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 focusing 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 environment 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. 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 in Games and Education

Experimenting with human behavior via human-computer interaction is a challenging and interesting topic with many open problems. Primarily we are focused on understanding and modeling human behavior via the development of artificial intelligence (AI) systems for computer games and simulations. In particular, we are using annotated recordings of soccer and tennis matches to model the behavior of opponents. Other projects include the analysis of human language polarity and grammar by using methods of corpus linguistics and visualizing text structure. Our goal is to simplify understanding of human language properties and thus assist language education.

3. Human-centric Software Design Patterns

The main goal of the project is in research and development of the multi- purposed Methodology allowing creation of service-oriented systems via integration of software and information components designed by different groups of developers. The set of applications is developing 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).

We are designing a system allowing numerical computer Tsunami simulations for crucial coastal areas. It supports so-called hybrid bathymetry that combines natural and artificial underwater objects. It also should include the tools allowing the user to manipulate with these objects. Research is in designing a public server client/server infrastructure as well as a structure of tsunami data to be stored and assembled. We are designing high-resolution digital Bathymetry of Fukushima Coast and Modeling Scenarios based on sources of the Japanese Great Earthquake. It includes computational experiments with the program modules, modify them as well as design visualizations of tsunami wave propagation. Service-

Division of Information and Systems

Oriented LEGO-Robot Programming Components allow developing WEB-based applications for Robot Control System, visualization of robot activities and data. It includes designing a prototype for the LEGO Robot Control scanning system including possibilities to specify operations for the internal robot program and data exchange. Hardware and software should be created using familiar LEGO parts and blueprints for faster assembly.

Refereed academic journal

[mozgovoy-308-004-01:2017] V. Khaustov and M. Mozgovoy. Teaching Automated Software Testing with Appium and Soccer Simulator. *North Ossetian State University Bulletin*, 4:124–127, 2017.

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[vazhenin-308-004-01:2017] Alexander P Vazhenin Kensaku Hayashi, Andrey G Marchuk. Numerical Modeling of Tsunami Propagation on a Sequence of Refining Grids. *AIP Conference Proceedings*, 1907(1):1–11, November 2017.

The multi-grid algorithm for the tsunami propagation computation from the initial source to the coastline that uses scale switching has been developed. Computations are carried out on a sequence of grids with various resolutions where one is embedded into another. Tsunami wave parameters are transferred from a larger domain to the embedded smaller one by means of the boundary conditions. Using the method proposed, the numerical simulation of tsunami generated by a model ellipsoidal source located in the middle of the Pacific was carried out.

Refereed proceedings of an academic conference

[rentaro-308-004-01:2017] R. Yoshioka and T. Kawaguchi. How to Foster Creativity? Curriculum of Creativity Development Program for Computer Science Students. In *The 49th ACM Technical Symposium on Computer Science Education*, pages 1074–1074, Baltimore, 2018. ACM, ACM.

The importance of problem solving skills in addition to computational skills for computer science graduates is increasing. The authors present a curriculum of a creativity development program for undergraduate computer science students that aims at exposing them to problem solving and software development through a series of three courses spanning a period of six months. The focus of this initiative is to teach problem solving skills and software development skills as an integrated skill-set and take advantage of the combined effect to address the challenge for students to connect computer science knowledge to real-world problems, an issue apparent in our current curriculum. The curriculum starts with the first course on creativity development in which students propose solutions to a real-world problem through field-work and information gathering/analysis spanning five days. The second course introduces project

management and software development through another five-day software development team project. In the final course, student teams work on a software development request from customers during a period of 4 months. All three courses use the same problem. The program is in its first year of offering with a relatively small group of students. The presentation will display our findings from program assessment including student scores on individual performance tests and student perception. Details of the project can be found at: https://www.u-aizu.ac.jp/enpit/

[rentaro-308-004-02:2017] T. Hoshino, R. Yoshioka, and M. Arai. An Impression Based Recording of Art Viewing Experience: Preliminary Implementation and Analysis. 2018.

