The Role of an Information Retrieval in the Current Era of Vast Computer Science Stream

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Abstract- The modern era of search technology has changed the way the information searched and retrieved compared to the previous decade of search engines. Today's search engine has evolved as a way of shifting the locus of control over information dissemination closer to the consumers of that content. Information retrieval being a vast field, has many application related to it. In this paper we analyze various fields in which IR is being used as an application. We divide the application into seven categories; they are Communication, Databases, Natural Language Processing, Multimedia, Document Ranking, Semantic Web and Software Engineering.

In this paper it can be observed that the importance of IR in the various fields just by sheer number of categories it supports. The more widely its used, the more it will change the way the mankind is going look at information and world at large.

Keywords: Information Retrieval, Web result clustering, Query optimization, Web and Databases, Semantic web, Document ranking, Data Engineering, Natural language processing;

I. INTRODUCTION

The typical Information Retrieval (**IR**) model of the search process consists of three essentials: query, documents and search results. A user looking to fulfil information need has to formulate a query usually consisting of a small set of keywords summarizing the information need. The goal of an IR system is to retrieve documents containing information which might be useful or relevant to the specific purpose it's being used [45].

Information retrieval systems can also be distinguished by the scale at which they operate, and it is useful to distinguish three prominent scales. In web search, the system has to provide search over billions of documents stored on millions of computers. At the other extreme is personal information retrieval. In the last few years, consumer operating systems have integrated information retrieval (such as Apple's Mac OS or Windows 7 Instant Search). Email programs usually not only provide search but also text classification: they at least provide a spam (junk mail) filter, and commonly also provide either manual or automatic means for classifying mail so that it can be placed directly into particular folders[46].

In between is the space of enterprise, institutional, and domain-specific search, where retrieval might be provided for collections such as a corporation's internal documents, a database of patents, or research articles on biochemistry.

Hence we can observe from the above paragraphs the various levels at which "Information Retrieval" can used as an application. The sheer levels at which information retrieval can play an important role in the form of applications cannot be ignored any longer. The more widely its used, the more it will change the way the mankind is going look at information and world at large.

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The field of **communication** being one of the emerging and dynamically developing technologies, IR is plays a crucial role in contextual influences of a user's mobile information needs and requires lot of development, to be adapted in portable device. In **database** field it's mainly used for providing relevant results output. In **document ranking** concept of IR is used for increasing the precision of Ranking of documents based on information need. In **Natural Language Processing (NLP) it is** **mainly used for** Context aware query translation. In the field **multimedia** it's mainly used for retrieval of relevant videos and audios. In the field of **semantic web** IR tool is used for data preparation, filtering of similar synonymous query and documents and cleaning aliases with similar findings in the web domain. Finally the field of *Software engineering* it's used for better software maintenance and reuse, by automatically capturing context of the source code.

II. IR APPLICATIONS IN THE FIELD OF COMMUNICATION

Applications that use information retrieval as the main task in the field of communication involve several areas. *Mobile search* being one of them is an evolving branch of information retrieval services that is centered around the convergence of mobile platforms and mobile phones, or that it can be used to tell information about something and other mobile devices. Table 1 gives the comparision of various applications of IR in the field of communication

Table1. Various applications of IR in the field of Communication

Sl No	Author	Methodology	Input parameter	Output parameter	Remarks
1	Nicholas D. Lane[2]	Large Margin Nearest Neighbor (LMNN) / K- Nearest Neighbor (KNN)	Queries are specified by the selection of a simple POI category and context.	Ranked list of Points of Interest (POIs)	A major transformation of local search services can be improved by using context along with query.
2	Michelle X. Zhou[3]	Note interpreter / Query generator.	User Notes with queries.	Automatic generation of data queries according to the context of user.	This work can identify multiple information requests at once, derive a full information request in context, and automatically reevaluate existing notes based on note updates.
3	David M Nichols[4]	PIM / gazetteers.	Query keywords based on location.	Information need based on the location for the user query	adaptation of devices and interfaces need to take into account a rich variety of situational factors.
4	Maryam Kamvar[5]	context using prediction model.	Dataset from Query context.	Large knowledge of the application being used and the location of the user.	Ease the phone's burden of computation by pre-computing word probabilities on the server side.
5	Niki Pissinou[6]	CPA (Context Pre fetching algorithm).	Location context and Query context.	Evicting cache data entries with minimum benefit.	It's a cost reduction approach to examine the effectiveness of this technique.

It is observed from Table 1 s local search is given importances due to in the change in the devices used in communication.

Increasing number of devices used in communication being mobile, the need for context based retrieval is growing in importance. Even though there is lot of research, nothing concrete has been implemented in large scale.

