Application of Artificial Intelligence on Library System, Operations and Services

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Abstract

This paper is going to aware in the field of Artificial Intelligence focusing on how it's applied in the Library world. The concept such as machine learning, deep learning and their various applications by Technique is enumerated. In this paper an attempt has been made to identify the different applications of Artificial Intelligence into the libraries. The various concepts such as expert system, natural language processing, pattern recognition and robotics and their application to the library operation and services have been explained thoroughly. The advantages and disadvantages of Artificial Intelligence have also been discussed.

Keywords: Consciousness; artificial intelligence; machine learning; deep learning, expert system, natural language processing, pattern recognition and robotics

1. Introduction

The father of Artificial Intelligence, John McCarthy, said "Every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions, and concepts, solve kinds of problems now reserved for humans, and improve themselves". Artificial Intelligence draws heavily on different domains of studies like Computer Science, Cognitive Science, Engineering, Ethics, Linguistics, Logic, Mathematics, Natural Sciences, Philosophy, Physiology, Psychology, Statistics, Library and Information Science. The concept of Artificial Intelligence is not a new and it was first coined way back in 1956 by John McCarthy, a professor at Dartmouth. For years, it was thought that computers would never match the power of the human brain, but this has proven to not be the case. Well, back then we did not have enough data and computation power, but now with Big Data coming into existence and with the advent of GPUs, Artificial Intelligence is possible. We know that 90% of the world's data has been generated in the past three years alone. Computers can make sense of all this information more quickly. Very soon, we can see Artificial Intelligence being a little less artificial and a lot more intelligent.

2. Literature Review

Asemi & Asemi (2018) have surveyed applications of AI in library and information science and introduce the potential of library system to apply AI techniques. They applied Exploratory Factor Analysis (EFA) as a primer method for identification of the most applicable AI techniques categories in LIS. They showed that most developed Recommender Systems (RM) in library systems in Iran and Natural Language Processing (NLP) is the most undeveloped criterion. **Massis (2018)** examined artificial intelligence (AI) and its potential relationship to the library. He presented a look at the potential of using AI in the library and discussed its potential benefits. **Wheatley & Hervieux (2019)** reviewed scholarly articles, university libraries' strategic plans, and library programming to determine if any reference to AI was being made and in what context. Top research universities in the United States and Canada were considered. The primary goal was to discover what role the librarian would play in an AI-dominant future, as well as how libraries are responding to this change. **Adejo and Misau (2021)** focused on the application of Artificial intelligence in Academic libraries in Nigeria. They showed that AI could be applied in Academic library services in Nigeria like Expert Systems in Reference Services, Technical, Indexing, Acquisition and its application in Natural Language Processing, Pattern Recognition and Robotics in library activities. **Cox (2022)** focused on the application of AI to knowledge discovery. Eleven different potential approaches libraries might adopt to such AI applications are analyzed and their likelihood evaluated. In addition, he contributed to understanding how to synthesize the competencies literature with the theory of the profession and presents a new understanding of libraries as hybrid.

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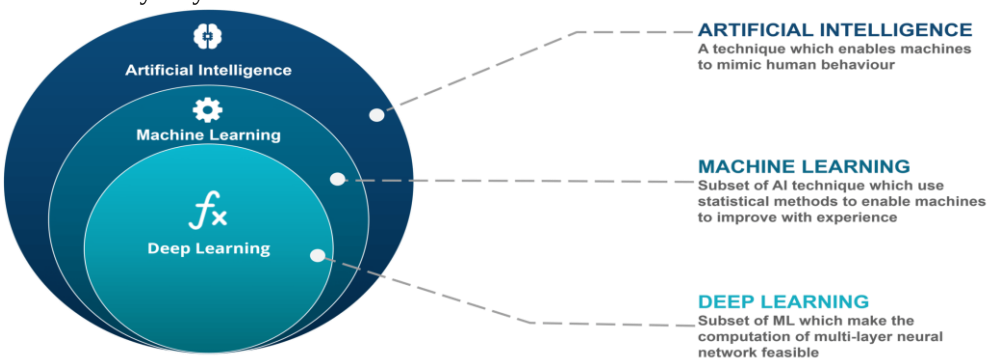
3. Need of Artificial Intelligence

There must be some reasons behind its need. Let us first see the differences between these two traditional Computer programs vs. Human Intelligence. As it's identified that normal humans have the same intellectual mechanisms and the intelligence is related to "quantitative biochemical and physiological conditions". Traditionally, we use computer to computing for performing mechanical computations using fixed procedures. Also, there are more complex problems which we need to solve. There are some examples like Computers have more trouble in understanding a specific situation, unlike humans. Also, we need AI to make machines think and tackle such complex assignments. Artificial Intelligence Technique involves data which is in huge volume, next to unimaginable and Data is not well-organized or well-formatted. Although, it keeps changing constantly.

