COMPUTER SCIENCE

2010-11
2011-12

Annual Report

PURDUE
UNIVERSITY

Students enrolled in Assistant Department Head Tim Korb's HCI course stand in front of the Harris Corporation Video Wall located in the commons area of the Lawson Computer Science Building. The centerpiece of the Lawson Commons is a 16'x9' tiled video wall, generously donated by the Harris Corporation. It has been used for a variety of purposes, including advertisement of special campus events, workshop and colloquium speakers, research demonstrations, news and information, and classroom materials.

The video wall, valued at $220,000, consists of 16 46" LCD monitors arranged in a 4x4 grid. Each monitor features ultra-narrow bezels to minimize the size of the seams between the displays. The monitors use Harris InfoCaster software, which provides a variety of features to manage content, video sources, overlays, and special effects.

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The Year in Review (August 1, 2010--September 1, 2012)

The 2010-2011 and 2011-2012 academic years included significant news for the department. Effective June 15, 2012, I transitioned from my role as Interim Department Head to the Department Head of Computer Science at a very exciting period for the department. Computing plays a central role in virtually all aspects of research, learning, and our personal lives. This is reflected in the bursting enrollments in computer science and outstanding prospects for graduates.

A Wall Street Journal (WSJ) survey of corporate recruiters released in September 2010 ranked Purdue University fourth in the nation in preparing students for the work force. The WSJ also ranked Purdue's Department of Computer Science at number eight, indicating that the department was among the top 10 U.S. schools in producing successful graduates in computer science, according to recruiters. Further, the 2011 Academic Ranking of World Universities ranked Purdue University's Department of Computer Science 18th out of 100 computer science programs among universities worldwide. The ranking is determined by weighing specific indicators, such as alumni success, faculty awards, research citations, and publishing productivity.

Eight women from Purdue Computer Science attended the sold-out Grace Hopper Celebration (GHC) of Women in Computing, which was held in Atlanta, Georgia from September 28 to October 2, 2010. The following year, nine women from the program attended the 2011 GHC in Portland, Oregon. Not only were they able to hear from multiple prominent females in the field of technology at these conferences, but they were also given the opportunity to share their research at one of the general poster sessions.

The department continued its outreach efforts with "CONNECT Through the World of Computer Science" events in October 2010 and April 2012. CONNECT was designed to enable high school females to dive into the world of computer science by interacting with current students, stretching their creativity with a fun computing project, and learning about careers in CS. More than 40 students from Indiana participated in each event.

In October 2010, the High Performance Scientific Computing was held at Purdue University in honor of Professor Ahmed Sameh on the occasion of his 70th birthday. More than 60 guests attended the conference, which was focused on high-performance scientific computing, with an emphasis on architectures, algorithms, and applications.

The Departments of Statistics and Computer Science, with additional support from Purdue's Discovery Park, hosted a Machine Learning Summer School (MLSS) in June 2011. Individuals new to machine learning were able to learn more about the theory and practice of this technology, while those wishing to broaden their expertise found the advanced courses particularly useful.

In the fall of 2010, the new National Science Foundation Science and Technology Center was initiated under the leadership of Professor Wojciech Szpankowski. The Center for Science of Information is the first in the state of Indiana and only the second such center focused on computer science. The center aims to make major advances in the science of information by developing principles that encompass such concepts as structure, time, space, and semantics. The center brings together leading researchers from across the globe and will be supported by NSF through a $25 million grant over five years.

The Cyber Center in Discovery Park, along with researchers at the universities of Texas at San Antonio and Texas at Dallas, has been awarded a $3 million grant from the National Science Foundation to study assured data provenance. Professor Elisa Bertino is the principal investigator on the project and has served as the director of the Cyber Center since July 2010.

A 16' x 9' tiled video wall located in the Commons was generously donated by the Harris Corporation in April 2011.

Year in Review

The wall is used for a variety of purposes, including advertising campus events, workshop and colloquium speakers, research demonstrations, news and information, and classroom materials. Eight students, who participated in the human-computer interaction course taught by Assistant Department Head Tim Korb, created interactive smartphone applications for the wall which was featured in local news media.

In September 2011, a series of art installations was unveiled, featuring the work of Professor Greg Frederickson, alumnus David Spellmeyer (B.S. '83), and Petrônio Bendito, a Purdue professor of art and design. The exhibition celebrates the intersections of computer science and artistic expression and was displayed throughout the 2011-2012 academic year.

Effective fall 2011, David Gleich joined the Purdue Computer Science faculty as an assistant professor. His research interests are in large-scale matrix computations, numerical graph algorithms, and sparse matrix computations. The following fall of 2012, Elena Grigorescu and Yi Wu joined the Purdue Computer Science faculty as assistant professors. Grigorescu's research interests lie in theoretical aspects of computer science, with a focus on sublinear-time algorithms, property testing, coding theory, and complexity theory. Wu's research interests include approximation algorithms, hardness of approximation, optimization, computational learning theory, probability, complexity theory, and randomized algorithms.

Awards, Honors, and Promotions

Faculty

The National Science Foundation chose seven members of the Purdue Computer Science Department to receive Faculty Early Career Development (CAREER) awards: Charles Killian, Ramana Kompella, Alan Qi, Olga Vitek, David Gleich, Jennifer Neville, and Xavier Tricoche. Assistant Professor Patrick Eugster was awarded a fellowship from the Alexander von Humboldt Foundation. Associate Professor Chris Clifton was recently recognized as one of the two senior faculty members across campus to receive Purdue's Teaching for Tomorrow Fellowship Award (Senior Faculty Category), and Professor Jan Vitek and Associate Professor Dongyan Xu were honored as University Faculty Scholars.

Professor Eugene Spafford was presented with a Lifetime Achievement Award by SANS, an Outstanding Achievement Award at WORLDCOMP'11, and Purdue's newly established Morrill Award. Professor Brad Lucier was named a Simons Fellow in Mathematics by the Simons Foundation in 2011. Professors Robert Skeel and Ahmed Sameh were named as SIAM Fellows for 2011. Sameh was also elected a Fellow of IACM in 2012. Professor Christoph Hoffmann was honored with the Pierre Bézier Award at the October 2011 SIAM Conference on Geometric and Physcial Modeling. Associate Professor Chris Clifton was awarded the 2011 IEEE ICDM Outstanding Service Award and was named a Fellow of CERIAS in April 2012.

Several Purdue Computer Science faculty were elected to leadership positions in the Association for Computing Machinery (ACM) in 2012: Professor Eugene Spafford is a Member-at-Large of the ACM Council, Professor Elisa Bertino is a Member-at-Large of the ACM SIG Governing Board, Professor Jan Vitek is the Chair of SIGPLAN, and Professor Walid Aref is the chair of SIGSPATIAL.

Professor Bharat Bhargava was honored at Purdue Research Foundation's annual Inventors Recognition Reception to honor Purdue researchers whose discoveries were patented during the 2010-2011 fiscal year. Professor Mikhail Atallah was similarly honored.

In the fall of 2011, Sonia Fahmy was promoted to full professor with tenure and S.V.N. Vishwanathan and Olga Vitek were each promoted to associate professors with tenure. In April 2012, Associate Professor of Educational Psychology Aman Yadav was given a courtesy appointment in Computer Science. Effective fall 2012, Patrick Eugster, Luo Si, and Xiangyu Zhang were each promoted to associate professors with tenure.

Year in Review

Staff
CS Outreach Coordinator, Mindy Hart, was re-elected to the board of the Computer Science Teachers Association (CSTA) in April 2011.

In February 2012, Assistant Department Head Tim Korb was recognized for his thirty years of service to Purdue University.

Students
Undergraduate students John Bohlmann and Sam Kerr have been selected for Honorable Mention in the Computing Research Association's Outstanding Undergraduate Researcher Award competition for 2011. Graduate student Aditi Gupta received Best Demo for her presentation at the PerCom 2011 conference in Seattle, Washington. Pelin Angin, also a graduate student, was selected to receive the Committee for the Education of Teaching Assistants (CETA) Teaching Award in April 2011.

The SIGBOTs of Purdue University's ACM chapter (including undergraduate CS majors Javid Habibi, Robb Glasser, Bridger Deimen, Ajay Panicker, and Ethan Madden) earned second place and a Judges Choice Award in the third annual Vex Robotics All-Star Challenge, held in Orlando, Florida in November 2011. In January 2012, undergraduate Nathaniel Cherry placed third in the first annual Windward International Collegiate Programming Finals.

Ashish Kundu (PhD '10) was awarded the CERIAS Diamond Award during the 2011 CERIAS Symposium and the following year, Jeffrey Seibert (PhD '12) received the Diamond Award during the 2012 symposium. The Diamond Award is given to a student (grad or undergrad) who exemplifies the "diamond in the rough" tranisition through outstanding academic achievement.

In spring 2012, PhD students Dan Zhang and Rongjing Xiang each received a 2012-2013 IBM Ph.D. Fellowship, which honors exceptional PhD students, who have an interest in solving problems that are fundamental to innovation in computer science.

Alumni
Cheryl Railey (BS '81), David Spellmeyer (BS '83), and Janice Zdankus (BS '85) were recognized as Outstanding Alumni in fall 2010, and John Riedl (MS '85, PhD '90), Ian Murdock (BS '96), and Bryn Dole (MS '96) were recognized as Outstanding Alumni in fall 2011. In the spring semesters, Dave Capka (MS '73, PhD '83) was honored as the Distinguished Alumnus for 2011 and Larry Peterson (MS 81, PhD '85) was honored as the Distinguished Alumnus for 2012. The continuing marching band activities of Steve (MS '76, PhD '81) and Janet (MS '78 in Mathematics) Tolopka were featured in the fall (2010) issue of Insights magazine. In late 2011, alumnus Alan Hevner (BS '73, MS '76, and PhD '79) was elected a Fellow of the American Association for the Advancement of Science.

Looking Ahead

We expect significant changes to the Computer Science Department and the entire university this coming year! Purdue will welcome a new president in former Indiana governor Mitch Daniels in spring 2013.

Throughout the 2012-13 academic year, the department will celebrate the 50th anniversary of the Computer Science Department, founded in October 1962.

Diversity

The Department of Computer Science is committed to diversity among our students, faculty, and staff, supporting both the participation and success of underrepresented minorities and women in computer science.

We have created computer science recruiting materials to emphasize the variety of career options available to CS graduates - career options that appeal to a diverse group of students. The department supports a number of events, programs, and other initiatives aimed at increasing the pipeline of women and underrepresented minorities. These initiatives reinforce the fact that successful companies depend on a variety of contributions from a diverse group of employees. Examples of current activities include middle school summer camps to expose underrepresented students to the excitement of computer science, an annual Women in Computer Science Career Day, and a student-led high school visitation program called "Reaching Out for Computer Science"–ROCS.

We work with the Midwest Crossroads AGEP program office at Purdue, offering summer-bridge programs to incoming students, and participation in conferences aimed at recruiting underrepresented minorities. We also host GEM consortium fellows, Science Bound summer interns, and Louis Stokes Alliance for Minority Participation (LSAMP) research students. One of our faculty has created a student group, "Association of Minorities in Graphics and Other Sciences"–AMIGOS, to encourage minority participation in departmental events.

We have an active presence at many conferences, including the Grace Hopper Celebration of Women in Computing and the CIC Summer Research Opportunities Program (SROP). We visit institutions and high schools with high enrollment of underrepresented minorities and encourage students to join our program.

Our department's Computer Science Women's Network (CSWN) is an organization of students, faculty, and staff dedicated to helping all members succeed in computer science. Over the past several years, we have been successful in hiring outstanding female faculty. As mentioned above, we hold an annual Women in Computer Science Career Day (now called CONNECT), targeting high school juniors. The career day event presents young women with fun lab activities that allow them to explore computer science as a career and Purdue Computer Science as a way to get there.

Bioinformatics and Computational Biology

Faculty in the area of bioinformatics and computational biology apply computational methodologies such as databases, machine learning, discrete, probabilistic, and numerical algorithms, and methods of statistical inference to problems in molecular biology, systems biology, structural biology, and molecular biophysics.

Bioinformatics and computational biology research enables researchers to process the massive data, becoming available with novel experimental methodologies in genomics and proteomics. Current work addressing this need includes the design and implementation of biological databases and text/data mining for life sciences - in particular, automatic gene function annotation from the literature.

Advances in molecular biology and systems biology involve the extraction of information and patterns from data. Work in this area includes finding context-sensitive modules from multiple cancer networks, identifying protein-DNA binding sites, analyzing flow cytometry data to find cancer stem cells, algorithms and statistical approaches for functional annotation of molecules based on their sequences, identifying protein biomarkers for lung and prostate cancer using clinical data and experiments with model organisms, and studies of biomolecular networks.

Data for these projects are obtained by a variety of experimental technologies, including gene expression microarrays, protein-DNA binding data, flow cytometry data, sequence data, mass spectrometry-based proteomics and metabolomics, and ionomic profiling.

Progress in structural biology and molecular biophysics requires models that incorporate physical properties of biomolecules, as well as data. Work in this direction includes prediction and analysis of the relationship among protein sequence, structure, and function, determining protein structure via NMR, determining transition paths of conformational change of proteins and free energies of protein-ligand binding, and simulating DNA dynamics and self-assembly.