III. IR APPLICATIONS IN DATA ENGINEERING

Information comes from a variety of sources, including text documents, photographic images, sensor data, Web pages, and biological sources etc., all kinds of data are stored in a single database. Accessing these data requires that information meaningful to humans be extracted from weakly structured or totally unstructured sources, in addition to conventional structured sources. The information must then be efficiently indexed and accurately retrieved. The most common approaches require formal statistical modeling and extensive empirical validation of the access techniques. In table 2 we discuss various applications of IR in the field of data engineering. It's observed that by incorporation of semantics in the data management process improves query accuracy, and permits more efficient and effective sharing and distribution services.

Table 2.Various applications of IR in the field of Data Engineering

Sl No	Author	Methodology	Input parameter	Output parameter	Remarks
1	Torsten Priebe[1]	Uses ontology for context mapping / OLAP (Online Analytical Processing)	Knowledge portal with OLAP report present in the OLAP port let.	Improve the performance in Global searching.	Provides access to structured data stored in a data warehouse, can be used by an information retrieval port.
2	Raphael Thollot [7]	Uses SAP for Entity extraction.	User's actual context described by document's context.	Access to information resources by using spatial context of the queries.	Aggregation results and show how T2Q can be successfully applied to an enterprise scenario as an extension for an office application.
3	Gloria Bordogna [8]	Fuzzy Minkowski for uncertain user's location and fuzzy inclusion method for uncertain user's instances	Spatial context of the user query and spatial location of the searched resources.	Uncertainty affects either userlocation, or instance locations and in conjunction with a soft spatial condition specified in the query.	A two-step evaluation procedure of LBSQs is outlined based on a filter and on a refinement phase.
4	Jidong Chen [9]	HMM (Hidden Morkov) model	User's activity logs and search context.	Documents re-ranked by their relevance's to the context with acceptable overhead	HMM (Hidden Morkov) model based user model to learn the user's activity logs and estimate the query context.
5	Yukun Li [10]	Context-based Database (CDB) / Context-based Reference (CRR) / C-Query engine / Query interface	User's activity logs and search context.	Increasing efficiency in revisiting the personal documents based on CR relationship.	This demonstrates an efficient method to identify CR relationship based on user operation logs, and present the processing method of C-Query.
6	Levandoski Mohamed [11]	CareDB	User's Context,Data base Context, Environmental context.	Processing the queries based on the expensive attributes.	Care DB provides scalable personalized location-based services to users based on their preferences and current surrounding context.

IV. IR APPLICATION IN FIELD OF DOCUMENT RANKING

Document Ranking is a problem in text mining. The task is to assign a document to one or more classes or categories. Documents may be classified according to their subjects and attributes. In this paper only subject classification is considered. There are two main philosophies of subject classification of documents: The content based approach and the request based approach. Content based classification is classification in which the weight given to particular subjects in a document determines the class to which the document is assigned. Request oriented classification may be classification that is targeted towards a particular audience or user group. From Table 3 it is mainly observed

that most of authors suggesting personalized document ranking on the basis of user context.

Table 3.Various applications of IR in the field of Document Ranking

SL No	Author	Methodology	Input parameter	Output parameter	Conclusion
1	Donjung Choi [13]	Distinguishing between hot query and cold query.	Search engines retrieved documents related to web content.	Increase in precision of the Ranking of documents	The characteristic of the query, it applied different sources to make vector of terms for documents ranking.
2	Zhicheng Dou [14]	personalized search based on query logs.	User's activity logs and search context.	Personalized document retrieved.	Significant improvements over common web search on queries with large click entropy.
3	Yangbo Zhu [15]	personal ranking.	Query-Context derived from previous queries.	personalized search documents.	To take advantage of ranked relevance judgments, it proposes weighted rank distance to measure ranking quality.
4	Liang Jeff Chen [16]	Data model / query model / Ranking model	Documents list which are not results of search results.	Ranking of context sensitive for documents retrieval	It addressed the problem of inefficient query evaluation for context-sensitive ranking.
5	Christina Lioma [17]	Sense Discrimination model.	Physics test collection.	Improve retrieval performance for technical domains.	Preliminary experiments on a real-life physics test collection gave positive findings.

V. APPLICATIONS OF IR TO NATURAL LANGUAGE PROCESSING (NLP)

Natural language processing (**NLP**) is a field of computer science, artificial intelligence, and linguistics concerned with the interactions between computers and human (natural) languages. As such, NLP is related to the area of human–computer interaction [48].

