Guest Editors’ Introduction: Knowledge and Data Engineering for E-Learning

Qing Li, Rynson W.H. Lau, Dennis McLeod, and Jiming Liu

With the advent of the Internet, we are seeing more sophisticated techniques being developed to support e-learning. The rapid development of Web-based learning and new concepts like virtual classrooms, virtual laboratories, and virtual universities introduces many new issues to be addressed. On the technical side, we need to develop effective e-technologies for supporting distance education. On the learning and management side, we need to consider issues such as new styles of learning and different system setup requirements. Finally, the issue of standardization of e-learning systems should also be considered. This special issue was developed in response to some of these needs. In response to the call for papers, we received a total of 55 submissions, out of which 17 were recommended submissions from the best ranked papers presented at the Sixth International Conference on Web-Based Learning (ICWL ‘07) held in August 2007 in Edinburgh, United Kingdom. After careful and rigorous reviews, we have selected 13 papers based on the quality and relevance of the papers.

The first paper is “Clustering and Sequential Pattern Mining of Online Collaborative Learning Data” by D. Perera, J. Kay, I. Koprinska, K. Yacef, and O.S. Zaı¨ane (from the University of Sydney, Australia, and the University of Alberta, Canada). Its goal is to support learning group skills in the context of a standard state-of-the-art tool. The authors have performed mining of data collected from students working in teams and using an online collaboration tool in a one-semester software development project. Clustering was applied to find both groups of similar teams and similar individual members, and sequential pattern mining was used to extract sequences of frequent events.

The second paper is “Monitoring Online Tests through Data Visualization” by G. Costagliola, V. Fuccella, M. Giordano, and G. Polese (from the Università degli Studi di Salerno, Italy). It proposes a data exploration approach exploiting information visualization in order to involve tutors in a visual data mining process aiming to detect structures, patterns, and relations between data. The approach includes the logging of important data related to learner interaction with the system during the execution of online tests, and exploits data visualization to highlight information useful to let tutors review and improve the whole assessment process.

The third paper is “Communities and Emerging Semantics in Semantic Link Network: Discovery and Learning” by H. Zhuge (from the Chinese Academy of Sciences, China). It proposes the Semantic Link Network (SLN), a self-organized semantic data model for semantically organizing resources so as to facilitate an e-learning environment to support discovery and learning in a semantic context. Through an actual prototype, the paper demonstrates the importance for such an e-learning system to know the emerging semantics of a community and the emerging semantic relations between resources in the SLN evolving with interaction between users and the e-learning system.

The fourth paper is “Toward a Fuzzy Domain Ontology Extraction Method for Adaptive e-Learning” by R.Y.K. Lau, D. Song, Y. Li, T.C.H. Cheung, and J.-X. Hao (from City University of Hong Kong, The Open University, United Kingdom, and Queensland University of Technology, Australia). It presents an application of fuzzy domain ontology extraction method to facilitate adaptive e-learning. A novel concept map generation mechanism is proposed that can automatically construct concept maps based on the messages posted to online discussion forums. As a result, instructors can conduct adaptive teaching and learning based on the information disclosed on the concept maps without being overwhelmed by the huge number of messages created by students in online discussion forums.

The fifth paper is “Open Smart Classroom: Extensible and Scalable Learning System in Smart Space Using Web Service Technology” by Y. Suo, N. Miyata, H. Morikawa, T. Ishida, and Y. Shi (from Tsinghua University, China, and Kyoto University, Japan). It presents the Open Smart Classroom, a prototype system developed based on the multi-agent system architecture using Web Services technology. Through an underlying Open Smart Platform, it enables intercontinental and intercultural class with such advanced features as better experience of mobile device cooperation and ability of easy deployment.

The sixth paper is “NNexus: An Automatic Linker for Collaborative Web-Based Corpora” by J. Gardner, A. Krowne, and L. Xiong (from Emory University, USA). It introduces NNexus, a generalization of the automatic linking engine of Noosphere and the first system that automates the process of linking disparate “encyclopedia” entries into a fully-connected conceptual network.

