

# Measuring The Impact of Ethical Dimension in AI Research Literature: Bibliometric Study

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**Abstract:** The modern era is often associated with the development of digital technology which affects almost all aspects of human life. As time goes by and the emergence of sophisticated technology today, we are able to present creative applications in the form of artificial intelligence (AI). The presence of Artificial Intelligence (AI) is an element of technological sophistication that is phenomenal at the moment, making researchers interested in conducting in-depth and organized studies. This research uses a quantitative approach by utilizing bibliometric analysis. The aim of this research is to map the results of publications about Artificial Intelligence in the Scopus database from 1980-2023 which are reviewed in terms of main information, research development, most relevant author, most citation, countries' scientific production, authors' production over time, most frequent words. The results of this research show that the research data or scientific works on artificial intelligence indexed by Scopus since 198-2023 amounted to 4,477 titles, and began to experience development from 2001 to 2023. The development of research publications on the topic of artificial intelligence in the period 1981-2023 experienced fluctuating development. The institution most active in publishing scientific papers until 2023 on artificial intelligence is the University of Oxford with a total of 220 scientific papers. In the most relevant author and most citation sections, the researcher who has the most influence and is most cited is Floridi L. Meanwhile, the country in the world that actively publishes scientific works on artificial intelligence is the USA with a total of 3279. In the Most Frequent Words section, the keywords that are frequently used in a study is artificial intelligence with 3553 uses of the word. Meanwhile, in the authors' production over time section, Floridi L is the author who has published the most scientific works on artificial intelligence in the last 19 years.

**Keywords:** Measuring, artificial intelligence, Bibliometric Study.

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## Introduction

The modern era is often associated with the development of digital technology which affects almost all aspects of human life. In this era, technology can become a medium to help humans in various sectors of life (Mahmudah & Putra, 2021). The presence of the digital era and technological advances cannot be avoided by anyone, current technological advances have an impact on increasing connectivity, the development of virtual and artificial intelligence digital systems (Doringin et al., 2020). However, in this sophisticated and modern era of globalization, society is required to be smarter in choosing and

sorting positive and negative things in order to control society's own morals (Idhamani, 2020).

The current era of globalization and disruption is relevant to the rapid and globalized development of technology (Salsabila et al., 2021). Entering the current era, technology is increasingly developing in accordance with the development of science which has influenced aspects of human life, starting from economic, political, educational and cultural aspects (Maritsa et al., 2021). The current development and improvement of technology can support and influence performance in all lines of human life, so that all parties involved are required to be able to balance and follow existing technological advances (Fadilah et al., 2021). Of course, current technological advances make it

easier for humans to communicate, easier to find information, easier to send messages, and easier to find information quickly (Wahyudi & Sukmasari, 2018).

As time goes by and the emergence of sophisticated technology today, we are able to present creative applications in the form of artificial intelligence (AI). This application functions to replace human labor to make it cheaper, more effective and efficient. Currently, artificial intelligence is able to provide an innovative influence on the movement of human life today. Therefore, artificial intelligence is able to help humans in completing various tasks (Pakpahan, 2021). AI applications are currently starting to spread among the general public, the presence of these applications offers many new innovations for specific needs (Arief Syarifuddin Sucipto, Adit Febrianto, Zulham M. Rais, 2023).

In addition to technological developments such as AI having a positive impact, it also has a negative impact in various aspects of human life, such as individuals becoming lazy in socializing physically, using time for useless things, Cyber Bullying (Edwar, 2021), diversion of the function of a teacher, because the learning system can be done individually, students become addicted to excessive cyberspace, and do not respond to it well and wisely so they use it in bad things, by accessing negative things such as pornography, online games that excessive and can cause apathy in students (Marryono Jamun, 2018).

