Chapter I

Translating Schemas Between Data Modelling Languages

Peter McBrien, Imperial College London, UK

Abstract

Data held in information systems is modelled using a variety of languages, where the choice of language may be decided by functional concerns as well as non-technical concerns. This chapter focuses on data modelling languages, and the challenges faced in mapping schemas in one data modelling language into another data modelling language. We review the ER, relational and UML modelling languages (the later being representative of object oriented programming languages), highlighting aspects of each modelling language that are not representable in the others. We describe how a nested hypergraph data model may be used as an underlying representation of data models, and hence present the differences between the modelling languages in a more precise

manner. Finally, we propose a platform for the future building of an automated procedure for translating schemas from one modelling language to another.

Introduction

Data held in information systems is modelled using a variety of languages, where the choice of language may be decided by functional concerns (such as using a language suited to a particular database system, or using a language with modelling constructs suited to modelling a particular domain) or non-technical concerns (such as following organisation or national standards, or simply reusing a model from some other application).

This chapter focuses on data modelling languages, and the challenges faced in mapping schemas in one data modelling language into another data modelling language. In *model management* (Bernstein, 2003), this mapping process is called ModelGen, and a mapping process that restructures schemas within one modeling language is called Mapping. To illustrate the issues faced in implementing ModelGen, consider the ER schema in Figure 1(a), which describes details of students and the departments in which they study. The cardinality constraints in the ER model, which in our version of the ER model use *look-here* semantics (Song, Evans, & Park, 1995), state that each student studies in exactly one department, and that each department must have at least one student.

When mapped into a relational schema, some ER to relational mapping techniques would produce the relation schema shown in Figure 1(b). This makes the "obvious" mapping between entities in the ER model, and tables in the relational model. The relationship between the student and dept is modelled by a did column in the student table in the relational model, together with a foreign key from that attribute pointing at the did column in the dept table.

Whilst apparently an exact representation of the ER schema in the relational model, Figure 1(b) contains one semantic difference, in that the relational schema allows instances of the dept table to exist that are not related to any student instances, whilst the ER schema forbids this. In practice, such changes in the semantics of the schema when translated between modelling languages means that applications may exhibit unexpected behaviour. In this particular case, it would be the case that the relational schema allows departments to be created without any students, which was disallowed when the application was modelling in the ER modelling language. The purpose of

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