

Winds of generative AI: Research trends of digital humanities in computer science publications

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Abstract

Digital Humanities (DH) represent a pivotal evolution in the integration of current technologies, especially Artificial Intelligence (AI) and particularly Generative AI (GenAI), within humanities research. Due to the interdisciplinary nature of DH and its interfaces with computational methods, this paper examines the penetration of DH into Computer Science (CS) publications over the years. This research applied a culturomics approach, using specific search queries in the dblp (computer science bibliography) database to track the emerging trends of DH-related terms in CS research publications from 1990 to 2024. Findings show Cultural Heritage (CH) is being dominant compared to all other DH terms since 1994, while DH has a consistent rising trend since 2006 within CS publications. The study reflects the need for knowledge sharing and joint expertise between researchers to create new knowledge. The implications of this study encourage greater openness of academia to cross-disciplinary publications that may lead to a broader understanding of complex societal and cultural issues.

Keywords: Digital Humanities, dblp (computer science bibliography), cultural heritage, generative artificial intelligence (GenAI), culturomics, interdisciplinary research, emerging research trends.

Introduction and Literature Review

Current technologies, such as artificial intelligence (AI), are challenging the nature of humanity itself by enhancing human capabilities, along with various other aspects (Russ, 2016). These innovative technologies and their impacts are manifested in a wave of multidisciplinary and interdisciplinary research. Digital Humanities (DH) represent a fundamental evolution in the integration of technology within humanities research. Initially emerging as a response to the digitization of texts and the development of online archives, DH has expanded to encompass a multidisciplinary approach that combines traditional scholarship with innovative digital methodologies. This shift highlights the crucial role of advanced computational tools, such as machine learning (ML) and AI, in reshaping research practices and enhancing the interpretation of cultural and historical phenomena (Gefen et al., 2021), as well as augmenting social sciences research (Bryda & Costa, 2023).

Notably, the integration of AI technologies is revolutionizing the ways in which humanities scholars engage with vast digital repositories and textual data. Landmark projects like Google Book Search (Michel et al., 2011) exemplify how digitized collections can facilitate new analytical

frameworks and methodologies, leading to a reevaluation of scholarly engagement within the humanities. Scholars, such as Gregory Crane (1996), have emphasized that these digital collections serve as the "stored record of humanity" (Crane, 2006), underlining their transformative potential for research (Griffin & Hayler, 2018; Maryl et al., 2023).

The purpose of this study is to trace the penetration trends of the field of humanities into publications in the field of computer science (CS). This study is situated within the body of literature on interdisciplinary research (see Newman (2024) for a systematic review) and studies on identifying trends of changes in interdisciplinary research, e.g., Rhoten's (2004) study on interdisciplinary research centers and programs in higher education. Specifically, the field of Humanities interests us due to the rise of the subfield of DH, a field that combines computational tools and methods in the traditional research of disciplines such as literature, history, archaeology, and cultural studies. This process reflects the transition of the humanities into computational thinking by adopting concepts, principles, and ideas from CS (e.g., big data, databases, natural language processing, information retrieval).

As digital practices began to permeate the humanities, researchers increasingly adopted interdisciplinary approaches. This integration allowed scholars to navigate the complexities of digital landscapes while also addressing broader issues of cultural memory and historical documentation. For instance, the recognition that "materiality may certainly affect our construction of knowledge" (Nygren et al., 2016) emphasized the need for a nuanced understanding of both digital and conventional methods in historical research (Bilgil et al., 2022).

DH encompasses a multidisciplinary approach that integrates digital tools and methodologies into humanities research, promoting a shift from traditional scientific cognition to a more inclusive, digital paradigm. Transitions towards multidisciplinary are common in science. For example, the academic field *bioinformatics* that emerged due to the cultural gap between the life sciences (concrete, descriptive, and empirical research) and the biocomputer sciences (abstract, mathematical, and logical research) and its connection through bioinformatics to the fact that work methods and thought processes from the computer sciences can contribute to the understanding of the life sciences, and vice versa. Another example is the emergence of *network analysis*. Originally a subfield of mathematics called *graph theory*, initiated in the 18th century, network analysis has penetrated almost every possible field of study (Segev, 2022). This process of shift and transition of terms is called *concretization* (Vodička, 1982).