The presence of Artificial Intelligence (AI) is an element of technological sophistication that is phenomenal at the moment, making researchers interested in conducting in-depth and organized studies. The presence of AI can become a new innovation that is increasingly creative and has a significant impact, so that this shows several interesting studies to study. Like research conducted by Zhisheng Chen which focuses on Ethics and discrimination in artificial intelligence enabled recruitment practices. This research explains the research gap on algorithmic discrimination caused by AI-powered hiring and explores technical and managerial solutions (Chen, 2023). Similar research was also conducted by Koochi Moghadam and Bae Kyotaet with the title

Generative AI in Medical Imaging: Applications, Challenges, and Ethics, this research explains that it has great potential in improving medical imaging tasks such as data augmentation, image synthesis, image-to-image translation, and creation of radiology reports assisted by artificial intelligence (Koochi-Moghadam & Bae, 2023)

Some of the research findings above show that Artificial Intelligence is used by humans in various aspects of activities, and has not been used to map, measure and visualize existing research on artificial intelligence and ethics. Therefore, further research is needed to be able to understand the mapping and visualization of the development of research on artificial intelligence from year to year so that it can be used as a reference in implementation and modification for further research.

Based on the above phenomenon, research using bibliometric analysis is focused on studies that discuss mapping the impact of artificial intelligence and ethics from the Scopus database which aims to provide bibliometric and bibliographic reports about main information, development of publications, most relevant affiliates, most relevant author, most citation, countries' scientific production, most frequent words, and authors' production over time, which will later be able to map, understand and visualize research results related to artificial intelligence as a whole in the Scopus database.

### **Research Methods**

This research uses a quantitative approach by utilizing bibliometric analysis. Bibliometric analysis is used to investigate and visualize the number of publications and scientific references that are not limited in scope (Bornmann, 2013; Bornmann, 2016).

This research uses Biblioshiny, a web-interface based application from the bibliometrix r-package which is part of the R-studio application. This software will help display the results of bibliometric visualization with statistics and is free (Krotov, 2017). In addition, the R program provides a variety of statistical and graphical operations

techniques that are very easy and extensible (Jannah, 2022). Therefore, bibliometrix r-package can carry out analysis flexibly, comprehensively and organized. Apart from that, this application is relatively light and can be integrated with statistical packages in other R-programs (Aria & Cuccurullo, 2017).

The data collection process in this research is carried out through a data search process or scientific work that focuses on article titles, keywords and abstracts of articles published on the scopus website using the keywords "ethic AND "artificial intelligence"" from 1981-2023 which is then metadata The data is extracted into CSV format. Data analysis in this research uses Biblioshiny which is part of the R-studio application. Some of the data obtained in this metadata is in the form of a research population consisting of 4,477 documents including journal articles, book chapters and other sources obtained during the period 1981 to 2023 related to the keywords "ethics AND "artificial intelligence" which have been published and recorded in the Scopus database.

## Results and Discussion

### Main Infotmation

The search results for the metadata "ethics AND "artificial intelligence" indexed in the Scopus database based on biblioshiny analysis totaled 4,477 documents. To be able to find out research developments that are in accordance with the scientific discipline of artificial intelligence, it is necessary to carry out filtering that can be focused on the scientific discipline of artificial intelligence by using the biblioshiny application which is part of the R package.

In table 1, the author presents data on the development of scientific research publications in the global world (Scopus) regarding ethics AND "artificial intelligence" from 1981-2023 in general. The main information obtained was the time span of the article documents which were analyzed according to year, number of research publications on ethics AND "artificial intelligence" and document type, author and document content. In

the main information section the data displayed is based on searching for the keywords ethics AND "artificial intelligence" by only limiting the article title, keywords and article abstract. The type of document used to display main information data with a total of 4,477 titles indexed by Scopus. Research on artificial intelligence began to develop in 2001, but began to experience rapid development in 2016-2023. The number of authors of scientific publications on artificial intelligence in the period 1981-2023 was 8748 authors with a total of 2188 articles. In the bibliometric analysis, scientific publication data on ethics AND "artificial intelligence" in general in the Scopus database from 1981-2023 was obtained as follows:

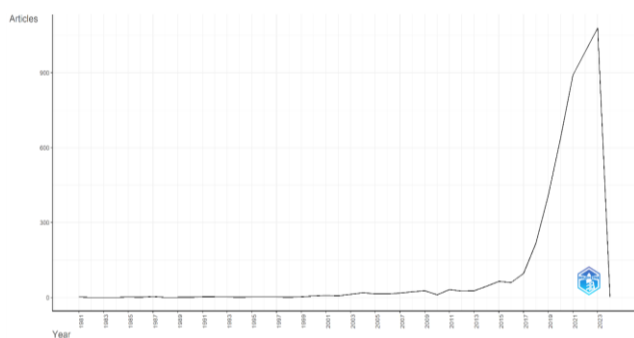
**Table 1.** Bibliometric Analysis Results Based on the Main Information of ethic AND "artificial intelligence" 1980-2023.

