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A Web-based Information Space for University Education

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Abstract

New technologies enable a new structuring of education material and learning processes. We present the concept of an information space with a modular structure consisting of fine grained reusable units. We describe our Web-based implementation and our experiences using it at university teaching.

Introduction

Due to the popularity of the Internet and the World Wide Web we have seen a dramatic evolution of methods and mechanisms for creating, distributing and using information. Since information and its conversion into knowledge are basic components of university education the new technologies, such as hypermedia, computer-supported cooperative work, multimedia and telecommunication have a major impact on the learning and teaching environment.

Currently we can observe a growing knowledge complexity and a growing relevance of interdisciplinary knowledge, as well as new target groups of learners in administration and industry with specific needs different from those of regular students. As a consequence we need modularly structured contents which are linkable across subject domains and support different kinds of usages, such as "life-long-learning" and "problem-oriented-learning". In the latter case learning is closely correlated to problems occurring within the job context.

This leads to an integrated approach where the usual collection of separate computer based courses is replaced by a comprehensive information space in which the learning process takes place in an individual or collaborative manner. The information space holds the contents (lecture material as well as administrative information) and makes them available in different forms. Furthermore, the information space provides other services needed in the learning process, such as orientation, navigation, communication, annotation management.

This article presents our approach and experiences using the concept of information space in the project Lecture 2000 (Schlichter 1997) which supports the study of Informatics at the Technische Universität München.

Usage Scenarios

We consider the following four main scenarios as relevant for working with the information space when studying Informatics.

- Planning the study. This includes finding the relevant information about the offered courses and the curriculum, selecting courses, and checking the selection against the curriculum, exam and timing constraints.
- Online use of course material in face-to-face lectures. In this case the teacher presents, explains and discusses the material in the presence of the students in a lecture room.
- Online use of course material at remote sites. This includes individual learning situations as well as collaborative learning where the communication among the students and between students and teachers is supported by the computer network. Additionally the lecture may be propagated to remote classrooms or workstations, thus supporting TeleTeaching scenarios.
- Offline use of course material. This is the case of individually or collaboratively working with the course material without connection to the campus network, e.g., at home.

These scenarios imply several requirements for the information space, such as containing administrative information and providing support for planning services, containing course material usable for presentation in large rooms and for private study at remote sites, groupware functionality for collaborative learning (Neal 1997) and support for annotating the course material.

Information Space

The information space designed as part of the project Lecture 2000 contains educational material such as lectures, seminar papers, tasks and solutions, master theses as well as administrative information such as announcements of courses, available theses subjects or projects, curricula and general study regulations. Additionally the information space includes domain specific dictionaries and references to external information sources, e.g. electronic libraries or information available in the Web.

The information space is structured according to the hypertext concept (Nielsen 1990). The content is divided into small semantical units (information units) which are linked together. The small information units may be combined to construct more

complex units. Additionally the information space is separated into different levels of sharing granularity. There is the private level capturing personal documents and annotations as well as a personal organization of the materials, there are team levels as shared work spaces for groups, there are spaces on the organizational level, such as a department or university, and there is the global space as provided by the Internet. The organizational space contains organization-specific information. In the case of universities this includes course material, curricula and other study related information. Information access at different levels is controlled by individual access rights.

In the following we will concentrate on the course material part of our information space and describe the approach taken as well as the current situation of the implementation.

The main focus of the information space is the electronic publication and electronic distribution of course material to students. At our chair we extended the common approach of providing coarse grained materials in HTML or Postscript format according to the concept of the information space. We provide materials

- in a fine-grained modularized form, separating the structure from the content such that the content can be reused in other contexts, and
- in a form that they can be used both in the lecture for presentation, and for private studies by the students.

The materials are provided in HTML format extended with JavaScript and Java applets, hence they can be presented using a Java capable Web browser. Our approach provides additional features over traditional paper-based material, such as full text search, integrated animations and links to external resources, e.g. other courses or electronic libraries.