Faculty involved in bioinformatics and computation biology at Purdue include Ananth Grama (p. 9), Daisuke Kihara, Alex Pothen (p. 9), Yuan (Alan) Qi, Luo Si (p. 19), Robert Skeel (p. 9), Wojciech Szpankowski (p. 27), and Olga Vitek.

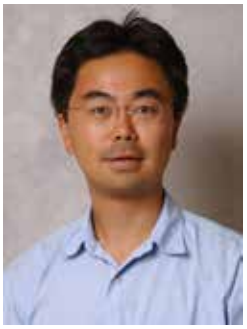
Selected Publications

Troy Hawkins, Stan Luban and Daisuke Kihara, "Enhanced automated function prediction using distantly related sequences and contextual association by PFP", Protein Science, Volume 15, 1550-1556, 2006.

Yen Hock Tan, He Huang, Daisuke Kihara, "Statistical potential-based amino acid similarity matrices for aligning distantly related protein sequences", Proteins: Structure, Function, Bioinformatics, Volume 64: pp. 587-600, 2006.

Jianjun Hu, Yifeng David Yang & Daisuke Kihara, "EMD: an ensemble algorithm for discovering regulatory motifs in DNA sequences", BMC Bioinformatics, 7:342, 2006.

A. L. Oberg, O. Vitek, "Statistical design of quantitative mass spectrometry-based proteomic experiments". Journal of Proteome Research, 8, p. 2144-2156, 2009.



Daisuke Kihara Olga Vitek

I. R. Baxter, O. Vitek, B. Lahner, B. Muthukumar, M. Borghi, J. Morrissey, M. L. Guerinot, D. E. Salt, "The leaf ionome as a multivariable system to detect a plant's physiological status", Proceedings of the National Academy of Sciences, 105, p.12081–12086, 2008.

A. Nesvizhskii, O. Vitek and R. Aebersold, "Analysis and validation of proteomic data generated by tandem mass spectrometry", Nature Methods, 4, p. 787-797, 2007.

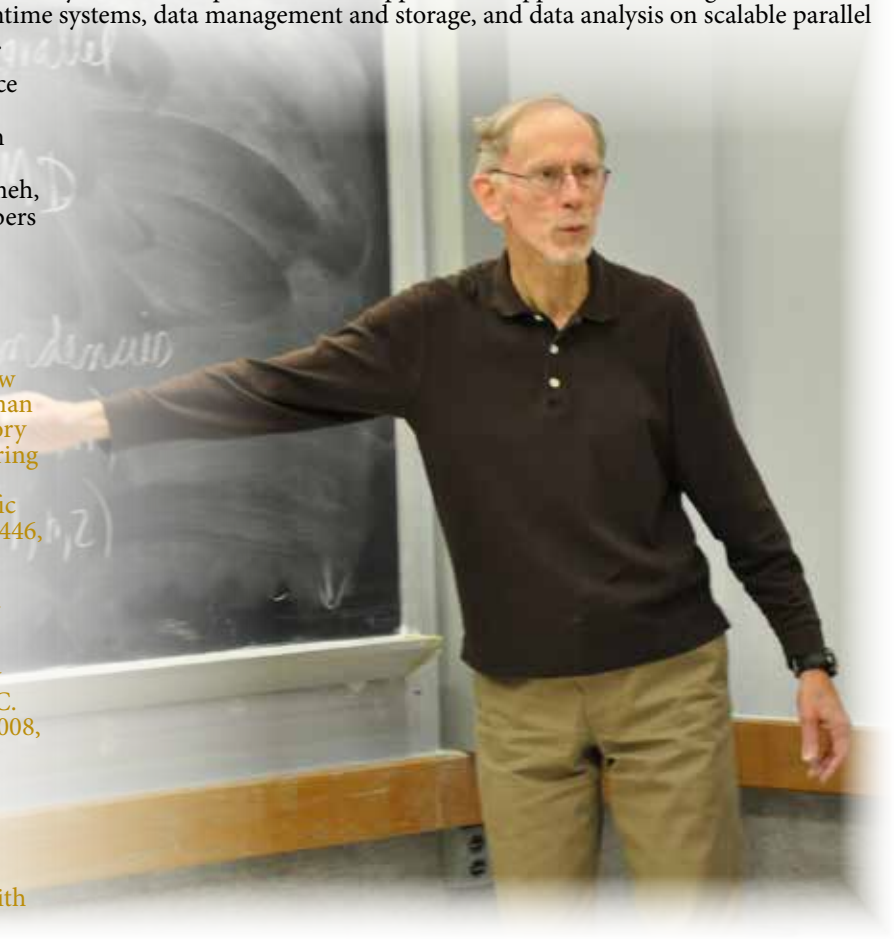
ASSOCIATE PROFESSOR DAISUKE KIHARA and postdoc researcher DR. SAEL LEE received the BEST PAPER AWARD at the 21st International Conference on Genome Informatics (GIW 2010).

Computational Science and Engineering

Computational science and engineering, or scientific computing, provided the impetus for many of the early computer science departments in the 1960s. Purdue is one of the few programs nationwide that have consistently maintained a leadership position in this important discipline. The computational science and engineering group includes nine full-time faculty members (one with a joint appointment in athematics). The group's research activity focuses on the development of algorithms (numerical as well as combinatorial), parallel and distributed techniques, software infrastructure, and novel computing platforms. These research efforts are driven by state-of-the-art applications in modeling of materials and bio-chemical processes (ranging from atomistic to systems-level models), novel microelectromechanical systems, structural mechanics and control, robotics and advanced manufacturing, image processing and visualization (with applications in life-sciences and health-care), and critical infrastructure protection (e.g., power grids and other civil infrastructure).

The algorithmic research activities concern the development of novel solvers (linear and non-linear system solvers, eigenvalue/singular-value decompositions), techniques for real-time control, numerical methods for modeling many-body systems, combinatorial scientific computing, automatic differentiation, and computational geometry algorithms for reasoning about shapes and mechanisms. Systems development efforts support these applications through the development of advanced compilers, runtime systems, data management and storage, and data analysis on scalable parallel platforms and distributed infrastructure.

Faculty involved in computational science and engineering at Purdue include David Gleich, Ananth Grama, Christoph Hoffmann (p. 15), Bradley Lucier, Alex Pothen, Elisha Sacks (p. 15), Ahmed Sameh, Robert Skeel, and research faculty members Assefaw Gebremedhin and Faisal Saied.



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Doruk Bozdag, Umit Catalyurek, Assefaw Gebremedhin, Fredrik Manne, Erik Boman and Fusun Ozguner, "Distributed-memory Parallel Algorithms for Distance-2 Coloring and Related Problems in Derivative Computation", SIAM Journal on Scientific Computing, Vol. 32, Issue 4, pp. 2418--2446, 2010.

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David Gleich **Ananth Grama** **Bradley Lucier** **Alex Pothen** **Ahmed Sameh** **Robert Skeel**

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Bogdan Carbunar, Ananth Grama, Jan Vitek, Octavian Carbunar, "Redundancy and Coverage Detection in Sensor Networks", ACM Transactions on Sensor Networks, Volume 2, Issue 1, 2006.

Mehmet Koyuturk, Yohan Kim, Shankar Subramaniam, Wojciech Szpankowski, and Ananth Grama, "Detecting conserved interaction patterns in biological networks", Journal of Computational Biology, 13(7), 1299-1322, 2006.

Ronaldo Ferreira, Suresh Jagannathan, and Ananth Grama, "Locality in Structured Peer-to-Peer Networks", Journal of Parallel and Distributed Computing, Volume 66, Number 2, pages 257-273, 2006.

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Antonin Chambolle, Stacey E. Levine, and Bradley J. Lucier, "An upwind finite-difference method for total variation-based image smoothing", SIAM Journal on Imaging Sciences, 4(1):277-299, 2011.

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Assefaw Gebremedhin, Alex Pothen, Arijit Tarafdar, and Andrea Walther, "Efficent Computation of Sparse Hessians using Coloring and Automatic Differentiation", INFORMS Journal on Computing, Vol. 21 (2), pp. 209-223, 2009.

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M. Sathe, O. Schenk, B. Ucar, and A. Sameh, "A Scalable Hybrid Linear Solver Based on Combinatorial Algorithms", in Combinatorial Scientific Computing, pp. 95-127, 2012, Editors: U. Nauman and O. Schenk, CRC Press.

M. Manguoglu, M. Koyuturk, A. Sameh, and A. Grama, "Weighted Matrix Ordering and Parallel Banded Preconditioners for Iterative System Solvers", SIAM J. on Sc. Comp.Vol. 32, pp. 1201-1216, 2010.

J.C. Phillips, R. Braun, W. Wang, J. Gumbart, E. Tajkhorshid, E. Villa, C. Chipot, R.D. Skeel, L. Kale, and K. Schulten, "Scalable molecular dynamics with NAMD", Journal of Computational Chemistry 26, 1781-1802, 2005.

R. D. Skeel, "What makes molecular dynamics work?", SIAM Journal of Scientific Computing 31, 1363-1378, 2009.

R. Zhao, J. Shen, and R. D. Skeel, "Maximum flux transition paths of conformational change", Journal of Chemical Theory and Computation 6, 2411-2423, 2010.

Databases and Data Mining

The database and data mining group at Purdue is composed of Professors Walid G. Aref, Elisa Bertino (p. 17), Bharat Bhargava, Christopher Clifton, Ahmed Elmagarmid, Susanne Hambrusch (p. 27), Jennifer Neville (p. 19), Ninghui Li (p. 17), Sunil Prabhakar, and Luo Si (p. 19); Research Associate Professor Mourad Ouzzani, and more than thirty graduate students. The group conducts fundamental and cutting-edge research in database systems, database privacy and security, data mining, web search, information retrieval, and natural language processing. Current projects and topics include:

Context aware database management systems (Aref, Bhargava, Ouzzani)
Cyber infrastructure (Elmagarmid, Ouzzani)
Data and service integration and schema matching (Elmagarmid, Ouzzani)
Data quality (Elmagarmid, Ouzzani)
Database security and online auctions (Bertino, Bhargava)
Location privacy (Aref, Bertino, Bhargava)
Massively parallel spatiotemporal data management (Aref, Ouzzani)
Privacy enhancing technologies for data, text, and data mining (Clifton, Si)
Private and secure data dissemination (Aref, Bhargava, Clifton)
Scientific data management (Aref, Elmagarmid, Ouzzani)
Search and Intelligent Tutoring (Si)
Self-learning disk scheduling (Bhargava)
Statistical relational models (Neville)
Stream data management (Aref, Elmagarmid, Prabhakar)
Uncertainty data management (Hambrusch, Neville, Prabhakar)
Trustworthy data from untrusted servers (Prabhakar)

Members of the database and data mining group engage in high-impact multidisciplinary projects and collaborations that involve multiple disciplines including Agronomy, Biology, Chemistry, Chemical Engineering, Linguistics, Nursing, Physics, and Social Sciences.

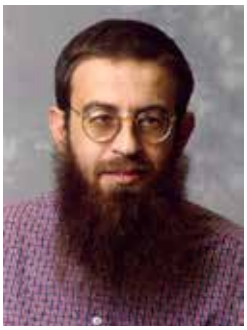
In the past five years, the database and data mining group has graduated more than 20 PhD students, who have started their careers in various universities (e.g., Alexandria University, Arizona State University, University of Calgary, SUNY Albany, Missouri University of Science and Technology, James Madison University, and Worchester Polytechnic Institute) and industry (e.g., Amazon, AT&T, Google, IBM, Microsoft, Teradata). Earlier graduates have distinguished themselves as faculty at top schools including IUPUI, University of Hong Kong, University of Minnesota, Rutgers University, University of South Florida, SUNY Stony Brook, University of Texas at Dallas, and Waterloo University.

Details about the above research conducted and the multidisciplinary projects can be found at www.cs.purdue.edu/icds.

Selected Publications

Thanaa M. Ghanem, Ahmed K. Elmagarmid, Paul Larson, Walid G. Aref, "Supporting views in data stream management systems", ACM Transactions on Database Systems (TODS), 35(1): (2010).

PROFESSOR BHARAT BHARGAVA, along with research assistant NOOPUR SINGH and ASHER SINCLAIR of the Air Force Research Laboratory, received the BEST PAPER AWARD at the first International Conference on Advances in Computing and Communication (ICACC 2011).





Walid Aref | Bharat Bhargava | Christopher Clifton | Ahmed Elmagarmid | Sunil Prabhakar

Ahmed M. Aly, Walid G. Aref, Mourad Ouzzani, "Spatial Queries with Two kNN Predicates," PVLDB 5(11): 1100-1111, 2012.

Yasin N. Silva, Walid G. Aref, Mohamed H. Ali, "The similarity join database operator", ICDE 2010: 892-903.

Pelin Angin, Bharat Bhargava, "Real-time Mobile-Cloud Computing for Context-Aware Blind Navigation", International Journal of Next Generation Computing, Vol 2, No 2, 2011.

Amit Shirsat, Bharat Bhargava, "Local geometric algorithm for hole boundary detection in sensor networks", Security and Communication Networks 4(9): 1003-1012 (2011).

Pelin Angin, Bharat K. Bhargava, Rohit Ranchal, Noopur Singh, Mark Linderman, Lotfi Ben Othmane, Leszek Lilien, "An Entity-Centric Approach for Privacy and Identity Management in Cloud Computing", SRDS 2010: 177-183.

