My general research interests are in the systems oriented aspects of computer science. I am particularly interested in the design and synthesis of complex software systems with quality of service (QoS) requirements. My long-term research vision revolves around the belief that quality of service requirements will become an important and integral part of software based systems. That is, in contrast to current practice, quality of service issues will play an integral role in the development of both the system software and the application design. Thus, systems software must be developed to allow an application to specify and control the QoS it receives from a system. Likewise, application development will include reasoning about the quality of service aspects, and using that to guide the software development.

My research background has been largely in the area of real-time systems, although I have also worked on problems in computer networking. Real-time systems have always incorporated notions of quality of service, especially for timeliness requirements. Indeed, the defining characteristic of real-time systems is that such systems consist of activities for which “when it is done” is as important as “what is done.” Thus, real-time software must be constructed to ensure that activities not only perform the correct function, but are also scheduled and executed in a timely manner.

A large class of real-time systems is in the domain of computerized control systems. Examples of such systems are found in everyday features such as the mechanisms responsible for cruise control and engine control in cars, as well as in more sophisticated application domains such as robotics, industrial process control and avionics. The role of a control system is to regulate one or more external variables to meet a predetermined level (e.g., maintain-
(Continued from page 1) Real-Time Software Design

As a result of our research, we found several problems in applying real-time scheduling theory results in the implementations generated by such design tools. One such problem was that the implementations could suffer from significant priority inversions, where a lower priority activity executes even when higher priority activities are pending. Another problem was that the implementations were based on an event handling architecture, where a single task could be processing many events of different types and priorities. This leads to a two level scheduling problem — within a task, a scheduler processes events queued up on the task’s event queue, and then across the system the operating system schedules these tasks. In our research we have extended real-time scheduling results to work with such an architecture and also developed implementation guidelines to avoid the priority inversion problems. Also, we have begun addressing problems of automatic derivation of various implementation attributes (e.g., priorities for events and tasks, mapping of objects to tasks) based on high level end-to-end timing requirements.

In our ongoing research, we continue to explore the problem of integrating quality of service concerns within real-time software design methods. We have just barely begun to address these problems within the context of object-oriented design methods. In the near future we will continue to explore problems of modeling, analysis, design, and implementation for meeting timeliness requirements. We also have plans to extend these ideas to multiprocessor and distributed systems, as well as to incorporate fault-tolerance and reliability concerns into the design process. Finally, we hope to extend these ideas to other interesting real-time domains such as real-time electronic commerce and multimedia applications.

Manas Saksena is a new Assistant Professor in the Department of Computer Science. He received his Ph.D. from the University of Maryland in July 1994.
Rami Melhem Named IEEE Fellow

Professor Rami Melhem has been elected as an IEEE Fellow, effective January 1, 2000. Recognizing the achievements of its members is an important part of the mission of the IEEE. Each year, following a rigorous evaluation procedure, the IEEE Fellow Committee recommends a select group of recipients for one of the Institute’s most prestigious honors, election to IEEE Fellow. Less than one in one thousand members of the IEEE will receive this honor in 2000. Professor Melhem was recognized for his contributions to application of optical technology and design of interconnection networks for computer systems.

(continued from page 1) Soffa Receives Presidential Award

the innovative programs she set up as the Dean of Graduate Studies. Of her 18 graduated Ph.D. students, 50 percent are women. Of her master’s degree students, 24 (53 percent) are women, one is African American and one is physically disabled. She currently advises three doctoral students including a Hispanic woman. Among her mentees is a Swedish female who was the first woman in her country to receive a doctorate in computer science. Among her graduates, 11 have received prestigious pre-doctoral fellowships, two are full professors, three are associate professors, two are assistant professors and one has received the NSF Young Investigator Award. While serving as Dean of Graduate Studies, she implemented an innovative program to recruit underrepresented students that increased their number by 100 percent in four years.

AN AI WEBSITE THAT’S JUST RIGHT
Bruce Buchanan

Information that is not too technical, and not too superficial, is just right for high school students and their teachers, college undergraduates and just about anyone who wants basic, substantive information about computers. AI TOPICS is a website designed to provide on-line access to introductory resources concerning artificial intelligence and its many dimensions. The site is also the perfect, time-saving referral for you, your colleagues and staff to recommend to people looking for answers to general AI queries.

The site is organized around a handful of major AI topics, each providing visitors with several categories of resources. First and foremost is Good Places to Start which satisfies both the visitors need for understandable information with substance and their expectation that full-text versions of these resources will be immediately available via embedded links. Throughout the site, the emphasis is on resources of the caliber of Scientific American and The Atlantic Monthly, both known for offering accurate, in-depth articles that are accessible to readers without a scientific background.

