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Performance Improvement In DBMS

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Abstract

The type of the workload on a database management system (DBMS) is a key consideration in tuning its performance. Allocations for resources such as main memory can be very different depending on whether the workload type is Online Transaction Processing (OLTP) or Decision Support System (DSS). Database administrators must, therefore, recognize the significant shifts of workload type that demand reconfiguring the system in order to maintain acceptable levels of performance. We envision autonomous, self-tuning DBMSs that have the capability to manage their own performance by automatically *recognizing* the workload type and *predicting* its change over time**.**

Introduction

In this thesis, we make two main contributions to the development of autonomic DBMSs. The first contribution is a methodology for automatically identifying a DBMS workload as either OLTP or DSS by building various classification models. We demonstrate the methodology with both industry standard workloads and with real workloads of global financial firms. The second contribution is a prediction architecture to forecast when the type of a workload may change.

The DBMS can therefore proactively adjust its parameters, without incurring the overhead associated with the constant monitoring. We present experiments to show that the performance of the DBMS using our prediction mode outperforms other possible operation modes. They also show that the prediction architecture can adapt to changes in the workload pattern. The architecture does not demand human intervention and is potentially a generic solution for other similar prediction problems.

1.Autonomic Systems

Autonomic computing systems are intelligent systems that manage their own performance. An important characteristic of these systems is an awareness of their environment, particularly their workloads. For a complex system such as the database management system (DBMS) to be self-managing, it should be adaptive to the type of the workload put upon it.

Specifically, the distinction whether the workload is OLTP (On-line Transaction Processing) or DSS (Decision Support System) is key to tuning a DBMS and adjusting its resource allocation (buffer pools, sort heap, locking, etc.). We build a workload classifier by analyzing a number of resource oriented performance measures collected from the DBMS. This workload classifier can be used to identify any workload sample collected over a small time interval. The primary output of the classifier is the *DSSness* index, which is the percentage of the DSS type vs. the OLTP type in the workload. A DSSness of 80% means that

80% of the workload is classified as DSS and 20% as OLTP.

Identifying the type of the workload, however, is just the beginning. A DBMS may experience changes in the type of workload it handles during its normal processing cycle. For example, a bank may experience an OLTP-like of short debit/credit transactions for most of the month, while in the last few days of the month, the workload becomes more DSSlike with the need to produce financial reports and run long executive queries to produce summaries. In the money market, it also has been observed that traders may exhibit some daily pattern as they access the information systems of their brokers.

We believe that such changes can be predicted by analyzing historical data of a DSSness time series. Therefore, it is not enough for autonomic DBMSs to identify the current type of the workload, but also to predict when a change in the workload type will occur.

We could simply keep the workload classifier activated and monitor the system constantly to sense significant shifts of workloads. However, this approach imposes undesirable overhead and perturbation on the system.

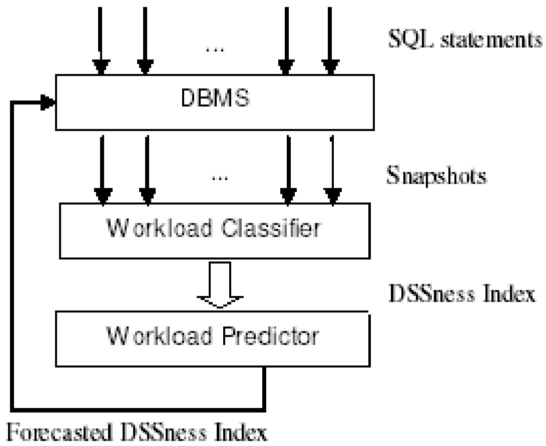

Figure. 1. The integration between the workload classifier and predictor

The main contribution of this paper is a more efficient solution by which the DBMS can learn about a workload's dynamic behavior over time and forecast *when* a change in the workload type might occur in order to proactively reset the DBMS parameters to suit the new workload. It is important to realize that the workload prediction problem builds on top of the work on workload identification, and complements it as illustrated in Fig. 1. The workload classifier's job is to assess
the DSSness of the workload at a given time. The workload prediction framework, after it analyzes a time series of DSSness, forecasts *major shifts* in the DSSness and alerts the DBMS of these shifts. Major shifts are formed when the DSSness reaches predefined thresholds that warrant reconfiguring the DBMS. These thresholds divide the DSSness range into three zones that lead to the identification of three main workload types: OLTP, MIX (of OLTP and DSS), and DSS.