Murat Kantarcioglu, Bowei Xi, Chris Clifton, "Classifier evaluation and attribute selection against active adversaries", Data Mining and Knowledge Discovovery 22(1-2): 291-335 (2011).

Mummoorthy Murugesan, Wei Jiang, Chris Clifton, Luo Si and Jaideep Vaidya, "Efficient Privacy-Preserving Similar Document Detection", The VLDB Journal, 19(4):457-475, August 2010.

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Hazem Elmeleegy, Ahmed K. Elmagarmid, Jaewoo Lee, "Leveraging query logs for schema mapping generation in U-MAP", SIGMOD Conference 2011: 121-132.

Mohamed Yakout, Ahmed K. Elmagarmid, Jennifer Neville, Mourad Ouzzani, Ihab F. Ilyas, "Guided data repair", PVLDB 4(5): 279-289 (2011).

Mohamed Yakout, Ahmed K. Elmagarmid, Hazem Elmeleegy, Mourad Ouzzani, Alan Qi, "Behavior Based Record Linkage", PVLDB 3(1): 439-448 (2010).

Biao Qin, Yuni Xia, Sunil Prabhakar, "Rule induction for uncertain data", Knowledge and Informantion Systems 29(1): 103-130 (2011).

William Sumner, Tao Bao, Xiangyu Zhang, Sunil Prabhakar, "Coalescing Executions for Fast Uncertainty Analysis", International Conference on Software Engineering (ICSE), 2010.

Chris Mayfield, Jennifer Neville, Sunil Prabhakar, "ERACER: A Database Approach for Statistical Inference and Data Cleaning", Proceedings of the ACM International Conference on Management of Data (SIGMOD), June 2010, Indianapolis, USA.

Distributed Systems

The distributed systems group focuses on designing distributed systems that are scalable, dependable, and secure, behaving according to their specification in spite of errors, misconfigurations, or being subjected to attacks. Areas of focus include:

Virtualization technologies. One thrust is developing advanced virtualization technologies for computer malware defense and cloud computing. Researchers at the Lab For Research In Emerging Network & Distributed Systems (FRIENDS) have been studying the security, reliability, and performance of virtual machines and virtual infrastructures in cloud computing environments.

Ongoing research efforts in the computer malware defense area include: operating system level information flow tracking for user-level malware investigation; virtual machine (VM) introspection for stealthy malware monitoring and detection, and VM memory shadowing for kernel-rootkit prevention and profiling. In the virtual distributed computing area, the lab has proposed and instantiated the concept of "virtual networked environment" for creating virtual infrastructures on top of a shared physical hosting infrastructure. The concept and its enabling techniques have been applied to support a number of emerging applications, such as scientific job execution, virtual organizations, and tele-immersion.

Intrusion tolerant systems. Researchers at the Dependable and Secure Distributed Systems Laboratory (DS2) are designing distributed systems, networks, and applications that can tolerate insiders, while maintaining acceptable levels of performance. Recent research lies in designing intrusion-tolerant systems in the context of (1) replication services, (2) routing for wireless ad hoc networks, and (3) unstructured overlays for peer-to-peer streaming.

Model checking and simulation testing. Another thrust is studying the utility of distributed-system model checking and simulation testing by coupling it with dynamic program slicing and machine learning. Each of these techniques have the ability to summarize and focus the massive amounts of available information so the programmer-designer can focus on the significant parts of the execution, while ignoring the rest. The goal is to develop enabling technologies and prototype frameworks for collaborative high-performance distributed computing and simulation that may be adapted and enhanced to deploy scalable and portable systems.

Experimental analysis. Researchers at the RAID laboratory are conducting scientific research in a variety of subjects related to experimental analysis such as: communication experiments for distributed applications, network communication measurement experiments, experimental analysis of communication infrastructure, adaptability experiments for distributed systems, replication and recovery experiments for distributed database systems, concurrent check-pointing and rollback-recovery algorithms, concurrency control for distributed database systems, efficient implementation techniques for distributed systems, digital library, and mobile communication.

Faculty involved in distributed systems at Purdue include Bharat Bhargava (p. 11), Patrick Eugster (p. 23), Ananth Grama (p. 9), Antony Hosking (p. 23), Suresh Jagannathan (p. 23), Charles Killian, Cristina Nita-Rotaru (p. 17), Kihong Park (p. 21), Vernon Rego, Dongyan Xu, and David Yau (p. 21).

Selected Publications

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Dongyan Xu

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Z. Lin, J. Rhee, X. Zhang, D. Xu, X. Jiang, "SigGraph: Brute Force Scanning of Kernel Data Structure Instances Using Graph-based Signatures", Proceedings of the 18th Network and Distributed System Security Symposium (NDSS 2011), February 2011.

S. Gamage, A. Kangarlou, R. Kompella, D. Xu, "Opportunistic Flooding to Improve TCP Transmit Performance in Virtualized Clouds", Proceedings of ACM Symposium on Cloud Computing (SOCC 2011), October 2011, (honored as "Paper of Distinction").

ASSOCIATE PROFESSOR DONGYAN XU and ASSISTANT PROFESSOR RAMANA KOMPELLA, along with graduate students SAHAN GAMAGE and ARDALAN KANGARLOU, received a PAPER OF DISTINCTION AWARD at the ACM Symposium on Cloud Computing (SOCC'11).

Graphics and Visualization

The graphics group performs research in graphics, visualization, computational geometry, and related applications. This report describes major projects on which the group focused.

Model acquisition. The graphics and visualization group developed self-calibrating methods for acquiring high-quality geometric models (accuracy as high as 0.05mm) of objects and of room-size scenes. They combined photometric measurements with geometric measurements and used algebra to eliminate many calibration parameters. This approach led to better algorithms for capturing dynamic scenes, for acquiring models of highly specular and inter-reflective scenes, and for changing the appearance of objects.

Simulation. In collaboration with civil engineers, the graphics and visualization team produced a high-fidelity simulation of the 9/11 attack on the World Trade Center. The interest in such a simulation transcends civil engineering and includes emergency response, defense, and society in general. The simulation follows the laws of physics as closely as possible. The results are presented through a visualization that is eloquent to users outside of civil engineering. The visualization has been downloaded more than five million times.

Image generalization. Images are used in computer graphics and visualization to convey information in cases like 3-D scene exploration, remote visualization, acceleration of high-cost rendering effects, and video surveillance. Images are computed by sampling data with rays defined by a camera model mostly by using the planar pinhole camera model, which suffers from important limitations. The camera model design paradigm is an infrastructure-level innovation with broad applicability used to overcome these limitations and advocates designing the set of rays that best suit a given application and optimizing it dynamically according to the data sampled. Camera model design is a flexible framework for generating images with multiple viewpoints and with a variable sampling rate. Like conventional images, the generated images are continuous, non-redundant, and can be computed efficiently with the help of graphics hardware.

Scientific visualization. Computer simulations and high-throughput measuring devices produce an overwhelming volume of data across science, engineering, and medicine. Current research spans a range of topics in visualization and geometric data processing to devise new models and efficient algorithms for the effective visual mapping and analysis of information. We have created new spatial data structures that dramatically increase the performance of a broad class of rendering and visualization methods. We have addressed the computational bottlenecks of advanced saliency models in fluid dynamics applications. We have investigated new representations and study the structural properties of large-scale particle assemblies in granular material simulations. We have applied topological concepts and advanced numerical algorithms to the efficient analysis and visualization of Hamiltonian systems in problems related to magnetic confinement and space mission planning. Finally, we have proposed a new hybrid CPU/GPU method for the extraction of ridge surfaces from three-dimensional datasets in scale space.

Urban modeling. Faculty in the area of graphics and visualization are working on the modeling and simulation of large urban environments. The goal is to obtain digital models of large-scale urban structures in order to simulate physical phenomena (e.g., changes in weather, vegetation, etc.) and human activities (e.g., population and employment changes). Purdue researchers have developed algorithms that use ground-level imagery, aerial imagery, procedural modeling, and street and parcel data to create and modify 3D geometry and 2D layouts making models more easily modifiable.

Robust computational geometry. Computational geometry algorithms are formulated in a model where arithmetic operations have infinite accuracy and unit cost. We developed robust versions of five core algorithms and validated them on examples that far exceed the capabilities of prior work.

Geometric computations and constraints. Complementing computational geometry, computations on nonlinear geometric structures are developed and analyzed. Applications include discrete manufacturing / CAD. New techniques for solving geometric constraint problems and including into the vocabulary curves and surfaces from CAGD are of particular interest. Data formats for succinct archival of geometric data in manufacturing and sensory image acquisition, as well as new approaches to interoperability are also under consideration.





Daniel Aliaga **Christoph Hoffmann** **Voicu Popescu** **Elisha Sacks** **Xavier Tricoche**

Faculty involved in graphics and visualization at Purdue include Daniel Aliaga, Christoph Hoffmann, Voicu Popescu, Elisha Sacks, and Xavier Tricoche.

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N. Andrysco, X. Tricoche, "Matrix Trees", Computer Graphics Forum, 29(3), 2010.

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Information Security and Assurance

Faculty involved with information security and assurance are often affiliated with the university-wide Center for Education and Research in Information Assurance and Security (CERIAS). CERIAS is considered to be the top-ranked such group in the world, with faculty from 18 departments at Purdue. Their research covers all aspects of computer and network security, privacy, and cyber crime investigation. Areas of special focus by CS faculty include:

Identification, authentication, and privacy. There is a tension between increased confidence and granularity of authorization provided by better identification of on-line entities, and with the need to protect the privacy rights of individuals and organizations. This area includes research in role-based access control, privacy-protecting transformations of data, privacy-protecting data mining methods, privacy regulation (e.g., HIPAA), oblivious multiparty computation, and digital identity management systems.

Incident detection, response, and investigation. Systems are attacked and sometimes attacks succeed. This area of expertise includes intrusion and misuse detection, integrity management issues, audit and logging analysis, sensor and alarm design, strike-back mechanisms, dynamic reconfiguration, honeypots and jails, cyberforensics, and intrusion-tolerance.

Cryptology and rights management. Controlling information from being read or altered by others, preserving marks of ownership and origin, and breaking the code of adversaries are all of interest in information security. Research interests include encryption, number theoretic foundations, cryptanalysis, and watermarking.

Data security. Data is often the most important asset that organizations have and it is the target of almost all attacks. Relevant research includes: secure architectures for databases, security of streaming data, high-assurance integrity systems for databases, anomaly detection, and response system mechanisms for databases.

System security. Advanced virtualization-based techniques are developed for the detection, prevention and profiling of both user-level and kernel-level computer malware. Research includes the use of these techniques for protection from botnets. New reverse engineering techniques are being developed for the analysis of binary programs and raw memory images. These techniques are being applied to computer forensics and software vulnerability discovery.

Trusted social and human interactions. How does IT change our interactions, and how can more trustworthy IT change them further? This includes studies of online trust, e-commerce (business-to-business and business-to-consumer), digital government services, e-conferencing, online personae and anonymity, online news, online research and the ephemeral nature of information, online propaganda, and spam.

Faculty involved in information security and assurance at Purdue include Mikhail Atallah, Elisa Bertino, Bharat Bhargava (p. 11), Christopher Clifton (p. 11), Sonia Fahmy (p. 21), Ninghui Li, Cristina Nita-Rotaru, Kihong Park (p. 21), Sunil Prabhakar (p. 11), Vernon Rego (p. 13), Eugene H. Spafford, Jan Vitek (p. 23), Samuel Wagstaff Dongyan Xu (p. 13), and David Yau (p. 21).

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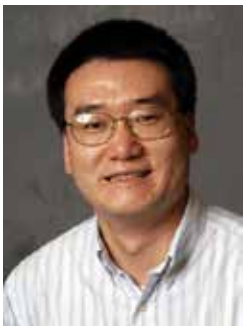


Mikhail Atallah **Elisa Bertino** **Ninghui Li** **Cristina Nita-Rotaru** **Eugene H. Spafford** **Samuel Wagstaff**

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Machine Learning and Information Retrieval

With massive data available from various engineering, scientific, and social disciplines, machine learning and information retrieval have played an imperative role in discovering hidden patterns or relationships between intertwined components (e.g., people, web pages, or genes in a complex system), understanding properties of various systems, and making meaningful predictions for a variety of applications.

In the past few years, Purdue has grown a strong machine learning and information retrieval group with strengths in multiple areas of this field. In particular, Professor Jennifer Neville works on multiple problems in relational modeling, such as fusion and analysis of multi-source relational data and modeling relational communication on distributed team effectiveness. Her team also integrates machine learning methods with agent-based models to form a compositional model, which will combine components that are learned from data with components that are hand-engineered using traditional methods. This combination will produce powerful tools for understanding the emergent behavior of complex social and organizational systems. Professor Luo Si develops federated text search, which is the search beyond traditional engines such as Google, Yahoo! or MSN by finding information that is "hidden" behind many search engines. His team also uses cutting-edge computer science techniques to construct an exploratory, but fully functioning differentiated instructional system of mathematical word problem solving. Professor Christopher Clifton (p. 11) addresses problems in privacy-preserving data mining by developing technology that share some information to calculate correct results, where the shared information can be shown not to disclose private data. Professor S.V.N. Vishwanathan works on kernel methods and interactions between machine learning and optimization. Professor Yuan (Alan) Qi's research interests span several areas in machine learning and computational biology. His team develops new methods to detect context sensitive modules for complex biological and social networks, combines statistical learning with ab-inito methods for computational materials design, and design Bayesian matrix factorization methods for collaborative filtering (with applications to online recommendation systems) and text clustering.

Faculty in this area have obtained significant funding support for their research activities. They also have received external recognition such as the IEEE "AI's 10 to watch" for Professor Neville, an NSF career award for Professor Si, and Microsoft Breakthrough research award (one out of ten nationally) for Professor Qi.

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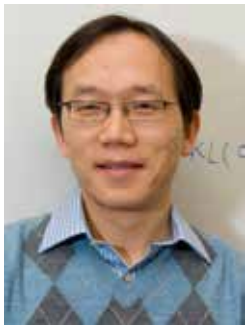

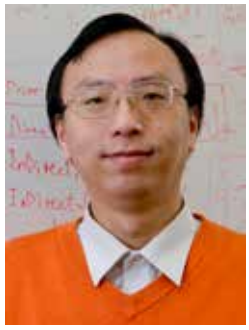

Jennifer Neville **Yuan (Alan) Qi** **Luo Si** **S.V.N. Vishwanathan**

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Networking and Operating Systems

Faculty in the area of networking and operating systems are tackling fundamental problems at different layers of the network protocol stack, from the medium access control layer all the way up to the application layer. The group uses theoretical models, simulation, emulation, and extensive testbed experimentation to develop and evaluate their proposed solutions. The group has leveraged techniques from game theory, information theory, complexity theory, optimization, and cryptography in their solutions. The group has implemented their methods on a variety of platforms, ranging from large clusters, to network processors and resource-constrained wireless sensor motes.

Projects that the faculty have recently undertaken include fault localization in enterprise networks; packet classification and scheduling in Internet routers; scalable Internet measurement; Internet routing policy analysis; secure and scalable media streaming over the Internet; secure network coding in wireless mesh networks; design of defenses against malware and denial of service attacks; scalable network simulation and emulation, and coverage, localization and data fusion in energy-constrained wireless sensor networks.

A project led by Professor Douglas Comer, which is part of the multi-institution Nebula grant sponsored by NSF and Cisco Systems, investigates future Internet architectures. Specifically, researchers led by Comer are exploring parallelism as a way to increase the communication throughput between cloud data centers and the core of the Internet. The group is also exploring Border Gateway Protocol defense systems, the use of GENI/OpenFlow technology, and distributed coordination and leadership algorithms for use inside a large core router, such as a Cisco CRS-1.

Another project, led by Professor Sonia Fahmy, considers scalable network security experiments. A primary reason for lack of deployment of network security mechanisms is that most mechanisms have not been validated under realistic conditions, or at sufficiently large scales. The project includes two complementary efforts to address both the fidelity and scale challenges in security experiments by designing: (1) high-fidelity yet scalable models for routers and other devices based on simple device measurements under a few well-crafted scenarios, and (2) techniques to simplify and map experimental scenarios before using simulation, emulation, or testbed experiments.

Professor Ramana Kompella conducts research on protocol design for data center networks. A recent project in this direction focused on fine-grained multi-path routing protocols for better network utilization in data center networks. In another project, he focused on improving TCP performance in virtualized environments, especially those where multiple virtual machines share one processor. As cloud computing gains more popularity, such networking issues become increasingly more important. He has also conducted research on scalable measurement solutions for low latency networks such as financial trading centers, data centers, storage and cluster networks. Specifically, it involved designing streaming algorithms for high-fidelity latency measurements within routers.

Faculty involved in networking and operating systems at Purdue include Douglas Comer, Sonia Fahmy, Charles Killian (p. 13), Ramana Kompella, Cristina Nita-Rotaru (p. 17), Kihong Park, Dongyan Xu (p. 13), and David Yau.

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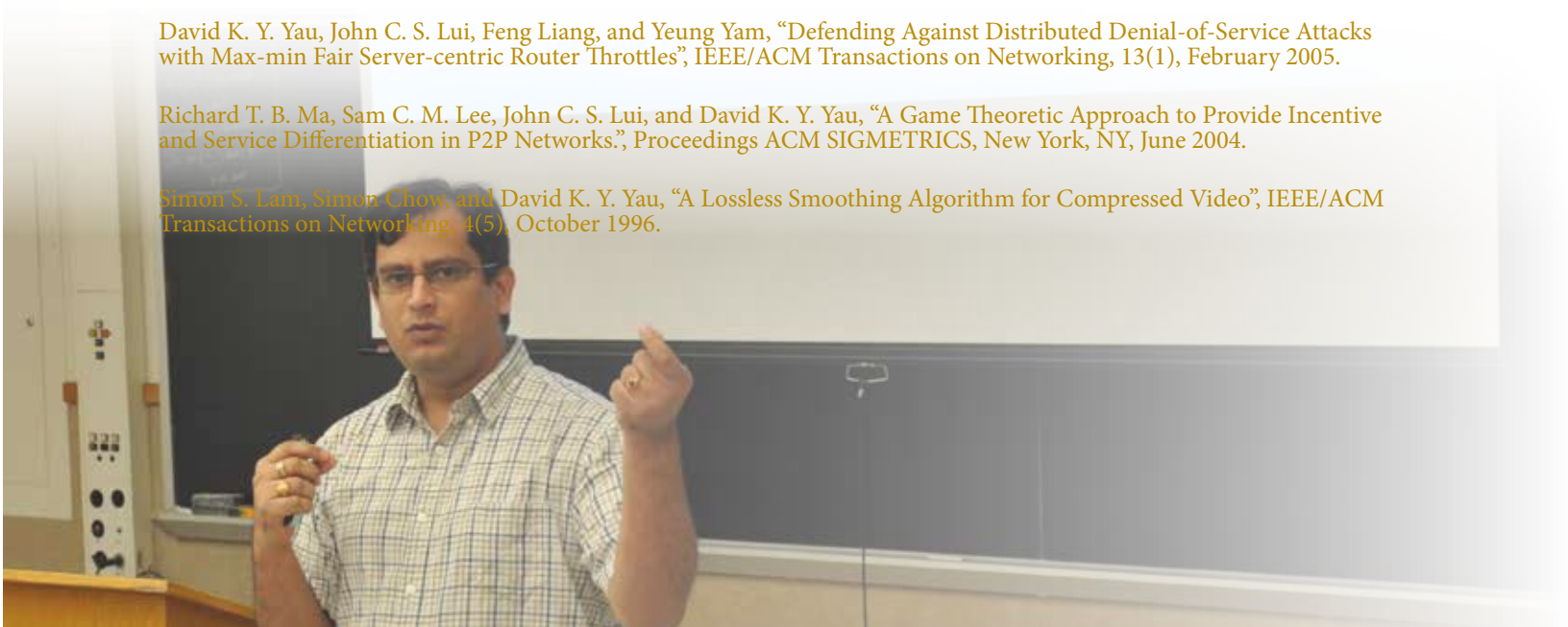

Programming Languages and Compilers

The programming languages and compilers group at Purdue engages in research, spanning all aspects of software systems design, analysis, and implementation. Our faculty have active research projects in functional and object-oriented programming languages, both static and dynamic compilation techniques for scalable multicore systems, scripting languages, distributed programming abstractions and implementations, realtime and embedded systems, mobile and untrusted computing environments, and runtime systems with special focus on memory management and parallel computing environments.

Faculty involved in programming languages and compilers at Purdue include Patrick Eugster, Antony Hosking, Suresh Jagannathan, Zhiyuan Li, Jan Vitek, and Xiangyu Zhang.

ASSOCIATE PROFESSOR PATRICK EUGSTER, along with graduate students JAYARAM KR and CHAMIKARA JAYALATH, received the BEST PAPER AWARD at Middleware 2010.






Patrick Eugster **Antony Hosking** **Suresh Jagannathan** **Zhiyuan Li** **Jan Vitek** **Xiangyu Zhang**

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Wrigstad, Zappa Nardelli, Lebresne, Ostlund, Vitek, "Integrating Typed and Untyped Code in a Scripting Language.", Proceedings of the Conference on Principles of Programming Languages (POPL), 2010.

Pizlo, Blanton, Hosking, Maj, Vitek, Ziarek, "Schism: Fragmentation-Tolerant Real-Time Garbage Collection", Proceedings of the Conference on Programming Language Design and Implementation (PLDI), 2010.

X. Zhang, N. Gupta, and R. Gupta, "Pruning Dynamic Slices With Confidence", ACM SIGPLAN Conference on Programming Language Design and Implementation, 2006.

X. Zhang and R. Gupta, "Whole Execution Traces and their Applications", ACM Transactions on Architecture and Code Optimization, 2005.

X. Zhang and R. Gupta, "Matching Execution Histories of Program Versions", Conference and 13th ACM SIGSOFT Symposium on the Foundations of Software Engineering, 2005.

Software Engineering

The software engineering group conducts research on applying advanced program analyses towards problems related to fault isolation, various kinds of bug detection, including those related to race conditions in concurrent programs, and specification inference for large-scale software systems. Aspect-oriented abstractions and new program slicing and mining techniques are some of the mechanisms that are being explored to address these issues.

Faculty involved in software engineering at Purdue include H. E. Dunsmore, Aditya Mathur, Vernon Rego (p. 13), Eugene H. Spafford (p. 17), Xiangyu Zhang (p. 23).

H. E. (Buster) Dunsmore

Aditya Mathur

Selected Publications

Ammar Masood, Rafae Bhatti, Arif Ghafoor, and Aditya Mathur, "Scalable and Effective Test Generation for Role-Based Access Control Systems", IEEE Transactions on Software Engineering, Volume 35, Issue 5, September-October 2009, pp. 654-668.

Ammar Masood, Arif Ghafoor, and Aditya Mathur, "Conformance Testing of Temporal Role-Based Access Control Systems", IEEE Transactions on Dependable and Secure Computing, 21 Jul. 2008. IEEE Computer Society Digital Library. IEEE Computer Society, (http://doi.ieeecomputersociety.org/10.1109/TDSC.2008.41).

Scott Miller, Raymond DeCarlo, and Aditya P. Mathur, "Quantitative Modeling for Incremental Software Process Control", Proceedings of the 32nd Annual IEEE International Computer Software and Applications Conference, pp. 937-942, Turku, Finland, July 28-August 1, 2008.

Theory of Computing and Algorithms

Research interests of the members of the theory of computing and algorithms group range over many areas of algorithms. These areas include analysis of algorithms, parallel computation, computational algebra and geometry, computational complexity theory, digital watermarking, data structures, graph algorithms, network algorithms, distributed computation, computational biology, information theory, analytic combinatorics, random structures, external memory algorithms, approximation algorithms, data mining, bioinformatics, and text indexing. Much of the research reflects interaction with other areas of the field, such as information security, databases, and geographic information systems.

The ongoing research at Purdue includes theoretical advances, theoretical improvements on applied problems, and algorithms with immediate potential for application. The group has made notable contributions on topics such as updating minimum spanning trees, shortest paths in planar graphs, computing approximate minimum spanning trees distributively, low-diameter P2P networks, parallel computational geometry, cascading divide and conquer, query indexing and velocity constrained indexing, external memory graph algorithms, compressed suffix arrays, and the analysis of Lempel-Ziv codes.

Faculty involved in theory of computing and algorithms at Purdue include Mikhail Atallah (p. 17), Saugata Basu, Greg Frederickson, Susanne Hambrusch, and Wojciech Szpankowski.

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S. Barone, S. Basu, "Refined bounds on the number of connected components of sign conditions on a variety", Discrete and Computational Geometry , 47:577-597 (2012).

S. Basu, "A complex analogue of Toda's theorem", Foundations of Computational Mathematics, June 2012, Volume 12, Issue 3, pp 327-362.

Saugata Basu, Thierry Zell, "Polynomial hierarchy, Betti Numbers and a real analogue of Toda's Theorem", Foundations of Computational Mathematics, 10:429:454, 2010, (preliminary version appeared in Proceedings of the Symposium on Foundations of Computer Science (FOCS), 2009).

Ethan Blanton, Sonia Fahmy, Greg N. Frederickson, and Sriharsha Gangam, "On the applicability of network inference mechanisms, IEEE Transactions on Parallel and Distributed Systems", 22, 4 (April 2011), pp. 662-672.

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Greg N. Frederickson and Barry Wittman, "Approximation algorithms for the traveling repairman and speeding deliveryman problems", Algorithmica, published online, April 22, 2011, DOI 10.1007/s00453-011-9515-4.

Mohamed Mokbel, Xiaopeng Xiong, Walid Aref, Susanne Hambrusch, Sunil Prabhakar, and Moustafa Hammad, "PLACE: A Query Processor for Handling Real-time Spatio-temporal Data Streams", Proceedings of the 13th International Conference on Very Large Data Bases (VLDB), pp. 1377-1380, 2004.

S.E. Hambrusch, C.-M. Liu, and S. Prabhakar, "Broadcasting and Querying Multi-dimensional Index Trees in a Multi-channel environment", Information Systems, Vol. 31, pp. 870-886, 2006.

