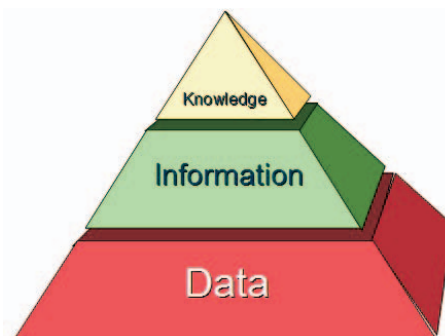


**COE Project: Advanced Methods for Knowledge Creation from Data Mining**

*Professor Tu Bao Ho, JAIST School of Knowledge Science*

The Knowledge Creating Methodology Laboratory is part of the School of Knowledge Science at JAIST. The laboratory's activities are intertwined with the goals and objectives of the COE. In the laboratory, many of our projects have a single unifying theme: creating knowledge by extracting it from large and complex databases. Now that the sheer volume of data in all fields has outstripped the ability of any one researcher or organization to assimilate all of it, new tools are required to extract any kind of meaning from this volume of data.

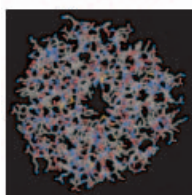
Statistical analysis of numerical data, in flat tables, is a relatively straightforward task. Thirty years ago numbers were almost all that were on computers. Today we face the need to mine completely different kinds of data. Mining text data, which is either semi-structured or non-structured data, is a more challenging task, one that researchers the world over continue to refine and revise. Temporal data and sequential data, which are typical in medicine and biology, raise other challenges. Structural data in physics and chemistry, for example, could be exploited to help determine the materials structures.



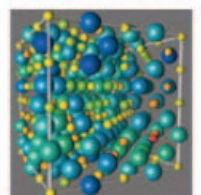
**Textual data**



**Temporal data**



**Sequential data**



**Structural data**

Of the four tasks we are undertaking for the COE, two concerns the mining of text and Web data. In the first of these two, we are attempting to develop an *information extraction* method. Unlike information retrieval systems like Google, which merely point researchers toward pages containing relevant information, the information extraction tool is designed to find actual, useful information within those pages. In the second task we want to develop the ability to detect emerging trends from the literature. Since no one person can possibly attend every conference or read every journal, this detection ability will be an invaluable tool

for researchers in a wide variety of fields.

Two other projects involve collaborations with scientists from both inside and outside JAIST. With researchers in the School of Materials Science, we are engaged in an innovative effort to determine the structure of crystals from limited experimental data on their structure. We are also part of a nation-wide team of researchers who are searching for a way to mine numerous bioinformatics databases in order to study protein interactions.

*(continued on page 2)*

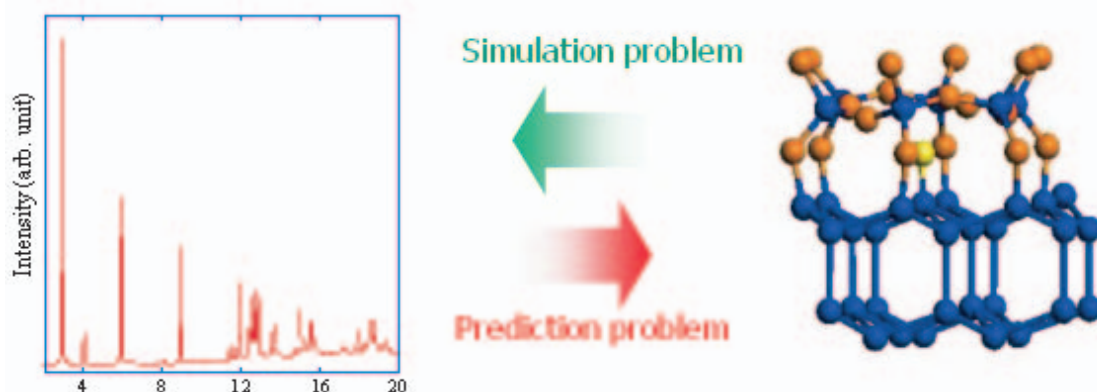
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Our laboratory also engages in collaborations with scientists from other countries. With Professor Erich Hofer of Ulm University and Professor Milan Vlack of Charles University in Prague, we recently submitted a proposal entitled “Uncertain Systems and Knowledge Management for Decision Making.” As part of this project we hope to use advanced multi-category classification and visualization techniques to develop methods for knowledge discovery from scientific data and for knowledge representation, as well as support systems for decision making under uncertainty.

