ISR*Connector*

HOT RESEARCH

Overcoming Privacy Barriers to Sales and Communication

Privacy and security issues are central to ISR's research mission, since they lie at the intersection of software design, human factors, business interests, and societal needs. ISR researchers are pursuing a number of privacy and security projects (last updated in the Fall/Winter 2002 **ISR** *Connector*). In the area of privacy, **Alfred Kobsa** and his colleagues are currently exploring better ways to combine users' privacy needs and international privacy law requirements with the best collaborative awareness tools and online personalization services. These improved tech-

Wang, Kobsa, Patil

nologies enable businesses to operate more efficiently through better collaborative work practices and to considerably increase sales by promoting greater customer trust.

Supported by several grants from the National Science Foundation (NSF) and others, Kobsa and his students have focused on two aspects of privacy-enhanced personalization, namely collaboration awareness and the design of personalized systems.

Awareness, Privacy in Collaborative Work

It is well-established that being aware of collaborators' activities, routines, tasks, and availability can greatly improve computer-supported collaborative work. The need for awareness, though, is frequently at odds with an individual's desire to keep private some of this information. Effectively balancing awareness and privacy needs has proven to be a

significant challenge for designers of awareness systems and related infrastructures.

This thorny balancing act is being examined as part of ISR's NSF-funded research on multiple aspects of distributed software

RESEARCH BRIEFS

Gloria Mark has been named a 2005-2006 Fulbright Scholar. In association with a 4-month sabbatical at Humboldt University in Berlin, she will study geographically distributed teams. Mark's research interests in computer-supported cooperative work will synergize with German researchers' long interest in work psychology.

Richard N. Taylor has received the 2005 ACM Special Interest Group on Software Engineering (SIGSOFT) Distinguished Service Award. The award, presented annually to an individual who has contributed dedicated and important service to the software engineering community, was presented at the 2005 International Conference on Software Engineering (ICSE) in May 2005.

With colleague Steven Cramer, Asst. Professor of Neurology at UCI, **Cristina Videira Lopes** has been awarded a Nicholas Foundation Prize for Cross-Disciplinary Research. Cramer and Lopes will develop a computerized communication platform to measure and transmit physical therapy data from patients' homes via the Internet to UCI, enabling detailed monitoring for speedier recovery from spinal cord injuries.

A National Science Foundation (NSF) grant of $775,000 was awarded to **Richard N. Taylor** to help build a new interdisciplinary Science of Design. The proposal, "Designing Architectures for Networked Applications: A REST-ful Approach," will help establish teachable scientific principles transforming the way complex software-intensive systems—everything from autos and rockets to web applications—are designed.

David Redmiles, Susan Elliott Sim and **André van der Hoek** have received IBM Eclipse Innovation grants. The Eclipse open-source community creates technologies and an open universal platform for tool integration. The grants encourage the application of Eclipse to innovation in teaching, research or community building.

Walt Scacchi and **Robert Nideffer**, co-leaders of the UCI Game Lab, are developing science learning games with a grant from the Orange County Discovery Science. The partnership will help children from 3 to 103 learn about dinosaurs and life sciences.

With Aerospace Corporation colleagues Sergio Alvarado and Scott Turner, ISR alumnus **Hadar Ziv** co-chaired the Working Group on Architecture-Centric Evolution, Evaluation, and Elaboration (ACE3) of Software-Intensive Systems at the 2005 Ground Systems Architecture Workshop (GSAW).

development. This Information and Technology Research (ITR) grant, which was recently extended by NSF, includes P.I. **Richard N. Taylor**, Kobsa and six other ISR faculty researchers, as well as four industry partners (see the Fall/Winter 2002 **ISR** *Connector* for grant details).

Focusing on one awareness technology in their ITR research project, Kobsa and ISR Ph.D. candidate **Sameer Patil** (A. Kobsa, advisor) found that Instant Messaging (IM) may be under-used in business settings when privacy is conventionally addressed in company policies. Kobsa and Patil propose empowering users to monitor and control privacy-sensitive information through modifiable policies and settings. This privacy-

MESSAGE FROM THE DIRECTOR

After several years in publication, the **ISR** *Connector* newsletter now reaches a worldwide audience with a wealth of information and news about our current research projects, faculty, industry partnerships, and events. This issue marks the introduction of a new column, "Focus on ISR Technologies" (see page 7). Innovative ISR tools and technologies have been instrumental in changing the way software engineers work and people in general interact with computers. Feedback from our readers suggests the newsletter should supplement the ISR website in providing a window to our hottest new technologies. The inaugural column updates you on the latest architecture developments of the REST architectural style, a technology that underlies today's Internet functionality, first described in the dissertation of one of my students, **Roy T. Fielding**. Let us know how you like the new column.

Taylor
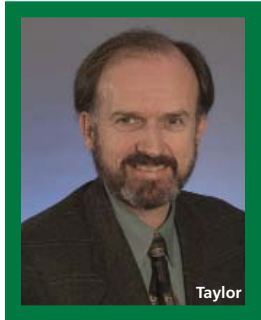
From July of this year through June 2006 I will be on sabbatical leave from ISR and UCI. The first part of this sabbatical will be spent at London Software Systems (LSS) a research institute established jointly by University College London and Imperial College of Science, Technology and Medicine. LSS focuses on techniques and tools for designing large-scale complex information technology systems. While in residence I will be working with Professors David Rosenblum (a former ISR colleague), Anthony Finkelstein, Jeff Kramer, and Jeff Magee, among others. I'm expecting to focus on issues of design and the relationship between architectures and requirements. Taking my place as Interim ISR Director will be **Walt Scacchi**, ISR's Senior Research Scientist. Stemming from his dual background in the computer sciences and management, Scacchi's research interests include organizational studies of open source software development, organizational and software process engineering, and computer game environments, to name a few. Hear about his latest research project, a collaboration with fellow ISR member **Robert Nideffer** funded through the Orange County Discovery Science Center, at the upcoming ISR Research Forum on June 3, 2005. I hope to see many of you there.

Richard N. Taylor
Professor and Director

enhanced solution has the advantage of considering not only the larger awareness needs of a collaborative group, but also individual privacy needs. Kobsa and Patil are currently exploring several design solutions to allow users to find the right balance between awareness and privacy, thereby increasing the use and effectiveness of collaborative awareness systems.

Privacy is also a research initiative of the European Commission's Information Society Technologies (IST) Program, specifically in the project "Privacy and Identity Management for Europe" (PRIME). The European Commission is seeking ways to make user's online navigation more privacy-protected. As part of a collaborative effort between NSF and IST, Kobsa has received funding to work with the PRIME project. His two-year project, initiated in 2004, seeks to unify privacy management solutions being developed in his own research with those being explored by PRIME. As part of this

collaboration, Patil will spend this summer at Karlstad University in Sweden. Lessons learned from previous research (e.g., see publications listed in http://www.isr.uci.edu/~kobsa/) will be explored and tested for applicability to Europe's Internet privacy concerns.

You can hear more about ISR research on balancing preferences for awareness and privacy at the ISR Research Forum on June 3, 2005. Patil will present his related internship work with ISR sponsor IBM Research (see http://www.isr.uci.edu/events/Research-Forum-2005/program.htm).

Privacy as a Design Requirement for Personalized Systems

Personalized web marketing is advantageous for both users and e-commerce—individuals can quickly access information and products tailored to their interests, while e-businesses reap the rewards of loyal consumers.

However, users remain particularly sensitive about the electronic collection of personal data, so the full potential of personalized web systems has not been realized.

For several years Kobsa and his research team have been studying user privacy requirements in such systems. In collaboration with faculty from Humboldt University in Berlin, they have examined international policies that govern the collection of personal data in web-based systems, researched user's attitudes towards that data collection, and introduced and tested a simple but effective privacy practice that is a win-win for both users and e-commerce.

The researchers have found trust is key to user's attitudes towards personalized web systems. Keeping international policies in mind, Kobsa's team designed privacy-friendly personalization templates that build user trust. When users enter data into each template field, a clear and concise explanation of how the retailer will use the data is shown, plus the benefits the customer can expect from sharing this personal information. Tests showed online shoppers using Kobsa's system were 20 percent more likely to share personal data and 33 percent more likely to buy, compared with websites with a traditional link to the company's privacy policies.

With ISR Ph.D. student **Yang Wang** and help from ISR faculty member **André van der Hoek** and Ph.D. student **Eric Dashofy** (R. Taylor, advisor), both software architecture researchers, Kobsa is taking personalization systems one step further. Kobsa and Wang are enabling a user modeling architecture to dynamically select personalization methods that satisfy current privacy constraints. The advantage of the software product line approach they employ is the flexibility of architecture-level configuration management, which can easily adapt to changing policies and user privacy preferences. The implementation of this state-of-the-art technology for privacy-enhanced personalization systems will synergize with emerging industry best practices for managing software variants at runtime.

For more information on ISR privacy and security research, see:
http://www.isr.uci.edu/research-privacy-security.html
http://www.isr.uci.edu/~kobsa/kobsa-research-frame.htm

Kobsa can be reached at kobsa@uci.edu.
Patil can be reached at patil@uci.edu.
Wang can be reached at yangwang@uci.edu.

Keynote presentations by ISR faculty: **Debra J. Richardson**, "Informatics: Contextualizing Computer Science and Software Engineering Education," at the 2005 Conference on Software Engineering Education and Training (CSEE&T); and **Paul Dourish**, "Software as an Embodied Phenomenon" at the 2004 IEEE Symposium on Human-Centric Computing, and "The Culture of Information: Ubiquitous Computing and Representations of Reality" at the 2005 IFIP 8.2 conference on Designing Ubiquitous Information Environments.

ISR faculty **Thomas A. Alspaugh** and **Debra J. Richardson** presented a paper titled "Scenarios, State Machines, and Purpose-Driven Testing" at the 4th International Workshop on Senarios and State Machines: Models, Algorithms and Tools (SCESM'05).

ISR Research Specialist **Margaret Elliott** presented a paper titled "A Common Information Space in Criminal Courts: Computer-Supported Cooperative Work (CSCW) Case Management Systems", co-authored with John L. King, Univ. of Michigan, at the Hawaii Int'l. Conf. on System Sciences (HICSS-38), January 3-6, 2005. The paper presented a study of the Los Angeles County Criminal Courts and how judges and court clerks coordinate their work through complex criminal justice case management systems.

ISR faculty filled significant roles in the Int'l Conf. on Software Engineering (ICSE 2005), the premier software engineering conference and the Conf. on Human Factors in Computing Systems (CHI 2005), the premier international conference on human-computer interaction. **André van der Hoek** served as Workshops and Co-located Events Co-Chair for ICSE 2005, held May 15-21 in St. Louis, MO. He also served on the Program Comittees for the Research Track, Doctoral Symposium, and Workshops. **Susan Elliott Sim** served on the ICSE 2005 Research Demonstrations Program Committee. **Gloria Mark** served as a Papers Associate Chair and **Paul Dourish** served as a Reviewer for CHI 2005, held April 2-7 in Portland, OR.

The Microsoft Business Solutions website recently featured an interview with **Alfred Kobsa** about Personalization and Privacy (see Hot Research, page 1, for more).
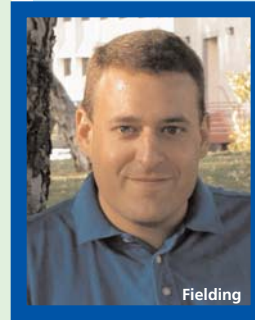
Fielding

Roy T. Fielding Ph.D. 2000 (R. Taylor, advisor) presented an Invited Talk titled "Software Architecture in an Open Source World" at ICSE 2005.
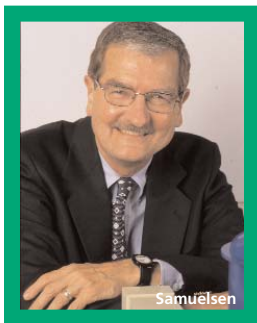
Jack Muramatsu (P. Dourish, advisor) received his Ph.D. in December 2004. His dissertation was titled, "Social Regulation of Online Multiplayer Games." Jack is currently an instructor with the Donald Bren School of Information and Computer Sciences at UC Irvine.

Peter Kammer, Ph.D. 2004 (R. Taylor, advisor), has been named senior software architect at Stream Theory, Inc. which recently merged with Endeavors Technology, Inc.

FOCUS ON FACULTY

MEET ADVANCED POWER RESEARCHER SCOTT SAMUELSEN

Going to the World's Fair this summer in Japan? Look there for the fruits of ISR faculty **Scott Samuelsen's** research. Samuelsen, Professor of Mechanical, Aerospace and Environmental Engineering and Director of the Advanced Power and Energy Program (APEP) at UCI <http://www.apep.uci.edu/samuelsen/>, conducts research on energy generation, distribution and use. His work also explores the environmental impact of these energy systems, the dynamic between energy generation and atmospheric quality, and the development of environmentally preferred, high-efficiency energy generation integrated into buildings and building complexes.

Samuelsen

APEP encompasses two research entities, the National Fuel Cell Research Center (NFCRC) and the UCI Combustion Laboratory (UCICL). The NFCRC's exhibit at the World's Fair demonstrates the fuel cell's promise as a dependable, efficient and environmentally friendly source of energy. The NFCRC has pioneered fuel cell technologies and applications, including hybrids of fuel cells and gas turbine engines. It deployed the first highway-ready vehicle powered by a hybrid electric fuel-cell engine, the Toyota FCHV. Nearly 2 million people are expected to visit the UCI fuel cell exhibit this summer, one of five main displays in the U.S. Pavilion.

Samuelsen collaborates with other ISR researchers at the intersection of energy and software engineering. One such project was part of an ISR $1.8 million NSF Information and Technology Research grant with multiple corporate and nonprofit partners. The project investigated topics in decentralized applications, such as fuel cells close to the point of use but networked together. Samuelsen and **Richard N. Taylor** are also looking at broad issues of coordination, control and decentralization in the electric power industry. The future of electricity generation and use is distributed generation, and the demand for software that supports secure, robust strategies for control and command, monitoring, and efficient business operating principles

has exploded in recent years.

Samuelsen received his B.S., M.S. and Ph.D. degrees in Mechanical Engineering from UC Berkeley. He is on the editorial boards of *Atomization and Spray Technology* and *Combustion Science and Technology*, has published extensively in refereed journals, books, government reports (e.g., NASA, NATO), and other publications, and is often invited to speak to international audiences on combustion and related topics. He serves on the Board of Directors for the Combustion Institute and as Secretariat of the Institute for Liquid Atomization and Spray Systems of the Americas, an organization of industrialists, researchers, academics and students engaged in professional activities connected with liquid sprays and spray systems. He is Co-Chair of the California Stationary Fuel Cell Collaborative, Director of the Pacific Rim Consortium on Energy, Combustion, and the Environment, and serves on the Advisory Panel for Gov. Schwarzenegger's Hydrogen Highway Network Initiative.

Samuelsen can be reached at gss@uci.edu, (949) 824-5468. The NFCRC display can be viewed until September 25 at the World's Fair "EXPO 2005" in Aichi, Japan, east of Nagoya. http://www.expo2005.or.jp.

Visiting Japanese Researcher Welcomed

In recent years, ISR has been privileged to host several long-term visiting researchers from Japan. Our visitors enrich our joint research collaborations and provide valuable interaction opportunities for all of us. This year ISR welcomes visiting researcher **Akira Karasudani** from Fujitsu Laboratories Ltd. in Japan, where he works in the I/O Systems Laboratory of the Storage and Intelligent Systems Laboratories.

Working with ISR host **Paul Dourish**, Karasudani's current project is on personal information management from a cognitive psychology perspective. He says his interest in human computer interaction problems (HCI) stems from "very discriminating Japanese customers," who demand high standards of usability from technology manufacturers. Hence HCI considerations are always taken seriously by Japanese software engineers. Karasudani is exploring technology options to support users of vast amounts of interactive data, such as researchers or managers.

Karasudani's research interests include low-level storage architectures such as I/O interfaces and high-level storage architectures, including network appliances. His background includes image and signal processing and embedded systems—he contributed to the development of embedded systems for Fujitsu's Magneto-Optical Disk Drive or HDD.

Karasudani is maximizing his visit to UCI by taking classes with ISR faculty **Alfred Kobsa**, Paul Dourish, and **Bonnie Nardi**, and is enjoying interactions with the cultural melting pot of the university community. In his free time, he has taken the opportunity to get in touch with American culture by traveling, listening to jazz music, and enjoying America's natural beauty. Irvine, he says, is a safe, comfortable place to live, but he misses the eclectic architecture and walking distances of home.

Karasudani presents his poster on "Personal Information Management using User's Episodic Activities Flow" at the 2005 ISR Research Forum. Until September 2005 he can be reached at akarasud@ics.uci.edu; after that at dany@labs.fujitsu.com.

FOCUS ON SPONSORS

ISR and Boeing Find the Meaning of Excellence through Collaboration

Thanks to a $1.8 million grant from the National Science Foundation, the Institute for Software Research and Boeing recently collaborated on a series of research projects that have been "a win-win for everyone concerned," according to Doug Sedgwick, until recently the Director of Boeing Anaheim Information Technology (IT).

With the help of Boeing IT project manager Kristie Kosaka, two teams of ISR researchers headed by faculty members **David Redmiles** and **Gloria Mark** conducted research at the Anaheim facility in 2004. The results showcased effective practices of IT's Center of Excellence (COE), previously validated primarily by customer loyalty and internal cross-group differences. "We've been asked, 'How does your group get cheaper faster?' Now we have independent research to share," reported Sedgwick. The research revealed COE practices worthy of industry-wide benchmarking, as COE practices were compared by researchers with those in other industry environments.

ISR alumnus **Mark Bergman**, Assistant Professor at the Naval Postgraduate School, and Gloria Mark found that COE's relationship building practices helped reduce "sensemaking" gaps between customers and service-providers at the critical stage when requirements and other information are being translated and negotiated in development loops. ISR graduate student **Hiroko Wilensky** (D. Redmiles, advisor), ISR Research Associate **Rogério de Paula**, and Redmiles found that the COE's extensive experience with collaboration technologies contributed to the group's effective practices and customer service, including the COE team members' facility in using, evolving and supporting the technologies, as well as helping customers to adopt and use them. Both

DID YOU KNOW?

Did you know that ISR faculty member **Jim Whitehead's** research resulted in the creation of the widely used IETF WebDAV protocol?

ISR STUDENT NEWSBRIEFS

Victor González (G. Mark, advisor) and his team of fellow students from UABC University and CICESE Research Center, México, placed second among 26 teams competing in the CHI 2005 Student Design Competition. Their technological solution to the problem of elderly people living in isolation was presented along with three other finalist teams at CHI, the premier international conference for human computer interaction researchers. Victor also served as a paper reviewer for CHI 2005.

The Orange County chapter of the Achievement Rewards for College Scientists (ARCS) Foundation awarded ARCS scholarships to two ISR students, **Keri Carpenter** (B. Nardi, advisor) and **Emily Oh Navarro** (A. van der Hoek, advisor) at the January 2005 award banquet. ARCS Scholars received $10,000 to support their graduate studies.

Lihua Xu presented her joint paper with **Hadar Ziv**, **Debra J. Richardson** (advisors) and Zhixiong Liu at the Early Aspects Workshop, held in conjunction with ASOD 2005 (Aspect-Oriented Software Development), the premier international conference on aspect-oriented technologies and practices. Their paper "Towards Modeling Nonfunctional Requirements in Software Architecture" was one of only three chosen to present.

Sameer Patil (A. Kobsa, advisor) presented a paper titled "Who Gets to Know What When: Configuring Privacy Permissions in an Awareness Application" at CHI 2005. The paper was co-authored with Jennifer Lai, IBM T.J. Watson. Read more about Patil in Hot Research, page 1.

Working with his advisor André van der Hoek on an IBM Eclipse Innovation project, **Chris van der Westhuizen** is developing a plug-in called Lighthouse, which will improve team coordination through design-based awareness. Eclipse is an open-source community that creates technology and an open universal platform for tool integration in extensible Integrated Development Environments (IDEs).

Amanda Williams (P. Dourish, advisor) has been honored with one of only 1,020 NSF Graduate Research Fellowships awarded nationwide. The fellowship supports 3 years of her research in the field of ubiquitous computing and user interfaces. Williams' project investigates the computing habits of urban residents in Bangkok, Thailand, which has a fast-growing technology infrastructure unlike those in the U.S.

John Georgas (R. Taylor, advisor) presented his paper titled "Knowledge-Based Architectural Adaptation Management for Self-Adaptive Systems" at the ICSE 2005 Doctoral Symposium. The Symposium provides useful guidance for completion of dissertation research and initiation of a research career. More about Georgas on page 7.

Johanna Brewer, ISR Research Associate and Ph.D. student as of Summer 2005 (P. Dourish, advisor), presented her paper titled "Who Cares About Our Conceptual System?" at the 1st UbiSoc Workshop, which was co-located with CHI 2005 in Portland, OR.

For more information on students: *http://www.isr.uci.edu/people.html*

WANT TO GET INVOLVED?

Sponsoring ISR has many benefits. It enables your company to form closer ties with our faculty and students, puts you on the fast track to our leading edge research, and gives you first crack at our experimental software tools. Choose from five levels of sponsorship:

Support Level	Annual Contribution	Contribution goes to:
Friend	$10,000	ISR's general research fund.
Affiliate—Research	$30,000	A designated ISR research area.
Affiliate—Visiting	$40,000	Host Faculty's research area.
Affiliate—Grad Student	$60,000	Graduate Student fellowship.
Partner	$100,000 or more	Large-scale research project.

For more information about ISR Sponsorship, please contact:

Dr. Susan J. Knight
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(949) 824-5927

ISR research teams are working with their Boeing collaborators on joint papers, presentations, and other means of distributing the research findings.

Following onsite research and analyses of the data, ISR researchers shared results with each group involved in the research and with COE management. "The teams found the research process and the results enlightening," said Kosaka. "We got to hear from an independent observer what we are doing well and how we compared with other companies." The experience created for the Boeing participants a better understanding of the research process, a deep awareness of current individual and group COE work practices, as well as knowledge of new ideas, skills, emerging tools, and techniques that could lead to better practices. Perhaps best of all, an ongoing partnership has blossomed between the two groups, leveraging the knowledge and resources of both for further mutual benefit.

Sedgwick feels the "excellence" in the COE he has directed for the past 6 years means finding the very best ways to serve customers. The COE, a department within Boeing Anaheim IT, functions to develop collaborative computing software. For any given project, developers may capture requirements, design, build, test, as well as train users and deploy the system solution. The COE typically provides post-implementation support for systems it has created and modified.

"We should constantly be asking ourselves, 'How can we give our customers value? How can we go beyond what is asked of us? And how can we ensure our old customers return and new customers seek us out?'" Sedgwick said. A key strategy component is fostering collaborative relationships—with internal customers, vendors and peers in other departments, as well as intra-team and inter-team.

Strong relationships have been built upon mutual respect and trust. "We solicit our customer's inputs regularly on what we can do to help, how well our systems solutions are working for them, how well we are performing our jobs, and what we can do better," said Sedgwick. Customer loyalty has remained strong since the COE's inception in 2000.

This philosophy has taken the COE outside its doors to pursue relationships with professional organizations, universities, and other external entities on the leading edge of emerging practices and technologies. "One cannot claim to be a Center of Excellence without continually, actively seeking out new ideas and keeping abreast of emerging solution sets. It is the responsibility of the COE to have ties with universities, think tanks and other researchers—as we do with ISR—in order to strengthen our own knowledge and capabilities," explained Sedgwick.

The impact of such interactions on customers can be far-reaching, not only for Boeing IT, but for society. "The positive effects of working relationships such as those we have with ISR could reach the National Security level," said Sedgwick.

Partnerships with industry are a win-win for all. Being able to hear about real-world problems and apply new solutions and technologies to them is invaluable to researchers

ISR Technical Reports Available Online

ISR technical reports present information resulting from student and faculty research carried out under the auspices of the Institute. They showcase early results not available in print elsewhere. ISR technical reports are available in PDF on the ISR website. Recent reports include:

"A Survey of Versatility for Publish/Subscribe Infrastructures"
Roberto Silveira Silva Filho, UCI-ISR-05-8, May 2005

"An Interdisciplinary Perspective on Interdependencies"
Cleidson de Souza, UCI-ISR-05-7, May 2005

"Temporally Expressive Scenarios in ScenarioML"
Thomas A. Alspaugh, UCI-ISR-05-6, May 2005

"A Survey of Software Engineering Educational Delivery Methods and Associated Learning Theories"
Emily Oh Navarro, UCI-ISR-05-5, April 2005

"A Survey of Distributed Hypermedia Systems"
Joachim Feise, UCI-ISR-05-4, April 2005

"A Survey of Collaborative Tools in Software Development"
Anita Sarma, UCI-ISR-05-3, March 2005

"Software Support for Calculations in Allen's Interval Algebra"
Thomas A. Alspaugh, UCI-ISR-05-2, February 2005

"Privacy, Security... and Risk and Danger and Secrecy and Trust and Morality and Identity and Power: Understanding Collective Information Practices"
Paul Dourish, Ken Anderson, UCI-ISR-05-1, January 2005

All ISR technical reports are available at:

http://www.isr.uci.edu/tech-reports.html

For more information, contact:

Debra A. Brodbeck, Technical Relations Director, brodbeck@uci.edu, (949) 824-2260

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and contributes to proposal success. It is also a good opportunity for students participating in the research to get acquainted with our industry partner, and vice versa, often leading to internships, employment, and/or further research opportunities. In addition, ISR technologies are more rapidly deployed to general use, speeding up technology transfer and improvement cycles.

