Query based Recommendation and Gaussian Firefly based Clustering Algorithm for Inferring User Feedback Sessions with Search Goals

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ABSTRACT
In web search based applications, queries are suggested by users to search and investigate web search engines information requirements regarding user. However the queries submitted by user sometimes might not easily understood by search engines , since queries submitted by user might be short representation and should not precisely characterize users' detailed information requirements. Because numerous uncertain queries might cover an extensive assortment of topic and diverse users might desire to obtain information on based on their diverse query. Since the query based recommendation and assessment of user search goals based on user feedback sessions might improve retrieval results of web search engine for users. Determining the various number of user search goals for same query and it doesn't automatically discover user search goals based on the user specified query , clustering is performed based on K means clustering. Still K means clustering methods have some major pitfalls such as random selection of initial centroid value and selection of K value; it reduces the grouping results of pseudo documents for user search. In order to shortcoming these issues query based recommendation system and optimization based clustering is proposed in this work. In the proposed work primarily concerns a query based recommendation system to understand user search goals through examining user search engine query logs files. It then creates and suggests the queries with the purpose to cover search goals of user. Second propose a novel Gaussian firefly algorithm (GFA) based clustering method to group similar user pseudo-documents from feedback session which can capably replicate user search goals. Then clustering results of proposed GFA is compared with existing Fuzzy C Means (FCM) and K means clustering methods for web search engines. At end of the clustering method the experimentation results is measured based on the classifier parameters such as Average Precision (AP) Voted Average Precision (VAP) and Classified Average Precision (CAP) to assess the performance accuracy of web search engine results based on the restructured web search results.

Keywords
User search goals, feedback sessions, pseudo-documents, classified average precision (CAP), Voted AP (VAP), average precision (AP), Information retrieval (IR) ,Fuzzy C means clustering(FCM), K-means clustering, Gaussian Firefly algorithm (GFA).

1. INTRODUCTION
In recent years web search based applications are mostly focused by users to search information regarding websites. Based on the queries submitted by users only web search engines provide information to user related to searching goals efficiently. The quires characterize the information requirements of users. However the queries submitted by user sometimes might not easily understood by search engines , since queries submitted by user might be short representation and should not precisely characterize users' detailed information requirements, because numerous uncertain queries might cover a extensive assortment of topic and diverse users might desire to obtain information on based on their diverse query. It is essential and prospective to confine diverse user search objective in information retrieval. Since query submitted by user in the web search engines may represent various aspects for single query, among them grouping the similar user aspects also more difficult. It helps web search engines to find the similar user needs and attain information to assure each user necessitates.

User search goals of various users one same aspect oriented queries results are formed as individual cluster based on user given query. To improve the web search engine based information retrieval, user suggestion and examination of user search goals plays major significant role. Initially, user can development of web search results [1] regarding in the direction of user's search goal through clustering the web search engine based search results through the equivalent search goal. Subsequent one if user search goals characterized through several number of keywords, it be able to employ in query proposal [2]. At lastly, the distributions of user search goals are able to moreover be helpful in several number of the applications such as reranking searching query based user profiles and web search results with the intention of include diverse user search goals.

X. Wang and C.-X Zhai et.al [1] introduces a user boundary based web search engine based on hierarchical structure for clustering similar user search goals regarding query in similar aspects of searching. Classification based methods based on the text are also used to categorize personal search consequences into an available grouping association. Query based search results is recommended by Hua-Jun Zeng et.al [3] on the behalf of user goal and rank the list of documents returned through a definite Web search engine, it initially mine and ranks a large amount imperative phrases as applicant cluster names, based on regression learning algorithm with label names defined by user . The documents returned by web search engines regarding user specified then

clustering is formed until the completion of user searching in web search engines and final clusters are returned that differentiate similar and dissimilar user based on user query . However the major shortcoming of the work it considers results based on user specified query only and it doesn't perform searching results based on user search goals in semantic manner.

