

# **Information Searching / Retrieval Practices (Tools and Techniques): Past, Present and Future**

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## **Abstract**

This communication is a review of searching practices from past to future and intends to explore the development of information retrieval from print to AI. The transformation took place since pre 1970 to future is analysed in simple manner to track the trends noticed in information retrieval.

**Key Words:** Information Retrieval, Information searching, trends in searching, tools and techniques of searching.

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## **Introduction:**

In recent years, transformative advancements in information searching and retrieval (ISR) have been driven by integrating deep learning and multimodal data processing. The shift from traditional models to neural approaches, such as transformer-based models and dense retrieval, which significantly enhance search accuracy. Multimodal IR has expanded retrieval capabilities by integrating text, images, and videos, while conversational IR systems have revolutionized user interaction through personalized and context-aware responses. Information Retrieval (IR) refers to identifying and retrieving relevant information from large datasets, enabling users to locate documents, data, or multimedia that satisfy their queries. IR has evolved significantly, from early keyword-based retrieval systems to sophisticated models that leverage semantics and deep learning to interpret user intent. This progression has been driven by the rapid growth of digital information, which requires more advanced tools to efficiently manage and extract meaningful content.

**Information Retrieval (IR)** plays a central role in access, organize, and use data in today's digital world. The volume of digital content continues to grow exponentially; IR systems also ensure that the right information must reaches to the right user at the right time. Information Retrieval refers to the process of finding relevant information from large collections of data, structured or unstructured based on a user's query. It's the core technology behind search engines, recommendation systems, digital assistants, and many AI tools. The structured information means "Data is **organized in a predefined format**, usually in **tables or databases**,

making it easily searchable and processable by machines. Whereas unstructured information that is “Data that **lacks a predefined structure or format**, making it more complex to store, search, and analyse directly”. (Data / information Not organized into tables, often text-heavy or multimedia-based etc.). Modern information systems (like Google Search, ChatGPT, or enterprise AI tools) rely on combining both types, structured data for precision and unstructured data for depth and richness.

The concept of "information retrieval" was first introduced in 1950 by computer scientist Calvin Mooers. At that time, the process primarily involved manual indexing and basic methods for locating information within systems. Over the years, it has evolved into a more structured process that includes identifying search terms, locating appropriate information sources, and evaluating the retrieved content for relevance to a particular need.

Information retrieval or searching involves identifying and accessing specific information from a collection of documents. This process requires not only selecting appropriate keywords but also determining the best resources from which to obtain the needed information. The effectiveness of this process is influenced by how well the searcher formulates their search strategy and evaluates the results.

In today’s knowledge-driven society, the ability to search or browse for information plays a critical role in decision-making. The success of information retrieval largely depends on the approach taken by the user, whether they are actively seeking specific data or browsing more broadly for insight. Information-seeking encompasses a wider context than searching alone—it refers to the process of acquiring information through both human interaction and technological means. On the other hand, information-searching is more technical, involving the creation of search strategies, the use of defined terms, and the identification of sources. Ultimately, strong skills in selecting keywords and designing search strategies are essential for effective information retrieval.

Information searching and retrieval has transformed over the decades, and this transformation is driven by changes in technology, data, data sources and databases availability, user expectations, and artificial intelligence etc. It is also observed that as media of storing information changes from print to digital, there is also a transformation took place in information searching and retrieving.

## **Types of Searching Information:**

Rowley and Hartley (2008, p. 114) identify three different types of searches that fall into the category of information searching, viz. **known information search**: searching information based on key words known for identify and locate information like, author's name, title, ISBN, journal title, key words etc. **Factual search**: when user need information on concrete facts like, fact finding information on a particular thing. **Subject search**: involves searching of information on a particular topic. Rowley and Hartley (2008) indicated that subject searching is The process of searching for information involves balancing two key objectives: (1) obtaining a sufficient amount of relevant data and (2) minimizing the retrieval of either excessive, insufficient, or irrelevant information. At its core, information searching is a fundamental activity aimed at locating specific items within a larger data set or collection