In this paper, we study the penetration of DH terms into CS. This goal is somewhat philosophical. Similarly to the aforementioned examples of *bioinformatics* and *network analysis*, processes of discipline penetration are indeed a two-way road, yet it is interesting to trace the computational thinking behind them – can we assume that the penetration of humanities into CS publications is motivated by the wish to understand human history and culture using computational thinking? Answering such a question is beyond the scope of our current study. The opposite direction of how CS themes penetrated humanities publications will be examined in future research.

Research Questions

Within our purpose to investigate the penetration of DH into CS publications, this study examines the following Research Questions (RQs):

RQ1: To what extent did DH themes penetrate CS publications?

RQ2: What are the DH themes trends in CS publications between 1990-2024?

RQ3: How is the current surge of AI studies reflected in the trends of DH themes in CS publications?

RQ4: How does the emergence of generative artificial intelligence (GenAI) influence the trends of DH themes penetration in CS publications?

Methodology

To answer the research questions, we applied the culturomics approach in the sense defined by Michel et al. (2011, p. 181): “Culturomics is the application of high-throughput data collection and analysis to the study of human culture.” Culturomics methodology is not only useful for discourse analysis of large-scale corpora, but also as a tool for mapping and measuring research trends in longitudinal research (Silber-Varod et al., 2019). Culturomics methods are used nowadays in a variety of fields, such as the field of biometrics (Luo et al., 2024). Luo et al. propose to “reframe Culturomics as a cross-level and interdisciplinary science, ranging from the micro to the macro levels, to investigate human behavior and cultural representations in multi-dimensional spaces.” (Luo et al., 2024, p. 4). In this paper, we use culturomics to investigate longitudinal trends of humanities-related research in CS publications, as reflected in the dblp computer science bibliography (<https://dblp.org/>).

The acronym dblp originally stood for DataBase systems and Logic Programming. We chose the dblp repository to examine the emergence of DH research within CS, due to its comprehensive collection of CS publications, which is not restricted to a specific publisher. The dblp repository provides results only for the terms that appear in the title or the metadata of the articles, not in the body of the articles. We find this attribute useful for our study because it assures the relevance of the search results to the query term. We designed the following set of search queries to create the dataset for the current study (*dataset building* uses certain keywords as search queries that construct a sub-dataset relevant for the researcher).

Set of search queries

The following five terms represent the main DH themes we looked at:

1. *Computational Social Sciences*
2. *Cultural Heritage*
3. *Digital Humanities*
4. *Humanities Computing*
5. *Literary Computing* (Aarseth, 2013; Bateman, 2021)

We added Cultural Heritage (CH) to the DH themes due to the strong link between cultural heritage artifacts and research in the humanities. For example, archeological sites, art, and music.

In light of technological developments of the past two years, we wanted to examine the impact of AI on the aforementioned publications and therefore combined the terms Artificial Intelligence and Generative AI in the searches. As a first step, we examined these terms separately:

6. *Artificial Intelligence*

7. *Generative AI*

We then created a set of all combinations of the five terms representing the main DH themes with the two AI terms. This resulted in a list of 10 more search queries (for example, *digital humanities* and *artificial intelligence*).

These search queries were written without quotation marks since dblp ignores them. Note that we did not search for the abbreviation “AI” in dblp for artificial intelligence, although we checked and saw that there is a substantive number of articles with “AI” in their title without its full explicit string. We did not include “AI” in our results because dblp includes in the results of the query parts of authors’ names, journal titles, and other items without allowing for filtering them out. The same goes for the query “GenAI”. This string was found not relevant in dblp. Over the years, the search results showed that the string “genai” was also part of authors’ names. In 2023, we manually examined the results of the query “GenAI” and found 15 relevant results out of 28 (the other 13 matches were part of authors’ names); in 2024, 155 matches were found, most of them with GenAI in publication titles.

Regarding the time span, we covered publications from 1990 until 2024 to compare trends over time. To provide a comprehensive overview, we also examined the first year that each query term appeared in dblp (see Table 1). Searches for the years 1990-2023 were carried out during November 2024. Searches for 2024 were carried out during January 2025. We are aware of minor changes in the number of publications’ results depending on the date of query, probably due to dblp repository updates. We therefore acknowledge that an exact replication of our results is not possible. Nevertheless, these results are adequate for identifying trends.

