1. **Sharing user models for adaptive hypermedia applications**
   In this paper we present an approach to sharing a user model among several adaptive hypermedia applications. Current adaptive hypermedia applications often realize the user model as the internal part of the system without any possibility to share this model with other applications. We introduce a Web service called UMoWS (user model Web service). The Web service acts as a store of user characteristics represented in pre-defined ontologies that define semantics of the stored knowledge. Access and corresponding privileges to the Web service is managed by the user through the management interface. The user is also allowed to inspect/modify the state of the user model. [1]

2. **Ontology-based user modeling for adaptive educational hypermedia system**
   To construct an accurate and comprehensive user model is required in e-learning. User model can describe explicitly the learning goals and information needs about an individual learner. In this paper, we analyze learner characters and propose an ontology-based user model, which involves five modules. After that, we separately introduce the representation methods and run mechanisms of the five modules in detail. This approach greatly improves the accuracy of knowledge acquisition. A new adaptive learning pattern is proposed. At present, this work has been applied in junior high school physics. Through experiments it proves to be an efficient method for adaptive learning. [2]

3. **A User Modeling Approach to Web Based Adaptive Educational Hypermedia Systems**
   In this paper, a new user modeling approach has been developed to determine the knowledge status of user in Adaptive Educational Hypermedia System (AEHS). The approach is based on forming the domain model and determining relations among elements of that model to decide the knowledge status of user from domain model independently. The proposed method provides flexibility to individual learning or studying steps. In comparison to the literature, the proposed approach enables quick and powerful adaptation for matching instructional needs of users. The difficulties faced in developing such a system are purifying the gathered data, obtaining and evaluating useful data and providing a powerful adaptation effect in a short time. [3]
4. **Survey of Data Mining Approaches to User Modeling for Adaptive Hypermedia**

The ability of an adaptive hypermedia system to create tailored environments depends mainly on the amount and accuracy of information stored in each user model. Some of the difficulties that user modeling faces are the amount of data available to create user models, the adequacy of the data, the noise within that data, and the necessity of capturing the imprecise nature of human behavior. Data mining and machine learning techniques have the ability to handle large amounts of data and to process uncertainty. These characteristics make these techniques suitable for automatic generation of user models that simulate human decision making. This paper surveys different data mining techniques that can be used to efficiently and accurately capture user behavior. The paper also presents guidelines that show which techniques may be used more efficiently according to the task implemented by the application [4].

5. **Adaptive hypermedia system in education: A user model and tracking strategy proposal**

New technologies are quickly changing the traditional educational approaches and systems. In fact, the integration of new technologies in the field of education offers new challenges and opportunities in distance learning, lifelong learning and e-learning in general. On the other hand, e-Learning is an interesting application area for adaptive hypermedia system (AEH). Through the use of user models, intelligent tutoring, and students tracking techniques, an AEH can recognize individual users and their needs adapting in an effective way the student learning path. This paper attempts to enhance student learning by addressing different learning styles by the use of the Adaptive Hypermedia System approach. In particular, it addresses to define a standardized and simple user model and some tracking parameters and techniques in order to update the proposed learning path. The proposed system collects information on the user learning style by the use of various well known in literature test. We propose a mapping of this acquired information in some parameters defined in standard metadata user description like IMS LIP. The final goal is a student learning style representation by the use of a quantitative model. So we can develop a tracking strategy through the observation of the main model parameters. A similar approach could be used for the description of learning objects in order to provide the introduction of well defined metrics for the dynamic tailoring of the learning path to the student’s learning style and needs. [5]


Most of the software systems are not developed taking into account the heterogeneous needs of users. It is known that each user has different levels of knowledge, goals, abilities, and preferences. This fact emphasizes the need of developing systems which can adapt themselves to different types of user, or stereotypes. Since the description of the knowledge and features of the user involves uncertainty and imprecise sense, the fuzzy theory can be applied in order to deal with this vagueness. This paper
proposes a user model for adaptive hypermedia systems using a structure, based on fuzzy theory. This model is able to properly reflect some of the user characteristics in the model, and adapt its own navigation and the content of hypermedia nodes for the user needs.[6]

