# COMPARATIVE STUDY OF SEARCH ENGINES IN CONTEXT OF FEATURES AND SEMANTICS

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## ABSTRACT

Web surfing for various purposes has become a habit of humans. Fact states that, after email, surfing/searching is the most popular act now days. Information quality linked through these searches is quite irregular. There are fair chances that these retrieved results can be irreverent and belongs to an unreliable source. 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 Features related to searching, but the ways of execution 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 contains survey work, which discusses a comparative study of different types of search engines in context of semantic web surfing. The present study compares the entire four search Engines mentioned above with respect to some recent queries and their results to show that how the search engines are evolving day by day.

**Keywords:** *Information Retrieval (IR), Search Engine, Precision, Search Engine Evaluation, 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 must 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 it's 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 links, text, images 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 exact search keyword and whatever more developed 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 uploaded on the web, such as catalogs of library and databases of articles. Such contents are termed as "Invisible Web"(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, differentiation of some popular Semantic search engines is described 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 with ambiguity, subjective content, high volatility, 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 are due to marketing, reposting as a 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, articles and books, for rapidly growing 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 information retrieval in search engine and issues of searching relevance.
Section III discusses about comparative analysis of search engines. Section IV is talking about searching Query, result analysis based on Appendix-1. Section V concludes the paper.

## 2. INFORMATION RETRIEVAL IN SEARCH ENGINE AND ISSUES OF SEARCHING RELEVANCE.

According to a very well known definition Information retrieval is a field concerned with structure, analysis organization, storage, searching and retrieval of information. In the initial days primary focus was given to text and text documents for searching like scholarly papers, books and news stories. These are some structure definition for all the above documents. These are called attributes or fields of a database. Search based on a user query is one of the task on text-based, others are filtering, classification and question answering.

### 2.1 Search Engine: A Bird's Eye View
When we are talking about search engine, automatically our mind goes to "Web Searching", but we should not forget desktop search or enterprise search are other applications of searching.
The First search engine was developed as school project by Alan Emtage back in 1990. The Major search engine found in use today originated in development between 1993 and 1998.

*TABLE 1: Traditional Search Engines with Year of Invention*

| S.No | Year | Search Engine Name |
|------|------|--------------------|
| 1 | 1993 | EXCITE |
| 2 | 1994 | YAHOO |
| 3 | 1994 | WEB CRAWLER |
| 4 | 1994 | LYCOS |
| 5 | 1994 | INFOSEEK |
| 6 | 1995 | ALTAVISTA |
| 7 | 1996 | INKTOMI |
| 8 | 1997 | ASK JEEVES(NOW ASK) |
| 9 | 1997 | GOOGLE |
| 10 | 1998 | MSN SEARCH (NOW WINDOWS LIVE) |
| 11 | 1998 | OVERTURE |
| 12 | 1999 | ALL THE WEB |

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. Performance of search engine depends on the factors like response time, query throughput and indexing speed. Spam is a practical issue of search engine, when we are talking about spam, generally we thought about unwanted email, but when we are searching the content in Google, yahoo, Bing and ask search engine lots of web pages or URLs are misleading, inappropriate or non-relevant information in a document. We

completely analyze the details of retrieval in our result and analysis section.

## 2.2 Issues of Searching Relevance

One of the issues is relevance. Relevance is a fundamental concept in information Retrieval. In general, a relevant document contains the formation that a user was looking for when he or she entered a query to the search engine. Again this is not 100%

| Features | Google | Yahoo | Bing | Ask |
|---|---|---|---|---|
| Website | Google.com | yahoo.com | bing.com | ask.com |
| Visiting Through and Visit Duration | YES | YES | NO | NO |
| Cross Language Search | NO | NO | NO | NO |
| Search based on time of events/content | Last 1 hour, 24 hour, week, month, year | Last day, week, month, year | Last 24 hour, week, month | NO |
| Forming Questions & Answers from Query | NO | NO | NO | YES |

correct, as there are many factors that go into person's decision as to whether the searched document is relevant. Other important issues are topical relevance and user relevance. A document is topical relevance to a query if it is on the same topic. For Example news about "Super Cyclone in the year October, 1999" would be topically relevant to the query "SEVERE CYCLONE IN ODISHA-INDIA". May be this is not that much relevant to the user who searches the topic, because she or he belongs to different country. That is called user relevance.

