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Comparative Study of Different Search Engines in Context of Features and Semantics

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ABSTRACT

Surfing internet for various purposes has become a habit of humans. Fact states that, after email, surfing/searching is the most did act now days. Information quality linked through these searches is quite irregular. There are chances that these retrieved results can be irreverent and belongs to an unreliable sources. Widely used search engines like Google, Yahoo, Bing and Ask are the most famous ones. Even though their job is the same i.e. to act as search engines and have Searching Features, but the ways of doing that is different. Semantic based search engines work on the semantics of the query. The WWW (World Wide Web) is the live proof of all the changes it has gone through within its short span of time, it has seen that search engines in past were recognized were either keyword based or dependent on traditional database. Researchers have been already working on various algorithms to provide better results. This paper concludes that semantic based search engines have more advantages over keyword based search engines in terms of accuracy of getting result. This paper also compares the retrieval effectiveness in terms of accuracy in searching of Google, Bing, Yahoo and Ask search engines for evaluating effectiveness of all four search engines. This paper is a survey and study work, which discusses a comparative study of different types of search engines in context of semantic web. The present study is also compares all the four search Engines mentioned above.

Keywords: Information Retrieval (IR), Intelligent Pattern Search, Search Engine, Semantic Network.

1. INTRODUCTION

For every search given, World Wide Web is not searched directly by the search engines. For doing so, these search engines surf through a database of pages available over the web that it has gathered and reserved. While surfing, user query is always a somewhat musty copy of the real web page available online. Results given as an answer for your query in form of links provides you with the current copies of those web pages for which you have searched for. Spiders are the computer robots which actually build search engine databases. These spiders actually "crawl" through the internet/web, in search of finding pages which are potentially capable of containing results as asked for and are present within these search engine databases. Imagination is not a solution for them to rely on. The drawback of these is that if any page is not linked to any other page via a link, then its not possible for spiders to find it. The solution to this is to put that brand new page as a link to already present pages or to add its URL manually for inclusion. This feature is already incorporated into every major search engine available online. As soon as these web pages come into contact to any of these spiders, another computer program is on to its work for "indexing." Indexing program is responsible for identifying text, links, and other content available in the web page and storing this page into the search engine database's files. Indexing these pages saves us from searching the whole web for the same search keyword and whatever more advanced approaches offered, thus limiting the rework and time. Such web pages which are not accessible by search engine spiders are excluded from the searchable databases mounted on the web, such as library catalogs and article databases. Such contents are termed as "Invisible Web" -- what you don't see in search engine results. When we talk about Search Keyword, it symbolizes that the query will extract documents that contain one or more words specified by the user. Semantic search helps to improve search efficiency by visualizing searcher intention and helps to generate more relevant results. Also, comparison of some popular Semantic search engines is provided with their features

There are certain issues with the existing search engines. Focusing our aim towards the issues in these search engines, we came across: ambiguity, high volatility, subjective content, high rates of technological change, reliability of result, monitory influences and many more. Sometimes, user's query drags us to a vast set of irrelevant documents with no relevance to the actual search

keyword. No guarantee can be given by these search engines for the relevance of the data. Sometimes results provided by these search engines are the frequent ones that is due to marketing, reposting as an internet meme, spamming, or self-promotion, rather than importance. Little mentioned or unmentioned things may be equally important. Search engine are incapable of providing us with the latest researches going on in depth as compared to hard copied journals and books, for rapidly developing subjects. Although search engine supports multilingual searches but the translation of the result to English may not be accurate.

New Search engines are being developed mainly to overcome few limitations present in the current Web technologies:

1. The web content structure for representation of information.
2. Ambiguity- Lack of interconnection between information.
3. Lack of automatic information transfer.
4. Slow pace in view to deal with large set of users and content ensuring trust at all levels.
5. Lack of universal format for systems in view to understand the provided information.

The rest of the paper is organized as follows. Section II focuses on comparison of different search engines. Section III discusses about comparative analysis of semantic search engines. Section IV is talking about searching Query, result analysis based on Appendix-1. Section V concludes the paper.

