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Reviewof Web Pre-Fetching and Caching Algorithms

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Abstract*:- Due to the fast development of internet services and a huge amount of network traffic, it is becoming an essential issue to reduce World Wide Web user-perceived latency. Web perfecting is a technique focused on web latency reduction based on predicting the next future web object to be accessed by the user and perfecting it in idle times. So, if finally the user requests it, the object will be already at the client's cache. In this paper, we analyze the perceived latency versus the traffic increase (both in bytes and in objects) to evaluate the benefits from the user's perspective. In addition, we also analyze the performance results from the prediction point of view, to provide insights on the observed performance.

Keywords: Web Perfecting; Performance Evaluation; User Perceived Latency, URL, Web Caching, Prediction.

I. Introduction

Web perfecting is an effective tool for imp-proving the access to the World Wide Web. Pre-fetching can be initiated either at the client side or at the server side .The benefit of web perfecting is to provide low retrieval latency for users, which can be explained as high hit ratio. Perfecting also increases system resource requirements in order to improve hit ratio.
Resources consumed by prefetching include server CPU cycles, server disk I/O's, and network bandwidth. The prefetching technique has two main components: The prefetching engine. The prediction engine runs a prediction al-growth to predict the next user's request and provide these predictions as hints to the prefetching engine. The prefetching engine handles the hints and de-cedes to prefect them or not depending on some con-dictions like available bandwidth or idle time. Several ways of prefetching user's requests have been proposed in the literature: the preprocessing of a request by the server the transference of the object requestedin advance and the pre-establishment of connections that are predicted to be made. In this paper, we compare different prediction algorithms and evaluate their performance using both old and current traces.

II. Literature Review

Yin-Fu Huang, Jhao-Min Hsu in 2006 presented a methodology to improve the hit ratios of prefetching and caching. In the paper, they developed an access sequence miner to mine popular surfing 2-sequences with their conditional probabilities from the proxy log, and stored them in the rule table. Then, according to buffer contents and the rule table, a prediction-based buffer manager also developed here will make appropriate actions such as document caching, document prefetching, and even cache/prefetch buffer size adjusting to achieve better buffer utilization. The method is as follows:
1) System architecture.
2) Mining mechanisms
3) Log file filter and access sequence miner (ASM).
4) Prediction based buffer manager (PBM).
Through the simulation, they found that their approach has much better performance than the other ones, in the quantitative measures such as hit ratios and byte hit ratios of accessed documents.

Johan Domenech in (2007) [2]the knowledge and comprehension of the behavior of aweb user are important keys in a wide range of fields relatedto the web architecture, design, and engineering. The informationthat can be extracted from web user's behavior permitsto infer and predict future accesses. This informationcan be used, for instance, for improving Web usabilitydeveloping on-line marketing techniques or reducinguser-perceived latency, which is the main goal of prefetchingtechniques. These techniques use access predictorsto process a user request before the user actually makes it.Several ways of prefetching user's requests have beenproposed in the literature: the preprocessing of a requestby the server, the transference of the object requested in advance, and

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the pre-establishment of connectionsthat are predicted to be made. Despite the large amountof research works focusing on this topic, comparative andevaluation studies from the user's point of view are rare.This fact leads to the inability to quantify in a real workingenvironment which proposal is better for the user. On theone hand, the underlying baseline system where prefetchingis applied differs widely among the studies. On the otherhand, different performance key metrics were used to evaluatetheir benefits. In addition, the used workloads arein most cases rather old, which significantly affect the predictionperformance, making the conclusions not validfor current workloads

Johann Marquez,Josep Domenech, Ana Pont, Jose A. Gilin 2008[3]an intelligent technique for controlling web prefetching costs at the server side.Prefetching is an interesting technique for improving
Web performance by reducing the user-perceived latency when surfing the web...In this paper they propose an intelligent prefetching mechanism thatdynamically adjusts the aggressiveness of the prefetching algorithm at the server side. To this end, they also propose a traffic estimation model that
Permits to accurately calculate, in the server side, the extra load and traffic generated by the prefetching
With the aim of reducing these negative effects we have developed an adaptive prefetching mechanism at the server side to control the traffic increase and its impact on the system. Applying the proposed adaptive mechanism, the prefetching technique canbe also improved since the prediction algorithm requires neither a long period to reach a stable state nor extra resources. Since our proposal proves that the negative effects of web prefetching can be controlled even at the server side, the use of prefetching can be safely spread among users and system administrators.

