Chapter I

Metamodeling Architectures and Interoperability of Web-Enabled Information Systems

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ABSTRACT

Metamodeling, which is extensively used in information system analysis & design, provides modelers with two complementary mechanisms for abstraction: abstraction by projection and abstraction by conceptualization. Metamodeling architectures are becoming a backbone of modeling environments in which modeling is carried out through a two-stage process: first, defining a convenient metamodel for the application domain, and second, describing the model of the application as an instantiation of the application-domain metamodel. We propose to use metamodeling—and its abstraction mechanisms—for modeling of web-enabled information systems and achieving their interoperability. Abstraction by projection allows us to describe user-specific features of web-enabled information systems and their security aspects more accurately. Abstraction by conceptualization allows us to define abstract bases of agreement for interoperability of web-based information systems.
INTRODUCTION

Web-enabled information systems present a particular challenge to interoperability because they are strongly heterogeneous in terms of their application domains, as well as their modeling languages. We propose to use metamodeling environments for development of web-enabled information systems. Metamodeling is extensively used in information system analysis and design as a powerful mechanism for abstraction. The abstraction enables modelers to describe complex systems, e.g., systems that provide many different user-specific functionalities and complex services (including distribution of resources, concurrency, etc.). Furthermore, the design phase itself is being carried out under stringent requirements, e.g., making software reuse possible, providing formal toolboxes for simulation and validation of models, and automatically generating code from formal specifications. In such a demanding context, abstraction is carried out by two complementary mechanisms: abstraction by conceptualization and abstraction by projection. An overview of such abstraction mechanisms follows.

Abstraction by conceptualization strives to structure a given description of an information system into several layers that constitute a metamodeling architecture. Many modeling environments refer to OMG’s metamodeling architecture, depicted in Figure 4, which goes beyond the two-layer description of databases by proposing four layers: instance, model, metamodel and meta-metamodel layers.

- The metamodel layer describes—at an abstract level—an application domain. More precisely, the metamodel layer defines which modeling constructs are to be used for modeling of information systems belonging to a given application domain. For example, the profiles of OMG are standard extensions of the UML metamodel that are dedicated to specific application domains. In Selic and Rumbaugh (1998), the authors propose three main constructs—capsule, port and connector—for their extension of UML to real-time modeling. They explain the need for a new construct port: “Although ports are boundary objects that act as interfaces, they do not map directly to UML interfaces. A UML interface is purely a behavioral thing—it has no implementation structure. A port, on the other hand, includes both structure and behavior.”

- The meta-metamodel layer describes how the real world is seen. A meta-metamodel encompasses a high-level description of the underlying logics (e.g., boolean or modal logics), a particular time model or spatial model which will be used to capture the semantics of the real world.
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