GRADUATE STUDIES

DONALD BREN SCHOOL OF
INFORMATION AND COMPUTER SCIENCES

UNIVERSITY OF CALIFORNIA, IRVINE
ABOUT THE UNIVERSITY OF CALIFORNIA, IRVINE

Since its founding as a department in 1968 and establishment as a school in 2002, the Donald Bren School of Information and Computer Sciences has achieved national and international recognition. Our reputation reflects the important research contributions of our faculty, the high caliber of our student body, the dynamics of our progressive curriculum, our technological orientation, and our exceptional commitment to quality education and research.

The UCI campus is built upon 1,500 beautiful acres of coastal foothills in Irvine, California, just five miles from the Pacific Ocean. The student body consists of over 25,000 students from every state in the nation and more than 100 countries. As a UCI student scholar, you will become a member of this diverse multicultural, international and intellectual community.

UCI's circular design successfully integrates the natural open space with the modern architecture of the academic, research and administrative structures. Ring Road, a mile in circumference walkway, is the pedestrian thoroughfare that connects the Student Center with campus classrooms, eateries, libraries, laboratories, housing and faculty offices. The Ring also serves as the outdoor staging area for a full calendar of cultural and social activities.

Life at UCI is as dynamic as it is intellectually challenging and rewarding.
Ten reasons why you should consider graduate education at the Donald Bren School of Information and Computer Sciences

1. **Unequaled Breadth** – At the Bren School, you can study all aspects of computer science and also the context of computing and information and their impact on society.

2. **Research Expertise** – ICS faculty expertise spans a diverse spectrum, including computer architecture, artificial intelligence, embedded systems design, social informatics, security and more! (See page 3 for a complete list.)

3. **Interdisciplinary Collaborations** – We cultivate a diversity of authentic, cutting-edge collaborations where information technology reshapes education, art and entertainment, emergency response, business and law, the environment and biological systems, health care and medicine.

4. **Our Faculty** – Bren School faculty are connected locally and globally. Our professors are members and fellows of many prestigious professional and academic associations including the American Association for the Advancement of Science, National Academy of Engineering, and more.

5. **Distinguished Chairs** – Named for benefactor Donald Bren, ICS is home to four distinguished scholars who work on emerging issues in information and computational sciences, including experiential computing, databases and human-computer interaction.

6. **We are Diverse** – Diversity in the student body and faculty are important ingredients for enriching classroom experiences and discussions. We have more than double the national average of female faculty. Our student clubs, organizations, and community service activities represent a broad range of interests and involvement opportunities.

7. **Entrepreneurial Spirit** – Bren School students have the opportunity to participate in business and product development competitions (with more than $10,000 in prizes) which help shape the future of technology, business and society.

8. **Research Opportunities** – Working directly with professors and undergraduate research students gives students the opportunity to experience and hone research and mentoring skills. You will solve complex problems that are in the process of being defined and understand what contributes to a research project’s success.

9. **Faculty Mentorship** – Bren School faculty truly enjoy teaching and mentoring graduate students. They regularly earn campus-wide awards for their educational innovations, efforts and service.

10. **National Distinctions** – UC Irvine and the Bren School graduate programs are nationally recognized.

**Academic Analytics**
- Ranked 1st in Networked Systems
- Ranked 3rd in Information Sciences

**US News & World Report**
- Rated 14th of public CS graduate programs
- UCI is the 10th best public university
DEGREES AND CONCENTRATIONS @ THE BREN SCHOOL OF ICS

Graduate students may work toward an M.S. or Ph.D. degree, specializing in one of the following research areas:

**Computer Science**
The Computer Science degree is a broad and flexible program which offers students opportunities for graduate study in the full spectrum of intellectual activity in computer science.

**Informatics**
The Informatics concentration focuses on the relationships between people, information and technology. Informatics explores the models, mechanisms and tools necessary to design and develop software-intensive systems and conduct methodological studies of technologies in society to understand their social shaping and consequences.

**Informatics in Biology and Medicine**
Informatics in Biology and Medicine is an interdisciplinary concentration at the interface between computer science, biological sciences and medicine.

**Networked Systems**
The Networked Systems degree provides education and research opportunities to graduate students in the areas of computer networks and telecommunication networks. This program is offered jointly with The Henry Samueli School of Engineering.

**Statistics**
The degree in Statistics focuses on development of statistical methodology and statistical theory and encourages interdisciplinary collaborations between disciplines such as medicine/biology, engineering, the natural sciences and the social sciences. (For more information, visit www.ics.uci.edu/statistics/)

In addition, there are three focused M.S. concentrations in Embedded Systems; Knowledge Discovery in Data; and Arts, Computation, and Engineering. There is also a general Information and Computer Science (ICS) M.S. degree.

* Students interested in studying Informatics should apply to the Information and Computer Science (ICS) degree.

BREN SCHOOL RESEARCH EXPERTISE

» Artificial Intelligence
» Arts Computation Engineering
» Bio-Medical Informatics
» Computational Biology
» Computer Architecture
» Computer Science Education
» Computer Supported Collaborative Work
» Compilers and Operating Systems
» Data Mining
» Databases and Information Management
» Embedded Systems Design
» Experiential Multimedia Computing
» Graphics and Visual Computing
» Human Computer Interaction
» Information Design
» Internet Computing
» Machine Learning and Data Mining
» Mobile Technology
» Networked and Distributed Systems
» Operations Research
» Programming Models and Languages
» Scientific Computing
» Security, Privacy and Cryptography
» Social Informatics
» Software Engineering
» Statistics / Statistical Theory
» Theory of Computing
» Ubiquitous Computing
Innovation
Collaboration
Stimulation

The Donald Bren School of Information and Computer Sciences excels to be a global leader in innovation, research and teaching. Our mission is to create new innovation and research collaborations through the various applications of the computing discipline (from circuits and systems to software engineering and human aspects of computing), thereby stimulating new knowledge. We cultivate a diversity of authentic, cutting-edge collaborations where information technology reshapes education, art and entertainment, emergency response, business and law, the environment and biological systems, health care and medicine. Consistent with our mission, we are committed to providing our undergraduate, graduate and post-doctoral communities a strong foundation by which they can conduct cutting-edge research that will greatly advance quality of life.

