

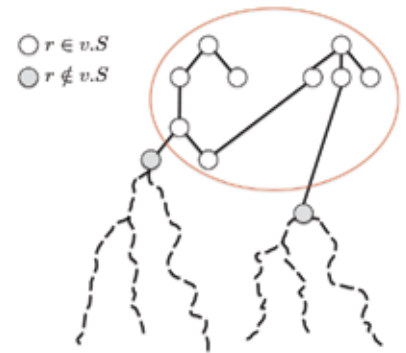


LINKS

NEWSLETTER OF THE DEPARTMENT OF COMPUTER SCIENCE

Volume 13 • Summer 2010

Research, Teaching, and Community for the New Decade



In this issue of LINKS: July 2009 – June 2010

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From the Chair: Daniel Mossé

It was the best of years, it was the worst of years... no, not really. It was a great year for me; my first year as Computer Science Department chair-person. There were a lot of challenges and a lot of rewards. No pain, no gain. Everyone I know gave me congratulations and added a cautionary warning about lots of admin work at the end.



But, administrative work has also been fun: finding out different processes, how different people work, and how to navigate the system. And learn I did. And I am still learning; is it a never-ending process? I hope so! And, as many of you who know me can attest, I will do this having as much fun as possible in the process. This is an amazing Department, and I now see more of its greatness: productivity with respect to research and teaching, engaging faculty-student relationships, preparing students for the next step, socializing among ourselves, and all this while maintaining a great environment. I am truly happy to be in such a great position in such a great department!!

I am seeing exciting times ahead in my crystal ball, donated by our Industry Board, who helps us keep an eye on the real world. Pitt's Career Services says that the average CS graduate this year got a job earning \$47,000/year, about 50% more than the average Arts and Sciences graduate. We had a hard time staffing our courses with TAs this summer, because almost all the graduate students are on internships or sponsored research positions — kudos to the graduate students. Our undergraduate student population keeps getting smarter, better, and more efficient. It's a growing pleasure to work with these students in research projects, class projects, and capstone projects. These are excellent rewards for the faculty who prepares students well and follows the faculty shared vision: innovate, educate, and create.

We saw interesting new research directions being explored and solidified, for example, several CS faculty got large NSF and NIH grants to study among other issues: Natural Language Processing, Efficiency in Data Centers,

and Development of Clinical Alerting Systems (see the news in this LINKS and on our website!). Our newest NSF CAREER Award went to Liz Marai (bringing the total to six, an awesome number for such small faculty, and 2nd largest in A&S!), Adam Lee received two new grants from NSF, and Sangyeun Cho and Youtao Zhang were co-PIs in a large NSF grant (Dr. Cho while getting tenure and having a baby!, Dr. Zhang while winding down his NSF CAREER Award). We are proud and excited for the young crowd. Younger faculty keep pushing the envelope and older faculty have to keep trying to be ahead of them. It is a rewarding game that promotes good results all around, excellent collaborations, and creates a great environment. This will certainly continue with the new additions to the faculty: John "Jack" Lange from Northwestern deals with Virtual Machines for Supercomputers and Jingtao Wang from Berkeley, in a joint position with LRDC, develops mobile systems and new user interfaces.

We keep innovating CS education. Our faculty has received eight ACIE awards for Innovation in Education (have I bragged that this is the most of any department in A&S?). New courses are being offered, opening up exciting fields in the department. This coming year will bring even more innovation: we're planning to create new courses, revamp old courses, and attract new populations to CS, all to enhance the quality even further. We have created a few new courses and educational materials (e.g., graphics, gaming, network security, system security, and robotics) and with the new faculty we will be surfing in the crest of the technological wave (what kind of analogy is this?). The faculty is also submitting grant proposals to attract more students and create better CS environments for high-school and middle-school students; our TLI is a perfect example, and this year we added a pilot program for middle-school girls. Come one, come all!

In staff news, Kathy O'Connor, who had been with us for 20 years, has left the department. We were sad to see her leave, but happy that we could foment growth in our own staff. Congratulations to Kathy for a job very well done while with us and we wish her good luck in her new endeavors.

About LINKS

LINKS has been published each year since 1998 by the University of Pittsburgh Department of Computer Science

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If you have news for LINKS or wish to receive a copy of the newsletter mailed to you, please use the form on the last page or email Wendy Bergstein at wab23@pitt.edu

You can find LINKS on the web at <http://www.cs.pitt.edu/links/>

On the front page of a newsletter, below the nameplate lies the *folio*, the line that tells you the volume number and issue. While the folio says that this is the 13th year that the Computer Science Department has put out the LINKS newsletter, this might be the first time you have found a copy in your mailbox. This year we have expanded our mailing list to include parents of current students and the chairs of other computer science departments in addition to the alumni, students, faculty, and staff that have previously received LINKS.

If this is your first issue, let me extend to you a warm welcome into the Pitt CS family. Our goal with LINKS is to show off all of the great things we have accomplished in the

previous year. This year's focus is on some of the spectacular research being done by our faculty. In this issue, we highlight three faculty whose new grants in this past year highlight some of the exciting work the CS Department will be doing in the new decade.

No less important are the outstanding students and teachers who come together to learn and share their love of computer science. We recognize their outstanding achievements and contributions as well.

We have so much good news to share this year that we have doubled the length of LINKS from the previous year. We hope you enjoy this issue and those in the years to come!

Application of Information Technology for Clinical Alerting

Medical professionals must go through a complex decision-making process when managing the care of a patient. They are required to carefully consider and evaluate large amounts of patient-specific information including results from various lab tests, the patient's symptoms, and possible therapeutic and surgical interventions. The complexity of certain patient cases and large amounts of patient-specific information may lead to some important information in the patient's data being overlooked, leading to a sub-optimal response to their problems, and in some instances, to medical errors. This has prompted the development of novel information technology solutions to aid clinicians in eliminating such potential mistakes.



