Peer review history for:

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Reviewer 1: Round 1
Date completed: 14 October 2024
Recommendation: Accept / **Revisions required** / Resubmit for review / Resubmit elsewhere / Decline / See comments
Conflicts of interest: None

With regard to our policy on 'Publishing peer review reports', do you give us permission to publish your anonymised peer review report alongside the authors' response, as a supplementary file to the published article? Publication is voluntary and only with permission from both yourself and the author.

Yes/No

Comments to the Author:
Thank you for an interesting study highlighting important gaps in the AI research field in SA. The paper presents findings which are much needed at this crucial time.

Some notes in the Word document from me are about some spelling and grammar issues - all minor errors that can be easily fixed.

Your paper consists of various short one-line paragraphs that could be combined to improve reading experience.

I think your paper may benefit from a clearer methodology section as it reads more like a summary of Lui et al's paper instead of a clear statement on what you have done which is similar to Lui et al.

Similarly with your findings section there is some repetition which is said earlier in the paper but it feels like some ideas are not fully developed. Strengthening these sections will improve the paper.

Some of the comments are suggestions for you to consider.

[See Appendix 1 for Reviewer 1's comments made directly on the manuscript]

Reviewer 2: Round 1
Date completed: 17 September 2024
Recommendation: Accept / Revisions required / Resubmit for review / Resubmit elsewhere / **Decline** / See comments
Conflicts of interest: None

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Yes/No

Comments to the Author:

Your article presents some interesting results which, as you indicate in your paper, have the potential to inform policy and research on AI in South Africa. You also draw on a valuable new search strategy from Liu et al (2021) which has the potential to uncover relevant articles that may be missed by other bibliometric approaches. There are a number of issues, however, which mean that the paper still needs quite a bit of work before it can be ready for publication. These are outlined below:

1) You indicate a number of times that you are using the scientometric approach in line with Liu et al. However, the authors that you have cited indicate that they are introducing a search strategy for bibliometric analysis. While the two are related, there are some subtle differences. From my understanding, scientometrics is considered as more the field of study and bibliometric analysis as an approach within this field.
2) The section that outlines your methodology needs quite a bit of work, from a detailed description and rationale for this approach, to a clear explanation of the choices you have made in terms of your search strategy and the tabled results. In other words, your reader wants to understand - in your own words - how you have applied the Liu et al search strategy to your own study, from the first step to the last. The reader also wants to know what your rationale or justification is for the choices you have made regarding, inter alia:
    - the journals you have selected - which in this instance seem to be the same as the Liu et al journals list. There is a missed opportunity here to draw on non-WoS journals from the African continent which may feature even more SA research - and maybe even more collaborations with colleagues from the continent.
    - the range of search terms you have used - and why you selected those particular terms. There is a potential here to maybe add different search terms from the Liu et al article. While you may use their search principles, the keywords that may emerge could be different because of the different context and different focus areas in AI research.
    - There are some unsubstantiated calculations, for example, the AI=0.61 on page 7 (line 233) and 65% on page 9 (line 288). Additionally, there are a number of very short lines/paragraphs which don't quite fit into the flow of the other text below them (see for example, the Approach section on page 4).
3) The Liu et al article provides a rationale for the various tables they have included and a detailed explanation of the importance of the results in each of the tables. Consider if you need to have the exact same tables - or if maybe the SA context could provide you with a unique opportunity to add a different perspective to the conversation. Additionally, a discussion section that draws from literature or a conceptual framework could have added depth to your discussion. The current discussion section is quite thin, and part of it is a repetition (almost word for word) of text in the results section. The paper also does not include a conclusion.

There are some grammatical errors, short paragraphs (one sentence long) and repetitions.

Author response to Reviewers: Round 1

1) The issue of bibliometrics *vis a vis* scientometrics is explained in p2. Bibliometrics is a sub-field of scientometrics.
2) The methodology has been enhanced as per reviewer suggestions. The choices made were outlined and justified in p 4, 5, and 6. (E.g. compatibility with other investigations; avoiding challenges of recall and precision). We also clarified that the search terms and names of journals covered is complete and appear in the appendices. The Activity Index is also estimated in detail.
3) The chapter *Discussion and Main Findings* is expanded and enriched with additional discussion. Furthermore, a conclusion section is added as per reviewer suggestion.