An implementation of a previously proposed method for expressing impressions of artwork is presented. The method employs sets of object-feeling pairs to describe impressions of artwork without relying on professional knowledge. The method is especially targeted for education of children as well as casual art fans. This work presents a practical implementation of the method with realistic format and symbol designs. Tests carried out with the implementation provide assuring results of the approach as well as insights into necessary improvements. Details of the implementation decisions and analysis of obtained results are reported.

[vazhenin-308-004-02:2017] Kensaku Hayashi Alexander Vazhenin Stanislav G Sedukhin Fumiya Kono, Naohito Nakasato. Performance Evaluation of Tsunami Simulation using OpenCL on GPU and FPGA. In *2017 IEEE 11th International Symposium on Embedded Multicore/Many-core Systems-on-Chip (MCSoC)*, pages 106–113, Seoul, South Korea, September 2017. Korea University, IEEE.

Prediction of the arrival time of tsunami is critical for evacuating people from coastal area. Solving many related to tsunami problems is important in order to decrease negative effects of this serious disaster. Numerical modeling of tsunami wave propagation is a computational intensive problem that requiresacceleration of calculations by means of parallel processing. The Method of Splitting Tsunami (MOST) is one of the well-known numerical solvers for modeling tsunami waves in the ocean. This paper focuses on design and evaluation of tsunami simulation code using OpenCL. We have developed a tsunami propagation code based on MOST, and implemented its different parallel optimizations for GPU and FPGA.

[vazhenin-308-004-03:2017] Andrey G Marchuk Kensaku Hayashi, Alexander P Vazhenin. Investigation of the Artificial Underwater Object's Protection Properties Using Numerical Modeling. In *The 27th International Ocean and Polar Engineering Conference, 25-30 June, San Francisco, California, USA*, pages 981–988, San Francisco, California, USA, June 2017. International Society of Offshore and Polar Engineer (ISOPE), International Society of Offshore and Polar Engineer (ISOPE).

> The important part of the tsunami research is focused on studying the considerable influence of natural geographical objects, like islands and near-coastal bathymetry, on tsunami waves. Complementing the physical modeling, we are designing a system for computer simulations of crucial coastal areas. The Bathymetry and Tsunami Source Data Editor is a basic system tool for editing bathymetric and tsunami source data by including/removing artificial seawalls and submerged barriers having different shapes and sizes. Results of numerical experiments are presented for the gridded hybrid bathymetry for several coastal areas of Japan. This system can help to issue recommendations for better protection of some crucial objects on a coastline.

[vazhenin-308-004-04:2017] Petr Dyadkov Andrey Marchuk Alexander Vazhenin, Anna Mikheeva. The Software using Digital Databases and GIS Interface for Detecting Geodynamic Structures. In Sigeru Omatu Hamido Fujita, Ali Selamat, editor, *New Trends in Intelligent Software Methodologies, Tools and Techniques - Proceedings of the 16th International Conference (SoMeT-17)*, volume 297 of *Frontiers in Artificial Intelligence and Applications*, pages 576–592. IOS Press, 2017.

> This paper presents a tool for studying a seismic, volcanic and impact natural disasters of GIS-ENDDB (the Earth's natural disasters Databases). The algorithms implemented in GIS-ENDDB allow visualizing a selected part of a current catalog of events in a pseudo-3D background map, to plot frequency dependences of magnitudes or sizes (crater diameters) and other parameters relationships of events from various samples. This high-tech expert system allows solving a wide range of seismological and geodynamic research tasks updated by including successively various mathematical methods for natural disasters data processing, characteristics of seismogeodynamic regime (b, A, EO, KAVG), and advanced representation tools. The paper shows examples of mapping these characteristics and studying their anomalies (slope of magnitude-recurrence curves, seismic quiescence, energy stability) and of revealing the grouping events (aftershocks, clusters, etc.). The detailed study on seismogeo-

dynamic regime of the linear and ring structures revealed by seismic grouping methods and in the anomalies of geophysical fields can give a lot of prognostic information to seismologists

[vazhenin-308-004-05:2017] Dmitry E. Kuzakov Alexander P. Vazhenin Mikhail M. Lavrentiev, Alexey A. Romanenko. Determination of Initial Tsunami Wave Shape at Sea Surface. In *Proceedings of the IEEE OCEANS 2017 ABERDEEN Conference*, pages 1–7, Aberdeen, UK, June 2017. IEEE.

