

Temporal Data Warehouses: Logical Models and Querying

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Abstract. Data warehouses (DWs) integrate data from multiple and heterogeneous data sources. Most of the DW design methods assume that the contents of the dimensions in a DW will not change, but this is not the case in reality. Therefore, DWs must reflect these changes in the real-world in order to enable users to ask various types of temporal queries. Since temporal queries are complex and costly, it is necessary to know which modeling approach is better for such queries. In this paper, we discuss two possible approaches to implement a DW capable of maintaining the history of the changes in dimension members. We also present a classification of temporal queries that can be used to evaluate the two approaches.

1 Introduction

A data warehouse (DW) integrates data from multiple, heterogeneous, and often distributed external data sources (EDSs). Integrated data are then analyzed by means of multiple types of analytical applications. Data stored in a DW are modeled as multidimensional cubes that consist of facts and dimensions. A *fact* is a data item being analyzed. It includes numerical features called *measures* that quantify the fact. Some examples of facts include sales, cash withdrawals, and telephone calls. Facts are analyzed in the context of *dimensions* that typically have a hierarchical structure. Some examples of dimensions include **Customer**, **Time**, and **Geography**, the last one having a hierarchical structure **City**→**State**→**Country**. The instances of a dimension are called *members*. An example of a member of the **Geography** dimension is **Brussels**→**Brussels-Capital Region**→**Belgium**.

An inherent feature of EDSs is that they change their content and structures over time. Content changes result from daily business operations. Structural changes are a consequence of the need to support new business requirements, using new technologies, and changes in the legislation, to name a few. Both content and structural changes must be reflected in a DW. The maintenance of the history of changes allows users to inquire about the state of the business world at a given time. Moreover, for audit and accountability purposes, keeping an accurate historical context is often a business requirement.