7. **The role of user models in adaptive hypermedia systems**
Computers have been used in education from the beginning. Educational systems have developed first from computer assisted learning systems to more complex intelligent tutoring systems and hypermedia systems. Intelligent tutoring systems are knowledge centred and are able to adapt the instructional sequence to the particular user. On the other hand, hypermedia systems are based on hypermedia and the user can freely browse the learning material. The last two technologies have merged into so called adaptive hypermedia systems. They are actually hypermedia systems, which incorporate some intelligent tutoring techniques. Therefore, they offer the freedom of exploratory learning, yet dynamically adapt to the individual user’s knowledge level and learning goals, provide intelligent guidance, and support the user in acquiring knowledge. In intelligent tutoring systems, the adaptation is based on user modelling. Since adaptive hypermedia systems take the adaptation principles from intelligent tutoring systems, they also use user models for adapting the system to a particular user. Hence, the user model is one of the most important components for adaptation. Although the adaptation itself can be realised through different techniques, it is always based on the user model. In the paper, adaptive hypermedia systems and their general structure are described first. Then the role of a user model is presented together with the various approaches to user modelling in adaptive hypermedia systems. Finally, we investigate user modelling in different educational adaptive hypermedia systems [7]

8. **An XML-based architecture for adaptive Web hypermedia systems using a probabilistic user model**
Web based hypermedia systems are becoming increasingly popular as tools for user driven access to information and services. The paper presents an architecture for the development of Web based adaptive hypermedia systems. The architecture uses weighted graphs of XML documents to describe the application domain and a probabilistic model to adapt the Web site content generation and presentation to the user’s behaviour. The user’s behaviour is modelled using a probabilistic model and the most promising profile, that is a view over the application domain, is dynamically assigned to the user, using a discrete probability density function.[8]

9. **Adaptive Educational Hypermedia System using Cognitive style approach: Challenges and opportunities**
E-learning systems have rapidly evolved from generation to another throughout the recent years. Adaptive Educational Hypermedia System (AEHS) provides capabilities to personalize the web-based system according to student’s model such as user’s interests, needs, preferences, knowledge, and background, which are personal characteristics gathered explicitly or implicitly. The goal of developing AEHS is to achieve an effective and
affective learning performance, as well as to get positive impacts on the student through gaining skills and learning experiences. Most AEHS are technologically-driven to transfer knowledge rather than pedagogically-driven focusing on gaining cognitive skills and other experiences. To overcome this gap many researchers considered Cognitive style (CS) as the most important factor for reasoning and predicting individual traits, learning strategies and other preferences. Furthermore many researchers proposed new cognitive factors- rational, intuitive, and interpersonal as the most innate, brain-based, fixed stable preferences to build a robust adaptive student model dynamically and to get positive influence on the affective and effective AEHS. Based on the literature review, we have identified a number of theoretical and technical issues related to the AEHS architecture in relation to the whole brain cognitive style model to achieve an effective learning outcomes. The findings will be used for designing a user model for AEHS.[9]

10. Adaptive hypermedia system: A design proposal and a case study

Adaptive hypermedia is a new and promising area of research at the crossroads of hypermedia and adaptive systems. One of the most important fields where this approach can be applied is the e-learning. In this context the adaptive learning resources selection and sequencing is recognized as among the most interesting research questions. This paper addresses the design problem of an Adaptive hypermedia system by the definition of original user and adaptation model. The proposed adaptive hypermedia system was integrated in an e-learning platform and an experimental campaign was conducted. In particular we used the proposed approach in three different blended courses (Introduction to Computer Science, Computer Networks and Web Design) and a comparison with traditional approach was conducted. The obtained results are very promising.[10]

11. Diversity of structures and adaptive methods on an evolutionary hypermedia system

SEM-HP is a model for the development of evolutionary and adaptive hypermedia systems by means of: a development process that consists in iterative and evolutionary phases; a layered architecture that captures each phase in subsystems divided into two levels of abstraction (system and metasystem); and an author tool that implements the model. The paper focuses on the capability of adaptation of the hypermedia systems developed according to the SEM-HP model, in particular, the learning subsystem that is in charge of performing the user adaptation. SEM-HP offers two important contributions: supporting the process of evolution of the development of adaptive hypermedia systems, ensuring easy, flexible and consistent maintenance; and the orientation support is that inherent to the navigational structure itself.[11]

12. Educational hypermedia: an evaluation study

The role of computers in education has changed significantly in the last
years. Educational systems have exceeded passive teaming systems and now actively participate in the teaming process. Web-based educational systems, for example, supported by incorporated intelligent tutoring techniques, are able to adapt information and its presentation to each individual user, and dynamically support navigation through the hypermedia material. This paper deals with the evaluation of educational hypermedia. An adaptive hypermedia system was developed and implemented for this purposes. The system is based on a concept domain model and also considers the elements of knowledge uncertainty in the process of user modelling. Both models are used for system adaptation, which builds on adaptive link insertion in addition to traditional adaptive navigation support technologies, like annotation and direct guidance. The system has been evaluated in a real environment and the results of the experiments are discussed here. In the paper, adaptive hypermedia systems in general are described first. Then our system is described, which was used in the evaluation study. In the end, the experiments are described and the results analysed in details.\[12\]