Another issue for information retrieval for evaluation. Quality of document depends on the user's expectations and how much he or she satisfied in this result. Two evaluation methods or measures are very popular Precision and Recall. We will discuss it in the next section.

The next issue for information retrieval is the user and their information requirement. That means the users/viewers of search engine are the real evaluator of search engine quality. This motivates us in past to do studies on how people interact with search engines. For example user enter "Lemon tree", all the search engines will you details about "Chain of Lemon tree Hotels", not the details about a plant lemon tree at least for first 10 URLS.

Now days many search engine uses techniques like query suggestion, query expansion and relevance feedback for refine the query inputted to produce better ranked lists.

## 3. COMPARATIVE ANALYSIS OF SEARCH ENGINES.

Studies have shown that almost 1/4 of surfers do not find satisfactory results in the first set of URLs returned for the searched keywords, because there's an increase of sixty-terabyte 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 contexts of a single keyword has increased the problems of information retrieval community like, word **"Lemon Tree"** can be "A PLANT" or "Chain of Hotels". In our earlier studies we have defined different features of Google, Yahoo, Bing and Ask. Here we have added some more, these features are defined in Table 2.

*TABLE 2: Features and Analysis of Google, Yahoo, Bing and ASK Search Engine*

### 3.1 Evaluation of Search Engines

Evaluation is the main key to progress of building better engine. A Civil Engineer doesn't make another new building structure without conforming about the feedback of the previous one. One of main difference made in the evaluation of search engine is between effectiveness or efficiency.

- **Effectiveness:** Measures the ability of the Search Engines to find the Right Information.
- **Efficiency:** How quickly this is done?

Effectiveness measures can be further divided into

$$Recall = |x \cap y| / |x|$$

$$Precision = |x \cap y| / |y|$$

$X \cap Y$ is the set of documents that are both relevant and retrieved. Precision calculates how well it is doing at rejecting non-relevant documents. Recalls calculates how well the search engine is doing for finding all the relevant documents. For example, to a given query, there is a set of documents or WebPages that are retrieved and set of documents or WebPages that aren't retrieved.

In our result and calculation section, we have taken 20 different queries. It is observed that if 20 documents were retrieved for a query, a precision whose value is 0.75 means that 15 out of 20 retrieved documents would be relevant.

Coming on to Google, it's one more feature is its capability explaining contents better. For example, writing "LEMON TREE" as search keyword, Google will provide us with portals having LEMON TREE HOTELS on the first page of the result set, whereas Yahoo's first page will have general content like Wikipedia entry on LEMON TREE HOTEL and Bing displayed the LEMON TREE HOTEL Wikipedia entry in its Snapshot.

## 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 2016 to 29Th February 2016. 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 10-20 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 engines like 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.

The results of these 20 queries with respect to user satisfaction of various search engines mentioned above are given in the Table 3, 4 and 5.

### 4.1 Comparative Study of Major Search Engines in Context of Precision Parameter

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 Computer science Students and average precision value is taken for consideration. After using these four search engines for searching the queries (Appendix-1), feedback of using the four search engines is compiled in the observation section.