Sandhaya Gawade and Hitesh Gupta in (2012) [4] presented a review of algorithms for prefetching and caching.Increasing popularity of the World Wide Web over the past few years has imposed a significant traffic burden upon the internet. Webcaching and pre-fetching are two important approaches used to reduce the noticeable response time perceived by users. An ideal pre fetchingcaching scheme is a system that able to predict the next (number of next) requests and pre load those into the cache .The pre-fetched objects are stored in a local cache to reduce the latency time. The paper presents survey of algorithms for handling a web caching and prefetching, Web caching and prefetching are well known strategies for improving the performance of internet systems. In this paper, a comprehensive survey of web prefetching and caching is presented. It describes various techniques that reducing successful latency time with the aim of reducing these negative effects at the server side to control the traffic and its impact on the system Image mining is an extension of data mining technique. Most of the image processingalgorithms include image mining. Therefore, image mining is always an emerging field and it has attracted a lot of researchers to investigate its applications in recent years.

III Proposed Method

We know that web data mining architecture havefollowing steps:
• Integration and merging of sample web log files.
• Pre-processing technique executed in which data Cleaning, user identification and session identificationoccurs.
• After that pattern discovery.
• Then Pattern Analysis.
• And at last analysis reports.
So, this step is the proposed methodology which we used to make our web-log files more useful andsmall.

IV. Web Pre-Fetching Techniques

A. Domain Top Approach

Seung Won Shin et al. proposes a domain top approach for web prefetching, which combines the proxy's active knowledge of most popular domains and documents[11], [13].In this approach proxy is responsible for calculating the most popular domains and most popular documents in those domains, then prepares a rank list for prefetching.

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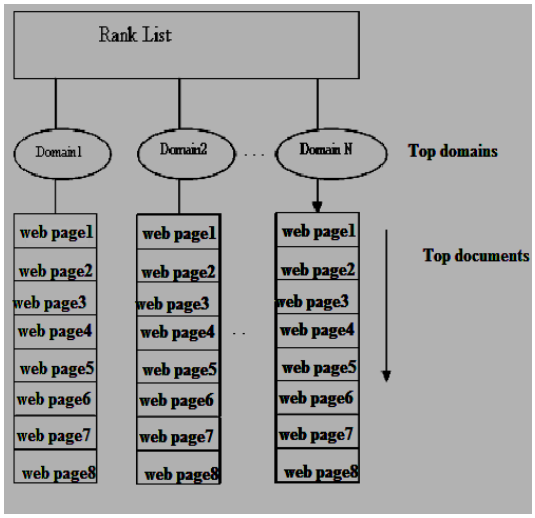

Figure 1: Structure of rank list for Domain Top Approach.

B. **Dynamic web prefetching**

In dynamic web pre-fetching technique [12], each user can keep a list of sites to access immediately called user's preference list. The preference list is stored in proxy server's database. Intelligent agents are used for parsing the web page, monitoring the bandwidth usage and maintaining hash table, preference list and cache consistency. It controls the web traffic by reducing pre-fetching at heavy traffic and increasing pre-fetching at light traffic. Thus it reduces the idle time of the existing network and makes the traffic almost constant. A hash table is maintained for storing theist of accessed URLs and itsweight information [12], [13]. Depending upon the bandwidth usage and weights in the hash table, the prediction engine decides the number of URLs to be pre-fetched and gives the list to pre-fetch engine for pre-fetching the predicted web pages. After pre-fetching, the proxy server keeps the pre-fetched web pages in a separate area called pre-fetch area.