The current information technology solutions rely on special equipment or a computer-based system that continuously monitors a patient for various adverse events, raising an alert if any of these events is encountered by the system. Typical computer-based systems developed for this purpose rely on clinical knowledge encoded in terms of a series of expert-derived rules. The rules take the form: 'if <condition> then <action>', where <condition> defines an adverse event and <action> defines the response following the detection, such as raising an alert or sending a reminder to a physician. One challenge with these systems is that these rules may be very difficult to extract from the actual experts. Another challenge is that the rules are also hard and time-consuming to tune to reach acceptable clinical performance. As a result, the number of alerting rules actually deployed in practice is small and many potentially adverse conditions remain uncovered.

To address these types of problems, the machine

learning group in the Department of Computer Science, led by *Professor Milos Hauskrecht*, together with their collaborators from the Department of Biomedical Informatics, Department of Critical Care, and the School of Pharmacy is pioneering the development of new methodologies for building and refining clinical alerting systems to enable them to acquire useful alert-specific information directly from data stored in past medical records. This "new" information helps to reduce both the expert effort and the time to build a working alerting system. Two grants led by Prof. Hauskrecht from the National Institutes of Health fund the development of these new data-driven alerting methodologies.

At the core of these new methodologies are state-of-the-art machine learning algorithms that enable the extraction of patterns or relations from large patient databases and to use those patterns to evaluate and analyze new patient instances. For example, a method may detect statistical outliers in the clinical care the group developed to identify a suboptimal patient management response, such as an omission of a lab test order, or the omission of a medication. To illustrate how the method works, assume that a patient develops a condition that requires a certain medication, but this medication has not been ordered yet. To detect that something is wrong and that the medication was not received, we rely on special machine learning methods that compare the actual patient-management decision regarding this medication to decisions that were made for patients who were treated in the hospital before and suffered from the same or similar condition. If the actual patient-management decision is unusual with respect to past patients, an alert is raised and the omission of the medication is reported.

Further information about Dr. Hauskrecht's research can be found on his personal web page: <http://www.cs.pitt.edu/~milos>

Modelling Trust in Networked Systems

These days, an ever-increasing collection of personal and corporate information is being collected, analyzed, and disseminated using networked systems. For instance, recent advances in mobile computing have made it easy for individuals to share a wealth of photographs and other digital artifacts via various social networking sites, while cloud computing and other outsourcing trends have led businesses to make vast amounts of data available online in order to facilitate their information processing needs. To guarantee that this information is used properly, it is critical to ensure that the techniques used to answer the question *Who should be permitted to access this data?* are both theoretically sound and practically enforceable. To this end, Assistant Professor Adam J. Lee has been awarded two grants from the National Science Foundation's Trustworthy Computing Program to investigate foundational aspects of policy capture and enforcement in open distributed systems.



and horizontal trust in a manner that is both amenable to formal analysis and efficiently deployable. This research advances the state of the art in trust management through a series of innovative results, including the design of a unified framework for specifying composite trust policies and the design and analysis of efficient algorithms for policy evaluation. The composite trust management approach championed by this project also enables policy authors to move beyond simple proof of compliance to identify the “top-k” preferred users satisfying security policies including subjective assessments. The beneficiaries of this research range from administrators of traditional computing systems who can better incorporate previous history into their decision-making processes, to users in social networks who can more carefully manage the exposure of their personal data.

Handling Uncertainty and Incomplete Information

Even when access control policies are specified using an appropriate formalism, the decisions made are essentially black and white: a user either satisfies a particular access policy or does not. This rigidity is a handicap in our complex and unpredictable world. As a result, even security-conscious organizations typically grossly overprovision principals with access rights and/or underconstrain access policies to ensure that principals can always carry out the organization's mission effectively and respond to unexpected opportunities and challenges. For example, a recent study has shown that employees of a major bank only *accumulate* new permissions as their job functions change. That is, they never actually *shed* access rights that were previously held, even if such rights are no longer needed! The use of weakened access policies or inflated sets of rights is a detriment to managing highly secure systems.

Dr. Lee's project, *Towards Formal, Risk-Aware Authorization* (CNS-0964295; 4 years), focuses on developing dynamic and risk-aware approaches to access control that allow organizations to make security-critical decisions in the face of incomplete information and unexpected circumstances. This is accomplished by combining proof-theoretic access controls with economic models of risk. In the event that the *expected* proof of authorization for an action cannot be generated, the systems developed in this project carry out an efficient search for *similar* proofs of authorization that minimize the overall risk incurred by deviating from the expected. This approach allows policies to adapt dynamically to the changing context of the systems in which they are deployed. This research will have several benefits, including increased system

(Continued on page 8)

Trust? What Trust?

Social scientists have identified two types of trust that people rely on when making everyday decisions: vertical and horizontal trust. Vertical trust captures trust relationships between individuals and institutions (e.g., I will stay at hotels that are highly-rated by the AAA, whom I trust). On the other hand, horizontal trust represents the trust inferred from the observations and opinions of others (e.g., I will eat at Joe's because several of my friends have recommended it). Traditional network and distributed systems security mechanisms, such as digital credentials, rely predominately on the notion of vertical trust. However, the recent paradigm shift towards more open and human-centric distributed systems has given rise to a great diversity of more subjective horizontal trust mechanisms, like reputation, recommendation, and collaborative filtering systems. Used alone, systems based on vertical trust provide strong formal guarantees about the security state of the system, but are rigid and inflexible. Conversely, systems based solely on horizontal trust provide flexibility at the cost of being fairly easy to subvert. Although significant benefit could be realized by combining horizontal and vertical trust assessment mechanisms for distributed systems, these classes of systems have evolved independently of one another.

Dr. Lee's project, *Towards a Dynamic and Composable Model of Trust* (CCF-0916015; 3 years), focuses on developing a composite trust model capable of tightly coupling vertical

Humanoid Articulations, From the Bottom Up

One of the next great frontiers of science is working toward understanding biological systems—with particular emphasis on the human body—and the processes that make them work. The ultimate goal is the creation of a computational model of the entire human body (a.k.a., *the virtual physiome*). This model will be able to adapt and be thus individual-specific; it will also have predictive capabilities, in terms of response to illness, therapy or surgery. Reaching such an ambitious goal requires both solving extraordinary computational challenges and pursuing interdisciplinary collaboration.