Description	Results
<b>MAIN INFORMATION ABOUT DATA</b>	
Timespan	1981:2023
Sources (Journals, Books, etc)	2165
Documents	4765
Annual Growth Rate %	0
Document Average Age	2.94
Average citations per doc	12.18
References	185260
<b>DOCUMENT CONTENTS</b>	
Keywords Plus (ID)	12790
Author's Keywords (DE)	8748
<b>AUTHORS</b>	
Authors	12515
Authors of single-authored docs	1332
<b>AUTHORS COLLABORATION</b>	
Single-authored docs	1532
Co-Authors per Doc	3.28
International co-authorships %	18.61
<b>DOCUMENT TYPES</b>	
Article	2188

### Development of Publication

The development of research publications on the topic of artificial intelligence in the period 1981-2023, reviewed through the biblioshiny application which is part of R-package, shows fluctuating developments. This can be seen in Figure 1 below which shows the development of scientific articles about artificial intelligence in 1981-2023. In this figure, it is found that the most research documentation on artificial intelligence contained

in Scopus data is in 2023, with a total of 1089 research papers. Furthermore, it can be seen that the lowest number of scientific works on artificial intelligence indexed by Scopus were found in 1986, 1989, 1990, 1994, 1998 with a total of only 1 article. Furthermore, in 1981, 1985, 1993, 1995, 1997 with a total of only 2 scientific works. However, if you look closely, the results of the analysis of the development of scientific work publications indexed by Scopus from 1981-2023 show fluctuating results. It was discovered in 2001 with a total of only 9 scientific papers, increasing to 19 documents in 2004 and dropping again in 2005. So it can be concluded that the number of scientific works on artificial intelligence indexed by Scopus from 2010-2015 shows a quite significant increase in the total 65 scientific works, however, in 2023 it will experience very rapid development with the number of scientific works amounting to 1089 documents.



Picture 1: Development of Publication

### Most Relevant Afiliation

In bibliometrics, the term Most Relevant Affiliation refers to the origin of the institution or institutions where a researcher works or studies. Mapping of affiliations or institutions that publish scientific papers is very important in bibliometric analysis, because it can provide insight or description of the contribution of certain institutions or institutions in the production of scientific research papers.

In this section, it can be seen that the most active institution publishing scientific papers until 2023 on artificial intelligence is the University of Oxford with 220 scientific papers, followed by the University of Toronto with 97 articles, University College London with 91 scientific papers, Technical University of Munich with 77 articles, University of Cambridge with a total of 58 scientific papers. The

affiliation of authors of scientific works on artificial intelligence is still dominated by institutions from the European continent, where the majority of the population is Christian. The purpose of the analysis of author affiliations is to find out which institutions produce many publications of scientific work on artificial intelligence. This analysis can later be used as a reference for future researchers to be used as a reference source for writing further articles or collaboration between authors, institutions, journal publication targets, etc.

Table 2. Most Relevant Afiliation.

Affiliation	Articles	Affiliation	Articles
University of Oxford	220	Imperial College London	45
University of Toronto	97	Stanford University School of Medicine	40
University College London	91	The University of Melbourne	39
Technical University of Munich	77	University of British Columbia	38
University of Cambridge	58	University Medical Center Utrecht	37
Stanford University	57	University of Sydney	37
National University of Singapore	51	University of Wollongong	34
University of California	48	Mcgill University	33
Monash University	46	University of Jyväskylä	32
Harvard Medical School	45	Massachusetts Institute of Technology	31

### Most Relevant Author

In this section, the analysis of researchers with the most relevance in terms of number of publications, H-index, number of citations and author influence factors can be seen in table 2. The work of researchers whose scientific work has been published and indexed by Scopus and has a very large influence is at the top. in the table below. In the table diagram, the data displayed are

researchers who have the most significant and effective influence and number of publications. In the table diagram it can be seen that Floridi L is in the top position with 51 articles or publications indexed in Scopus, then followed by Taddeo M with 28 articles, Vakkuri V with 19 articles, and Kamell K-K with 18 articles, who are then followed by other researchers with sufficient influence. both of which are below the top four researchers in the table diagram. Meanwhile, the researchers who had the lowest impact were the 4 researchers who were in the bottom 4 tables, such as Stahl Bc Coeckelbergh M, Halme E, Liu Y who only had 11 publications indexed by Scopus and Bandel O who only had 11 article publications in Scopus.

