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CMSC 676: INFORMATION RETRIEVAL

IEEE PAPER: “WEBPAGE RANKING USING DOMAIN BASED KNOWLEDGE”

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Introduction

Search Engines use the keywords used by the user to find set of relevant documents in the database which contains these keywords. Many web pages are discarded as they have unmatched keywords. However, there will be useful pages that are still relevant to the user can be selected from the discarded web pages. So, to do that Primary and Secondary quotient values are introduced and considered to rank the webpages irrespective of the matched words. Similarity Index concept is also used to consider the pages with partially matched keywords.

Related Work:

There are many ranking algorithms like graph-based ranking for example HIT and PageRank, probability-based ranking, concept-based ranking, and machine learning based ranking algorithms.

The HIT (Hyperlinked Induced Topic Search) is a popular ranking algorithm used to rank web pages according to their degree. In HITS algorithm there are “authorities and hubs”. Authorities are the webpages that have more inbound degree and hubs are the web pages that have more outbound degree or links. In a graph for each vertex the HITS will score the page in two ways one for authority score and other for hub score.

$$HITS_A(V_i) = \sum_{V_j \in In(V_i)} HITS_H(V_j)$$

$$HITS_H(V_i) = \sum_{V_j \in Out(V_i)} HITS_A(V_j)$$

PageRank algorithm is one of most famous page ranking algorithm by Page and Brin. The pagerank scores the web page based on both inbound and outbound at once.

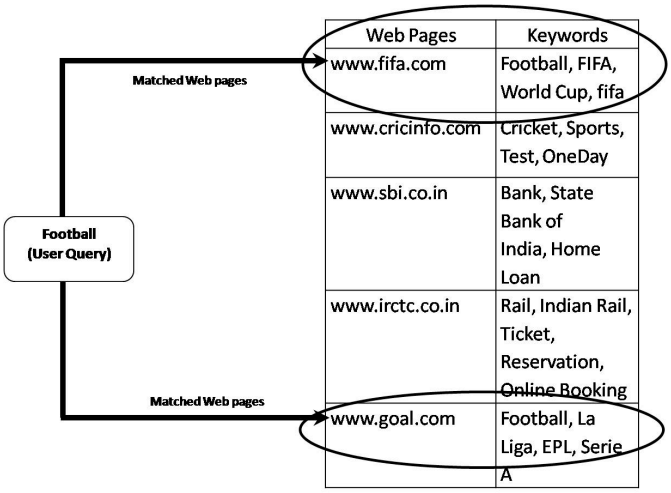
$$PR(V_i) = (1-d) + d * \sum_{V_j \in In(V_i)} \frac{PR(V_j)}{|Out(V_j)|}$$

These both algorithms start from arbitrary values assigned to the vertices in the graph. And computed iteratively till it converges on given threshold.

Proposed Approach:

The domains in this approach are created using direct matching of the user query and web page keywords. In most of the existing approaches the domains are selected on the server side but in this approach, it is done runtime. Pages which are having matched and pages which have minimum possibility of matching with the user keywords are displayed in the results.

The webpage URLs are resided in the predefined database. These pages are tagged as primary secondary based on the following proposed algorithm. The primary webpages are selected by matching the user query words. The following figure shows how the selection is carried out.



Web Pages	Keywords
www.fifa.com	Football, FIFA, World Cup, fifa
www.cricinfo.com	Cricket, Sports, Test, OneDay
www.sbi.co.in	Bank, State Bank of India, Home Loan
www.irctc.co.in	Rail, Indian Rail, Ticket, Reservation, Online Booking
www.goal.com	Football, La Liga, EPL, Serie A

The Primary quotient value of the primary webpages are calculate using the R_1 equation. Here $PR(W_i)$ is the page rank of inbound web page in W, S_w is the visitor's session in webpage in W, N_w is the total number of visitors in web page W.

$$R_1(W) = \left(\frac{1}{\sum PR(W)} + \frac{\sum S_w}{N_w} \right)$$

Web pages may not need to contain the exact keywords to know whether that has relevant information or not. A web page that does not have the matched words still can be useful. So, using the Secondary web page concept the pages whose content matches are selected for ranking and later presented to the user. MatchKeyword algorithm shows the Secondary webpage selection process.

Algorithm: matchKeyword (K, W_p)

Input: Keywords(K), Webpage (Wp)

Step 1: Initialize variable A, Digging factor (= 2)

Step 2: Consider parent webpage of W_p as W_1

Step 3: If W_p is the root then go to Step 6. Else, go to Step 4.