Assistant Professor Liz Marai has been recently awarded the National Science Foundation CAREER award, the agency's most prestigious award for young faculty, to research geometric representations, computational modeling, visualization, and analysis tools necessary for the simulation and analysis of complex biological systems. In the long run, Dr. Marai's research goal is to build tools that will help us to generate and simulate an integrated computational human model. Meanwhile, the tools and collaborations she builds help solve practical scientific problems in disciplines such as biology, medicine, robotics, and computer animation.

Human(oid) articulations

Human articulations are amazingly complex and adaptable pieces of machinery. Someday we will routinely be able to replicate in detail their intricate design and functionality in hospitals, in the computer animation studio, or at the Robotics Institute. However, until that day, many of us will continue to suffer from baffling, debilitating articulation afflictions, which are seemingly incurable. (Twenty percent of all computer users damage their wrists due to excessive typing [3].) One step further, robots and orthopedic implants still have a long way to go to match the complexity and capabilities of human articulations. For example, the figure on page 6 shows both a human wrist and a state of the art wrist implant [1]; attempts at total wrist replacement with such highly-simplified articulation implants have historically been fraught with complications, most commonly prosthetic dislocation and loosening [1][2]. Lastly, articulations in physically-based digital human characters are in general neither sophisticated nor convincing. For examples of current animations generated without the help of a large team of skilled artistic animators, see <http://www.theseisgame.com/>; in the released clips, note in particular the unrealistic shoulder motion.

Dr. Marai believes that the key to further progress in replicating human articulation capabilities is a much more detailed consideration of the human anatomy and dynamics.

Computational Challenges

In theory, we could build bottom-up articulation models from the molecular level up to full motor function. Constructing such a model would require accurate and well-defined inputs, including: complete digital anatomical models of all joint components, the material properties for all components, and a detailed understanding of the applied forces. Once the model geometry is constructed and the forces defined, algorithms and representations must be implemented to computationally model and then simulate the interactions among joint components and finally the behavior of the articulation.

However, building such models from the molecular level up will take a long time, and simulating them will be enormously slow. In practice, slightly less accurate but faster models of anatomy in which we treat bones, for instance, as rigid bodies, and tendons as inelastic bands, could serve to advance life science in the same way that the development of rigid body physics—while failing to take into account molecular forces and relativistic effects—has helped advance physical science and engineering for 150 years. The first challenge on the path to realistic computational articulations is deciding what level of modeling detail is necessary, and developing appropriate representations and approximations so that we obtain biologically significant measurements (or realistic motion in animation), while keeping the resulting models efficient to simulate.

The second challenge is that many of the inputs we need to build models of human articulations are not directly measurable in live individuals. Some *in vivo* (live) measuring restrictions come from current limitations of imaging technology. In time, progress in imaging technologies may overcome such limitations. Other measuring limitations are, however, inherently linked to *in vivo* investigation: detailed subject-specific material properties and undeformed geometry cannot be acquired without invasively disrupting the articulation and thus altering its kinematics.

A Data-Driven Approach

Dr. Marai's idea is that a data-driven approach can overcome long-standing limitations in humanoid articulation modeling. Her proposed approach is to use sampled dynamic motion data to infer unknown data such as soft-tissue geometry and behavior. The idea here is that motion information



Human wrist — showing eight carpal bones, two forearm bones, and five metacarpals — and a state of the art orthopedic wrist implant. Attempts at total wrist replacement have historically been fraught with complications, most commonly prosthetic dislocation and loosening.

can provide insight into soft-tissue properties: for example, wider ranges of motion can be associated with laxer soft-tissues, while narrower ranges of motion can be associated with stiffer soft-tissues. To this end, Dr. Marai's research pursues three promising directions: (1) accurate, robust methods for tracking dynamic bone motion from medical images. Such methods will generate databases of detailed, accurate skeletal dynamics, and may enable the study of soft-tissue deformation with motion; (2) computational representations of soft-tissues and contact based on dynamic motion information. Computational tools will be developed for estimating and modeling soft-tissue geometry and behavior from skeletal dynamics. These tools will help us overcome long-standing limitations in articulation imaging; and (3) predictive computational models of humanoid articulations. Combining these representations will enable us to achieve simple, elegant, and accurate estimations of biologically-relevant measurements, as well as more realistic digital character motion.

The expected outcome of this research is a set of human-anatomy based (i.e., *humanoid*) models of articulations that will impact orthopedists' understanding of articulation injury and disease, and will dramatically improve the realism of digital character animation. Through tight collaboration with Pitt bioengineers and orthopedists, Dr. Marai intends to demonstrate the application of this data-driven approach to the human spine and knee.

Integrating Research and Teaching

Dr. Marai's research into medical computing and physical-based modeling and their applications is tightly coupled

with an educational framework for identifying and teaching the skills needed for successful multi-disciplinary research. Her education effort — recognized so far by multiple teaching awards — includes two courses, a cross-campus research group, and a peer-based framework for strengthening “soft”, cross-disciplinary communication skills. The graduate-level courses walk students through the process of multi-disciplinary research, from selecting a scientific problem and forming a qualified team all the way to presenting the research results. Her undergraduate courses are geared towards recruiting undergraduate students into multi-disciplinary work, through a modeling and simulation approach to teaching computer graphics. Both undergraduate and graduate students stand to benefit from Dr. Marai's interdisciplinary research group.

References

- [1] Adams, B.D. and Grosland, N.M., *Biomechanical Evaluation of a New Prosthesis Design for Use in Total Wrist Arthroplasty*, <http://www.uihealthcare.com/depts/med/orthopaedicsurgery/wristreplacement/pdf/evaluation.pdf>
- [2] Ferlic, D.C., Jolly, S.N., and Clayton, M.L., *Salvage for failed implant arthroplasty of the wrist*, *J Hand Surg*, 17(5), pages 917-23, 1992.
- [3] Pascarelli, E. and Quilter, D., *Repetitive Strain Injury: A Computer User's Guide*, Wiley & Sons, 1994.

