time dependent variables. Also, models for predicting the probabilities of default and delay of clients of a microfinance institution in Ghana with variables or features which depend on time, macroeconomic factors and other social factors such as Christmas, New Year, Easter, among others. Statistical methods and machine learning models were used for building the models.
		Viani Biatat Djeundje	University of Edinburgh		
		Nathaniel Howard	University of Cape Coast		
2	Eke Nnanna Arua	Peter Diggle	Lancaster University	Geospatial statistical methods for real-time or near-real-time monitoring of multiple diseases in low-income settings	Model-based geostatistics (MBG) are becoming the state of the art approach for mapping disease prevalence and/or incidence as well as quantifying the risk factors of diseases in low-income settings. The methods are often limited to the analysis of one disease at a time and are unable to make the best use of data accumulating over time. Furthermore, they suffer computational challenges when analysing large data sets, making the use of electronic health data for real-time disease monitoring difficult. We propose the development of new MBG methods that will allow for the joint analysis of several diseases in real or near-real time. To overcome the expected computational challenges of these models, we will implement existing state of the art approximation of Gaussian processes and explore novel methods for approximate inference and intractable likelihoods.
		Claudio Fronterre	Lancaster University		
		Maia Lesosky	University of Cape Town		
3	Elhadji Moustapha Seck	Gervais Mendy	Ecole Superieur Polytechnique / Universite Cheikh Anta Diop	Deep Transfer Learning	Deep learning has recently acquired significant research interest and has been used in many real-world applications. One approach of traditional deep learning methodologies is that the training and test data are drawn from the same domain, so that the input space and data distribution characteristics are the same. However, there are situations where this assumption does not hold. For example, there are cases where one has insufficient training data or difficulties to collect new data. But one of the most powerful idea in deep learning is that sometimes we can take knowledge that the neural network has learned from one task and apply that knowledge to a separate task. For example, one can train a neural network to recognize objects like cats and then use that knowledge or part of that knowledge to help do a better job reading X-ray scans. This is called deep transfer learning. This has motivated many research works that have been done to address deep transfer learning challenges. However, many more important research issues such as how to avoid negative transfer learning remain challenging and need to be understood. This is the main motivation of this PhD project. As most of these researches focused on supervised learning, in this work we are interested in investigating both theoretically and computationally semi-supervised and unsupervised negative transfer learning using deep neural networks. These techniques would allow us to be able to use a mix of labeled and unlabeled data. Simulations will be used to support theoretical findings.
		Bubacarr Bah	AIMS - South Africa and Stellenbosch University		
		Jared Tanner	University of Oxford		

4	Everlyn Asiko Chimoto	Bruce Bassett	University of Cape Town & AIMS - South Africa	Theory of Neural Machine Translation for Low Resource Languages	African languages, despite being numerous and spoken by large populations, are yet to extensively benefit from machines performing translations. The lack of translation models is due to the scarcity of digitized language data, which is paramount to machine translation models. Hence, most African languages are low-resource languages. To solve this problem, this proposal details techniques that can generate language data as well as leverage language datasets that are yet to be translated to augment translation datasets that are already available. These datasets will go into improving current machine translation models. In addition, this proposal specifies analysing models built on several translation datasets (multilingual) to understand language similarity and select which combinations yield better improvement on machine translation models. The aim is to create language datasets and build good translation models. The building of these datasets and machine translation models for low-resource African languages is crucial enabling communication in Africa and fostering pride in language technology built for African languages. These benefits of machine translation will enable cultural and educational exchange that will develop the African ecosystem.
		Emmanuel Dufourq	AIMS - South Africa and Stellenbosch University		
5	Jeremiah Fadugba	Philipp Berens	Institute for Ophthalmic Research & Cluster of Excellence "Machine Learning", University of Tübingen	AI Augmented Computational Ophthalmology Assessment of Eye Health	Fundus images says a lot in the early screening and diagnosis of eye diseases which are of great clinical importance. By using a non-invasive examination of the fundus image, we can get varieties of relevant clinical sign that can guide clinical decision making With the use of a mobile fundus camera, high quality image of the eye fundus would be collected. This makes it the first African fundus image dataset. This dataset would be used to develop an interpretable and reliable solution for fundus image analysis. By leveraging artificial intelligence, we aim to solve a plethora of open problems to make this system work in practice. This solution is developed to guide prevention and treatment services to large population in the sub-Saharan region of Africa.
		Bolanle Oladejo	University of Ibadan		
		Delmiro Fernandez-Reyes	University College London		
		Petru Manescu	University College London		
6	John Bagiliko	David Stern	IDEMS international	Leveraging machine learning to improve satellite rainfall estimates for African rainfed agriculture	Rainfall estimation from satellite imagery is of great importance, especially in the African rainfed agriculture setting. However, most of the precipitation estimation products rely on the relationship between cloud-top brightness temperature and actual rainfall, assuming that precipitation originates from convective clouds with cold tops. This leaves most of them underestimating rainfall in areas with warm cloud tops while overestimating rainfall in areas of cold cloud tops. We will leverage machine learning, specifically Neural Network, to learn to cluster pixels in raw satellite images in a desired spatial resolution. We will repeat this temporally to find which clusters persist and which ones do not. Satellite images, unlike normal RGB images, have more bands such as the Near Infrared, and Infrared. We will mix these bands in various fashions and let the Neural Network learn more complex patterns and clusters. By doing so, the objective will be to see if these clusters and detected patterns tell us something about meteorological phenomena per our domain knowledge, and also by comparing with station data. We are trying to learn, from satellite images, patterns that contribute to extreme rainfall events. For example, it may be possible to differentiate between non-precipitating cirrus clouds from other clouds by doing so. Significant results from this research can then be adopted by the existing rainfall estimation products for better quantification of rain from satellite data. Also, the focus will be on the African rainfed agriculture setting.
		Denis Ndanguza	University of Rwanda		
7	Theonille Mukamana	Lassi Roininen	Lappeenranta University of Technology	Deep Learning BSDE with Applications in Quantitative Finance	Recently, neural networks techniques have evolved into a powerful tool for dealing with a number of problems for which classical solution approaches reach their limits. This study develops a robust neural network approximation framework and tools for efficient training to solve one of the most challenging problems in applied mathematics: The approximation of solutions to high-dimensional nonlinear Partial Differential Equations arising in quantitative finance via classical PDE approaches suffer from the so-called curse of dimensionality, that is, the computational cost goes up exponentially with the dimensionality. We will investigate deep learning of Backward Stochastic Differential Equations and related variational inequalities in order to overcome this difficulty. The goal of this research project is to provide a framework to assess the strengths and weaknesses of different neural network architectures for the problem at hand and to provide both the theoretical and computational foundation for efficient training of these networks. We believe this study will have a strong impact as it will help clarify how these new tools can and should be applied in practice in a controlled way.
		Martin Simon	Frankfurt University of Applied Sciences and MathFinance AG		
		Simo Sarkka	Aalto University		
		Heikki Haario	Lappeenranta University of Technology		
		Denis Ndanguza	University of Rwanda		