4. Concept of Artificial Intelligence

Artificial Intelligence is the broader umbrella under which **Machine Learning** and **Deep Learning** come. And you can also see from the below diagram that even deep learning is a subset of Machine Learning. So all three of them AI, machine learning and deep learning are just the subsets of each other. Now let us try to understand how exactly they are different from each other.



4.1 Machine Learning

Machine Learning is a field in Data Science, where machines can "learn" themselves, without being explicitly programmed by humans. By analysing past data called "training data", the Machine Learning model forms patterns and uses these patterns to learn and make future predictions. The precision of predictions made using ML models has been increasing every day. Machine Learning Techniques can be used in practically every field now these days. The main techniques of Machine Learning are Regression, Classification, Clustering, Recommendation Systems, Anomaly Detection, Dimensionality Reduction and Forecasting. Similarly, each of the use cases can look into by Industry, by Business Function and by Technique.

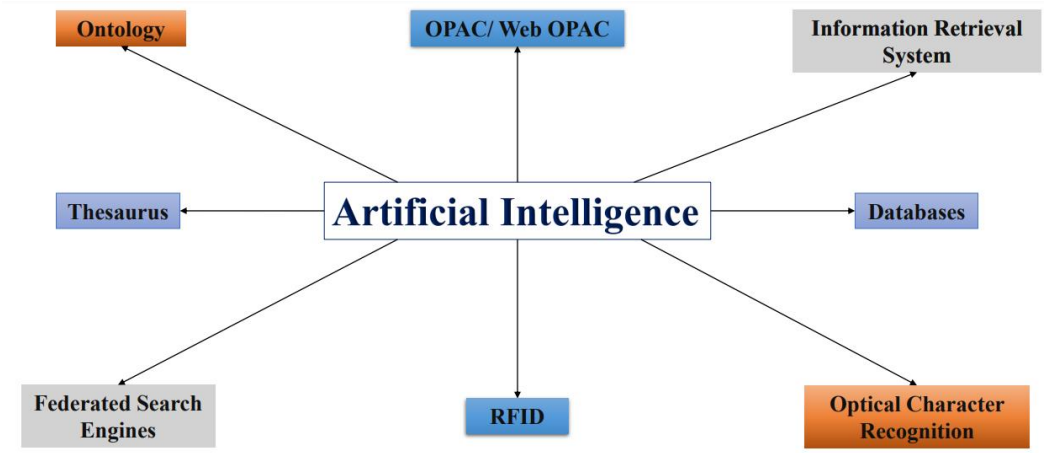
- BFSI: Credit scoring is based on customer behaviour of purchasing. In Fraud Detection the Bank can detect a fraud by following the money transaction and there automatically give a warning alert to the customer that there may be a fraud is here.
- Manufacturing: Manufacturing has a predictive maintenance like when a machine fails and then you have to fix it. But in machine learning approach we have to predict where the next failure is going to happen and at what time and which machine is going to fail.
- Retail: Whenever you call to customer care, the customer care guys already know your last purchase, latest update or your interests and based of this they guide you some other products which you might take.
- Health care: Health care based on lots of attributes different tumour we can predict cancer.
- Insurance: The claim of money predicts the increase price value.
- Education: In education if you, again and again, check your plagiarism, automatically your score will increase.
- Customer Analytics: In Retail, if we trying to understand more about your customer, customer churn, customer model, customer lifetime value.

4.2 Deep Learning

Deep Learning is a branch of Artificial Intelligence that is producing life-changing results. Deep Learning means neural networks with a large number of hidden layers. It is an attempt to replicate the functioning of a human brain. Just like the exact functioning of a human brain is unknown, not much is known about the exact working of Deep Learning too. Deep Nets, we will be closer to understanding how a human brain works. Today, Deep Learning has applications in Natural Language Processing, Image Recognition, Spam Filtering, Fraud Detection, etc.

