Computer Science

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UNIVERSITY OF KENTUCKY
College of Engineering

Message from the Chair

Kenneth L. Calvert, Chair

Greetings! This edition marks a time of transition in the life of our department. In June we celebrated and acknowledged the outstanding service of Prof. Mirek Truszczynski over the last 14 years as Chair, Professor Greg Wasilkowski for the same number of years as Director of Graduate Studies, and Professor Tony Baxter for more than 12 years as Director of Undergraduate Studies. Under their leadership, the department has made great progress, and we are grateful for their dedication.

Jerzy W. Jaromczyk

In July, the position of DGS role was taken over by Professor Raphael Finkel, and Professor Jurek Jaromczyk stepped in as the new DUS. No doubt you will be hearing more from them in the future in their new roles!

Among the good things happening in the department: We are pleased to welcome our newest faculty member, Dr. Jinze Liu, who joins us from the University of North Carolina at Chapel Hill. Our faculty is as productive as ever. And our enrollment is up, notwithstanding higher admission standards for the College of Engineering!

Raphael A. Finkel

Read more about these and other good things happening in the Department of Computer Science in the rest of this newsletter. Then send us your good news: we welcome your input, and would like to know what you've been up to — whether you are a recent graduate, or one of our old-timers.

Ken Calvert
Professor and Chair

News

New Faculty

Jinze Liu

Dr. Jinze Liu joined the department as an assistant professor in August 2007. She received a BS degree from Peking University in 1999, a MS degree from the University of Virginia at Charlottesville in 2001 and a Ph.D. degree from the University of North Carolina at Chapel Hill in 2006. She was a postdoc fellow in the Department of Biostatistics from August 2006 to August, 2007. Her research interests include data mining, bioinformatics, statistical genetics, and databases. She received a graduate fellowship at the University of Virginia and a Future Faculty Fellowship Award at the University of North Carolina at Chapel Hill.

Promotions

Congratulations to Drs. KenCalvert and Brent Seales who were promoted to Full Professor.

Ph.D. Graduation

Ph.D. student Wensheng Shen defended his dissertation in May 2007 and is now an Assistant Professor of Computational Sciences at the State University of New York at Brockport, Brockport, NY.

Awards

The 2006-2007 Best Teacher Award by ACM University of Kentucky Student Chapter & Upsilon Pi Epsilon Gamma Chapter was presented to Professor Fuhua Cheng. Congratulations.

Miscellaneous

Congratulations to Professors Brent Seales and Jane Hayes, who were both elected to the Faculty Senate. Our department currently has four representatives, including Professors Finkel and Calvert.

Professors Jim Griffioen and Zongming Fei, together with Dr. David Laverell of Calvin College, have been experimenting with ways to enhance hands-on experience for students in operating systems and

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see blue.

networking type classes. In particular, they have been working on ways to build and use Edulabs facilities specifically designed for teaching. An Edulab system (designed by the University of Utah) is made up of a set of PCs that can be dynamically assigned to users via a simple web interface. Edulabs can support many simultaneous experiments and users. Feedback from the initial use has been overwhelmingly positive, and the authors hope to see their enhancements adopted by other Edulabs as well.

Distinguished Lecture Series

http://www.cs.uky.edu/events/distingLectures.php

October 26, 2007, 5:30 p.m.
Lexmark Room, Main Building
"Machines Reasoning About Machines"
J Strother Moore
University of Texas at Austin

November 8, 2007
Lexmark Room, Main Building
"Learning to Think About the World"
Leslie Pack Kaelbling
Massachusetts Institute of Technology

January 15, 2008
"Redoing the Foundations of Decision Theory: Decision Theory with Subjective States and Outcomes"
Joe Halpern
Cornell University

April 7, 2008
"Value-based Software Engineering"
Barry Boehm
University of Southern California

Professional Activities

Grants Awarded

Professor Jun Zhang received a $6,000 National Science Foundation grant, "Undergraduate Research Experience in Computational Medical Imaging." This project provides research experience for one or two undergraduate students from June 1, 2007 to September 30, 2008.

Professor Jun Zhang is a member of a research team that received a National Institutes of Health grant, "Computer Modeling of Perlecan as a Vascular Regulator." This project runs from January 1, 2007 to December 30, 2010 at an estimated funding level of $1.3 million.

Professor Ruigang Yang was awarded a $70,000 grant from the Department of Defense (NAVY) STTR Phase I (in collaboration with VSee Lab).

Professor Ruigang Yang was awarded a Gift from Microsoft Research.

Professor Fuhua Cheng was awarded a $150,000 grant for Portable Digital Mouth and Occlusion Reproducer, Kentucky Science & Technology Corporation (CIF-712-COM), 4/1/2007-3/31/09.