BREN SCHOOL AFFILIATED RESEARCH CENTERS

» Ada Byron Research Center
   http://abrc.uci.edu/

» Arts, Computation and Engineering (ACE)
   http://www.ace.uci.edu/

» California Institute for Telecommunications and Information Technology
   http://www.calit2.net/

» Center for Embedded Computer Systems
   http://www.cecs.uci.edu/

» Center for Emergency Response Technologies
   http://www.cert.ics.uci.edu

» Center for Ethnography
   http://www.socsci.uci.edu/~ethnog/

» Center for Machine Learning and Intelligent Systems
   http://cml.ics.uci.edu/

» Center on Organizational Research
   http://www.cor.web.uci.edu/

» Center for Pervasive Communications and Computing
   http://www.cpcc.uci.edu/

» Center for Research on Information Technology and Organizations
   http://www.crito.uci.edu/

» Computational Vision Lab
   http://vision.ics.uci.edu/

» Genetic Epidemiology Research Institute
   http://www.geri.uci.edu/

» Graphics, Visualization and Imaging Technology
   http://cg.calit2.uci.edu/cg/cgv/

» Institute for Genomics and Bioinformatics
   http://www.igb.uci.edu/

» Institute for Mathematical Behavioral Sciences
   http://www.imbs.uci.edu/

» Institute for Software Research
   http://www.isr.uci.edu/

» Institute for Transportation Studies
   http://www.its.uci.edu/

» Laboratory for Ubiquitous Computing and Interaction
   http://luc.ics.uci.edu/

» Networked Systems Center
   http://www.networkedsystems.uci.edu/

» Secure Computing and Networking Center
   http://sconce.ics.uci.edu/

» Secure Systems and Software Laboratory
   http://www.sslab.org/

» Statistical Computing Center
   http://www.ics.uci.edu/statistics/
The Department of Computer Science is internationally recognized as a unique group of faculty, visiting researchers, and students involved in a variety of educational and research programs. Computer Science faculty conduct research in numerous aspects of computer science. This research is performed in an open and interdisciplinary culture: faculty and students frequently are part of multiple research groups, continuously fostering new collaborations, and are at the forefront of addressing core issues in computer science.

The Department of Computer Science offers opportunities for graduate study in almost every principle area within the field of computer science as well as many new interdisciplinary areas. We invite you to explore our areas of research and respective faculty information on our Web pages.

**GRADUATE STUDIES**
The Department of Computer Science currently has 37 faculty members and 190 Ph.D. students. In addition, there are currently 60 students pursuing an M.S. degree in Information and Computer Science. Almost all of our Ph.D. students receive financial support in the form of teaching assistantships or research assistantships during their time at UC Irvine.

**Degrees and Specializations**
The Computer Science Department offers M.S. and Ph.D. degrees in Computer Science. To learn more about the specific requirements these degrees, view the degree requirements Web site ([www.ics.uci.edu/grad/degrees/](http://www.ics.uci.edu/grad/degrees/)).

**Related degrees**
The Department of Computer Science in collaboration with the Department of Electrical Engineering and Computer Science (EECS) in The Henry Samueli School of Engineering, offers M.S. and Ph.D. degrees in Networked Systems.

Within the Bren School, Ph.D. and M.S. degrees are also offered in Information and Computer Science with concentrations in Informatics in Biology and Medicine, and Informatics. Detailed information if available on the Web ([www.ics.uci.edu/grad/degrees/](http://www.ics.uci.edu/grad/degrees/)).
RESEARCH AREAS OF EXCELLENCE

» Computer Architecture
Computer architecture is the conceptual design and fundamental operational structure of a computer system. It is a blueprint and functional description of requirements and design implementations for the various parts of a computer — focusing largely on the way by which the CPU performs internally and accesses addresses in memory.

» Embedded Systems Design
Embedded Systems Design focuses on issues relating to embedded systems, a special-purpose system in which the computer is completely encapsulated by the device it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs pre-defined tasks, usually with very specific requirements.

» Networked and Distributed Systems
Researchers investigate various issues in the design and analysis of high-speed networks for multimedia applications. They are actively involved in research on computer networks and distributed systems, with the goal of designing, analyzing and implementing communication systems that allow high-speed transport of multimedia information between end-users.

» Compilers and Operating Systems
Compilers and Operating Systems concentrates on translating source code to create an executable program and the set of computer programs that manage the hardware and software resources of a computer. At the foundation of all system software, an operating system performs basic tasks such as controlling and allocating memory, prioritizing system requests, controlling input and output devices, facilitating networking, and managing files.

Alumni Profile  |  EINAR MYKELTUN ‘06

Einar Mykletun can trace his passion for algorithms back to childhood when he thought it was “super cool” to be able to send hidden messages back and forth on the computer. Then, while pursuing his bachelor degree, Mykletun took a Computer Algorithms class that introduced him to Yao’s Millionaire Problem.

This classic cryptography problem, where several millionaires wish to find out who is richest, without revealing to each other their net worth, led him to write his senior thesis on modern and quantum cryptography.

In laymen’s terms, Mykletun’s research involves looking into security issues related to vendors providing the service of hosting databases for companies (outsourcing of databases).

“Our main focus is on how to protect the confidentiality of the customers’ data stored at these vendors (who may not be trusted with the data contents) through the use of data encryption, while still allowing the vendors to operate on the data (run queries over it), which, when encrypted, is unintelligible to the vendors.