The seventh paper is “Effective Collaboration with Information Sharing in Virtual Universities” by H. Wang, Y. Zhang, and J. Cao (from the University of Southern Queensland, Victoria University, and La Trobe University, Australian Southern Cross University, Victoria University, and The Open University, United Kingdom). It presents an application of fuzzy domain ontology extraction method to facilitate adaptive e-learning. A novel concept map generation mechanism is proposed that can automatically construct concept maps based on the messages posted to online discussion forums. As a result, instructors can conduct adaptive teaching and learning based on the information disclosed on the concept maps without being overwhelmed by the huge number of messages created by students in online discussion forums.
Australia. It advocates a new rule-based framework to identify and address issues of information sharing in virtual university environments through role-based access control management (RBAC). The framework includes a role-based group delegation granting model, group delegation revocation model, authorization granting, and authorization revocation.

The eighth paper is “Interactive Correction and Recommendation for Computer Language Learning and Training” by C. Pahl and C. Kenny (from Dublin City University, Ireland). It presents an automated learning and skills training system for a database programming environment that promotes procedural knowledge acquisition and skills training. The system provides meaningful, knowledge-level feedback such as correction of student solutions and personalized guidance through recommendations.

The ninth paper is “Subontology-Based Resource Management for Web-Based e-Learning” by Z. Wu, Y. Mao, and H. Chen (from Zhejiang University, China). It provides a semantic mapping mechanism to integrate e-learning databases by using ontology semantics. Heterogeneous e-learning databases can be integrated under a mediated ontology. Taking into account the locality of resource reuse, this paper proposes representing context-specific portions from the whole ontology as subontologies. It also proposes a subontology-based approach for resource reuse based on an evolutionary algorithm.

The 10th paper is “Enhancing Learning Objects with an Ontology-Based Memory” by A. Zouaq and R. Nkambou (from the University of Quebec, Canada). It presents an approach to capitalize on existing learning resources by creating “content metadata” through text mining and natural language processing and dynamically learning knowledge objects. The proposed model also suggests integrating explicitly instructional theories in an on-the-fly composition process of learning objects. Semantic Web technologies are used to satisfy such an objective by creating an ontology-based organizational memory able to act as a knowledge base for multiple training environments.

The 11th paper is “Providing Flexible Process Support to Project-Centered Learning” by S. Ceri, F. Daniel, M. Matera, and A. Raffio (from the Politecnico di Milano, Italy). It describes an application-independent approach to flexible process support by discussing the abstractions required for modeling, creating, enacting, and modifying flexible processes. The paper demonstrates this approach at work in the context of project-centered learning. As students may be geographically dispersed or under severe timing constraints, they need communication technology in order to interact and workflow technology in order to organize their work. The platform provides a comprehensible, e-learning-specific set of activities and process templates, which can be combined through a simple Web interface into project-centered collaboration processes.

The 12th paper is “Learning in an Ambient Intelligent World: Enabling Technologies and Practices” by X. Li, L. Feng, L. Zhou, and Y. Shi (from Tsinghua University, China). This survey paper examines some major characteristics of an Ambient Intelligent (Aml) learning environment. It reviews some latest enabling-technologies in context-awareness and interactive learning to deliver an effective solution to ambient learning. It also describes the author's experience in designing and implementing a smart class prototype, which allows teachers to simultaneously instruct both local and remote students in a context-aware and natural way.

The 13th paper is “An Implementation of the CORDRA Architecture Enhanced for Systematic Reuse of Learning Objects” by F.H. Lin, T.K. Shih, and W. Kim (from the Chihlee Institute of Technology, Taiwan, the National Taiwan University of Education, Taiwan, and Sungkyunkwan University, Korea). It proposes a revised CORDRA (Content Object Repository Discovery and Registration/Resolution Architecture) and a reusability mechanism to make instruction design easier. In particular, it proposes a structure called a reusability tree for tracking the reuse history of learning objects in CORDRA.

Finally, we would like to thank those individuals who have helped make this special issue possible. Most important of all, we would like to thank Professors Xindong Wu and Beng Chin Ooi, the former and the current Editor-in-Chief of IEEE TKDE, respectively, for their strong support of this special issue and for their constructive comments on the accepted papers. We would also like to thank the authors who submitted manuscripts for consideration and the many dedicated, anonymous reviewers who helped us arrive at our final decision.

Qing Li
Rynson W.H. Lau
Dennis McLeod
Jiming Liu
Guest Editors

Qing Li received the PhD degree in computer science from USC. He is a professor at the City University of Hong Kong where has been in the Department of Computer Science since 1998. Prior to that, he has taught at the Hong Kong Polytechnic University, the Hong Kong University of Science and Technology, and the Australian National University (Canberra, Australia). Professor Li is an author/coauthor of more than 260 published papers in peer-reviewed journals and conferences in the areas of data modeling, multimedia database, data mining/warehousing, Web services, and e-learning systems. He has been actively involved in the research community by serving as an associate editor and reviewer for technical journals including the ACM Transactions on Internet Technology, the IEEE Transactions on Knowledge and Data Engineering, World Wide Web, etc., and as an organizer/co-organizer of numerous international conferences. Some recent conferences in which he is playing or has played major roles include APWeb-WAIM '09, ER '08, U-Media '08, WISE '07, ICWL '06, HIS '05, WAIM '04, VLDB '02, PAKDD '01, IFIP 2.6 DS-9, and WISE '00. In addition, he served as a program committee member for numerous international conferences (including VLDB, ICDE, ER, CIKM, ICDCS, CAISE, DASFAA, etc.). He is currently a senior member of the IEEE, a member of ACM-SIGMOD, and the IEEE Technical Committee on Data Engineering. He is the chairperson of the Hong Kong Web Society, and also served/is serving as an executive committee (EXCO) member of the IEEE-Hong Kong Computer Chapter and the ACM Hong Kong Chapter. In addition, he serves as a councilor of the Database Society of Chinese Computer Federation, a councilor of the Computer Animation and Digital Entertainment Chapter of Chinese Computer Imaging and Graphics Society, and is a steering committee member of DASFAA, ICWL, and the international WISE Society.
Rynson W.H. Lau received the BSc degree from the University of Kent and the PhD degree from the University of Cambridge. He has been on the faculty of the University of Durham, the City University of Hong Kong, and the Hong Kong Polytechnic University. He is currently with the City University of Hong Kong. He has served as the guest editor of a number of journal special issues, including the *ACM Transactions on Internet Technology*, the *IEEE Transactions on Multimedia*, the *IEEE Transactions on Visualization and Computer Graphics*, Presence, *IEEE Computer Graphics & Applications*, and *IEEE Internet Computing*. He has also served on the conference committee of a number of conferences, including as program cochair of ACM VRST ’04, ICAT ’06, ICEC ’07, and IEEE U-Media ’09, and as conference cochair of ACM VRST ’05, CASA ’05, and IDET ’08.

Dennis McLeod received the BS, MS, and PhD degrees in computer science and electrical engineering from Massachusetts Institute of Technology. He is currently a professor of computer science at the University of Southern California (USC) and director of the Semantic Information Research Laboratory at USC. He is also deputy director of the USC Center for Knowledge Integration and Discovery (a DHS University Research Center). Dr. McLeod has published widely in the areas of data and knowledge base systems, federated databases, database models and design, ontologies, knowledge discovery, scientific data management, information trust and privacy, and multimedia information management. His current research focuses on structured domain ontologies, user-customized information access, database semantic heterogeneity resolution and interdatabase correlation; personalized information management environments; information management environments for Earth science; database support for crisis management, environmental systems, and homeland security; and privacy and trust in information management systems.

Jiming Liu is a professor and the head of the Computer Science Department at Hong Kong Baptist University. His current research interests include: Autonomy-Oriented Computing (AOC), Web Intelligence (WI), and self-organizing systems and complex networks, with applications to: 1) characterizing working mechanisms that lead to emergent behavior in natural and artificial complex systems (e.g., phenomena in Web Science and the dynamics of social networks and neural systems), and 2) developing solutions to large-scale, distributed computational problems (e.g., distributed scalable scientific or social computing, and collective intelligence). Professor Liu has contributed to the scientific literature in those areas, including more than 250 journal and conference papers, and five authored research monographs, e.g., *Autonomy Oriented Computing: From Problem Solving to Complex Systems Modeling* (Kluwer Academic/Springer) and *Spatial Reasoning and Planning: Geometry, Mechanism, and Motion* (Springer). He serves as the editor-in-chief of *Web Intelligence and Agent Systems* and as an associate editor of the *IEEE Transactions on Knowledge and Data Engineering*, the *IEEE Transactions on Systems, Man, and Cybernetics—Part B*, and *Computational Intelligence*, and is a member of the editorial boards of several other journals.