Professor Jim Griffioen was awarded a $2.4M grant from the U.S. Treasury Department, "The Kentucky Center for Resilient Information Systems," Kucera (Managing PI), Griffioen (Technical PI), Calvert, Fei, Finkel, Manivannan, Singhal (Co-PIs)

The computer science department held a picnic in Woodland Park June 1, 2007. More pictures can be found online at http://halsted.vis.uky.edu/downloads/videos/Picnic6-1-07/1.html

Did you know . . . ?

Faculty in the Department serve as editors, associate editors, and editorial board members of more than 20 international journals (more than one journal per faculty member) The list of journals includes the following:

Advances in Mathematics of Communications
Cryptography and Communications Discrete Structures, Boolean Functions and Sequences
Wireless Personal Communications
International Journal of Multimedia and Ubiquitous Engineering
Engineering Letters
International Journal of Approximate Reasoning (special issue)
Journal of CAD & Computer Graphics
Journal of Complexity
Fundamenta Informaticae
Central European Journal of Mathematics
Studia Logica
Journal of Applied Logic
Journal of Artificial Intelligence Research
Theory and Practice of Logic Programming
AI Communications
Journal of 3D Imaging and Analysis
Journal of Software Test Verification and Reliability
Journal of Applied Mathematics and Computing
Journal of Computational Science and Engineering
International Journal of Nonlinear Sciences and Numerical Simulation
The Open Applied Mathematics Journal
The Open Biomedical Engineering Journal
The Open Mechanics Journal

Alumnus Corner

Editor's Note: Starting this issue, we will have a new column dedicated to stories from you-our alums. This inaugural article is written, incidentally, by one of the inaugural graduate students — Steven Cool. So here are his experiences during the early days of this department.

By Steven Cool, BS Psychology '70, MSCS '74

My first experience with computers was at Henry Clay High School, around 1964, in an independent computer club with access to UK's IBM 1620 computer. To run even the simplest FORTRAN program, we loaded long trays of cards containing the compiler into the 1620's card reader, followed by our small stack of program cards. If we were careful (and, possibly, lucky), the 1620's typewriter or printer would do our bidding.

Several years later, as an undergraduate psychology major at UK, I realized that what interested me most was experimental psychology, and that its need for data organization, number crunching and analysis gave me the chance to write programs! Momentum and pragmatism made me complete my BS in psychology, but by then I was thoroughly immersed in the early offerings of the nascent Computer Science Department.

In 1970 I was in the small first group of students to begin studying for our MS degrees in computer science at UK, under a memorable and eclectic group of professors, including Thaddeus Curtz (department chairman), A.C.R. Newbery, Henry Thacher and Ronald Alter.

UK's Computer Science Department emerged from the Mathematics Department, so our curriculum was highly mathematical. Nonetheless, Dr. Curtz et al. allowed considerable leeway for exploring other interests and application areas. My interest was in medical applications, and I divided my last several years at UK between the Computer Science Department and the Department of Therapeutic Radiology and Nuclear Medicine at the UK Medical Center.

We had our ups and downs. In the spring of 1971, after completing our first year in the MS program, Dr. Curtz informed us that UK had decided not to grant MS degrees in Computer Science, after all! A mad scramble ensued to switch to other majors or other schools by fall, 1971. The University of Maryland accepted me, but about 10 days before I was to leave Lexington Dr. Curtz called and said that if I wanted to gamble, that he believed that UK's program would be approved. I took the bet, stayed on at UK, and indeed he was correct.

This was an interesting period of slow but certain change in computing. UK's computers (all two or three of them) resided in raised-floor air-conditioned rooms. McVey Hall's basement housed the enormous IBM 360 that did UK's payroll, printed grade reports and ran students' programs in "batch" mode, and was inaccessible to all but a select, privileged few. However, at the Medical Center we had our own DEC PDP-8 with 8,192 bytes of memory, and interactive FOCAL (something like BASIC)!

(Steven Cool (stever70@aol.com) lives near Boston, Massachusetts. Since graduating UK he has designed, developed and marketed medical imaging systems, high-speed computers and materials and instruments for radiation detection and measurement, and conceived and hosted one of the first nationally syndicated radio programs on computers and computing.)

Professional Activities

Conference Organizations

Professor Jun Zhang was a session chair at the First IEEE International Conference on Bioinformatics and Biomedical Engineering, Wuhan, China, July 2007.

Professor Jun Zhang will be the co-chair of the second IEEE International Conference on Bioinformatics and Biomedical Engineering, Shanghai, China, May 2008.

Professor Ruigang Yang is Poster Chair, 3rd International Workshop on Projector-Camera Systems, 2007.

Professor Ruigang Yang is Poster Demo/Chair, ACM Conferences on Virtual Reality Software and Technology (VRST) 2007.

Professor Judy Goldsmith was co-organizer of the AAAI Workshop on Preference Handling in Artificial Intelligence, and co-organizer of the UAI Workshop on Bayesian Applications. Both workshops happened in July in Vancouver, British Columbia, Canada.

Professor Ken Calvert was Technical Program co-Chair of the IEEE International Conference on Network Protocols (ICNP 07) in Beijing.

Conference Presentations

M.S. student Ryan Bauman and Ph.D. student Qing Zhang presented a poster titled "A Catadioptric Projector System With Application To Pseudo HDR Display" and a poster titled "Anywhere Pixel Compositor" was also presented by Dr. Yang at the conference.

Ph.D. student Ning Cao presented a paper, "Computing White Matter Fiber Orientations using BiGaussian model in High Angular Resolution Diffusion-Weighted MRI," at the International Conference on Computational and Mathematical Methods in Science and Engineering, Chicago, IL, June 20-23, 2007.

Ph.D. candidate Saikat Chakrabarti presented a paper, "Authenticating DSR using a Novel Multisignature Scheme based on Cubic LFSR Sequences at the Fourth European Workshop

on Security and Privacy in Ad hoc and Sensor Networks (ESAS), Cambridge, UK, July 2-3, 2007; and "Authenticating Feedback in Multicast Applications Using a Novel Multisignature Scheme Based on Cubic LFSR Sequences" at the 3rd IEEE International Symposium on Security in Networks and Distributed Systems (SSNDS-07); and "Graphical Passwords: Drawing a Secret With Rotation As A New Degree of Freedom" at the Fourth IASTED Asian Conference on Communication Systems and Networks (AsiaCSN 2007), Phuket, Thailand.

Professor Fuhua Cheng presented "Shape Reconstruction Using Subdivision Surfaces: Similarity based Interpolation," National Cheng-Kung University, Tainan, Taiwan, October 9, 2006; and "Similarity based Interpolation using Catmull-Clark Subdivision Surfaces" at Pacific Graphics 2006, Taipei, Taiwan, October 10-11,2006; and "Subdivision Surface based Modeling," at Oklahoma State University, March 5, 2007; and "Shadow Generation for Objects Represented by Catmull-Clark Subdivision Surfaces" at The 25th Computer Graphics International Conference (CGI2007) Petropolis, Brazil, May 30-June 2, 2007; and "Robust and Error Controllable Boolean Operations on Free-form Solids Represented by Catmull-Clark Subdivision Surfaces" at CAD '07, Honolulu, Hawaii, June 25-29, 2007.

Professor Zongming Fei presented "Route Design for Multiple Ferries in Delay Tolerant Networks," co-authored with Zheng Zhang, at the IEEE Wireless Communications and Networking Conference (WCNC '07) in Hong Kong, March 2007.

Ph.D. student Jizhou Gao presented "Examplar-based Shape From Shading" at the International Conference on 3-D Digital Imaging and Modeling (3DIM) 2007, Montreal, Canada.

Professor Judy Goldsmith presented "Automatic generation of four-part harmony" at the Proc. UAI- 07 Workshop on Bayesian Modeling Applications, 2007. Professor Judy Goldsmith and Peng Dai presented "Multithreaded BLAO* Algorithm," Proc. FLAIRS, 2007; and "The Conference Paper Assignment Problem" at the Proc. AAAI Workshop on Preference Handling in Artificial Intelligence, 2007; and "Separating Routing and Forwarding" at the Internet Research Task Force's Routing Research Group, July 2007.

Professors James Griffioen and Raphael Finkel presented research findings of the UK CRIS group to representatives of the US Treasury and the Financial Services Sector Coordinating Council for Critical Infrastructure Protection and Homeland Security, April 2007.

Ph.D student Qiangfeng Jiang presented a paper on "An Optimistic Checkpointing and Message Logging Approach for

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consistent Global Checkpoint Collection in Distributed Systems" at the IEEE International Parallel and Distributed Processing Symposium, Long Beach, CA, March 26-30, 2007.

Professor Andrew Klapper presented "The Asymptotic Behavior of $\pi\pi$-Adic Complexity with $\pi^2 = -2\pi^2 = -2$" at the Workshop on Sequences, Subsequences, and Consequences, University of Southern California, May 2007; and Algebraic Feedback Shift Registers at the International Workshop on Codes and Cryptography, Wuyishan, China, June 2007.

Student Jody Larsen presented a paper at the Workshop on Predictive Models of Software Engineering (PROMISE) at the International Conference on Software Engineering in Minneapolis, MN, May 2007.

Ph.D. student Lian Liu presented "Privacy-Preserving Data Distortion Techniques Via SVD" at Eastern Kentucky University's 21st Annual Symposium in Mathematical, Statistical and Computer Sciences, Richmond, KY, March 23, 2007.

Professors Gregory Stump and Raphael Finkel presented "Principal parts and morphological typology" at the Ohio State University Linguistics department, 6/2007.

Ph.D. student Jie Wang presented a paper on "Addressing Accuracy Issues in Privacy Preserving Data Mining through Matrix Factorization" at the 2007 IEEE International Conference on Intelligence and Security Informatics, New Brunswick, NJ, May 23-25, 2007.

Ph.D. student Liang Wang presented "Light Fall-off Stereo," and Ph.D. student Qingxiong Yang presented "Spatial-Depth Super Resolution for Range Images" at the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR) 2007,Minneapolis, MN.

Ph.D. student Yin Wang presented a poster "SVD Stabilized Block Diagonal Preconditioner for Large Dense Complex Linear Systems in Electromagnetics," and won second prize in the poster section at the International Conference on Computational and Mathematical Methods in Science and Engineering, Chicago, IL, June 20-23, 2007. In the same conference, Ph.D. student Xuwei Liang also presented a paper "Quantitative Diffusion Tensor Imaging Tractography Measures Along Geodesic Distances in Amnestic Mild Cognitive Impairment".

Ph.D. student Jianchang Yang presented a paper on "Performance Comparison of Two Channel Allocation Approaches: Channel Pre-Allocation Vs. Non-Pre- Allocation," in the International Conference on Wireless and Mobile Communications, Guadeloupe, French Caribbean, March 4-9, 2007.

Ph.D. student Changjiang Zhang presented a paper on "Multiscale Simulation of Ligand-Receptor Binding and Dissociation In Circulation" at the 45th ACM Southeast Conference, Winston-Salem, NC, March 23-24, 2007.

Professor Jun Zhang presented "Diffusion Simulation for Understanding Human Brain Connectivity," at the Third Workshop on Interdisciplinary Computational Science, University of Houston, Houston, TX, March 22-23, 2007; and "Computing White Matter Fiber Orientations In High Angular Resolution Diffusion-Weighted MRI" at the First IEEE International Conference on Bioinformatics and Biomedical Engineering, Wuhan, China, uly 2007; and "Diffusion Tensor Analysis of Mild Cognitive Impairment Along a White Matter Pathway" at the Alzheimer's association International Conference on Prevention of Dementia, Washington, DC, May 2007.

Ph.D. Student Qi Zhuang presented "Krylove Subspace Methods to Solve Convection Diffusion Equation" and Xuwei Liang presented "Visual Analysis in Diffusion Imaging Data," both at Eastern Kentucky University's 21st Annual Symposium in Mathematical, Statistical and Computer Sciences, Richmond, KY,

Invited Talks

Professor D. Manivannan gave a talk on "Checkpointing and Recovery in Distributed Systems," Department of Computer Science and Engineering, Indian Institute of Technology, Kanpur, India, April 16, 2007.

Professor D. Manivannan gave a talk on "A Routing Protocol with Selective Forwarding for Mobile Ad-Hoc Networks," Department of Computer Science, Universita di Roma "La Sapienza," February 19, 2007. This is a joint work with Professor D. Manivannan's Ph.D. student, Qiangfeng Jiang, and Professors Raphael Finkel and Mukesh Singhal.

Professor Ruigang Yang was Invited to lecture at the University of Delaware, (host: Professor Jingyu Yi), April 2007 and at Adobe (host: Dr. Hailin Jin), July 2007 and a GRATIS lecture at Microsoft Research (host: Dr. Zhengyou Zhang), May 2007. He was also invited to talk to two universities in Brazil: University of Sao Paulo (host: Professor Marcelo K. Zuffo) and the Federal University of ABC (host: Professor Celso S. Kurashima), June 2007.

Professor Mirek Truszczynski gave an invited talk at the Answer-Set Programming Workshop in Porto, Portugal, and an invited tutorial at the International Conference on Logic Programming, also at Porto, September 2007.

Sabbatical Activities

Professor Hayes is on sabbatical for 2007-2008. She is collaborating with Dr. Giulio Antoniol of Ecole Polytechnique de Montreal, Dr. Yann-Gael Gueheneuc of University of Montreal, Dr. Jane Cleland-Huang of DePaul University, Dr. Jonathan Maletic of Kent State University, and Dr. Tim Menzies of WVU while on sabbatical, traveling to Montreal, Chicago, Ohio, and West Virginia.

