Abstract—Prefetching is the process of bringing data from the web server into the web cache before it is needed. When the client needs data, then instead of waiting for the responses from the memory, it can directly access the data from the cache. The prefetched data is stored in web cache in the form of web objects for later use. Caching is the technique of storing a copy of the data that has been requested by the client. Web cache is mainly used to reduce access latency, that is, it speeds up the process of data retrieval. It also reduces heavy load on the web server. The paper proposes a framework for reducing web traffic. The data is first extracted from the proxy server and then preprocessing is performed. The preprocessed data is then classified and the patterns to be prefetched are obtained.

Index Terms—Prefetching, classification, proxy server, cache.

I. INTRODUCTION

With the advent in technology, the web has grown as a rich collection of dynamic and interactive services. This huge growth of web has resulted into an increasing load on the web servers. Clients experience delay from remote servers whenever there is a need to retrieve data. We can overcome this problem by increasing the bandwidth but this leads to increased cost. Caching is hence used to reduce cost and to enhance the performance. A web cache is a technique used for storing the data in the form of web objects which reduces the load on the server and improves the access latency. Cache is used for storing the recent and frequently accessed data.

Proxy server is used for implementing web cache. Reverse Proxy is a service between a client and a server where the request is sent by the client to the proxy. It acts as a forwarding service which connects the server and exchanges data between the client and the server. At each request of the client, the proxy is first contacted to check whether it has a valid copy of that particular object [2]. A cache hit occurs if the requested object is found in the proxy, otherwise a cache miss occurs. In the latter case, the request of the client is forwarded to the web server. The proxy services keep a copy of a new object in the form of a temporary web object. The patterns and the requests of a specific web user are same most of the time at a specific instant. Some web documents are also more accessed as compared to others. Some of the popular servers have most of the load as the load is not distributed uniformly.

Therefore the common object is stored in the web cache and hence the latency of the server is reduce efficiently. User web requests patterns are required to be pre-fetched to improve the web performance, for which user’s next request pattern needs to be known previously. This framework uses the SVM algorithm for classification in the section 1. SVM is a supervised learning method used for classification and regression analysis. It is a classification algorithm that learns by example to classify objects into groups (two classes, relevant and non-relevant). SVM works by mapping data to a high-dimensional feature space so that data points can be categorized, even when the data are not otherwise linearly separable.

In this paper, a framework is proposed to support the prefetching criteria on web servers. According to the framework, there are basically five steps to predict and prefetch the user’s requests, viz. data extraction from proxy web log, data preprocessing, data classification and lastly prefetching. The proposed framework has few merits over the previously used techniques. The paper is divided into different sections for the ease. Section 2 provides an overview of primarily research done in this field. A lot of work has been done previously in this field and this part of paper explains the same. Section 3 concentrates on the proposed framework given in the paper. It’s further divided into subsections viz. preprocessing, classification and prefetching. In section 4, merits and demerits of the proposed technique are explained. Finally, the conclusion of the paper has been written, explaining the work done in brief with the merits and scope of the work in the present scenario.

II. LITERATURE REVIEW

Hongjun et.al [1] presented various classification algorithms that have been designed to tackle the problem by researchers in different fields such as mathematical programming, machine learning, and statistics. He primarily focused on neural networks and addressed their merits and demerits. Pallis et.al [2] addressed the short-term prefetching problem on a Web cache environment using an algorithm (clustWeb) for clustering inter-site web pages. The proposed scheme efficiently integrates Web caching and prefetching. According to this scheme, each time a user requests an object, the proxy fetches all the objects which are in the same cluster with the requested object.

Podlipnig et.al [3] provides an exhaustive survey of cache replacement strategies proposed for Web caches. The paper concentrated on proposals for proxy caches that manage the cache replacement process at one specific proxy. A simple classification scheme for these replacement strategies was...
III. THE PROPOSED FRAMEWORK

Web caching is used to reduce network traffic and congestion by caching the web at proxy. The paper presents a framework for a prefetching scheme so as to improve the web performance. The prefetching scheme interprets the user’s request depending upon their previous access behavior [7]. The previous access records of the user are extracted from reverse proxy log data and this extracted data is then preprocessed. Thereafter, the preprocessed data is classified using the Support Vector Machine (SVM) algorithm [11, 12].

SVM works by mapping data to a high-dimensional feature space so that data points can be categorized, even when the data are not otherwise linearly separable. One disadvantage of many classification techniques is that the classification process is difficult to understand so the SVM algorithm has been devised as replacement for them. Hence, depending upon this prediction, web documents will be pre-fetched in the proxy server cache, so as to improve the cache hit ratio.