Normalization

For normalizing the results and controlling for the general growth in publications over the years, we divided the raw data of the search results by the total number of publications in dblp per year. This way we got relative results. The total number of publications per year in dblp is published online (<https://dblp.org/statistics/publicationsperyear.html>).

Results

In the following, we will present noteworthy findings with regard to our research questions on the penetration of DH into publications in the field of CS. Table 1 presents the first year that a search query term appeared in dblp and the total number of publications of each query over the years (1990-2024). As expected, *Artificial Intelligence* is the oldest term and has six exact matches in publication titles in 1962. *Generative AI* appeared for the first time as a single book’s chapter in 2011 (van der Zant et al., 2013). Note that on Google Scholar, this book was published in 2013.

As for the DH terms, *Cultural Heritage* appeared first in 1978. Computing in the Humanities is “a thing” in 1977 (Lusignan & North (Eds.), 1977, according to dblp it was published in 1979). But Busa (1980) published the first paper with the exact *Humanities Computing* term. *Literary*

Computing was first founded in 1988, while eight years later, in 1996, digital studies in the Humanities appeared (Crane, 1996). However, the exact match of *Digital Humanities* is found only in 2006 (e.g., Cantara, 2006). The words *Computational Social Sciences* appear in one title in 2005, but the exact match in a title appears only in 2016 (Sagarra et al., 2016).

The combination of *AI* and *CH* is earlier than *AI* and *DH*, 2003 and 2021, respectively. Only in 2024 do we see the combined terms: *DH* and *GenAI*, and *CH* and *GenAI*.

Table 1. First Year of Appearance in a Title and the Total Publications of Each Query

Search query	First year in a publication title	Total publications over the years (1990-2024)
Artificial Intelligence	1962	23,529
Cultural Heritage	1978	3,715
Humanities Computing	1980	97
Literary Computing	1988	4
Cultural Heritage; Artificial Intelligence (including AI)	2003	34
Computational Social Sciences	2005	35
Digital Humanities	2006	1,298
Generative AI	2011/2013	2,342
Digital Humanities; Artificial Intelligence (including AI)	2021	5
Digital Humanities; Generative AI (including GenAI)	2024	15
Cultural Heritage; Generative AI (including GenAI)	2024	64

Figure 1 and Figure 2 present the relative frequencies of the Humanities terms and the CS terms, respectively, over the years. Figure 1 shows clearly the interchange of the terminology. During 1990-1993, Humanities computing was dominant, and since 1994, CH has been dominant until the present day. A brief example of the importance of CH and the wide interest in CH within CS publications is the 72 results of CH in 2001. Among which, 48 are proceedings papers of the Virtual Reality, Archeology, and Cultural Heritage 2001 conference in Glyfada, Greece. DH has a consistently rising trend, but with a lower linear regression compared to the CH trend ($R^2 = 0.623$ and $R^2 = 0.873$, respectively).

Figure 2 shows clearly the “AI winter” of the 1990s and early 2000s (Haigh, 2023). According to the findings, only in 2019, publications on AI reached their top ratios compared to previous years, and they have been growing exponentially ever since.