You can access the site by going directly to the AI TOPICS homepage at www.aaai.org/Pathfinder/pathfinder.html, or by clicking the AI TOPICS button on the homepage of the American Association for Artificial Intelligence (www.aaai.org), the sites sponsor. Bruce Buchanan, University Professor of Computer Science at Pitt and president of AAAI, oversees the project’s part-time staff, Jon Glick and Jose Tobar, who are busy updating and improving the site with everything from the on-line version of the visionary classic by Vannevar Bush that appeared in The Atlantic Monthly in 1945 and anticipated much of the desktop computing revolution (History), to a link to a recent article in the Pittsburgh Post-Gazette about Nomad, an intelligent robot from Pittsburgh, searching for meteorites in Antarctica (AI in the News).

Please check out the site and be sure to let us know if you have any suggestions for new material and/or comments of any kind. In fact, we are currently seeking material for our new FAQ page and we’d really like to hear what questions you think we should include. You can send these to jglick@cs.pitt.edu and perhaps your name will soon be added to the long list of those who have already helped (see Acknowledgment on our homepage).

LINKS is published semi-annually by the Computer Science Department, University of Pittsburgh. Your suggestions, comments and contributions are welcome. Please send them to the address below.

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FORTS: Fault Tolerant through Scheduling in Real-Time Systems

Rami Melhem and Daniel Mossé

We are working on several problems related to fault-tolerant, real-time and distributed systems. A real-time system is a system in which computations must be completed within specified deadlines. In a hard real-time system, missing a deadline can be catastrophic. A real-time system may be based on a single processor or multiple processors. A multiprocessor system may be tightly coupled, that is, the processors are connected together by a high-speed bus, possibly sharing memory and typically physically located within a few racks or cabinets. Alternatively the processors may be distributed around a factory and connected by a local area network. A fault-tolerant system is one that automatically recovers from a specified number of failures. Typically this involves scheduling multiple instances of a task so that if one instance fails, its duties will be assigned to a backup instance.

We are developing new algorithms that guarantee the completion of a set of scheduled tasks before their deadlines in the presence of processor failures (transient failures, permanent failures, temporary failures, etc). Our algorithm schedules several backup tasks on top of one another and dynamically delegates the backups as soon as the original tasks complete executions, thus increasing the utilization of processors. This scheme can be used for both periodic and aperiodic, preemptive and non-preemptive task models.

Simulation results showed that our method achieves higher task schedulability than using a spare processor as a backup to be invoked in the event of a failure. Further, we are developing a new theoretical expression for accepting tasks with fault tolerance provisions in a single processor. Several students participate in the project, casting different lights on different problems and helping out with the implementation. Hakan Aydin recently cracked the problem of fault-tolerant real-time scheduling for imprecise computations, in which tasks have a better reward the longer they execute. Libin Dong is tackling the problem of networking in the FORTS environment. Sylvain Lauzac is focusing on the problem of multiprocessor scheduling with different priority assignments, and Hugo Varotto is implementing the schemes on a modified Linux kernel. Jesse Cronce is also doing some kernel modifications, implementing an Earliest Deadline First scheduling in a multiprocessor system. The first three are PhD students, and the last two are MS and BS students, respectively.

From simulation results to actual implementations, lies a long hard (kernel hacking) road. Anthony Egan was the main implementor of the project, hacking all types of parts of the kernel, followed by Dan Bauman, who continued the task of fixing and modifying kernels. Joan Kettering incremented the implementation of the systems by allowing not only periodic non-preemptive tasks, but also tasks with precedence constraints. Joydeep Sen Sarma (with Tony) created a middleware implementation of a distributed FORTS, loaded with fault injection, fault detection and recovery capabilities. John Drescher (at the time an undergraduate student) implemented a master-slave clock synchronization algorithm, after building a hardware device to connect several machines within our subnetwork.

Our project is being demonstrated through a series of applications, varying from a simulated train track control system (borrowing the expertise of David Kutz, one of our former M.S. students) to the implementation of a control system of a toy car, with a remote control connected to the serial port of a PC instead of a joystick (designed and constructed by Jim Valenti, one of our former undergraduate students).

Rami Melhem is a Full Professor and Daniel Mossé is an Associate Professor in the Department of Computer Science.

Martha Pollack Wins Chancellor’s Distinguished Research Award

We are very pleased to announce that Professor Martha Pollack is a winner of the Chancellor’s Distinguished Research Award in the Senior Scholars category for the year 2000. Her record of research achievements in AI is truly outstanding. She is acknowledged to be a leader in the subarea of plan generation and management. Her results have had significant impact. She is credited with being largely responsible for defining the study of “resource-bounded planning.”