Further information about Dr. Marai's research can be found on her personal web page: <http://www.cs.pitt.edu/~marai>

New Research Funding 2009–2010

The total research expenditure for fiscal year 2010 was nearly 2.8 million dollars. The new grants awarded since the previous issue of LINKS are listed in the table below.

Faculty	Title	Agency
Cho	Enabling Fast and Versatile Packet Processing for Future Larger-Scale Networks	NSF
Hauskrecht	Detecting Deviations in Clinical Care in ICU Data Streams	NIH
Hauskrecht	Discovering Complex Anomalous Patterns	NIH
Hauskrecht	Using Medical Records Repositories to Improve the Alert System Design	NIH
Lee	Towards a Dynamic and Composable Model of Trust	NSF
Lee	Towards Formal, Risk-Aware Authorization	NSF
Litman	An Affect-Adaptive Spoken Dialogue System that Responds Based on User Model and Multiple Affect States	NSF
Litman	Improving a Natural-Language Tutoring System that Engages Students in Deep Reasoning Dialogues About Physics	NSF
Litman	Student Research Workshop in Computational Linguistics at the NAACL HLT 2010 Conference	NSF
Marai	CAREER: Data-Driven Bottom-Up Humanoid Articulations	NSF
Wiebe	Word Sense and Multilingual Subjectivity Analysis	NSF

In Memoriam: Yasir Khalifa

It is with great sadness that we mourn the loss of *Dr. Yasir Khalifa*, who had served as a Lecturer in the CS Department since 2002. Dr. Khalifa was spending the summer at Carnegie Mellon University in Qatar as an adjunct lecturer. He and his son, Malek, were involved in a boating accident. Malek is recuperating from his injuries and is expected to make a full recovery. His wife, AnnMarie Zanger, was not involved in the accident.



Dr. Khalifa received his PhD and MS in Computer Science from the University of Pittsburgh. His dissertation was entitled: “Organizational Medical Simulation System: Effects of Intelligent Multi-Agent Communications on System Performance.” He also received an MS in Computer Engineering from Northeastern University and his BS in Electrical Engineering from the University of Aleppo.

During his time as a Lecturer, Dr. Khalifa authored four textbooks and was awarded an Advisory Council on Instructional Excellence (ACIE) award in 2004 to improve the teaching of discrete mathematics with Professors George Novacky and Patchrawat Uthaisombut. Dr. Khalifa was 53.

2008–2009 Teaching Awards

These awards are given to faculty for achieving the highest student evaluation score for overall teaching effectiveness.

TEACHING ASSISTANT:	<i>Michael Lipschultz</i>
PART-TIME FACULTY:	<i>Don Bonidie & George Jucha</i>
CORE UG LECTURER:	<i>John Ramirez</i>
CORE UG TENURE-STREAM:	<i>Sangyeun Cho</i>
UPPER-LEVEL COURSES LECTURER:	<i>John Ramirez</i>
UPPER-LEVEL COURSES TENURE-STREAM:	<i>Sangyeun Cho</i>
GRADUATE 2000 LEVEL:	<i>G. Elisabeta Marai</i>
GRADUATE 3000 LEVEL:	<i>Panos K. Chrysanthis & Alexandros Labrinidis (co-taught)</i>

2008–2009 Grad Student Awards

The department recognizes outstanding graduate students in both teaching and research each year.

TAULBEE AWARD:	<i>Michael C. Lipschultz</i>
RUNNER-UP (TAULBEE AWARD):	<i>Ryan Moore</i>
MELLON FELLOWS:	<i>Ihsan Ayyub Qazi & Swapna Somsundaran</i>
TA MENTOR:	<i>Ryan Moore</i>

Dara Kusic

Dara Kusic has joined the Department of Computer Science as a 2009-2010 Computing Innovations Post-doctoral Fellow of the National Science Foundation (CIFellows). The work funded by the fellowship, and mentored by Department Chair Daniel Mossé, will develop fault-detection, diagnostic analysis, and fault-recovery methods aimed at minimizing both the diagnosis latency and cost in high-performance distributed systems.



Generally, performance management and fault diagnosis are treated independently of one another by separate control frameworks. By inputting diagnostic information to a controller, this data can be used to initiate rescue and recovery actions aimed at maintaining performance through abnormal system behaviors. Fault-adaptive control technology can integrate control and fault-diagnosis components into a common, model-based framework.

The Computing Community Consortium (CCC) and the Computing Research Association (CRA), with funding from the National Science Foundation (NSF), initiated the CIFellows program for new PhD graduates to obtain one-to-two year postdoctoral positions at host organizations including universities, industrial research laboratories, and other organizations that advance the field of computing and its positive impact on society.

The goals of the CIFellows project are to retain new PhDs in research and teaching and to support intellectual renewal and diversity in the computing fields at U.S. organizations. More information on the CIFellows program can be found at <http://cifellows.org/>.

Modelling Trust...

(Continued from page 4)

availability during disasters or other uncommon cases not explicitly modeled by policies; reduced instances of permission creep, as overprovisioning users is no longer required to ensure that an organization's business needs are met; a quantifiable means of assessing how policies are actually used and how they might be changed to better reflect the evolution of organizations; and the development of metrics for assessing access control risks.

Further information about Dr. Lee's research can be found on his personal web page: <http://www.cs.pitt.edu/~adamlee>

New CS Industry Board Chair: Gerard Pompa

The Department of Computer Science's Industry Board elected a new chairman, *Gerard A. Pompa*, Senior Vice President of Compunetix. Mr. Pompa will serve a term of three years as the chair. He replaces D. Raja who has been chair of the board since it was formed in 2005. Many thanks to Raja for the excellent job he did as chair.



