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Artificial Intelligence in Libraries: Reshaping the Way, We Access, Organize, and Experience Knowledge

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ABSTRACT

Libraries have always been something more than just a building with books; they have been a dynamic organization, adapting to the changing world. Recently, however, Artificial Intelligence has begun to subtly, yet significantly, impact the way in which libraries operate. Be it the way in which information is cataloged, the way in which users interact with this information, or the way in which users are recommended this information according to their individual interests, Artificial Intelligence is changing the library experience from the inside out. The intent of this paper is to look at the ways in which Artificial Intelligence is being utilized in the real world to operate libraries, the benefits and detriments to this, and what this may all mean in the future. Special consideration is given to the human element of this equation. The intent is to show that, rather than taking a binary approach to Artificial Intelligence, in which it is either the answer to all problems or the problem itself, a more nuanced approach is necessary.

KEYWORDS: artificial intelligence, libraries, information retrieval, machine learning, natural language processing, digital preservation, ethical AI.

1. INTRODUCTION

Go to any library in the world. Take a look around. You'll probably notice that the traditional lines at the circulation desk to check out books have been replaced by self-service kiosks. You'll probably notice that digital catalog systems now respond to natural language queries. You'll probably notice that chat windows now provide instant reference help 24/7. But behind the scenes, algorithms are at work suggesting books to readers, tracking overdue books, and even predicting what books might be in demand next season. This is not the future of libraries. This is the present.

Artificial Intelligence, broadly defined as the ability of machines to perform tasks that would otherwise require human intelligence to accomplish, has found a home in library environments. Libraries by their very nature are

information-based organizations. They gather information. They organize information. They maintain information. They disseminate information. This is precisely what Artificial Intelligence-based systems increasingly help to accomplish. But the use of Artificial Intelligence in libraries is more than just a "technology" story. It's a "story" about organizations reinventing themselves in a digital world. It's a "story" about people reinventing themselves in a digital world. It's a "story" about communities.

This paper takes this full picture seriously. Section 2 will be a literature review, Section 3 a survey of the areas of application, with examples drawn from libraries across the world, Section 4 a review of the benefits, some of which will be obvious, some not so obvious, Section 5 a frank look at the challenges, especially the ethical ones, which perhaps have not always been given the attention they deserve, and Section 6 a look at where this whole area of AI-assisted library development might be going.

2. LITERATURE REVIEW

There was a noticeable surge in the number of publications in academic literature with regards to AI in library and information science in recent times, from initial discussions on its application in certain areas to more recent discussions on its potential impact on the very existence of the field.

For instance, in 2018, Breeding wrote an article that discussed the potential impact of AI in library technology vendors' discovery platforms. This was in line with what was to be expected in that AI would be able to learn and thus make its searches more relevant. At around this same period, studies published in the Journal of the American Society for Information Science and Technology were commencing an investigation into whether natural language processing would be able to assist in refining metadata and bridge the gap between controlled vocabulary and what users themselves might use in searches.

The chatbot and virtual reference service issue was also very prominent in 2016 and later. This was at a period in which the general public was also showing interest in chatbots.

A very pertinent investigation was done by Lund & Wang (2023) with regards to AI-generated content in academic library settings. They also asked this question, which is now more pertinent than ever. Ethics has emerged as a major theme in contemporary literature. The studies by Bali and Bhatt (2020) and Kaushik and Arora (2021) focus on the potential for perpetuating existing inequalities in terms of access to information, which is linked to the bias inherent in algorithms. The literature on privacy, as far as libraries are concerned, has been a major concern within the profession. This has now been extended to incorporate the tension between the values represented by AI's role in data collection/behavioral analysis and those of confidentiality.

The overall impression that is given by this literature is that the profession is indeed enthusiastic about the potential offered by AI, but at the same time is becoming more aware of the potential dangers that are represented by unthinking adoption. The most thoughtful literature that has been reviewed within this debate is that which promotes an equity/justice approach to the implementation of AI, which is a position that this paper endorses.

3. RESEARCH METHODOLOGY

In order to identify the literature, a systematic research methodology will be followed, with an emphasis on the parameters of the research. The terms that will be used for the purpose of conducting the literature search are as follows: Artificial Intelligence in Libraries, Machine Learning Library and Information Science, AI-Powered Cataloging, Intelligent Library Systems, Natural Language Processing in Libraries, Chatbots Library Services, Automated Collection Management, etc. The Boolean terms will be used to obtain the maximum number of combinations of the terms, as there are various applications of AI for various purposes of libraries. To filter the literature, the time parameters will be used, with an emphasis on the literature published during the period of 2015 to the present, as there has been tremendous growth of AI during this period. The language parameters will be used, with an emphasis on the English language, as it will provide more consistent analysis of the data. To check the credibility of the literature, relevance, credibility of the source, number of citations, relevance to the research study, etc. will be taken into consideration.