Chancellor Mark Nordenberg wrote to Prof. Pollack, that “The University is proud to honor your work as a founder of one of the central approaches to reasoning about plans and intentions. In addition, your work on simulation and testbed systems broke methodological ground and spurred much subsequent work in experimental AI.”

Besides her position on the faculty of the Department of Computer Science, Prof. Pollack is the current Director of the Intelligent Systems Program at Pitt.

Bob Hoffman Receives Chancellor’s Award for Staff Excellence

Any alumni who had reason to use our Departmental computer and communications infrastructure at any point during the last 20 years, and who required help in solving some technical problems, are likely to remember Robert Hoffman, our senior technical staff person. We are delighted to report that he has won the Chancellor’s Distinguished Service Award for Staff for the year 2000.

Bob has exhibited incredible knowledge and loyalty to the Department and the University. Not only are the faculty, students and staff dependent on his abilities; various other University departments consult him in times of need for his technical expertise. In addition, Bob has been amazingly active in various roles of community service — too numerous to detail here.

Chancellor Mark Nordenberg wrote, “On behalf of the entire University community, let me express deep gratitude for your dedication and hard work.”
**ACCOLADES: 1999 - 2000**

**FACULTY**

**Bruce Buchanan** will chair the Board of Scientific Counselors for the National Library of Medicine in 2000.

Bruce is also serving as President of the American Association for Artificial Intelligence for 2000 and 2001.

**Panos Chrysanthis** received a Teaching Award for an Undergraduate Service Course in 1998/99.

**Robert Daley** received a Teaching Award for an Undergraduate Advanced Course in 1998/99.

**Mark Moir** is on the Program Committee for ACM Symposium on Principles of Dist. Comp. (PODC).

Mark has also been invited to serve on the Program Committee for the 21st IEEE Real-Time Systems Symposium, (RTSS 2000) in Orlando, FL, November 2000.

**Daniel Mossé** received a Teaching Award for an Undergraduate Advanced Course in 1998/99.

**George Novacky** received Teaching Awards for an Undergraduate Service Course, an Undergraduate Core Course and an Undergraduate Advanced Course in 1998/99.

**Martha Pollack** was promoted to Professor of Computer Science effective September 1, 1999.

Martha also received a Teaching Award for a Graduate Level Elective Course in 1998/99.

**Kirk Pruhs** was appointed as an associate editor for INFORMS Journal of Computing.

**John Ramirez** received a Teaching Awards for an Undergraduate Service Course and an Undergraduate Core Course in 1998/99.

**Manas Saksena** and **Yun Wang** co-authored a paper “Scheduling Fixed-Priority Tasks with Preemption Threshold,” that was awarded the Best Student award (Yun Wang) by the International Conference on Real-Time Computing Systems and Applications, December 1999. Yun is a Ph.D. student at Concordia University; Manas is his supervisor.

Also, Manas is a member of the program committees for (1) the Eighth International Workshop on Parallel and Distributed Real-Time Systems (WPDRTS 2000), to be held in May 2000, and (2) The 3rd IEEE International Symposium on Object-oriented Real-time distributed Computing (ISORC 2K), to be held in March 2000.

**Mary Lou Soffa** received a Teaching Award for a Graduate Level Core Course in 1998/99.

Mary Lou is also the Co-Chair of CRAW, the women’s committee of Computing Research Association (CRA), 2000-2002

**UNDERGRADUATE STUDENTS**

**Michael J. Damico** was awarded the Joseph B. Lawler Memorial Scholarship for the 1999 fall term.

**David A. Gingrich** was awarded a Wilma Binder Zeder Memorial Scholarship for the 1999 fall term.

**Jeremy E. Greenwald** was awarded a Wilma Binder Zeder Memorial Scholarship for the 1999 fall term.

**Scott J. Rattay** was awarded a Wilma Binder Zeder Memorial Scholarship for the 1999 fall term.

**Mark Seigle** was honored by receiving honorable mention for the Computing Research Association (CRA) Outstanding Undergraduate Award. This award is a nationally competitive award.

Mark also received a Wilma Binder Zeder Memorial Scholarship for the 1999 fall term.

**Jonathan R. Speicher** was awarded a Wilma Binder Zeder Memorial Scholarship for the 1999 fall term.

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**Jonathan R. Speicher** was awarded a Wilma Binder Zeder Memorial Scholarship for the 1999 fall term.