2. COMPARISON OF SEARCH ENGINES

The web search of today is the traditional web search that is the Key Word search whereas the web search of tomorrow comprises of Knowledge based searching. The following table discusses about the comparison between Web of Today and Tomorrow:

Table 1: Traditional Web Vs Knowledge Based Web

Traditional Web	Knowledge Based Web
Key Word search	Meaningful search
Huge Search result many of which are irrelevant	More relevant and specific results
Free text Search	Concept based search
Slow, Ineffective and Non- Intelligent web	Fast, Effective and Intelligent web

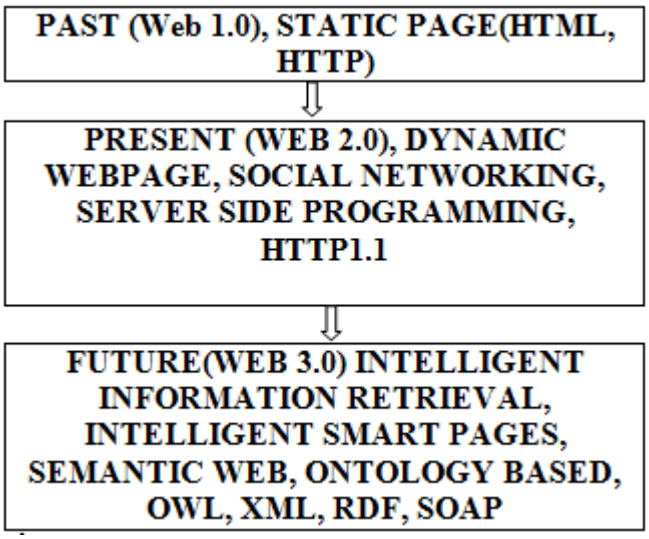

Figure 1. Web: Past, present and future

2.1 Comparison between Keyword and Semantic Search Engine

How can be a semantic based search engine will be more beneficial to a keyword based search engine that explained in the following table.

Table 2: Keyword Based Search Engine Vs semantic Based search engine

Keyword based Search Engine	Semantic Web based Search Engine
1. It is a traditional search engines that produce results of given query within the given context.	1. It works on Semantic based approach which is useful for having accurate and relevant information about the given query.
2. The information which is retrieved is dependent on keywords and page ranking algorithms that can produce spam results.	2. The information retrieved is independent of keywords and page rank algorithms that produce exact results rather than any irrelevant results.
3. It does not focus on stop words like is, or, and, how because it does not give accurate results what user is searching to get information.	3. It focuses on stop words and punctuation marks because it takes into account each and every small character as it affects search results.
4. It displays all web pages that may or may not satisfy user's query and to select relevant page from many pages is difficult task.	4. It will show only those results that will answer our query.
5. It does not highlight any words or phrases which are useful in answering getting accurate results.	5. It highlights the sentences or words that give answer to query asked by the user.
6. It makes use of keywords to expand query instead of using any methodology.	6. It uses ontology to get relations between the keywords.
7. It uses HTML, XML language for creation of metadata.	7. It uses Semantic Web languages like OWL, RDF for creation of metadata. .

2.2 Comparison between Different Semantic Search Engines

There are so many semantic based search engines invented, but how they are different from each other, here we have explained in following table.

Table 3: Types of Semantic based Search Engines

Deepdyve	Calculates the meaning of the document by indexing every word in the document and calculating the factorial of the keywords used in the document. In addition to that industrial method is considered that used to assess the impact on data.
Hakia	Based on the concept of match rather than popularity ranking or keyword match.
Kosmix	This engine organizes result by category and then adds numerous filters allowing end users to drill down for more control, accuracy and relevance.
Exalead	It provides packed searched result page that contain title, keywords, thumbnails, domain name, and refine options.
Powerset	Powerset uses a sophisticated natural language parser (licensed from Xerox PARC) to search synonyms, objects, subjects, verbs, and other elements for indexing.
Factbites	Factbites based on the technology that searching content should not break into fragments rather than on full sentences about their search topic that must be returned back to end user.
Sensebot	It uses multi document summarization and text mining to extract senses from web documents and reply to the user in a organized manner.
Lexxe	The engine allows the end user if the keywords are formed as one or more phases and to search the relevant factual information.

Cognition	The search engine based on cognition technology touts to have the perfect recipe to nail meaning in search that takes account of consideration, morphology, ontology, and synonymy.
Swoogle	Swoogle is a semantic search engine that employs crawlers to search documents that are written in RDF or OWF. It provides services to end user by browser interface and to software agents by web services.