Clustering web search engine and their results becomes a most important method to group similar user and dissimilar user, easy method to appropriate documents rapidly. Wang and Zhai [4] knowledge "motivating aspects" of a theme beginning Web search logs in addition to categorize search results and make more important cluster labels via the past query words submitted by users. But the major shortcoming it is not easily applicable to all user since the queries submitted by user regarding dissimilar point of view is very small when compare to similar user search goals ,so clustering majorly focus on the similar search goals ,thus reduces the clustering accuracy . The another shortcoming of the existing work is that it doesn't automatically discover user search goals based on the user information produced by web search engines at various aspect of point on specified user query.

To perform clustering process for user search goals, initially the feedback session are collected by web search engines that include the information of URLs which is categorized into clicked URL and Unclicked URL links. The clicked URL consists the information for user search query to reach user search goals and unclicked consists of unimportant information for user search goals and they must practically be a part of the user feedback. Inside the feedback session, the clicked URLs notify what users necessitate and the unclicked URLs replicate what users do not care regarding user search goals. Additionally, there is profusion of various feedback sessions in user click-through logs. So, in support of inferring user search goals, it is new well-organized to examine the feedback sessions than to investigate the exploration results straightforwardly. In the way to solve and manage this issues specified in above ,in this work presents a novel hybrid clustering methods which automatically group the similar user goals ,not only grouping to enhance the web user search goals ,query based suggestion also supported in this work ,since the query submitted by user not correct for all times ,so query based recommendation system is supported in searching of web users to accumulate equivalent feedbacks sessions, the major contribution have the following steps:

In first step of the work a query based recommendations system is supported based on the queries submitted by user with several number of keywords by selecting the drop down list and queries with user click through links. This method will be useful to users to obtain the necessitate information straightforwardly and rapidly. The proposed query based recommendation system suggested several numbers of topics for single user specified query. `In this manner, users can construct an appropriate search query regarding to their goal and by the way of the information domain terminology which will assist search engine to obtain the preferred results.

Feedback sessions for individual pseudo documents are clustered to collect information of the clicked URLs and assure user goals to retrieve the relevant information. Clustering is performed by using swarm intelligence [5] based Gaussian firefly algorithm (GFA). Firefly population are randomly generated for user feedback session and clustered the similar user feedback session based on fitness function. The proposed GFA for clustering user pseudocuments based on the flashing behavior of fireflies. Finally evaluate the hybrid GFA and existing FCM and K clustering methods we use the classification parameters such as Average Precision (AP) Voted Average Precision (VAP) and Classified Average Precision (CAP) performance for web search results related to user search goals. The experimentation results show that the purpose to measure the evaluation results of web search engines while inferring user search goals. Because of user search goals inadequacy, numerous methods have been investigated and done in earlier works based on user search goals. It is classified into three classes: query classification [4], search result reorganization [6], and session boundary detection [7].

2. BACKGROUND KNOWLEDGE

The difficulty of clustering investigate also results investigate during a numeral of previous works. During all of the earlier work are appropriate clustering algorithms which primary grouping documents addicted to similar groups according to satisfied comparison, as well as produce communicative review for clusters.

Zamir and Etzioni [8] introduced a Suffix Tree Clustering (STC) which initial identify group of documents with the purpose of split common phrases, along with after to create clusters according toward these phrases. Our applicant phrase extraction system is comparable toward STC although supplementary estimate a number of considerable properties recognize salient phrases, as well as use of learn methods toward rank these salient phrases. Several topics finding otherwise text trend analysis method is moreover associated to our method. The difference with the purpose of specified titles moreover short snippets somewhat than full documents. For the meantime, we prepare regression model used for the ranking cluster which is directly associated toward efficiency **of** users browsing.