The CS Industry Board is currently composed of 12 companies with local presence. The purpose of the board is to help guide the educational mission of the University with feedback on the state of the industry and ensuring the curriculum meets the needs of industry. The board also helps raise funds and provides sponsorships for the department, creates hiring opportunities for graduates, and fosters an entrepreneurial culture for ideas and spin-off companies. The board is also involved in alumni socials which are held during the year to promote networking and presents a lecture series for industry representatives to speak to the students and faculty.

Compunetix was founded in 1968 and today is a leading manufacturer of sophisticated electronics, including: systems for voice and data collaboration, video conferencing, and mission-critical systems primarily for aerospace, the military, and government. Compunetix is located in Monroeville, PA.

Mr. Pompa is a Pittsburgh native, graduating from Pitt with a BS in Computer Science in 1981 and a Masters in CS in 1987. He joined Compunetix in October 1988 as a software engineer in the Communications Systems Division (CSD). He was involved in the software design and development of the Triple Redundant Controller for the NASA Voice Switching System (VSS). Additionally, he developed the software requirements and architecture for the system control computer for the NASA Voice Distribution System (VDS). Mr. Pompa then took on the responsibility of Principal Software Engineer for Compunetix and managed the software engineering staff and process within CSD. In 1990, he assumed the responsibility of the CONTEX® Teleconferencing System Program and Development Manager. After two years, he took on the position of CSD Division Manager.

Mr. Pompa has also served on several boards as a Director for Compunetix since November of 1992 and as a director of Compunetix Research since 1995, as well as a director of Sonexis Technology Inc. since 2008. He was promoted to Vice President of the Corporation in 1998 and was promoted to Senior Vice President of the Corporation in 2008.

Ricardo Villamarín-Salomón

Improving Computer Systems' Security with Warning Polymorphism and Security-Conditioning Applications

Many computer security decisions depend on contextual information that computer systems cannot automatically obtain or verify. Users need to supply such information through, e.g., computer dialogs. Unfortunately, users often do not provide true information to computer systems, but rather (intentionally or automatically) input whatever information will quickly dismiss security dialogs and allow them to proceed with their primary goal (which is rarely computer security). Obviously, such user behavior can compromise computer systems' security. With the generalized use of the Internet today, an individual's insecure behavior can have severe negative consequences to his organization, including financial losses, unintended release of private information, or an inability to operate normally in everyday activities. In spite of such potential consequences, users continue to behave insecurely. Industry surveys and security researchers still find users to be the weakest link in the computer security chain.

To address the aforementioned problems, we first propose a model that helps explain why users behave insecurely when operating computer systems. Then, based on that model, we propose and evaluate techniques that improve users' security behaviors by automatically manipulating antecedents and consequences of such behaviors. First, we propose the use of warning polymorphism, which randomizes options in security warning dialogs, and delays activation of some of those options, so as to avoid cuing automatic, possibly untrue user responses. Second, we contribute the notion of security-conditioning applications (SCAs), and implement and evaluate two types of such applications, namely, security-reinforcing applications (SRAs) and insecurity-punishing applications (IPAs). SRAs strengthen users' secure behaviors by reliably delivering reinforcing stimuli contingently upon such behaviors, according to a specific reinforcement policy and schedule. IPAs weaken users' insecure behaviors by reliably delivering aversive stimuli, pre-specified by a policy, contingently upon those behaviors. Finally, we devise vicarious security-conditioning interventions to prepare users for interaction with SCAs and accelerate the latter's security benefits and user acceptance.

Results of empirical evaluations of our proposed techniques show that they are, indeed, effective in improving users' security behaviors, which in turn increases computer



systems' security. Moreover, we show that, when using specific schedules and stimuli, such improvements are resistant to extinction over time.

ADVISED BY: *Dr. José Carlos Brustoloni* and *Dr. Adam J. Lee*

Ruibin Xu

Software Developer
Quantlab Financial LLC, Houston, TX

Energy-Aware Scheduling for Streaming Applications

Streaming applications have become increasingly important and widespread, with application domains ranging from embedded devices to server systems. Traditionally, researchers have been focusing on improving the performance of streaming applications to achieve high throughput and low response time. However, increasingly more attention is being shifted to power/performance trade-off because power consumption has become a limiting factor on system design as integrated circuits enter the realm of nanometer technology.

This work addresses the problem of scheduling a streaming application (represented by a task graph) with the goal of minimizing its energy consumption while satisfying its two quality of service (QoS) requirements, namely, throughput and response time. The available power management mechanisms are dynamic voltage scaling (DVS), which has been shown to be effective in reducing dynamic power consumption, and vary-on/vary-off, which turns processors on and off to save static power consumption.

Scheduling algorithms are proposed for different computing platforms (uniprocessor and multiprocessor systems), different characteristics of the workload (deterministic and stochastic workload), and different types of task graphs (single task and general task graphs). Both continuous and discrete processor power models are considered. The highlights are a unified approach for obtaining optimal (or provably close to optimal) uniprocessor DVS schemes for various DVS strategies and a novel multiprocessor scheduling algorithm that exploits the difference between two QoS requirements to perform processor allocation, task mapping, and task speed scheduling simultaneously.

ADVISED BY: *Dr. Rami Melhem* and *Dr. Daniel Mossé*



TLI Summer Workshops

This summer the Technology Leadership Initiative (TLI), under the direction of *Tonya Groover*, has added an all-girls *Tech Divaz* program in addition to the high school Summer Robotics Academy. The all-girls computer science and programming workshop is for students in grades 7 to 9 and will be led by an experienced, all-women staff that engages the girls in several computer science related areas, such as:

Workshop Radio — create a radio show to interview women in computer science and technology.

Computer Science Roadshow — brief introduction to the field of computer science with hands on activities.

Robots and the Physical World — explore simple robotic programming using the Finch robot.

Programming with Alice — create animations for storytelling, gaming, or video creation.

Web Design — build a Web site and customize the look using CSS

The workshop topics also include building computers.