While at UCI Mykletun served as a Teaching Assistant and an instructor during the ten-week summer session in 2005. He considers both experiences valuable in that they taught him to appreciate all that is necessary for a professor to do when teaching.

Intrigued? Read more about Einar online @ http://www.ics.uci.edu/spotlight

Hometown: Oslo, Norway
B.S. degree from: Macalester College Saint Paul, MN
Now at: Quest Software Aliso Viejo, CA

“If it solves today’s problems, it may not qualify as research.”
» Programming Models and Languages
Sets of software technologies express parallel algorithms and match applications with the underlying parallel systems. Programming models and languages encompasses the areas of applications, programming languages, compilers, libraries, communications systems, and parallel I/O. A programming model is usually judged by its expressibility and simplicity, which are by all meanings conflicting factors. The ultimate goal is to improve productivity of programming.

» Databases and Information Management
Database and Information Management studies both the structure and behavior of computers systems from repositories, interfaces and channels to services and messages.

» Artificial Intelligence and Machine Learning
Research in AI is concerned with producing machines to automate tasks requiring intelligent behavior. Examples include computer vision, bioinformatics, constraint-based problem solving, text understanding, data mining and smart sensor networks.

» Security, Privacy and Cryptography
The development of secure communication protocols is a critical issue in today’s age of pervasive communication. Researchers in this area work on issues that include anonymity and authentication in network security, key agreement and digital signatures.

» Graphics and Visual Computing
Focuses on the field of visual computing, where one utilizes computers both to generate visual images synthetically and to integrate or alter visual and spatial information sampled from the real world. Current and future research areas include multi resolution modeling, surface reconstruction and image based rendering.

» Experiential Multimedia Computing
An important but often ignored fact in information-centric computing environment designs is that humans are very efficient in perceptual analysis and relatively weak in logical analysis; computers today are exactly opposite. By using computers and users synergistically as a system, a very different type of computing environment, experiential environments, can be developed.

» Scientific Computing
Refers to the application of computers to scientific problems, from astrophysics to zoology. The mode of application can be system modelling, data analysis and mining, or visualization. The focus can be on developing new computational techniques, such as parallel algorithms or new data mining ideas, or on the novel application of existing techniques to new scientific problems.

» Theory of Computing
Bren School faculty members have made significant contributions to many topics in this field, including graph algorithms and graph drawing (computing with systems of pairwise interactions between objects such
After completing his Bachelor degree at UCI, Rex Chen saw no reason to leave the friendly and supportive confines of Irvine when he choose to pursue his Ph.D. “I really like the atmosphere at UCI and in the Bren School,” Chen said. “The students and faculty are all very friendly and supportive. Since a Ph.D. takes several years, I thought it was important to choose a place that I would enjoy.”

Chen’s research interest is on peer-to-peer (P2P) and wireless mesh networks. P2P comprises many participating peers that form a network and utilize computing resources from these machines rather than dedicated servers.

“UCI and the Bren School is a dynamic environment with researchers collaborating together and working on many interesting problems in Computer Science,” Chen said. “The Bren School is growing very fast, and is a top research ‘think-tank.’”

In addition to participating in emerging technologies and addressing relevant research problems, Chen sees other intangible benefits to pursuing a Ph.D. “I wanted to gain the experiences and training that one goes through in pursuing a Ph.D.,” Chen said. “I think it enables one to acquire new critical thinking skills and be able to approach and solve problems differently.”

Though graduation is still a few years down the line, Chen has already thought of life after his time at the friendly confines of UCI. “I’d like to work on innovative technologies that have the potential to change our lives for the better,” Chen said. “My passion is to pursue entrepreneurship some day. It takes a team of people sharing common goals and requires courage, dedication, and persistence.”

Intrigued? Read more about Rex online @ http://www.ics.uci.edu/spotlight
Informatics is the interdisciplinary study of the design, application, use and impacts of information technology. It goes beyond technical design, to focus on the relationship between information system design and use in real-world settings.

Informatics covers all areas of the design, use, applications and implications of information and communication technology. Research in informatics leads to new forms of system architecture, new approaches to system design and development, and new means of information system implementation and deployment as well as new models of interaction between technology and social, cultural and organizational settings.

Informatics uses interdisciplinary techniques to analyze the behavior of computing systems and the behavior of end users with systems including laboratory and field evaluations, to develop new software tools and techniques for the development and evaluation of innovative software systems, and to develop new ways to understand computing at the level of individuals, organizations, and society.

Since our research endeavors are interdisciplinary, our research typically draws on multiple techniques. Examples include developing novel tools for architectural specification and studying how they affect the social organization of software development projects in real organizations, using experimental techniques to create new frameworks for preserving privacy in mobile networked devices, or creating theoretical models of interaction with embedded devices that draw not just on studies of technological opportunities but also on social structures and organizational constraints.

Informatics research studies real-world use of information technology within California and beyond, and the understandings we gain through these studies enable the development of technologies which are themselves distributed and shared with colleagues across the world.

**RESEARCH AREAS OF EXCELLENCE**

» **Social Informatics**

Social informatics is part of a larger body of socio-economic research that examines the ways in which the technological artifact and human social context mutually constitute the information and communications technology ensemble. UCI is an internationally recognized center for research on the social and managerial dimensions of computerization, computer-supported cooperative work, and human-computer interaction.

» **Ubiquitous Computing**

Ubiquitous computing builds upon and unites virtually all of the current research strengths in the Bren School. Researchers are addressing issues such as context-aware computing, whereby mobile computing responds to one’s current context.

» **Computer Supported Collaborative Work**

Computer Supported Collaborative Work researches and innovates collaborative technologies. The discipline studies the hardware,
software and processes designed to aid in group related tasks such as basic communication, information sharing, decision making, scheduling, and design.

» Software Engineering
Software research is aimed at creating new software technology and solutions, furthering the information revolution. The central goal of this research is improvement in software development, evolution, deployment, quality, understandability and cost-effectiveness.