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Sarvjeet Singh, Chris Mayfield, Sunil Prabhakar, Rahul Shah, Susanne E. Hambrusch, "Indexing Uncertain Categorical Data," 23rd IEEE International Conference on Data Engineering (ICDE 2007), 2007.

M. Drmota and W. Szpankowski, "Precise Minimax Redundancy and Regrets", IEEE Trans. Information Theory, 50, 2686-2707, 2004.

P. Flajolet, W. Szpankowski, and B. Vallee, "Hidden Word Statistics", Journal of the ACM, 53, 1-37, 2006.

M. Koyuturk, Y. Kim, S. Subramaniam, W. Szpankowski, and A. Grama, "Detecting conserved interaction patterns in biological networks", Journal of Computational Biology, 13, 1299-1322, 2006.

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Daniel Aliaga(pi), and Dongyan Xu(co-pi). PMR: Portable Mixed Reality. Microsoft Corporation. 2005.

Bedrich Benes(pi), and Daniel Aliaga(co-pi). Vector Pattern Modeling and Editing. Adobe Corporation. 2008.

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Daniel Aliaga(pi), and Mikhail J. Atallah(co-pi). RI: Small: A Computational Framework for Marking Physical Objects against Counterfeiting and Tampering. National Science Foundation. 2009-2013.

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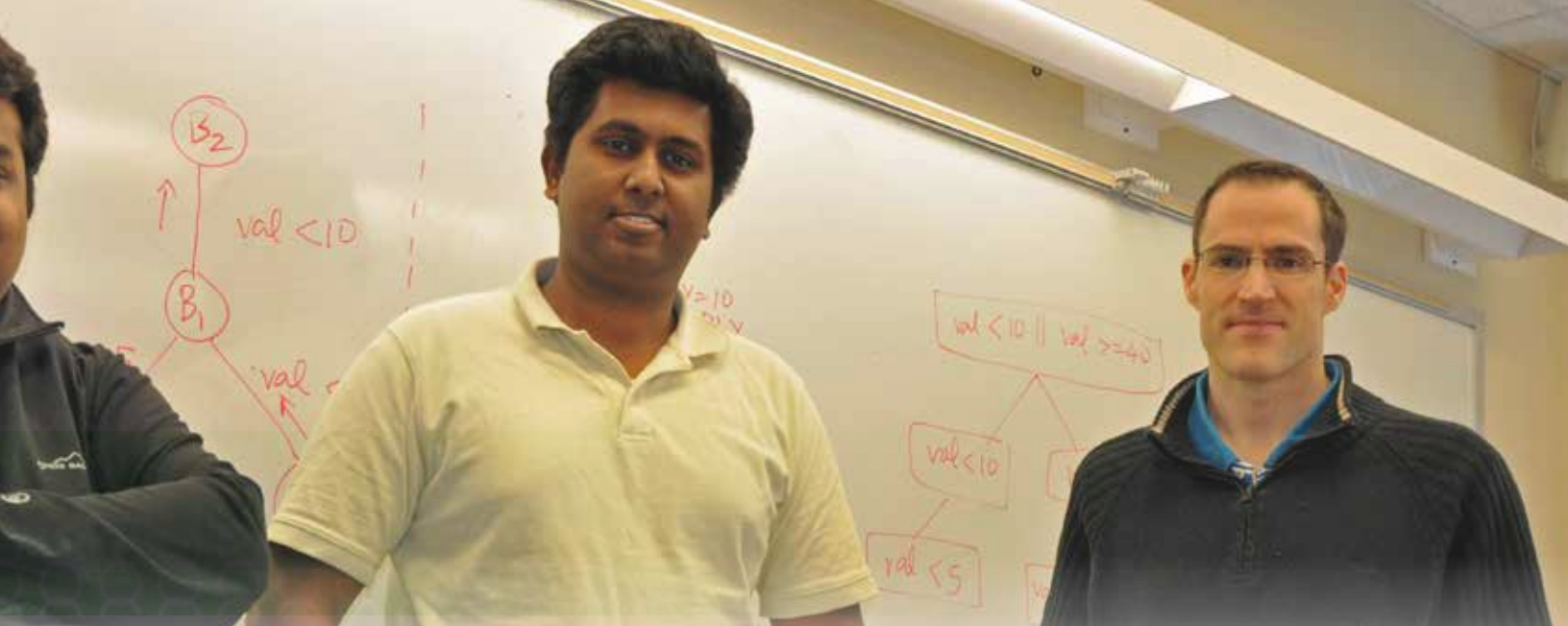

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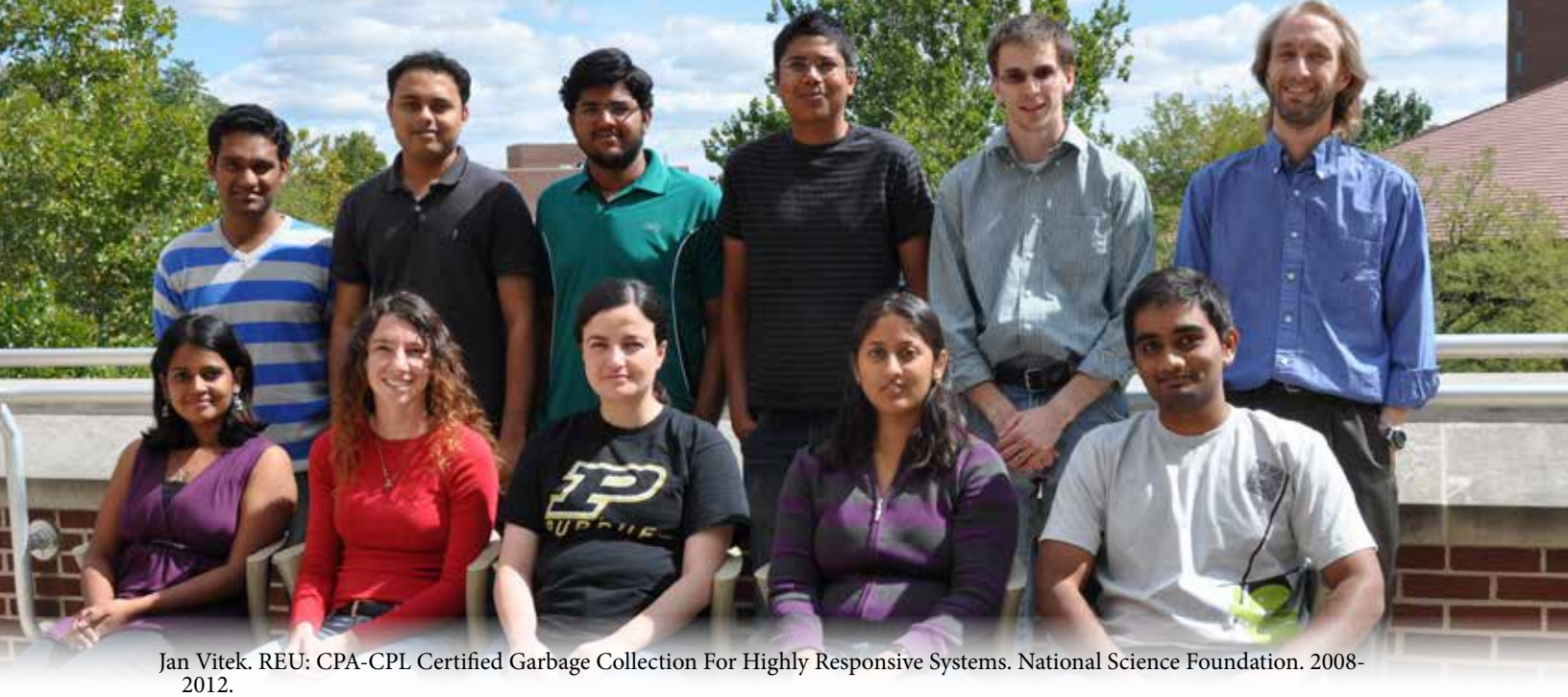

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Research Highlights

Towards a Knowledge Plane for Data Centers

In recent years, data centers (DCs) have emerged as the cornerstones of modern communication and computing infrastructure. The increased computational and data analysis demands of many enterprises are increasingly being met through parallel and distributed processing in corporate DCs, or more recently in 'cloud' based DCs owned by third-party providers such as Amazon, Google or Microsoft. The performance of many DC applications (e.g., high-performance computing applications) directly depends on the underlying network performance; managing data center network (DCN) performance efficiently is therefore of utmost importance.

Managing DCN performance is challenging. One of the most important reasons is the fact that, in contrast to the wide-area Internet applications that require latencies in the order of 10s to 100s of milliseconds, DC applications typically expect much lower end-to-end latencies—some requiring as low as 10 microseconds. For example, several high-performance computing (HPC) applications typically require latencies within 10us as several CPU cycles are wasted if messages do not arrive in time. Algorithmic trading applications in financial data centers, that have gained immense popularity in recent times, also demand low end-to-end latency (within 100us).

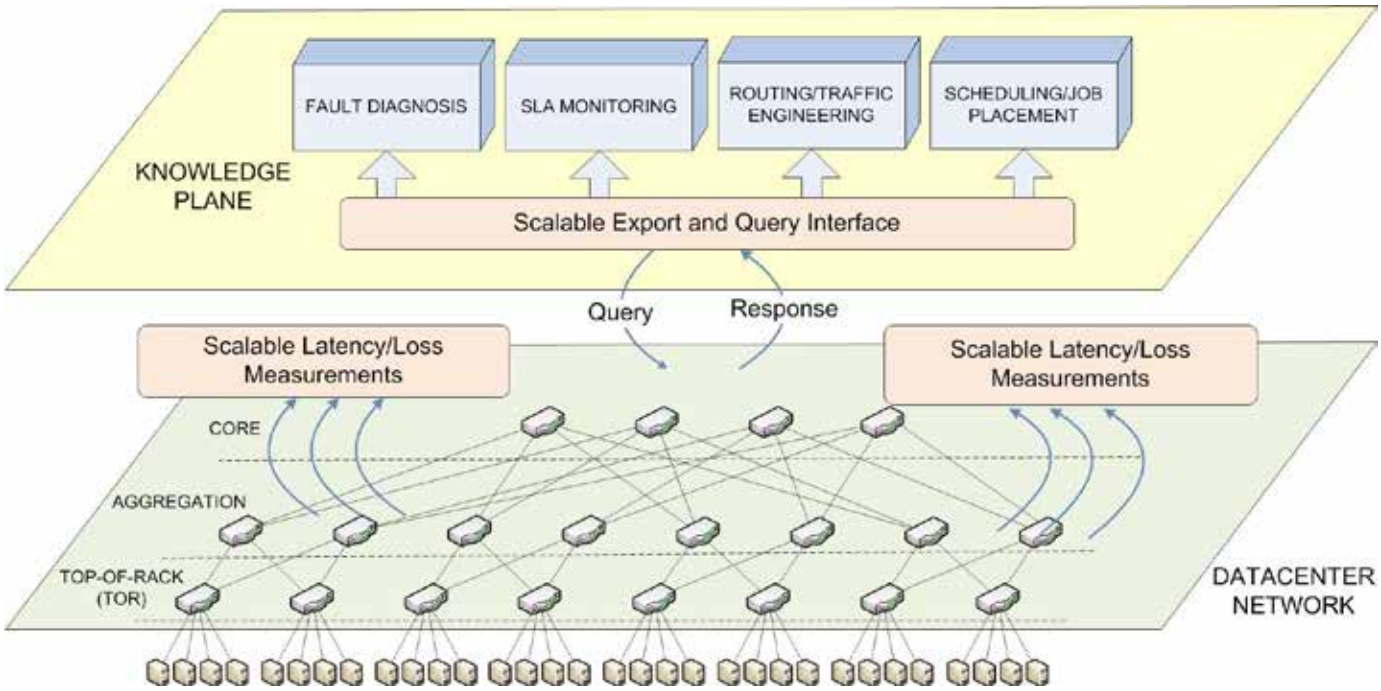
Further complicating the problem is the fact that, DCs today host a myriad number of heterogeneous applications belonging to either different customers, or to the same customer, all on the same infrastructure. In order to provide each customer with the required performance isolation, service providers often engage in service level agreements (SLAs) that are associated with costly financial obligations in case of performance violations. One option to honor these SLAs is to provide an isolated and secluded data center for each customer. This option will, however, lead to decreased cost benefit from consolidating computing resources across different customers, and is therefore not viable in the long run. Thus, data center operators today walk the tight rope of maintaining a complex network fabric running a heterogeneous set of applications from multiple tenants with tight SLA requirements, and yet be financially viable—a tough challenge in practice. DCN operators therefore need effective automated measurement tools to simplify the task of managing network performance.

To address these issues, Professor Kompella's research group has been focusing on techniques and solutions towards realizing the vision of a knowledge plane for data center networks. The knowledge plane (shown on the following page) will allow operators to perform fault diagnosis, SLA monitoring, traffic engineering, network provisioning and other such management tasks in modern data center networks in an accurate and automated fashion. The up-to-date knowledge of the data center network performance will also help in building effective scheduling and job placement algorithms that are network performance aware to improve the performance of various high-performance and distributed computing DC applications.

