Active Knowledge Engineering Laboratory

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The Active Knowledge Engineering Lab activities include investigations that are about discovering, externalizing, expressing, representing, sharing, exploring, configuring, activating, growing and managing enterprise knowledge as well as designing new programming platforms based on mentioned above principles. This year we have been focused on the following topics.

1. Filmfications of Methods and Data Existing systems of symbols and notations are usually very abstract and there is a great gap between the form and meaning of data/knowledge. Our long-term education, in an essential part, is reduced to training our brain for being 'encoding-decoding' machine bridging this gap. The abstractness mentioned and bridging operations are sources of serious mental and physical problems for a great variety of people and, especially for disabled and elderly. Our aging society is also becoming information society. So, the above-mentioned aspect of our environment is becoming crucial. That is why, our research is to develop a new environ-

ment with lesser level of abstraction and with the better quality of people life. Our general program is cyber-infrastructure including high-performance computing. We are also thinking about active knowledge being developed by humanity and undertaking research efforts in visual (multimedia) languages and tools, parallel and distributed systems. In a great part, our research and development are based on an idea of self-explanatory components in a cyberFilm format. A cyberFilm is a set of color stills supported, if necessary, by text, voice/sound and special links. Each still is to represent a view (some features) of objects or processes. Each cyberFilm is to represent a multiple view (an extended set of dynamic and/or static features) of objects or processes. The more accurate and relevant views are used, the greater adequacy is reached. The idea of cyberFilms is used for the specification of information resources and programming operations with the resources, as well as for the representation of multimedia messages and implementation of human-computer interfaces. The idea of equal opportunities to all individuals in the use of information resources is used to create a right set of cyberFilms and methods of their adaptation. We lead four clusters of projects related to filmification of methods and data: 1) Active Knowledge Studio for teachers, students, and programmers, 2) Semantic Surfaces in Ambient Living Environments for elderly, 3) Virtual objects, haptic interface and 3D printers for people doing fast prototyping, and 4) WWW-based software for users involved in multimedia programming and distance learning.

2. Human-Computer Interaction and Natural Language Parsing

Experimenting with human behavior via human-computer interaction is challenging and interesting topic with many possible problems. Our research interests include: - Artificial intelligence systems for computer games; - Virtual experiments based on human-computer interaction; - Understanding and modeling human behavior. Natural language processing is a challenging branch of modern artificial intelligence. Its applications include text analysis, machine translation, computer-assisted language learning, grammar checking, and information retrieval. Our current research is mostly focused at parsing, i.e. at analysis of language sentences in order to discover dependencies between individual words

3 Human-centric Software for Multi-resolution High-performance Tsunami Modeling and e-Learning

The main goal of the project is in research and development of the multi-purposed Programming Platform via integration of software and information

components designed by different groups of developers. The set of applications will be developed based on the original Virtual-Model-View-Controller (V-MVC) design pattern that is an integration of two well-known approaches: Service-Oriented Architecture (SOA) and the Model-View-Controller (MVC). Based on this approach, the main components of the SOA-based High-Performance Tsunami Modeling System are designing. Main components of the Service-Oriented Architecture (SOA) for the Tsunami Wave Propagation Modeling are developing by adaptation of the MOST (Method of Splitting Tsunami) software package. A software tool developed allows implementing calculations remotely on the server by choosing the available computational resources via the agent-based resource management. The proposed system allows applying modern approaches, including collaboration among distributed clients and computational services in a customizable working environment. Through parallel testing of models under identical conditions, the community can determine the relative merits of different computational formulations, an important step to further improvements in speed, accuracy, and reliability. We will focus on acceleration of the calculation process by means of parallel processing. Our preliminary results of numerical experiments show the possibility of a significant acceleration of the Tsunami Wave Propagation Modeling especially for the CUDA platform (about 45 times). The other subsystem is the e-Learning Arena allowing personalizing the use of exercises and test materials as a tournament as well as reducing the teacher ' s efforts. The e-Learning arena can also be considered as a variety of learning services consumed by different types users: Teachers, Students, Judges, etc. associated with the Objective as a project class with Course and Tournament as the two main variants. A Course is defined as a set of tasks to be implemented such as lectures and tests. The Tournament is the second variant of learning objective. The objective can be extended defining new types and easily integrated under the model structure. Tests can be realized as Exercise, Quiz or Exams. The class Metrics is to evaluate and record the student performances that can be consumed by students and Judges that are evaluator users with a lifetime in the system strictly related with the learning objectives in execution. Wikipedia Miner re-usable services are an important part of this approach. We prototyped the WikiGloss tool which is based on a glossing approach helping learners of English-as-second-language on an extensive reading task. The other application is an Intelligent Hints service for a Task Management Environment by providing explanatory links from relevant Wikipedia articles related to topics of the e-Learning task.

Refereed Journal Papers

[mozgovoy-01:2013] R. Efimov M. Mozgovoy. WordBricks: a Virtual Language Lab Inspired by Scratch Environment and Dependency Grammars. *Human-centric Computing and Information Sciences*, 3(4):–, 2013.

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[vazhenin-01:2013] M. Drozdowicz, K. Hayashi, M. Ganzha, M. Paprzycki, A. Vazhenin, and Y. Watanobe. Implementing Agent-based Resource Management in Tsunami Modeling - Preliminary Considerations. *Lecture Notes in Computer Science*, 8381:95–111, 2014.

Recently, work has started to apply the agent-semantic infrastructure, developed within the scope of the Agents in Grid project, to the resource management needed in tsunami modeling. The original proposal was based on the perceived simplicity, versatility and flexibility of the agent-based approach that makes it easier to deploy than the standard grid middlewares. The aim of this paper is to report on the progress in implementing and deploying the proposed system at the University of Aizu. To this effect, we start with a brief summary of the state-of-the-art in tsunami modeling. Next, we outline the MOST algorithm designed for tsunami simulation, and provide details of the implementation developed and used at the University of Aizu. We follow with an overview of the Agents in Grid system and discuss its key aspects related to the process of its customization to the requirements of tsunami modeling. Finally, we provide a description of the process of specifying and submitting a job within the distributed tsunami modeling laboratory. This process is used to illustrate key features of the system under development.

Refereed Proceeding Papers

[mozgovoy-02:2013] T. Kakkonen V. Klyuev E. Sutinen M. Munezero, M. Mozgovoy. Antisocial Behavior Corpus for Harmful Language Detection. In *Proceedings of the 3rd International Workshop on Advances in Semantic Information Retrieval*, pages 261–265, 2013.

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[mozgovoy-03:2013] M. Mozgovoy E. Sutinen M. Munezero, C. Montero. Exploiting Sentiment Analysis to Track Emotion in Students' Learning Diaries. In *Proceedings of the 13th Koli Calling International Conference On Computing Education Research*, pages 145–152, 2013.

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[mozgovoy-04:2013] M. Mozgovoy A. Zgonnikov, I. Lubashevsky. Dynamical Trap Effect in Virtual Stick Balancing. In *Springer Proceedings in Complexity*, pages 43–50, 2013.

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[rentaro-01:2013] Rentaro Yoshioka Nikolay Mirenkov and Kamen Kanev. Social and Educational Aspects of 3D Printing. In *Proceedings of 16th International Conference on Humans and Computers (HC 2013)*, pages 1661–1670. The Humans and Computers Committee, December 2013.

3D printing, called additive manufacturing, is considered as a future technology which will shape the global economy. In fact, the era of 3D printing has already begun and a great variety of industries applies the technology for design and fabrication of their goods. For example, it is used by architects for designing building models, by car and plane makers for producing parts, and by artists for organizing 3D printing Art shows. Even home users employ the technology for their hobbies. In this new era, we are challenged to discover intelligent applications of the 3D printed objects that would have been difficult or impossible to realize without this technology. It is now the time to revisit the visual aspects of 3D objects and to redefine their roles and capabilities as tangible objects for communication, presentation, manipulation, education and even computation.

[vazhenin-02:2013] A. Vazhenin, Yu. Watanobe, K. Hayashi, M. Drozdowicz, M. Ganzha, M. Paprzycki, and et al. Agent-based Resource Management in Tsunami Modeling. In M. Paprzycki Editors M. Ganzha, L. Maciaszek, editor, *Federated Conference on Computer Science and Information Systems, FedCSIS 2013*, pages 1047–1052, Krakow, Poland, September 2013. IEEE sponsored, Gesellschaft fur Informatik Asociacion de Tecnicos de Informatica, Naukowe Towarzystwo Informatyki Ekonomicznej, IEEE Conference Publications.

Complexity of tsunami modeling requires designing software system with high level of reusability and interoperability of its components, and flexible resource management. In this paper we investigate how to integrate the tsunami modeling software with an agent-based resource management infrastructure. Here, agents' flexibility and ability for negotiations will allow malevolent use of resources belonging to different administrative domains.We have discussed changes (simplifi- cations) that need to be introduced to the AiG infrastructure to adapt it to the needs of the tsunami modeling, as a task completed using machines available within the University of Aizu. Finally, we have presented a detailed scenario how the user would use the AiG infrastructure to run a simulation.

[vazhenin-03:2013] R. Cortez, H. Tan, A. Vazhenin, and D. Vazhenin. Service Oriented Movie-based Programming Environment. In Proceedings Editor A. Szakal, editor, *Intelligent Software Methodologies, Tools and Techniques (SoMeT), 2013 IEEE 12th International Conference on*, pages 149–155, Budapest, Hungary, September 2013. IEEE sponsored, IEEE Conference Publications.

Movie-based (MB) programming environment is a visual programming platform for creating algorithms and programs applying animation frames with computational and sensible operations. It facilitates the user's understanding and debugging of a program by coloring correlated areas of structures, introducing appropriate computational formulas as well as specifying algorithmic and logical behavior of those areas. The goal of the presented work is adapting the current system to Service-oriented Architecture in order to organize a sharable storage and server-based execution of MB-programs and algorithms. Therefore, the MB-programs/algorithms could be shared and reused by different developers. In this paper, features of MB-programming paradigm and the corresponding software are presented, which are used to enhance capabilities for data/knowledge and execution management. In the framework of Virtual-MVC design pattern, the MB-management architecture, component's design steps and a prototype of service-oriented MB-programming environment are discussed, including concepts and examples of usage.

[vazhenin-04:2013] K. Abe, R. Cortez, and A. Vazhenin. Task management strategies for automatic task generation and verification. In *Awareness Science and Technology and Ubi-Media Comput-*

ing (iCAST-UMEDIA), 2013 International Joint Conference on, pages 601–606, Aizu-Wakamatsu, Japan, November 2013. IEEE sponsored, IEEE Conference Publications.

In this research, we propose a strategy to support automatic task generation and verification for subjects that require handling mathematical formulas. The importance of supporting automatic problem generation is to reduce the teacher's efforts and to personalize e-learning tasks for students enforcing their understanding of a subject. Also, the automatic verification strategy provides immediate feedback. Our approach is based on a standardization of learning tasks by providing a formal definition of the structure of a learning activity. As e-Learning platforms are evolving towards service-orientation, we prototype our strategy by developing an e-Learning component that can be used as a stand-alone application, or its logic can be exposed as a set of services for external applications.

Unrefereed Papers

[vazhenin-05:2013] K. Hayashi, A. Vazhenin, and An. Marchuk. Visualization Engine in the SOA-based Tsunami Modeling Environment. In *The 2013 Tohoku-Section Joint Conference of Institutes of Electrical and Information Engineers*, page 13, Aizu-Wakamatsu, Japan, August 2013. IEEE Sendai Section.

Currently, Service-Oriented Architecture (SOA) may be considered as a state of the art approach for the complex software design and implementation because of high-level of operability and reusability of system components. Accordingly, we are applying the SOA-patterns to the creating the Tsunami Wave Propagation Modeling Environment because of complexity and versatility of tsunami modeling methods and tools. Our approach is followed an original Virtual Model-View-Controller pattern (VMVC) that is an adaptation of the traditional MVC to SOA. It is demarcating a Functional (View) and an Implementation (Model) task by inducing an Integrator (Controller) that encapsulates non-functional activities such as security, reliability, scalability, and routing. The presented paper is devoted to developing the Tsunami Modeling System components that are functioning at the Model layer. Especially we are focusing on the developing the Tsunami Visualizing Engine (TVE) allow-

ing to transform the digital results of modeling to the human-centered representation.

[vazhenin-06:2013] H. Tan, R. Cortez, and A. Vazhenin. Adapting Movie-based Programming Environment for SOA. In *The 2013 Tohoku-Section Joint Conference of Institutes of Electrical and Information Engineers*, page 12, Aizu-Wakamatsu, Japan, August 2013. IEEE Sendai Section.

In this work we propose the extension of a Visual Programming Lamguage to share resources under a distributed environment applying a Service-Oriented Architecture (SOA) design pattern and support distributed storage, sharing and reusing of algorithms knowledge representation and software components. The advantage of designing processing logic in the Movie-Based Engine, is that the services can be composed and reused by different applications and combined with services in other engines. The executable code of the MP-film uploaded in the model can be reused for processing the corresponding calculations and exposed as individual applications that can be accessed outside of a visual system as well. The variety of local and remote computational resources can be also implemented as a set of Engines. From the user 's point of view, it is a subset of endpoint services that encompass functionalities of an API and realize processing that is specific to an application. This makes possible to provide the flexibility of available computational resources, supporting the execution of MP-programs on various programming platforms.

[vazhenin-07:2013] K. Abe, R. Cortez, and A. Vazhenin. Automatic Problem generation E-Learning Component based on Task Management Principles. In *The 2013 Tohoku-Section Joint Conference of Institutes of Electrical and Information Engineers*, page 14, Aizu-Wakamatsu, Japan, August 2013. IEEE Sendai Section.

In this paper we discussed the definition of Task Management approach. Based on the Atomic Task and Composite Task definitions, we designed a strategy that separates the problem's element definitions from the data values. Consequently, is more flexible to customize the learning task by generating automatically multiple versions, as well as supporting the verification strategy for multiple answers. The logic for automatic task generation and verification is deployed into the Verification and Formula Engines which are part of a Service Inventory in the model. Therefore, the approach supports reusability of the logic, and it can be exposed to external applications as services.

Academic Activities

[rentaro-02:2013] R Yoshioka, Nov. 2013.
Advisory Board, iCERi 2013.

[vazhenin-08:2013] A. Vazhenin, 2013.
Member of IEEE, ACM, IEICE, IPSJ

[vazhenin-09:2013] A. Vazhenin, 2013.
The Director of the 2013 ACM-ICPC Asia Aizu Regional Contest

[vazhenin-10:2013] A. Vazhenin, 2013.
Program Committee Member of the 12th International Conference on New Trends in Software Methodologies, Tools and Techniques (SoMeT 2013)

[vazhenin-11:2013] A. Vazhenin, September 2013.
Program Committee Member of the Federated Conference on Computer Science and Information Systems (FedCSIS2013)

Patents

[rentaro-03:2013] R Yoshioka. Method and Tool to Support Editing of Programs Registered PAT.NO. 5164032, Jan. 2013.

Ph.D and Others Theses

[rentaro-04:2013] Hidehito Sawai. Graduation Thesis: A Format for Work Specification, University of Aizu, 2013.
Thesis Advisor: Yoshioka, R.

[rentaro-05:2013] Shota Furuya. Graduation Thesis: An Analysis Tool for a Programming Contest for High-school Students, University of Aizu, 2013.
Thesis Advisor: Yoshioka, R.

[rentaro-06:2013] Katsuki Yanai. Graduation Thesis: An Approach to Assist Programming Education Using Source Code Differences, University of Aizu, 2013.
Thesis Advisor: Yoshioka, R.

[vazhenin-12:2013] Kazuma Abe. SOA-based Automated Task Management Environment, University of Aizu, 2013.

Thesis Advisor: A. Vazhenin

[vazhenin-13:2013] Kensaku Hayashi. Master Thesis: Tsunami Modeling Environment based on Virtual MVC Design Patterns, University of Aizu, 2013.

Thesis Advisor: A. Vazhenin