Step 4: Calc Similarity Index using the following equation

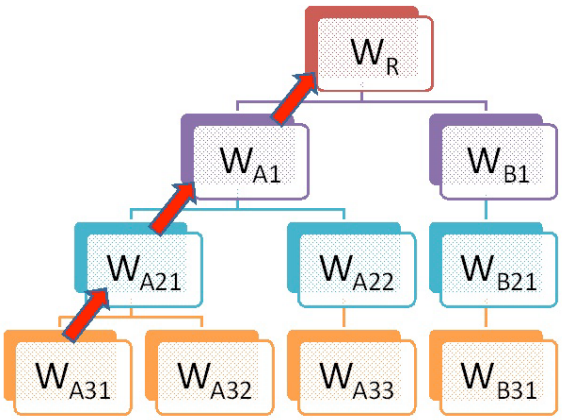
$$I_S = \frac{(K_{FM} + 0.5) \times K_{0.5}}{K_N(W)}$$

Here I_s is the similarity index, K_{FM} is the number of fully matched keywords, $K_{0.5}$ is the number of 50% matched keywords, $K_N(W)$ is the total number of keywords in web page W.

Step 5: If SI > 0.5 then tag W_p as Secondary web page and go to Step 7 else Step 6

Step 6: Consider parent web page of W_1. A = A+1. Go to step 7.

Step 7: If no more pages in the database, then end. Else, consider another webpage and go to Step 1

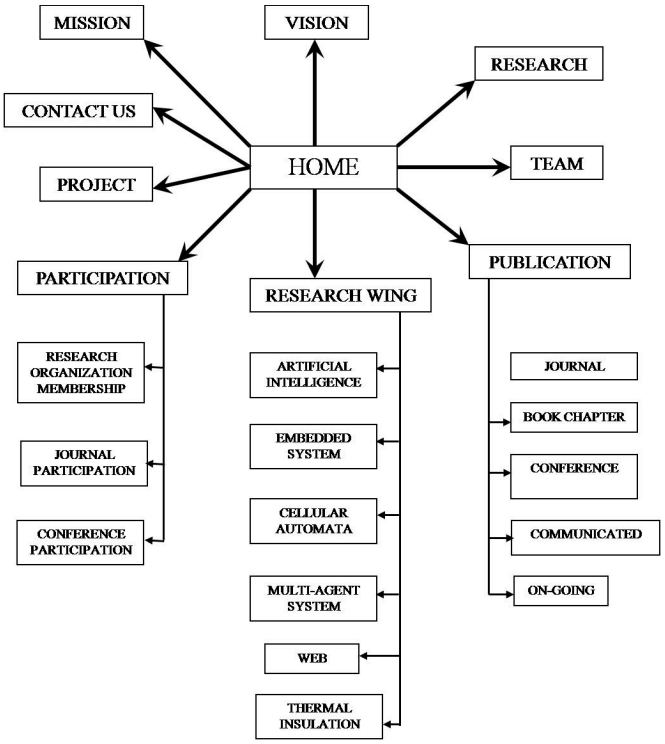


Once we have tagged the secondary webpages, we find the secondary quotient values using the R_2 equation. Here if you observe we use something called as digging factor to distinguish the primary and secondary pages. It is used to keep track of the level in the hierarchy in bottom-up fashion. And if we observe we are calculating the quotients in the same way except that in case of the secondary quotient we are using the digging factor. So, the same features are being used for the ranking process. Now all the webpages selected are merged and displayed according to the ranking.

$$R_2(W) = \frac{\left(\frac{1}{\sum PR(W_1)} + \frac{\sum S_W}{N_W} \right)}{D_F}$$

Experimental Results:

Let us consider a URL http://www.capexindia.com/IRL and now we search for the primary and secondary pages. Following diagram depicts the links from the URL.



The user query k = “Multi Agent”. When searched for the primary webpages we find the following results

Web Page	Web Page(W)	Classification
WI	http://www.capexindia.com/IRL/index.htm	UNMATCHED
WM	http://www.capexindia.com/IRL/mission.htm	UNMATCHED
WV	http://www.capexindia.com/IRL/vision.htm	UNMATCHED
WR	http://www.capexindia.com/IRL/research.htm	MATCHED
WAI	http://www.capexindia.com/IRL/centre_for_AI.htm	UNMATCHED
WES	http://www.capexindia.com/IRL/centre_for_ES.htm	UNMATCHED
WCA	http://www.capexindia.com/IRL/centre_for_CA.htm	UNMATCHED
WMAS	http://www.capexindia.com/IRL/centre_for_MAS.htm	MATCHED
WWEB	http://www.capexindia.com/IRL/centre_for_web.htm	UNMATCHED
WTI	http://www.capexindia.com/IRL/centre_for_TI.htm	UNMATCHED
WT	http://www.capexindia.com/IRL/team.htm	UNMATCHED
WPJ	http://www.capexindia.com/IRL/published_journal.htm	MATCHED
WPBC	http://www.capexindia.com/IRL/book_chapter.htm	MATCHED
WPC	http://www.capexindia.com/IRL/published_conference.htm	MATCHED
WCP	http://www.capexindia.com/IRL/communicated_papers.htm	UNMATCHED
WOGP	http://www.capexindia.com/IRL/on_going_papers.htm	MATCHED
WMEM	http://www.capexindia.com/IRL/member.htm	UNMATCHED
WJP	http://www.capexindia.com/IRL/journal_participation.htm	UNMATCHED
WCPART	http://www.capexindia.com/IRL/conference_participation.htm	UNMATCHED
WPROJ	http://www.capexindia.com/IRL/projects.htm	MATCHED
WCON	http://www.capexindia.com/IRL/contact.htm	UNMATCHED

Using the Primary quotient R_1 we now find the rank of these primary pages. The results are displayed in the following table.