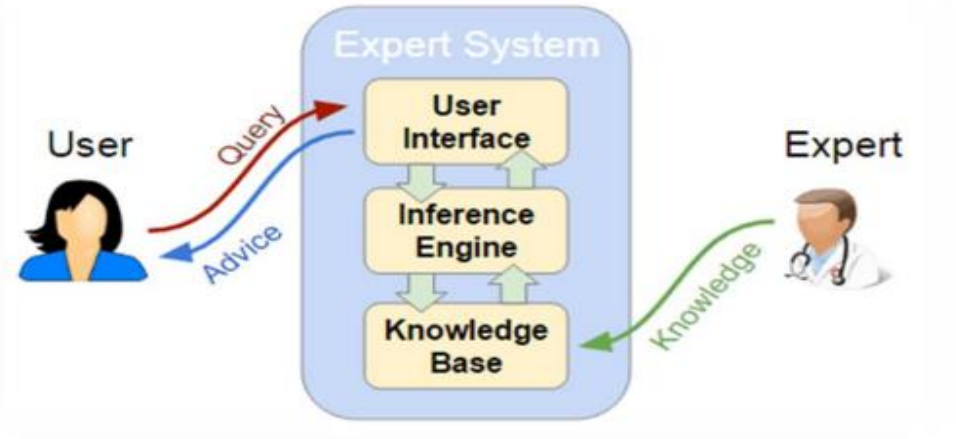
5.Artificial Intelligence and its applications in Libraries:

Computers provide the perfect medium for the experimentation and application of Artificial Intelligence technology in the present era. AI has more success at intellectual tasks such as computer based game playing and theorem proving than perceptual tasks. Sometimes these computer programs are intended to stimulate human behaviour and they are built for technological applications also such as Computer aided instruction (CAI).In many cases the main goal is to find any technique that does the task quick in the better way.



5.1 Application of Expert System in Library Activities:

Library activities related to the reading materials, users and staff. The application of Expert Systems where dialogue between staff and users, users and database appears quite promising. A well programmed Expert System will also improve the quality. A computer program that provides expert advice, decision, or recommended solution for a given situation. An Expert System helps the librarian in realizing the need for an improvement in the library operations and services. A well programmed Expert System improve the quality of the operations and services. The Expert System works as a substitute for a reference librarian.



5.1.1 Applications of Expert Systems in Reference Service:

Reference service is a prime activity of any library and the Expert System will work as a substitute for a reference librarian. Following are some of the examples of Expert Systems used for Reference Service.

(a) REFSEARCH: It is a system that supplies patrons, the recommended sources to lookup for certain question. The system can be used to teach students reference skills or as a computerized aid for practicing reference librarians and information specialists.

REFSEARCH

(b)POINTER: It was the early successful working application of computer system in the area of reference work. It directs the users to the reference sources. It is not a Knowledge Based System but a computer assisted reference program.

POINTER

(c) Online Reference Assistance (ORA): This system intended to stimulate the services of an academic reference Librarian for questions of low and medium level, by using several technologies: a videotext like database, computer assisted instruction modules, and knowledge based system.ORA consists of Directional transactions like library locations, services and polices.

Online Reference Assistance (ORA)

(d)AMSWERMAN: A Knowledge based system to help users for reference questions on agricultural topics. It uses series of menus to narrow down the subject of the questions and the type of tool needed. It can function as either a consultation system or as a front end to external databases and CD-ROM reference tools.

(e)PLEXUS: This is a referral tool used in Public Libraries. It includes knowledge about the reference process, information retrieval about certain subject areas, reference sources, and library users. All the above systems are advisory systems for locating reference source books and factual data.

5.1.2 Application of Expert System in Cataloguing:

Cataloguing is one of the oldest library crafts. Recent attempts to automate cataloguing through Expert Systems have focused on descriptive cataloguing because it is considered rule-based(AACR2).There are two approaches for applying artificial intelligence techniques to cataloguing .

a) A human-machine interface, where the intellect effort is divided between the intermediary and the support system; and

b) An Expert System with full cataloguing capability linked into electronic publishing system, so that as a text is generated on-line, it can be passed through knowledge based systems and cataloguing process is done without any intellectual input from an intermediary. There have been problem in every attempt to convert AACR2 into the highly structured rules necessary to run the Expert System.

5.1.3 Application of Expert System in Classification:

Classification is the fundamental activity in the organization of knowledge. For this reason it is prominent in all systems for organizing knowledge in libraries and information centres. Application of Expert System in the area of classifications in libraries includes the following:

(a).**Coal SORT:** It is a conceptual browser designed to serve either as a search or an indexing tool. Coal SORT consists primarily of a frame-based semantic network and the software needed to allow users to display portions of it and to move around in the conceptual structure. The expert knowledge in the system is embodied almost entirely in the semantic network.