*TABLE 3: Precision value taken for 10 URLs*

| Precision @10 URLs | | | |
|---|---|---|---|
| | Google | Yahoo | Ask | Bing |
| Q1 | 0.56 | 0.61 | 0.43 | 0.63 |
| Q2 | 0.68 | 0.68 | 0.56 | 0.63 |
| Q3 | 0.55 | 0.5 | 0.075 | 0.3 |
| Q4 | 0.5 | 0.6 | 0.27 | 0.56 |
| Q5 | 0.8 | 0.38 | 0.66 | 0.72 |
| Q6 | 0.78 | 0.57 | 0.52 | 0.55 |
| Q7 | 0.68 | 0.67 | 0.46 | 0.71 |
| Q8 | 0.75 | 0.67 | 0.63 | 0.66 |
| Q9 | 0.76 | 0.78 | 0.33 | 0.66 |
| Q10 | 0.72 | 0.67 | 0.4 | 0.58 |
| Q11 | 0.71 | 0.63 | 0.51 | 0.48 |
| Q12 | 0.66 | 0.65 | 0.46 | 0.52 |
| Q13 | 0.65 | 0.66 | 0.43 | 0.52 |
| Q14 | 0.65 | 0.68 | 0.4 | 0.65 |
| Q15 | 0.67 | 0.72 | 0.41 | 0.58 |
| Q16 | 0.57 | 0.61 | 0.35 | 0.55 |
| Q17 | 0.7 | 0.61 | 0.45 | 0.62 |
| Q18 | 0.72 | 0.73 | 0.46 | 0.55 |

| | | | | |
|-----|------|------|------|------|
| Q19 | 0.8 | 0.76 | 0.57 | 0.53 |
| Q20 | 0.67 | 0.7 | 0.23 | 0.48 |



*Figure 2: Analytical Graph of Precision values for First 10 URLs*



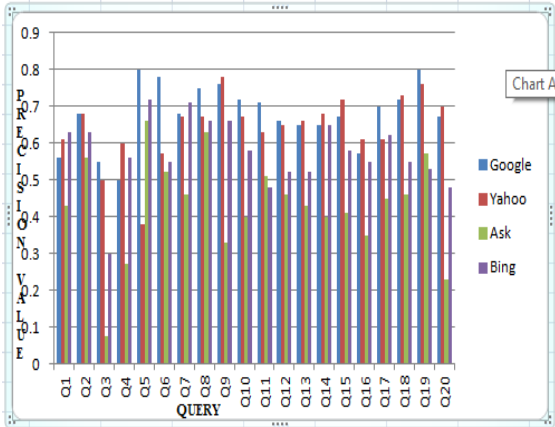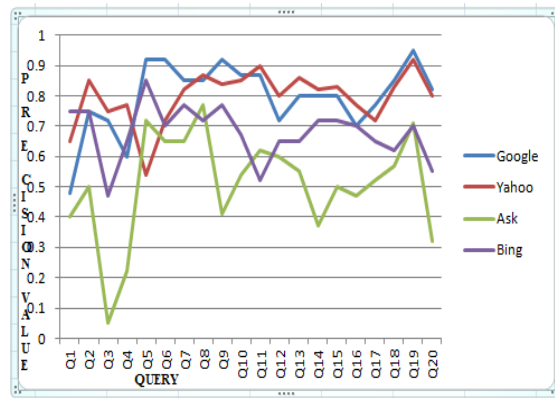*Figure 3: Analytical Graph of Precision values for First 5 URLs*

*TABLE 4: Precision value taken for 5 URLs*

| Precision @5 URLs | | | |
|-----|--------|-------|------|------|
| | Google | Yahoo | Ask | Bing |
| Q1 | 0.48 | 0.65 | 0.4 | 0.75 |
| Q2 | 0.75 | 0.85 | 0.5 | 0.75 |
| Q3 | 0.72 | 0.75 | 0.05 | 0.47 |
| Q4 | 0.6 | 0.77 | 0.22 | 0.65 |
| Q5 | 0.92 | 0.54 | 0.72 | 0.85 |
| Q6 | 0.92 | 0.72 | 0.65 | 0.7 |
| Q7 | 0.85 | 0.82 | 0.65 | 0.77 |
| Q8 | 0.85 | 0.87 | 0.77 | 0.72 |
| Q9 | 0.92 | 0.84 | 0.41 | 0.77 |
| Q10 | 0.87 | 0.85 | 0.54 | 0.67 |
| Q11 | 0.87 | 0.9 | 0.62 | 0.52 |
| Q12 | 0.72 | 0.8 | 0.6 | 0.65 |
| Q13 | 0.8 | 0.86 | 0.55 | 0.65 |
| Q14 | 0.8 | 0.82 | 0.37 | 0.72 |
| Q15 | 0.8 | 0.83 | 0.5 | 0.72 |
| Q16 | 0.7 | 0.77 | 0.47 | 0.7 |
| Q17 | 0.77 | 0.72 | 0.52 | 0.65 |
| Q18 | 0.85 | 0.83 | 0.57 | 0.62 |
| Q19 | 0.95 | 0.92 | 0.71 | 0.7 |
| Q20 | 0.82 | 0.8 | 0.32 | 0.55 |