TLI is also conducting its regular Summer Academy for all students entering grades 9 through 12. This year's academy happens in late July and its theme is Robotics, using Lego Robots NXT. Returning and experienced students refresh their skills from last year, while new students acquire the skills to do beginner tasks such as making the robot follow a path, follow a wall, and find a position in a room. The academy concludes with a competition in which the students program their robots to navigate through a game board and acquire points.

This year's programs present 3-day and 8-day workshops. The goal of the Technology Leadership Initiative is to provide high school students opportunities, tools, and motivation to excel in Computer Science. For more information visit the TLI website: www.cs.pitt.edu/tli/.



Students work on robots during the summer TLI robotics workshop.

Undergraduate Briefs

Here are some interesting and exciting occurrences in the CS Department Undergraduate program over the past year.

Programming Competitions

We once again sent two teams to the ACM East Central North America Regional Programming Competition. Our Pitt Blue team (*Heather Friedberg, Bin Gao, Dylan White*) finished 27th and our Pitt Gold team (*Ellen Gawryla, David Goldberg and Matt Czarnek*) finished 61st out of 113 teams. If penalty points are discounted (given for time and multiple submissions) Pitt Blue tied for 15th place with 3 problems solved and Pitt Gold tied for 30th place with 2 problems solved. We congratulate all of our competitors and look forward to another strong finish next year.

Our programmers also participated in the CMU Invitational Programming Contest this past Spring. In that competition Pitt Blue (*Heather Friedberg, Dylan White, Ellen Gawryla*) finished 4th out of 20 teams and Pitt Gold (*Sean Synder, Victor Powell, James Cervone*) finished 9th.

Guest Speakers

In conjunction with our CS Capstone Courses and our Industry Board, we welcomed a number of guest speakers over the past year to address our students. These speakers included:

Kamal Nigam, Google: *Software Engineering at Google: Product Search*

Peter Johnson, Bank of New York Mellon: *Technology Trends that Threaten and Create Opportunities for BNY Mellon*

Michael Lehman, PantherLab Works: *The Entrepreneurial Forum: Roadmap from Idea to Company*

Jim McMahon and John Broderick, FedEx Services: *The Different Paths for CS Graduates*

Richard Stallman, GNU: *Copyright vs. Community in the Age of Computer Networks*

Mark Borger, Technology Collaborative: *Business Plan Tutorial*

Morris K. Udall Scholarship

Amy Scarbrough, a Bioinformatics major, was awarded the Morris K. Udall Scholarship based on her strong academic record and her pursuit of research on the environment. Bioinformatics is an interdisciplinary major housed in the Departments of Computer Science and Biological Sciences. Amy's research pursuits are ecology and supercomputing, and she hopes to benefit the environment by simulating

ecosystems. The *Pitt Chronicle* newspaper featured an article about Amy and the Udall Scholarship in the April 12, 2010 issue. You can view the article online at: <http://www.chronicle.pitt.edu/?p=5299> to read more.

Awards

The 2009 Moyé Information Technology Initiative Summer Research Experience awards were given to computer science majors *Marylou Kunkle* and *Yann Le Gall*. The Moyé Information Technology Initiative Summer Research Experience, is a program initiated and funded by Pitt alum Dr. Aftred Moyé to foster undergraduate research in CS.

In addition to his Moyé award, *Yann Le Gall* was also named the Computer Science Outstanding Undergraduate Student for academic year 2009-2010. This award is given each year to the student who best embodies the qualities that the CS Department believes a computer science student should have. Yann is currently doing research with faculty

member Dr. Adam Lee and has been admitted to the CS Graduate Program at Pitt starting in Fall 2010.

Honor Roll

The CS Honor Roll consists of full-time CS majors who have met the following criteria in the previous academic year:

1. Completion of at least 3 CS courses, two of which must be upper-level courses
2. A CS GPA of at least 3.75
3. An overall GPA of at least 3.50

The CS Honor Roll for Academic Year 2008-2009 is:

Jacob Busofsky

Heather Friedberg

Bin Gao

Nathan Good

Sarah Greenwood

Yann Le Gall

Adam Modlin

Daniel Oliphant

Abraham Schreiber

Curtis Stine

Jesse Szwedko

Keith Wyss

Congratulations Class of 2010!

Graduation was held on Sunday, May 2, 2010, in the Peterson Events Center. This year, the CS Department awarded 43 new Bachelor's Degrees. On the evening prior to the ceremony, the department held a celebratory dinner (attendees pictured below) for the graduates and their families at the William Pitt Union. Congratulations to all of the new graduates!



Alumni Spotlight: Hugo Varotto

Hugo Varotto has a BS in Systems (1994) from CAECE (Centro de Altos Estudios en Ciencias Exactas), Buenos Aires, Argentina and an MS in Computer Science (2000) from the University of Pittsburgh. His areas of interest are: distributed and real-time systems, fault-tolerant systems, wide-area communications systems, and system of systems integrations. He has worked on international projects in the nuclear, communications, and aerospace areas. He lives with his wife Mariana and two sons (Lucas and Alec) in the beautiful Pacific Northwest, where you can find him on a kayak somewhere.

1. What led you to the University of Pittsburgh?

In 1997, I was working for INVAP in Argentina, designing and building control systems for nuclear reactors. These were distributed real-time systems, using (at the time) state-of-the-art Pentium 60 Mhz chips. One interesting tidbit was that we were using Token-bus networks (ARCNet) instead of the most common Ethernet, since token-bus networks were predictable.

I wanted to continue learning more about real-time and fault-tolerant systems. At that time, my university (CAECE in Buenos Aires, Argentina) had an academic agreement with the University of Pittsburgh (to collaborate on projects and such) and they put me in touch with Dr Mossé. He and Dr Melhem were at that time driving a research project called FORTS (Fault Tolerant Real-Time Systems), which sounded very interesting. One thing led to another and somehow at the end of November 1997, while I was in Egypt during the startup of the MPR nuclear reactor, I got accepted at grad school in Pittsburgh.