Any Tsunami Early Warning System (TEWS) should provide reliable prediction of the wave parameters as early as possible. Numerical calculation of the tsunami wave propagation over the particular part of the ocean can be implemented rather efficiently using modern high-performance system. It is possible when the initial wave shape at tsunami source is given. In this paper we discuss and show the fast algorithm for reconstructing the initial sea surface displacement at tsunami source. Based on the Fourier approximation theory, the presented algorithm treats the measured wave profile as a linear combination of synthetic (calculated) waves from the so-called unit sources. Using an artificial bathymetry, we evaluate the algorithm parameters focusing on its precision and performance. Moreover, a large tsunami sources (several hundred kilometers long) are also simulated.

[vazhenin-308-004-06:2017] Alexander Vazhenin Ruth Cortez Subhash Bhalla Shashank Shrestha Absalom Shu, Konstantin Markov. Unified User-Interface and Protocol for Managing Heterogeneous Deep Learning Services. In *New Trends in Intelligent Software Methodologies, Tools and Techniques - Proceedings of the 16th International Conference (SoMeT-17)*, volume 297 of *Frontiers in Artificial Intelligence and Applications*, pages 563–575. IOS Press, September 2017.

In the last decade, cheaper and more powerful computations have favored a sufficient surge in research and development of applications in the fields of machine and deep learning. Though often varying in approach, these activities aim mostly at solving similar tasks such as speech synthesis, emotion detection, image recognition, mathematical computations etc. Usually, the typical scenario of using designed algorithms/applications includes inputting data represented in some predefined formats and launching a corresponding program tool that produces expected output data as well as analyzing obtained results. These applications are numerous, and are created by different research teams and laboratories using different techniques and environments including

locations, interfaces and procedures to access, query and use them. In a collaborative working environment, developing independent user interfaces for each deep learning application could entail a lot of additional development efforts. In the presented paper, we propose a standardized and flexible interface to reduce design efforts, based on integration of various Deep Learning services (DL services). We also demonstrate a protocol for communication between the user interface and the heterogeneous services. This platform will enable developers of deep learning models to be concerned solely with developing and tuning their models, which can be easily plugged into the central user interface, conveniently exposing their services to users who will have homogeneous central access to a wide-range of DL services, from a unified interface.

[vazhenin-308-004-07:2017] Yilang Wu Ruth Cortez Alexander Vazhenin Absalom Shu Subhash Bhalla Shashank Shrestha, Wanming Chu. Workflow Based Query Management System for Astronomical Data Repository. In *New Trends in Intelligent Software Methodologies, Tools and Techniques - Proceedings of the 16th International Conference (SoMeT-17)*, volume 297 of *Frontiers in Artificial Intelligence and Applications*, pages 719–730. IOS Press, September 2017.

Astronomy is a data-intensive science. The large amount of data available in the astronomical domain needs query languages to gain valuable astronomical information. The paper has two goals. First, it presents the challenges for domain-specific query language for managing astronomical data. Second, it proposes a solution of managing such large amount of data through incorporating a multi-stage query language with Workflow Management technique. The paper demonstrates a web based query management system able to handle user queries in single or multi-stage.

Research grants from scientific research funds and public organizations

[vazhenin-308-004-08:2017] Alexander Vazhenin. Service-oriented Infrastructure for Tsunami Education and Digital Badges support for English Learning Management System, 2017.

Academic society activities

Summary of Achievement

[vazhenin-308-004-09:2017] Alexander Vazhenin, 2017.

> member

[vazhenin-308-004-10:2017] Alexander Vazhenin, 2017.

> Member

[vazhenin-308-004-11:2017] Alexander Vazhenin, 2017.

> Member

[vazhenin-308-004-12:2017] Alexander Vazhenin, 2017.

> Member

[vazhenin-308-004-13:2017] Alexander Vazhenin, 2017.

> Member

[vazhenin-308-004-14:2017] Alexander Vazhenin, 2017.

> Program Committee Member of the Federated Conference on Computer Science and Information Systems, FedCSIS 2017

[vazhenin-308-004-15:2017] Alexander Vazhenin, 2017.

> Program Committee Member of the 9th IEEE International Conference on Ubi-Media Computing

Advisor for undergraduate research and graduate research

[rentaro-308-004-03:2017] Toshihiro Endo.   Graduation Thesis: Self-Theories based Feedbacks for a Programming Learning System, University of Aizu, 2017.

> Thesis Advisor: Yoshioka, R.

[rentaro-308-004-04:2017] Mamoru Kondo. Graduation Thesis: Migrating a Program Learning System to a Reactive Micro-Service Architecture: A Case-Study, University of Aizu, 2017.

> Thesis Advisor: Yoshioka, R.

[rentaro-308-004-05:2017] Koyo Fushimi. Graduation Thesis: A Knowledge Model and Algorithm for Event-based Automatic Commentary, University of Aizu, 2017.

Thesis Advisor: Yoshioka, R.

[vazhenin-308-004-16:2017] Tatsuya Hirose.   Graduation thesis, undergraduate, University Of Aizu, March 2017.

> The important part of the tsunami research is focused on studying the considerable influence of natural geographical objects, like islands and near-coastal bathymetry, on tsunami waves. We are designing a system for computer simulations of crucial coastal areas based on hybrid bathymetry including Artificial Underwater Objects (AUO). The Bathymetry and Tsunami Source Data Editor (TSB-editor) is a basic system tool for editing bathymetric and tsunami source data by including artificial seawalls and submerged barriers with different shapes and sizes. The presented work is devoted to extend possibilities of TSB-editor in order to prepare a set of bathymetry data allowing providing multiple experiments. This supports a generation of a set of AUOs with parametrical ordering of their parameters. Paper describes these group functions as well as examples of the corresponding AUOs.

[vazhenin-308-004-17:2017] Ryuki Ito. Graduation thesis, Undergraduate, University of Aizu, March 2017.

> The aim of this study is to create a system allowing investigating the influence of natural geographical objects such as island and coastal seabed topography through modeling of the tsunami. Dependences between modeling zones are changeable and complex. This requires having effective and management environment with convenient web-based end-user interface allowing to input and validate modeling data as well as to control modeling process via WWW-browser.

[vazhenin-308-004-18:2017] Georges Meguro. Graduation thesis, Graduate, University of aizu, March 2017.

> LEGO Education EV3 robotics is the third generation of LEGO Educational robotics. It can be considered as a good solution allowing teaching students how to program, build and test their robot models. Based on a human-centered approach, the presented paper is devoted to design extension of the current EV3 system. It includes visual programming as one of important human-centered programming approach as well as end-user application extending possibilities of the on-line users control via the World Wide Web (WWW)-based interface. The visual tool is presented for studying how to program internal LEGO-programs. The special attention is focused on data exchange mechanism design between a LEGO robot and server. Based on this approach, the WWW-based remote EV3

controller is described providing the ability of simple remote operations of EV3 by web page.

Contributions related to syllabus preparation

[rentaro-308-004-06:2017] Software Engineering I

[rentaro-308-004-07:2017] Venture Startup Factory 6 Introductory PBL

[rentaro-308-004-08:2017] Software Studio

[rentaro-308-004-09:2017] Creativity Studio

[rentaro-308-004-10:2017] Creativity Development

[vazhenin-308-004-19:2017] Undergraduate Course: Operating Systems

[vazhenin-308-004-20:2017] Undergraduate Course: Advanced Software Engineering

[vazhenin-308-004-21:2017] SCCP Project: Practical application and network defence

[vazhenin-308-004-22:2017] Graduate Core Course: Software Engineering

[vazhenin-308-004-23:2017] Graduate Course: Theory and Practice of Software Engineering

[vazhenin-308-004-24:2017] Graduate Course: Parallel, Distributed and Interenet Computations

Scholarly paper prepared by undergraduate/graduate student(s) you advised

[rentaro-308-004-11:2017] T. Hoshino, R. Yoshioka, and M. Arai. An Impression Based Recording of Art Viewing Experience: Preliminary Implementation and Analysis. *Proceedings of 7th International Conference on Educational and Information Technology*, 2018.