» Programming Models and Languages
Sets of software technologies express parallel algorithms and match applications with the underlying parallel systems. Programming models and languages encloses the areas of applications, programming languages, compilers, libraries, communications systems, and parallel I/O. The ultimate goal is to improve productivity of programming.

» Computer Science Education, Informatics Curriculum
Computer Science Education concentrates on curricular development and evaluation of student software. The program at the Bren School focuses on finding new delivery methods for materials being taught instead of the traditional research in software engineering education that tends to focus on the materials to be taught or the kinds of class projects to be used in training students.

» Human Computer Interaction
Human Computer Interaction explores the interaction between people (users) and computers. It is an interdisciplinary subject, relating computer science with many other fields of study and research. Interaction between users and computers occurs at the user interface, which includes both software and hardware, for example, general-purpose computer peripherals and large-scale mechanical systems such as aircraft and power plants.

» Information Design
Information Design is the art and science of preparing information so that human beings can use it with efficiency and effectiveness. More specifically, it focuses on visual displays of data, information architecture, the design of information systems, databases and data structures.

Student Profile  |  LILLY IRANI

While an undergraduate at Stanford, Lilly Irani did a thesis that examined why women left computer science at Stanford. The experience was challenging but very rewarding and stuck with her after graduation, while she spent four years as a user experience designer at Google.

The Bren School’s reputation as a top place for Human Computer Interaction research and the interdisciplinary nature of the program drew Irani to UCI. “I saw an opportunity to pursue my own research agendas here in concert with professors, rather than just working on pieces of professor’s existing projects,” Irani said.

Irani’s research focuses on studying how the experiences of gender and cultural background, such as national background, influence the way technologies get designed. Irani works in the Bren School’s Laboratory for Ubiquitous Computing and Interaction (LUCI) that address a range of research problems that arise from the ubiquitous computing vision.

“I would recommend the Informatics program to other Ph.D. students who are interested in learning from the many top notch professors in the department in an environment that offers low pressure with high expectations, matched with mentorship and a real chance to pursue your own research interests,” Irani said.

“The department also offers a unique opportunity to develop a deep understanding of social analysis while still being able to build, design, and explore those analytics through making.”

Intrigued? Read more about Lilly online @ http://www.ics.uci.edu/spotlight
Picture this: You’re working with collaborators in Singapore while sitting in a lab in California. But as you experience this virtual workspace, you may as well have traveled the dozen hours to Asia because you are in fact sitting next to your collaborators and taking a similar approach and view at objects and visuals present in the meeting.

By creating a similar situation model for the other environments, a joint situation model can be prepared that can help in presenting appropriate information in both environments at adequate locations.

The environment you are in is intelligent and knows where the participants in the meeting sit and what you are doing.

According to Jain, this innovative communication model will make interactions among people in different locations much more natural because unlike current device-to-device models, “people will be free and natural in their environment and will be able to interact with remote environments as if they are at the same place.”

And this environmental data is picked up by sensors and presented to participants in the most convenient perspective for each person.

The applications of E2E technologies are diverse. There are business applications in which two international office can have truly one on one meetings, to bringing an interactive museum exhibit into your own home.

Is this science fiction or computer science?

Donald Bren Professor of Information and Computer Sciences Ramesh Jain and his research group are taking an event-centric approach for media management. Communication has typically been a person-to-person (P2P) interaction. Computers, cell phones and other technology have transitioned communication to occur in a device-to-device (D2D) method. Jain is looking at taking this interaction back to a P2P approach using technology to bring people closer together in an ever-connected world.

According to Jain, this innovative communication model will make interactions among people in different locations much more natural because unlike current device-to-device models, “people will be free and natural in their environment and will be able to interact with remote environments as if they are at the same place.”

This new approach, environment to environment (E2E) connectivity, can be achieved by placing multiple heterogeneous sensors (cameras, microphones, infrared, etc.) in an environment to detect appropriate objects and events continuously and creating a dynamic situation model of the environment.

According to Jain, this innovative communication model will make interactions among people in different locations much more natural because unlike current device-to-device models, “people will be free and natural in their environment and will be able to interact with remote environments as if they are at the same place.”

This situation model can be used to provide adequate symbolic as well as sensory (experiential) information to users in other environments.

The first prototype E2E communications are now taking place between UC Irvine and the National University of Singapore.

Professor Jain hopes to take what has become such a media-centric world into an event-centric society. “People should not be concerned about the functionality and focus of communication through a single medium, such as teleconferencing. Events are a natural approach for organizing and managing human experience.”
Communication plays a crucial role in our lives – from the daily interactions we have with people to the molecular connections of our cells that keep us alive.

As new technology emerges in medicine and computing, it has become ever more important to understand and make sure that genetically engineered cells, or nanomachines, are able to communicate.

This engineered biological communication is the budding field of molecular communication.

Computer science professor Tatsuya Suda and his students are exploring the possibility of molecular communication as a solution for sharing information between biological nanomachines such as motor proteins, ATPases and bacterium.

Suda’s research explores how cells compute information and share them with other biological (cells) and biologically derived nanomachines, or molecular sensors.

Nanomachines perform computation and sense their environments. Molecular communication provides a mechanism for these nanomachines to communicate over a short distance using molecules as a communication carrier.

Suda and his research team are focusing on understanding these biological nanomachines and on artificially creating counterparts of biological nanomachines.

“Communication provides a means by which nanomachines perform coordinated tasks that cannot be accomplished by a single nanomachine,” says Suda. “For example, medical nanomachines with communication capabilities may perform coordinated monitoring of human health.”

So what is the ultimate goal of this molecular communications research?

Suda hopes to design and engineer molecular-scale information processing and communication systems by understanding cellular behaviors including cell-to-cell communications.