C. **Link Pre-fetching**

. A web page provides a set of pre-fetching hints to the browser and after the browserfinishes loading the page, it starts pre-fetching specified documents and stores them in its cache. When the user visits one of the pre-fetched documents, it can be served up quickly out of thebrowser's cache. Fisher et. Al proposed a server driven approach for ink prefetching [15].In thisapproach browser follows special directives from the web server or proxy server that instructs itto pre-fetch specific documents. This mechanism allows servers to control the contents to be perfectedby the browser. The browser looks for either HTML <link> tag or an HTTP Link: headerTag to pre-fetch the subsequent links. The Link: header can also be specified within the HTMLdocument itself by using a HTML <meta>tag[16].When the browser is idle, it observes thesehints and queues up each unique request to be pre-fetched.

D.**Top 10 Approach**

Evangelos P. Markatos et al. proposes a top 10 approach to prefetching on the web , in which theserver calculates the list of most popular documents[2].This approach is easy to implement in aclient server architecture. It considers frequency of access for predicting the web object, not theclient characteristics on the web.

E. Model based Predictive Pre-fetching

Yang et. al proposed a model based predictive pre-fetching, in which an integrated web-caching and web-pre-fetching model is used[22]. The prediction model used in this is based on the statistical correlation between web objects. The prediction model is time based, prediction window represents some specific time period than number. The algorithm constructs a logical graph called correlation graph, which shows the correlation between web objects and pre-fetch web objects that are highly correlated to a currently requested object. They developed an integrated caching and prefetching algorithm, Pre-GDF. This algorithm is based on the algorithms GD-Size [23] and its enhancement GDSF [24]. The key components in the algorithm are replacement manager, pre-fetching agent, prediction queue and cache.

F. Adaptive pre-fetching Scheme

Adaptive pre-fetch scheme are developed to adapt user's browsing history and habits [25]. Jiangand et al. proposed an adaptive pre-fetch scheme, in which the number of files to be pre-fetcheddepends on user access history and network conditions [26]. This scheme consists of two modules: prediction module and threshold module. The prediction module updates the history and computesthe access probability of each file. Files whose access probabilities greater than or equal to thepre-fetch threshold are onlypre-fetched. Chen and et. al[27] proposed an adaptive pre-fetchscheme, in which dynamically adjust the pre-fetch aggressiveness in web servers and uses athreshold to adjust the aggressiveness of pre-fetching. Fagni and et. al[28] proposed uses

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anapproach for boosting the performance of search engine by exploiting the spatial and temporallocality present in the stream of processed queries.

G. Semantic prefetching

"Semantics", hidden in web documents. From certain point of view, the semantics of web document is already considered in history-based prediction. In that case, this semantics is derived from user interest assuming that users passing the same URL-graph are interested in the same thing semantically.
They do not consider real semantics of document, however. As semantic prefetching we understand prefetching based on preferences of past retrieved documents in semantics, rather than on the chronological relationships between URL accesses.
Semantically based prefetching tries to extract a semantic description of a document and asks server to provide pages with similar semantics, with the same so called "semantic locality". Based on the document semantics, this approach is capable of prefetching documents whose URLs have neverbeen accessed [15].

V Conclusion

In these papers, evaluation of web prefetching algorithms has been studied. Each algorithm has its own advantages and disadvantages and each algorithm has its own application area. Applying the proposed adaptive mechanism, the prefetching technique can be also improved since the prediction algorithm requires neither a long period to reach a stable state nor extra resources. Since our proposal proves that the negative effects of web prefetching can be controlled even at the server side, the use of prefetching can be safely spread among users and system administration.

Table 1: Comparison of web prefetching & caching techniques.

Author's & Paper Name	**Techniques**	**Results**
Yin-Fu Huang et al 2006 Mining web logs to improve hit ratios of prefetching and caching	Web access prediction, caching, prefetching	Much better performance for hit ratio and byte ratio of access documents
Josep Domenech et al. 2007 A user-focused evaluation of web prefetching algorithms	Cost-benefit analysis, Prefetching algorithm	Latency reduction and reduce prediction of pages
Johann Marquez 2008 An intelligent technique for controlling web pre-fetching costs at the server side	Prefetching algorithm, traffic estimation model	Better traffic estimation and adaption mechanism
Sandheya Gwade et al. 2010 Review of algorithms for Prefetching and caching	Web access prediction, caching, prefetching	Reducing latency time to control the traffic and its impact on the system