(b) **EP-X**: The Environmental Pollution Expert (EP-X) has certain things in common with coal SORT in that both are concentrating on enhancing interface using a Knowledge Based approach. The knowledge base of EP-X consists of hierarchical frame-based semantic network of concepts and a set of template that express the patterns called the pragmatic relationship among concepts. These patterns are referred to as conceptual information.

(c) **BIOSIS:** BIOSIS uses a knowledge base, including a significant amount of procedural knowledge, to assign documents to categories automatically. It is designed as an indexer aid. BIOSIS uses the information in the titles of biological documents to assign as many categories as possible of those that would be assigned by human indexers.

5.1.4 Application of Expert System in Indexing:

Indexing of periodicals is another area where expert systems are being developed. Indexing a periodical article involves identification of concepts, to translate these concepts into verbal descriptions, & selecting and assigning controlled vocabulary terms that are conceptually equivalent to verbal descriptions. The reason for automating the intellectual aspects of indexing is to improve the indexing consistency and quality. Based on the information provided by the information provided by the indexer, the systems can arrive at appropriate preferred terms automatically to assign relevant subdivisions. The system can make inferences & based on the inference, it can take appropriate action.' Med Index' is the best example of indexing system used in the library Indexing activity. Very few library users have interacted with knowledge based systems. In general, users have had very little contact with these systems due to the fact that most of them are not perfect enough to be used by the everyday library patron.

5.1.5 Application of Expert System in Acquisition:

The collection of documents is another integral part of the library. The librarian or the information officer is key person in this activity. The users of the library have a significant role to play in building electronic collections and that their help and advice should be solicited in the process. Several systems have been incorporated. Monograph Selection Advisor, a pioneering effort in applying this emerging technology in another area of Library Science i.e. building library collection. Specifically, the task modelled is the item-by-item decision that a subject bibliographer makes in selecting monograph. The knowledge base has to be broad enough and the interfacing aspect must be easy enough for the library to get the desired information from the machine.

5.2 Applications of Natural Language Processing in Library Activities:

Natural Language Processing in Library (NPL) allows a computer to understand the main linguistic concepts within a question or solution. Its goal is to design and build computer that analyze, understand and generate language that human use naturally.

When we think of the term NPL, the first thought one might have is of being able to speak or write in a complete sentence and have a machine process the request and speak. NPL can be applied to many disciplines. To apply this to the field of Library and Information science and more specifically to searching database such as online public access catalogues (OPAC) Indexing is the basis for document retrieval. The aim of indexing is to increase precision, the portion of the retrieved documents that are relevant; and recall, the proportion of relevant documents that are retrieved". Key words, which have been weighted by the indexer as being basic to human thinking on a particular subject, will be fed into the electronic database in the way that will trigger the citing of an article or book on the computer screen, when these keywords are strung together in the proper sequence by the searcher. The main constraint is the variability in the ways a concept can be expressed. This variability is partly a matter of semantics, i.e., using the word mobile home vs. trailers. The word trailer has been replaced by the word mobile home in most parts of the country. Library patrons may not recognize the ambiguity of their search strategy. The use of natural language for Dialog database searches would allow the library patrons to search Dialog database directly, without the assistance of information professional. A patron using an electronic catalogue in a library may prefer to have the catalogue understand a complete sentence like "Find all your sources which contain mention of natural language processing for the use of Library and information science." The human librarian has the advantage of being trained in search & query as well as natural language and can act as an intermediary between the machine and the library patron. Some URLs are also case sensitive. In the future, it may be possible to use natural language to access the website also. Library patrons must become computer literate to take the advantage of this new technology.

5.3 Application of Pattern Recognition in Library Activities:

The process of establishing a close match between some new stimulus and previously stored stimulus patterns like Bar Code, QR Code, Biometric, etc. The components of pattern recognition are Data Acquisition, Pre-Processing, Feature Extraction, Model Selection and Training, and Evaluation.