Building a scalable knowledge plane for DCNs requires several building blocks. One of the most basic building blocks required is a scalable way to measure packet latency through a single router or a switch, specifically between a pair of router interfaces. A naive solution to the measurement problem is for the two interfaces to timestamp each packet and exchange the packet timestamps at the end of a measurement interval. Unfortunately, this approach is very inefficient in the storage and communication overheads, as switches operate at high line rates (10 Gbps and beyond). In additon, it is not easy to embed timestamps in packets, which require header changes involving significant third party components, making it a difficult problem.

Kompella's group proposed a solution called Lossy Difference Aggregator (LDA) that is essentially a randomized streaming algorithm that exploits one key observation: One could easily estimate average latency if the two ends maintained just the timestamp sums and number of packets and exchanged this information after every measurement interval. This requires storage of just one counter and communication of one counter and thus efficient in both storage as well as communication complexity. Unfortunately, packets could get lost, which means this approach may, in practice, result in severe errors since the timestamp sums may not be consistent. To address this problem, LDA splits packets into random sub-streams and computes aggregates on these sub-streams. Lost packets will corrupt only a few sub-streams, but keep the remaining in tact to obtain a good number of samples for measurement. To deal with arbitrary loss, LDA also uses an extra stage of sampling to ensure the measurement error gracefully degrades with increasing loss.

Several such variants of these streaming data structures have been proposed by Professor Kompella's group to obtain other measurements, such as per-flow latency measurements. The papers related to these data structures have been published in top networking conferences such as ACM's Special Interest Group on Data Communications, ACM's Special Interest Group on Measurement and Evaluation, and IEEE International Conference on Computer Communication. They also received significant media attention with articles published in magazines such as ArsTechnica, DataCenterDynamics, Science Daily, and making it to the ACM and NSF news headlines. This research was funded by National Science Foundation and a grant from Cisco Systems.



Research Highlights

CS4EDU: Computer Science for Education

A joint program between the Purdue Computer Science Department and the College of Education is working to increase the supply of high school computer science teachers. The latest step in this project is to identify and develop a set of courses that, when completed, fulfill the requirements for a "supplemental licensure in computer science". A student obtaining this supplemental licensure is qualified to teach computer science at the high school level. The licensure satisfies the educational computing standards set by the National Council for Accreditation of Teacher Education (NCATE) and the International Society for Technology in Education (ISTE). It incorporates recommendations made in the ACM Model Curriculum for K-12 Computer Science as well as by the Computer Science Teachers Association (CSTA).

"This project represents a first in terms of collaboration between the two departments in the area of teacher licensing at Purdue," says James Lehman, Associate Dean in the College of Education and a member of the project team. "We are excited about the opportunity this provides for secondary teaching majors to add an additional area of certification, which helps to make them more marketable as prospective teachers. At the same time, the program is helping to strengthen the teaching of computer science in high schools, which should ultimately help students to be better educated for the twenty-first century."

The endorsement consists of two components, one in education and the other in computer science. Students take courses in Computer Science to build content knowledge of the discipline. They take courses in the College of Education to learn pedagogical principles.

Faculty in both departments have developed two new courses for the endorsement. The first is a one-credit course titled "Contemporary Issues in Computing" (currently offered as CS 19000), which explores how computing affects everyone in society, how the Internet has changed the way societies and individuals function, and what the implications are for the future. The second is a three-credit course on "Methods of Teaching Computer Science" (currently offered jointly as CS 49000 / EDPS 49100). The methods course covers topics that explore effective techniques for teaching computational thinking, and presents the latest education research on how to teach computing concepts and programming skills. Both courses are co-taught by faculty in Computer Science and Education.

In addition to the two new courses, students seeking the licensure take four computer science courses in programming, discrete mathematics, and data structures and algorithms (more details about the curriculum are available at http://cs4edu.cs.purdue.edu/endorsement). The licensure allows courses taken in computer science, mathematics, and electrical and computer engineering to be counted towards the requirements, reflecting the broad student population the endorsement is reaching.

Establishing this supplemental licensure was one of the goals of the NSF-funded "Computer Science for Education" (CS4EDU) project, whose overarching mission is to create new pathways for undergraduate education majors to become computationally-educated secondary teachers. The CS4EDU project was started by former department head, Susanne Hambrusch, who recently returned from NSF and is now on sabbatical. She noted that the new Teaching Endorsement is a "vital component towards creating a computationally-educated workforce for the 21st century." Computer Science education in the high schools is starting to undergo a major revision and reevaluation, adding "there is a need to increase the number of teachers who are educated in computational thinking and are prepared to teach programming."

Christoph Hoffmann, the current leader of the CS4EDU project team, said that creating strong programs in computing and computational thinking at the high school level will build "an important basis for future generations to successfully compete in the global economy." He added that "in a flat world, the well-being of the nation will depend on computer savvy and scientific literacy. We are excited to be at the forefront of this initiative."

In a national effort to increase the teaching of computer science in schools, the National Science Foundation has started an initiative to expand the number of high school educators, who are qualified to teach computer science from 2,000 to 10,000 by 2015. It also aims to reverse the declining college enrollment in computer science by improving the quality and availability of an advanced computer science curriculum at the high school level.

According to the national Computer Science Teachers Association (CSTA), this project addresses a profound and widespread gap in teacher certification. "If we are going to address national competitiveness issues, we to need repair the disconnect between courses that are critical to student success and teacher preparation and certification. This project ensures that new teachers will be both properly prepared and credentialed to teach computer science", said Chris Stephenson, executive director of CSTA.

Project participants include Christoph Hoffmann, Susanne Hambrusch, Tim Korb, and Voicu Popescu from the Department of Computer Science, and James Lehman and Aman Yadav from the College of Education. The CS4EDU project is funded in part by the National Science Foundation and a gift from State Farm.

Research from ASSISTANT PROFESSOR CHARLES (Chip) KILLIAN -

Prof. Killian's research continues to advance the state-of-the-art in building and testing robust, high-performance, large-scale distributed systems. His work has been supported by an NSF CAREER award, as well as an HP Open Innovation grant and the support of the Purdue Research Foundation. This work includes a framework for automatically discovering insider attacks, application of machine learning techniques to application logs to diagnose system bugs, language support for automatic application parallelization and distributed partitioning, and a reliability protocol allowing developers to ignore crash-restart failures. While the work is generally making systems faster and more dependable, these machine learning techniques notably have identified bugs in both HBase and Transmission, popular implementations of Google's BigTable and Cohen's BitTorrent, respectively.

PhD Graduates

December 2010

Hazem Elmeleegy
Leveraging External User-Generated Information for Large-Scale Data Integration
Advisor: Ahmed Elmagarmid
Employer: AT&T Labs

Ashish Kundu
Data in the Cloud: Authentication without Leaking
Advisor: Elisa Bertino
Employer: IBM T.J. Watson Research Lab

Lixia Liu
Effective Performance Analysis and Optimizations for Memory Intensive Programs on Multicore
Advisor: Zhiyuan Li
Employer: Google

Yu Tak (Chris) Ma
Mobility in Mobile Sensor Networks - A Study of Sensing Performance and Privacy
Advisor: David K. Y. Yau
Employer: not reported

May 2011

Armand Navabi
The Semantics and Analysis of Safe Futures
Advisor: Suresh Jagannathan
Employer: Google

Lukasz Ziarek
Database Support for Uncertain Data
Advisor: Sunil K. Prabhakar
Employer: Purdue University

August 2011

Nathan Robert Andrysco
Data Structures for Efficient Analysis of Large-Scale Unstructured Datasets
Advisor: Xavier Tricoche
Employer: Intel Corporation

Ardalan Kangarlou-Haghighi
Improving the Reliability and Performance of Virtual Cloud Infrastructures
Advisor: Dongyan Xu
Employer: NetApp Inc.

Michael Scott Kirkpatrick
ITrusted Enforcement of Contextual Access Control
Advisor: Elisa Bertino
Employer: James Madison University

Alvin Jon-Hang Law
Compensation Compliant Appearance Editing of Physical Objects with Arbitrary Shape and Color
Advisor: Daniel Aliaga
Employer: Google

Zhiqiang Lin
Reverse Engineering of Data Structures from Binary
Advisor: Dongyan Xu
Employer: University of Texas, Dallas

Christopher Scott Mayfield
Statstical Inference and Data Cleaning in Relational Database Systems
Advisors: Sunil Prabhakar and Jennifer Neville
Employer: James Madison University

Yinian Qi
Efficient Query Processing for Uncertain Data
Advisor: Sunil Prabhakar
Employer: Oracle

Junghwan Rhee
Data-Centric Approaches to Kernel Malware Defense
Advisor: Dongyan Xu
Employer: NEC Laboratories America

Education

December 2011

Ethan Blanton
Controlling the Cost and Increasing the Utility of Network Mesurement Infrastructures
Advisor: Sonia Fahmy
Employer: Fiji Systems, LLC

Sundararaman Jeyaraman
Practical Automatic Determination of Causal Relationships in Software Execution Traces
Advisor: Mikhail J. Atallah
Employer: Cisco

Bin Li
Geometrical Analysis of Interaction Sites of Proteins
Advisor: Daisuke Kihara
Employer: LaJolla Institute for Allergy and Immunology

Jacques Thomas
Accomodative Mandatory Access Control
Advisors: Jan Vitek and Partick T. Eugster
Employer: Amazon

May 2012

Hoda Eldardiry
Ensemble Classification Techniques for Relational Domains
Advisor: Jennifer L. Neville
Employer: Palo Alto Research Center

Jeffrey Seibert
Security and Economic Implication of Localizing Traffic in Overlay Networks
Advisor: Cristina Nita-Rotaru
Employer: MIT, Lincoln Labs

Carlos Vanegas
Modeling the Appearance and Behavior of Urban Spaces
Advisor: Daniel Aliaga
Employer: University of California, Berkeley

August 2012

Yi Fang
Probabilistic Approaches to Entity Retrieval
Advisor: Luo Si
Employer: Santa Clara University

Mohamed Raouf Fouad
Privacy Risk and Scalability of Differentially-Private Anonymization
Advisor: Elisa Bertino
Employer: Google

Mohamed Yoosuf Mohamed Nabeel
Privacy Preserving Access Control on Third-Party Data Management Systems
Advisor: Elisa Bertino
Employer: Purdue University

Mohamed Yakout
Guided Data Cleaning
Advisor: Ahmed K. Elmagarmid
Employer: Microsoft

Education

Graduate Lecturer

Carl Christian Kjelgaard Mikkelsen

Graduate Teaching Assistants

Salman Rehmat Al-Ansari
Mohammed Hamoud Almeshekah
Balamurugan Anandan
Nathan Robert Andrysco
Pelin Angin
Mehdi Azarmi
Ahmet Bugdayci
Nguyen Duc Cao
Suleyman Cetintas
Vaishnavi Chandrasekaran
Yi-Liu Chao
Keith Godwin Chapman
Vivek Kumar Chaurasiya
Cheng Cheng
Wei-Chiu Chuang
Jian Cui
William John Culhane
Robert Steven Cutler
Chenyun Dai
Abhinav Dangeti
Anmer Daskin
Zhanibek Datbayev
Jyotishka Datta
Amanda Grace Day
Wei-Yen Day
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Aditi Gupta
Pei He
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Dung Trung Hong
Md. Endadul Hoque
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Dasarath Weeratunge
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Tyler Robert Riehle Wykoff
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Lei Zhao
Pengxuan Zheng
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Aurangzeb Aurangzeb
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Mehdi Azarmi
Sahan Sajeewa Bamunavita Gamage
Tao Bao
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Haining Chen
Qi Chen
Meghana Vasant Chitale
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Wei-Chiu Chuang
Kelly Anne Cole
Mariheida Cordova-Sanchez
Jian Cui
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Chao Wu
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Temitope Adetokunbo Toriola
Mu Wang
Sherry Wei
Mohamed Ahmed Mohamed Ahmed Yakout
Pinar Yanardag Delul
Weining Yang
He Zhu

Facilities

The department is committed to providing high-quality computing facilities for use by computer science faculty, students, and administrative personnel. The facilities are operated by an excellent, customer-oriented technical staff, who are not only responsible for the installation and maintenance of the systems, but are also dedicated to assist faculty and students in the development of software systems for research projects. The staff periodically attends training courses and workshops to complete certifications and upgrade their skills. CS is also a certified warranty repair center for Dell computers. The facilities staff includes a director, facilities manager, network engineer, hardware engineer, five system administrators, and several student assistants.

General Facilities

General computing facilities are available for both administrative activities (such as the preparation of research reports and technical publications) and research needs that are not supported by other dedicated equipment. The main server systems are multi-core multiprocessors with large main memories and large disk arrays for storage. Personal workstations and laptops from a variety of vendors are used by faculty, staff, and students throughout the department.

Educational Facilities

The department operates seven instructional laboratories in two buildings. These labs are used for both undergraduate and graduate computer science courses and include more than 200 Intel workstations. Supported operating systems include Windows 7, Linux. Two labs are collaboration team project labs dedicated to group learning with the assistance of interactive SMARTboard technology. A later section lists equipment owned and maintained by ITaP, but used by computer science students.

I/O Equipment

The department operates both special-purpose output devices, as well as general output equipment, including laser printers, color printers, poster printers, and multi-functional printer/scanner/copier/fax machines. The department also provides video projectors, digital video recording and editing capabilities, as well as phone conferencing and a variation of video conferencing equipment. The CS department provides video conferencing in dedicated conference rooms in addition to mobile video conferencing stations. The CS department also provides a state-of-the-art Cisco Telepresence video conference room. The latest addition is a large 16' x 9' video wall, donated by the Harris Corporation and located in the Commons.

Networking Services

The department is strongly committed to the most current networking technology to provide access to and communication among its systems, as well as to those elsewhere on campus and throughout the world. Our departmental infrastructure supports gigabit per second data rates to the desktop throughout our two buildings using Ethernet VLAN-capable switches from Force10, Cisco Systems, and Dell. Wiring in the new Lawson Computer Science Building is based on Panduit augmented CAT6 data cable and patch panels, capable of 10 gigabit per second speeds. This network infrastructure is bi-connected to the campus backbone by two 1 gigabit per second redundant fiber links. The campus is connected to multiple high speed Internet backbones, including Abilene/Internet2 and I-Light. DSL, cable, and cellular data services are widely used for remote access.

Information Technology at Purdue (ITaP)

In addition to the facilities described above, students and faculty have access to computing systems owned and operated by ITaP. General instructional facilities operated by ITaP include large Sun SPARCservers and several Sun and Intel workstation laboratories. In addition, ITaP provides systems for use in courses taught by the CS Department. These systems include UNIX-based Sun SPARC stations for undergraduate computer science courses and Microsoft Windows-based Intel personal computers for use in an introductory course for non-majors (CS 110). Departmental research projects make use of other facilities provided by ITaP. These include a large IBM SP cluster and the Envision Center for Data Perceptualization.

2010 Computer Science Outstanding Alumni

On September 24, 2010, the Department of Computer Science honored three alumni for their outstanding professional accomplishments. Dr. David Spellmeyer, Mrs. Janice Zdankus, and Mrs. Cheryl Railey were joined by faculty, staff, and students of the Computer Science Department for a ceremony in the Lawson Computer Science building where Assistant Department Head, Dr. Tim Korb, presented the honorees with their awards. Later, the recipients were honored by Dean Jeff Roberts at the College of Science ceremony in the Commons, where they had the opportunity to meet the other Outstanding Alumni from the various science departments.

Dr. Spellmeyer graduated from Purdue in 1983 with a BS in Computer Science. Dr. Spellmeyer is currently Chief Technology Officer and Chief Informatics Officer of Nodality, a biotech company centered in South San Francisco. Mrs. Janice Zdankus earned her bachelor's degree from the department in 1985. She works for Hewlett Packard, as the Vice President of Solutions & Services Enablement & TCE. Mrs. Cheryl Railey graduated with her BS in 1981 and currently serves as the VP of Program Management, IT Shared Services at Johnson and Johnson.

2011 Computer Science Outstanding Alumni

On September 30, 2011, the department honored three alumni for their outstanding achievements in their professional careers. Dr. John Riedl, Mr. Ian Murdock, and Mr. Bryn Dole were honored with a ceremony in Lawson where Department Head Sunil Prabhakar presented the awards to the recipients. Later, they were recognized by Dean Jeff Roberts at the College of Science Ceremony along with other Outstanding Alumni and guests.

Dr. Riedl earned his MS from Purdue in 1985 and his PhD in 1990. He is currently a professor of computer science at the University of Minnesota. Mr. Murdock graduated in 1996 with a bachelor's degree. He is the vice president of Platform at ExactTarget, a leading global provider of on-demand email marketing and interactive marketing solutions. Mr. Dole graduated with his MS in Computer Science in 1996 and currently works at Blekko, a search engine startup that he co-founded.

Dr. David Capka was the 2011 Distinguished Alumnus for the Department of Computer Science.

Dean Jeff Roberts, Prof. Larry Peterson, and Prof. Sunil Prabhakar at the 2012 College of Science Distinguished Alumni ceremony.

Engagement

2011 Computer Science Distinguished Alumnus

In April 2011, Dr. David Capka was named the 2011 Distinguished Alumnus for the Department of Computer Science. Dr. Capka was presented with his award on April 8th of 2011 by the Computer Science Department and the College of Science. Capka recently served as the Distinguished Technical Fellow and Chief Scientist for the Compass Project at Northrop Grumman. Dr. Capka has been with the company since 1983. David earned both his MS and PhD in Computer Science, and has subsequently returned to campus to serve on the CS corporate partners' board. Not only was Dr. Capka a participant in the Corporate Partners Program; his enthusiasm and support lead to Northrop Grumman's support for scholarships, student groups, and retention programs.

2012 Computer Science Distinguished Alumnus

Professor Larry Peterson was named the 2012 Distinguished Alumnus for the Department of Computer Science in April of 2012. Professor Peterson was presented with his award on April 13th of 2012 by the Computer Science Department and the College of Science. Peterson is the Robert E. Kahn Professor of Computer Science at Princeton University, Director of the Princeton-hosted PlanetLab Consortium, and Chief Scientist of Verivue, Inc. He served as Chair of the Princeton CS Department from 2003-2009. Peterson is co-author of the best-selling networking textbook "Computer Networks: A Systems Approach (5e)," and chaired the initial planning efforts that led to NSF's GENI Initiative. His research focuses on the design and implementation of networked systems.

Corporate Partners

The Corporate Partners Program (CPP) was launched to foster close communication between the Department of Computer Science and private industry in the context of a mutually beneficial relationship. The department enjoys the benefit of financial contributions, nurturing experiences for our student, and faculty research collaboration with industry leaders. Members in our CPP reap the benefit of increased visibility, priority access to top students who may become future employees, and priority access to faculty who are experts in relevant technical fields.

Companies participate through strategic, unrestricted donations at tier levels and are involved in many core activities of the department. Recent activities supported have enabled CS students to participate in conferences and programing competitions and student organizations to mentor incoming students.

Gifts of equipment are used by students in the classrooms and faculty for research. The Harris Video Wall, mentioned earlier in the report, was a gift from the Harris Corporation and creative uses for learning and developing with the wall continue to evolve. The wall also initiated a collaboration with Petronio Bendito, Associate Professor of Art and Design at Purdue University.

Company representatives take advantage of opportunities to speak in classes, sponsor student projects, and make significant contact with CS students and faculty. Members of the CPP include giants of the information technology industry; as well as companies, large and small, in a wide variety of sectors. Partner members represent Indiana-based companies and other outstanding firms nationwide. This diverse and dynamic membership provides CS students with exposure to a myriad of career opportunities across the United States.

The Corporate Partners meet twice each year to provide input and feedback to departmental and college leadership. Recent contributions of the council include assistance in revising the undergraduate and graduate curricula, suggestions regarding recruiting, retention and enrollment issues, collaborative efforts with faculty and student research, as well as alerting the department to industry areas of concern.

Engagement

Premier Corporate Partners

- Cisco
- Eli Lilly and Company
- Google, Inc.
- Harris Corporation
- IBM
- Intel Corporation
- Interactive Intelligence
- Lockheed Martin
- Microsoft Corporation
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- Amazon
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- ExactTarget
- Indiana Economic Development Corporation
- National Security Agency
- Raytheon Technical Services Company
- State Farm
- Tata Consultancy Services
- TechPoint

Friends

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- Caterpillar
- Cerner Corporation
- Extron Electronics
- ExxonMobil
- FactSet Research Systems, Inc.
- Freddie Mac
- Lutron Electronics
- Microsemi Corporation
- Nielsen
- Qualcomm, Inc.
- Sonoma Partners
- Target
- WellPoint
- Yelp

Development of Private Support

With support from alumni and friends, Purdue Computer Science competes for the best faculty, recruits top students, provides scholarships, supports research, and funds new program initiatives. The department is deeply grateful to these donors who made contributions and pledges in the 2010-11 and 2011-12 academic years.

Donor Honor Roll - Individuals

$100,000 and above
Mr. Gene H. Kim and Mrs. Margueritte Kim

$10,000 - $99,999
Dr. David C. Spellmeyer

$5,000 - $9,999
Dr. Alan R. Hevner and Mrs. Cynthia Y. Hevner
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K-12 Outreach

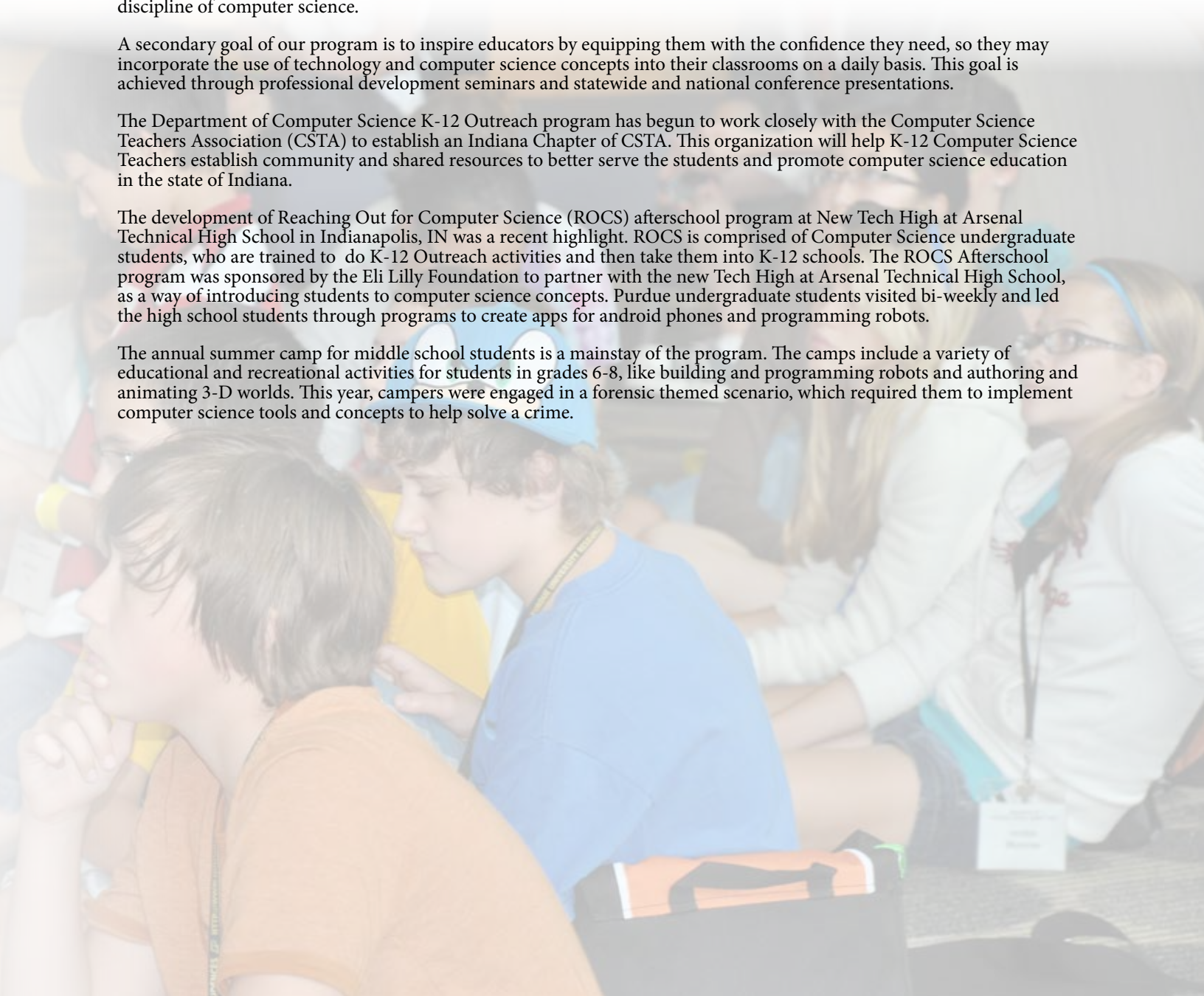
The main purpose of the K-12 Outreach program is to promote scientific literacy and stimulate interest in computer science among students in the K-12 school systems. Visits to K-12 schools include presentations, workshops, and teacher consultations. Additionally, bringing students and teachers to campus provides opportunities to create awareness of the discipline of computer science.

A secondary goal of our program is to inspire educators by equipping them with the confidence they need, so they may incorporate the use of technology and computer science concepts into their classrooms on a daily basis. This goal is achieved through professional development seminars and statewide and national conference presentations.

The Department of Computer Science K-12 Outreach program has begun to work closely with the Computer Science Teachers Association (CSTA) to establish an Indiana Chapter of CSTA. This organization will help K-12 Computer Science Teachers establish community and shared resources to better serve the students and promote computer science education in the state of Indiana.

The development of Reaching Out for Computer Science (ROCS) afterschool program at New Tech High at Arsenal Technical High School in Indianapolis, IN was a recent highlight. ROCS is comprised of Computer Science undergraduate students, who are trained to do K-12 Outreach activities and then take them into K-12 schools. The ROCS Afterschool program was sponsored by the Eli Lilly Foundation to partner with the new Tech High at Arsenal Technical High School, as a way of introducing students to computer science concepts. Purdue undergraduate students visited bi-weekly and led the high school students through programs to create apps for android phones and programming robots.

The annual summer camp for middle school students is a mainstay of the program. The camps include a variety of educational and recreational activities for students in grades 6-8, like building and programming robots and authoring and animating 3-D worlds. This year, campers were engaged in a forensic themed scenario, which required them to implement computer science tools and concepts to help solve a crime.



