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DATABASE SOLUTIONS IN E-LEARNING SYSTEMS

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Abstract:

This paper describes main features and advantages of e-learning education and the importance of data allocation in the process of designing a database system which contains all the data the e-learning system needs. We will discuss possible system-to-database communication methods. We describe several possible ways to store the data with regard to the local- and distributed database server solutions. In addition, we discuss available query execution optimization methods in a distributed database systems, in order to obtain the smallest system response time and CPU loads.

Keywords:

e-learning, databases, query optimization

1 INTRODUCTION

1.1 E-Learning

It is rather difficult to get a clear idea of what exactly the term ”e-learning” is. It is a complicated undertaking, as there are numerous different definitions available throughout literature. Anastasiu says that e-learning is all forms of electronic supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of the learner. There are also other definitions but this one gives us the clearest perspective of what e-learning in fact is [1].

Also, e-learning can mean using new multimedia technologies and Internet to improve the quality of learning and evaluation process [2].

Aside Tangible e-learning mode described by Anastasiu, another e-learning method is present – Web Based Training (WBT) which is perfect substitution for traditional face-to-face education method. WBT has several characteristics: technological (usage of online technologies), economical (no need for installation or maintaining software – everything is online) and psychological (online group learning may have a positive impact on the learning experience). WBT may be defined as the process of learning with tutor and learner separated by time or space where this gap is bridged by online technologies [3].

1.2 E-learning database communication methods and database architectures

All sorts of data can be stored using several different methods. Most common method of storing data is a database (like MSSQL, MySQL, etc.). Other possible method is to store data inside various formats of files, like XML or MDB format. Some applications use more than one of these methods at once. Depending on e-learning system size, user count, etc., different methods are used. Also under the same conditions, local or distributed databases (DDB) are used. Figure 1 presents three different database architectures.

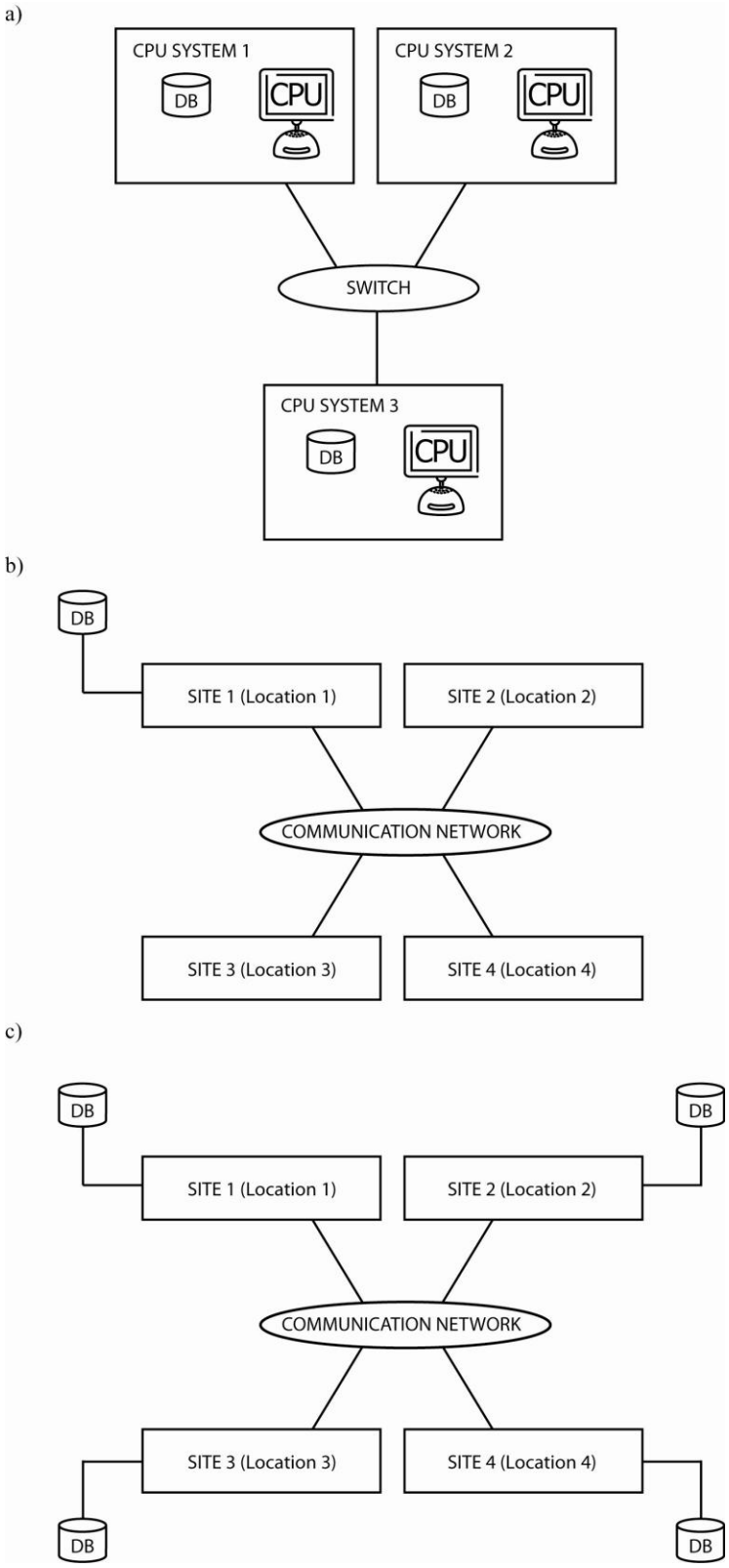

Figure 1 Different database architectures: a) Local architecture (no data sharing), b) Centralized database architecture, c) True distributed database architecture

For smaller e-learning systems local or centralized architectures are the solution. For larger e-learning systems distributed architectures are necessary. A distributed database (DDB) can be defined as a collection of logically interrelated databases which are physically distributed over several computers (a network of computers) [2].

