Chapter XII

Coherence in Data Schema Transformations: The Notion of Semantic Change Patterns

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Abstract

This chapter focuses on change in the information system’s Conceptual Schema in its operational life cycle phase, introducing Semantic Change Patterns as a novel notion in Conceptual Schema evolution. Each pattern outlines a coherent way to accommodate new information needs, both on the level of the existing data structure, and on the level of the data instances (data coercion). An initial catalogue of Semantic Change Patterns is proposed, based on actual schema changes observed in business cases. The catalogue exposes some of the schema evolution expertise that can be found in maintenance practice.
Introduction

Evolving Conceptual Schemas

According to the classic 3-Schema Architecture (ANSI/X3/Sparc, 1975), the Conceptual Schema captures and defines the semantics of, and the relationships between, all the data stored and transacted by an information system. It is a well-known finding by Lehman and Belady that every information system that is used will evolve in order to meet the ever-changing user requirements (Lehman & Belady, 1978). As the operational information system evolves, its Conceptual Schema will be subject to change. To paraphrase Lehman and Belady, it is our experience, and the motivation of this chapter, that any Conceptual Schema that is used can and will evolve over time. In other words, a Conceptual Schema, once designed, may claim to be stable in its operational life, but it cannot be assumed to remain rigid and fixed forever more.

This chapter focuses on change in the CS (Conceptual Schema) in the information system’s operational life cycle phase. We use the term “operational CS” to designate the unique schema that captures and defines the semantics and relationships of all the data handled by the operational information system.

It is remarkable that contemporary modeling theories and design practices regarding Conceptual Schemas tend to overlook evolution of the operational CS in the operational life cycle phase of information systems. Most approaches seem to be restricted to the system development phase only, relying on a single design effort to deliver a once-and-for-all CS. However, this fails to recognize the fact that every CS will be subjected to ongoing changes in its operational life. To remedy this lack, we introduce the notion of Semantic Change Patterns. This notion regarding CS evolution has not been recognized before in the literature, but we have found it to be embraced by business practitioners engaged in the area of schema maintenance.

Once the need for change in the data schema has emerged, an appropriate pattern can be selected and applied to the problem at hand. The pattern outlines how new information needs can be accommodated on the level of existing data structure and on the level of data instances (data coercion). As such, the patterns comprise some of the know-how experience from maintenance, and make that knowledge available to data administrators and researchers.

Objectives of this chapter are to introduce the notion of Semantic Change Patterns, to argue its relevance in Conceptual Schema evolution, and to propose an initial catalogue of patterns. We believe that the use of Semantic Change Patterns can and will be instrumental in achieving the quality and consistency that engineers look for in Conceptual Schema evolution.
Knowledge Strategy and Its Role in the Organization: An Exploratory Study
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