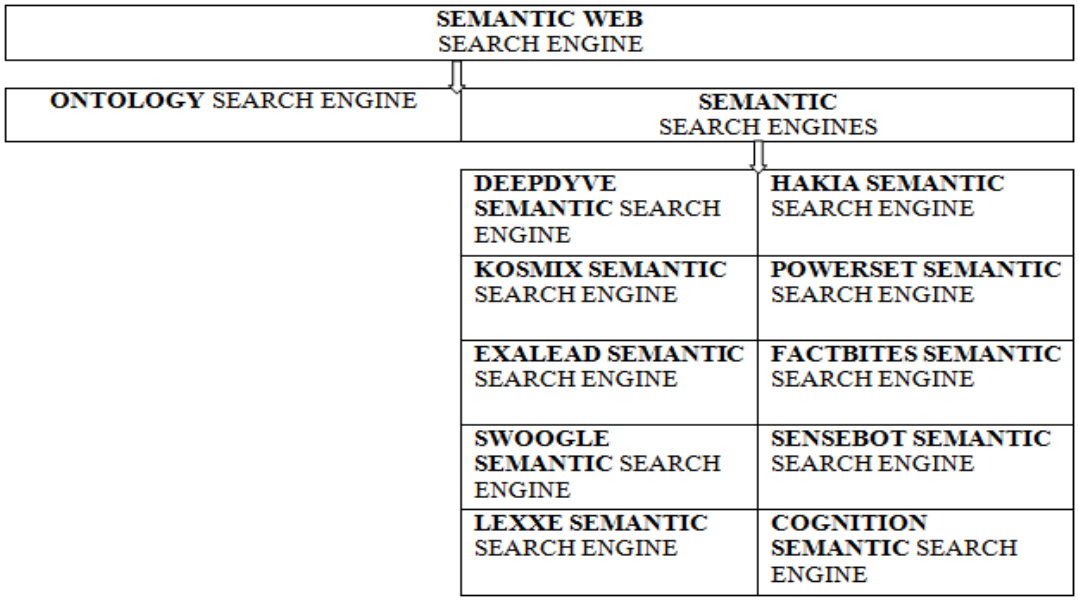

Figure 2. Classification of Semantic Web Search Engines

3. COMPARATIVE ANALYSIS OF SEMANTIC SEARCH ENGINES.

According to a research paper titled "Comparative Analysis of Semantic Search Engines Based on Requirement Space Pyramid" by Maliha Majid Qureshi, Bibi Asma, and Hikmat Ullah Khan, the comparative analysis of semantic search engines described ON THREE SCALES [LOW, MEDIUM, HIGH]

Table 4: Comparative Analysis of Semantic Search Engines

Requirements	Semantic Search Engines				
	Hakia	**Sensebot**	**Powerset**	**Cognition**	**Lexxe**
Search Environment					
Large Scale	Eminent	Eminent	Eminent	Eminent	Eminent
Heterogeneity	Eminent	Average	Eminent	Low	Eminent
Portability	Eminent	Low	Average	Low	Eminent
Query Type					
Parameterized Search	Average	Eminent	Average	Eminent	Eminent
Relation Search	Eminent	Average	Average	Average	Average
Entity Search	Eminent	Eminent	Average	Eminent	Average
Intrinsic Problem					
Understanding	Eminent	Eminent	Eminent	Eminent	Eminent
Requirement	Eminent	Eminent	Average	Eminent	Eminent
Matching	Eminent	Eminent	Average	Eminent	Eminent
Iterative and Exploratory					
Reuse	Eminent	Eminent	Eminent	Eminent	Eminent
Recommendation	Low	Eminent	Eminent	Eminent	Eminent
Refinement	Eminent	Eminent	Eminent	Eminent	Eminent

Studies have shown that almost 1/4 of surfers do not find satisfactory results from the first set of URLs returned for the searched keywords, because there's an increase of sixty-terabyte of data available online daily thus increasing the size of the Web [4]. Every user query contains multiple meanings or present with multiple contexts. Among all the documents that the search keyword is present, maximum are irrelevant to the surfer. Multiple meaning or context of a single keyword has increased the problems of information retrieval community like, word "**BASS"** can be **SEA FISH** or **TONES OF LOW FREQUENCY**. Other than being different in meanings, words with same meanings like "baby" and "infant" are treated as synonyms, but "Baby doll" has nothing to do with "infant". "Baby doll" is a song title of one of Bollywood movie.