Reviewer 1: Round 2
Date completed: 18 December 2024
Recommendation: Accept / Revisions required / Resubmit for review / Resubmit elsewhere / Decline / See comments
Conflicts of interest: None

With regard to our policy on 'Publishing peer review reports', do you give us permission to publish your anonymised peer review report alongside the authors' response, as a supplementary file to the published article? Publication is voluntary and only with permission from both yourself and the author.

Yes/No

Comments to the Author:
Thank you for a great paper. The paper will be very useful to start a debate and focus some discussion going forward.

Reviewer 2: Round 2
Date completed: 16 February 2025
Recommendation: Accept / Revisions required / Resubmit for review / Resubmit elsewhere / Decline / See comments
Conflicts of interest: None

With regard to our policy on 'Publishing peer review reports', do you give us permission to publish your anonymised peer review report alongside the authors' response, as a supplementary file to the published article? Publication is voluntary and only with permission from both yourself and the author.

Yes/No

Comments to the Author:
I acknowledge the changes that have been made to address the comments. The methodological approach has been further clarified and explained. There is also a stronger link between the approach and the results - which are now explicitly stated in the abstract. The conclusion also helps to draw the reader back to the main contribution of the paper and possible future direction for AI research in SA.

I would suggest that a language editor looks at the document before publication. While some grammatical errors were addressed from the last submission, some were introduced in the text added with this submission. There are also punctuation errors (like the question mark after the definition of Recall) and 'Department of Education' instead of Department of Higher Education and Training on page 4. A language editor should address these issues.

Appendix 1: Reviewer 1's comments on manuscript (Round 1)

The State of Artificial Intelligence Research in South Africa

Abstract

This article presents the results of a scientometric investigation of the field of artificial intelligence in South Africa over the period 2013-2022. Such investigations inform policy and research management development and assist researchers to identify topics for investigation, collaborating organisations etc. The Liu *et al*[1] methodology is utilised for the identification of the artificial intelligence documents. The approach is appropriate for a growing discipline where new terms are developed continuously. The activity index is estimated in order to reveal the contribution of South African researchers in the field of artificial intelligence taking into account the country's scientific size and the world's involvement in the field. Finally, content analysis of the titles of South African publications is employed in order to reveal the domains of emphasis and weakness of the SA's research in the field.

Significance:

Artificial Intelligence has attracted national and international attention with the promise to revolutionize the socio-economic environment. In South Africa AI research is growing and receives a high number of citations and an H-Index of 110. Scientometric analysis of the production of research during the 2013-2022 period identifies the Universities as main producers of AI research and foreign organisations as the main funders. Content analysis identifies the areas of emphasis and areas of neglect. The findings (concentration of research; sources of research funding and areas of focus) have policy implications and are elaborated in the article.

Keywords: Artificial Intelligence; South Africa; Scientometrics; Content Analysis.

Appendices and Tables inserted at the end of the document.

Introduction

Artificial Intelligence has attracted national and international attention promising to revolutionise the workplace, the economy and even our personal lives.

Artificial intelligence has its roots in philosophy, mathematics, computation, psychology, and neuroscience,[2] and is becoming the 'new normal' in both manufacturing and service industries[3].

There is no anyone definition acceptable about artificial intelligence. Probably the broader one is by Nilsson[4] who maintains that "artificial intelligence … is concerned with intelligent behaviour in artefacts".

Currently high profile artificial intelligence applications include a variety of domains. Examples are: manufacturing robots; advanced web search engines such as Google Search; autonomous cars like Tesla; recommendation systems that analyse user data to provide personalised recommendations (used by YouTube, Amazon, and Netflix), understanding human speech and perform services for individuals (such as Siri and Alexa), generative or creative tools (ChatGPT; Ernie bot and AI art), automated decision-making, and competing at the highest level in strategic game systems (such as chess and Go).

