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## Chapter 3

# Adaptation Engineering in Adaptive Concept-Based Systems

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## Abstract

*This chapter presents main issues and the state of the art of research on adaptation engineering in adaptive concept-based systems. Adaptive concept-based systems are characterised by the prominent role of concept structures, which makes content classification and conceptualisation play central roles in engineering. On top of these concept structures, adaptation is engineered in order to achieve personalisation of both the content and their presentation. For this presentation many systems use hypermedia structures, as that nicely supports the Web-based application. As a consequence, navigation adaptation is also a central issue in system design. Next to modelling domain and adaptation, it is necessary to model the user and what the system knows or assumes of the user. To discuss different approaches to these issues, we have identified three main classes of adaptive concept-based systems. Adaptive Web information systems build the more general class of data-intensive applications. We use the Hera design methodology to explain the properties of this class. The second class*

of systems is that of adaptive hypermedia systems. On the basis of the AHAM reference model and the AHA! system, we illustrate this class. The third class consists of adaptive task-based systems, for which we present AIMS as a representative.

## Introduction

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In the past decade we have witnessed a growing interest in applying adaptation and personalisation in numerous application domains. Information systems, and other applications in which large bodies of information are offered to the users, have in the era of the Web turned into systems with a significantly different nature than say two decades ago. Many of these information systems have been styled in a way the users are familiar with from their visits to the Web. Think for example of the typical book catalogue database from 20 years ago and the Web site of a book seller nowadays. A characteristic aspect of the restyling is the attention the application pays to the specific individual user. As the technology has evolved in such a way that it allows the application to treat users individually, application designers have exploited this to offer adaptation and personalisation in the information systems.

The applications that we consider in this chapter belong to the class of information systems and are characterised by large bodies of information. In order to design such applications, and particularly the adaptation and personalisation involved in them, the designer needs to engineer the information accordingly. In the case of a Web site for a book store, the designer will have to define an appropriate structure for the collection of books available, with all the relevant properties involved. Typically in these designs, the information is organised in terms of structures of concepts, where the concepts represent the actual information objects, that is, the actual text that describes the content of a certain book. The engineering of the adaptation and personalisation is performed on the level of these (abstract) concepts. We refer to these applications as *concept-based systems*.

*Adaptive concept-based systems* are becoming especially accepted in application areas where the main goal is to tailor large amounts of information to the individual preferences and knowledge state of the different users. In the case of a book store Web site, it has become more or less standard that the site expresses a behaviour that matches the specific user (as, by the way, was long the case for the real book store where the salesperson would encounter each customer differently). Besides electronic shopping, other examples include online museums (where the visitor can wander through the collection on an individual basis) and e-learning applications (where the student can be involved with some learning material in a way that according to the teacher fits the student's personal situation).

The construction of concept-based systems is not a straightforward issue, and when the challenge is combined with the desire to add adaptation, it is clear that it is not a matter of art but thorough engineering. Several approaches to engineer adaptive concept-based systems are used in practice, while researchers particularly study modelling approaches for these systems. As an example, *adaptive hypermedia systems* owe the gain in their

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