A. DSS vs OLTP

OLTP business applications (such as PeopleSoft, Siebel, and SAP) support multiple users who require very rapid response times. Frequently, the database serves thousands of concurrent users. Response time may include CPU, sort, locking, and I/O times. The majority of SQL statements in an OLTP workload are INSERT, UPDATE, and DELETE that require contention management and locking strategies. Yet, some OLTP applications include batch-processing components and probably some concurrent decision-support queries. In contrast, DSS users ask complex business questions relevant to the available data requiring complex SQL queries. Response times in a DSS environment are typically measured in minutes rather than seconds. However, response time requirements vary significantly based on business needs. DSS workloads are mostly read-only queries.

2.EXISTING SYSTEM

The performance evaluation of computer systems requires understanding of a system's workload. As shown in Figure 2, the workload is a set of requests, or components, that place different demands on various system resources.

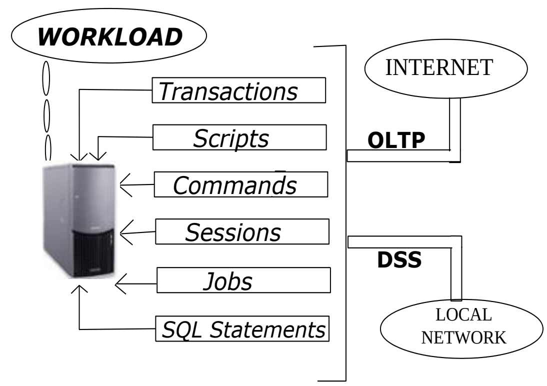

Figure 2. Existing DBMS with uncharacterized Workload

Workload characterization provides a model of a system's workload by means of quantities parameters and functions. The model should be representative, compact, and accurate, and should be able to describe and reproduce the dynamic behavior of the workload and its most essential static features.

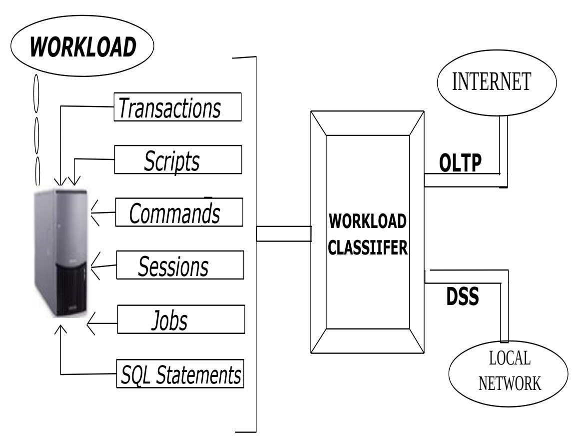

Figure 3. The Workload Characterization Process

We specifically discuss how important it is for a complex system such as a DBMS to automatically recognize the type

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of its workload, namely whether it is OLTP or DSS, in order to tune its performance. We also presented a classification methodology by which the DBMS can identify the type of the workload automatically.

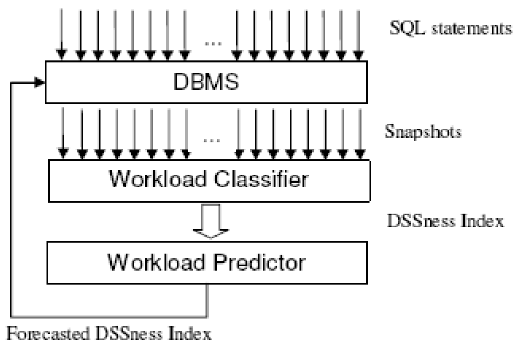

Figure 4. The integration between Workload Classifier and Predictor

3.Systeystem Architecture

We view the problem of classifying DBMS workloads as a machine-learning problem in which the DBMS must learn how to recognize the type of the workload mix. The workload itself contains valuable information about its characteristics that can be extracted and analyzed using data mining tools. Our approach is to therefore use data mining classification techniques, specifically Decision Trees Induction, to build a classification model. One of the advantages of using decision tree induction is its high *interpretability*, that is, the ease of extracting the classification rules and the ability to understand and justify the results, in comparison with other techniques such as neural networks.

4.Conclusion

In this thesis, we discussed the important characteristics that DBMSs should have in order to be self-managing. A closer look at present, prominent commercial DBMSs reveals that there is a lot of effort remaining to make them autonomous. The complexity of managing these systems in particular stem from several sources such as the increased emphasis on QoS, the numerous functionalities and advanced features added everyday, housekeeping tasks, expanding database size, and the strong trending towards e-service era. Try not to list more than three books or published articles. The format for listing publishers of a book within the biography is: title of book (city, state: publisher name, year) similar to a reference. The biography is ended with the author's contact

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Biographies

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