You can get a personal review of one of these research projects at the upcoming ISR Research Forum. Look for the "xTreme Requirements Analysis in Systems Development" poster by K. Kosaka, M. Bergman, and G. Mark:

http://www.isr.uci.edu/events/Research-Forum-2005/posters.htm

Become Part of the ISR Family

Rubbing elbows with ISR faculty, staff and students gives you a valuable window into the technology landscape of the future. But a relationship with ISR can be much more: Think of us an extension of your company—a think tank, an R&D department, a research library, a consulting firm, a training department, and an employment agency, all rolled into one. More importantly, when you sponsor ISR you become part of a friendly group of folks who speak the same language and are eager to work with you to solve your current technical problems in the most cost-effective way possible.
Be part of the ISR Family—a Friend, Affiliate, or Partner.

For more information, visit our website:
http://www.isr.uci.edu/sponsorship.html
or contact:

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Honoring the Late Rob Kling

Margaret Elliott, ISR Research Specialist, and Kenneth Kraemer, Director of ISR's sister organization CRITO (the Center for Research on Information Technology in Organizations), planned and coordinated the Social Informatics Workshop in March 2005. The event recognized the contributions of late Professor Rob Kling as founder of Social Informatics, and extended his contributions in the area of "computerization movements." Kling was a Professor of Information and Computer Science at UC Irvine and a Faculty Associate of CRITO from 1973-1993. As described by Kling and colleagues, Social Informatics "refers to the interdisciplinary study of the design, uses and consequences of information and communication technologies (ICTs) that takes into account their interaction with institutional and cultural contexts, including organizations and society." The idea of a "computerization movement" calls attention to the fact that the diffusion of technological innovations is fundamentally shaped by the interests of various actors such as vendors, consultants, media, movement organizations, users, and futurists whose interests coalesce to advance the use of technology within organizations and society. Computerization movement advocates focus on technologies' potential for causing positive social change. Recent computerization movements focus on personal computers, free and open source software, the Internet, and ubiquitous computing.

UCI's Donald Bren School of Information and Computer Science has established a graduate fellowship fund in Professor Kling's name. For more information or to contribute to the fund, please email: klingfund@ics.uci.edu.

Materials from the workshop can be found at http://www.crito.uci.edu/si.
Margaret Elliott, who contributed this article, can be reached at melliott@ics.uci.edu.

Designing a RESTful World

All of us use the World Wide Web daily, enjoying the ability to seamlessly access information distributed across thousands of computers around the world. But few of us appreciate how architectural design decisions fostered the Web's smooth scale-up to global proportions while continuing to enable a steady stream of new services and content.

These design decisions, critical to the maturation and modern form of the Web, were described and codified by ISR alumnus **Roy T. Fielding** (R. Taylor, advisor) in his 2000 Ph.D. dissertation. Fielding's formulation of the REST architectural style underlies today's World Wide Web and its primary protocol HTTP/1.1, which he co-authored.

REST, shorthand for REpresentational State Transfer, is an architectural style—a set of rules and guidelines for designing a system to achieve certain desirable qualities. In the Web's case, these qualities include scalability, reliability, robustness, and flexibility, all of which are due to REST's unique perspective.

Erenkrantz, Georgas, Dashofy, Gorlick

Rather than viewing the Web as a loosely-organized collection of files available for download, REST treats all Web content—text, images, audio, dynamically generated reports, and so on—as 'resources.' Resources are identified by name in the form of a Uniform Resource Identifier (URI), a Uniform Resource Locator (URL), or both. A key REST insight is that the network is not used to transfer resources themselves—resources are abstract concepts. Rather, concrete representations of these resources are transferred among hosts. For example, a resource might be "the current temperature in Los Angeles," while representations of that resource may be integer values in Fahrenheit, Celsius, and Kelvin. This allows content-providing hosts (servers) to provide content requestors (clients) with representations that

REST in the Real World

The design decisions codified in the REST architectural style are making an impact on how we live and work on the Web today. Some examples of how REST is changing the face of the Web include:

No more "Server too Busy" errors: REST's statelessness allows companies like Akamai to distribute content across multiple servers with ease, making it possible for people to get breaking news and popular content without overloading the original server.

What you see is what you want: REST's use of resource representations allows the Web to tailor content to the client's environment, by automatically translating the same resource into the client's preferred language or making it accessible on the client's browsing device, be it supercomputer or BlackBerry.

