Chapter 16

Knowledge and Object-Oriented Approach for Interoperability of Heterogeneous Information Management Systems

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For the interoperability of heterogeneous information management systems, schema mapping approaches have been used to build a unified view. The schema mapping approach offers full transparencies and is very powerful from the user’s point of view. However, the traditional mapping approach needs to be strengthened for information management systems that have non-traditional data types, no schema, or incompatible schemas. We have incorporated numerous concepts and constructs associated with the knowledge and object-oriented paradigm such as abstract views with a set of procedures, encapsulation, inheritance and class composition hierarchies to resolve the above problem. This extension also accommodates the ability to determine and explicitly represent the semantics in the schema. Additionally, we have outlined a query processing method using the unified view. We are currently developing a prototype to support seamless access to structured data and unstructured data managed by different information management systems.
The information of a large organization is distributed across diverse information management systems. The diversity is mainly caused by the difference of requirements of applications, the advances in information management technologies, the ad hoc historical development of systems, and evolution of systems in organizations. Therefore, it is unlikely that the diversity will diminish. The interoperability of heterogeneous information management systems is necessary to provide the sharing of an organization’s information.

In past years, several projects have been developed to address the interoperability. Their approaches, federated or schema mapping approach, centered around the ability to define a unified view and to support translation to/from local schemas (Chung, 1990; Dao et al., 1987; Garcia-Solaco et al., 1995; Thomas, 1990). The schema integration process for building this unified view is a very critical process in the federated approach.

The federated approach using the relational data model as a common data model offers full data distribution transparency and is very powerful from the user’s point of view. But this approach is limited with respect to information management systems that have no schema or incompatible schema models (e.g., file systems, text, spatial, geographical information systems).

In the federated approach, a common data model is needed to represent the unified view. Several research projects suggest the use of relational, semantic, entity-relationship (ER)/extended ER, and object-oriented data models, etc, for the common data model.

Databases offer facilities for managing large amounts of data, but are limited in their expression and structuring facilities; while object-oriented programming languages provide features for expressing and structuring complex entities (through data abstraction, encapsulation, and inheritance). The object-oriented data model incorporates ideas from the semantic data model and the object-oriented programming language. Semantic data modeling offers richer types of relationships (i.e. aggregation and groupings), whereas the object-oriented language encapsulates behavioral aspects of objects. The object-oriented data model is currently implemented in several object-oriented database management systems (OODBMS) (Butterworth, 1991; Deux, 1991; Kim et al., 1990; Lamb et al., 1991; Soloviev, 1992).

Our approach is to use advanced modeling concepts (i.e. a semantic data model, knowledge representation) in an object-oriented paradigm to form a common data model. The goal of the model is to provide flexible features to resolve data structure incompatibilities of underlying data models, interrelationships of objects at different locations during schema integration, and the semantics required by different applications.
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