## **Information Searching / Retrieval Practices: Past**

During the oral communication practices the knowledge was orally transmitted to generations to generations and the religious personalities were playing the key role in information dissemination and guiding others to find the sources of knowledge. Invention of paper leads to preserve the knowledge and information in the form of manuscripts and handwritten documents (in single copy). Later due to the innovation printing the manuscripts and handwritten documents stored in libraries or monasteries (e.g., the Library of Alexandria) converted in the print media. In the both conditions access was limited to scholars and the practices were depending on searching information manually based on memory or personal organization systems. The information sources were only available through personal kingly collection, private libraries etc.

In the print era (pre-1970), people used different practices (tools and techniques) to search for information till 2000 and 2010. The main sources of getting information were from the libraries (public, academic and special) and archives as well as experts and academicians, scholars etc. Library collection was retrieved using card catalogues and still they are popular till 20<sup>th</sup> century. The catalogue cards were prepared under few major heads like authors (Max three), editors, tile ad sub – title, subject headings, keywords etc. arranged in alphabetical order (dictionary catalogue). Users searched for information using different key words like subject headings, key words and authors or even classification systems. The tools used to retrieve collection using controlled vocabularies, thesaurus (e.g. MeSH in medicine) and techniques like Boolean logic (AND, OR, NOT). Dialog and LexisNexis used Boolean operators for searching precision

information. Information professionals relied on pre-defined subject headings to categorize data. The literature search was mainly conducted using indexes, abstracts, encyclopaedias, bibliographies, reference sources etc. to explore the published literature. Subject-specific bibliographies helped researchers, scholars and R & D users to find books and articles on their topics. These tools are popular for searching structured and comprehensive knowledge bases, but researchers have to refer and read physical journals, newspapers, and archives manually using indexes and abstracts. The techniques used by the users were skimming and scanning of literature, identify further reading by citations, footnotes, bibliographies etc. Consulting peers, subject experts, guides, etc. including librarian was more prominent. Keeping personal records were prominent. Early Digital Search Engines were also used for searching information like online databases (e.g., MEDLINE, ERIC) and required specific syntax and expertise to search effectively. Initial search engines (e.g., AltaVista, Yahoo Directory) indexed limited parts of the web and used keyword-based retrieval. During 1970's to 1990's development of online and offline databases made information retrieval much faster and accurate and tools like Dialog, LexisNexis, and ERIC became popular in academic and research fields. Bulletin Board Systems (BBS) initiated by Usenet groups to share knowledge. During 1990's to 2000 internet era took new shape in managing and searching information using search engines. AltaVista, Yahoo!, and Ask Jeeves are few among them. Google (1998–present), revolutionized search with “PageRank Algorithm” and relevance-based results.

### **Information Searching / Retrieval Practices: Present Scenario**

Since 2010 use of ICT and emerging technologies, softwares etc. (to analyse retrieved data) used to retrieve information from the voluminous data sets easily, quickly and with many access terms. Google, Google Scholar, Scirus, Bing, DuckDuckGo search engines made impact on current search practices and dominated. Personalised Searching based on user data, location, and past activity became more popular. Google's Search Generative Experience (SGE), helps in generating summaries on complex topics more easily, provide contextual results after searching and also provide links to the sources. Tools like ChatGPT, Gemini, Claude, Perplexity used for getting information on complex topics and queries. These tools are very popular in academia, coding, business analytics, and content generation etc. Devices like Alexa, Siri, and Google Assistant offering voice-based information retrieval also which is more popular. Visual Search Tools like Google Lens, Pinterest Lens, and AR-enabled apps helps users in searching images based data. Social Media tools helps Users (Facebook, Twitter, LinkedIn etc.) sharing knowledge among similar groups. These tools also support to e-learning