**Table 3.** Most Relevant Afilition.

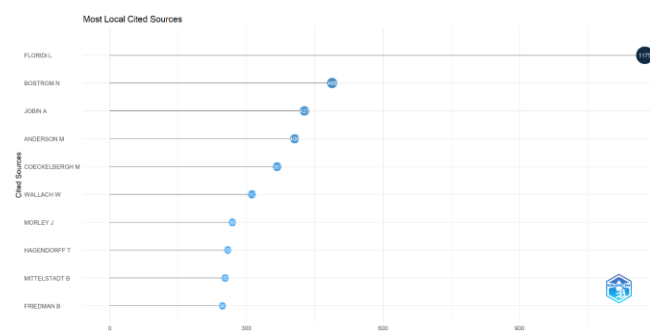
Authors	Articles	Articles Fractionalized
Floridi L	51	20,46
Taddeo M	28	7,63
Vakkuri V	19	4,82
Kemell K-K	18	4,48
Abrahamsson P	17	4,31
Anderson Sl	17	7,75
Anderson M	16	6,91
Cowls J	14	2,55
Gunkel Dj	14	11,83
Morley J	14	2,79
Wang Y	14	3,67
Li L	12	2,33
Liu X	12	1,57
Ryan M	12	6,02
Stahl Bc	12	5,16
Coeckelbergh M	11	7,5
Halme E	11	2,48
Liu Y	11	1,73
Bandel O	10	9,33

### Most Citation

Analysis of the number of citations for a scientific work is a major part of the character of a scientific work. This analysis aims to analyze various scientific works and cited phenomena to determine the characteristics of bibliometric analysis methods. Around 1920, citation analysis began to emerge. In 1927 Gross and his friends first began to undertake quotations in the history of Literature. The scientific articles analyzed consisted of several chemical engineering magazines and chemical education magazines. This citation analysis method

is effective when applied in bibliometric research methods (Qiu et al., 2017). However, citation analysis is currently used more by information scientists and sociologists to study history, the structure of natural sciences, and other scientific disciplines (Shapiro, 2016).

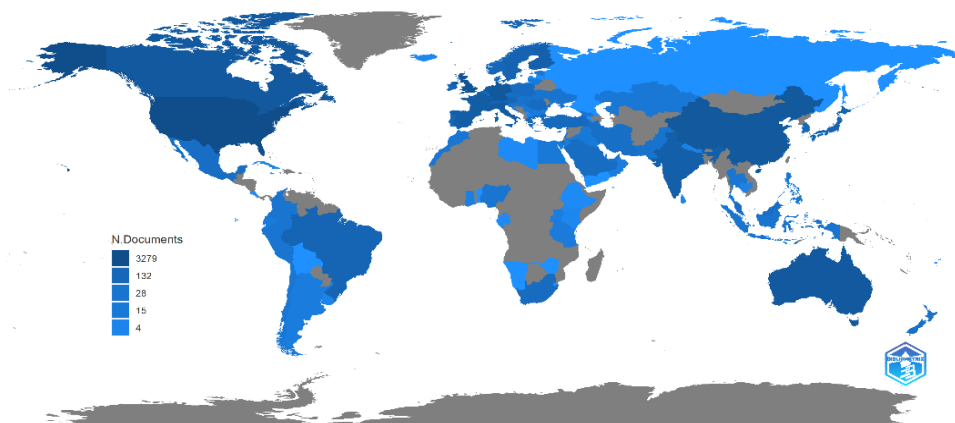
In Figure 2, it can be seen that the researcher whose work was most cited was Floridi L, published in 2004 with 1175 citations. Then followed by Bostrom N in 1996 with 488 citations. Next was Jobin A in 2001 with 427 citations and Anderson M with 408 citations in 2003. Apart from that, in the last position in 1999 there were at least 247 citations with an author named Friedman B.