According to Fortune Business Insight[5] the global artificial intelligence market size was valued at $428.00 billion in 2022 and was projected to grow from $ 515.31 billion in 2023 to $ 2 025.12 billion by 2030 –a compound annual growth rate of 21.6%.

This article aims to provide information related to the state of AI research in South Africa. Scientometrics is usually the approach used in the effort to identify the state of a scientific topic or discipline in a particular context (e.g. in a country or in a research organisation). Scientometrics has been used widely in the context of South Africa and internationally.[6-8]

Analyses are undertaken for the period 2013-2022 (the most recent year for which complete data were available). The approach uses more than 100 key-words in order to search the WoS database (appendix 1) and they are also include 19 journals which are specialising in artificial intelligence (appendix 2). The search words are chosen to qualify in terms of recall and precision – the necessary preconditions for the validity of a scientometric investigation.

Literature Review

AI has attracted the attention of researchers and multilateral organisations like OECD which investigated scientometrically the field.

Commented [A1]: This sentence needs an edit.

Commented [A2]: This could be one paragraph as it deals with more or less the same idea on the definition and origin of AI and making the case on why we should study AI.

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OECD[9] identified and measured AI-related developments in science, algorithms and technologies using information from scientific publications, open source software (OSS) and patents. The major findings were that since 2015, AI-related publications ~~wer~~have increased by 23% per year; from 2015 to 2017, AI-related OSS contributions grew at a rate three times greater than other OSS contributions; and AI-related inventions comprised, on average, more than 2.3% of IP5 patent families in 2017. China's growing role in the AI space also was identified.

Njei *et al*[10] investigated AI for healthcare in Africa. They identified 26 relevant articles published by 178 authors from 31 countries. The most prolific African countries were South Africa, Nigeria and Ghana.

Liu *et al*[1] developed a scientometric approach in order to resolve the issue of searching for AI using only the term Artificial Intelligence. Their approach started with benchmark records of AI captured by using a core keyword and specialised journal search. Subsequently they extracted candidate terms from high frequency keywords of benchmark records, refined keywords and complement their methodology with the journal subject category 'artificial Intelligence'.

Vasquez *et al*[11] present a scientometric analysis to answer the question, what is the academic overview of the application of artificial intelligence in agriculture? They cover the period 2000 to 2019 using data from Web of Science and Scopus databases. They identify that the countries with the highest number of publications are China, the United States, India, and Australia.

Pereira *et al*[12] reviewed 60 papers exploring the relationship between artificial intelligence and workplace outcomes. The interface between AI and workplace outcomes was examined, drawing on different levels of analysis, disciplines, and organisational functions.

A scientometric analysis of scientific productivity of artificial intelligence research in India[13] presents a scientometric analysis of publications related to AI research in India during 2009-2018. It evaluates the scientific productivity, collaboration, citation impact, and research focus of Indian AI researchers and compares them with other countries.

A variety of other investigations have been published focusing on particular topics. Chatterjee *et al*[14] investigated wind-turbines; *Marugán et al* [15] undertook a survey of artificial neural network in wind energy systems. Their research was focused on diagnosis of faults and

relevant predictions. Similarly Maldonado-Correa et al [16] reviewed the literature related to AI use for energy forecasting.

Approach

The WoS databases are usually utilised for scientometric analyses.

The journals indexed are among the most prestigious ones internationally and are uniquely useful for the objectives of the current investigation.

The most important advantage of the ISI journals is that they constitute the most important (in terms of impact) journals in the world.

In South Africa the Department of Education has identified the ISI indexed journals for subsidy purposes and universities give incentives to their researchers to publish in ISI indexed journals. Consequently, it is expected that the databases will cover not only the most important South African AI related research but the majority of it as well.

