Chapter 7
Adaptive Content Delivery in E-Learning Systems using Mobile Agents

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ABSTRACT
The e-Learning refers to the use of networking technologies to create, foster, deliver and facilitate learning anytime, anywhere. This chapter discusses our research on personalization of e-Learning content based on the learner’s profile. After justifying the feasibility of using mobile agents in distributed computing systems for information retrieval, processing and mining, the authors deal with the relevance of mobile agents in e-Learning domain. The chapter discusses the proposed Case-Based Reasoning (CBR) as an approach to context-aware adaptive content delivery. Different parameters like technological, cultural and educational background of a learner are taken as the basis for forming the case-base that determines the type of content to be delivered. Along with the CBR, a diagnostic assessment to gauge an insight into the student’s current skills is done to determine the type of content to deliver. The implementation observations of such implementation vis-à-vis traditional e-Learning are also documented.

INTRODUCTION
With the advent of information and communication technology and widespread acceptance of Internet, e-Learning coupled with multimedia and network technology has proven to provide new methods and ideas for traditional teaching. The e-Learning can be defined as a learning environment supported by continually evolving, collaborative processes focused on increasing individual and organizational performance. The e-Learning has become the unifying term to describe the fields of online learning, web-based training, and technology-
Adaptive Content Delivery in E-Learning Systems using Mobile Agents

delivered instruction. However, the emphasis of e-Learning has shifted from computer-based training to web-based content delivery to personalized, context-aware service based on learner profile and modern pedagogy. The importance of e-Learning has shifted from how to solve the limitation of space-time problem in traditional teaching to build up the personalized learning environment, and offer personalized content delivery (Wu Yanwen & Luo Qi., 2006). There exists a great deal of difference in the profile of individual learners. Adapting the learning content and delivering it to realize teaching according to learners’ needs is the need of the day (S.R. Mangalwede & D.H. Rao, 2009; Wu Yanwen & Wu Zhonghong, 2004).

A Mobile Agent (MA) can be defined as a problem solving computational entity that is capable of autonomously performing operations in dynamic unpredictable environments (Danny B. Lange, 1998). A Multi-Agent System (MAS) is defined as “a loosely-coupled network of MAs that work together to solve problems that are beyond their individual capabilities.” The primary characteristics of MA are mobility and autonomy. The mobility borrows a lot from process migration which consists of transferring a process from one computer to another. The code, the data, and the running state of the MA are all moved to the destination when migration occurs. The autonomy also gives MA some artificial intelligence features. An MA not only decides what to do next according to its autonomous strategy, but also can change it to fit in with the new situation that some external changes cause. Because agents exhibit these characteristics they can be used to implement an optimal personalized e-Learning environment that helps in making intelligent decisions and ensures interoperability between different systems that are to be integrated into an operational e-Learning system. Besides that, it solves the problem of heterogeneity and low-bandwidth, reduces network traffic, process data locally instead of transmitting the data over a network (Danny B. Lange & Mitsuru Oshima, 1999).

This chapter focuses on issues in current e-Learning systems and how agents can be used in such e-Learning systems in the context of distributed computing systems for information retrieval, processing and mining. The chapter also discusses the use of CBR for adaptive content delivery. Experimental experiences of the work carried out are also presented.

BACKGROUND

The e-Learning can be defined as a learning environment supported by continuously evolving, collaborative processes focused on increasing individual and organizational performance. Many organizations are working to develop e-Learning standards. Core development specifications include metadata, learner profiling, content sequencing, web-based courseware, and computer managed instruction. Some of them include (but not limited to):

- **LTSC (Learning Technology Standards Committee)** chartered by IEEE Computer Society Standards Activity Board.
- **Learning Object Metadata (LOM)** group that specifies data schema that defines the structure of a metadata instance for a learning object.
- **ADL**, an initiative of Department of Defense (DoD) to develop strategy for using learning and information technologies to modernize education and training and to promote cooperation between government, industry and academia to develop e-Learning standardization. It has specified SCORM (Sharable Content Object Reference Model) that defines an Internet-based learning “Content Aggregation Model” and “Run-Time Environment” for learning objects.
- **AICC (Aviation Industry CBT Committee)**
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