**GRADUATE STUDENTS**

**Colleen McCarthy** was awarded The National Physical Science Consortium Fellowship 2000-2002.

**Atif M. Memon**, co-authored a paper “Using a Goal-driven Approach to Generate Test Cases for GUIs,” with Martha Pollack and Mary Lou Soffa at the 21st ACM/IEEE International Conference on Software Engineering, which was selected as one of the outstanding papers of the conference. The authors were invited to send a revised version of the paper to be published in a special issue of the IEEE Transactions on Software Engineering.

Atif was also awarded the Andrew Mellon Predoctoral Fellowship (2000-2001)

**Tarun Nakra** was awarded the Andrew Mellon Predoctoral Fellowship 2000-2002.
ALUMNI NEWS

B.S. GRADUATES:

Kimberly Batch, B.S., 1994 (e-mail: BatchKR@MSX.UPMC.EDU)

Kim is a research associate for the University of Pittsburgh Medical School presently in the role of Enterprise Information Architect for the Integrated Advanced Information Management Systems (IAIMS) effort between the University of Pittsburgh Schools of the Health Sciences and the UPMC-Health System. Kim has been serving in this position since Sept. 1998.

Matthew L. Baynard, B.S. 1988 (e-mail: MATTHEW_BAYNARD@HP-USA-om13.om.hp.com)

Matthew is currently an account manager for technical activities within the Lucent Technologies account worldwide. His primary area of responsibility is telecommunications and emerging technologies.

James A. Briscoe, B.S., 1993 (e-mail: jbriscoe@aarcorp.com)

James is currently working as a Material Manager at AAR Aircraft Turbine Center.

Cedric Childs, B.S., 1997 (e-mail: clcest16@AOL.COM)

Cedric is presently employed as a Software Engineer at Boeing Aircrafts & Missiles.

Mercy Fung, B.S., 1994 (e-mail: mercyfung@earthlink.net)

Mercy is currently living in Georgia.

Charles Griffith, B.S., 1987 (e-mail: cgriffith@pacificnet.net)

Charles is employed as a Senior Software Engineer at Microcadam, Inc.

David M. Hunt, B.S., 1994 (e-mail: dmhunt@umich.edu)

David is currently employed as a Systems Administrator at the University of Michigan.

Hanh H. Huynh, B.S., 1985 (e-mail: hhuynh@american.edu)

Hanh is employed at American University in Washington, DC. He is the Director of Information Services in the Office of Development.

Curtis J. Matz, B.S. 1993 (e-mail: cmatz@usaor.net)

Curtis is currently working at Daimler-Chrysler Rail Systems (North America) Inc., also known as Adtranz, as their webmaster and one of their network administrators.

Karen Rhody Murray, B.S. 1992 (e-mail: Karen_M_Murray@dlc.dqe.com)

Karen is working as a Senior Consultant for Innovative Decisions, Inc. Her current assignment is with Duquesne Light. Karen is developing various PowerBuilder/DB2 applications for their invoicing department.

Christopher M. Powers, B.S., 1992 (e-mail: cpowers@uss.com)

Chris is employed at United States Steel as a Systems Designer.

Dennis Rich, B.S., 1984 (e-mail: denny_rich@ameritech.net)

Dennis is presently self employed. Denison Rich Associates, Inc, is an Ohio Corporation that provides international project management consulting in the field of Information Technology.

David Sarandria, B.S., 1998 (e-mail: dsarandria@silverstate.com)

David is employed at Silver State Software as a software developer.

Justin G. Tolmer, B.S., 1996 (e-mail: jtolmer@microsoft.com)

Justin is working for Microsoft Corporation as a Software Design Engineer.

Michele Wilson, B.S., 1975 (e-mail: mwilson@shym.com)

Michele would like to see an alumni directory established so that she can find some people she knew way back when and perhaps establish contact with them.

Kim Winslow, B.S., 1995 (e-mail: kim.winslow@sabre.com)

Kim is currently employed at Sabre as a Sr. Consultant.

Jeffrey D. Zink, B.S., 1987 (e-mail: JZink71316@aol.com)

Jeffrey is employed at IBS Consulting Services as a Project Consultant.