*TABLE 5: Precision value taken for 3 URLs*

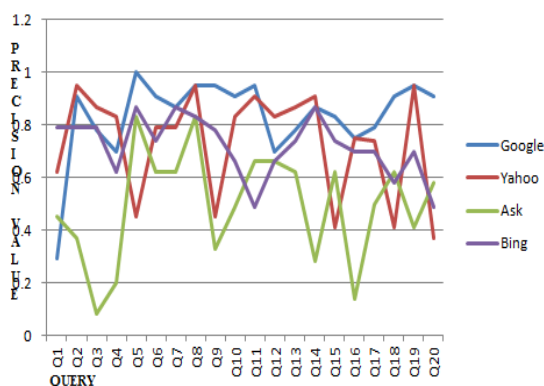| Precision @3 URLs | | | |
|-----|--------|-------|------|------|
| | Google | Yahoo | Ask | Bing |
| Q1 | 0.29 | 0.62 | 0.45 | 0.79 |
| Q2 | 0.91 | 0.95 | 0.37 | 0.79 |
| Q3 | 0.78 | 0.87 | 0.08 | 0.79 |
| Q4 | 0.70 | 0.83 | 0.20 | 0.62 |
| Q5 | 1 | 0.45 | 0.83 | 0.87 |
| Q6 | 0.91 | 0.79 | 0.62 | 0.74 |
| Q7 | 0.87 | 0.79 | 0.62 | 0.87 |
| Q8 | 0.95 | 0.95 | 0.83 | 0.83 |
| Q9 | 0.95 | 0.45 | 0.33 | 0.78 |
| Q10 | 0.91 | 0.83 | 0.49 | 0.66 |
| Q11 | 0.95 | 0.91 | 0.66 | 0.49 |
| Q12 | 0.70 | 0.83 | 0.66 | 0.66 |
| Q13 | 0.78 | 0.87 | 0.62 | 0.74 |
| Q14 | 0.87 | 0.91 | 0.28 | 0.87 |
| Q15 | 0.83 | 0.41 | 0.62 | 0.74 |
| Q16 | 0.75 | 0.75 | 0.14 | 0.70 |
| Q17 | 0.79 | 0.74 | 0.5 | 0.70 |
| Q18 | 0.91 | 0.41 | 0.62 | 0.58 |
| Q19 | 0.95 | 0.95 | 0.41 | 0.70 |
| Q20 | 0.91 | 0.37 | 0.58 | 0.49 |

*Figure 4: Analytical Graph of Precision values for First 3 URLs*

### 4.2 Observations after Using the Queries

After using these four search engines for searching the queries (Appendix-1), feedback of using the four search engines is compiled as following.

### GOOGLE

According to student's observations, Google has un-doubtfully withstood its title as the "Quickest and Reliable" search engine. During the execution of the twenty queries given to students, the students have said Google has given the quickest results upon each query searched. The question of reliability does still stand, where students detected that all the top ten search results were not as reliable as needed. They found out the top four to five URLs in Google search result are relevant data according to its search. The data relevancy downgrades after its top four to five URLs given, although the data thereafter remained connected to its topic searched but it became vague. One student said Google provides the most instant as well as reliable source of information. Whatever may be the query, it will always show response for it as quick as possible. "www.news.google.com" is the only website which does not show the desired output in the search results. Google automatically identifies whether the topic is an event or news or an article.