3.1 Features of Google, Yahoo, Bing and ASK

Google (**Global Organization of Oriented Group Language of Earth)**, the most known search engine and company has an array of products integrated with search—the search engine being the flagship product. Among these famous search engines, Bing is known as a helper to other search engine which empowers their search modules. Talking about Yahoo **(Yet Another Hierarchical Officious Oracle)** is famous for being a web portal along with a search engine. This paper will incorporate all these famous search engines for its study along with **Bing** (known previously as **Live Search**, **Windows Live Search**, and **MSN Search**) which is an another search engine. It makes use of semantic technology. It provides video and image search. We have also taken ASK (originally known as **Ask** Jeeves) search engine.

Coming on to Google, it's one more feature is its capability of explaining contents better. For example, writing "Syria conflict," as search keyword, Google will provide us with portals having news, videos, and images on the first page of the result set, whereas Yahoo's first page will have general content like Wikipedia entry on Syria and Bing displayed the Syria Wikipedia entry in its Snapshot. SERP (Search engine result page) first page on Google will be completely dedicated to results about the current conflict in Syria.

Table 5: Features and Analysis of Google, Yahoo, Bing and Ask

Features	Google	Yahoo	Bing	Ask
Website	Google.com	yahoo.com	bing.com	ask.com
Search Maps	YES	NO	YES	No
Email Facility	YES	YES	NO	No
Search Books	YES	YES	YES	YES
Change Background	YES	NO	YES	No
Shopping	NO	YES	NO	NO
Translation	YES	NO	YES	NO
Multi-Language Support	YES	NO	YES	NO
Questions/Answer	YES	YES	YES	YES
Business Services	YES	YES	NO	NO
Career	NO	YES	NO	NO
Social Site	YES	YES	NO	NO
Case Sensitive	NO	NO	NO	NO
Key Distribution Graph	NO	NO	NO	NO
Live Search	YES	YES	YES	NO
Highlighting	YES	YES	NO	NO
Rank Operator	YES	YES	NO	NO
Boolean Searching	YES	YES	YES	YES
Banner Ad	YES	YES	YES	YES
Visiting Through and Visit Duration	YES	YES	NO	NO

Table 6: Search Engines and their Inventions

Search Engine Name	Year Of Invention	Invented By
Yahoo	1994	Jerry yang and David Filo
Ask.com	1995	Garrett Gruener and David Warthen
Google	1996	Larry Page and Sergey Brin
Bing	2009	Steve Balmer

4. RESULTS and DISCUSSION

Four Search engines namely Google, Yahoo, Bing and Ask were taken as sample to examine the semantic nature of text for some selected search queries during 1st January 2015 to December 17, 2015. We have also interested for MSN, but it is powered by Bing, so we have dropped the idea. Getting relevant search results from search engines, advance features of search engines have been studied and used. While performing experiments on the search results, first 20 sites were only taken into consideration as web surfer hardly goes beyond two to three pages of the search results, for every query. Results from all over world were selected for evaluation. A total of 20 queries from various segments were selected for the study (see Appendix-1).

In this study the search results which were retrieved by google,bing,yahoo and ask were evaluated through total no of sites retreived and time taken to retrieve.What we have found that, Search engine yahoo, Bing and Ask were not refected the total time taken for data retrieval like google doing.Ask is not providing the total no websites retrived so takening into account this fact, we have made a tabular structure analysis as follows.

Table 7: Retrieval of websites and time taken by Google for Simple Multi- Word Queries

Query	No Of Site Retrieved	Time In Sec	Details
Q1	10,90,000	0.51	page containing New Delhi word also retrieving
Q2	5,03,00,000	0.47	page containing vehicle and car word are also retrieving
Q3	25,40,000	0.78	page containing COO word are also retrieving
Q4	17,500	0.52	page containing R K Mathur is also coming
Q5	2,51,000	0.6	page containing SC word are also matching
Q6	2,43,000	0.64	page containing Reserve bank of India, Right to information are also retrieving
Q7	4,28,000	0.66	page containing airline, plane are also retrieving
Q8	24,500	0.61	pages containing sushil ansal and uphaar tragedy are also coming
Q9	2,45,00,000	0.61	pages containing mail and central are also coming
Q10	2,82,000	0.8	pages containing jandk is also coming
Q11	1,68,000	0.69	pages containing plastic product ,poor quality, plastic sheet plastic cup, plastic bag are also coming
Q12	4,810	0.51	membership word is also
Q13	2,460	0.61	e-commerce giant of India
Q14	98,280	0.59	movie word is coming
Q15	1,440	0.64	currency word is coming
Q16	1,06,000	0.69	IIT-JEE under privilege
Q17	86,600	0.54	naval, navy, biggest
Q18	6,58,000	0.42	ethical hacker ,ankit fadia
Q19	2,13,000	0.68	best, most compelling evidence
Q20	17,20,000	0.87	ends, reversal