In particular, his research group hopes to control calcium signaling which is universally used to modulate cellular behaviors, such as growth and death, in many types of cells.
Voice over IP (VOIP) phone technology, like Vonage, which utilizes the Internet’s higher bandwidth and lower overhead, provide a cost efficient alternative to traditional copper-based phone networks. But unlike traditional phone networks, an unsecured VOIP phone can be a juicy target for hackers who can easily cause havoc with your phone service.

A VOIP phone is like a computer, which means it is susceptible to denial of service and other attacks that have long been the bane of networked computers.

That is what associate professor of computer science, Ian Harris, and members of his Systems Test lab are trying to prevent.

“Denial of service is probably the most prevalent threat today to VOIP networks,” Harris said. “A VOIP system has so many moving parts and has very strict network requirements. There are a lot of evil things you can do.”

Harris and his research group are working on ways to test the software security of phones. One way is by utilizing the Session Initiation Protocol (SIP) to reveal security weakness in VOIP phones.

SIP establishes calls between phones and acts as a traffic cop, sending data packets across the Internet via proxy servers to their correct locations.

By utilizing random test generation to selectively inject errors in the SIP message sequence, Harris hopes to trigger a wide range of security vulnerabilities.

These vulnerabilities include man-in-the-middle attacks, where a program is inserted between the SIP phone and SIP proxy, allowing the manipulation of audio. For example, calls can be dropped or rerouted or background noise can be added.

“Over the next couple of years, there will be an increase in attacks,” Harris said. “The trick is to stay ahead of them and develop methods of preventing them.”

Alumni Profile  
ANITA SARMA ‘07

After college, Anita Sarma took a job as a software engineer learning to code and design. When this became repetitive, she looked toward research and exploring new technology. Sarma then got a M.S. in Computer Science at UCI and then entered the Ph.D program.

The wide variety of faculty and the reputation of UCI as one of the best centers for software engineering is what lured her to the Bren School. She enjoyed the benefits of a fellowship and admits that the sunny California weather was a big plus.

Sarma’s research aims to prevent breakdowns in the coordination of software development projects. Towards this goal, Sarma has developed a novel approach to coordination, whereby developers are warned of relevant parallel activities and changes that will lead to potential development conflicts.

She has designed and created three software applications that follow this approach and are designed for different domains and different phases of the software life cycle.

Intrigued? Read more about Anita online @ http://www.ics.uci.edu/spotlight
Medical and scientific researchers had a dilemma. Because most computer screens offer only about one million pixels, they couldn’t view large digital picture files without scrolling up and down. They couldn’t work on multiple documents without wasting time switching between screens.

Enormous data sets compounded the predicament. Researchers had to zoom in and out to locate specific data, while simultaneously attempting to view the whole picture.

The problem isn’t confined to researchers. The military requires realistic simulators for training personnel. Architects want to visualize their work in high resolution before breaking ground for a building. And entertainment companies want to build virtual environments in theme parks and hotels. All require lifelike, high-resolution visualization options.

Professor Aditi Majumder had an idea. She constructed a multi-projector display in the Calit2 Viz Lab that utilizes camera-based calibration techniques and custom algorithms to automatically align images and eliminate color variations.

Her display utilizes nine projectors, each of which connects wirelessly to a computer and a digital camera with computer interface.

The display is completely automated. Instead of an individual adjusting each projector to assure proper alignment, the camera and computer work together to automatically adjust the nine images.

The camera “sees” the display and then defines the misalignment and color mismatch mathematically. A sophisticated algorithm is used to apply a digital compensation method that modifies the image going to each projector.

The result is a 3,000 x 2,000-pixel, perfectly aligned, seamless image. It is also color calibrated, without “hot spots,” fading and color variations inherent in most multi-projector displays.

Majumder’s innovative color-correction solution is based on human perception.

The optimization method factors in the human eye’s inability to distinguish whether something is truly uniform. The result: a perceptually seamless display that does not sacrifice brightness or contrast.

“We are probably the only place in the U.S. right now that makes use of human perception to calibrate color,” says Majumder.

Now, Majumder and her students are developing a “plug-and-play” version.

Technology makes these displays portable for the first time. They can be easily deployed in temporary situations such as emergency incident sites or war zones.

Majumder predicts that these machines will change the very definition of collaboration.
In a study of the work practices of analysts, software developers and managers, graduate student Victor M. González and his advisor, Informatics professor Gloria Mark, has come to the rather stunning revelation that people average a mere three minutes on a single task.

Tool use in completing these tasks, on average, is somewhat more than two minutes. The longest duration of tool use is with PCs, yet this averages only slightly more than three minutes at any one time.

These are the key results from a seven-month ethnographic study in which González and Mark observed work practices and interviewed key personnel at a representative information technology organization.

This landmark study demonstrates the far-reaching extent of the frequency of interruptions on the fragmentation of work.

People are just as likely to interrupt themselves as to be interrupted by others. An interesting area for future research is to understand the reasons that lead information workers such as these to interrupt themselves so frequently.

Current information technology is designed to support individual events such as word processing or e-mail use rather than to provide mechanisms to integrate the multiple information objects required by some working spheres.

The research shows that design of information technology needs to consider how information workers switch constantly among working spheres.

The implications are tremendous: virtually all of today’s tools are centered around a single task and context, and do not facilitate easy switching.

González and Mark argue that tools should be centered on working spheres, individual’s conceptualizations of their basic units of work, and must facilitate rapidly and seamlessly switching among tasks within such spheres.
Professor Eric Mjolsness and his colleagues at Caltech are researching how genetic makeup and the environment interact to shape intricate developmental processes that lead to functional tissues, organs and organisms from undifferentiated plant cells.

Biologists have tackled this question since they started wondering about the development of multicellular organisms. Researchers have traditionally used microscopy, mutants and other methods to understand molecular and cellular bases for development. More recently, genomics has become another tool added to the developmental biologists’ arsenal.

