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A Presentation Model & Non-Traditional Visualization for OLAP

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ABSTRACT

Data visualization is one of the major issues of database research. OLAP a decision support technology, is clearly in the center of this effort. Thus far, visualization has not been incorporated in the abstraction levels of DBMS architecture (conceptual, logical, physical); neither has it been formally treated in this context. In this paper we start by reconsidering the separation of the aforementioned abstraction levels to take visualization into consideration. Then, we present the Cube Presentation Model (CPM), a novel presentational model for OLAP screens. The proposal lies on the fundamental idea of separating the logical part of a data cube computation from the presentational part of the client tool. Then, CPM can be naturally mapped on the Table Lens, which is an advanced visualization technique from the Human-Computer Interaction area, particularly tailored for cross-tab reports. Based on the particularities of Table Lens, we propose automated proactive support to the user for the interaction with an OLAP screen. Finally, we discuss implementation and usage issues in the context of an academic prototype system (CubeView) that we have implemented.

Keywords: *graphical user interface; mobile technologies; OLAP; presentation model; visualization*

INTRODUCTION

In the last years, Online Analytical Processing (OLAP) and data warehousing (DW) have become major research areas in the database community (Abiteboul et al., 2003; Inmon, 1996). Although the *modeling* of data (Tsois et al., 2001; Vassiliadis & Sellis, 1999) has been extensively dealt with, an equally important issue in the OLAP domain, the *presentation* of data, has not been adequately investigated.

As the Lowell report (Abiteboul et al., 2003) mentions, visualization is one of the big issues of database research for the next years. To cite the Lowell report:

The original Laguna-Beach report lamented that there was little research on user interfaces to DBMSs. … There have not been comparable advances in the last 15 years. There is a crying need for better ideas in this area.

It is easy to understand that of all fields of database research, decision support, and OLAP are the ones to be affected most out of this phenomenon.

In the context of OLAP, data visualization deals with the techniques and tools used for presenting OLAP-specific information to end users and decision makers. During the next years, the database community expects visualization to be of significant importance in the area (Abiteboul et al., 2003), and although research has provided results dealing with the presentation of vast amounts of data (Gebhardt et al., 1997; Inselberg, 2001; Keim, 1997), to our knowledge, OLAP has not been part of advanced visualization techniques so far.

For us, it is clear that one of the main reasons for the research community not dealing with visualization issues so far is the heritage of the computing paradigm of the past three decades. This paradigm silently made the assumption that the user sitting in front of a console makes *one* query and retrieves *one* answer (as would have happened in a UNIX terminal 30 years ago). Still, this is not the case with modern user interfaces for datasets, especially in the context of OLAP. A single front-end screen typically involves the combination of more than one back-end query. Still, to the best of our knowledge, there are no modeling techniques and languages (from the relational model to SQL and the OLAP modeling efforts proposed in the academia) that build upon this fact. Our effort tries to formalize the simultaneous presence of more than one query, which is done in two layers. In the presentational layer, we provide a uniform and generic model for the user interface, which hides the complexity of answer retrieval, detached in the logical layer. As a second interesting difference, note that the users work in *sessions* of queries, as opposed to *sequences* of unrelated queries. OLAP is a typical, but not the only, case for this behavior.

In this paper, we try to approach the problem from a clean sheet of paper. Although we do not claim to provide a generic answer for all kinds of database visualization problems, we focus on the specifics of the OLAP field. Having observed that presentational models are not really part of the classical conceptual-logical-physical hierarchy of database models (depicted in Figure 1), we propose a new separation of layers. In the sequel, we will refer to the different layers of abstraction (models) that help us design, manage, and operate an OLAP environment through the term layers.

In the middle, there is a *logical layer* that abstracts from the particularities of data storage and describes cubes and dimensions. This layer is naturally mapped to physical storage entities, like relational tables (ROLAP), or proprietary structures like multidimensional matrices (MOLAP). These kinds of physical entities form the *physical layer*. Having these structures covers well enough the part pertaining to the query formulation. Still, although the logical layer deals with the representation of data in an abstract form, as well as the formulation of queries and operations over them, we need a way to model how the answer to a query is represented in the client part. The role of the logical layer for the server is played by the *presentational layer* for the client, which involves a simple and generic model to abstract from the particularities of data retrieval. The ultimate