Web investigate engines challenge toward satisfy users information requests through standing web pages with respect to queries. But the practicality of network search is to facilitate, it is commonly a method of querying, learning, as well as reformulating. A sequence of communications along with user also search engine preserve necessary toward satisfy solitary information need [9]. Though users query search engines within organize to complete tasks on a diversity of granularities, issue numerous query since effort toward accomplish tasks. In earlier [6] learn actual sessions manually labelled addicted to hierarchical tasks, as well as demonstrate that timeouts, something their length, are of unfinished utility during identifying task boundaries, achieving a maximum precision. Although, their technique simply identifies whether a couple of queries belongs to similar goal otherwise mission as well as does not mind what the goal is in aspect.

U. Lee, Z. Liu, and J. Cho [10] learning the "goal" at the back based taking place a user's Web query, consequently to this goal preserve used toward find improved excellence of a investigate engine's results. Preceding studies encompass generally focused taking place manual query-log analysis to identify Web query goals. Recognize user goal mechanically through no any explicit comment from the user. User search goal represent through a numeral of keywords preserve utilize in query suggestion [11-12]; accordingly, the recommended queries can assist user toward form their query additional accurately. A preceding exploitation of the user click-through logs toward acquires user understood feedback on the way to expand preparation data when knowledge ranking functions in information retrieval. Adapt an improvement structure to challenging groups of users as well as exacting collections of

documents agree additional improvement during retrieval quality designed for at least two reasons. Since physically adapt retrieval purpose illustration consuming otherwise even not practical, investigate taking place automatic adaptation through means of machine learning is receiving of huge deal notice.

T. Joachims [13] discover as well as evaluate strategy designed for how toward mechanically generate training example for learning retrieval functions since experimental user behavior. Yet, implicit feedback is additional hard toward interpret as well as potentially noisy. Primary observe the which types of implicit feedback know how to be reliably extracted since experiential user behaviour, in particular click through data in WWW search. The learn projected on the way to examine how users correlate through list of ranked consequences as of the Google search engine moreover how their behaviour preserve interpret significance judgments. Thorsten Joachim's did a lot of workings scheduled how to use implicit feedback toward acquire better retrieval quality [14]. In our attempt we believe feedback sessions since user implicit feedback as well as recommend a novel optimization method toward merge clicked as well as unclicked URLs during feedback sessions toward discover what users actually require along with what they do not mind. Individual submission of user search goals is reorganization web study results. In this work we infer user search goals establishment user click-through logs as well as reorganize search results according toward inferred user search goals along with then finally determine results.

3. PROPOSED SEMANTIC QUERY BASED RECOMMENDATION SYSTEM AND GAUSSIAN FIREFLY BASED CLUSTERING FOR PSEUDOCUMENTS TYPESET TEXT

In this paper presents a novel web search engine based methods to perform the search engines results based on user search goals which satisfies user requirements. The proposed methods consist of two major phases to satisfy user search goals as follows: user search goal based query recommendation system and clustering is performed based on user search goals via the collection of pseudo-documents from the web pages. Then asses the accuracy of information retrieval results for search goals using criterion functions CAP, VAP, AP and Risk. The initial step of the work is to collect information of web pages regarding user specified query. For example when the user specified query as book then book related web pages are collected from user log files with link pages clicked by user .Then contents are collected from web links to record the feedback session of the every one user.

3.1 Feedback Session

The initial step of the work is to the collection of the web pages based on the user specified query. For example when the user specified query as book then book related web pages are collected from user log files with link pages clicked by user .Before that the number of links searched by user and select content from the web links . Then contents are collected from web links to record the feedback session of the every one user. Consider that the feedback session [7] of the user is denoted as S_i for user $i \in \{1, \ldots . h\}$ with set of users 0 to identify the current user. In order to perform query based recommendation system extends the procedure to feedback session S_0 of the present uses and their searched summary as S_0^{pred} . This predicated summary results based on the user search goals with recommended query results are investigated. It consists of three major steps:

1. The creation of a user feedback session review S_i for every one of the user ,
2. The division of a "predicted" searching review S_0^{pred} of the current user in online and the history of past user information also collected and
3. The creation of queries based on the predicted search goals feedback session S_0^{pred} .These created queries is used for query based recommendations process.

