Data Model Templates for Teaching
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Abstract
This paper describes work in progress on developing a set of templates that represent common data modelling situations encountered in designing databases, as a teaching resource for undergraduate students.

Introduction
A well-designed database is an essential component of most if not all information systems. Data modelling is therefore one of the most useful practical skills a graduate can take with them into the workplace. Despite the current crop of object relational products, it seems likely that an understanding of data modelling and relational database design will remain essential for some time to come.

However, data modelling is not particularly intuitive and many students find it difficult. Typical problems include trying to incorporate aspects of process into what should be a representation of data 'at rest', lack of understanding of cardinality rules, inability to develop a normalised data model from a complex real life 'object' such as an order form, and many others. However, like any skill, data modelling can be learned, and strategies for developing expertise explicitly taught.

Research shows that experts and novices demonstrate very different approaches to data modelling (eg. Batra & Davis, 1992; Chaiyasut & Shanks, 1994), including experts’ ability to re-use generic models and to model at a higher level of abstraction than novices. Recognising patterns, or commonalities between similar themes, is part of expert behaviour in a variety of problem domains. Novices, on the other hand, tend to ‘reinvent the wheel’ for each new problem they encounter.

Strategies for developing expert behaviour, including the recognition and re-use of common patterns, has been a theme in the teaching of several skills, including computer programming (e.g. Linn & Clancy, 1992). McGill & Hobbs (1996) have successfully used this approach in developing a set of programming templates for use in introductory programming units. Hay (1996) has produced a book of reusable data model ‘patterns’, intended for practitioners, showing how common
patterns arise in different problem domains, and how they can be extended to meet new requirements.

This paper describes work in progress on the development of a set of data model templates to support student learning of data modelling. The templates will each incorporate several different perspectives on the data model. It is hoped that by presenting the context of use of each model, rather than simply a set of diagrams, students will be better able to understand the more subtle semantics of the model and thus be able to form abstractions that enable them to adapt to the next problem.

The templates

The structure of each template includes several components. These are briefly described here with a commonly encountered data modelling example: that of a purchase order.

The template is introduced with a description of the problem area, in everyday terms, to help the student locate a template suitable for the problem at hand. An entity-relationship diagram of the basic template (Figure 1) is accompanied by an explanation of what the entities, attributes and relationships represent. Typical errors to look out for are included, with explanations of why they are incorrect.

![Figure 1. Entity-Relationship diagram for a purchase order](image1.png)

Modifications and additions to the basic model are included to demonstrate how the model can be adapted to new requirements within the same problem domain without beginning again from scratch. Here, the concept of flexible design can be reinforced (Figure 2).

![Figure 2. Extending the basic ERD to include delivery notification](image2.png)
Similar templates from different domains are included, so that students can learn to recognise the commonalities of structure between different subject areas (Figure 3).

![ERD diagram](image)

Figure 3. Examples of other ERDs with similar structures from other domains

We also wish to enhance students’ appreciation of the necessity of the model to support processing requirements. To this end we include a description of typical transactions the model needs to support, and, where appropriate, a representation of how the model (or parts of it) might be encountered in ‘real life’, such as a report or a paper order form (Figure 4). Typical queries used to manipulate the model (translated to a relational schema) can also be included.

![Purchase Order](image)

Figure 4. A typical purchase order form.

Integration of templates into teaching

The main use of the templates will be as reference material within the Information Systems and Computer Science programmes, for units such as Databases, Systems Analysis and Systems Design. The materials will be developed for web delivery as well as print, to take advantage of hyperlinking to reinforce the theme of similarity and adaptation among designs. They will also be integrated with other resource materials on data modelling and database design that are currently under development.
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References