Web page (W)	$\Sigma(PR(W_i))$	ΣS_W	N_W	R_1 (W) value
http://www.capexindia.com/IRL/research.htm	04	14	04	3.5
http://www.capexindia.com/IRL/centre_for_MAS.htm	04	32	03	10.91
http://www.capexindia.com/IRL/published_journal.htm	04	26	05	5.45
http://www.capexindia.com/IRL/book_chapter.htm	04	07	03	2.58
http://www.capexindia.com/IRL/on_going_papers.htm	04	07	03	2.58
http://www.capexindia.com/IRL/projects.htm	04	09	02	4.75

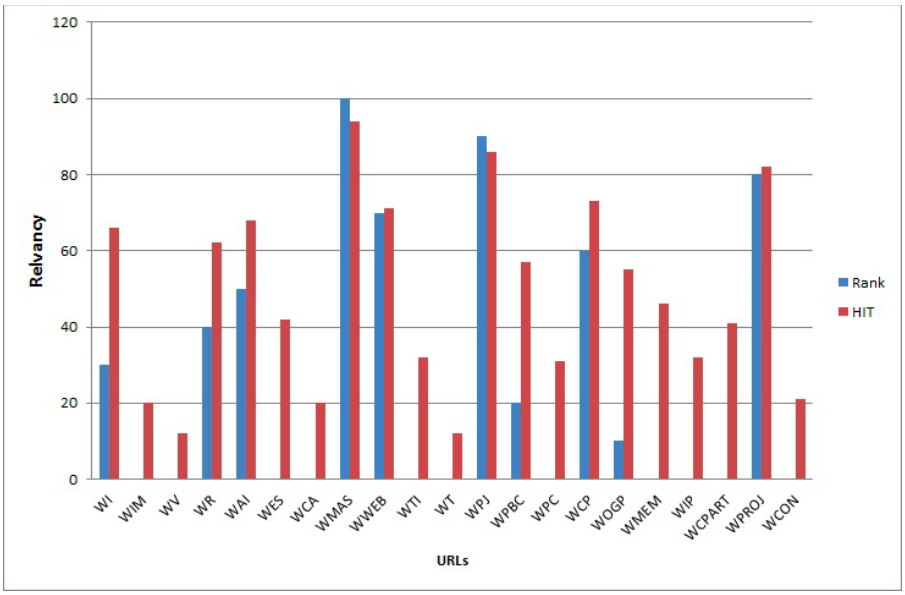
All the matched pages are our primary pages. And the unmatched ones need to be run through the algorithm for the secondary pages. once we tag the pages as secondary, we find the rank of these pages. The results of which are displayed in the following table.

Web page	Σ $(PR(W_i))$	Σ S_W	N_W	Digging Factor (D_F)	R_2 (W) value
http://www.capexindia.com/IRL/index.htm	04	24	10	01	2.65
http://www.capexindia.com/IRL/centre_for_AI.htm	04	21	02	03	3.58
http://www.capexindia.com/IRL/centre_for_web.htm	04	26	02	03	4.41
http://www.capexindia.com/IRL/communicated_papers.htm	04	32	03	03	3.63

Following are the ranks of the combined pages with primary and secondary.

Web pages	Web pages (URL)	Quotient Value	Rank
WR	http://www.capexindia.com/IRL/research.htm	3.5	07
WMAS	http://www.capexindia.com/IRL/centre_for_MAS.htm	10.91	01
WPJ	http://www.capexindia.com/IRL/published_journal.htm	5.45	02
WPBC	http://www.capexindia.com/IRL/book_chapter.htm	2.58	09
WOGP	http://www.capexindia.com/IRL/on_going_papers.htm	2.58	10
WPROJ	http://www.capexindia.com/IRL/projects.htm	4.75	03
WI	http://www.capexindia.com/IRL/index.htm	2.65	08
WAI	http://www.capexindia.com/IRL/centre_for_AI.htm	3.58	06
WWEB	http://www.capexindia.com/IRL/centre_for_web.htm	4.41	04
WCP	http://www.capexindia.com/IRL/communicated_papers.htm	3.63	05

In real time we use the HITs of the page to validate whether the ranking algorithm is generating results as expected or not. So, when we compare the hit ratio and the ranking that the pages got after using this new approach, we can see that the results are almost like the user behavior.



Conclusion:

Using the new approach, we can see satisfied results. The emphasis on the secondary pages helps generating better results. Proper distinction is maintained between the primary and secondary pages using the digging factor. Secondary pages are selected based on the similarity of the keywords and unmatched pages. This new approach does not hamper the accuracy or the efficiency of the results.

References:

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