

Architecture for Symbolic Object Warehouse

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INTRODUCTION

Much information stored in current databases is not always present at necessary different levels of detail or granularity for Decision-Making Processes (DMP). Some organizations have implemented the use of central database - Data Warehouse (DW) - where information performs analysis tasks. This fact depends on the Information Systems (IS) maturity, the type of informational requirements or necessities the organizational structure and business own characteristic.

A further important point is the *intrinsic structure of complex data*; nowadays it is very common to work with complex data, due to syntactic or semantic aspects and the processing type (Darmont et al., 2006). Therefore, we must design systems, which can to maintain data complexity to improve the DMP.

OLAP systems solve the problem of present different aggregation levels and visualization for multidimensional data through cube's paradigm. The classical data analysis techniques (factorial analysis, regression, dispersion, etc.) are applied to individuals (tuples or individuals in transactional databases). The classic analysis objects are not expressive enough to represent tuples, which contain distributions, logic rules, multivariate attributes, and intervals. Also, they must be able to respect their internal variation and taxonomy maintaining the dualism between individual and class.

Consequently, we need a new data type holding these characteristics. This is just the mathematical concept model introduced by Diday called Symbolic Object (SO). SO allows modeling physic entities or real world concepts. The former are the tuples stored in transactional databases and the latter are high entities obtained from expert's analysis, automatic classification or some particular aggregation taken from analysis units (Bock & Diday, 2000).

The SO concept helps construct the DW and it is an important development for Data Mining (DM): for the manipulation and analysis of aggregated information (Nigro & González Císaro, 2005). According to Calvanese, data integration is a central problem in the design of DWs and Decision Support Systems (Calvanese, 2003; Cali, et al., 2003); we make the architecture for Symbolic Object Warehouse construction with integrative goal. Also, it combines with Data Analysis tasks or DM.

This paper is presented as follows: First, Background: DW concepts are introduced. Second, Main Focus divided into: SOs Basic Concepts, Construing SOs and Architecture. Third, Future Trends, Conclusions, References and Key Terms.

Background

The classical definition given by the theme's pioneer is "a Data Warehouse is a subject-oriented, integrated, time-variant, and non-volatile collection of data in support of management's Decision-Making Process" (Inmon, 1996). The fundamental purpose of a DW is to empower the business staff with information that allows making decisions based on consolidated information. In essence, a DW is in a continuous process of transformation as regards information and business rules; both of them must be considered at design time to assure increase robustness and flexibility of the system.

Extraction, Transformation and Load (ETL) constitute the fundamental process in the DW. It is liable for the extraction of data from several sources, their cleansing, customization and insertion into a DW (Simitsis, et al., 2005). When complex data is involved, this process becomes difficult, because of the integration of different semantics (especially with text data, sound, images, etc) or complex structures. So, it is necessary to include integration functions able to join and to merge them.

Metadata management, in DW construction, helps the user understand the stored contents. Information about the meaning of data elements and the availability of reports are indispensable to successfully use the DW.

The generation and management of metadata serve two purposes (Staudt et al., 1999):

1. To minimize the efforts for development and administration of a DW
2. To improve the extraction from it.

Web Warehouse (WW) is a major topic widely researched and developed (Han & Kamber, 2001), as a result of the increasing and intensive use in e-commerce and e-business applications. WW tools and applications are morphing into enterprise portals and analytical applications are being extended to transactional systems. With the same direction, the audiences for WW have expanded as analytical applications have rapidly moved (indirectly) into the transactional world ERP, SCM and CRM (King, 2000).

Spatial data warehousing (SDW) responds to the need of providing users with a set of operations for easily exploring large amounts of spatial data, as well as for aggregating spatial data into synthetic information most suitable for decision-making (Damiani & Spaccapietra, 2006). Gorawski & Malczok (2004) present a distributed SDW system designed for storing and analyzing a wide range of spatial data. The SDW works with the new data model called cascaded star model that allows efficient storing and analyzes of huge amounts of spatial data.

MAIN FOCUS

SOs Basic Concepts

Formally, a SO is a triple $s = (a, R, d)$ where R is a relation between descriptions, d is a description and “ a ” is a mapping defined from $\Omega(\text{discourse universe})$ in L depending on R and d (Diday, 2003).

According to Gowda’s definition: “SOs are extensions of classical data types and they are defined by a logical conjunction of events linking values and variables in which the variables can take one or more values, and all the SOs need not be defined on the same variables” (Gowda, 2004). We consider SOs as a new

data type for complex data define algebra at Symbolic Data Analysis.

An SO models an individual or a class maintaining its taxonomy and internal variation. In fact, we can represent a concept by its intentional description, i.e. the necessary attributes to characterize to the studied phenomenon and the description allows distinguishing ones from others.

The key characteristics enumerated by Gowda (2004) that do SO a complex data are:

- All objects of a symbolic data set may not be defined on the same variables.
- Each variable may take more than one value or even an interval of values.
- In complex SOs, the values, which the variables take, may include one or more elementary objects.
- The description of an SO may depend on the existing relations between other objects.
- The descriptor values may have typicality values, which indicate frequency of occurrence, relative likelihood, level of importance of the values, ...

There are two main kinds of SOs (Diday & Billard, 2002):

- *Boolean SOs*: The instance of one binary relation between the descriptor of the object and the definition domain, which is defined to have values true or false. If $[y(w) R d] = \{\text{true}, \text{false}\}$ is a Boolean SO. Example: $s = (\text{pay-mode} \in \{\text{good}; \text{regular}\})$, here we are describing an individual/class of customer whose payment mode is good or regular.
- *Modal SOs*: In some situations, we cannot say true or false, we have a degree of belonging, or some linguistic imprecision as always true, often true, fifty-fifty, often false, always false; here we say that the relation is fuzzy. If $[y(w) R d] \in L = [0,1]$ is a Modal SO. Example: $s = (\text{pay-mode} \in [(0.25) \text{good}; (0.75) \text{regular}])$, at this point we are describing an individual/class of customer that has payment mode: 0.25 good; 0.75 regular.

The *SO extension* is a function that helps recognize when an individual belongs to the class description or a class fits into a more generic one. In the Boolean case,

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