A literature review[1] identified that different approaches are used for scientometric analysis of the discipline of artificial intelligence. The approaches range from the use of the term 'Artificial Intelligence' to searching journals specialising on Artificial Intelligence, to utilisation of a variety of related key words. In the last approach the challenge is that in order to fully evaluate the effectiveness of a model, one must examine both precision and recall. Unfortunately, precision and recall are often in tension. That is, improving precision typically reduces recall and vice versa.

Recall refers to the proportion of actual positives that were identified correctly?

Precision attempts to answer the following question: What proportion of positive identifications was actually correct?

To state it differently precision is of critical importance. If it is ignored then the search engine will include terms that are only partially (if at all) relevant to the subject matter of the investigation and will over-inflate the identified population.

Liu *et al*[1] developed a particular methodology for bibliometric analysis of artificial intelligence and compared it with methodologies of other researchers. Their approach appeared to be covering better the field of artificial intelligence. That is the approach identified more

Commented [A4]: Again, this could also be one paragraph long and does not need to be split up. This all deals with the literature on bibliographic studies of AI.

Commented [A5]: Consider changing to Approach and Methodlogy

Commented [A6]: This needs a reference to substantiate the claim.

Commented [A7]: Are you referring to DHET?

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documents in the database and fewer of them were irrelevant. It should be emphasised that authors rarely compare their methodologies with others used in the field.

There are four key steps in the procedure used to build the search strategy. In the words of the authors (Liu et al):

> *"First, we generate a benchmark set of artificial intelligence publications. We use the core lexical query 'artificial intelligence' as a topic search as well as a query of specialised artificial intelligence journals as a source search. Second, from these benchmark records, we extract 'Author Keywords' and 'Keywords Plus' and derive the frequencies of these keywords. We confirm the precise meanings of high-frequency keywords from descriptions found in online sources. This process leads to a retained list of high-frequency 'candidate keywords' related to artificial intelligence. Third, to maintain balance between recall and precision, we test and refine this set of terms through co-occurrence analysis and manual checking identification. Fourth, we augment our strategy by combining the final term set with the use of a subject category search."*

For our investigation we utilise the Liu *et al*[1]approach.

Liu *et al* compared their investigation with those by Gao *et al*[17]; Zhou *et al*[18] and WIPO[19]. The Liu *at al*[1] approach identified all articles by Gao *et al*[17] and just over 78% of the records captured by Zhou *et al*[18].

The WIPO approach delivered a larger number of outputs. Liu et al suggested that more than one-half (54%) of WIPO's search result was comprised of records not included in Liu definition of 'artificial intelligence'. They argued that several generic statistical and mathematical terms such as 'logistic regression', 'hidden Markov model' and 'fuzzy logic' are included by WIPO but excluded in the Liu approach. These three terms returned 195 477 article records in the search period.

Commented [A9]: This section is more a summary of the Liu's approach to their bibliometric study. This section needs to outline your choices and evidence why this approach is sound. This is not clearly communicated here and needs to be revised.

A brief bibliometric overview of Artificial Intelligence 2013-2022: A global view

According to the WoS, 1 536 741 documents on the subject of artificial intelligence were published in the last ten years.

Commented [A10]: Did the search only search on the Science Index or did it include the Social Science Index? This is not clear from your methods section.

Commented [A11]: Is this globally on this database or the filtering for the journals?

Table 1 shows the top scientific disciplines that attract research documents related to artificial intelligence. The various branches of computer science dominate the domain followed by engineering and mathematics. It should be mentioned that articles may be categorised to more than one scientific discipline. Take Table 1:

Table 2 shows the most productive nations in the field, as well as South Africa. Peoples R China dominates the table with 311 712 documents. The United States of America ranks second with 229 911 documents. India is third, with 77 530 documents. Take Table 2:

Over the era, South Africa published 4610 papers during the period.

Table 3 shows the main funders of AI internationally. Take Table 3:

With over 175 000 acknowledgements, National Natural Science Foundation of China stands at the top of the list. The National Science Foundation (NSF) in the USA comes in second, with approximately 38 000 acknowledgements.