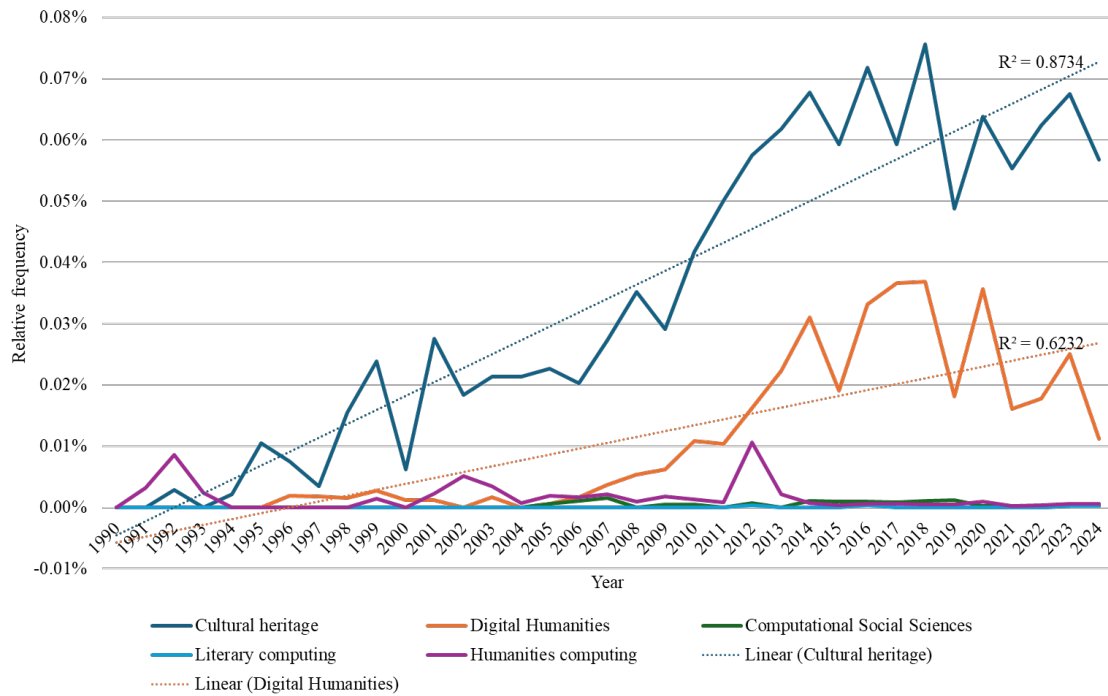


Figure 1. Relative frequency of the Humanities terms in dblp

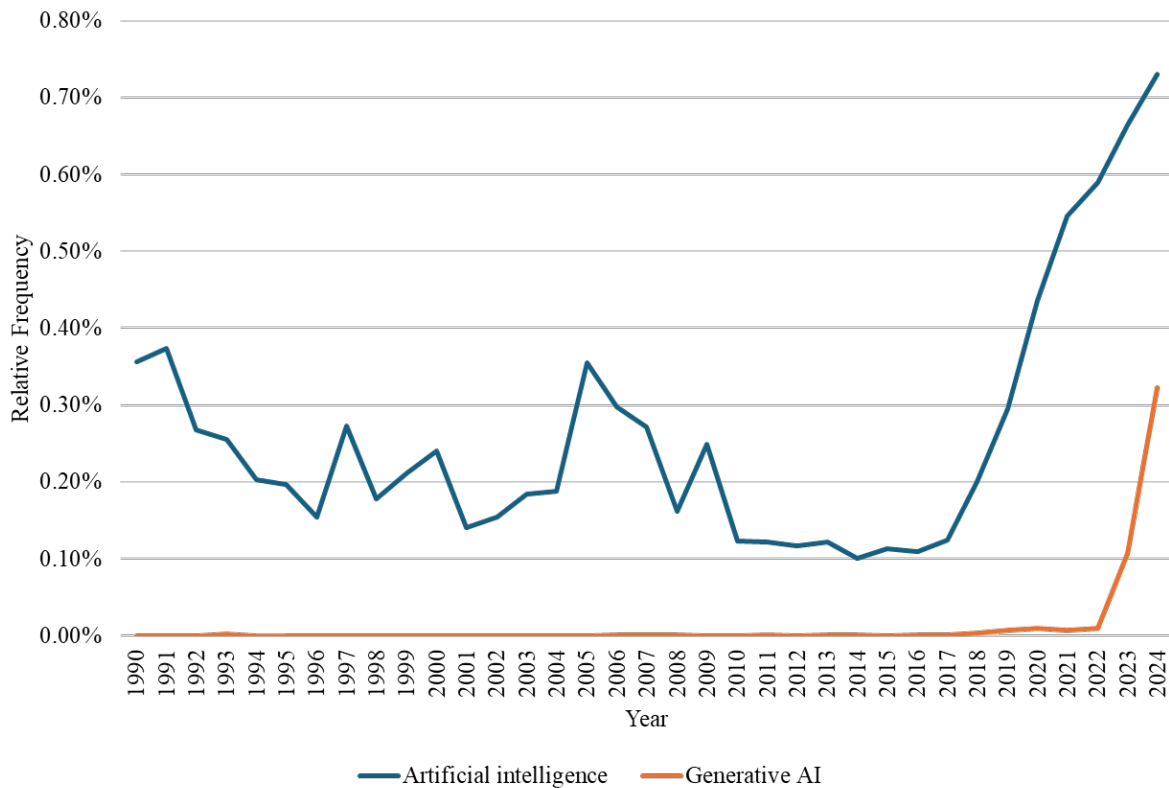


Figure 2. Relative frequency of the terms: Artificial Intelligence; Generative AI, in dblp

Table 2 presents the correlation of each humanistic term query with AI results. It seems that the positive correlations are higher for the two main terms (i.e., CH and DH) compared to the three other Humanities terms. Further, as shown in Table 1, these other Humanities terms (i.e., Literary computing, Computational social sciences, and humanities computing) are rarely mentioned in dblp. Therefore, the following analysis focuses on DH and CH.

Table 2. Correlation coefficient of Humanities terms with Artificial Intelligence

Humanities Term	Correlation coefficient with Artificial Intelligence
Cultural heritage	0.771
Digital humanities	0.570
Literary computing	0.473
Computational social sciences	0.132
Humanities computing	0.009

In recent years, the findings of the combination of the prevalent Humanities terms (DH and CH) with the CS terms (AI and GenAI) show that the combinations still do not constitute a high percentage (Figure 3 and Figure 