Employment guidance

[vazhenin-308-004-25:2017] Member of the Selection Committee

Advisor of a student club or circle

[rentaro-308-004-12:2017] Adviser of the University of Aizu Orchestra Dolce

Contribution related to on-campus/off-campus publicity work

[rentaro-308-004-13:2017] Presented PBL activities of UoA at enPiT workshops and symposium

[vazhenin-308-004-26:2017] Public Lecture about the University of Aizu at the Novosibirsk State University, March 2017.

Contribution related to planning administration for research, research conferences, or international research

[vazhenin-308-004-27:2017] Collaboration agreement with Novosibirsk State University (Russia), Tallinn University of Thechnology (Estonia), and Systems Research Institute Polish Academy of Sciences(Poland).

Other significant contribution toward university planning, management, or administration

[rentaro-308-004-14:2017] Preparation and organization of programming contest as an organizing committee member of PC Koshien 2017

[rentaro-308-004-15:2017] Preparation of course material and management of an online programming learning system for students admitted by recommendation

[rentaro-308-004-16:2017] Student recruiting activities for the Graduate Department of Information Technologies and Project Management

[vazhenin-308-004-28:2017] Chair of the Graduate School Department on Information Technology and Project Management Member of the Graduate School Academic Affairs Committee Member of the CAIST evaluation Committee

Summary of Achievement

Contributions related to regional education

[rentaro-308-004-17:2017] Offered lecture on Information Science at the Takeda Nurses
School

Did you participate in Faculty Development? (Yes or No) If yes, please describe what you did.

[rentaro-308-004-18:2017] Organized a PBL workshop for local faculty on June 22, 2017

Did you participate in Public Lectures, and/or Open Campus? (Yes or No) If yes, please describe what you did.

[rentaro-308-004-19:2017] Organization of open-lab during Open Campus event

[rentaro-308-004-20:2017] Organization of open-lab during University Festival

[rentaro-308-004-21:2017] Preparation and organization of open-online course 'Algorithms and Programming' for PC Koshien participants.

[vazhenin-308-004-29:2017] OpenLab and OpenCampus: 1. Presentation of research on
Tsunami Modeling and Lego Robot Programming 2. Presentation of WWW-server
on Deep Learning Applications (with Prof. Markov)

Research achievement that can be used for University-Industry collaboration and its characteristics.(for UBIC's information)

[vazhenin-308-004-30:2017] Our investigations are focused on studying the considerable
influence of natural geographical objects, like islands and coast bathymetry, on the
tsunami waves. The original editor allows tuning/editing bathymetric and tsunami
source data by including/removing artificial barriers as well as specifying their placement, shapes and sizes. It is also oriented to support modeling experiments with the
bathymetry data of the Fukushima prefecture coast and tsunami sources including
data obtained from the Great Japanese earthquake. The result of investigations can
be used to control the tsunami wave height by underwater artificial objects, study
features of the natural bathymetry as well as make design a set of digital artificial
objects (islands) that can be used to protect the coastal areas.

Do you have experience of University-Industry collaboration? If yes, please describe your experience. (for UBIC's information)

[rentaro-308-004-22:2017] Developed a Injection Drug Prescription Support software for doctors in cooperation with the Aizu Medical Center

[rentaro-308-004-23:2017] Developed a Pain Relief Prescription Analysis software for doctors in cooperation with the Aizu Medical Center

[rentaro-308-004-24:2017] Organized a workshop for reducing vacant houses in Minami-Aizu Town in cooperation with town office

[rentaro-308-004-25:2017] Developed a social network service to raise awareness of vacant houses in cooperation with Minami-Aizu town

[rentaro-308-004-26:2017] Developed a real-estate matching system in cooperation with Minami-Aizu town

[rentaro-308-004-27:2017] Developed a real-estate ranking system to activate circulation in cooperation with Minami-Aizu town