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assignment 4 – Data and AI

ICT In africa

## 1. CITATION/REFERENCE:

A. E. Ezugwu, O. N. Oyelade, A. M. Ikotun, J. O. Agushaka, and Y.-S. Ho, ‘Machine Learning Research Trends in Africa: A 30 Years Overview with Bibliometric Analysis Review’, *Arch Computat Methods Eng*, vol. 30, no. 7, pp. 4177–4207, Sep. 2023, doi: [10.1007/s11831-023-09930-z](https://doi.org/10.1007/s11831-023-09930-z).

## 2. AUTHORS:

The authors of the paper are Absalom Ezugwu, Olaide Oyelade, Abiodun Ikotun, Jeffery Agushaka, and Yuh‑Shan Ho.

Absalom Ezugwu is a professor of Computer Science at North-West University in South Africa. At the time of the research, he was an associate professor at the University of KwaZulu-Natal in South Africa. He held this position for six years. According to Google Scholar, he has about 150 publications focused on Machine Learning and Computer Algorithms.

Dr Olaide Oyelade is currently a research fellow at Queen’s University Belfast (UK) in the School of Electronics, Electrical Engineering and Computer Science. He has also been a Postdoctoral Fellow at the University of KwaZulu-Natal in the School of Mathematics, Statistics, and Computer Science. According to Google Scholar, he has about 60 publications focused on Machine Learning and Algorithm Optimization

Abiodun Ikotun has a PhD in Computer Science from the University of KwaZulu-Natal. She is currently a Principal Lecturer at the Yaba College of Technology in the Department of Computer Technology. According to Google Scholar, she has about 28 publications focused on Machine Learning.

Jeffery Agushaka has a PhD in Computer Science from the University of KwaZulu-Natal. He is currently a member of the Federal University of Lafia in Nigeria. He has about 38 publications focused on Artificial Intelligence and Algorithm Optimization.

Yuh‑Shan Ho has a PhD in Chemical Engineering from the University of Birmingham in the United Kingdom. One of his research interests is bibliometric and research trend studies. He has published 165 bibliometric research articles in diverse fields such as tsunami research, drinking water research and stroke-related research.

## 3. FUNDING AND CONFLICTS OF INTEREST:

This research is funded by North-West University, a university in South Africa. Since one aspect of the bibliometric study is an evaluation of research institutions’ publications, this presents a possible conflict of interest. Also, the fact that four of the authors are affiliated with an African university (University of KwaZulu-Natal) presents a possibility of conflict of interest.

## 4. PUBLISHER:

The publisher of this research is Springer. Springer publishes articles from diverse fields of scientific research. Springer conducts peer reviews by two or more experts before publishing a paper and is therefore selective.

The publication is a review article. It reviews Machine Learning-related research in Africa.

## 5. PURPOSE:

The objective of this article is to identify the development and trends in machine learning research in Africa, with the desired outcome of improving collaboration and knowledge sharing among African Machine Learning researchers.

The article is a literature review of African machine learning-related research.

Therefore, the research question of this article is: "What is the development and trend of machine learning research in Africa?"

## 6. RESEARCH METHODS:

The research method used was bibliometric analysis. The data—machine learning-related research documents—was extracted from a citation index named Science Citation Index Expanded. The data collection involved searching the citation index for keywords related to machine learning in Africa in the documents’ title, abstract, author keywords and Keywords Plus. Variations of the keywords (like “machine learner” and “machine learnt”) and misspelt variations (like “machine learnin”) were included to ensure comprehensive coverage. 2,770 documents, including 2,477 articles, were found and considered for analysis.

Six publication indicators were used to assess the publication performance of countries and institutions. These are:

* Total number of articles
* Single-country or single-institution articles
* Internationally collaborative articles
* First-author articles
* Corresponding-author articles
* Single-author articles

And six citation indicators were used to assess the impact of publication. These are:

* Total citation per publication in a specific year.
* Total citations received since publication till specified year.
* Total articles published in a specific context.
* Average citations per article in a specific context.
* Total citations per single-country article in 2021.
* Total citations per internationally collaborative article.

Furthermore, an extensive literature review was conducted to explore recent machine learning research and applications in Africa.

The important assumptions made are that research productivity is directly proportional to the number of publications and that the impact of research is directly proportional to the number of citations it receives.

## 7. MOST IMPORTANT FINDINGS:

**Spike in machine learning-related research in Africa**: The bibliometric analysis revealed a sharp rise in the number of published articles related to machine learning in Africa in 2021. Before 2010, there were fewer than 10 articles, followed by 14 in 2010, and 98 in 2017. However, the number surged to 1031 in 2021. The research does not explain the cause of this spike. However, it is possible that it was a result of COVID-19.

**Research focus**: The bibliometric analysis found that the top four topics of focus in machine learning research in Africa are:

* Classification, which appeared in 841 articles
* Deep Learning, 430 articles
* Feature extraction, 375 articles
* Random Forest, 190 articles

All these were found to be continuingly increasing in popularity.

**Applications areas of ML in Africa**: The literature review of recent ML research that was conducted found that ML research in Africa was generally concerned with the application of ML in certain socio-economically significant areas. The following is a list of the most some of these application areas and research done in them

* *Healthcare*. Researchers in Egypt proposed the use of deep learning to detect brain tumours from brain MRIs
* *Cybersecurity*. Researchers in South Africa propose an ML solution for detecting zero-day (new and unprepared for) intrusion attacks.
* *Prediction and Decision-Making*. Researchers in South Africa proposed an ML algorithm that predicts unmined gold concentration and quality using limited geological data.

## 8. WEAKNESSES:

A shortcoming of the paper is that the trends identified in the analysis may not generalize well across Africa, as about 80% of the articles used in the bibliometric analysis are from the top 5 productive countries.

One additional limitation of the research is the potential bias introduced by the researchers' affiliation with an African research institution (University of KwaZulu-Natal). This affiliation may have influenced the findings and content of the research unfairly. For example, a large section of the paper (Quantum-Based Machine Learning) is about research (not representative of Africa but) from the University of KwaZulu-Natal.

## 9. BROADER IMPLICATIONS:

The spike in ML-related research in Africa suggests a growing interest and investment in this field, which can lead to advancements in ML technology and applications in Africa and consequently, improved socio-economic status.

The cited research on applications of machine learning in areas such as healthcare, transport, cybersecurity, and agriculture is promising. They show us that ML researchers are already tackling problems that are pertinent to the continent.

The paper leaves us with the question of why five countries are doing most of the ML research in Africa (in terms of the number of publications). Understanding the cause of the research productivity in these top countries and the barriers holding the rest of the countries back can help increase ML research activity across Africa. This may have the desirable effect of solving long-standing problems unique to African communities using ML.