Chapter 11
WEBCAP:
Web Scheduler for Distance Learning Multimedia Documents with Web Workload Considerations

Sami Habib
Kuwait University, Kuwait

Maytham Safar
Kuwait University, Kuwait

ABSTRACT

In many web applications, such as the distance learning, the frequency of refreshing multimedia web documents places a heavy burden on the WWW resources. Moreover, the updated web documents may encounter inordinate delays, which make it difficult to retrieve web documents in time. Here, we present an Internet tool called WEBCAP that can schedule the retrieval of multimedia web documents in time while considering the workloads on the WWW resources by applying capacity planning techniques. We have modeled a multimedia web document as a 4-level hierarchy (object, operation, timing, and precedence.) The transformations between levels are performed automatically, followed by the application of Bellman-Ford's algorithm on the precedence graph to schedule all operations (fetch, transmit, process, and render) while satisfying the in time retrieval and all workload resources constraints. Our results demonstrate how effective WEBCAP is in scheduling the refreshing of multimedia web documents.

INTRODUCTION

Distance learning is the largest growing sector of the 1-to-12 and higher education in the world today. It defines a new way of interacting teaching that uses latest technologies to deliver the materials to remote students (usually off-campus). With the introduction of the Internet and the World Wide Web (WWW), the possibilities and the participation in distance learning have taken a large leap forward. Hence, the geographical boundaries and scheduling conflicts are not the obstacles to learning, which might have been in the past. This is usually accomplished by augmenting Internet applications and Web technology into a traditional classroom setting, which has created new chal-

lenges regarding material delivery, especially through the Internet. Because of the nature of the Internet as a distributed information system, heterogeneity, large frequent changes, and non-uniformity of information access, the growth of the Internet in terms of increasing resources cannot be sustained in keeping up with users' demands. The solution lies in sharing the limited Internet resources (servers and networks) among the users wisely.

The periodical refreshing multimedia (PRM) allows users to frequently access the latest information. PRM consists of various information objects such as a text, still image, audio, video, animation and mixes of all these objects. PRM may involve presentation of static and dynamic objects, which require specific order and timing. Thus, PRM imposes stringent and diverse constraints on the resources of the Web caching architecture such as the requirements of larger storage capacity, higher network bandwidth and higher transfer time. For example, the collected satellite images of past hurricanes and their visualizations can be used in educating how these violent weather fronts form and function, as well as their effects on the natural and human landscapes. In addition, the material collected can be used in class as a part of a tool for teaching Geosciences with Visualizations. For example, the tool could help in visualizing the Earth, its processes, and its evolution through time as a fundamental aspect of geosciences. Research sheds light on why teaching with visualizations is effective. Visualization has the power and ability to clarify relationships rather than reproducing exactly the natural world.

Geoscientists use a wide variety of tools to assist them in creating their own mental images. For example, multi-layered visualizations of geographically referenced data are usually created as animations to look at changes in data, model output through time, and to analyze the relationships between different variables. With new access to online data and new technologies for visualizing data, it is becoming increasingly important to analyze the relationships between the animated objects and system/network load in order to design a powerful tool for teaching geosciences. Our proposed system can measure the effectiveness of online visualizations in teaching, and can provide a hint on what resources are needed to increase the capability of teaching with visualizations in the geosciences.

In general, the Web caching architecture has to provide both network transparency and object availability so that clients can access these objects locally or remotely as if they were on the same site. To deliver the requested PRM from remote servers to users in time, while placing the least demands on the servers and networks is a challenging optimization (scheduling) problem due to the unpredictably of the execution time of server, and network involved in retrieving the PRM.

Due to the explosive and ever growing size of the Web, distributed Web caching has received considerable attention. The main goal of caches is to move the frequently accessed information closer to the users. Caching systems should improve performance for end users, network operators, and content providers. Caching can be recognized as an effective way to: speed up Web access, reduce latency perceived by the users, reduce network traffic, reduce server load, and improve response time to the users. Since the Web is huge in size, most caching techniques used a distributed cache system rather than a centralized cache system. In a centralized caching system, requesting direction would be efficient and maintaining the consistency of data is cheaper. However, the main bottleneck will be the communication with the central resource. On the other hand, distributed caching system increases the processing power by storing information on many servers. Moreover, it strives to store data close to users.

In this article, we present a novel Internet tool (WEBCAP) that has been collectively envisioned on the authors' work (Habib, 1997; 2005; Safar, 2000; 2002). The WEBCAP performs the following tasks: