

Fatos Xhafa, Santi Caballé, Ajith Abraham, Thanasis Daradoumis, and
Angel Alejandro Juan Perez (Eds.)

Computational Intelligence for Technology Enhanced Learning

Studies in Computational Intelligence, Volume 273

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ISBN 978-3-642-11217-1
- Vol. 273. Fatos Xhafa, Santi Caballé, Ajith Abraham, Thanasis Daradoumis, and Angel Alejandro Juan Perez (Eds.)
Computational Intelligence for Technology Enhanced Learning, 2010
ISBN 978-3-642-11223-2

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Computational Intelligence for Technology Enhanced Learning

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ISBN 978-3-642-11223-2

e-ISBN 978-3-642-11224-9

DOI 10.1007/978-3-642-11224-9

Studies in Computational Intelligence

ISSN 1860-949X

Library of Congress Control Number: 2009943589

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Typeset & Cover Design: Scientific Publishing Services Pvt. Ltd., Chennai, India.

Printed in acid-free paper

9 8 7 6 5 4 3 2 1

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Preface

In this book is presented up-to-date research on computational intelligence oriented to support technology-enhanced learning systems and processes. Regarding the topics of online work and learning, the book aims at providing both instructors and researchers with new approaches for effective and efficient means to assist e-learning participants in enforcing and improving their online learning and working activities –both at individual and group levels. Moreover, the book appeals for providing software developers and researchers in the field of online learning systems with fresh and innovative ideas that allow them to extend current capabilities and functionalities of e-learning platforms. The goal here is to make an efficient use of these e-learning platforms in a distributed environment where learning design and material producers, service providers, and users –either instructors, learners, or academic coordinators– share similar learning and work experiences.

Despite the considerable progress that has been made in recent years in the field of computational intelligence for technology enhanced learning, there are still plenty of issues to investigate on how to employ the emergent computational technologies to fully support online learning and teaching activities. To this end, the chapters in this book give special emphasis on applications of computational-intelligence approaches to a variety of research topics, among others: personalization of learning, mobile learning, adaptive learning, interactive digital TV learning, collaborative learning, web-based tutoring systems, interaction data analysis and mining, or intelligent skill development. Therefore, this book covers the needs and interests of a wide range of readers, giving them the opportunity to deepen further on these issues and also to extend their knowledge to areas other than the ones they are used to work with. Moreover, the merge of all these synergies represents an attractive challenge that will yield systems capable of providing more effective answers on how to improve and enhance the on-line learning and teaching experiences.

Among the many features highlighted in the book, which provide a significant support to the design and development of computational-intelligence e-learning systems and models, we could distinguish the following ones by chapter:

Intelligent Techniques in Personalization of Learning in e-Learning Systems: This chapter contains an overview of intelligent techniques that can be applied in different stages of e-learning systems to achieve personalization, including:

clustering methods, classification methods, rule based systems, etc. It describes examples of their application to various e-learning platforms to create profiles of learners and to define personalized learning paths. The chapter also includes a critical discussion of the existing approaches and suggests possible research lines in this field.

Fuzzy ECA Rules for Pervasive Decision-Centric Personalized Mobile Learning: This chapter addresses personalization in intelligent context-aware information systems. The chapter introduces a personalized mobile learning system as an information system related to the educational domain. Since personalization requires both identification and selection of individuals, the chapter proposes the use of individual profiles and introduces Fuzzy Event: Condition: Action (FECA) rules as an effective approach that allows applying computational intelligence to personalized mobile learning systems. The proposed FECA rules algorithm is introduced and evaluated. The chapter also includes some suggestions of future research lines in this area.

Developing an Adaptive Learning Based Tourism Information System Using Ant Colony Metaphor: This chapter proposes an adaptive-learning algorithm, which is bio-inspired, in the context of Travel Information Systems. Adaptive learning has two features, e.g. diversity and interactivity across the group members. The chapter proposes a model which reveals that intelligent-learning technologies can make use of group's behavior to evaluate the current learning state and, consequently, to recommend the next best move or selection. The final goal of this learning process is to optimize the different available service and product pattern across a heterogeneous group of tourists, which is attained by simulating the pheromone deposition and update mechanism of ants.