For more information about the projects described in this article, contact Professor Ho at [bao@jaist.ac.jp](mailto:bao@jaist.ac.jp) or visit <http://www.jaist.ac.jp/ks/labs/ho>.

## COE Activities Highlights

February 26, 2004: The JAIST seminar on Creation of a New Industry by Dr. Osamu Okuma of New Industry Research Organization (NIRO), Kobe held in JAIST

March 8-10, 2004: The First JAIST International Symposium on Knowledge Management for Strategic Creation of Technology, held in Ishikawa High-Tech. Conference Center, Tatsunokuchi, Japan

April 27, 2004: The JAIST seminar on the Trial of Knowledge Management System in Advanced Technology by Dr. Shigenori Fujikawa of RIKEN, Saitama held in JAIST

May 27, 2004: The JAIST seminar on the Trial of Fusion of Nanotechnology and Informatics by Dr. Eiichi Watanabe of the Nanomaterial Center, Institute of Engineering Innovation, University of Tokyo, Tokyo held in JAIST

June 25, 2004: Seminar on An Educational Program for the Coordinator of Science and Technology to Support Industrial Innovation by Professor Yoshiteru Nakamori (JAIST); Professor Hidenobu Hori (JAIST); Professor Nobuhiko Yui (JAIST); Dr. Hideo Ishizaka (JMA Consultants Inc.); Mr. Kensuke Nishiyama (Development Bank of Japan); Mr. Kei Iwasaki (RCAST, Tokyo University); Mr. Shohei Otaki (Chubu Bureau of Economy, METI) held in Kanazawa

Weekly/Biweekly/Monthly (depending on the project): Colloquia at JAIST.

### **The First JAIST-COE International Symposium: A Student's Perspective**

*Tunç D. Medeni, Doctoral Student at JAIST Knowledge Science School (Umemoto Lab) and Research Assistant at the Center for Strategic Development of Science and Technology*

The First International Symposium on Knowledge Management for Strategic Creation of Technology was held at the Ishikawa High-Tech Exchange Center on March 8-10, 2004. This 3-day intellectual gathering and academic discussion was quite interesting and stimulating, and provided several opportunities to gain important knowledge and experience for my personal, academic and professional interests.

There were several remarkable highlights during these three days. For example, Dr. Abul Iqbal, of IQChem, Inc., spoke on "DPP- The Colorful Journey of an Industrial Pigment from the Laboratory to the Market." His speech about his groundbreaking discovery of a new color pigment, and how he made it into a business success story, very interesting. Moreover, it was amazing to watch and feel his excitement while he was humbly talking about his accomplishments, even though he has done the same thing many times over in the last ten years! I indeed wished that all Material Science students in JAIST, who are just starting their own long journey, could have been there to see this encouraging presentation.

I think the Symposium was also notable in terms of its potential to facilitate some challenging discussions about knowledge and knowledge science, which fit well into the vision and framework of the symposium and its organizers, the COE Program in the Knowledge Science School of JAIST. For instance, a dominant view treated knowledge management for the strategic development of science and technology as a purely scientific methodology, like a scientific experiment conducted in a materials science laboratory; the opposing view was that the dynamics and determinants originating from the human situation and social reality cannot be ignored. I also recall well a small, but stimulating discussion during the presentation of Professor Michael C. Jackson of Hull University about whether or not Knowledge Management itself is just another management fad!

Since the Symposium, I have observed that in many theoretical and practical aspects, it has reinforced my understanding of the benefits of having *Knowledge, Information and Material Science under the same umbrella*, supporting the development of intercommunication and exchange among different individual or institutional entities. It was a very good "1<sup>st</sup> symposium" and I look forward to participating again and again. For following symposiums, since much more is achieved at informal meals than in formal meetings, I would like to suggest that the organizing committee think about creating more occasions to promote informal interaction opportunities among the participants and attendees.

*For more information on this article, contact Mr. Medeni at [medeni@jaist.ac.jp](mailto:medeni@jaist.ac.jp)*

### **Forthcoming International Forum:**

November 10-12, 2004: The Sixth JAIST International Forum on Technology Creation Based on Knowledge Science: Theory and Practice to be held at Ishikawa High-Tech. Conference Center, Tatsunokuchi, and Kanazawa Art Hall, Kanazawa, Japan.

## COE Project: Theory of Knowledge Expression and Integration

Professor Andrzej P. Wierzbicki, JAIST Center for Strategic Development of Science and Technology

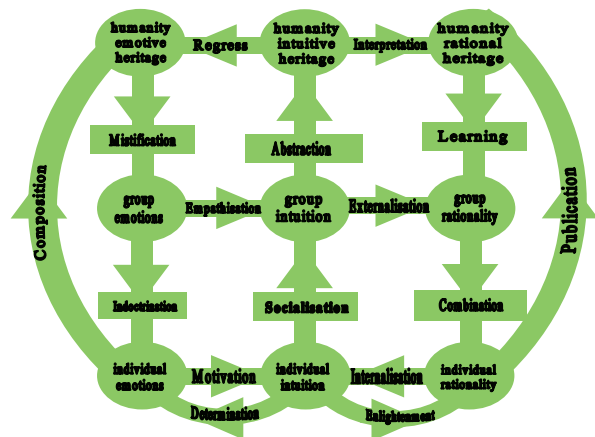
This COE project concentrates on two goals: knowledge integration, summarized by a book, and diverse methods of knowledge expression represented by studies resulting in journal publications.

The first goal is the integration of a number of existing theories of knowledge creation – such as *Shinayakana Systems Approach* of Sawaragi and Nakamori (1992), *Knowledge Creating Organization* of Nonaka and Takeuchi (1995) with its *SECI Spiral*, *Regress Theory* of Motycka (1998), *I<sup>5</sup> System* of Nakamori (2000) and others. As a tool of such integration, *Rational Theory of Intuition* of Wierzbicki (1997) and a new concept of *Creative Space* is used, as shown in the Figure.

The goal of such integration is not only to present all known theories of knowledge creation in a common framework, but also to draw conclusions about their regions of applicability and their advantages and disadvantages, as well as diverse practical conclusions resulting from such theories. The findings of this study will be presented in a book entitled *Creative Space and Creative Environments*, edited by Professors Andrzej P. Wierzbicki and Yoshiteru Nakamori.

The second goal is related to diverse methods of knowledge representation and expression, mostly in the form of various types of computerized mathematical models; it includes issues of knowledge integration in virtual laboratories, gaming as a way of expressing knowledge, reasoning with uncertain knowledge, multi-criteria decisions and vague knowledge representation, and knowledge discovery in large repositories of scientific literature. The project is augmented by broad international cooperation – for example, with the International Institute for Applied Systems Analysis (IIASA) in Austria and the National Institute of Telecommunications (NIT) in Poland – as well as cooperation within Japan – e.g., with Tsukuba University (Tsukuba and Tokyo), Konan University (Kobe).

### The concept of Creative Space



For more information about the Theory of Knowledge Expression and Integration Project, contact Professor Wierzbicki at [andrzej@jaist.ac.jp](mailto:andrzej@jaist.ac.jp)

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Questions, comments, and article proposals can be sent to: [hasan@jaist.ac.jp](mailto:hasan@jaist.ac.jp), tel. +81-761-51-1787.

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## **JAIST-COE Academic/Research/Administrative Staff**

### **Yoshiteru Nakamori**

Professor Yoshiteru Nakamori is the leader of the COE, coordinating and managing the entire COE program. He earned his B.S., M.S., and Ph.D. degrees, all in applied mathematics and physics, from Kyoto University, Kyoto, Japan, and joined JAIST in 1998 as a professor in the School of Knowledge Science.