Advances in biological knowledge, imaging instrumentation, applied biomathematics, and computing, has made it possible to create and apply computational modeling to integrate multidisciplinary approaches and different types of biological data in studying development. Mjolsness plans to develop a mathematical and computational infrastructure to characterize the pathways and interactions between complex molecules and the cellular environment.

To capture the development, the team will use green fluorescent proteins to mark specific cell types in the meristem (the inner plant tissue where regulated cell division, pattern formation and differentiation give rise to plant parts like leaves and flowers) of the arabidopsis thaliana, an excellent living laboratory due to its quick maturation period.

The marked proteins will allow the group to image the cell’s lineages through meristem development and differentiation leading to specific arrangement of leaves and reproductive growth.

Automation of image acquisition and analysis will help them generate and visualize a vast amount of data, which will be used to model cells and their patterns in the developing meristem and simulate developmental processes under different conditions. These simulations will result in predictions that will be tested experimentally using mutants, altered hormone gradients, and other manipulations of plant cells.

Workers of today are expected to be competent in negotiating through a variety of communication technologies like e-mail, instant messaging and mobile phones. Studying how people combine certain media types, and how they manage their interactions can reveal what strategies and policies organizations can employ to alleviate “communication” overload as well as inform the design of systems to manage communications.

Over the past couple years, Norman Makoto Su has been shadowing employees during their work day, using his watch to notate the start and end of events, like interactions and computer usage to answer this question. His recent research has investigated “communication chains”, interactions that happen one after another.

About his experience at the Bren School, Su says, “The school offers an unparalleled program in multidisciplinary studies. Many schools emphasize the technical aspects of computer science, but UCI has a great tradition in looking at the social side of computing.”

Su was always interested in pursuing a Ph.D., but after participating in the UC Exchange Abroad Program and doing research at Osaka University in Japan was his heart really set on it. “A Ph.D. is also simply exciting work – you always feel like you are pushing the envelope.”

Intrigued? Read more about Norman online @ http://www.ics.uci.edu/spotlight
Informatics professor David Redmiles and Ph.D. student Cleidson de Souza are studying the interplay between software development practices and their effects on collaboration. Specifically, they are investigating the consequences of the use of application programming interfaces (API’s), a widely adopted technique to structure programs in a modular fashion.

The investigation was performed through a qualitative study on how practitioners use API’s in their daily work. The study observed that API’s were successful in supporting collaboration by serving as contracts among stakeholders, reifying organizational boundaries, and as a result minimizing dependencies among software developers. In effect, they help in limiting the amount of interference among multiple developers working on the same project.

Surprisingly, the same separation also hindered other forms of collaboration, particularly among members of different teams. Basically, by reinforcing the organizational boundaries, API’s reinforce team membership, consequently making communication and coordination more difficult. These results indicate directions for further improvement of collaborative software development practices and tools, such as tools that explicitly understand the role of API’s and bridge different teams “hiding” behind them.

Computer science professor Wayne Hayes is interested in the numerical reliability of simulations of physical systems. An example is the image at left, which is from a computer simulation of a collision between two galaxies. (Image courtesy of John Dubinski of the Canadian Institute for Theoretical Astrophysics.)

Since numerical simulations of physical systems form a crucial link between theory and observation, it is important to verify that the numerical aspects of such simulations are accurate enough to properly represent a theory that is being tested. Recently he demonstrated that the above galaxy simulation is more than 95 percent accurate, but that some other galaxy simulations are significantly less accurate. His technique can be used to test the reliability of any simulation of a large number of particles, such as a molecular system.

Professor Hayes also performs billion-year simulations of the solar system at the unprecedented accuracy of 30 digits of precision, in order to test the reliability of less accurate simulations, and to test the hypothesis that our solar system is chaotic.

Check out Professor Hayes’ video on Galaxy Simulations on YouTube at: http://www.youtube.com/user/UCIBrenICS/.
Professor of Informatics Crista Lopes and her colleagues are developing a web-based watershed information and management tool called the California Sustainable Wetland Information Manager, CalSWIM.

CalSWIM is an academic-government initiative to develop an intelligent database for accessing and interacting with environmental monitoring data. An interdisciplinary team of researchers conduct field work and modeling studies collectively aimed at creating and implementing this web-based expert system and integrated information manager.

CalSWIM is designed both as a public forum for exploring local watersheds and as a web location to help coastal managers make cost-effective and scientifically justifiable decisions regarding the monitoring, management, and alteration of coastal urban wetlands and their associated watersheds.

CalSWIM is an ongoing project with the visionary goal of developing a protocol and method that can be applied to all watersheds in California, facilitating coordinated, integrated, and informed management decisions for those in the water resources profession.

Lopes is the IT technical leader of CalSWIM, with which she is conducting advanced research pertaining to software development. With CalSWIM she is developing a novel wiki-based web development method that enables environmental experts, who are not software experts, to actively edit and program CalSWIM. This method will be crucial in scaling up CalSWIM to its visionary goal.

The development and implementation of CalSWIM is carried out in close consultation with government and private sector personnel directly responsible for the management and restoration of coastal urban wetlands, and is built on monitoring and modeling efforts carried out by the Orange County Health Care Agency, Coast Keepers, the Army Corps of Engineers, and the Southern California Coastal Water Research Project.
As technology only becomes more ubiquitous, and society becomes increasingly reliant on ubiquitous devices, researchers are facing challenges in how to make the everyday functionality of these systems work within constraints.

The constraints come from all aspects of production and usability, including budgets and financial resources, power usage and safety concerns.

Chancellor’s Professor Nikil Dutt is taking a look at an end-to-end approach in designing efficient embedded systems in his lab, Architectures and Compilers for Embedded Systems (ACES).

Dutt and his research group look into how embedded systems can improve daily. Their research proposes novel techniques to reduce the cost and development time of communication architectures for high performance electronic systems used in the next generation electronic devices such as mobile phones, video game consoles and high-speed networking equipment.