and teaching at any level. “Mobile-First Searching” provide 60–70% of searches using mobile technology. Thus, more emphasis was on semantic search and contextual relevance. Digital /virtual libraries transformed content to digital from print and tools like Tools like Google Scholar, JSTOR, PubMed, Scopus, and IEEE Xplore remain impactful in academic research. Semantic Scholar and ResearchRabbit providing AI-powered literature search and discovery. Search Engine Optimization (SEO) Trends Focuses on E-E-A-T (Experience, Expertise, Authoritativeness, Trustworthiness), and support to semantic search and contextual relevance search. Due to use of ICT user’s information search behaviour is also transformed from keyword and subject search to Natural language search using AI and voice interfaces. Metadata and tagging enhances document discovery methods. Federated searching **assist users in** simultaneous searching information across multiple databases and also helps in filtering and analysing retrieved information. Users are preferring to Mobile-First Searching using smartphones than desktops. Users expectations are increasing and they need instant, analysed, summarized, and highly relevant information on the topic of search. Users are more powerful searcher of information due to use of technology and natural search techniques.

### **Information Searching / Retrieval Practices: Future Practices**

More focus may be on Proactive and Predictive Searching of information based on “Context-aware systems” and anticipate information needs based on behaviour, environment, and intent of users. Tools like Google Discover helps in Search less retrieval Systems that provide information to users before users actively ask for based on search history practices. In future, “quantum information retrieval” might improve searching and processing of massive, unstructured datasets. “Neuro-symbolic systems” combine logic rules with AI models like neural networks to make search results both smart and easy to understand. “Decentralized search platforms” (e.g., Presearch) may offer more alternatives with less data tracking. Future searching will combine text, voice, image, and video inputs (e.g., Google Lens, multimodal AI) and search the information form the global resources. Search engines may use visual clues, gesture recognition, and augmented reality (AR) to retrieve information in real-time environments. “Neural IR models” using deep learning (neural networks) improve search systems by understanding and rank documents (or answers) in response to user queries. This helps in providing better relevance, semantic searching etc. Generative AI tools (like ChatGPT, Gemini, and Claude) are changing and reshaping user’s interaction with information. The future trends in information searching mostly depend on natural language processing and deep

learning, voice-enabled searching, Augmented reality etc. Information retrieval systems have advanced rapidly from ancient libraries to AI and deep learning.

Traditional search engines that primarily rely on keyword matching and link analysis, AI-powered search engines can interpret the intent behind users' queries, understand the context of the content, and personalize search results based on individual user behaviours and preferences. (Olson, 2020). The best AI search engines for research depends on nature of research like academic, technical, scientific, market-based, or general knowledge. Some of the good search engines for research are: Semantic Scholar (by Allen Institute) ([semanticscholar.org](https://www.semanticscholar.org)), Perplexity AI (<https://www.perplexity.ai>), Elicit by Ought (<https://elicit.org>), Scite.ai (<https://scite.ai>), Consensus (<https://consensus.app>), Research Rabbit (<https://www.researchrabbit.ai>), Scispace (formerly Typeset) (<https://www.scispace.com>), etc. becomes more popular search engines in the future. AI-powered search engines differ fundamentally from traditional tools like Google Search in how they process natural language, understand user intent, and generate results. While Google Search is fast, popular, and does use AI to some extent, AI-first search platforms go further by leveraging advanced machine learning to offer more context-aware, conversational, and personalized responses. As technology continues to evolve, the future of search engine technology looks brighter than ever. The key features of AI powered search engine covers Understanding search query, manages semantic search, visual search capabilities, Interpreting Search Terms, Improving Accuracy of Search Results, Ensuring User Privacy, Advanced Capabilities for Complex Queries etc. Semantic communication is very useful for searching, especially in research and information retrieval. Semantic communication refers to search engines that understand the meaning behind words not just the keywords themselves. This involves interpreting context, intent, and relationships between concepts to provide more accurate and relevant results while information searching and retrieval. Semantic search engines interpret and respond query and present with meaningful results, even if the words don't exactly match in the documents but using synonyms and context search is conducted.