Using the following function we compute "predicted" searching review S_0^{pred} via existing summaries:

$$S_0^{pred} = \sum_{0 \leq i \leq h} (\text{sim}(S_0, S_i) \times S_i) \quad (1)$$

The similarity function sim can be realized via vector based cosine similarity measure. This function is extended to query based recommendation process by allocation of queries to each S_0^{pred} , as follows

$$\left(Q, S_0^{pred}\right) = \text{Sim}(S_Q, S_0^{pred}) \quad (2)$$

For computing the similarity for above feedback session summary will improve the results ,here use the Min Hash probabilistic similarity function with the purpose to maps each session summary S_i to a "signature" $h(S_i)$, similarity between two user feedback session vectors is computed as :

$$\text{JaccardSim}(S_i, S_0) = \text{sim}(h(S_i), h(S_0)) \quad (3)$$

Initially the feedback session are collected by web search engines that include the information of URLs which is categorized into clicked URL and Unclicked URL links. The clicked URL consists the information for user search query to reach user search goals and unclicked consists of unimportant information for user search goals and they must practically be a part of the user feedback. Inside the feedback session, the clicked URLs notify what users necessitate and the unclicked URLs replicate what users do not care regarding user search goals. Additionally, there is profusion of various feedback sessions in user click-through logs. So, in support of inferring user search goals, it is new well-organized to examine the feedback sessions than to investigate the exploration results straightforwardly. To characterize the user feedback session proficiently a number of demonstration methods is required, since each user searching behavior is differs for same query and their resultant log files is moreover altered. Feedback session to Pseudo-Documents is represented in the form of binary vector "0" denoted as "unclicked" URL and '1" denoted as the "clicked" URL [0110001] for each user.

Building a pseudo documents: The pseudo documents of the each user are created based on the performing preprocess step such as stemming and remove stop words. The highest URL's title and snippet are created via the calculation of Term Frequency-Inverse Document Frequency (TF-IDF) vector,

$$T_{u_i} = \{T_{W_1}, T_{W_2}, \ldots \ldots, T_{W_n}\}^T \quad (4)$$

$$S_{u_i} = \{S_{W_1}, S_{W_2}, \ldots \ldots, S_{W_n}\}^T \quad (5)$$

Where

T_{u_i}- TF-IDF vectors of the URL's title

S_{u_i} are the TF-IDF vectors of the URL's snippet .

u_i- i^{th} URL in the feedback session.

W_n n^{th} term materialized in the enriched URLs. T_{W_n} and S_{W_n} represented as the TF-IDF impact of the n^{th} term for URL's title and snippet, equally. If the value of the dissimilar is denoted as T_{u_i} and S_{u_i},

$$f_{u_i} = T_{u_i}\omega_t + S_{u_i}\omega_s = \{f_{W_1}, f_{W_2}, \dots\dots, f_{W_n}\}^T \quad (6)$$

Where f_{u_i} is denoted as the feature representation value for URL in the feedback session, and weights of the titles and snippets is represented as ω_t and ω_s. The entire session with feature representation is specified as ,

$$F_{f_s} = \left[f_{f_s}(\omega_1), \dots\dots f_{f_s}(\omega_n)\right)]^T \quad (7)$$

Then the similarity among the pseudocuments is determined via cosine similarity score ,

$$Sim_{\,i,j} = \cos\left(f_{f_{s_i}}, f_{f_{s_j}}\right) = \frac{f_{f_{s_i}} f_{f_{s_j}}}{|f_{f_{s_i}}||f_{f_{s_j}}|} \quad (8)$$

$$Dis_{\,i,j} = 1 - Sim_{\,i,j} \quad (9)$$

3.2 Cluster Pseudo-Documents with K means

Perform the K-means clustering method to group pseudo documents of the user with different K values.

$$F_{center_{\,i}} = \frac{\sum_{k=1}^{C_i} F_{f_{S_k}}}{C_i}, \left(F_{f_{S_k}} \subset Cluster\ i\right) \quad (10)$$

where $F_{center_{\,i}}$- centroid value for k means clustering methods and C_i is denoted as the cluster. $F_{center_{\,i}}$ with highest values is considered and forms a new cluster for each user.