Intelligent and Interactive Web-based Tutoring System in Engineering Education: Reviews, Perspectives and Development: During the last years, a large number of Web-based intelligent tutoring systems have been developed and implemented worldwide. This chapter argues that, in despite of this fact, there is still a lack of relevant comprehensive research concerning the efficiency of these systems in the context of engineering education. Therefore, the chapter outlines and discusses important issues related to the development of Web-based intelligent tutoring systems in the engineering education arena. Also, a case study regarding the development of a Web-based computer-assisted laboratory for electrical engineers is presented and discussed.

Granular Mining of Student's Learning Behavior in Learning Management System Using Rough Set Technique: Users' behaviors and interactions in learning management systems can be intelligently examined in order to analyzing students' learning styles. Such behavioral and interaction patterns include the way the user navigate, the links he/she selects among the ones provided by the system, the most popular learning materials, and the usage level of each system tool. In this chapter, a model to analyze students' preferences in online learning systems is proposed. The model is based on the integrated Felder-Silverman learning style model. An example of the proposed methodology, based on the use of Moodle, is also introduced. The chapter also discusses how the students' preferences are consistent with the characteristics of the learning styles described by the Felder-Silverman model.

Personalised hybrid approaches based on ontologies and folksonomies to support T-learning 2.0: The aim of this chapter is to export the technology of collaborative tagging to the field of learning through Interactive Digital TV (IDTV) (t-learning). This technology has become a popular practice to annotate resources on the web, and it is now reaching e-learning initiatives. Previous research describes learning experiences for t-learning based on combining TV programmes and learning elements in order to lure viewers into education and make these experiences more entertaining. On the one hand, the current approach reasons over ontologies for the combination of the different elements, and it tries to take into account the user's point of view towards the contents. On the other hand, it goes a step further and presents a proposal that includes collaborative tagging techniques, complementing ontologies with folksonomies to establish the relationships between the contents linked to create the learning experiences.

Computational intelligence infrastructures to support complex e-learning systems: This chapter is based on the fact that modern on-line learning environments have to enable and scale the involvement of increasing large number of single/group participants who can be geographically distributed, and need to transparently share a huge variety of both software and hardware distributed learning resources. As a result, collaborative learning applications are to overcome important non-functional requirements arisen in distributed environments, such as scalability, flexibility, availability, interoperability, and integration of different, heterogeneous, and legacy collaborative learning systems. Therefore, e-Learning applications need to be developed in a way that overcome these demanding requirements as well as to provide educational organizations with fast, flexible and effective solutions for the enhancement and improvement of the learning performance and outcomes. To this end, this chapter presents, evaluates and validates an innovative engineering software technique that combines the Generic Programming paradigm and Service-Oriented Architectures to construct flexible, distributed, scalable, interoperable and robust applications as much effectively and timely as possible, as key aspects to address the demanding and changing requirements in the current e-Learning domain.

Use of Artificial Intelligence skills to build role-playing platforms for negotiation training: In recent decades, a number of trainers have used role-playing games to teach negotiation skills. This chapter presents a teaching methodology that makes possible to conduct this kind of approaches in a virtual environment. The teaching methodologies exploits a specially-developed technology platform that allows a small community of players to communicate interacts and play online in order to acquire basic notions and rules about negotiation and then shows how to apply this knowledge. The work presents initial results of investigating Artificial Intelligence techniques that can be used to evaluate possibilities of implementation of computer-controlled "artificial players" that embody some intelligent behaviour.

Computational intelligence methods for data analysis and mining of eLearning activities: This chapter investigates the development and use of data mining and computational intelligent approaches to enhance the effectiveness of web-based education and provide better learning environments. The development of such

intelligent technologies may not only contribute to the growth of e-learning as an important education method but also enable learners to participate in 'any time, any place' personalized training. This work consists, in its first part, of a survey of the applications of data mining and computational intelligence in web based education during 2004–2009, while in the second part it presents a case study that aims at analyzing students' activities performed in a Learning Management System.