In this era of the Internet and distributed, multimedia computing, new and emerging classes of information systems applications have swept into the lives of office workers and everyday people. New applications ranging from digital libraries, multimedia systems, geographic information systems, and collaborative computing to electronic commerce have created tremendous opportunities for information researchers and practitioners. As the application become more overwhelming, pressing and diverse, several well known information retrieval problems have become even more urgent in this network centric information age. The most fundamental techniques in IR involves identifying key features in objects. For example, automatic indexing and natural language processing are frequently used to automatically extract meaningful words. Texture, colour, or shape based indexing and segmentation techniques are often used to identify images. For audio and video applications, voice recognition, speech recognition, and scene segmentation techniques can be used to identify meaningful description in audio and video stream. Several classes of techniques have been used for semantic analysis of texts or multimedia objects. Symbolic machine learning, graph-based clustering and

classification, statistics-based multivariate analyses, artificial neural networks, and evolution-based programming are among the popular techniques. In this information age, we believe these techniques will serve as good alternatives for processing analyzing, and summarizing large amounts of diverse and rapidly changing multimedia information. The result from a semantic analysis process could be represented in the form of semantic networks, decisions, rules, or predicate logic. Spreading activation-based inferencing methods are often used to traverse various large-scale knowledge structures. One of the major trends in almost all emerging information systems applications is the focus on the user-friendly, graphical, &seamless Human-Computer Interactions. The Web-based browsers for texts, images, and videos have raised user expectation on the rendering and manipulation of information. Recent advances in the development languages and platforms such as Java, OpenGL, and VRML and the availability of advanced graphical workstations at affordable prices have also made information visualization a promising area for research.

5.4 Applications of Robotics in the Library Activities:

Robot is a mechanical device which performs automation tasks, either according to direct human supervision or a pre-defined program or a set of general guidelines, using artificial intelligence techniques.

Robot is "An automatically controlled, reprogrammable, multi-purpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in automation applications." The robots are on scrambling, rolling, flying, and climbing. They are figuring out how to get here on their own. As libraries provide a growing array of digital library services and resources, they continue to acquire large quantities of printed materials. This combined pressure of providing electronic and print-based resources and services has led to severe space constraints for many libraries, especially academic research libraries. The goal of the Comprehensive Access to Printed Material (CAPM) is to build a robotic, on-demand and batch scanning system that will allow for real-time browsing of printed material through a web interface. The user will engage the CAPM system that, in turn, will initiate a robot that will retrieve the requested item. The robot will deliver this item to another robotic system that will open the item and turn the pages automatically. By using existing scanners, optical character recognition (OCR) software, and indexing software developed by the Digital Knowledge Centre, the CAPM system will not only allow for browsing of images of text, but also for searching and analyzing of full-text generated from the images.

6.Pros and Cons of Artificial Intelligence

6.1 Benefits of Artificial intelligence to society:

- **Reducing the cost of operation and training**: AI using neural networks and deep learning algorithms to learning thing like humans do. Moreover, in this way they eliminating the need to write new code every time.
- **Increasing work efficiency**: AI-powered machines are great with amazing efficiency for a particular repetitive task. AI removes human errors from their tasks to achieve more accurate results.
- **Refreshment or breaks is not Required**: Machines does not require frequent breaks and refreshments like humans. Since machines are programmed for long hours and they can continuously perform without getting bored.

- **Fraud Detection:** Banking, Financial and Insurance Institution are widely using Artificial Intelligence to organize and manage data. Moreover, Artificial Intelligence is heavily used to detect the fraud user in credit/debit card based system.
- **Error Minimization**: In most of the cases artificial intelligence will helps us in reducing the risk. Moreover, it will increase the chance of reaching accuracy with the greater degree of precision.

6.2 Disadvantages of AI in society:

- **Huge cost**: Huge cost is required to use Artificial Intelligence for different complex machines or process. It will also carry huge cost for repair and maintenance.
- **No human backup**: As intelligence is believed to be a gift of nature. An ethical argument continues, whether human intelligence is to be replicated or not.
- **Unemployment will increase**: As we are aware that machines do routine and repeatable tasks much better than humans. Moreover, machines can be used instead of humans.
- **Lack of Personal Connections**: We can't rely too much on these machines for educational oversights.

7. Conclusion

Huge number of applications based on Artificial Intelligence has been already developed and deployed in Business sectors, Industrial sectors, Military sectors, Scientific sectors, Academic and Research organizations like Libraries to save the money as well as time. AI applications and their utilities will be increasing day by day in many sectors including library operations and services. AI can also applied in many IT oriented educational Institutions, which are contributing AI related recorded information on its AI technology and its utilities in various areas/subject fields. AI focuses on Search and Optimization, Fuzzy System, Natural Language Processing and Knowledge Representation, Computer Vision, Machine Learning and Probabilistic Reasoning, and Planning and Decision-Making.

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