3.3 Semantic Similarity with Swarm Intelligence based GFA method for Clustering

WordNet is tool to determine the semantic similarity among the words for each documents and that is chosen by user .It finds the semantic similarity between the user specified queries via Parts of Speech (POS) - noun, verb, adjective, and adverb. The wordnet results are represented in the form of synset it consists of explanation, and its synonyms for each word. The specific suggestion for user given query in the POS tags is named as sense. Synsets are associated with each other via representing unambiguous semantic relations (hypernym, hyponym for nouns, and hypernym and troponym for verbs) for pseudo documents terms.

Some modifications are done in general firefly algorithm that is the step length of the variable is changed simultaneously for each user firefly from one feedback session pseudo documents to another pseudo documents to perform clustering process .The clustering is performed based on the behaviour of firefly (user feedback session) through association of pseudo documents based on the objective function from equation (8). So all the pseudo documents in the search engine results moves from one place to another place cluster to perform best clustering based on user specified objective function. Based on this process entire best results are formed based on the user search goals for each pseudo documents .Proposed system GFA clustering methods for pseudo documents uses a weight value for each pseudo documents and rely on total number of iterations.

$$W_{iter} = u + \frac{(iter_{max} - iter)^n}{(iter_{max})^n} + (v - u) \quad (11)$$

W_{iter} is the weight value of the pseudo documents for each user. The weight of W_{iter} is assigned between two different user pseudo documents u and v, $\alpha \in [0,1]$ so $u = 0\ \&v = 1.n$ and iter is specified in [21]. In equation (11) n value is determined by:

$$n = 10^{(-\text{dimension})} \quad (12)$$

If the value n becomes low and number of iterations performed by system is too low, thus improves the clustering results of each user in web search engine system. In proposed algorithm GFA method is performed based on the random selection of the pseudo documents. Random selection of pseudo documents follows the procedure of random walking [15] with consecutive selection of random number of pseudo documents in the feedback session. The random selection is performed based on the predicted step length value from (11); it finds best cluster pseudo documents for each user via Gaussian distribution is specified in the equation (13).

$$p = f(u|\mu, \delta) = \frac{1}{\delta\sqrt{2\pi}} e^{\frac{-(u-\mu)^2}{2\delta^2}} \quad (13)$$

Where u is an error value of the cluster and fitness value firefly$i$.

$$u = F_{center_{\,i}}(g_{best}) - F_{center_{\,i}} \quad (14)$$

μ is mean and δ is standard deviation which is predefined as $\mu = 0$ and $\delta = 1$, it is associated to probability value p is followed by:

$$u_i = u_i + \alpha * (1 - p) * U(u, v) \quad (15)$$

That $U(u, v) \in [0,1]$ .l behavior, if the new cluster data points are found based on the centroid value ; it is selected as cluster data points for each user in the user feedback session. This way of finding best cluster data points in the feedback session is repeated until all the number of feedback session is completed.

Gaussian Firefly Algorithm (GFA) for Clustering Pseudo Document of the Users

1. Define objective function to user search goals $f(u) = (u_1, u_2, \dots u_d)^T$
2. Initialize a population of number of users in the web search engines as fireflies $u = (u_1, u_2, \dots u_n)$
3. Define light absorption coefficient γ is similar user query range
4. While $(t < \text{MaxGeneration})$
5. For $i = 1{:}\,n$ (all n fireflies)
6. For $j = 1{:}\,i$
7. Light intensity is determined by $f(u_i)$
8. Define objective function to user search goals $f(u) = (u_1, u_2, \dots u_d)^T$
9. Initialize a population of number of users in the web search engines as fireflies $u = (u_1, u_2, \dots u_n)$