Professor Nakamori's specialties are systems methodology, complex systems modeling, and simulation. His fields of research interest cover the identification and measurement optimization of large-scale complex systems, modeling and control of environmental systems, and methodology and software for decision support systems. Recent activities include development of a modeling methodology based on hard as well as soft data, and support systems for soft thinking around hard data.

### **Toshiya Kobayashi**

Toshiya Kobayashi is an Associate Professor of Strategic Development of Science and Technology, JAIST-COE Program. His present research theme is developing technology policy using the principles of knowledge science, one of the main pillars of the COE enterprise.

Mr. Kobayashi acquired the degree of Master of Arts and Science in Waseda University in 1997. Prior to joining JAIST he was an associate professor at the University of Tokyo, studying advanced science and technology strategy there. For some ten years he also was a researcher at the Institute for Future Technology, a Tokyo-based think tank, doing research on science and technology policy and on environmental problems. He is currently pursuing a Ph.D. in science policy studies.

### **Andrzej P. Wierzbicki**

Andrzej P. Wierzbicki is a Research Professor in the JAIST-COE Program. His current research involves the integration of several theories of knowledge creation into a common framework and an investigation of diverse methods of knowledge representation and expression. He received his PhD and DSc degrees for investigations of nonlinear feedback systems and the optimization of dynamic systems.

Prior to joining JAIST, Professor Wierzbicki was director general of the National Institute of Telecommunications (NIT) in Poland and a professor of optimization and decision theory at Warsaw University of Technology. He is the author of over 180 publications, including 11 books, and has been granted 3 patents. He also has served on numerous committees and advisory groups in Poland and throughout Europe and the EEC. His research interests include optimal control, sensitivity of control systems, mathematical modeling and computational optimization, vector optimization and multiple criteria decision support, parallelization of optimization algorithms using multiple criteria approaches, diverse aspects of negotiation and decision support, game theory and gaming, distance learning, diverse issues of information society and civilization, rational theory of intuition and theories of scientific creativity.

## **JAIST-COE Academic/Research/Administrative Staff (continued)**

### **Quamrul Hasan**

Quamrul Hasan is a Research Professor in the JAIST-COE Program, focusing on two research projects: knowledge management for research and development, and international networking and knowledge mapping. He received his Bachelors and Masters degrees in biochemistry from the University of Dhaka, in Bangladesh, and his PhD in biotechnology from Kyoto University, in Japan.

Previously, Professor Hasan was a Senior Scientist at Proctor & Gamble, and an R&D Project Manager/Leader at Japanese companies for collaborative research projects with universities. He has some 50 international scientific patents and papers to his credit, and was awarded a P&G Innovation Award in May 1999. Later his research at P&G, as the Technical Leader for a Global R&D Project, led to a successful home hygiene product globally, “Febreze Allergen Reducer” (marketed in Japan as “Febreze House Dust Clear”). His current research interests include management communication in research environments, especially those in which scientists from different countries and backgrounds must work together to produce innovative technology.

### **Takashi Tatsuse**

Takashi Tatsuse is a Fellow in the JAIST-COE Program. He is studying the role of knowledge coordinator as an important aspect of university/industry cooperative projects.

Mr. Tatsuse received his Bachelor’s degree from the School of Letters, Arts and Sciences, Department of Asian Philosophy at Waseda University in Tokyo. His previous research includes a project on the social implications of traditional medical treatment in the Hokuriku region of Japan.

### **Tiejun Ma**

Tiejun Ma is a postdoctoral researcher in the JAIST-COE Program. His current research includes information infrastructure for knowledge management, and methodologies and systems of roadmapping for supporting scientific research.

Dr. Ma received his Bachelor’s degree in industrial engineering and Masters in systems engineering from Dalian University of Technology, China, and his Ph.D. in knowledge science from the Japan Advanced Institute of Science and Technology.

### **Akiko Kawabata, Terumi Kawai**

Akiko Kawabata and Terumi Kawai are the administrative staff of the Center for Strategic Development of Science and Technology (JAIST-COE Program).

To contact the Center: Telephone 0761-51-1837; Fax 0761-51-1767; E-mail [coe.secr@jaist.ac.jp](mailto:coe.secr@jaist.ac.jp).