Since I had to be there on January 3rd, and had work to finish in Egypt until mid-December, my future wife prepared our whole wedding by herself in Argentina (in 30 days!). Ten days after my arrival we got married and we flew immediately to Pittsburgh, PA.

2. Do you have any fond memories of your days at the University of Pittsburgh?

I remember very much my research days at the Mineral Industries Building (which no longer exists) with the FORTS group, they were some of the most brilliant people I've ever met. Hakan Aydin, Libin Dong, Frank Liberato, Sylvain Lauzac, and Pedro Mejia Alvarez were some great people to work/study with. I'm very lucky that 10 years later, Sylvain and his wife Susan also live here in Seattle, so we see each other frequently.



Hugo with his sons Alec (age 1, left) and Lucas (age 3, right).

I also really enjoyed my classes. Some that I immediately remember are Parallel Computing with Dr Melhem, Advanced Topics in Real Time Systems with Dr Mossé, and Advanced Topics in Concurrent and Distributed Systems with Dr Moir.

3. What have you been doing since you graduated?

The first eight years I worked with Motorola in Chicago, IL, on private radio networks (you can think of them as wide-area distributed wireless real-time communication systems). These are critical systems used by police departments, firefighters, military, etc., which require very high-reliability and performance. Some of them are so big that they encompass entire countries! I worked with the X-Zone Zone Controller, the central voice and data entity for wide-area networks (chief architect), and afterwards worked on Large Transit Systems with the Astro Systems Architecture and Design group.

While there, I also discovered kayaking as a sport. I got so much into it that I got certified as a kayak instructor and taught for more than 6 years while at Chicago. My wife and I paddle whitewater and sea kayaks, and have even built two sea-kayaks during a long Chicago winter that we used on multi-day trips. I cannot wait for my sons to grow up and join us!

The last two years I have been with Boeing in Seattle, WA, working on a large System-of-Systems project called GoldCare, supporting the brand-new 787 aircraft. With GoldCare, Boeing leads a global team of world-class Maintenance, Repair, & Overhaul (MRO) and Supplier partners who deliver maintenance services and material management for the 787 aircraft. In addition, Boeing integrates these services with engineering and planning services. The Boeing website has lots more details about the program; I'm very

excited about it. I'm mainly working as the architect for the Materials Management Service, and I've also worked as the architect for the Reliability (Engineering) Service.

4. *What achievements are you most proud of?*

From a personal point of view, I'd have to say that my two sons Lucas (3 years old) and Alec (1 year old) are my pride and joy along with my wonderful wife, Mariana. Becoming a father shakes your mind a lot!

From a professional point of view, I'm very happy of having worked on so many different areas. I've worked with nuclear control systems, done operating systems kernel research, wireless communications, and now, reliability and materials management in the aerospace/airline industry. At the end of the day, all of the projects that I've worked with have proved to be meaningful, and some have even contributed to save lives (I cannot ask for more).

I've realized over the years that there is not a single discipline that is the means to cure all. I've worked in projects with mechanical, electrical, microwave, chemical and nuclear engineers, business processes, reliability engineers, super-smart computer scientists, etc. It's truly beautiful how everybody contributes his or her expertise to the ultimate goal: to have a controlled nuclear reaction, to have an airplane fly for the first time, to ensure that a firefighter always has a communication link while deep inside a building on fire, etc. We live in a collaborative world in which no complex project is impossible, all we need is the right set of smart people with a "can-do" attitude.

Richard Stallman Talks Copyright and Community

On Friday, February 19, 2010, *Richard Stallman*, the founder of the GNU Project (www.gnu.org) and the Free Software Foundation (www.fsf.org), gave a talk entitled "Copyright vs Community in the age of Computer Networks." Over 300 people attended the talk, which was held in the Lower Lounge of the William Pitt Union.



Mr. Stallman focused on how the principles of open source software can be applied to copyright reform. Among his ideas are a ten-year limited term from publication for copyrights of creative works and the right to modify and redistribute any "useful" work such as a computer program or recipe. A lively question and answer session followed his talk. The event was part of the successful 2009–2010 colloquium series sponsored by the Department.

Distinguished Lecturer Series

The 2009-2010 Distinguished Lecturer Series was held during the fall term and was supported by Compunetix and Google Pittsburgh, both members of the Industry Board. The talks were well attended by students and faculty. The new series is currently in the planning stage and will be available on our website at www.cs.pitt.edu in the fall.

September 18, 2009

Mootaz Elnozahy, IBM — Austin Research Lab
Efficient Data Centers through Virtualization?

October 2, 2009

Dan Roth, Professor, Department of Computer Science, University of Illinois at Urbana-Champaign
Constrained Conditional Models: Learning and Inference in Natural Language Understanding

October 23, 2009

Sandy Irani, Professor, Department of Computer Science, University of California, Irvine
Computational Complexity of Quantum Systems

November 6, 2009

Joseph A. Konstan, Distinguished McKnight Professor of Computer Science and Engineering, University of Minnesota
Bridging Computer Science and Behavioral Science: Research Examples



Over 300 people came to the William Pitt Union to see Richard Stallman's talk.

CS Day 2010

The Department held its 10th Annual Computer Science Day on Friday, March 26, 2010. The events were attended by Computer Science educators, students, alumni, and industry representatives.

The day began with the High School CS Bowl in which high school students from eight schools around the area answered questions regarding Computer Science. After three preliminary rounds, Trinity, Peters Township, and Seneca Valley met in the finals with Seneca Valley going on to win the competition. Congratulations to the winners and to all of the participating students!

Around noon, guests began to browse the marketplace which showcased over two dozen companies and programs. The marketplace is held for two hours after lunch during CS Day and each participant hosts a table where representatives are able to talk to students about their company. To add to the excitement of the marketplace, the scavenger hunt was redesigned. Professors Adam Lee and Jonathan Misurda worked with undergraduate students Nathaniel Buck and Keith Carlson to reward students for visiting multiple tables across the two floors of Sennott Square where the marketplace is held. The scavenger hunt awarded prizes as an incentive for visiting booths.