10. Define light absorption coefficient γ is similar user query range
11. While (t < MaxGeneration)
12. For i = 1: n (all n fireflies)
13. For j = 1: i
14. Light intensity is determined by $f(u_i)$
15. If ($I_i > I_j$)
16. Move nodes i towards j in all d dimensions
17. Else
18. Move nodes firefly i towards best solution in that iteration
19. End if
20. Attractiveness varies with distance via user search goal query
21. End for j
22. End for i
23. Rank the nodes and find the current best search engine group of the user with query
24. Define normal distribution
25. For k = 1 ... n all n fireflies
26. Draw a random number from defined distribution and apply Eq. (13).
27. Evaluate new solution($F_{Sim\ i,j}$))
28. If(($F_{Sim\ i,j} < F_{Sim\ i,j}$(i))&&($F_{Sim\ i,j} <$ $last\_cost_{iteration}$ ($F_{Sim\ i,j}$(i))))
29. Move firefly i towards current best
30. Else
31. Repeat steps 4 to 14 again
32. End if
33. End for k
34. End while

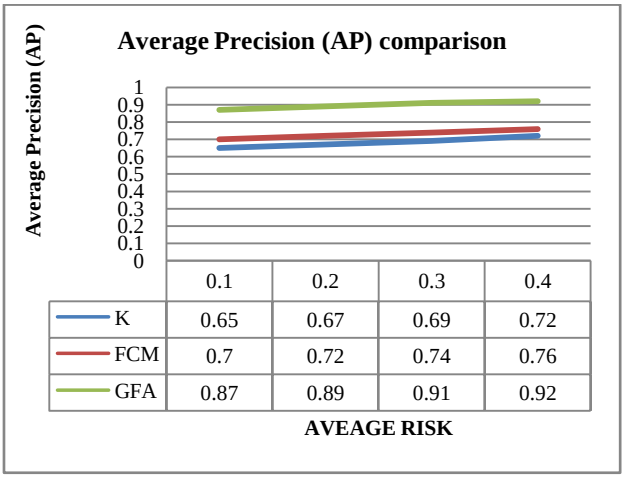
4. EXPERIMENTATION RESULTS

Before going to the part of the conclusion and their remarks of the present work, it becomes very important to study the experimentation work and analysis the results of the methods based on the user search goals. The clustering results of each methods are evaluated based on the following metrics such as Classified Average Precision (CAP), Voted AP (VAP) and average precision (AP) were used. The results of each metrics are evaluated between the clustering methods (K, FCM and GFA) with user search Goal along with semantic similarity values.

AP: AP is determined based on the user implicit feedbacks session with user search goals, which is average precision value of pseudo documents with ranked sequence

$$AP = \frac{1}{N^+}\sum_{r=1}^{N} rel(r)\frac{R_r}{r} \tag{16}$$

Where N^+ is the denoted as the amount of clicked documents, r is the rank, N is the total amount of the documents returned during search process, rel(r) is relevance score value for each document, and R_r is the total amount of the documents which is most relevant to query .Then illustrate the results of the clustering methods (K, FCM and GFA) for AP and is shown in Fig 1.it shows that proposed GFA achieves higher AP results than existing methods.



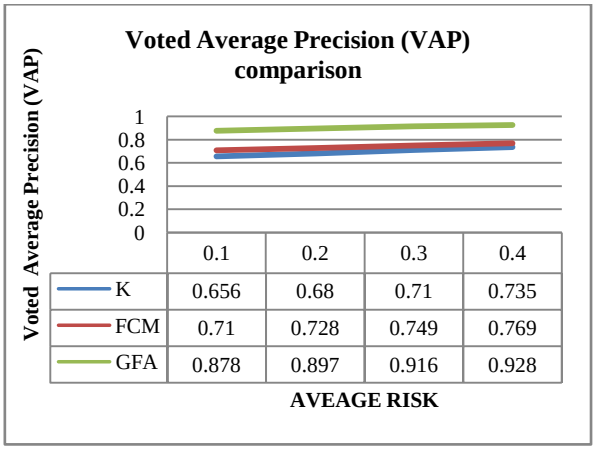
	0.1	0.2	0.3	0.4
K	0.65	0.67	0.69	0.72
FCM	0.7	0.72	0.74	0.76
GFA	0.87	0.89	0.91	0.92