Table 8: Retrieval of websites and time taken by Yahoo for Simple Multi- Word Queries

Query	No of Site Retrieved	Time in Sec	Details
Q1	14,20,000	NA	page containing New Delhi word also retrieving
Q2	4,14,00,000	NA	Car
Q3	72,90,000	NA	page containing COO word are also retrieving
Q4	14,700	NA	Page containing R K Mathur is also coming
Q5	93,200	NA	page containing SC word are also matching
Q6	45,800	NA	page containing Reserve bank of India, Right to information are also retrieving
Q7	1,22,000	NA	page containing airline plane are also retrieving
Q8	4,890	NA	pages containing sushil ansal, gopal ansal and uphaar tragedy are also coming
Q9	32,00,000	NA	Words like mail and central government is finding
Q10	73,600	NA	pages containing jandk is also coming
Q11	17,600	NA	words like plastic product ,poor quality, plastic sheet ,plastic cup, plastic bag are also coming
Q12	381	NA	
Q13	1,050	NA	e-commerce firm, buys
Q14	11,100	NA	
Q15	494	NA	currency word is coming
Q16	37,400	NA	IIT-JEE underprivileged
Q17	6,780	NA	naval, navy, biggest
Q18	5,35,000	NA	ethical hacker , ankit fadia
Q19	1,20,000	NA	best, most compelling evidence
Q20	18,80,000	NA	ends, reversal

Table 9: Retrieval of websites and time taken by Bing for Simple Multi- Word Queries

Query	No of Site Retrieved	Time in sec	Details
Q-1	1,67,00,000	NA	page containing New Delhi Word also retrieving
Q-2	2,06,00,000	NA	combat, car
Q-3	40,400	NA	COO
Q-4	40,400	NA	page related to Indian divine radha krishan , chief related like chief secretary is coming
Q-5	2,72,000	NA	other amendment related article are also coming
Q-6	6,51,000	NA	page containing Reserve bank of India, Right to information are also retrieving
Q-7	31,20,000	NA	page containing airline, plane are also retrieving
Q-8	68,100	NA	pages containing sushil ansal, gopal ansal and uphaar tragedy are also coming
Q-9	5,81,00,000	NA	central govt.
Q-10	41,000	NA	Jandk
Q-11	5,36,00,000	NA	words like plastic product ,poor quality, plastic sheet plastic cup, plastic bag are also coming
Q-12	18,200	NA	membership word is also
Q-13	43,700	NA	e-commerce firm, buys
Q-14	19,600	NA	
Q-15	7,85,000	NA	currency word is coming
Q-16	1,93,000	NA	IIT-JEE underprivileged
Q-17	1,76,000	NA	naval, navy, biggest
Q-18	4,50,000	NA	ethical hacker ,ankit fadia
Q-19	25,60,000	NA	best, most compelling evidence
Q-20	2,01,000	NA	ends, reversal

The results of these 20 queries with respect to user satisfaction of various search engines mentioned above are given in the Table 7, 8 and 9.

4.1 Comparative Study of Google, Bing, Yahoo, Ask Search Engines in Context of Precision parameter

4.1.1 What is Precision?

Precision can be better understood with an example, so let's assume that there's an information request I (of a test reference collection) and its set of relevant documents can be termed as D. Let |D| as number of documents in present in set D. Now let's assume that for a given retrieval approach (under evaluation) practices the information request i and as a result set generates an answer set R. Let |R| gives the number of documents in answer set R. Further, let |Dr| represents the intersection of the document set D and R and also provides us with the count of the same. Figure -3 illustrates these sets precision measures.
Precision can be stated as fraction of results set (the set R) which is relevant i.e. |Dr|/|R|. Precision, as stated, assumes that all the documents in the result set R have been tested (or seen). However, the result or answer set is not completely presented to the user at once.