Additionally, the material includes self assessment tasks. These exercises do not provide answers, instead they incorporate links to those parts of the course material where the concepts needed for the answers are explained.

Finally, there is a communication subsystem supporting synchronous and asynchronous text-based information exchange among all participating students, and a lecture plan linking the course material to single lecture hours. The communication subsystem was used for discussions about the course content. All contributions were recorded and could be displayed by any participant at any time. The lecture plan was used as a history of the lecture hours and as an entry point into the material at the beginning of each presentation in a lecture.

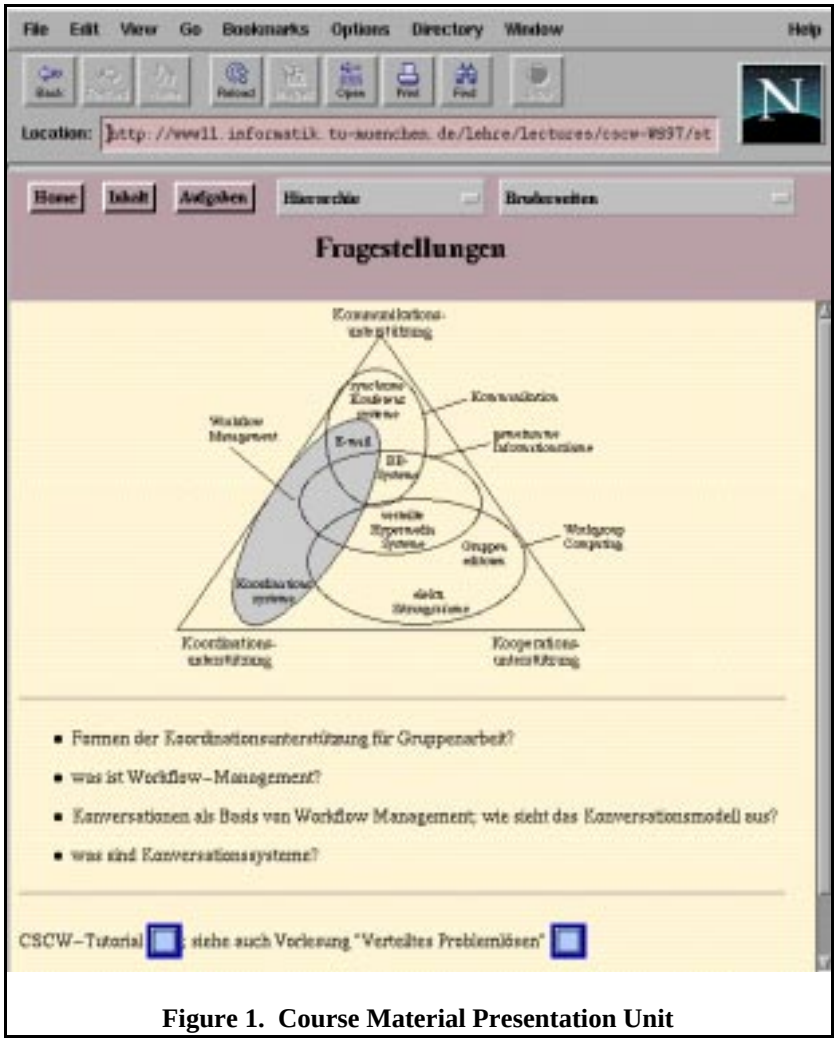

Figure 1. Course Material Presentation Unit

The content has been represented using HTML with frames and Java applets. Each presentation unit is presented with the help of three frames (see Figure 1). The topmost frame contains a Java applet providing navigational support. Navigation employs a tree structure with tree nodes representing presentation units of the course. The navigation frame offers two menus for ancestor and sibling units of the current presentation unit. Additionally it provides links to tasks and the table of contents. The next frame contains the title of the presentation unit and the third frame contains the actual content of the unit as an HTML page.

The two buttons at the bottom of figure 1 are examples of external links leading to other courses.