Quantum communication uses principles of quantum mechanics, like superposition and entanglement to transmit information. Quantum communication, not directly used in search engines today, but has the potential to revolutionize to perform searching and information retrieval in the future especially in terms of speed, security, and data processing efficiency. Searches could be anonymized and protected at a quantum level, offering far greater privacy than current methods.

## **Searching Tools and Techniques:**

### **a) Searching Tools:**

### **b) Searching Techniques:**

#### **a) Information Search Tools:**

Information Searching Tools are basically software applications, platforms, or systems that help searchers to find, access, and retrieve information from various published sources like the internet, academic databases, libraries, or internal knowledge systems. Information searching tools are the tools that helps to search for and find information needed, whether it's a web page, article, book, image, or data etc. quickly and efficiently. The tools also help searchers to: search information using different access points, filter and rank the search results, allow to search information using advanced search techniques like Boolean search, as well as access all types of documents related to the query.

Some of the popular information search tools are:

- **Google Search Engine:** support to fast, broad coverage of information displays mostly suitable for academic community.
- **Google Scholar:** support to freely available articles, scholarly publications, theses, and other literature. Full text files are also made available to searchers, citations to documents are also reported for analysing impact of communication in the society. It is very popular academic search engine.
- **Google Patents:** It is a free online patent information search tool that allows users to search and explore patents and patent applications filed around the world. This search engine includes patent documents from major patent offices like the USPTO, EPO, WIPO, and others. Allows to refer full patent documents, including claims, drawings, citations, and legal status etc. Searcher can search information on various access points like keyword, inventor, assignee, date, classification, etc. Through Google Scholar, link scholarly articles and scientific papers related to the patent. This is good tool for innovators, researchers, scholars, R & D and S & T staff, academia, legal professionals,
- **Google Library:** This search engine refers to Google Books and its Library Projects. Google digitized and make searchable the collections of major libraries around the world. Google Books (<https://books.google.com/>) is a searchable digital archive of books that includes and covers full texts, previews, or bibliographic information depending on copyright status. Google Library Project began in 2004 and digitised

millions of books from major libraries like Harvard, Oxford, Stanford, New York Public Library etc. and also searchable through Google Books. Searchers can read or download books that are no longer under copyright, but can view selected pages for few copyrighted works for browsing. This search engine is very useful for academic and historical research, preparing literature review, browse book before purchase for its utility etc.

- **Bing (MS):** This web search engine launched in 2009, as a successor to MSN Search and Live Search), it is not popular as Google, but useful for general information search purpose, and second most popular search engine globally after Google. Support to finding websites, images, news, and videos using keywords or natural language. It is Powered by GPT-4 through Copilot in Bing, and provide conversational answers. Search images also by uploading a photo or use a camera.
- **Scirus (2001- 2014):** **Scirus** was a comprehensive science-specific search engine, first launched in 2001. It was a comprehensive science-specific search engine, focused on scientific information.
- **PubMed:** It is a bio-medical online database available free for searching. It is most reliable, authoritative source of information in life sciences, biomedical, health, nursing, dentistry, veterinary developed by National Institute of Health and maintained by the U.S. National Library of Medicine (NLM). Most entries in it include abstracts; and some links to full-text articles also. MeSH (Medical Subject Headings) thesaurus is used for accurate and structured searching. The source collects contents from reputable journals and peer-reviewed research documents.
- **Scopus:** This is a subscription based Abstract & Citation Database resource, developed by Elsevier. It is widely used by researchers, academics, and institutions to discover, evaluate, and track scholarly literature. This source provides abstracts (summaries) and detailed citation counts to documents, includes author h-index, affiliations, and publication history, indicate metrics like CiteScore, SJR, and SNIP to evaluate journal impact. Supports to literature search in science, technology, medicine, social sciences, and arts & humanities. This information resource is very useful for literature review, citation analysis, research evaluation, measure of metrics, identify research trends, author impact, collaboration networks etc. and used by universities for ranking, subscription decisions etc.

- **Web of Science:** Web of Science (WoS) is a comprehensive, subscription-based multi-disciplinary database and research platform for academic and scientific literature, maintained by Clarivate Analytics. It is one of the most trusted tools for citation indexing, research discovery, and impact analysis in scholarly publishing, authors profiles and h-indexing etc.
- **ERIC (Education Resources Information Center):** This information resource supporting to education, teaching, learning and research, covers peer reviewed articles and Government publications, journal articles, research reports, policy papers, conference proceedings, dissertations etc. It is a free online digital library funded by the U.S. Department of Education, providing access to a wide range of education-related literature and research. ERIC is maintained by the Institute of Education Sciences (IES), U.S. Dept. of Education. Useful for students, teachers, education researchers, policymakers etc.
- **JSTOR:** (short for *Journal Storage*) A digital library that offers access to a vast collection of academic journals, books, and primary documents across numerous fields such as humanities, social sciences, arts, history, economics, and science. It serves as a valuable resource for conducting detailed research, performing literature reviews, and exploring historical topics. Widely utilized by students, researchers, and scholars, it provides reliable and scholarly content for academic work.
- **Science Direct:** Science Direct is a scientific database available on online publishing platform by Elsevier. It offers access to peer-reviewed journal articles, book chapters, and research papers across science, technology, medicine, and social sciences. Contains over 18 million articles and 2,500+ journals and includes thousands of scientific books also.
- **Research Gate:** Research Gate is a professional network and collaboration platform for scientists and researchers. It permits users to share research papers, ask and answer questions, connect with peers, and track research impact. It is called the "LinkedIn for researchers." Upload and access research papers, preprints, theses, and conference papers and connect with researchers worldwide in field of study.
- **Pro-Quest:** ProQuest is a comprehensive online research platform, provides access to databases of scholarly journals, dissertations, newspapers, magazines, and other academic content. It is widely used in universities, libraries, and research institutions

and covers subjects like humanities, social sciences, education, health, business, etc. This is World's largest collection of doctoral dissertations and master's theses.

- **EBSCO:** EBSCO (short for Elton B. Stephens Company) is a leading provider of research databases, e-journals, e-books, and other online resources for libraries, universities, and institutions. Its platform is called EBSCOhost. Millions of **full-text scholarly articles** available for academic and professional users and large collection of **e-books**, magazines, and trade publications.

From the above sources Scopus (Elsevier), Web Of Science (WOS), Science Direct, ProQuest, EBSCOhost, IEEE Xplore, Lexis-Nexis are commercial information sources. Other information resources are open access and free available to users like: Google Scholar, Google Patents, Google Library, PubMed, ERIC, DOAJ, Research Gate, etc.

### **Search Techniques:**

A search technique is a method used to locate relevant information within an information system. These systems can be either internal (in-house) or external (online). An in-house information system refers to data and resources stored within an organization, available in both print and digital formats for internal use. In contrast, an online information system stores electronic resources on remote servers, accessible via communication networks. These systems are typically compatible with the World Wide Web and can be accessed through the internet..

Search techniques refer to the strategies and tools used to find accurate, relevant, and efficient information. These techniques are essential in academic research, online browsing, and professional data retrieval. The techniques used for searching are:

Understand the query or topic on which information is to be sought. From the topic identify key terms or phrases involved in it which are relevant for searching information. Similarly using the tools like thesaurus find out synonyms, relevant terms, broader and narrower terms, even used for terms are also to be covered. Properly organise the terms selected and using Boolean Operators and (AND used for narrowing or limiting search results, OR broaden search results, NOT exclude certain words or terms) prepare suitable search query statement. Exact Keyword phrase searching term must be enclosed in "--", e.g. "Artificial Intelligence in LIS". It is also possible to truncate the terms using wild cards for root searching and symbols used are (\* or? or \$ based on databases accepts) for finding variations starting with the root, e.g. Educat\* = Education, Educational, Educated, educate, Educator, Educationist etc.