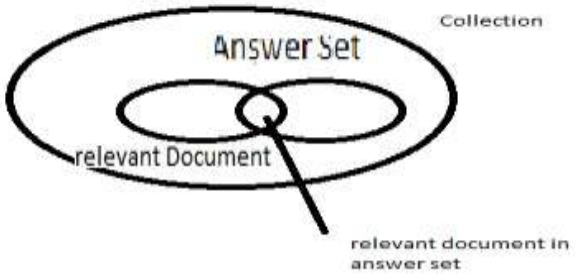

Figure 3. Precision Parameters

In a vast search results, the viewer is sometimes able to retrieve relevant information and sometimes able to retrieve irrelevant information. As explained above, the quality of searching the accurate information would be the precision value of the search engine. Here in this paper, we have taken the following parameters for precision calculation.

1) If the content page is closely matched with the query, then it is given score 1
2) If the content page is bit closely related to the subject matter but consists of some relevant information, then it is given score 0.75
3) If the content page is not closely related to the subject matter but consists of some relevant information, then it is given a score 0.5
4) If the content page is not related to the search query, then it is given 0.

The precision values for the 20 queries have been computed by a group of B. Tech. Students.

Table 10: Precision value taken for 10 URLs

Precision @10 URLs				
	Google	**Bing**	**Yahoo**	**Ask**
Q1	0.45	0.45	0.4	0.35
Q2	0.325	0.7	0.3	0.125
Q3	0.625	0.5	0.525	0.55
Q4	0.65	0.45	0.4	0.4
Q5	0.6	0.5	0.4	0.2
Q6	0.75	0.595	0.7	0.8
Q7	0.55	0.6	0.6	0.725
Q8	0.75	0.575	0.625	0.725
Q9	0.5	0.1	0.475	0
Q10	0.675	0.75	0.675	0.55

Q11	0.425	0.15	0.35	0
Q12	0.675	0.725	0.85	0.825
Q13	0.95	0.95	0.85	0.675
Q14	0.825	0.675	0.8	0.55
Q15	0.95	0.75	0.8	0.75
Q16	0.7	0.65	0.65	0.625
Q17	0.725	0.925	0.85	0.675
Q18	1	0.9	1	0.975
Q19	0.925	0.9	1	0.875
Q20	0.9	0.825	0.775	0.875

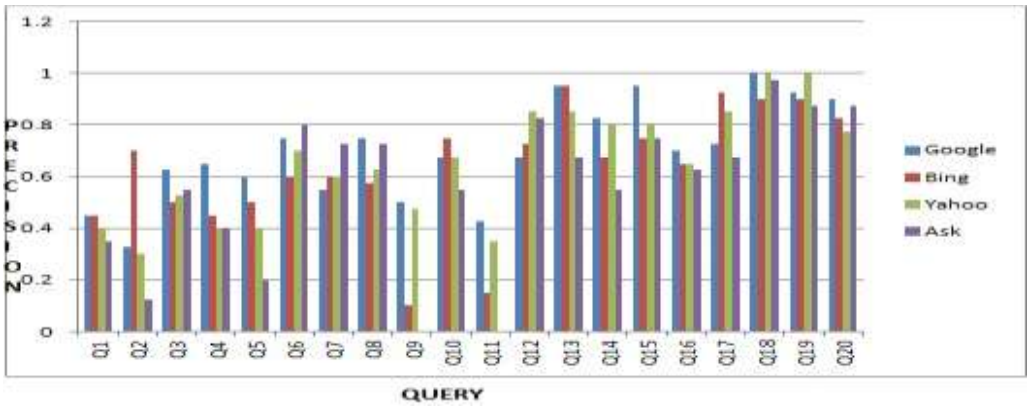

Figure 4. Analytical Graph of Precision values for First 10 URLs

Table 11: Precision value taken for 5 URLs

Precision @5 URLs				
	Google	**Bing**	**Yahoo**	**Ask**
Q1	0.5	0.5	0.3	0.6
Q2	0.35	0.85	0.25	0.25
Q3	0.75	0.5	0.55	0.6
Q4	0.6	0.6	0.5	0.6
Q5	0.6	0.6	0.6	0.2
Q6	0.8	0.55	0.75	0.75
Q7	0.7	0.75	0.65	0.7
Q8	0.75	0.75	0.8	0.75
Q9	0.4	0.2	0.65	0
Q10	0.8	0.8	0.7	0.6
Q11	0.25	0.2	0.4	0
Q12	0.75	0.8	0.9	0.75
Q13	0.95	0.95	0.95	0.75
Q14	0.9	0.85	0.85	0.55
Q15	1	0.8	0.9	1
Q16	0.85	0.75	0.75	0.7
Q17	0.95	0.85	0.95	0.7
Q18	1	1	1	1
Q19	1	0.8	1	1
Q20	1	0.8	0.85	0.8

