configurations

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A Newsletter of the Department of Computer Science and Engineering at the University of Notre Dame

in this issue

CSE Class of 2003 Graduates

The Class of 2003 graduated May 18, with a department ceremony taking place in the morning honoring the graduates and their parents. Fifty-eight seniors took part in the ceremony, 35 in compter science and 23 in computer engineering. The Class of 2003 was one of the largest the CSE department has graduated.

Several students earned special recognition: **Charles Giefer** received the Outstanding Computer Engineering Senior Award, whereas **Daniel Brunner** and **Joseph Lammersfeld** received the Outstanding Computer Science Senior Award. Lammersfeld, **Chris Boehnen,** and **Tony Schorer** will enter our Ph.D. program in the fall.

The students selected Professor Ramzi Bualuan to speak at the ceremony. Professor Lambert Schaelicke received the annual outstanding faculty award.

In keeping with a departmental tradition, the ceremony was planned and organized by students. This year seniors **Christine Bryant** and **Sarah Dreznes** took charge of running the graduation ceremony. Our thanks go to Christine and Sarah for a job well done.

We hope to see you all back at Notre Dame many times in the future. We also hope to hear from you, and all of our alumni, about the important events in your lives.

— Ramzi Bualuan, director of undergraduate studies, and Kevin Bowyer, the Schubmehl-Prein Chair of Computer Science and Engineering

Meyer Visits Notre Dame

Professor Bertrand Meyer, who holds the chair of Software Engineering at ETH Zurich, visited Notre Dame from December 4 through December 7, 2002. Professor Meyer is the author of the seminal book "Object-Oriented Software Construction," and the inventor of the programming language Eiffel. He is a frequent keynote speaker at the top software engineering conferences in the world and distinguished lecturer in outstanding computer science departments.

During his visit, Meyer met with several faculty members and gave four lectures. On Thursday, he gave a master lecture for the students of CSE 331: Data Structures, taught by his local host, Assistant Professor **Jesus A. Izaguirre.**

His main lecture was entitled "From Design by Contract to Trusted Components: Does Anyone Care about Software Quality?" He argued that in spite of widespread dissatisfaction about software non-quality and its visible effects such as attacks on security, the software industry has not put quality at the center of its concerns. He presented the notion of "design by contract" as a way of building reliable software.

On Friday Meyer met with faculty and graduate students to discuss teaching software engineering through the inverted curriculum. He also spoke of the new curriculum at the computer science department at ETH Zurich. Students are using Eiffel and robust libraries to learn software construction through a "progressive opening of black boxes," where they can quickly produce working applications and then start understanding the design and implementation that makes this possible.

Finally, he presented a session on techniques for proving program correctness at the class level, even in the presence of pointers. This session was attended by faculty and students from the University of Chicago and other neighboring institutions. His presentations were exciting and may well open avenues for further exchange with one of the luminaries in our field.

Kogge Gives Keynotes at Two Conferences

Peter M. Kogge, the Ted H. McCourtney Professor of Computer Science and Engineering, gave a keynote presentation at the IEEE Microsystems Education Conference in Anaheim, Calif., in June 2003. The title of his talk was "The Nano Revolution and Its Effects on Micro/Nano Systems Education." The talk began with a a brief review nano technology in general — what it means, the current prime research directions, and how it compares to the silicon roadmap. During the presentation Kogge emphasized that designing with silicon can, and should, interact with designing in these new technologies. This latter point is especially relevant to any discussion on the future of microsystem education, mainly because of the significant component of managing design complexity. The talk also outlined some proposals for a transitional microsystems design curriculum to help prepare students for dealing with nano technologies in the future, especially when the exact details of the technologies are not yet available.

Kogge also gave a keynote speech at the 9th High Performance Computer Architecture Conference in Anaheim, Calif., in February 2003. This talk was titled "The State of State." Key to this discussion, says Kogge, was a focus on the "memory wall." "We are all aware of the 'memory wall' and the deleterious effects that bandwidth and latency limitations have on performance. We also watch with some degree of amazement at the relentless march of Moore's Law as ever larger numbers of transistors are used in increasingly clever architectural and microarchitectural techniques to attempt to reduce the effects of the wall. What has not risen to the same level of consciousness, however, are the effects that all of this has on the size of 'program state' and our ability to manipulate it, and move it, to avoid the wall. Instead, the Law of Unintended Consequences has left us with heavier and heavier state, which in turn condemns them to continued existence in the bowels of bigger and bigger microprocessor chips, and farther and farther away from the data they seek in memory." His talk urged fellow computer architects to reconsider what they have been doing and ask if there are alternatives that have been overlooked. It outlined the explosive growth of state over the last 30 years. The main points of expansion were correlated with architectural and microarchitectural "advances." The talk also walked through observations gained from exploring design opportunities in emerging technologies and asked about alternative execution models, particularly models premised on light-weight states, and what they might do to increase performance and reduce complexity.

Marian Kennedy Fischer Hall

Schaelicke

Freeland

Team Led by Schaelicke and Freeland Develops High-performance Network Intrusion Detection System

Over the past few years, the computerization of our society has brought security to the forefront of technical challenges. Potential security threats range from annoying e-mail worms to targeted access to confidential information. Network Intrusion Detection Systems (NIDS) complement firewalls by detecting security breaches while they are happening and can help fine-tune other security measures. Traditionally, NIDS are employed at the edge of an organization's intranet where they receive a copy of every incoming and outgoing network packet.

Today, NIDS face a serious challenge on high-speed networks, where the amount of information flowing through the network may exceed the processing capabilities of the intrusion detection sensors. A Gigabit-Ethernet link can transfer data at up to 125 Mbytes per second and can generate over a million interrupts per second at the receiving host. Most general-purpose computers are not able to handle this load and are forced to drop packets. Unlike the hosts participating in network conversations, the NIDS is only eavesdropping and cannot use flow control mechanisms to limit the amount of data received. Significant packet loss by the NIDS increases the likelihood that an attack could remain undetected, rendering the NIDS ineffective.