4). The trends suggest that these combinations will rapidly increase in the coming years. Figure 3 shows “CH and AI” trends from 2020 until 2024 (22 publications). Though 6 sporadic publications have appeared already since 2003. Between 2020-2024, we also included the abbreviation AI in the search queries because we noticed that the abbreviation was becoming more common, and we did not want to ignore this linguistic trend. The calculations in Figure 3 and Figure 4 are the ratio between the results of the pair of queries: “CH/DH; Artificial Intelligence” and “CH/DH; AI” divided by the total number of CH/DH publications. Due to the use of the AI abbreviations, the results were manually checked. As for the combination with GenAI, CH+GenAI appears only 6 times in 2024, and GenAI+DH appears only 3 times in 2024.

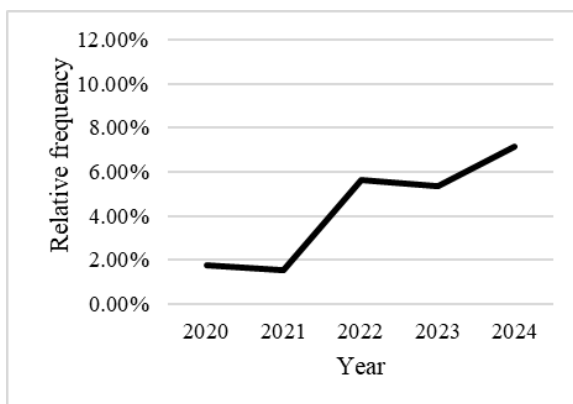


Figure 3. Relative frequencies of the ratio between complex search query CH+AI (including full and abbreviation AI) divided by CH query results.

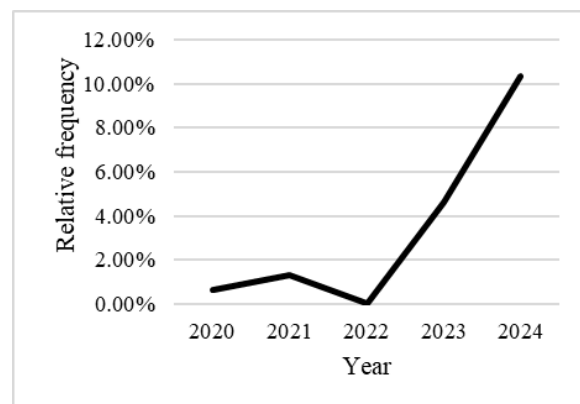


Figure 4. Relative frequencies of the ratio between complex search query DH+AI (including full and abbreviation AI) divided by DH query results.