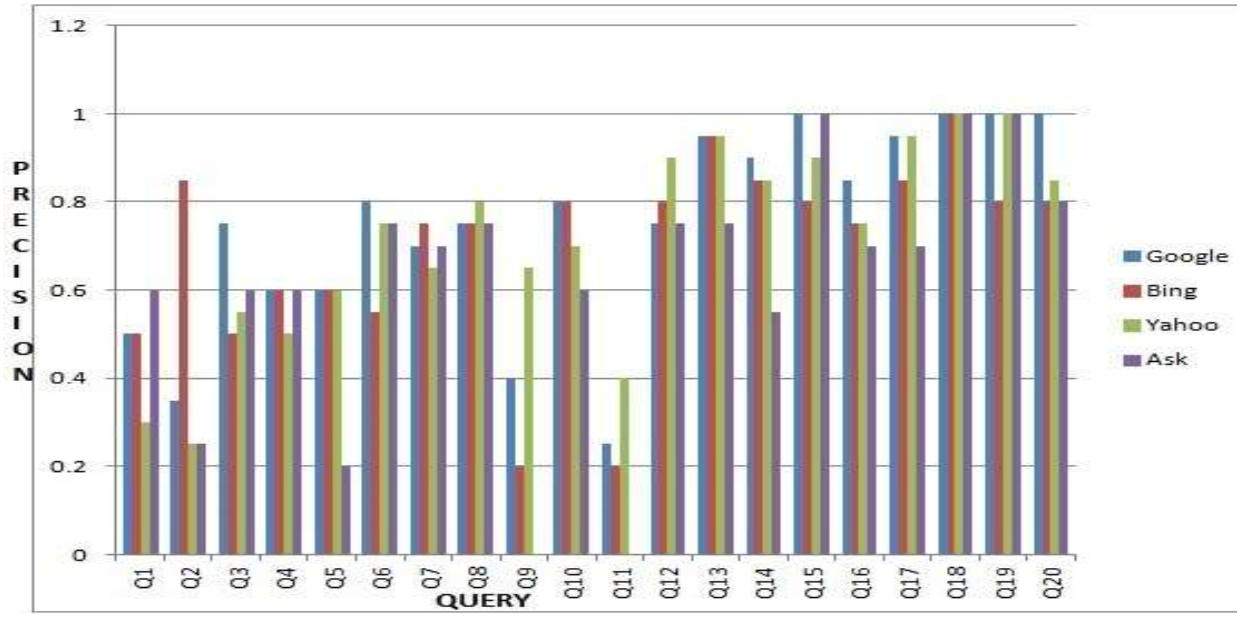

Figure 5. Analytical Graph of Precision values for First 5 URLs

5. CONCLUSION

In this paper we have compared the performance of 4 known search engines. We observed that in most of the cases Google gives better result in comparison to the other search engines because Google considers semantics of the query. However lot of improvement is still required in the search engines because the precision (P@5) for the first 5 URLs should almost tend to one which we are achieving in case of few queries.

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Appendix-I

Query-1	Nirbhaya case Delhi
Query-2	Light weight vehicle
Query-3	Jeff Williams Chief Operating Officer of Apple Inc.
Query-4	Radha Krishna Mathur Chief Information Commissioner of India
Query-5	Amendments in the Constitution (Scheduled Castes) Order, 1950
Query-6	RBI RTI Act: Supreme Court
Query-7	Malaysia MH370 flight disappearance
Query-8	Upahaar cinema case Delhi
Query9	Union Government blocked private email
Query10	Mufti Mohammed Sayeed Chief Minister of Jammu and Kashmir
Query 11	Low quality plastic items banned in Ahmedabad
Query12	Seychelles became 161st Member of WTO
Query13	Flipkart acquired mobile marketing firm Appiterate
Query14	Mukesh Khanna appointed as Chairperson of Children's Film Society of India
Query15	Finance Minister inaugurated new Bank Note Paper Line unit in Hoshangabad, MP
Query16	Anand Kumar, Founder of Super 30,
Query17	INS Kochi, indigenously built largest warship,
Query18	Brand Ambassadors for Digital India Programme
Query19	Strong Evidence of Liquid Water on Mars: NASA
Query20	China abandoned its decades old 'One Child Policy'