13. **Fuzzy user modeling for adaptation in educational hypermedia**

Education is a dominating application area for adaptive hypermedia. Web-based adaptive educational systems incorporate complex intelligent tutoring techniques, which enable the system to recognize an individual user and their needs, and consequently adapt the instructional sequence. The personalization is done through the user model, which collects information about the user. Since the description of user knowledge and features also involves imprecision and vagueness, a user model has to be designed that is able to deal with this uncertainty. This paper presents a way of describing the uncertainty of user knowledge, which is used for user knowledge modeling in an adaptive educational system. The system builds on the concept domain model. A fuzzy user model is proposed to deal with vagueness in the user’s knowledge description. The model uses fuzzy sets for knowledge representation and linguistic rules for model updating. The data from the fuzzy user model form the basis for the system adaptation, which implements various navigation support techniques. The evaluation of the presented educational system has shown that the system and its adaptation techniques provide a valuable, easy-to-use tool, which positively affects user knowledge acquisition and, therefore, leads to better learning results.\[13\]

14. **Support Personalization in Distributed E-Learning Systems through Learner Modeling**

The growing popularity of e-learning has created a need for personalization. Based on individual difference of learners' abilities and preferred learning styles in hypermedia environment, the learning outcomes vary essentially. Meanwhile, with the development of e-learning technologies, learners can be provided more effective learning environment to optimize their learning. Adaptive e-learning systems are built to personalize and adapt e-learning content, pedagogical models, and interactions between participants in the environment to meet the individual needs and prefer-
ences of users if and when they arise. The learner model is an essential component in adaptive e-learning systems since it is used to modify the interaction between system and learners to suit the needs of individual learners. While learner model plays an important role in the personalization of e-learning systems, it is seen as a part of the e-learning system in many applications. In our paper, we first explain the reason of why this issue prevents the e-learning systems to provide better personalized support to meet the individual learning requirements. Then we propose a novel centralized learner model technique for e-learning systems to overcome those problems. To achieve the goal to design a learner model for distributed systems meeting the requirements, the paper introduce five work steps: analyze e-learning standards, articulate modeling requirements, develop the representation of learning styles, generate learner activity ontology and design the learner model. Finally, we illustrate the architectural design of modeling system[14]

15. XML Based CBR for Adaptive Educational Hypermedia
In this paper, we present an adaptive educational hypermedia (AEH) based on case based reasoning (CBR) approach and XML language. CBR may be very useful in e-learning technologies. It should be viewed as a medium to be used in conjunction with the majority shared information system. In this context, we think that a standard way of marking up cases will facilitate this use. We suggest XML as the likely candidate to provide such standard. XML is used in order to represent the domain model, the user model and the case in the CBR system. CBR is used to simplify the process of personalization by reusing previous experiences[15]

16. The Application of Learning Styles in Both Individual and Collaborative Learning
With the goal of applying learning styles in both individual and collaborative learning, some adaptation mechanisms have been developed. These mechanisms try to improve the process of learning by matching the teaching style with the student’s learning style and by grouping students in some specific ways. We use the Felder-Silverman learning style model and its index of learning styles (ILS) questionnaire, in order to classify students, depending on their preferences on four dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global). The benefits of learning styles, it can be of interest for adaptive hypermedia learning systems in both individual and collaborative activities, especially if they support automatic grouping of users. From the results obtained by a case study with students of Computer Science in a collaborative task can be concluded that some dimensions of the learning style model seem to affect the quality of the resulting work. With this aim, new grouping rules have been incorporated in the TANGOW/WOTAN system to be used in the corresponding courses[16]

17. An approach to modeling adaptive hypermedia for children with disabilities
We present the outcome of the first stage of the ongoing research that deals with the education of children with cerebral palsy using the adaptive hypermedia courseware. Teachers can use software as an interactive
multimedia designed unit of instruction to supplement traditional education teaching methods. This requirement acquires even greater significance in smaller nonEnglish speaking countries where the need for educational software in their national languages is more thoroughly emphasized. If interactive multimedia is designed as an educational adaptive hypermedia system, it is even more helpful for persons with disabilities. We can enhance the learning process of such users by modeling adaptive presentations and adaptive navigation.[17]

18. Apprenticeship instruction through adaptive human-computer interaction

Discusses an approach and issues regarding the use of intelligent adaptive user interfaces, coupled with hypermedia, to provide supportive learning situations for users within an instructional paradigm of cognitive apprenticeship. Existing models of user interaction are examined and extended with a supportive learning model of user interaction. The paper addresses learning opportunities provided by implementing this model of interaction using intelligent computer-human interaction, as well as identifies issues which are yet to be resolved in providing supportive learning situations within the apprenticeship learning paradigm[18]