Table 5.Various applications of IR in the field of Natural Language Processing (NLP)

SL NO	Author	Methodology	Input parameter	Output parameter	Conclusion
1	Tobias Rho[18]	Context management system (CMS),	User's context information.	Integration of context query language to context information.	.
2	Rohit Bharadwaj [19]	Cross lingual information access (CLIA)	Context aware queries.	Context aware query translation.	Increase the coverage of the dictionaries and increases the overall precision.
3	Qi Guo [27]	Contextualized Interaction (CxI) model	User's session considering click through graph.		Client-side interactions. It improve ad click through prediction Accuracy.
4	Rachel Pottinger [29]	MinCon	A set of views over the database.	Query answering.	The MinCon algorithm makes use of binding patterns.
5	Raymond Y. K [30]	Belief-based adaptive IR system	-	-	The belief-based adaptive IR deals with large and complex IR tasks,
6	Jeffrey Dalton [31]	Pseudo-relevance feedback (PRF).	Speech tagging and entity reorganization	Incorporating sequence label.	Passage retrieval can achieve significant improvements on in-domain accuracy
7	Sergio Duarte [32]	Analysis of queries and sessions intended to satisfy children's information needs	Large- Scale query log	Increases the scalability of children's information needs.	Large-scale can be applied to characterize the search behavior of different user groups.
8	Kristen Parton [33]	Cross-lingual question answering (CLQA).	Content words that are deleted during MT	Deleting content words with high precision.	The error detection algorithm focused on content word deletion,
9	Yan Qi [34]	Location-Based Spatial Queries (LBSQ)	User's query.	Probability approach of formalizing all situations of uncertain LBSQ's	QUEST relies on a novel constraint-based data model
10	Xing Wei [35]	Synonym discovery based on Co-Clicked query.	Web search query.	derives concept based synonyms with the help of query segmentation	Increasing the accuracy of 40% to above 80%.
11	Xiaohui Yan [36]	Higher order model, parameters estimation model reduction.	User's query context.	High order relation in query logs	learning the High-order relations between the current query, its click-though and the next query

In Table 5 we observe that IR applications play crucial role in the field of natural language processing (NLP). In NLP mainly seen that input is taken in the form of context user query so that processing itself is done in a much personalized manner. This has lead to a increase accuracy of the output in many of the mentioned applications.

VI. APPLICATIONS OF IR TO MULTIMEDIA

Multi Media Information Retrieval (MMIR) is a research discipline of IR that aims at extracting semantic information from multimedia data sources. Data sources include directly perceivable media such as audio, image and video, indirectly perceivable sources such as text, bio signals as well as not perceivable sources such as bio information, stock prices, etc.

Table 6.Various applications of IR in the field of Multimedia

SL NO	Author	Methodology	Input parameter	Output parameter	Conclusion
1	Stefanos Vrochidis [21]	Classifier that could identify shots marked as relevant to a new query topic.	Use's query for video search.	Retrieving videos relevant to user's query.	Results show that exploiting gaze-based implicit feedback, expressed in terms of fixations and pupil dilations..
2	Alexandar Jaffe [22]	Clustering	User's query for image search.	Retrieving videos relevant to user's query	Large collections are inherently difficult to browse, making summaries an important tool in rendering these collections Accessible.
		Ranking Scoring Clusters			
3	Kenneth M. Anderson [23]	HyCon contextual hypermedia system.	Templates and queries.	Building Hypermedia system.	Structural templates provide a flexible and extensible foundation for specifying a wide range of information objects.
4	Yi-Hsuan Yang [24]	Use's context Seer framework.ranking algorithm	User's input query.	Improve search quality.	
5	Xing Xing Yi Zhang [25]	Mixture model using various query context and document fields.	User's query for image search.	Retrieving videos that are relevant to the image input user's query.	In preliminary results are significantly better results than models without context.
6	Graves [26]	Interface model (IN)	Use's query for video search.	Retrieving videos relevant to user's query	

From the Table 6 it is seen that most of the research in multimedia retrieval applications has focused on retrieval by content or retrieval by example. This paper discusses statistical approaches to analyze images and video content and conclude with a discussion regarding the described methods.

VII. APPLICATIONS OF IR TO SOFTWARE ENGINEERING

The application of IR in SE has given rise to many useful tools in the areas of requirements discovery, maintaining software repositories, establishing trace-ability links, efficient software reuse, and effective software metrics. In particular, these tools show that useful information can be extracted from the natural-language contained in source code's identifiers and comments as well as other natural-language artifacts associated with a software project. Such artifacts can be manipulated by tools in tasks that previously required extensive human effort or provide an alternative perspective, as in the development of effective software metrics.