4. APPLICATIONS OF AI IN LIBRARIES

It is not possible to talk about the application of AI in libraries in general terms. AI is used in various functions with different characteristics. The following is an overview of the most important functions in which AI is applied in libraries.

4.1 Automated Cataloging and Metadata Generation

One of the painstaking processes that librarians have been undertaking has been the cataloging of library materials. This process involves creating metadata to ensure that library resources can easily be accessed. This process has been significantly improved by the introduction of AI technologies that ensure metadata is created based on the text of the document. This has proved to be successful in suggesting subject headings, classification numbers, and even suggesting related works. The machine learning technologies have proved to be impressive in their accuracy, especially when they are trained on large databases containing existing catalogs. This technology has proved to be successful in handling large quantities of digital materials that would otherwise be overwhelming to human catalogers.

The Library of Congress has been at the forefront in testing AI technologies that ensure the cataloging process is improved. This technology has proved to be successful in ensuring that the time taken in the cataloging process is significantly reduced. However, it is important to note that human involvement is still essential in the process since AI technologies have been shown to produce inaccurate information that may sound plausible.

4.2 Intelligent Search and Information Retrieval

In the past, library catalogs have used a rather rigid system based on keyword matching. That is to say, a patron of the library attempting to locate information on 'heart disease' would not necessarily locate information on 'cardiovascular illness' unless the system was specifically set up to cross-reference these keywords. By contrast, modern library discovery systems based on AI technologies are far more flexible. Not only can they locate information based on keywords, but they can also locate information based on the intent behind the keywords.

All three largest library system vendors have incorporated machine learning into their discovery system. This allows users to have a far more intuitive experience, especially if they have no formal training in library science.

4.3 Chatbots and Virtual Reference Services

Reference services, answering patrons' questions, providing guidance on research, or suggesting resources are some of the most uniquely human tasks that librarians are engaged in. AI has begun to be used in this area as well, though not as intuitively as one might have hoped.

Chatbots powered by large language models have been proven to be highly effective at answering a vast range of basic reference questions. Some academic libraries have already started to use AI chatbots that are capable of providing patrons with step-by-step guidance on how to go about their research. These are clearly useful tools that extend reference services to 2 am when no librarian is available.

The problems with chatbots are that they are not effective at answering complex questions or providing accurate yet incorrect answers. These are critical problems that make chatbots not very useful for research. The most successful use of chatbots has been by libraries that have used it as a first line of reference.

4.4 Personalized Recommendation Systems

Any user of online services such as a streaming service or online bookstore is familiar with recommendation algorithms. Libraries have adapted this technology to their own needs. Depending upon the patron's borrowing history, interests expressed, or even browsing activity within the library's online environment, patrons can be provided with books, articles, or other materials that they are likely to find of interest.

Recommendation systems have been enthusiastically adopted within public library environments for reader advisory services. For instance, they can assist patrons in finding fiction that they might enjoy reading. In academic library environments, personalized alerts for patrons related to newly acquired resources within their area of specialization have been enthusiastically accepted. The difficulty for designers of these systems is to achieve a balance between personalization and serendipity; that is to say, a system that only provides patrons with what they already know they will like may be limiting the kind of serendipity that libraries have traditionally excelled at.

4.5 Digital Preservation and Archiving

One of the less glamorous but certainly important issues for modern libraries to deal with is what to do with digital collections in the long term. AI is also helping with this in several ways, from identifying duplicate or near-duplicate media to automatically producing transcriptions to aid in accessibility, to even helping archivists prioritize what to digitize based on potential research value.

Optical character recognition has revolutionized the process of making scanned historical documents accessible in a way that is actually cost-effective. Handwriting recognition is also helping to make manuscript collections accessible to researchers for the first time because they've largely remained hidden due to a lack of resources to transcribe them. I think this is perhaps the most obviously transformative way in which AI is being used in libraries, not to perform a task in place of a human but to perform a task that would not be possible at all without it.

5. BENEFITS OF AI INTEGRATION IN LIBRARIES

The reason behind the use of AI in libraries is supported by a number of extremely strong arguments, all of which have their roots in the real world.

Of course, first and foremost, there is the issue of efficiency. Many processes which used to require skilled laborers hours to accomplish, such as cataloging a collection of donated materials, working through a backlog of digital objects, or answering the same question over and over again, now require less time and less money with the assistance of AI. Of course, this is not to say anything against the skilled laborers; rather, it is to say that they have more time to focus on the complex relationship-building and judgment-requiring work which they are uniquely suited to accomplish.

Of course, another important advantage is the issue of availability. Most libraries cannot afford to have a reference desk open twenty-four hours a day. A chatbot, on the other hand, is able to provide meaningful assistance even at off-peak times, particularly with regard to procedural questions which make up so large a percentage of reference questions.It also has the potential to address equity of access. For a patron who may not be comfortable using the formal library search tools, a more forgiving interface will be beneficial. Recommendation services can give patrons access to material that they might not have even considered looking for. The transcription services for the visually impaired are not to be taken lightly.