VI.References

[1] I. Dirac et al., "Advanced AI techniques for web mining," Proceedings of the 10th WSEAS international conference on Mathematical methods, computational techniques and intelligent systems. Cor fu Greece. 2008.
[2] J. B. Patil and B. V. Pawar, "Improving Performance on WWW using Intelligent Predictive Caching for Web Proxy Servers," IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 1, January 2011.
[3] Alexandra's Nanopoulos, Dimitrios Katsaros, and Yannis Manolopoulos, "Exploiting Web Log Miningfor Web Cache Enhancement," LNAI 2356, Springer-Verlag Berlin Heidelberg , pp. 68–87, 2002.
[4] Siddharth Jain, Ruchi Dave, Devendra Kumar Sharma, "An approach using Association Rule Mining Technique for frequently matched pattern of an Organization's web log data", International Journal of Engineering Sciences & Research Technology, Vol.1, No.5, pp 297-300, 2012.
[5] P. Somrutai, "Improving the Performance of a Proxy Server using Web log mining," M.S. thesis, San Jose State University, 2011.
[6] Rudeekorn Soonthornsutee, Pramote Luenam, "Web Log Mining for Improvement of Caching Performance", Proceedings of the International Multi-conference of Engineers and Computer Scientists, Vol- 1, pp 14-16, March 2012.
[7] Josep Domenech, Ana Pont, Julio Sahuquillo, Jose´ A. Gil," A user-focused evaluation of web prefetching algorithms", Computer Communications, Science Direct, Vol- 30, pp 2213-2224, 2007.
[8] J. Srivastava, R. Cooley, M. Deshpande, P.-N. Tan," Web usage mining: discovery and applications

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of usage patterns from web data", SIGKDD Explorations, Vol – 1, Issue- 2, pp 12–23, 2000.
[9] Yin-Fu Huang, Jhao-Min Hsu," Mining web logs to improve hit ratios of prefetching and caching", Knowledge-Based Systems, Science Direct, Vol- 21, pp 62-69, 2008.
[10] Johann Marquez,Josep Domenech, Ana Pont, Julio ,Jose A.Gil ," An intelligenttechnique for controlling web prefetching costs at the server side" 2008 IEEE.
[11] Sandhaya Gawade and Hitesh Gupta, "Review of algorithms for prefetching and caching" 2012 IJARCCE.
[12]Heung Ki Lee, Baik Song an, and Eun Jung Kim, "AdaptivePrefetching Scheme Using Web Log Mining in Cluster-based Web", InternationalConference on Web Services, IEEE, 2009, pp. 903-910.
[13] Wenying Feng and Karan Vij, "Machine Learning Prediction and WebAccess Modeling", IEEE, 2007, pp. 607-612.
[14] Achuthsankar S. Nair, Jayasudha J.S., "Dynamic Web Pre-fetchingTechnique for Latency Reduction", IEEE, 2007 pp. 202-206.
[15] Wenying Feng and Hua Chen ,"A Matrix Algorithm for Web Cache Prefetching", International Conference IEEE/ACIS, 2007, pp. 788-794.
[16] C. Umapathi and J. Raja, "A Prefetching Algorithm for improving a webcache Performance", Journal of application science, Asian NetworkScientific information, 2006, pp. 3122-3127.
[17] Payal Gulati, A. K. Sharma, Amit Goel, Jyoti Pandey, "A NovelApproach for Determining Next Page Access", IEEE, 2008, pp. 1109-1113.
[18] B. de la Ossa, J. A. Gil, J. Sahuquillo and A. Pont, "Improving WebPrefetching by Making Predictions at Prefetch", IEEE, 2007, pp. 21-27.

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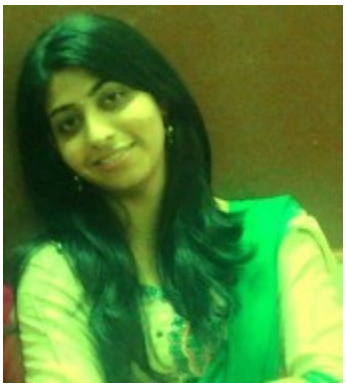

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