Take a place like Google for example, who have large numbers of machines in their data centers. How do you keep them from overheating with the constraints of the space that they are in?

Another real-world embedded system problem is energy use in personal devices such as cell phones, PDAs and handheld game consoles. These gadgets all run on batteries and packaging powerful long-lasting batteries in increasingly smaller accessories that run more demanding problems is a huge challenge.

A recent Best Paper entitled Backlight Optimization Scheme for Video Playback on Mobile Devices, examined ways to create substantial energy savings by dynamically adapting backlight intensity levels on low power portable devices like the Compaq iPAQ.

Dutt is intrigued by the challenges of embedded systems, “It’s easy to get functions of a system working. How you make it work within constraints is what we research.”
Informatics Professor André van der Hoek and his research group have developed Palantír, a novel configuration management (CM) workspace awareness tool.

Configuration management systems enable parallel development, that is, tens or hundreds of developers all implementing parts of a single software system.

CM systems use the copy-modify-merge paradigm to coordinate changes: each developer works in a private workspace until their changes are complete, upon which they synchronize those changes with a central repository.

A problem in this kind of approach is conflict: because of the isolation of each workspace, developers often end up making changes that (directly or indirectly) conflict with each other and break the software under development. Resolving these conflicts is typically a time consuming and difficult task that significantly reduces overall productivity.

Palantír addresses this problem by reducing both the number and severity of conflicts through early detection. Palantír informs a developer of which other developers are changing which other artifacts in parallel.

Developers, thus, do not have to wait until their changes have been completed to know that a conflict may exist; the awareness raised by Palantír allows them to proactively self-coordinate and avoid conflicts as they arise.

Palantír incorporates a series of different visualizations to illustrate the presence of conflicts and also has been integrated with the Eclipse integrated development environment. A fully-functioning prototype is currently available for use.
The Department of Statistics was founded in 2002 with an emphasis on research in statistical theory and interdisciplinary collaborations. Statistics — concerned with developing and studying methods for collecting, analyzing, interpreting and presenting empirical data — is important for addressing questions in public policy, medicine, industry and virtually every branch of science.

Interest in statistical methods has increased dramatically with the abundance of large databases in fields like computer science (Internet and Web traffic), business and marketing (transaction records), and biology (the human genome and related data). It is the substantial questions in the various areas of application that drive the development of new statistical methods and motivate the mathematical study of the methods’ properties.

Research areas in Statistics at the Bren School of ICS include Bayesian Methodology, Biostatistics, Statistical Computing and Astrostatistics.

For more information on the Statistics graduate degree program, visit: www.ics.uci.edu/statistics/.

**CHARACTERIZING VARIATION IN MEDICAL IMAGING EXPERIMENTS**

Statistics professor Hal Stern, along with Computer Science professor Padhraic Smyth and graduate students, are working to characterize the variation in medical imaging at different sites and on different subjects. A National Institutes of Health-funded Biomedical Informatics Research Network (BIRN) research project is developing methods to facilitate inter-university collaborations in mental health research.

Specifically, 11 sites across the United States are attempting to share functional MR images. As an initial step a set of five volunteers visited each of the 11 sites and performed the same cognitive, sensorimotor, breathholding, and rest tasks on each of two days. This data provides an opportunity to characterize the relative contribution to estimated brain activation of run-to-run variation within a visit, visit-to-visit variation for the same person at the same site, site-to-site variation and subject-to-subject variation.

The research focuses on developing a number of different ways of characterizing the variation, including the possibility of characterizing variation in extent and location of brain activation to a particular task. It has been striking to see the amount of variation in this influential imaging technique even when the same person is performing the same task on the same machine on the same day.

Professors Falko Kuester, Hal Stern, Biff Bunney, and Steven Potkin (left to right), are working to characterize the variation in medical imaging at different sites and on different subjects.
ACE is an interdisciplinary graduate program in Arts, Computation and Engineering at UC Irvine. ACE brings together the Bren School with the Claire Trevor School of the Arts and The Henry Samueli School of Engineering.

ACE addresses emerging practices and career paths that combine skills and sensibilities of technical and scientific disciplines with arts and humanities. ACE exists at the intersection of Arts, Humanities, Social Sciences, Computer Sciences, Engineering and other disciplines. ACE is rigorously interdisciplinary. The ACE program is oriented towards informed production. ACE students make things that work, and they understand the technical, historical and socio-cultural locations of their work. ACE favors originators of novel techno-cultural formations, makers of machines, responsive environments, socio-politically situated action and non-standard technological systems.

Theoretical and historical perspectives from the Arts, Cultural Studies, Critical Theory, Science and Technology Studies, Human-Computer Interaction, Artificial Intelligence, Cognitive Science, and a variety of other sources are combined to provide students an intellectual and practical foundation that combines analytic and practical perspectives germane to their practice.

The sensibilities of sculpture, installation and performance art, graphics, improvisatory dance, drama and music are central in the production of new cultural forms. Real time computation, robotics and motion control, microcontroller and sensor technologies, immersive media technologies, computer graphics, networking/telematics, gaming, embedded and wireless technologies are key technical areas.

The ACE program moves beyond works whose final form is non-interactive linear image streams (such as traditional film and video) and sedentary desktop interaction (such as conventional web design). Instead, the central focus of our program is computational techniques involving embodied, emergent and generative real-time performance, including immersive installations, artificial life, autonomous agents, and social simulation.

For more information on ACE, visit: www.ace.uci.edu/.
The University of California, Irvine guarantees an offer of on-campus housing to every newly-admitted, full-time Ph.D. student. Ph.D. students will be guaranteed housing for a term of one year less than normal time to degree for the academic program.