**Picture 3.** Most Citation.

### Countries' Scientific Production

The results of the bibliometric analysis presented in the figures and tables show that the number of countries contributing to international scientific journals on Islamic education is 65 countries. These countries come from all countries in the world. Country is calculated based on researcher affiliation. For example, if the article was written jointly by 2 researchers from the USA and 2 others from Germany, then 1 USA and 1 Germany will be counted. Based on the results of the bibliometric analysis, it can be seen that the results of the findings are scientific publication data indexed in Scopus and the largest producer of scientific publications in the world regarding artificial intelligence in the USA with a total of 3279 scientific article documents. Then followed by the UK with 1610, Gemany 954, China 843, and Canada 778.



Picture 4. Countries' Scientific Production.

Table 4. Countries' Scientific Production.

Region	Freq	Region	Freq	Region	Freq
Usa	3279	India	370	Belgium	132
Uk	1610	Finland	347	Norway	132
Germany	954	Switzerland	247	Greece	129
China	843	Sweden	216	South Korea	108
Canada	778	Japan	191	Denmark	98
Australia	752	Ireland	171	Turkey	91
Italy	614	Brazil	166	South Africa	74
France	507	Portugal	158	Poland	70
Netherlands	489	Austria	151	Romania	70
Spain	409	Singapore	141	Saudi Arabia	65

**Most Frequent Words**

One of the important steps in bibliometric analysis is identifying the key words that appear most frequently in the literature reviewed. Keyword frequency analysis is one of the first steps that can help you understand developments and key issues in scientific literature related to your research topic in bibliometric analysis.

Apart from global documents, analysis can also be done by looking at keywords that are relevant and widely used in writing this article. Clearly, the keyword that is relevant and frequently used in research is artificial intelligence with 3553 uses of the word, followed by human with 1279 uses of the word.

However, if the results of the keyword documents analyzed using Biblioshiny are diagrammed in the form of a box diagram, it is very clear that artificial intelligence keywords have a very effective percentage with a total of 3553.23%, then human keywords with a total of 1279.8%, and

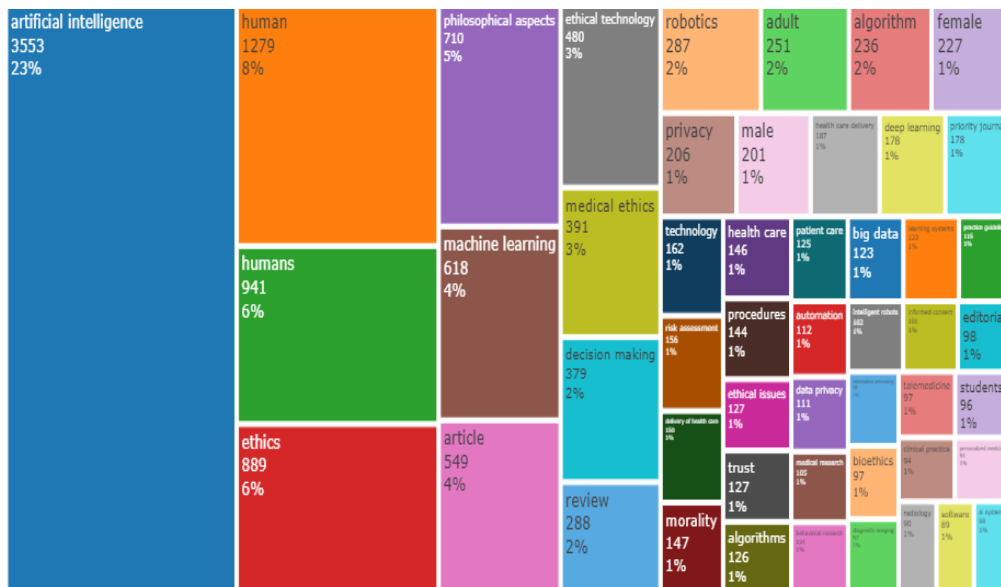
the keywords humans were 941.6%, and ethics were 889.6%.

Table 5. Most Frequent Words.

Words	Occurences
artificial intelligence	3553
human	1279
humans	941
ethics	889
philosophical aspects	710
machine learning	618
article	549
ethical technology	480
medical ethics	391
decision making	379

The frequency with which these concepts are used in articles over the years with the word growth plot. This plot was obtained by following the directions of biblioshiny, document, word dynamics, Field-keyword plus, occurrence-Per year

and a list of their respective stages (Büyükkidik, 2022).