DDB design aims to ensure several principles: 1. maximizing local processing of data (can be done by placing data closer to the applications they require), 2. enabling a high level of data security and availability (can be done by data replication to numerous sites), 3. parallel data processing (can be done by the efficient using of CPU capacity of each station). The DDB systems presents a number of advantages mainly related to the increase of system performance, by reducing the relative costs, processing and transmission of data [4]

Main DDB advantages are: 1. Management of distributed data with different levels of transparency (Distribution or network transparency, Replication transparency, Fragmentation transparency), 2. Increased reliability and availability, 3. Improved performance, 4. Easier expansion [5].

Additional Functions of Distributed Databases would be: 1. Keeping track of data, 2. Distributed query processing, 3. Distributed transaction management, 4. Replicated data management, 5. Distributed database recovery, 6. Security, 7. Distributed directory management [5].

At the physical hardware level, the following main factors distinguish a Distributed Database Management System (DDBMS) from a centralized system: 1. There are multiple computers, called sites or nodes, 2. These sites must be connected by some type of communication network to transmit data and commands among sites [5].

The optimal solution for the distribution can be defined by two objectives: a. minimize costs involves calculating the total cost of a query execution, b. maximizing performance. The performances are measured, especially, by system response times when dealing with read/write data processing operations [5].

2 EXPERIMENTAL AND RESULTS

2.1 Query optimization

Query optimization is a process of creating and choosing the best and the most efficient query to execute inside a DDB. The more complex query is, more time and resources is necessary for its execution. Query complexity is evaluated by requested data fragmentation (in tables) [6].

Main goal of query optimization is to minimize the execution time to minimize the total cost of query execution and by that increase DDB (and e-learning) system efficiency. The smaller execution time is, the smaller amount of resources is used and therefore the smaller query execution costs are. The total cost of a query execution in a distributed system consists of the CPU cost for processing, the cost of accessing the discs and the cost of communication between nodes (consists of the cost of sending/receiving messages between nodes and, respectively, the cost of transferring data between nodes).

2.2 Database Server model

Figure 2 describes a Web database system. There are four load independent queues: the first one is the queue of incoming requests on Web servers. The second queue is for the file requests and the third queue is for the database involved requests. The last one depicts the response queue waiting for being sent back through the network.

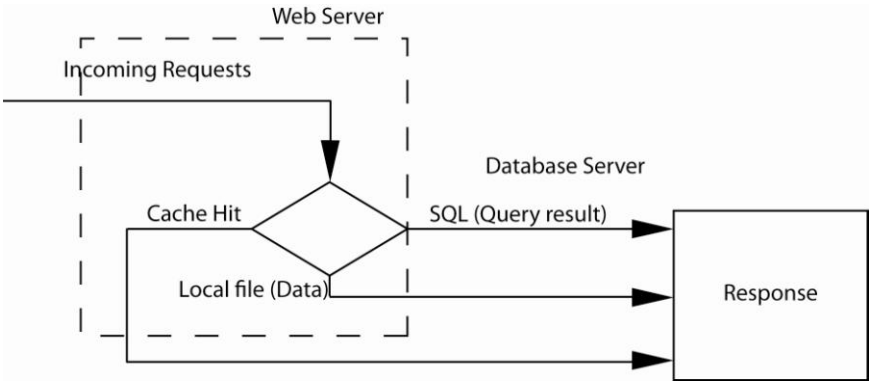

Figure 2: Web database system model

At first point, an incoming request arrives to server. Server parses the request and (depending on gathered information) serves data. The data can be gathered from cache which is fastest. Data also can be a local document or SQL Server response type. Depending on input information, appropriate Response is generated and served to client. After that client parses the response and uses given data.

2.3 Web database performance evaluations

Web databases serve the back-ends of Web-Servers. Web databases are the classic examples of high load, high performance database systems. The most common performance metrics for such database systems are average response time and throughput, fault tolerance, scalability etc. The challenges in performance evaluation of web databases is the proper workload selection representative of the typical load as well as highly loaded situations. Zhu and Lü propose a workload that consists of a query mix as shown in Table 1. The objective behind the query design is to provide fundamental queries that can be elementarily grouped to provide different load and resource utilization conditions.[7]

Table 1: Web database performance evaluation samples[7]

	Description	**DB Server Load**		**WEB Server Load**		**Network Load**
		CPU	**DISK**	**CPU**	**DISK**	
1	Complex query with small result size	High	Low	Low	N/A	Low
2	Complex query with large result size	High	High	High	N/A	High
3	Simple query with small result size	Low	Low	Low	N/A	Low
4	Simple query with large result size	Low	High	High	N/A	High
5	No query, small file size	N/A	N/A	Low	Low	Low
6	No query, large file size	N/A	N/A	High	High	High

3 CONCLUSIONS

E-learning probably shall never replace traditional learning and teaching methods, but with the increasing development of technology and above all the Internet, the student-to-teacher distance became easier to overcome or even eliminate completely. Using combined methods, traditional and e-learning can expand the ways and methods of transferring knowledge from teacher to student.

Database architecture choice is an important step during e-learning system creation process. Right choice means stability, security, performance and efficiency of the system. The choice is made depending on resources needs, user count and geographical factors.

Distributed databases in e-learning systems have the aim is the creation of an educational network based on e-learning tools which allows greater flexibility in the training of persons in terms of efficiency. The new information and communication technologies change the perspective of educational practice, complementing the educational system with modern learning methodologies involving information technology benefits. This new way of learning using modern technologies is implemented in schools as an alternative to traditional education, and has contributed to the distance learning form of study.

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