Table 7.Various applications of IR in the field of Software Engineering

SL NO	Author	Methodology	Input parameter	Output parameter	Conclusion
1	Emily Hill [28]	Iterative query refinement and search process.	Context of words surrounding the query terms.	Automatically captures the source code context.	Useful information can be extracted automatically from the natural-language contained in source code's identifiers and comments as well as other natural-language artifacts associated with a software project.

From the table 7, its seen that applying IR to SE is a relatively young endeavor, many new applications are likely to appear. In future, these can be expected to leverage the diversity of new work from the IR community; however, as the field matures more IR-based techniques designed explicitly to solve SE problems should start to emerge.

VIII. APPLICATIONS OF IR TO SEMANTIC WEB

Semantic web is an extension of the current web that provides an easier way to find, share, reuse and combine information. It is based on machine-readable information and builds on XML technology's capability to define customized tagging schemes and RDF's.

Table 8. Various applications of IR in the field of Semantic Web

Sl No	Author	Methodology	Input parameter	Output parameter	Conclusion
1	Li Chen Maryann [12]	Queries categorized by usage context.	User's query. , Mapping ontologies to store schema	Ontological data is stored in OntoQuest database.	User can easily get ontological data using Onto Quest.
2	Latifur Khan [20]	Ontology defines set of representational terms. Segmentation of audio.	User's query.	Generate information selection requests in database queries.	Efficient and user friendly retrieval
3	Jaudete Daltio [37]	Ontological predicates model is invoked by the query processor to expand queries and process.	Biodiversity queries.	complex ecological predicates and multi-ontology management	Solutions for several web services.
4	Amit Thawani [38]	Customer entities.	Query related context-information	context-aware information retrieval.	The contextual information aids the agent in such a way as to reduce the agent's need for training.
		Agent entities.			
		Business entities.			
5	Gan Keng Hoon [39]	Use's two ways to find semantic candidate. Lsemantic, Lindex.	Unstructured information	Mapping unstructured query to web resources	Information retrieval system can obtain results that are more relevant to the context of a query and clearer descriptive Snippet for a result.
6.	Rifat Ozcan [40]	Discusses cost aware strategies for static and dynamic caching setups.	-	-	It observes considerable reductions in total query processing time for all three caching modes
7.	Renato F. Bulcao Neto [41]	Use's SeCom model,	Context information	Web based system can make use of services to store, query and reason about context	Web Memex is able to reason about context when users' social networks are used as auxiliary criteria for web pages recommendation
		SCK infrastructure			
		WebMemex			
8	Nish Parikh [42]	Session relationship graph.	Large scale query		Improves search relevance.
9	Mohammad Al Hasan [43]	Data cleaning and normalization using bot-filtering and the removal of black-listed and advanced queries.	User's Query	Suggestions for the query related to e-commerce sites	This work provides more quantitative evidence to the earlier findings.
10	Cheng Te Li [44]	GrpSteiner make label based grouping that collects individuals into groups according to each query label	a query set of labels consisting of a targeted name label	A ranking list possessing the targeted name label and connect to others context labels with min communication cost.	Defines the problem of context-based people search in a labeled social network

(**R**esource **D**escription **F**ramework) *flexible approach to representing data.* The Semantic Web provides common formats for the interchange of data (where on the Web there is only an interchange of documents). It also provides a common language for recording how data relates to real world objects, allowing a person or a machine to start off in one database, and then move through an unending set of databases which are connected not by wires but by being about the same thing [47].In this paper we discuss several approaches to using information retrieval systems with both semantic web documents and with text documents that have semantic web annotations. Information retrieval technology has been central to the success of the Web. In this paper we observe that for semantic web documents or annotations to have an impact, they will have to be compatible with Web based indexing and retrieval technology. Information retrieval technology has been central to the success of the Web.

Web based indexing and search systems such as Google and Yahoo have profoundly changed the way we access information. For the semantic web technologies to have an impact, they will have to be compatible with Web search engines and information retrieval technology in general

IX. CONCLUSION

In this paper, we have discussed and analyzed various categories of application of Information retrieval against their performance that have been used by various researchers in applications of IR. We analyze the importance of IR various fields and observe that each field has its own requirement and IR needs to be modified according to each of its needs. It's especially true for mobile communication and also software engineering field.We also observe that by integrating IR with various other fields, it increases the performance of that particular system. Hence we conclude that field of IR is not just restricted to web search engines but it comes as handy to various other fields. Although the above discussed categories of applications of IR implement efficiently implement the stated objectives, but still the efficient IR process lack due to it just concentrating on large data set i.e. the web search. By going by current technology change, the challenge lies in making adaptable to portable devices and the communication field, where the nature of information is small but vast due to the connectivity the flow of information is huge, which needs to be captured efficiently and correctly according to the user. Hence development of IR must be according to the field its being used and not generic in nature.

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