Fig 1: Average Precision (AP) comparison

VAP: VAP is measured based in on the search result for AP class is 1, it is specified as ,

$$VAP = \frac{1}{NC}\sum_{r=1}^{NC} rel(r)\frac{R_r}{r} \tag{17}$$

Where N is the total amount of the documents returned during search process with class label one,rel(r) is relevance score value for each document, and R_r is the total amount of the documents which is most relevant to query is illustrated in Fig 2. Then illustrate the results of the clustering methods (K, FCM and GFA) for VAP and is shown in Fig 2.it shows that proposed GFA achieves higher VAP results than existing methods.



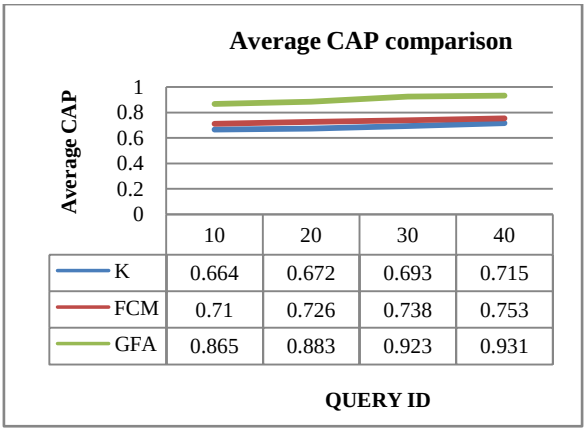
	0.1	0.2	0.3	0.4
K	0.656	0.68	0.71	0.735
FCM	0.71	0.728	0.749	0.769
GFA	0.878	0.897	0.916	0.928

Fig 2: Voted Average Precision (VAP) comparison

CAP: Expand the procedure of VAP via adding Risk and it is specified as CAP,

$$CAP = VAP * (1 - risk)^{\gamma} \tag{18}$$

Where $\boldsymbol{\gamma}$ is used as the important factor to adjust Risk value on CAP.



	10	20	30	40
K	0.664	0.672	0.693	0.715
FCM	0.71	0.726	0.738	0.753
GFA	0.865	0.883	0.923	0.931

Fig 3: Classified Average Precision (CAP) comparison

Then illustrate the results of the clustering methods (K, FCM and GFA) for VAP and is shown in Fig 3.it shows that proposed GFA achieves higher CAP results than existing methods.

Risk: The error value of the clustering methods is evaluated based on the risk as follows:

$$\text{Risk} = \frac{\sum_{i,j=1(i<j)}^{m} d_{ij}}{C_m^2} \quad (19)$$

5. CONCLUSION AND FUTURE WORK

In this paper presents a novel clustering method to group the similar user feedback sessions represented by pseudo-documents via infer user search goals for specified query. In initial part of the work is to perform query based recommendation system to select various types' queries for same concept. Feedback sessions are created for each search based on the counts of clicked and unclicked URLs. Then created feedback sessions regarding reflects user information needs. The created feedback consists of several numbers of pseudo-documents which represents the information of URLs with textual contents (titles and snippets). Based on these pseudo-documents only clustering is performed via GFA algorithm to group each similar user feedback sessions. GFA is compared with existing clustering methods k means and FCM clustering methods .The clustering results are measured via the parameters AP,VAP ,CAP and risk for each user search goal inference. In future we apply other types of clustering methods such as subspace clustering, hierarchical clustering methods, parallel clustering and density clustering algorithm to improve clustering results for each user feedback session in well-organized manner. In real time implementation, it can be also extended to complex queries in both online and offline manner. Then, for same user given several number of results are found in various categories is also extended to user search goals in both online and offline manner. Thus, users can be able to discover what they want easily.

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