Guest Speakers

DATE	SPEAKER/AFFILIATION	TALK TITLE
09/10/2010	Emina Torlak, PhD; IBM Research Lab	MemSAT: Checking Axiomatic Specifications of Memory Models
09/16/2010	Nathan Srebro, PhD; Toyota Technological Institute at Chicago	Sebro Colloquium
09/17/2010	Prof. Darko Marinov; University of Illinois at Urbana-Champaign	Systematic Software Testing Using Test Abstractions
10/04/2010	Prof. Greg Shannon; CERT	Data-Driven Science for Cyber Security
10/06/2010	Prof. Matt Might; University of Utah	Challenges in the Static Analysis of Dynamically Typed Higher Order Languages
10/12/2010	Joseph Grcar, PhD; Lawrence Berkeley National Laboratory	The History of Gaussian Elimination
10/13/2010	Sherry Li, PhD; Lawrence Berkeley National Laboratory	Enhancing Parallel Performance of the Schur Complement Method for Highly-indefinite Linear Systems
10/13/2010	Prof. Gernot Heiser; University of New South Wales and NICTA	The Road to Trustworthy Systems
10/13/2010	Prof. Ali Butt; Virginia Tech	Decentralized Data Offloading and Staging for High-Performance Computing Centers
10/19/2010	Prof. Cary Supalo; Penn State University	Technologies to Educate the Blind
10/20/2010	Prof. Robin R. Murphy; Texas A&M University	Robots to the Rescue!
10/21/2010	Prof. Christopher Raphael; Indiana University	The Rhythmic Parsing Problem
10/22/2010	Peter Wonka, PhD; Arizona State University	Procedural Modeling of Architecture and Patterns on Surfaces
11/01/2010	Prof. David Garlan; Carnegie Mellon University	Engineering Self-healing and Self-improving Systems
11/03/2010	Prof. Kai Li; Princeton University	Building a Commercial Deduplication Storage System
11/10/2010	Prof. Peter Steenkiste; Carnegie Mellon University	Internet Access Using Dense Self-Managing Wireless Networks
11/15/2010	Prof. Yi Chen; Arizona State University	Keyword Search on Databases and Beyond
11/18/2010	Prof. Mikhail Belkin; Ohio State University	Clustering, Gaussian Mixture Models, and Sparse Eigenfunction Bases for Semi-Supervised Learning
12/02/2010	Prof. Fred Schneider; Cornell University	Principles and Principals for Authorization in Nexus
12/06/2010	Prof. Edward Lee; University of California, Berkeley	Computing Needs Time
12/08/2010	Prof. Iulian Neamtiu; University of California, Riverside	Studying Software Evolution for Facilitating Maintenance and Development

DATE	SPEAKER/AFFILIATION	TALK TITLE
12/13/2010	Prof. Thomas Reps; University of Wisconsin, Madison	There's Plenty of Room at the Bottom: Analyzing and Verifying Machine Code
01/28/2011	Prof. Torsten Braun; University of Bern, Switzerland	Design and Evaluation of an Adaptive and Energy-Efficient MAC Protocol for Wireless Sensor Networks
02/14/2011	Bogdan Carbunar; Motorola's Applied Research and Technology Center (ARTC)	Secure Synchronization of Periodic Updates in Ad Hoc Networks
02/21/2011	Curtis Chong, PhD; Iowa Department for the Blind	What Technology Can Do to Assist Blind and Visually Impaired
02/22/2011	Christian Cachin, PhD; IBM Research Zuerich	Integrity and Consistency for Untrusted Services
02/25/2011	Mr. Roger Scott; Architect in Coverity's C/C++ Analysis Group	Using Static Analysis to Detect Bugs in Software
03/03/2011	Madhur Tulsiani, PhD; Princeton University	Effectiveness and Limitations of Convex Relaxations
03/10/2011	Rishi Saket, PhD; Princeton University	Intractability in Computational Learning and Approximation
03/24/2011	Alexander Sherstov, PhD; Microsoft Research	Limits of Communication
03/24/2011	Barnabás Póczos, PhD; Carnegie Mellon University	Nonparametric Divergence Estimation
03/28/2011	Ms. Barna Saha; University of Maryland, College Park	Allocating Resources and Processing Top-k Queries: The Power of Probabilistic Methods
03/30/2011	Mr. Vladimir Braverman; University of California, Los Angeles	Space-Efficient algorithms for Data Streams
04/06/2011	Prof. Yousef Saad; University of Minnesota	Multilevel Preconditioning Techniques with Applications
04/07/2011	Prof. Dianne O'Leary; University of Maryland	Where am I? Position from Incomplete Distance Information
04/11/2011	Brendan Juba, PhD; Harvard University and MIT CSAIL	Universal Semantic Communication
04/11/2011	Prof. Michael Goodrich; University of California, Irvine	Mastermind Privacy Attacks for String and Vector Databases
04/11/2011	Aditya Nori, PhD; Microsoft Research India	Guessing Program Annotations with Probabilistic Inference
04/11/2011	Prof. Thomas Anderson; University of Washington	A Case for OneSwarm
04/12/2011	Prof. Thomas Anderson; University of Washington	Towards a Highly Available Internet
04/13/2011	Prof. Tom Manteuffel; University of Colorado at Boulder	A Parallel, Adaptive, First-Order System Least-Squares (FOSLS) Algorithm for Incompressible, Resistive Magnetohydrodynamics
04/13/2011	Adam Chlipala, PhD; Harvard University	Formal Verification of Software Infrastructure: From Science to Engineering
04/19/2011	Prof. Aviral Shrivastava; Arizona State University	Multi-core Challenge: Missing Memory Virtualization
05/04/2011	George Atia, PhD; University of Illinois, Urbana-Champaign	Group Testing: An Information Theoretic Perspective and a Spectrum Violation Corrective
07/29/2011	Prof. William H. Winsborough; University of Texas, San Antonio	Towards Practical Privacy Policy Enforcement
08/16/2011	Prof. Amir Herzberg; Bar-Ilan University	Internet Security: A Call to Arms

Guest Speakers

DATE	SPEAKER/AFFILIATION	TALK TITLE
08/26/2011	Ryan Riley, PhD; Qatar University	Furthering Data-Only Rootkit Attacks
09/01/2011	Susanne Hambrusch, PhD; National Science Foundation CISE/CCF; Purdue University	Funding Opportunities in FY12 for the CISE Research Community
09/02/2011	Alefiya Hussain, PhD; University of Southern California Information Sciences Institute	A Collaborative Cyber Security Experiment Design and Analysis
09/02/2011	David Brumley, PhD; Carnegie Mellon University	Automatically Identifying Exploitable Bugs
09/06/2011	Peter Christen, PhD; The Australian National University	Scalable Privacy-Preserving Record Linkage Using Similarity-Based Indexing
09/13/2011	Laxmi Parida, PhD; IBM T. J. Watson Research Center	The Re-Combinatorics of Chromosomes
09/20/2011	Radha Jagadeesan, PhD; DePaul University	Operational Semantics for Relaxed Memory Models
09/20/2011	Prof. Fredrik Manne; University of Bergen	The Disjoint-set Data Structure Revisited
09/22/2011	Prof. Daniel B. Szyld; Temple University	Algebraic Optimizable Schwarz Methods for the Solution of Banded Linear Systems and PDEs on Irregular Domains
09/22/2011	Gaël Thomas, PhD; Pierre and Marie Curie University	VMKit: A Substrate for Managed Runtime Environments
09/23/2011	Prof. Luo Si; Purdue University	Searching for Brains: Expert Search
09/26/2011	Michael Locasto, PhD; University of Calgary	Deep Introspection
09/27/2011	Prof. Patrick Eugster; Purdue University	On Expressiveness and Efficiency in Content-based Publish Subscribe
10/06/2011	Prof. Xiangyu Zhang; Purdue University	Canonicalizing Execution for Automated Debugging
10/18/2011	Matt Wallace; Allston Trading	Optimization in Algorithmic Trading
10/19/2011	Prof. Bruce Croft; University of Massachusetts Amherst	Social Search - Information Retrieval with Ephemeral Data
10/21/2011	John Wilkes, PhD; Google	Cluster Management at Google
10/24/2011	Prof. Ben Leimkuhler; The University of Edinburgh	Controlling Statistical Properties in Simulations of Extended Dynamical Systems
10/28/2011	Arun Chauhan, PhD; Indiana University	Effective (Parallel) Programming for the Masses: Optimizing High-level Languages
11/07/2011	Thomas Ball, PhD; Microsoft	Two for the Price of One: A Model for Parallel and Incremental Computation
11/10/2011	Arif Merchant, PhD; Google	Controlling Storage Quality of Service
11/17/2011	Gabriel Dos Reis, PhD; Texas A&M University	Type Checking Elementary Function Integration
11/21/2011	Prof. David H. Laidlaw; Brown University	The Ultimate Visualization Display
12/01/2011	Prof. Ken Birman; Cornell University	Can Cloud Computing Systems Guarantee Strong Consistency?
12/07/2011	Jianlin Xia, PhD; Purdue University	Recent Developments on Fast Structured Solvers for Large-Scale Scientific Computing
12/08/2011	David Kuck, PhD; Intel	Codesign of HW/SW Systems
12/13/2011	Saurabh Sinha, PhD; IBM Research - India	Automating Test Automation
12/19/2011	Oren Livne, PhD; Institute of Genomics & Systems Biology	Lean Algebraic Multigrid (LAMG): A Fast Graph Laplacian Linear Solver

DATE	SPEAKER/AFFILIATION	TALK TITLE
02/02/2012	Flavio Chierichetti, PhD; Cornell University	Information Spreading in Social Networks
02/09/2012	Yuriy Brun, PhD; University of Washington	Speculative Analysis: What's Wrong with the Program I Haven't Written Yet?
02/13/2012	John Regehr, PhD; University of Utah	Random Testing for C Compilers
02/16/2012	Hwanjo Yu, PhD; Pohang University of Science and Technology	SVM Indexing and Processing for Data Retrieval
02/23/2012	Prof. Uzi Vishkin; University of Maryland Institute for Advanced Computer Studies	Can the Floodgate of General-Purpose Computing Innovation Reopen with Many-Core Parallelism?
02/27/2012	Yi Wu, PhD; IBM Research - Almaden	The Approximability of NP-hard Optimization Problems
03/01/2012	Elena Grigorescu, PhD; Georgia Institute of Technology	Testing Symmetric Properties of Massive Data
03/08/2012	Christian Kästner, Phd; University of Marburg	Parsing and Type Checking all 2^10000 Configurations of the Linux Kernel
03/19/2012	Shaili Jain, PhD; Yale University	Incentives in Social Computing
03/22/2012	Mr. Sungjin Im; University of Illinois at Urbana-Champaign	Recent Developments for Online Scheduling Algorithms
03/23/2012	Puneet Sharma, PhD; HP Labs	Cloud Connectivity Challenges
03/27/2012	Howard Karloff, PhD; AT&T Labs Research	Disjoint-Path Facility Location: Theory and Practice
03/30/2012	Hanghang Tong, PhD; IBM T. J. Watson Research Center	Algorithms to Affect Influence Propagation on Large Graphs
04/02/2012	Prof. Joseph F. Traub; Columbia University	Algorithms and Complexity for Quantum Computing
04/04/2012	Mr. Shay Mozes, PhD; Brown University	Exploiting Graph Structure: Beauty and Efficiency in Planar Graphs
04/04/2012	Sebastian Fischmeister, PhD; University of Waterloo	Code Instrumentation While Preserving Non-functional Properties
04/05/2012	Mihai Pop, PhD; University of Maryland	Genome Assembly in the 21st Century
04/12/2012	Mr. Amir Nayyeri; University of Illinois at Urbana-Champaign	Combinatorial Optimization on Surfaces
04/13/2012	Prof. Larry Peterson; Princeton University	Extending the Cloud to the Network Edge
04/16/2012	Prof. Doug Oard; University of Maryland	Evaluating E-Discovery Search: The TREC Legal Track
04/17/2012	Dr. Aman Yadav, PhD; Purdue University	The Role of Education Research in Computer Science Education
04/19/2012	Prof. Sumi Helal; University of Florida	Sentience- and Energy-Efficient Cloud-Sensor Systems
04/19/2012	Aditya Nori, PhD; Microsoft Research India	Invariant Generation: A Machine Learning Perspective
04/19/2012	Prof. Randy Katz; University of California, Berkeley	Mesos: A Platform for Fine-Grained Resource Sharing in the Data Center
04/24/2012	Prof. Walter Gautschi; Purdue University	Mathematics and Music: In Memory of Werner Gautschi 1927-1959
05/18/2012	Feng Qin, PhD; Ohio State University	Hunting Bugs in General-Purpose and High-Performance Systems
06/05/2012	Prof. Sandrine Blazy; University of Rennes	CompCert, a Formally Verified C Compiler
07/16/2012	Prof. Peter Dinda; Northwestern University	Towards Adaptive Virtualization at Scale
07/19/2012	Mark Ebersole; NVIDIA	Accelerate Your Programming or Science Career with GPU Computing: An Introduction to Using CUDA; CUDA 5 and Beyond
08/08/2012	Jaewoo Lee; Purdue University	KDD Practice Talk: Differential Identifiability

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