OCB: A Generic Benchmark to Evaluate the Performances of Object-Oriented Database Systems

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Abstract. We present in this paper a generic object-oriented benchmark (the Object Clustering Benchmark) that has been designed to evaluate the performances of clustering policies in object-oriented databases. OCB is generic because its sample database may be customized to fit the databases introduced by the main existing benchmarks (e.g., OO1). OCB's current form is clustering-oriented because of its clustering-oriented workload, but it can be easily adapted to other purposes. Lastly, OCB's code is compact and easily portable. OCB has been implemented in a real system (Texas, running on a Sun workstation), in order to test a specific clustering policy called DSTC. A few results concerning this test are presented.

Keywords: object-oriented databases, clustering, performance evaluation, benchmarking, DSTC.

1 Introduction

This study originates from the design of clustering algorithms to improve the performance of object-oriented databases. The principle of clustering is to store related objects close together on secondary storage, so that when an object is accessed from disk, all its related objects are also loaded into the main memory. Subsequent accesses to these related objects are thus main memory accesses, instead of much slower I/Os.

But clustering involves some overhead (to gather and maintain usage statistics, to reorganize the database...), so it is not easy to determine the real impact of a given clustering heuristic on the overall performances. Hence, clustering algorithms are validated only if performance tests demonstrate their actual value.

The validation of clustering methods can be achieved by several ways. First, mathematical analysis can be used to ascertain the complexity of a clustering
algorithm [7]. Although mathematical analysis provides exact results, it is very difficult to take into account all the parameters defining a real system. Hence, simplification hypothesis are made, and results tend to differ from reality. Simulation may also be used, and offers several advantages [8]. First, clustering algorithms that are possibly implemented on different OODBs and/or operating systems can be compared within the same environment, and thus on the same basis. A given algorithm can also be tested on different platforms to determine how its behavior might be influenced by its host system. Simulation also allows the a priori modeling of research prototypes before they are actually implemented in an OODB. Eventually, the most customary mean to measure the performances of DBMSs in general is the use of benchmarks, that directly gauge the response of an existing system, and, a fortiori, the performances of a clustering algorithm implemented in an existing system. However, the usual general purpose benchmarks are not well suited to the evaluation of clustering algorithms, that are very data dependent.

Some authors propose dedicated tools to evaluate the performances of their own clustering heuristic. We preferred to design generic tools, in order to be able to compare different algorithms on the same basis, using standard and easy to implement metrics. It is actually interesting to compare clustering policies together, instead of comparing them to a non-clustering policy. We can also use different platforms to test a given algorithm. We are actually involved in the development of both simulation models and a benchmark. We focus in this paper on the latter, a generic, clustering-oriented benchmark called the Object Clustering Benchmark (OCB).

The remainder of this paper is organized as follows. Section 2 presents the most popular benchmarks for evaluating the performances of OODBs. Our own benchmark, OCB, is then described in Section 3. Section 4 presents experiments we performed to validate our benchmark. Section 5 eventually concludes this paper and provides future research directions.

2 Related Work

Benchmarking the performances of an OODB consists of performing a set of tests in order to measure the system response under certain conditions. Benchmarks are used to compare the global performances of OODBs, but also to illustrate the advantages of one system or another in a given situation, or to determine an optimal hardware configuration (memory buffer size, number of disks...) for a given OODB and/or application. Several well-known standard object-oriented benchmarks are used nowadays. The presentation of three of them (OO1, HyperModel, and O07) follows.

Typically, a benchmark is constituted of two main elements:

- a database (a conceptual schema, and a database generation method);
- a workload (a set of operations to perform on the database, e.g., different kind of queries; and a protocol detailing the execution of these operations).