Artificial Intelligence in South Africa's academic domain (2013-2022).

Table 4 shows the South Africa publications related to AI produced over the period under consideration. This production placed the country 46th position in the world. The field grew 7.8 times during the period –from 137 publications during 2013 to 1 071 publications during 2022. Take Table 4:

Table 5 highlights the scientific disciplines that are being prioritised in the field of AI in South Africa. The list of disciplines is nearly identical to the worldwide list (Table 1) for the first two fields. It should be noted that the field of energy and fuels appears in the fifth position in South Africa while internationally the position is occupied by the field of telecommunications. Similarly, environmental sciences ecology occupies the third position in South Africa while in the international list the position is occupied by the field of mathematics. Take Table 5:

Table 6 shows the main producers of AI publications in South Africa. The University of Johannesburg is on top of the list with 856 publications followed by the University of Kwazulu Natal with almost the same number of publications. It is noticeable that the annual number of publications by the different universities is relatively small. The top universities in the world (e.g. Harvard) in the field produce twice as many publications as all South African universities

Commented [A12]: What could be interesting is the percentage of output from the top 3 producing countries in relation to the rest of the world and SA. This could be added to the table as well. It will also place the activity index in relation to this to show the extent of the problem your study is identifying.

Commented [A13]: period may be better

Commented [A14]: Again to give more than just a description adding the percentage of the top 3 funders could show something meaningful.

Commented [A15]: If I look at the table what is also significant is up to 2018 41% of papers were written and after 2019 59% of papers were produced. Something happened during that time.

Commented [A16]: Is this not meant to describe the disciplines that prioritise AI research?

Commented [A17R16]: Is there no speculation why this is the case? Maybe a industry requirement or something? I am just wondering why there is a difference and what the rank of Mathematics in SA is.

Commented [A18]: Again what is the reason UJ has focussed on 4IR which includes a VC who was pro AI research and UKZN may have something similar or a research centre? I think it is important to ask the question at least to provide some depth to the findings and make the argument you are making stronger that innovation in the field of AI research is driven by individual agendas and not a central focus policy strategy.

produce together. It can be argued that this is the result of the pluralistic management approach used in the national system of innovation. Take Table 6:

Table 7 shows the main funders of AI research in South Africa. NRF is on top of the list. It is noticeable that all other funders mentioned by the authors are international organisations in the UK, China and USA. Take Table 7:

Table 8 shows the countries collaborating with SA in the field of artificial intelligence. USA, England and China are the main collaborating countries. Take Table 8:

In order to judge the South African production in artificial intelligence in comparison with the worldwide productivity of AI research we estimated the activity index. The activity index is the country's share in the world's publication output in the given field divided by the country's share in world's publication output in all science fields. Hence, the index takes cognisance of the country's scientific size vis a vis the rest of the world.

An AI=1 indicates that the country's research effort in the investigated field corresponds precisely to the world average. An AI greater than one reflects a higher than average effort dedicated to the field under investigation and an AI lower than one reflects a lower than average effort in the field.

The activity index of artificial intelligence in South Africa for the period 2013 -2022 is 0.61. This means that South Africa is producing well below the world average research related to artificial intelligence.

We also estimated the activity index for the most recent year (2022) in order to make sure that the substantial growth in the number of SA's artificial intelligence publications has not changed over the period. The 2022 activity index is 0, 65. Slightly higher but still well below the international average.

We also undertook a content analysis of the titles of AI articles by South African authors for the period 2020-2023. Such analyses can be used to provide indicators of the main topics, trends, and challenges of AI research in the country.

Table 9 identifies the list of the most often appearing terms in the titles of SA related research about AI. Take Table 9:

Commented [A19]: I would say explain this simpler and a more accessible way and support with a reference.

Commented [A20]: Again a percentage would make this more meaningful. How much is SA supported this could support the argument in the findings later on the SA needs to prioritise a stratgegy and commit funding to secure national priorities.

Commented [A21]: This can be one paragraph it is the same idea. There are a number of paragraphs that are one-liners but could easily be combined with the paragraphs that follow.