The Scalable Appliance-based Network Intrusion Detection System (SPANIDS) project under the direction of Assistant Professor **Lambert Schaelicke** and **Curt Freeland,** associate professional specialist, is developing a parallel platform for high-speed network intrusion detection. Based on the idea of distributing high-speed network traffic across a number of general-purpose NIDS sensors, SPANIDS combines the flexibility of software-based intrusion detection with the performance of parallel processing. The long-term goal of this National Science Foundation sponsored project is to develop a working prototype system that can process traffic on a saturated Gigabit-Ethernet link. The system will consist of a hardware-based load-balancing stage and a number of rack-mounted Intel-based servers running Linux. The critical component of this approach is the method by which packets are distributed to the sensor systems. It is not sufficient to apply a simple round-robin load-balancing scheme, since that would spread packets from one network conversation over many different nodes and would render most analysis useless. At the same time, the load-balancing scheme must minimize hot spots to avoid overloading individual sensors.

The SPANIDS team with graduate students **Tom Slabach** and **Kyle Wheeler** is currently investigating a number of heuristics that provide good load balancing, while not negatively affecting the effectiveness of individual sensors. Undergraduate students **Divish Ranjan** and **Ahmad Zakaria** are beginning work on the FPGA-based packet distribution stage. **Matt Geiger,** also an undergraduate, is investigating the design of a high-performance database system to gather and process alerts. During the summer of 2003, **Diana Lawrence** is visiting from St. Edwards University in Austin, Texas, under the McNair Scholars Program to perform a qualitative and quantitative comparison of different open-source IDS software packages.

The results of an analysis of NIDS performance on various systems will be published in the Sixth International Symposium on Recent Advances in Intrusion Detection (RAID) in September. A first implementation of the load-balancing stage is expected by the beginning of 2004, at which point different heuristics can be tested on live network data. Upon completion, the SPANIDS project will provide techniques for effective NIDS-specific load-balancing that makes existing NIDS approaches applicable to high-speed networks. In addition, the project provides unique and exciting research experiences to graduate and undergraduate students alike.

Computer Science and Engineering in London

Notre Dame undergraduate students may select from among a dozen sites for a foreign study experience. London is the most popular site for our CSE students, because the courses are taught in English and because the location provides abundant professional, cultural, and social activities. Students can participate in the Summer Engineering Program, but they can also spend the first semester of their junior year in London. Notre Dame faculty and local adjunct professors teach the required engineering courses, while other faculty offer a variety of liberal arts electives. The summer program has been available to all engineering undergraduates since 1988. The fall semester program for EE and CSE undergraduates began in 1998 and continues with an annual enrollment of about 20 students. The semester in London starts earlier and ends later than the campus term, allowing two one-week breaks for students to travel throughout Europe.

Marian Kennedy Fischer Hall on Trafalgar Square became the greatly expanded and newly renovated site of the Notre Dame London Center in 1998. The five-floor, 27,000-sq.ft. structure accommodates undergraduate study-abroad programs, as well as graduate programs in Law and Business Administration. Engineering students and faculty who have participated in the London program often express great appreciation for the broadening experience that it provides.

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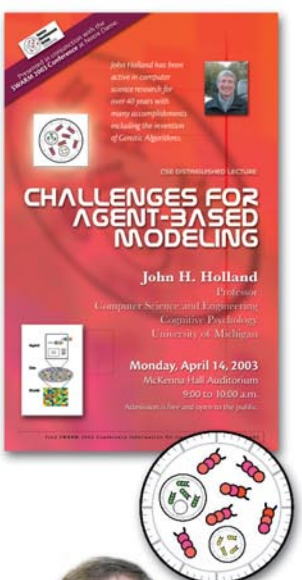

Madey

International Swarm Research Conference Hosted by CSE

The Department of Computer Science and Engineering, along with the Center for the Study of Biocomplexity, hosted the Seventh Annual Swarm Researchers Conference (Swarm2003) in April 2003 on the Notre Dame campus.

Approximately 100 researchers, modelers, and programmers working in a wide variety of domains had an opportunity to share their research, knowledge, and experience with multi-agent modeling at the international conference. Agent-based modeling is a simulation and modeling technique with methodological roots in computational social science, artificial life, cellular automata, complex systems, self-organization, emergence, and complex adaptive systems. Applications of agent-based modeling include problems in economics, ecology, social science, environmental science, urban planning, business, cognitive science, biocomplexity, and the design and engineering of complex systems.

John Holland delivered the conference's keynote address, titled "Challenges for Agent-based Modeling." Holland holds a dual appointment at the University of Michigan as a professor in both cognitive psychology and electrical engineering and computer science. He originated the field of genetic algorithms, a science that may one day allow computers to evolve flexible intelligence. Holland is the recipient of the prestigious MacArthur Fellow Award and was co-chairman of the Sante Fe Institute Science Board. He has been studying complex adaptive systems for a number of years.

In addition to the keynote by Holland, the conference included 25 research presentations, 25 poster presentations, and a short course on agent-based modeling using Swarm. Attendees at the conference came from Hungary, Australia, India, Russia, the Netherlands, Ireland, Canada, the People's Republic of China, Italy, Canada, and the United States.

The conference was organized and chaired by Associate Professor **Gregory R. Madey.** Madey and his research group are currently applying Swarm modeling techniques to problems in environmental geochemistry and a National Science Foundation study of the Open Source Software development phenomenon. They contributed several papers to the conference. Additional information about the event can be found at **http://www.nd.edu/~swarm03/.**