It is also possible to search information based on any specific field also. This limits search to particular term under the field like author, title, subject, keyword etc. This type of search helps in limiting the search result with great precision. This is common facility in databases and academic search engines. In addition to this advanced search filters can also be used in searching like: “ Year, date, Language, file type (pdf, txt, doc), site or domain name like .gov, .org, etc. this helps in limiting the search.

“Proximity searching” permit to search the two terms apart from certain spaces with each other like (5 W) syntax varies depending on use of databases. Higher education (2W) schools. “Natural Language Searching” is used in AI based techniques more where, questions are asked in simple way like “Why inflation in market?”, “what are best search practices in Internet era?”. Such facilities are now available and supported by tools like Google, ChatGPT, etc. For searching precise information in scholarly databases tools like controlled vocabulary, thesaurus, subject dictionaries, are very helpful to identify standard terms like TEST thesaurus for engineering, MESH thesaurus for medical etc. Using citation databases like Scopus, Google Scholar, it is possible to search cited articles data useful for tracking research impact and related studies in subjects.

These techniques and practices help searchers in improving precision and accuracy in searching data and eliminating unwanted data, save the time in analysing unnecessary data, Filter irrelevant results, and Access deeper or more specific information systematically.

### **Types of Information Searches:**

**Simple search:** It is a quick way of searching of information, generally by entering a few keywords into a search engine or databases

**Advanced Search:** An advanced search is a more precise and powerful way to find information. It allows to narrow down results using specific filters, search operators, and settings.

**Full Text Search:** Full Text Search (FTS) is a search technique that looks for keywords throughout the entire content of documents, not just in titles or summaries. It’s used in databases, search engines, websites, and digital libraries to find all instances of a word or phrase.

**Field Search:** It is a search technique in which specific parts fields of a record or documents are searched by using field name such as the title, author, date, subject, or abstract rather than searching the keyword in entire text.

**Truncation Search or Root Search:** This is a technique used to find multiple word variations by shortening the root of a word and adding a symbol (usually \*) at the end. It tells the search tool to find all words that start with that root.

**Keyword Search:** This is one of the most widely used methods for retrieving information. It involves entering specific words or phrases into search engines, online databases, or websites to locate relevant content. Keyword searching is particularly effective when the information sought is clear, specific, and focused on a well-defined topic.

**Phrase searching:** A phrase search involves searching for an exact phrase or sequence of words within a document or database. This type of search is useful when the information needed is specific and requires a precise search strategy.

**Boolean Search:** Boolean search utilizes logical operators such as AND, OR, and NOT to structure search queries in a way that narrows or broadens results. This method is particularly effective for handling complex information needs, as it enables users to create more focused and accurate searches by combining or excluding specific terms.

**Federated Search:** It is a search technology that allow users to search multiple databases or information sources at the same time using a single search interface. In this search the query is sends to several databases or websites at once or at a time and combines search results from all sources in one list.

**Transactional Search:** A transactional search is a type of search where the user's intent to find a specific action or transaction. Ex. Issue return transaction

**Navigational Search:** A navigational search is a query into a search engine with the intent of finding a specific website or page, a known brand, platform, or service.

**Informational Search:** This search uses a search engine to learn something, looking for facts, explanations, definitions, or how-to guides or learn or understand something.

**Proximity Search:** Proximity search refers to the method of locating keywords that are situated close to one another within a text or database. This approach is particularly effective when the user's information need demands a more context-aware search technique, allowing for more accurate and relevant results based on word placement and relationship.

**Structure Search:** This is a very specific search useful for precise searching of information using chemical structure to find the information on drawn structure accurately. This type of search is specifically carried out in chemical sciences.

**Subject Search:** This search is used in library catalogues, academic databases, or digital archives to find information materials on a certain topic. It uses predefined subject headings rather than just keywords.

**Range Search:** This search is a search technique used to find results within a specific range of values, such as: Dates, Numbers, Prices, etc. Used in databases, search engines, library catalogues, to narrow results to a defined interval.