Professor Goldsmith was on sabbatical for 2006-2007. She visited a number of universities around the globe, including University of Illinois-Chicago (hosted by Robert Sloan); The Rutgers Laboratory for Real-Life Reinforcement Learning (hosted by Michael Littman); Universitaet Jena (hosted by Martin Mundhenk) and Universitaet Dusseldorf (hosted by Joerge Rothe), both in Germany; the Cork Center for Constraint Computation, Cork, Ireland; the University of Utrecht (hosted by Linda van der Gaag), the Netherlands; Pierre et Marie Curie University (hosted by Patrice Perny); and the Computer Science Laboratory of Paris 6 University (LIP6).

Professor D. Manivannan served as a visiting faculty member from January 2007 to April 2007 in the Department of Computer Science and Engineering at Indian Institute of Technology, Kanpur, India.

My Research

My research centers about tool-building for various purposes. Two of my currently active projects involve tools for research in natural- language morphology and instruction in organic chemistry.

Dr. Raphael Finkel, Professor of Computer Science

Finkel

1 Research in morphology

Morphology is the study of the components that make up words and the rules for composing them. For example, even though you may have never seen the word unencryptably, you can see that it is composed of un 'not', en 'make', crypt, able 'capable of', and y [adverbial marker]. Dr. Gregory Stump of the English Department and I have been following two related lines of inquiry. The first suggests that a natural language's inflectional system is inferential: inflectional exponents (such as verb endings in Latin) are markings associated with the application of rules by which complex word forms are deduced from simpler roots and stems. We have developed the KATR formalism for representing those rules. KATR allows one to specify rules that hold in general (for all verbs, for instance), more specifically (for verbs with a particular theme vowel, for instance), and very specifically (for a particular verb). The more specific rules can override the more general rules. The KATR formalism has allowed us to represent in full detail the verb structures of Biblical Hebrew and Classical Latin, as well as large amounts of Polish, Spanish, Lingala, and Slovak. Our KATR theories (that is, formal specifications) are productive, in the sense that they generate all the verb forms. We use a Perl script to convert KATR theories to Prolog programs, and we then format the output of those programs.

The second line of inquiry suggests that a language's inflectional system is lexical: an inflectional exponent's association with a particular set of morphosyntactic properties is listed in the lexicon. Starting with a chart of all the forms of all the conjugations of verbs in a language (we have concentrated primarily on French and Latin), we find similarities among the conjugations and forms, distilling the chart into a reduced form. We then analyze the reduced chart to discover which forms are predictive of other forms; we call these special forms principal parts. There are several ways to define principal parts. This study leads to a typography of natural languages along several dimensions. To our surprise, we find that although Latin has only four principal parts (according to the most obvious definition,and in agreement with Latin pedagogy for at least a millennium), French apparently has about 11. We have been able to reduce this count by turning to a phonetic, as opposed to a spelled, representation of the French verb chart.

2 Instruction in organic chemistry

Dr. Robert Grossman of the Chemistry department and I have been developing ACE, a web-based application for organic chemistry homework. ACE allows authors to create questions, instructors to assemble the questions into assignments, and students to submit responses to those questions. Responses are often chemical structures, which the students construct with a structure-drawing applet. Each incorrect response elicits feedback that helps the student correct the response without actually revealing the answer.

The heart of ACE is the concept of a response evaluator. The author of a question, typically an experienced organic chemistry instructor, knows what mistakes students are likely to make. We have built several dozen evaluators that the author can assemble to be tried one after the other. For instance, a question might ask for the result of a reaction. The author might schedule the first evaluator to check if the response is exactly the correct compound; if so, the feedback might indicate not only that that the response is correct, but give some reinforcement, explaining why this response is right. The next few evaluators might check for particular incorrect responses. If none of these first evaluators matches the response, it must be wrong in an unexpected way. The author might then schedule more generic evaluators, looking at the total charge of the response, the number of molecules, the number of atoms of a particular element, the skeleton of the response, and the presence of particular substructures. In addition to structure-drawing questions, we have designed questions that require students to draw a Lewis structure (showing electrons in the outer shell) or to draw a mechanism (with arrows showing where electrons are transferred as bonds form and break). We also have multiple choice and ranking questions, although they are often pedagogically less sound. We are currently working on questions addressing synthesis of compounds and questions with R-groups, which are non reactive substructures selected from a constrained set when the student first sees a question. This project has been partially funded by Prentice-Hall. Thousands of students use this software every semester in their organic chemistry courses.