Commented [A22]: Is there a substantial difference in the first year of the data?

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The most frequent used terms ('learning', 'using', 'machine', 'neural', 'artificial', and 'network') suggest that machine learning and neural networks are the dominant methods and techniques of AI research in the country. These methods are used internationally for issues of detection, classification, prediction, forecasting, recognition, and optimisation.

Similarly, the terms 'data', 'model', 'models, 'modeling', and 'modelling', indicate that data-driven and model-based approaches are also prevalent in AI research in South Africa.

The terms 'education', 'health', 'agriculture', 'security', 'power', 'energy', 'smart', and 'development' indicate the main domains and sectors that AI research in South Africa is applies to. Similarly the terms 'Africa', 'African', 'COVID', and 'sentinel' reflect the specific contexts (regional and continental perspectives) and challenges (e.g. COVID) that AI research in South Africa addresses.

The identified focus on the above terms also reveals the lack on investigations to topics such as natural language processing, computer vision etc. and on issues related to coordination and alignment of AI research and national policy (scarcity of terms like regulation, standardisation, certification etc.).

Commented [A24]: Why is this significant?

Citation analysis of the South African articles reveals that the articles received 87 310 citations (over the period under examination) or approximately 19 citations per article. ~~.~~ Four articles were identified to have received more than 1000 citations. The set of South African articles has an H-Index of 110. An h-index of 110 means that there are 110 articles that received more than 110 citations. This profile is relatively high as the median number of citations for AI papers in the computer sciences (among the the most cited 500 articles including AI) is approximately 21.8 citations per paper (Lee Teh et al 2021). It can be argued that the multiplicity of co-authors and funders contribute to the quality of South African articles as it is manifested in citations.

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Discussion and Main Findings

This article investigates the state of artificial intelligence research in South Africa. The findings are important for policy and management of the support and funding of the field in the country and research planning of the relevant researchers. It should be emphasised that the issue of AI is not officially among the priorities identified in the country's foresight exercise. The foresight ~~exersice~~exercise in South Africa is not dynamic and it took place before 2019. That is before AI was recognised for its socio-economic impact nationally and internationally. ~~Curently~~Currently AI is supported by most countries in the world including USA, China,

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Europe, India and others. South Africa does not have a funding incentive for artificial intelligence development.

Our investigation shows that the field grew substantially during the 10 year of the investigation from 137 publications during 2013 to 1071 publications during 2022. However, estimation of the field's activity index reveals that the field is producing only 65% of what is expected according to the country's scientific size and the international performance of the field. It is emphasised that the identified performance of AI research is self–generated –as the government does not offer any relevant incentives for promoting the field of AI.

It is also identified that South African research in the field is funded substantially by international funders. It is important to note that foreign funders will not support the national interest particularly on a topic like AI which appears to be close to commercialisation.

It should also be noted that the top universities in the world (e.g. Harvard) in the field produce as many publications as all South African universities produce together. It can be argued that this is the result of the pluralistic management approach used in the national system of innovation in South Africa.

It can be argued that the followed approach creates diseconomies of scale. Universities could resolve the issue through collaboration (nationally and internationally) although the best approach for the local system is through central coordination.

Content analysis of the titles of the South African articles in artificial intelligence identifies that machine learning and neural networks are the dominant methods and techniques of AI research in the country.

Scarcity of terms like regulation, standardisation, certification etc. reveals the lack of investigations related to coordination and alignment of AI research and national policy.

Countries interested to accommodate AI activies need to support infrastructural needs such as investment in high speed internet and computing power; support research institutions and Universities; develop AI-specific regulations; revamp education system; address job displacement concerns etc. While all issues mentioned above need addressing data governance and access (open data initiatives; data privacy ~~regualtions~~regulations) and R&D support may be among the first issues to be addressed.

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Commented [A28]: Reference

Commented [A29]: why is this the best way? This has not been explained except in relation to Harvard output and pluralistic management? This would also require a reference.