Advanced learning technology systems in mathematics education: Mathematics education is a very active field of research. Among the many issues raised, there is a special interest in the development of professional skills for using effective computational and modelling tools in solving real world problems. This chapter investigates the impact that technologically advanced learning technologies may have on mathematics education. It also discusses how web based approaches might suggest new paradigms of mathematical learning aimed to face the new educational challenges of the modern advanced ICT and Network Society in an effective way.

All in all, Computational Intelligence for Technology Enhanced Learning is a major research theme in the Computational Intelligence and e-Learning research community. It comprises a variety of research topics that focus on developing models and systems that are more powerful and also more adaptable to the learning process, thus providing better answers to the paradigmatic principles of on-line learning and work. The chapters collected in this book provide new insights, findings and approaches both on the analysis and the development of more powerful e-learning settings and environments. Researchers will find in this book the latest trends in these research topics. On the other hand, academics will find practical insights on how to use conceptual and experimental approaches in their daily tasks. Finally, developers from e-learning community can be inspired and put in practice the proposed models in order to evaluate them for the specific purposes of their own work and context.

We hope the readers of this book will find it a valuable resource in their research, development and educational activities in online environments.

Acknowledgment: We would like to thank the authors of the chapters and also the referees for their invaluable collaboration and prompt responses to our enquiries, which enabled completion of this book on time. We gratefully acknowledge the support and encouragement received from Prof. Janusz Kacprzyk, the editor in chief of Springer series "*Studies in Computational Intelligence*", and Ms Heather King for the great assistance during the editorial work.

Fatos Xhafa's research work partially completed at Birkbeck, University of London, on Leave from Technical University of Catalonia (Barcelona, Spain). His research is supported by a grant from the General Secretariat of Universities of the Ministry of Education, Spain.

October 2009

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Contents

Intelligent Techniques in Personalization of Learning in e-Learning Systems	1
<i>Urszula Markowska-Kaczmar, Halina Kwasnicka, Mariusz Paradowski</i>	
Fuzzy ECA Rules for Pervasive Decision-Centric Personalised Mobile Learning	25
<i>Philip Moore, Mike Jackson, Bin Hu</i>	
Developing an Adaptive Learning Based Tourism Information System Using Ant Colony Metaphor	59
<i>Soumya Banerjee, Monica Chis, G.S. Dangayach</i>	
Intelligent and Interactive Web-Based Tutoring System in Engineering Education: Reviews, Perspectives and Development	79
<i>Arun S. Patil, Ajith Abraham</i>	
Granular Mining of Student's Learning Behavior in Learning Management System Using Rough Set Technique	99
<i>Nor Bahiah Hj Ahmad, Siti Mariyam Shamsuddin, Ajith Abraham</i>	
T-Learning 2.0: A Personalised Hybrid Approach Based on Ontologies and Folksonomies	125
<i>Marta Rey-López, Rebeca P. Díaz-Redondo, Ana Fernández-Vilas, José J. Pazos-Arias</i>	
Computational Intelligence Infrastructure in Support for Complex e-Learning Systems	143
<i>Santi Caballé, Fatos Xhafa</i>	

SISINE: A Negotiation Training Dedicated Multi-Player Role-Playing Platform Using Artificial Intelligence Skills	169
<i>Kurosh Madani, Amine Chohra, Arash Bahrammirzaee, Dalel Kanzari</i>	
Computational Intelligence Methods for Data Analysis and Mining of eLearning Activities	195
<i>Pavla Dráždilová, Gamila Obadi, Kateřina Slaninová, Shawki Al-Dubae, Jan Martinovič, Václav Snášel</i>	
Advanced Learning Technology Systems in Mathematics Education	225
<i>Valeria Marina Monetti, Loredana Randazzo, Antonello Santini, Gerardo Toraldo</i>	
Author Index	249

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