Improvement of cache hit ratio will lead to decrease in the latency and would also decrease web traffic. The architecture of the proposed framework has been shown in figure 1 and figure 2 shows the pseudocode for the framework steps.

A. Data Extraction

Firstly, data from reverse proxy web log is extracted, as the web log keeps the user records for their previous requests. Data extraction is the process of retrieving data from data sources for preprocessing. The preprocessed data is then classified and certain access patterns are hence obtained. Depending upon these access patterns of users, prediction for next requests of users will be done. Hence, data is extracted very carefully from the proxy web log so that accurate information about the user access behavior is taken [7].

B. Data Preprocessing

Preprocessing means removal of noise and irrelevant information from the data set present. Preprocessing is important before applying clustering on the extracted data. Pre-processed data improves the efficiency and facilitates ease of mining process [13].

Data preprocessing is not a simple task, it consists of basically 4 important steps as explained below:

1. First step, data cleaning, is the process of cleaning the data entries by filling the missing values, removing inconsistencies and smoothing the noisy data.

2. Second step is data integration. Data might be taken from multiple resources for analysis or prediction, as used in the framework scenario. So, data taken from multiple resources needs to be clumped together into a single file and this process of clumping data from all the sources is known as data integration.

3. Third step is data transformation of pre-processed data. Data transformation is the process of transforming the data into the forms relevant for the mining process.

4. Fourth Step, data reduction is done. In data reduction, data set is reduced in such a manner that after and before reduction, the data set produces the same analytical results [7].

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Figure 1: The proposed framework
C. Support Vector machine for classification
The framework uses support vector machine algorithm for classification as the next step. It takes a set of input data and predicts, for each given input, which of two possible classes forms the output, making it a non-probabilistic binary linear classifier. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other.

A training set of patterns is separable if there exists at least one linear classifier defined by the pair \((w, b)\) which correctly classifies all training patterns. SVM makes use of kernel functions in order to transform the problem. In this way we can apply linear classification technique to non-linear classification data. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible [12]. The pseudocode for the algorithm is also being provided in figure 3.

D. Web Prefetching
According to the framework, prediction is done using classification and no other algorithm is required for prediction. Web prediction will let cache know, what might be the requests of the users in near future, then accordingly data will be maintained in the cache and as a result number of cache hits will be improved. After predicting the user’s request patterns, the prefetching is done. The web cache prefetches the patterns and provides it to the user [9]. These patterns hence result in ease of availability of the data that has already been accessed.

This paper shows how prefetching combined with classification increases the speed of data retrieval and thus reduces web congestion.

IV. MERITS OF THE FRAMEWORK
The base of the framework is web cache and support vector machine based classification algorithm. There are a number of advantages of using these in this framework, which actually are the merits of the proposed approach:

- It reduces bandwidth consumption resulting in reduction in network traffic and congestion.
- Access latency is also reduced.
- It disseminates the load of web server among proxies and leads to load reduction of the remote server.
- If the remote server is not available due to remote server’s crash or network partitioning, it can access a cached copy at proxy. Thus, the robustness of the web service is enhanced [11].
- It helps to analyse the access patterns of the organisation.
- Support vector algorithm is effective in high dimensional space and it uses a subset of training points in the decision function, so it is also memory efficient.
V. CONCLUSION

In this paper, the problem of network congestion and web latency has been addressed. The paper proposes an efficient approach using prefetching for the same. Cache stores the copies of documents passing through it, so that if next time request comes for the same document, it can be fulfilled directly from the cache. The paper proposes a new approach to improve cache performance. After analyzing the user access behaviour, proxy server can prefetch the next requests of the users. The paper basically changes the conventional technique by applying support vector machine algorithm for classification. The framework proposes that caching the data and pre-fetching the upcoming requests of the user’s will improve the web server performance. The technique explains that proxy web log data must be pre-processed and then

\[ \text{Figure 3: Pseudo code of svm based classification Algorithm [11, 12]} \]
Proposed Framework for the Reduction of Web Congestion using Classification

classified according to the user access behaviour. At last, prefetching rules are generated. It will result in performance improvement of the web via web latency reduction; cache hit ratio improvement; faster response of user requests and web traffic reduction. Application of this framework in the real world will actually improve the cache hit ratio and congestion problems in the network.

VI. FUTURE WORK
For the future, our plan is to investigate the performance of web after applying the proposed framework and its implementation on proxy servers. Further, comparing the proposed approach with the present scenario and trying out other classification algorithms for further improvement of the web, are in the future scope. Finally, extending the use of classification and prefetching in other applications such as in mobile environment, content distribution network etc. is another aim.

REFERENCES


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