AI has potential to boost economic growth and productivity, but at the same time it creates equally serious risks, rising inequality, unemployment and emergence of new undesirable industrial structures. Our investigation reveals a distributed approach in the development of AI in South Africa and lack of support or coordination by the government. SA policy needs to create the conditions necessary for nurturing the potential of AI, while considering carefully how to address the risks it involves.

Commented [A30]: Your conclusion has some repritition of the ideas in the paper. These need to be rewritten to give a better flow and make a stronger argument on the need for a central policy and prioritising funding. Some ideas could be further explored.

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Appendix 1: Artificial Intelligence Search Terms

No	Search strategy	Search terms
#1	Core lexical query	TS = ("Artificial Intelligen*" or "Neural Net*" or "Machine* Learning" or "Expert System$" or "Natural Language Processing" or "Deep Learning" or "Reinforcement Learning" or "Learning Algorithm$" or "*Supervised Learning" or "Intelligent Agent*")
#2	Expanded lexical query 1	TS = (("Backpropagation Learning" or "Back-propagation Learning" or "Bp Learning") or ("Backpropagation Algorithm*" or "Back-propagation Algorithm*") or "Long Short-term Memory" or ((Pcnn$ not Pcnnt) or "Pulse Coupled Neural Net*") or "Perceptron$" or ("Neuro-evolution" or Neuroevolution) or "Liquid State Machine*" or "Deep Belief Net*" or ("Radial Basis Function Net*" or Rbfnn* or "Rbf Net*") or "Deep Net*" or Autoencoder* or "Committee Machine*" or "Training Algorithm$" or ("Backpropagation Net*" or "Back-propagation Net*" or "Bp Network*") or "Q learning" or "Convolution* Net*" or "Actor-critic Algorithm$" or ("Feedforward Net*" or "Feed-Forward Net*") or "Hopfield Net*" or Neocognitron* or Xgboost* or "Boltzmann Machine*" or "Activation Function$" or ("Neurodynamic Programming" or "Neuro dynamic Programming") or "Learning Model*" or (Neurocomputing or "Neuro-Computing") or "Temporal Difference Learning" or "Echo State* Net*")
#3	Expanded lexical query 2	TS = ("Transfer Learning" or "Gradient Boosting" or "Adversarial Learning" or "Feature Learning" or "Generative Adversarial Net*" or "Representation Learning" or ("Multiagent Learning" or "Multi-agent Learning") or "Reservoir Computing" or "Co-training" or ("Pac Learning" or "Probabl* Approximate* Correct Learning") or "Extreme Learning Machine*" or "Ensemble Learning" or "Machine* Intelligen*" or ("Neuro fuzzy" or Neurofuzzy) or "Lazy Learning" or ("Multi* instance Learning" or "Multiinstance Learning") or ("Multi* task Learning" or "Multitask Learning") or "Computation* Intelligen*" or "Neural Model*" or ("Multi* label Learning" or "Multilabel Learning") or "Similarity Learning" or "Statistical Relation* Learning" or "Support* Vector* Regression" or "Manifold Regulari?ation" or "Decision Forest*" or "Generali?ation Error*" or "Transductive Learning" or (Neurorobotic* or "Neuro-robotic*") or "Inductive Logic Programming" or "Natural Language Understanding" or (Adaboost* or "Adaptive Boosting") or "Incremental Learning" or "Random Forest*" or "Metric Learning" or "Neural Gas" or "Grammatical Inference" or "Support* Vector* Machine*" or ("Multi* label Classification" or "Multilabel Classification") or "Conditional Random Field*" or ("Multi* class Classification" or "Multiclass Classification") or "Mixture Of Expert*" or "Concept* Drift" or "Genetic Programming" or "String Kernel*" or ("Learning To Rank*" or "Machine-learned Ranking") or "Boosting Algorithm$" or "Robot* Learning" or "Relevance Vector* Machine*" or Connectionis* or ("Multi* Kernel$ Learning" or "Multikernel$ Learning") or "Graph Learning" or "Naive bayes* Classifi*" or "Rule-based System$" or "Classification Algorithm*" or "Graph* Kernel*" or "Rule* induction" or "Manifold Learning" or "Label Propagation" or "Hypergraph* Learning" or "One class Classifi*" or "Intelligent Algorithm*")
#4	WoS category	WC = ("Artificial Intelligence")
#5	Total	#1 OR #2 OR #3 OR #4

Source: Liu et al[1] (under a Creative Commons Attribution 4.0 license).