Lastly, there is the issue of the data that is created by the use of AI. What are the most used collections? What are the areas of study that are under-served? What are the research needs at different times of the academic year? Good data is the foundation of good decision-making.

6. CHALLENGES AND ETHICAL CONSIDERATIONS

Any discussion of AI in libraries would not be complete without considering the challenges. Some of these challenges, as we shall shortly see, extend beyond the technical to some of the very values at the heart of the library profession.

6.1 Data Privacy and Patron Confidentiality

The tradition of patron confidentiality is a proud one for libraries. The idea that a person reads or searches for certain topics is private information, especially in this era of surveillance capitalism. AIs are, by definition, learning tools that learn from their users. This means they are creating detailed records of their users. The question of what this means, how this information is stored, who has access to this information, and how this information is used is not a technical question; it is an ethical question, especially within a library setting. Libraries that are using AIs have a responsibility to uphold the same level of ethics with AI systems as we do with circulation records. This means that we do not collect more information than necessary, we are transparent about what we do collect, and we do not allow vendors to use this information for any reason other than what we have agreed to.

6.2 Algorithmic Bias and Equity

One of the most important aspects of AI is that it learns from the information it is given. The information it is given, in turn, is the world as it is, not the world as it should be. A catalog system will be based on the assumptions it has been fed, which come from library records. A search system will be based on the assumptions it has been fed, which come from users. If there have been communities in the library system that have been less well-served, it is likely the AI will be as well.

There has already been research done on the biases in hiring algorithms, facial recognition algorithms, and medical diagnosis algorithms. There is no reason to believe library algorithms will be any different.
In order to eliminate biases in library software, there will be a need to examine the algorithms it is using, as well as the communities it might be serving.

6.3 Cost and Institutional Capacity

There can be no doubt that the introduction of AI technology is not without its cost. While this can be considerable in the case of licensing sophisticated discovery systems, chatbot software, or preservation tools, it can also be beyond the reach of smaller libraries that, in many cases, serve the most needy communities.
There is a very real danger that any benefits in the quality of library service that AI can bring will, in the first instance, be enjoyed by the better-resourced libraries, thus reinforcing an existing divide.
How this is to be addressed is a complex issue.

6.4 Staff Roles and Workforce Transition

Library staff have a reasonable interest in understanding how their work will change with the advent of AI. The answer to that is that we don't really know how their work will change, although some of their work will be automated and some of their work will change in kind. There will also be some kinds of work that we have not yet thought of. All of that will require investment in training and development, and it will require that we engage our staff in a meaningful way in discussions of how we will use AI, not just present it to them as a fait accompli.

7. FUTURE DIRECTIONS

The trajectory of development for AI indicates that expansion will continue on the role that AI plays within libraries. What this will mean will be up to library communities, vendors, and policymakers to decide.
Consider what could be done with search engines that are semantic or contextual. These search engines currently allow people to find documents that match their query. The next generation could allow people to find answers to questions by synthesizing answers from multiple sources. This would make them research assistants. This has implications for who is an authority or a librarian who helps people find quality sources.

Consider multimodal AI that not only works with text but also images, sounds, and videos. This could have implications for libraries that have large holdings of audiovisual materials. Description, transcription, and subject analysis could unlock doors to materials that are barely accessible at present.

The potential integration with other emerging technologies such as linked data technologies, digital humanities, and open knowledge approaches also has the potential to significantly impact how library collections relate to one another and to the world at large. It may become possible to easily move back and forth between an archive in one place, a library database in another place, and a primary source collection held privately, with AI helping to facilitate these movements.

Perhaps the most important question is how the future of AI in libraries depends on the profession's efforts to shape it. Libraries that become engaged in standards development, in research on algorithmic fairness, and in advocating

for vendor accountability will be in a stronger position to ensure that AI supports library values rather than supplanting them.

CONCLUSION

Libraries are no stranger to change. The evolution from handwritten card catalogs to card catalogs to online databases was not an easy one. Each step forward was a step into the unknown and was anxiety-provoking. Each step forward was a step into more and better service to our communities. AI is no different.

The difference in our current situation is not in the nature of the changes we face but in scope and in the way technology determines its own course in ways that impact us. That is why our relationship with AI cannot be passive. It is not enough to use technology created by others for purposes other than our own and hope that it aligns with our values. Libraries must be active participants in the creation and governance of AI.

If done thoughtfully, AI has the potential to bring to libraries a true chance: to serve more people, more effectively, more personally, and to free the skilled professionals at their heart to do the deeply human work that has always been at the heart of the profession. That's a future worth working towards – thoughtfully, critically, and with real partnership with the communities that they exist to serve.

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