Loose coupling, more flexibility: By binding names (URIs) and locators (URLs) to abstract resources rather than specific instances or documents, REST allows content providers to provide dynamic, up-to-the-minute content.

More secure, more private: The ability to transfer (and transform) resource representations through one or more intermediate proxies can help to guarantee security and anonymity over the public Internet.

most closely fit their needs. For example, a server may choose to automatically translate a requested document resource into another language for a client in a foreign country, or it might format a graphics-intensive resource into a simpler, less-detailed representation for display on a cellular phone screen. This allows servers to maintain resources in any way convenient or appropriate, providing loose coupling between a resource and its actual implementation. This property promotes extensive flexibility in how content is made available to clients and how servers store and provide that content, a key aspect of the Web's success and broad usefulness.

REST interactions are essentially stateless. That is, a persistent (and thus fragile) connection need not be maintained between clients and servers over the course of many requests and responses. Each request from client to server contains all of the information necessary to understand the request. Consequently, Web applications built in the REST style are more robust, even in the face of the intermittent disconnections between clients and servers that are common in the decentralized world of the Internet.

Moreover, these stateless interactions permit

DID YOU KNOW?

Did you know that the latest release of DAV Explorer by ISR Ph.D. student **Joe Feise** is the first application supporting the Access Control Layer security protocol for WebDAV?

a single set of client requests to be serviced by any number of servers, including intermediate caches and proxies that mirror oft-requested resource representations. By decoupling clients from servers and copying and distributing popular resources among hosts, the Web scales dramatically, since no one server is solely responsible for all transactions on a particular resource and therefore cannot be a single point of failure.

Besides providing design guidance for the Web as it exists today, REST is influencing the applications of tomorrow. REST allows us to view the Web as a software development platform, rather than simply a way of browsing and reading hypertext documents. Further, it provides an alternative to tightly-coupled distributed object architectures that work well in small, single-agency local-area settings but fail in the face of large systems distributed over a global multi-agency network like the Internet. Many in the information technology industry speculate that Web Services will be the next "big step forward" in interoperability across wide organizational and geographic boundaries. Web Services run atop the existing Web and allow organizations to advertise their computational and information services in a standard format. Clients will be able to access these services as Web resources in a RESTful manner. In applying the REST style to Web Services, developers impart the scalability, reliability, and flexibility of the Web to the next generation of interorganizational Web applications. ISR continues to build upon REST to provide additional capabilities. In his Ph.D. dis-

raging incrementalism: an agile, incremental development process to support keeping pace with an ever-accelerating rate of technical change. RESTful compositions are flexible and support loose coupling between software elements; largely due to these qualities, this work has produced two systems intended for the Western and Eastern Launch Ranges— one for peer-to-peer video collection, distribution, and archive, and the second for decentralized launch countdown—that are fast to build, and cheap to maintain and upgrade. Future plans include the use of raging incrementalism and the REST architectural style for the development of a fully-featured satellite telemetry ground system.

This article was contributed by ISR Ph.D. students Dashofy, Georgas, Erenkrantz and Gorlick and ISR alumnus Rohit Khare.

ASE 2005 in Long Beach, CA

The IEEE/ACM International Conference on Automated Software Engineering will be held in Long Beach, California, Nov. 7-11, 2005. The conference is in its 20th year! It draws on research in areas ranging from formal modeling and reasoning about software systems to experimental data about human-computer interaction and collaboration with software tools, as well as many other topics described on the website. General Chair **David Redmiles** worked specifically to bring this international conference to Long Beach so that the many researchers and professionals in the wider Los Angeles region could have the opportunity to participate without the usual expense of travel. Both industry and academic participants will find topics and events of interest, as well as a great opportunity to network.

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sertation, ISR alumnus **Rohit Khare** codified the ARRESTED family of styles, extensions to REST that can be used as guidelines to construct large-scale, multi-agency systems that communicate over high-latency networks. ISR graduate student **Justin Erenkrantz** (R. Taylor, advisor) is studying how applications can take advantage of REST principles, making them more effective within a RESTful world. Two such applications are the popular Apache HTTP Server (on which Erenkrantz is a core developer) and a new client library called Serf, which he is designing from the ground up with RESTful principles. These architectural principles are also being leveraged in the larger context of software development methodology research. In collaboration with The Aerospace Corporation, ISR graduate students **Michael Gorlick** and **John Georgas** (R. Taylor, advisor) are using REST as the underpinning of