In the afternoon, a debate was conducted by the William Pitt Debating Union entitled: Google Books: Access vs. Privacy. Members of the debate team directed by Gordon Mitchell squared off against two expert advocates: Ginger McCall, Staff counsel for the Electronic Privacy Information Center, Washington, D.C. and Lateef Mtima, Professor of Law and Director of the Institute for Intellectual Property and Social Justice at the Howard University School of Law.

Other activities included the Digital Media Contest, Research Competition, Business Plan and Poster Competition.



Students from area high schools competed in the CS Bowl answering questions about CS and technology.

Graduate and undergraduate students could submit an entry for the Second Annual Business Plan Competition. The 2010 competition was sponsored by CEI and was presented to Md. Abedul Haque and Adam M. Smith. Undergraduate students Terence Sperringer, Luke Weng, Daniel Oliphant, Yann Le Gall and Stephen Kao had the winning video “CATASTROPHE” and graduate students P.J. Dillon and Lory Al Moakar won for “Thank you, Rami”. Graduate students also competed for the honor of the best research award sponsored by Compunetix. Shenoda Guirguis received the Graduate Student Research Award with his research on “Weaved Sharing of Aggregate Continuous Queries” and Iyad Batal received the Runner-Up award for research on “A Concise Representation of Association Rules Using Minimal Descriptive Rules.”

CS Day also provided awards and prizes for the Poster Competition. Both graduate and undergraduate students presented their research projects in posters. Prizes were offered by Ericsson. The list of award recipients is as follows:

BEST GRADUATE STUDENT POSTER

Santiago Bock and Alexandre Ferreira

RUNNER-UP GRADUATE STUDENT POSTER

Md. Abedul Haque

BEST UNDERGRADUATE STUDENT POSTER

Joanna Drummond

RUNNER-UP UNDERGRADUATE STUDENT POSTER

Brian Madden and David Wilkinson

PEOPLE’S CHOICE UNDERGRADUATE STUDENT POSTER

Yann Le Gall



Students use a kiosk for the scavenger hunt, scanning barcodes with a webcam to record their progress.

A social gathering was held at Joe Mama’s restaurant following CS Day for alumni, faculty, industry representatives and staff to conclude another successful and exciting CS Day!

CS Day Debate — Google Books: Access vs. Privacy

On Friday, March 26, 2010, as part of the annual CS Day festivities, the Computer Science Department along with *Associate Professor Gordon Mitchell* of the Communications Department and head of the William Pitt Debating Union (WPDU) conducted a one-hour debate entitled “Google Books: Access vs. Privacy.”

Google Books is a service from the ubiquitous internet search company where books from several libraries and book publishers are scanned and provided online for searching and viewing. In 2005, the Authors Guild of America and the Association of American Publishers each sued Google for copyright infringement. In 2008, a settlement was reached which resulted in a change in the way Google Books worked. As part of the settlement, Google is able to display up to 20% of a book’s text to an individual, display advertisements, and sell copies of the out-of-print digital books.

In order to implement the restriction on how much of a book an individual may access, Google must maintain a database to record the information. Brick-and-mortar libraries have legal privacy requirements and patron reading lists require a warrant to obtain. These protections do not clearly extend to a third-party corporation like Google who seeks to make a profit via displaying targeted advertising.

This leads to the topic of the debate: does the social good of having convenient access to hard-to-find books outweigh the right to have what you read remain private.

Arguing for the importance of Google Books for information access was *Lateef Mtima*, a Professor of Law and the Founder and Director of the Institute for Intellectual Property and Social Justice at the Howard University School of Law.



Aleksey Smalianchuk asks a question to Carolyn Just during the CS Day debate on Google Books.

He was joined by *Carolyn Just*, a University of Pittsburgh undergraduate debater who is a sophomore studying in philosophy and art history.

The position that the right to privacy trumps the social good of Google Books was argued by *Ginger McCall*, Staff Counsel of the Electronic Privacy Information Center and Pitt alumnus. She was joined by *Aleksey Smalianchuk*, a Pitt junior majoring in computer science who was enrolled in the Department of Communication’s Argument class.

Sarah Banducci and *Sora Borenstein*, undergraduate members of the WPDU, served as questioners periodically asking for clarifications and raising points for the debaters to address.

The debate was concluded with an opportunity for audience members to ask questions of the panel.



The spring social was held in the upper floor of Joe Mama’s restaurant following CS Day.

Fall Networking Social

This Fall we will hold a Networking Social (formerly the Alumni Social) for alumni, faculty, staff, and soon-to-graduate students.

The details are still being arranged and the final announcement will be posted on the CS website (www.cs.pitt.edu) and to the CS alumni mailing list. If you want to sign up for the mailing list, email Wendy Bergstein at wab23@pitt.edu or register with the CS Alumni Portal. The information can be found on the last page of LINKS.

We look forward to seeing you in the Fall!

LINKS Newsletter
Department of Computer Science
University of Pittsburgh
Pittsburgh, PA 15260
USA

STAY IN TOUCH!

Visit the Pitt CS Alumni Portal

Go to <http://www.cs.pitt.edu/people/alumni/> to:

- Register for the CS Community
- Update your contact information
- Get alumni event news

This community is only for alumni of the Computer Science Department and is not related to the University's alumni database. We will not publish or share your email address with anyone unless we have your consent.

We'd like to hear from you and so would your classmates!

Please submit information about your new employment, retirement, marriage, honors earned, civic and organizational office, and/or family addition by completing the following and returning it to the address below or via email to wab23@pitt.edu. Your email address will not be published or shared with anyone unless we have your consent.

Name: _____ Email Address: _____

What have you been doing since you left Pitt? _____

May we include your news in the CS Newsletter LINKS? Yes No

If you know other alumni who may not be receiving the newsletter, please forward the Alumni Portal Link to them.
Thank you for taking the time to update your information... we look forward to hearing from you!

Contributing to the University?

You can make sure your contribution supports the Computer Science Department directly by designating the department as your primary beneficiary. Thank you for your generosity!