Discussion

Although DH is attracting wide attention in Humanities research, few studies have investigated its integration in the CS research contexts. To gain a deeper understanding of the integration of DH in CS publications, we examined the penetration of Humanities into CS by quantifying publication titles that were published between 1990 and 2024. We adopted a Culturomics approach that, according to Silber-Varod et al. (2019), enables tracing longitudinal trends of specific research themes, as well as identifying potential themes that require further research. The current research demonstrates how culturomics may be utilized for exploring interconnectedness between research fields and themes.

Our findings show that the year 2024 is a turning point for DH research in CS publications. The moment GenAI emerged as a ubiquitous term, we saw a big leap for DH. This might be related to the fact that GenAI tools are based on Large Language Models (LLMs) abilities for interpretive analysis that were designed for text analysis. Hence, GenAI is an innovation that the field of DH quickly adopted.

Regarding our research questions, our findings show that DH themes only marginally penetrated CS publications until 2015. Since 2015, there has been a relatively massive, though unstable, increase in this trend. These findings answer RQ1 and RQ2. On the other hand, the relative increase in AI occurred only in 2018. Following these findings, we suggest the joint occurrence of AI and DH or AI and CH publications was most dominant in 2023-2024 and that it might be attributed to the emergence of GenAI. The findings also showed that AI studies have existed since the 1960s, and we did see a positive high correlation between the number of publications of the two main humanistic terms and the relative frequency of AI titles. Our findings suggest that the rise of AI and GenAI technologies has likely led to an increase in DH and CH publications in dblp. These findings answer RQ3 and RQ4.

Limitations

We followed systematic and objective methods. However, our study focused only on publications where the search terms appeared in titles or metadata, potentially missing relevant articles that mention these terms in the body text. Moreover, the dblp database contains mainly publications in English, which predominantly represent the global Western academic culture. On the other hand, if the terms appear in the title, it means that the articles are focused on those terms. Moreover, separate queries and queries with abbreviations make it difficult to interpret the results because they include part of the metadata, such as the author's name. Therefore, the results provide trends and not absolute accuracy.

Future research

Interdisciplinary and cross-disciplinary research is a two-way road. While this study examined the penetration of DH into CS publications, it remains for future research to explore how, and when, an inverse movement happened – i.e., for future research, we intend to further expand this study by presenting the contents through the lens of the humanities and social sciences.

Beyond the current approach, analyzing authors' institutional affiliations offers another approach to assess the interconnection between fields, potentially revealing shifts in interdisciplinary

collaborative patterns. In this context, the 6-D model (Hofstede et al., 2010) may provide a structured way to analyze the influence of the national cultural backgrounds of researchers (as derived from their academic institutions or affiliations). A future study may show how Hofstede et al.'s (2010) model can be used as a theoretical basis for explaining how cultural background is shaping interdisciplinary research in the Digital Humanities.

Conclusions

The new developments in the fields of AI, particularly GenAI, create a breakthrough for research in the fields of Humanities and Social Sciences (Messeri & Crockett, 2024). However, to fulfill the potential of this advancement, the academic establishment also needs to be open to the acceptance of cross-disciplinary and interdisciplinary research. Messeri and Crockett (2024, p. 56) refer to the training of future scientists needed for dealing with the epistemic risks of AI and suggest that it "will require not only technical education, but also exposure to scholarship in science and technology studies, social epistemology, and philosophy of science." This yields the conclusion that scholars must acquire new skills to remain relevant in the labor market (Russ, 2017). However, knowledge sharing and interdisciplinary approaches are drivers of change. This is shown clearly through our study in the case of cultural heritage and the enormous contribution of CS to it. Noteworthy are EU grant opportunities that show growth in this direction (EU Funding and Tenders Portal, 2023).

Our research contributes to academic research by demonstrating the interdisciplinary and cross-disciplinary increasing penetration trends of DH into CS publications, which reflect the need for knowledge sharing and joint expertise between researchers to create new knowledge. The implications of the current study encourage greater openness of academia to cross-disciplinary publications that could lead to more comprehensive research outcomes, increased collaboration between experts from different fields, development of new research methodologies and tools; and a broader understanding of complex societal and cultural issues.

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