Three different types of housing options are available:

**Palo Verde** is a graduate and family community with 652 unfurnished apartments in three- and four-story buildings. Each apartment comes with a stove, refrigerator, window and floor coverings. All apartments have ethernet connection and cable TV connections.

**Verano Place** is a graduate and family apartment community located on the east campus, housing roughly 1,250 students in 862 unfurnished apartments. Verano serves graduate students and undergraduates who are 25 or older, and students with families.

**Vista del Campo** and **Vista del Campo Norte** are privately owned and managed apartment communities located on the UC Irvine campus, offering furnished apartments to single students who are sophomores, juniors, seniors, or graduate students.

Nearby off campus housing is also readily available.

For further information, prospective students should visit [http://www.housing.uci.edu](http://www.housing.uci.edu).

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**FINANCIAL AID**

Paying for graduate education is usually a major concern for most students considering an advanced degree. What most prospective graduate students usually do not realize, however, is that the out-of-pocket expenses necessary to finance a graduate education are typically much less than the out-of-pocket expenses associated with an undergraduate education.

Unlike your undergraduate degree, there are more extensive financial resources available to you to help you earn a graduate degree. For example, you may be paid to be a teaching assistant to help teach undergraduate courses. This responsibility, while central to your graduate education and experience, is a position which pays you both a salary and, in some cases, pays most of your registration/educational fees.

Graduate fees for the academic year 2008-09 are estimated at $9669.50 for California residents. Out-of-state and international students should expect to pay an additional $14,694 per year. All graduate students are assessed $756 per quarter for health insurance. All fees are subject to change.

For more information on graduate funding, visit the Office of Graduate Studies’ Prospective Students site: [http://www.rgs.uci.edu/grad/prospective/](http://www.rgs.uci.edu/grad/prospective/).
Welcome to the University of California, Irvine’s Donald Bren School of Information and Computer Sciences (ICS).

As a graduate student at the Bren School of ICS, you will be part of the outstanding research establishment that defines our campus.

The Bren School is the only computing-focused school in the University of California and one of only a handful of such institutions in the nation. As a school, we’re more nimble and able to adapt to our rapidly changing field, with which comes our reputation for excellence. An education here provides you with a blend of science, scholarship, research skills, and practical experience, and prepares you to achieve your dreams.

With 71 faculty members spanning three departments – Computer Science, Informatics and Statistics – a new 90,000 sq. ft. building and a transformational naming gift from philanthropist Donald Bren, this is a very exciting time to be a part of the Bren School.

At the Bren School, you’ll be joining our more than 250 Ph.D. and 100 Masters students studying virtually every principal area within the fields of computer science, informatics and statistics as well as many new interdisciplinary areas.

Virtually all of our Ph.D. students receive financial aid in the form of teaching assistantships or research assistantships during their time at UC Irvine. Our graduates frequently receive job offers from many top academic institutions and research labs.

These pages highlight only a fraction of the innovation and collaboration taking place at the Bren School. I encourage you to visit our Web site (www.ics.uci.edu) and view our multimedia highlights, as well as faculty Web pages to learn more.

Discover for yourself how the Bren School of ICS may be the place for you!

Debra J. Richardson,  
Ted and Janice Smith Family Dean
STUDENT BODY

260 Ph.D. and 100 M.S. graduate students are currently enrolled full time. Of the current students, there are 86 women and 198 international students. Average GRE scores for fall 2007 accepted students are 570 (verbal), 780 (quantitative), and 718 (analytical).

Faculty members are interested in students with experience in academic or industrial research and who share research interests with faculty.

Recent graduates have pursued both academic and professional careers.

ALUMNI

Recent Ph.D. graduates have taken academic or research positions at institutions including the University of California; University of Washington; University of Pennsylvania; and Cambridge University.

Many entrepreneurial alumni have made the transition to the private sector by founding their own companies or working in such companies as Apple, Google, HP, Hughes, IBM, Intel, Google, Qualcomm, and Yahoo or in industries as varied as medicine, law, government, startups, entertainment and media.

ICS alumni include the architect of Hypertext Transfer Protocol (HTTP/1.1), author of the first implementation of Simple Mail Transfer Protocol (SMTP) and creator of the Domain Name System (DNS), and father of Computer-Aided Drafting and Manufacturing (CAD-CAM).

LOCATION

UCI is a beautiful campus situated just 40 miles south of downtown Los Angeles, less than five miles from the Pacific Ocean, just two hours from deserts and mountains, and amid rapidly growing residential communities and a dynamic multinational complex that affords many research and employment opportunities.

Several Orange County cities are rated among the best large cities in the country based on low crime, health, education, economy, jobs, lifestyle and child care. Irvine is listed fifth in the small cities category based on these same indicators.
RESEARCH FACILITIES

The University of California is the state’s primary research institution and the Bren School of ICS is the only independent computer science school on any UC campus.

Faculty and student-driven research in ICS is supported through a variety of grants, gifts and contracts from public and private institutions such as the National Science Foundation, the National Institutes of Health, NASA, various U.S. defense agencies, the U.S. Department of Education, the State of California, and numerous companies, including Boeing, Conexant, HP, IBM, Intel, Microsoft, Raytheon, Sun, Toshiba and Unisys.

Since 2000, ICS has received more than $66 million in extramural funding, in addition to a recent $20 million endowment.

In support of the Bren School’s educational and research missions, the school offers several specialized labs that range from computational biology, ubiquitous computing, homeland security, visualization, graphics, and multimedia research initiatives.

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The University of California, Irvine (UCI) is one of ten campuses in the University of California system. UCI is located in coastal Southern California, approximately 40 miles south of Los Angeles and 80 miles north of San Diego. Situated in dynamic Orange County, the main campus in Irvine and UC Irvine Medical Center in the nearby city of Orange are reachable from several major airports, the closest being Orange County/ John Wayne Airport (SNA), and by major freeways. For additional maps and driving directions, visit www.uci.edu/campusmaps.