M.S. GRADUATES:

Rodger C. Blair, M.S., 1995 (e-mail: Rodger_C_Blair@Keane.com)

Rodger is working at Keane on establishing a business line of products and services based on the SEI Capability Maturity Model. This is what he worked on at the Software Engineering Institute, Carnegie Mellon University, 1987-90. Rodger is now commercializing it for Keane. He is also teaching a course in Software Inspection and is developing a training course in the “Introduction to the Capability Maturity Model for Software” to be taught to Keane clients. Currently, he is consulting about 60% of the time and teaching the other 40%. Rodger loves his work, but misses friends and colleagues at Pitt!

continued on page 7
Farhat Jabeen Lakhavani, M.S. 1982  
(e-mail: meena@cmu.edu)  
Farhat is employed at Carnegie Mellon  
University as the Director of User Services.

Richard Meyer, M.S., 1994 (e-mail:  
rick.meyer@eds.com)  
Rick worked for three years in the World  
Trade Center in NYC. He moved back to  
Pittsburgh two years ago. Rick is currently  
an information specialist for Electronic Data Systems.

Douglas Roesch, M.S., 1994 (e-mail:  
DERoesch@aol.com)  
Doug is employed as a Senior System  
Designer at CLARITECH Corporation.

Ph.D. GRADUATES:

Tawfig Al-Rabiah, Ph.D., 1999 (e-mail:  
tawfig@ksu.edu.sa)  
Tawfig is currently employed at King Saud University as an Assistant Professor.

AbdulRahman Aljadhai, Ph.D., 1999  
(e-mail: asj@acm.org)  
AbdulRahman is currently employed at the Riyadh College of Technology as an Assistant Professor.

Joel Adams, Ph.D., 1988  
(e-mail: adams@ursa.calvin.edu)  
Joel just spent a year as a Fulbright Scholar at the University of Mauritius (an island country 1000 miles east of Madagascar). His wife and two boys (Roy was 2 years old, Ian was 2 months old when they left) accompanied him.

Situated just south of the equator, Mauritius has striking mountains, beautiful sandy beaches, a coral reef that protects a wide variety of tropical fish and other aquatic organisms, and some of the friendliest people he ever met. In the US, Mauritius is perhaps best known as the only island where the dodo lived — the now extinct bird that has become the poster-child for endangered species around the world. Mauritius has been independent since 1968, but was a British colony before that, a French colony before that, and a Dutch colony before that. Ethnically, its people are roughly 53% of Indian origin, 25% of African origin, 15% of Arabic origin, and 5% of Chinese origin — a very dynamic, diverse mix of cultures, traditions, foods, and so on.

It was a great cross-cultural experience, and it made Joel and his family appreciate many things that they had previously taken for granted. Joel would recommend it as an enriching experience for anyone, and would encourage anyone who’s feeling a bit “stale” to consider applying for a Fulbright grant — there are many opportunities around the world for people with expertise in computing. Mauritius follows the British/Cambridge system of education, so his first semester there he “lectured” on Compiler Design (thank you again, Dr. Soffia) and “tutored” on Computer Organization and Programming Methodologies. The second semester Joel “lectured” on Object-Oriented Techniques and also taught a faculty seminar on Java Programming. During holidays and free time, he worked on his research project: building an O-O (C++) code-generating system for TCP/IP clients and/or servers for any of BSD, Linux, System V/Solaris, or Windows.

In August 1999, he returned to his position as Professor in the Department of Computer Science at Calvin College. Those of you who remember him may be interested to know that former Pitt CS faculty member Harry Plantinga will be joining that department in a tenure-track position this fall, and continuing his research in Digital Libraries.

Sunondo Ghosh, Ph.D., 1996 (e-mail:  
sghosh@htc.honeywell.com)  
Sunondo is a Principal Research Scientist at Honeywell.

Yi Pan, Ph.D., 1991  
(e-mail: pan@cps.udayton.edu)  
Yi is employed as Associate Professor and Director of Graduate Studies at the University of Dayton. He was recently awarded the Outstanding Scholarship Award of the College of Arts and Sciences at University of Dayton. He was also appointed as Editorial board member of The Journal of Supercomputing, Editor of the journal of Parallel and Distributed Computing Practices, Associate Editor of the International Journal of Parallel and Distributed Systems and Networks, and Editorial board member of INFORMATION, an International Journal.

Frank C. Wimberly, Ph.D., 1978  
(e-mail: wimberly@biosgroup.com)  
Frank is working as a Senior Software Engineer for Bios Group LP in Santa Fe.
We would like to hear from you. Please update your address and tell us what you are currently doing. Also if you know the whereabouts of any CSD alumni please send us the person’s name and address. You can use this form or send us e-mail.

CONTRIBUTIONS TO THE CSD
If you are in a position to consider making a contribution (or donation) to support the programs of the CSD, please contact our Department Chair, Sig Treu (412-624-8493 or treu@cs.pitt.edu) or any of our faculty. We would be delighted to talk with you.

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