Appendix 2: AI journals included in the search

1. Artificial intelligence Elsevier
2. Journal of machine learning research
3. Autonomous agents and multi-agent systems
4. IEEE transactions on neural networks and learning systems
5. Journal of artificial intelligence research
6. Machine learning
7. Computational intelligence
8. Expert systems
9. International journal of intelligent systems
10. Neurocomputing
11. Journal of experimental and theoretical artificial intelligence
12. IEEE computational intelligence magazine
13. Artificial intelligence review
14. Autonomous robots
15. International journal of machine learning and cybernetics
16. ACM transactions on intelligent systems and technology
17. AI magazine
18. Progress in artificial intelligence

19. Swarm intelligence

Tables

Table 1: Classification of AI articles to scientific disciplines (2013-2022).

Research Area	Record Count
Computer Science	976 047
Engineering	771 215
Mathematics	322 326
Communication	189 544
Telecommunications	188 179

Table 2. Prolific countries producing AI research and South Africa (2013 - 2022).

Country	Record Count
China	311 712
USA	229 911
India	77 530
Germany	55 558
England	54 985
Canada	42 237
Japan	41 267
South Korea	40 148
Italy	37 820
South Africa	4 610

T**able 3:** Main Funders of AI research according to number of acknowledgements (2013-2022).

Funding Agencies	Record Count
National Natural Science Foundation Of China NSFC	175 105
National Science Foundation NSF	38 180

United States Department Of Health Human Services	33 601
National Institutes Of Health NIH USA	33 178
Fundamental Research Funds For The Central Universities	25 019

Table 4: AI Publications from South Africa

Year	Record Count
2022	1 071
2021	866
2020	685
2019	546
2018	377
2017	300
2016	282
2015	170
2014	176
2013	137

Table 5: Classification of SA AI articles to scientific disciplines (2013-2022).

SA Research Area	Record Count
Computer Science	1 492
Engineering	1 435
Environmental Sciences Ecology	405
Science Technology Other Topics	318
Energy Fuels	299

Table 6: Prolific SA universities in the field of AI (2013-2022).

SA Affiliations	Record Count
University of Johannesburg	856
University of KwaZulu Natal	810
University of Pretoria	548
University of the Witwatersrand	544
University of Cape Town	514

Table 7: Main Funders of SA research in AI

SA Funding Agencies	Record Count
National Research Foundation South Africa	366
UK Research Innovation UKRI	148
National Natural Science Foundation of China NSFC	145
National Science Foundation NSF	118
United States Department of Health Human Services	104

Table 8: Countries collaborating with SA

Countries	Record Count
South Africa	4 610
USA	615
~~Englad~~England	381
Peoples Republic of China	342
France	292
India	277
Australia	273
Canada	272
Germany	260
Nigeria	219

Table 9: Frequency of words in SA titles about AI.

Words Repetitively Used	Record Count
learning	534
using	517
machine	326
neural	297
artificial	232
network	214
data	167
networks	157
intelligence	142

analysis	142
detection	137
classification	132
prediction	127
model	120
review	114
Africa	113
approach	112
system	88
models	86
study	81
techniques	76
predicting	72
application	69
forecasting	69
systems	63
mapping	62
African	62
optimization	61
recognition	61
performance	60
modeling	60
convolutional	59
algorithms	58
power	57
sentinel	57
energy	54
COVID	53
modelling	53
hybrid	52
time	50
development	49
methods	49
case	48
estimation	47
AI	46
framework	45
framework	44
algorithm	41

smart	41
applications	40

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