### YAHOO

Yahoo search engine as people say has become less actively used. Nonetheless, it is still used by few around the world. As per student's opinion on the search engine, they have said that it has become a slow and inactive search engine. They again said, during their search of the twenty queries on Yahoo, they came to find out that most of the URLs in the result were exactly the same as the results of Google's. Nonetheless, the top three URLs had the most relevant data, as for the rest of the URL result the data became sparse and vague on the topic searched. On the other hand Yahoo goes hand in hand with Google regarding the search results. The difference being that yahoo sometimes does not show the most appropriate link and the most resourceful link on the top. If we look upon Yahoo! before 2010, its search engine logic has changed drastically and is quite visible now.

### ASK

Ask, in detection was the most unreliable search engine during their search of the queries. The data found in the top ten URLs were disturbingly off topic and sparse. The connectivity of the data to its topic searched was very unclear and irrelevant. Ask gave the most unpredictable URLs result of the query searched. They said, they would not recommend using the search engine for detailed work. Ask.com is a website only for very basic search queries. It sometimes displays only few results on the main page and the resources cannot be accessed very easily. It is non-reliable and definitely outdated. Ask failed in most of the queries that were searched. In fact around 70% of search results weren't appropriate given by ask. The interesting feature is it is able to create questions from the queries and also try to found suitable answers for the same.

### BING

They surprise Bing is a reliable and a smooth operating search engine, having not knowing about it at all. Bing as per their observation gave them reliable and precise data according to the topics searched for its top two to three URLs. Although in-between the results some of the URLs came out to be imprecise but some URLs after those were still related to the topic searched. They also said, they would recommend using Bing as an alternative to Google. Bing is an upcoming search engine. It is almost as helpful as Google or Yahoo. Bing can be used to search something very trivial but cannot be always useful for a peculiar or a typical topic.

### 5. CONCLUSION

In this paper we have compared the performance of 4 known search engines. We observed that Google contains more features than the others and also in most of the cases it gives better result in comparison to the other search engines because it

considers semantics of the query. However lot of improvement in ranking of the documents is still required in the search engines because the precision (P@3 & P@5) for the first 3 and 5 URLs should almost tend to one which we are achieved in case of few queries. So, along with semantics of the query a lot more has to be looked into for achieving the perfect score of 1 which is going to vary from user to user. In the end we would say that Google and Yahoo are improving every day while Bing is improving every month and Ask.com has become outdated. So summing it up, Google being at the top is followed by Yahoo and then comes Bing with respect to relevance of the query results.

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**APPENDIX-I**

1. Maharashtra Cabinet Approved Prohibition Of Social Boycott Bill 2016.

2. Health Minister J P Nadda Launched Project 'Clean Street Food'

3. Sanjay Gupta, Jagran Group Ceo And Dainik Jagran Editor, Chosen Iaa Editor Of The Year.

4. India Inc Became First In World To Formally Adopt Un's Sustainable Goals.

5. India Sucessfully Test-Fired Agni-I Ballistic Missile.

6. Long March Against Indo-Bangladesh Power Plant Near Sunderbans Started

7. India To Supply 18 Meter Gauge Diesel Electric Locomotives To Myanmar.

8. Rajya Sabha Passed Real Estate Bill 2015.

9. Assure Call Drops Do Not Exceed 2%: Sc To Telecom Operators.

10. Tezpur University And Jnu Won The Annual Visitor's Awards For Central Universities

11. Union Cabinet Gave Green Signal For Amendment To Sikh Gurdwaras Act, 1925.

12. Former Sc Judge B S Chauhan Appointed 21st Law Commission Chairman.

13. Ccea Approved Pradhan Mantri Ujjwala Yojana To Provide Free Lpg Connections To Bpl Households.

14. Union Cabinet Approved Mou Between India And Bahrain On Corporation For Prevention Of Human Trafficking.

15. Loksabha Passed Enemy Property Amendment Bill, 2016.

16. Nirbharya Case Delhi

17. Uphaar Cinema Case Delhi

18. Rajya Sabha Passed National Waterways Bill, 2015

19. Icici Bank Launched Iwork@Home Programme For Its Women Employees.

20. Ca Media Appointed Vivek Jain As Ceo Of Digital Business.