Each presentation unit is stored in four files: The main file defining the frame structure and one file for each frame content. We use a Python script to automatically generate the navigation applet from a navigation description. As a result, content and (tree) structure are separated from each other. It is easy to reuse the content of a unit in a different context by replacing the navigation description. However, currently this separation only applies to the tree structure. Links integrated into the content, e.g. cross references must be adjusted manually. It is planned to extract these links

from the content in a similar manner and describe them separately. Then we are able to automatically generate navigational support even for these links.

Another technical aspect concerns the different usages of the material. In the lecture we used a beamer for presenting the material in a large room. To make the material legible from all places in the room, it was necessary to scale them by about 200% relative to the use at a computer display. While it is rather simple to configure this for text parts, it results in bad quality when GIF images are scaled directly. Hence we created two versions of all GIF images by scaling the original graphics. This resulted in two versions of the course material where the text parts are linked with the differently scaled images. One version is used in the lecture, the other one is used for private study. The text exists only once, thus the HTML pages do not incorporate any size information for the images.

Experiences

The course material stored in the information space have been used on a regular basis since 1996. Here are some of our experiences:

Acceptance: The number of students visiting the lectures and their active participation in the classroom has remained nearly the same as before. Working with the self assessment tasks was only hesitantly accepted. Our initial goal that students would apply the available material for lecture preparation in advance did not work on a voluntary basis.

Representations of the Material: We found the following representations necessary: Electronic forms for online use in face-to-face lectures and for offline use during private studies. These were complemented by paper versions for the teacher and for the students. All these different forms were created from the same original information.

Effort: For the creation of the material from a traditional monolithic script in Word format about 10 to 15 hours of preparation were needed for one lecture hour. The conversion was eased by the fact that there were only few mathematical formulas in the text which are not well supported by HTML yet.

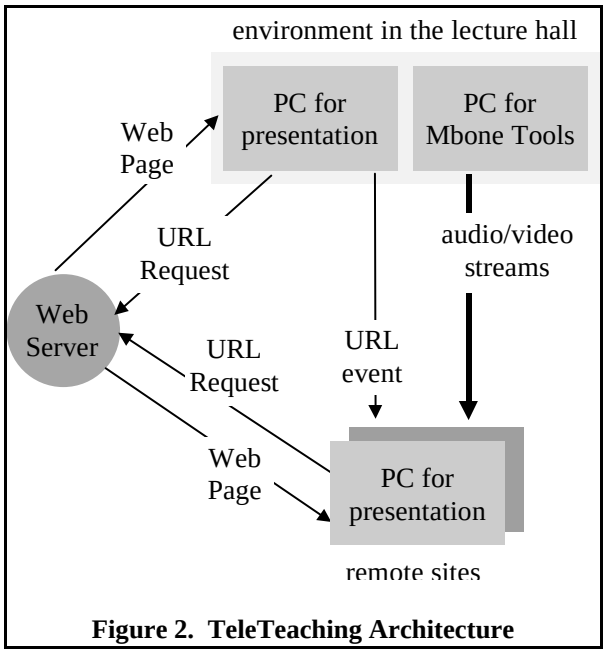

Figure 2. TeleTeaching Architecture

Problems: As main problems occurring in the use of our approach we found a missing support for annotations and a general lack for content management, especially version control and the difficulties of reusing the same content for different purposes, e.g. in different courses. Since summer 1997 our online lectures are regularly transmitted to remote sites via the Internet. For the propagation of the audio and video streams we apply Mbone tools (Macedonia and Brutzman (1994) while for the data stream we use a multicast-capable Netscape browser (see Figure 2). Only URL events are sent to the remote sites using a multicast communication protocol. If the course material is replicated on several Web-Servers the URL events are mapped to the local information space.

Conclusion

We have demonstrated that it is possible to implement a modular information space using Web technology. However, currently there is a lack of support for managing richly structured information networks and using them in different contexts. The development of functionality for separating content, structure, and use processes is an important prerequisite for an efficient management of educational material which enable differentiated and flexible learning processes.

References

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