### **Information Search Process:**

Information searching involves the process of seeking and retrieving relevant information by developing search terms, using search engines, databases etc. and collecting evaluating information resources to meet specific needs of the users. The Information Search Process (ISP) is a process or a model that describes the steps or procedure involved in information searching. One of the influential models of the ISP was developed by Carol Kuhlthau, a scholar in library and information science, and he has presented six steps in information search process. Viz. initiation, selection, exploration, formulation, collection and presentation. Initiation stage involve identification of need and query of user and find out what information on topic is required. Selection relates to fixing of topic, related keywords and selection of reference sources to get more relevant documents. Exploration means clearing doubts form the requester regarding the selection of keywords after browsing some information on trial basis. Formulate the search query based on topic, subject, keywords, homonymous, synonymous words and prepare good search strategy. Search the query in databases or catalogues and gather the information at the collection stage, verify the sear results and its relevance to the user if not then discuss with user and reframe the strategy for search. After gathering the records present the search results summarising as per user need and finalise the search. Kuhlthau also pointed out that the searching process in not a linear process it can be altered the steps, to manage the research process better. All the six-stages in model relates to affective (feelings), cognitive (thoughts), and physical (actions) aspects.

The process of identifying and retrieving information relies heavily on the effectiveness of the methods used for seeking and searching data. Information-seeking refers to a broader concept that goes beyond

just locating specific data—it often involves exploring or browsing to uncover relevant information. In contrast, information-searching is a more targeted activity that involves selecting appropriate search terms and applying strategies to locate specific resources. These resources are then assessed for their relevance to the user's needs. Successful information searching requires familiarity with both the subject matter and the techniques for formulating effective queries. Typically, the information search process includes several key stages: identifying the topic, formulating a plan, conducting the search, analysing the results, and selecting the most appropriate sources for use.

### **Role of information managers and information professionals in Information Searching:**

Information managers and information professionals (such as librarians, data curators, records managers, and knowledge specialists) play a critical role in the process of information searching. Their expertise ensures that users can find the right information efficiently, accurately, and ethically. The key roles played by information professionals relates to:

Assessing and understanding User need and topic of information to be searched properly. To digest the topic, have discussions with users and conduct reference interviews or needs assessments to clarify what users are exactly looking for. Prepare key terms, identify synonyms, homonyms using thesaurus and prepare search strategy using advanced techniques like Boolean operators, truncating terms, selecting suitable information resources and databases etc. Information professionals must have skills of searching, analysing, evaluating and presenting summaries of results.

### **Conclusion:**

The practices of information retrieval have transformed from manual and keyword-based systems to intelligent, predictive, and context-aware tools. The integration of AI, multimodal interfaces, and privacy-centric technologies defines the future of user's access and interaction with information. Gaining access to the right information at right time quickly and reliably is fundamental element of searching information using different tools, techniques and practices.

Despite decades of research and development, the pursuit of more efficient search algorithms remains an active area of study. The growing influence of artificial intelligence (AI) is expected

to drive further innovation in this domain. Additionally, the emergence of quantum computing is anticipated to significantly reshape current approaches to search technologies.

AI has already proven valuable in interpreting user queries, but its applications extend well beyond text-based searches. One promising direction for future exploration is visual or image-based search. While some platforms already provide functionality to find images based on visual similarity or textual descriptions, these systems face several limitations.

A key challenge in image search lies in the absence of comprehensive and structured ontologies. Unlike text, which can be easily analyzed through established linguistic models, images require a deep semantic understanding that remains complex to achieve. Detecting visual similarities and extracting meaningful information from images is a difficult task, limiting the performance of current systems.

However, advancements in machine learning and AI are helping to bridge this gap. Modern image recognition techniques are becoming increasingly capable of identifying and analyzing the content within images. As these technologies mature, we can anticipate significant improvements in the accuracy and reliability of image-based search systems.

Meanwhile, quantum computing holds great promise for revolutionizing search algorithms. A notable example is Grover's algorithm, which offers a quantum approach to searching through unstructured data. Often referred to as a "quantum database search," this algorithm could provide substantial speedups over classical methods, highlighting the transformative potential of quantum technologies in the field of information retrieval.

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