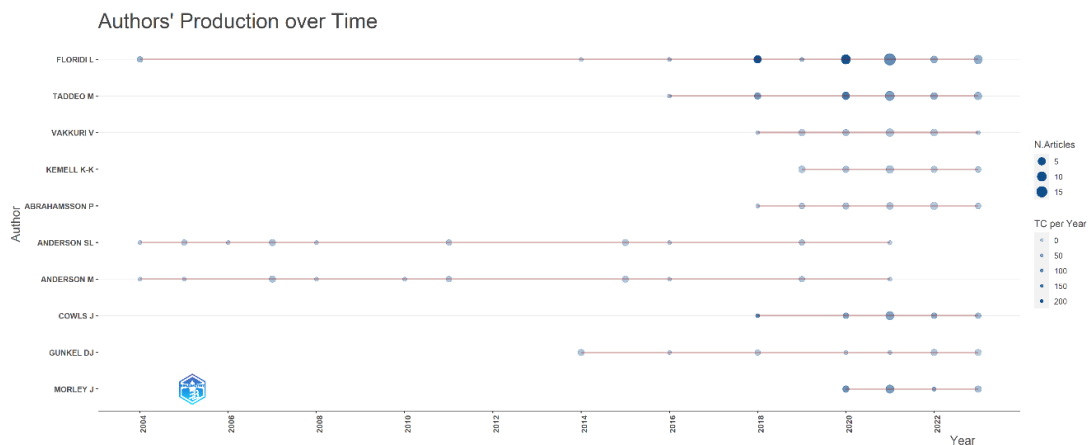


Picture 5. Most Frequent Words.

### Authors' Production over Time

Author production over time is an important component in bibliometric analysis which can help researchers to identify and understand patterns of author productivity in a research field or scientific discipline. In the context of bibliometrics, this analysis involves collecting data about an author's publications from sources such as academic databases and scientific journals, and then analyzing the development of that author's productivity over time.

For the frequency of publication of articles by authors from 2004 to 2023, it is led by Florida L with a total of 2 articles in 2004, 1 article in 2014, 2016 and 2019, 5 articles in 2018, 10 articles in 2020, 19 articles in 2019, 4 articles in 2022, and 8 articles in 2023. And Floridi L is one of the writers who published the most articles in 2021, and is the writer who published the most articles in the last 19 years. Then followed by Anderson SL who published 1 article in 2004, 2006, 2008, 2016, 2021, 2 articles in 2005, 2011, and 2019, 3 articles in 2007, and 2015. The details can be seen in Figure 6.



Picture 6. Authors' Production over Time.

## Conclusion

The presence of Artificial Intelligence (AI) is an element of technological sophistication that is phenomenal at the moment, making researchers interested in conducting in-depth and organized studies. The implication of this research is that we can find out the development and mapping of research publications in the Scopus database on artificial intelligence from 1981-2023 which we can see from bibliometric analysis mapping starting from main information, development of publications, most relevant affiliates, most relevant author, most citations, countries' scientific production, most frequent words, and authors' production over time.

In a period of 42 years, research data or scientific works on artificial intelligence indexed by Scopus from 1981-2023 amounted to 4,477 titles and began to develop from 2001 to 2023. The development of research publications on the topic of artificial intelligence in the period 1981-2023 experienced development which is fluctuating. The institution most active in publishing scientific papers until 2023 on artificial intelligence is the University of Oxford with a total of 220 scientific papers, followed by the University of Toronto with 97 articles, and University College London with 91 scientific papers.

In the most relevant author and most citation sections, the researcher who had the most influence and was most cited was Floridi L with a total of 1175 citations, followed by Bostrom N in 1996 with 488 citations. Meanwhile, the countries in the world that actively publish scientific works on artificial intelligence are the USA with 3279, followed by the United Kingdom (UK) with 1610, and Germany with 954. In the Most Frequent Words section, the keywords that are often used in research are artificial intelligence 3553 times and human with 1279 times. Meanwhile, in the authors' production over time section, Floridi L is the author who has published the most scientific works on artificial intelligence in the last 19 years.

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