19. Towards Practical Modeling of Web Applications and Generating Tests

As Web applications evolve, their structures become more and more complex. Web browsers may influence on the correctness of the Web applications, and Web browser’s interactions can cause further complications of Web application. Existing navigation models are static ones on the whole. Users’ navigation paths are all determined on stage of model design. Web browser interactions have not been taken into account make them different from practical navigation in Web applications. Moreover, as Web applications evolve and new technologies emerge, adaptive navigation was wildly incorporated in current Web applications. It aggravates the complexity of Web navigations. In this paper, a practical approach to modeling of Web applications and generating tests was pro-posed. And special care is taken on Web browser’s interactions and adaptive navigation during the user’s traversal within hypermedia space. At last, test generation is given out which satisfy the corresponding coverage.[19]

20. A fuzzy approach to adaptive hypermedia

We present an open, concurrent model of adaptive hypermedia; all its functionality and data are completely distributed on a web of autonomous actors. The model that enables the system to interact adaptively is a fuzzy stereotype-based user model. Its presentation and application are exploited in the cooperative actor-based environment, generated from the hypermedia model. The merge of these two paradigms offers a new concurrent and fuzzy approach in the adaptive hypermedia system domain[20]

21. SAC: a self-paced and adaptive courseware system

The paper presents the design and implementation of a self-paced and
adaptive courseware, in short SAC. The main focus of SAC is to formulate a model that encompasses the important requirements of supporting an adaptive learning courseware environment. The paper begins by discussing the issues and design requirements of developing an interactive and adaptive learning system that is able to individualize a student learning style, with the ultimate objective of maximizing his learning experience and effectiveness. The system has been designed and implemented on a three-tier Web application architecture, which uses the AHAM (Adaptive Hypermedia Application Model) approach to structure the domain, user and teaching model for use by the adaptation engine[21].

22. **Personalized Presentation and Navigation of Cultural Heritage Content**

The goal of the CHIP (Cultural Heritage Information Personalization) project is to provide personalized access to combined cultural heritage content. The driving case is given by the Rijksmuseum content presented on the museum Web site and visitor guides. The CHIP project aims to extend and integrate existing technologies for semantic browsing and search (e.g. Topia (Rutledge, L., et al., 2003), Noadster (Rutledge, L., et al., 2005), OntoAIMS), ontology-based user modeling (e.g. OWL-OLM (Deenaux, R., et al., 2005)), adaptation strategies (e.g. AHA! (Bra, P.D., et al., 2004)) and presentation of structured information (e.g. Hera (Fiala, Z., et al., 2004)) in order to achieve its goals. We use as a starting point the Topia demonstrator, which provides search and browsing interface to 1250 semantically described Rijksmuseum artifacts. We extend further this research by involving semantic-aware adaptation strategies and semantic based reasoning user model elicitation to allow for effective personalization of the content navigation and presentation on various devices (e.g. Web application, PDA, etc.). In this, we integrate artifacts and background information that span over several collections and sources. Adaptive clustering mechanisms show the relations between art objects and links to background information, based on their metadata. Further, hypermedia formats support multi-branched story lines connecting art objects in “precooked” or automatically generated ways[22].

23. **Development of adaptive and intelligent web-based educational systems**

The objective of this study is to discuss the problems to be come across in new generation web based educational system designs and the solutions derived for these problems. Some of the objects of challenges in education applications are formation of domain models belonging to the applications, determination of user knowledge states and formation of adaptive content, link and navigation maps. The problems to be faced in new generation educational systems can be solved by combining adaptive and intelligent approaches adopted in hypermedia models. It is expected that this study might be a guide for developing new generation web-based educational applications.[23]

24. **Observing web users: conjecturing and refutation on partial evidence**
Personalized hypermedia and Web systems are confronted with the challenge of inferring complex user traits like knowledge or preferences from very basic data like the 'clickstream' or ordinal-scale ratings. In consequence, the resulting user models are only approximations that must be subject to continuous revision. Nonetheless, knowledge revision procedures are rarely made explicit in existing adaptive systems and models. In this paper, we sketch a frame-work for user modeling structured around revision and refutation of provisional conjectures drawn from basic data. This model can be used as a reference framework for the evaluation of the adequacy of the inferences carried out by existing adaptive hypermedia systems. Additionally, a number of existing adaptive systems is reviewed according to the core concepts of this model. It is also argued that Possibility Theory can be used to generalize different forms of uncertainty that are not precisely justified in existing applications.[24]

References


