Henning Schulzrinne, Professor & Chair

This fall, the Department of Computer Science at Columbia University was proud to celebrate its 25th anniversary under the banner “Academic Excellence, Innovative Research.” The celebration began with a dinner with Peter Likins, the current President of the University of Arizona. In the late 1970’s, Peter as provost of Columbia University was one of the principal individuals who helped create the Department. This was a bold move for Columbia because in those times computer science was not yet universally recognized as an academic discipline.

The event was highlighted by a one-day symposium by current new faculty and alumni, with a keynote address by Bob Kahn and a retrospective from the first department chair, Joe Traub (see pg. 7). The article on pg. 7 provides more details and links to photos and video recordings. The Department has now 34 faculty, complemented by an increasing number of adjunct professors from the local research laboratories teaching advanced graduate courses. Unlike most other departments, our PhD, MS and undergraduate student populations are of the same magnitude, with 124 PhD students, about 160 Masters students, and 145 undergraduate majors. The Department’s research and teaching is supported by 16 administrative staff and 5 system administrators. Last year, we conducted research supported by almost $10 million of external funding.

Since 1979, we have graduated more than 150 PhDs, now working in most of the major computer science-related laboratories and in many universities, both in the United States and beyond. 1620 undergraduates have received a Columbia CS degree over the years, along with 1206 MS students. We want to continue to leverage our broad and deep coverage to provide more than just a textbook education to our students. For example, our low student-to-faculty ratio allows us to offer individually supervised research projects, with almost all MS students and many of the undergraduates taking part in at least one such project during their time at Columbia. Despite the vastly wider scope and reach of computer science as a whole, the Department’s faculty and students have continued to work together, in research groups, long-term collaborations and shorter-term research projects.

(continued on page 10)
In cooperation with the National Emergency Number Association (NENA), MapInfo and Texas A&M University, two Columbia Computer Science students, Matthew Mintz-Habib and Anshuman Rawat, together with Professor Henning Schulzrinne are working on designing and prototyping the next generation of emergency calling (“9-1-1”) for the United States and beyond.

The existing 911 system has evolved slowly since its beginnings in the 1970s, often still using the same technology. For example, information about the caller is limited to eight or ten digit phone numbers which are then used to look up the street address of the caller based on telephone company subscriber data. The proliferation of cell phones and, most recently, voice-over-IP (VoIP) technology is stretching the ability of the system to keep up. For example, despite investment of billions of dollars, only about 30% of the nation can currently receive caller location from mobile phones, leading to delays in dispatching emergency assistance. For VoIP, the old structure relying on mapping telephone numbers to location fails completely.

This has led to a number of organizations to work together to design and prototype a next-generation, packet-based infrastructure that is slated to slowly replace the existing analog, circuit-switched system over the next decade. The new system relies on the Session Initiation Protocol (SIP) for call signaling, carrying end system location information for stationary, nomadic and mobile callers. VoIP phones learn their location through network configuration protocols such as DHCP. The caller location is then used to locate the appropriate emergency call center for the area and to display the caller’s location on a map at the call taker’s work station.

Unlike the traditional telephone version, this system can easily migrate call handling should the primary call center be overloaded or disrupted. Longer term, still photos and live bidirectional video, e.g., from camera phones, can allow emergency personnel to better assess the nature and severity of the incident, as well as to provide pre-arrival first-aid instruction.

The project is funded by a grant from the National Telecommunications and Information Administration (NTIA) and the Center for Advanced Telecommunication Technology (CATT).

http://www.cs.columbia.edu/irt/sos

Yannakakis gives Milner Lecture

Professor Mihalis Yannakakis gave the ninth annual Milner Lecture at the University of Edinburgh in May. The Milner Lecture is given each year “by someone from outside the University who has done or is doing excellent

and original theoretical work which has a perceived significance for practical computing.”

In July, Yannakakis gave a joint invited lecture on “Testing, Optimization, and Games” at the 31st ICALP International Colloquium on Automata, Languages and Programming (ICALP) and the Twentieth IEEE Symposium on Logic and Computer Science (LICS) which were held in Turku, Finland. Yannakakis, who is the Percy K. and Vida L. Hud Hudson Professor of Computer Science, joined Columbia January 2004 after a year at Stanford University and more than twenty years at Bell Labs Research.
Al Aho, Vice Chair for Undergraduate Education

In the fall of 2004, the Computer Science Department at Columbia University launched a new undergraduate program in Computer Science.

The department spent the previous two academic years planning and designing the new program. It was felt that in an era in which computers, networks, software, and digital information are pervading society an integrated curriculum was needed to prepare Columbia students for a rapidly evolving world in which exponential advances in information technology are continuously transforming every area of human endeavor.

The new program provides students with three complementary kinds of knowledge: contemporary information technology skills, fundamental concepts of computer science, and most importantly algorithmic problem-solving capabilities that can be applied to virtually any field. These three kinds of knowledge were advocated for all graduates (not just CS graduates) of four-year colleges and universities in the National Research Council report, "Being Fluent with Information Technology," National Academy Press, 1999. (I was a member of the committee that created this report.)

- Contemporary skills give students the ability to apply today’s information technology immediately. These skills also provide students with a store of practical knowledge on which to build new competencies.
- Fundamental concepts give students the ability to understand the basic principles and ideas underlying modern Computer Science. The core courses are:
  - CS I: Intro to CS and Programming in Java (COMS W1104)
  - CS II: Intro to Computer Science (COMS W1107 or W1201)
  - CS III: Advanced Programming (COMS W2101)
  - CS IV: Data Structures and Algorithms (COMS W3137 or W3139)

- Algorithmic problem-solving capabilities give students the ability to apply their skills and concepts to design solutions in complex interdisciplinary situations arising in scientific, engineering, and business applications. These capabilities allow students to create and implement new technologies to meet the challenges of future applications.

The new program has a core Computer Science curriculum that is taken in the first two and a half years to provide the basic skills and concepts underlying modern Computer Science. The core courses are:
- CS I: Intro to CS and Programming in Java (COMS W1104)
- CS II: Intro to Computer Science (COMS W1107 or W1201)
- CS III: Advanced Programming (COMS W2101)
- CS IV: Data Structures and Algorithms (COMS W3137 or W3139)

The first course, COMS W1104, has been designed for students with little or no programming background making it easy for high school students of all backgrounds to enter and study Computer Science. If a student has taken AP CS in Java in high school and gotten a 4 or 5, the student can go directly into the second course, COMS W1107 and on successful completion of COMS W1107 also get credit for COMS W1104. The first two courses (COMS W1104 and 1007) are taught in Java. The second two courses (COMS W3137 and COMS W3139) are taught in C++. In this way, Columbia computer science students become fluent in more than one programming language.

In the junior year students select one of five tracks in which they then learn an important field of computer science close to its technical frontiers. Each track has a set of required courses, breadth courses, and a large selection of elective courses. The tracks are:
- Foundations - for students wishing to pursue graduate study in computer science, and for students interested in machine learning, artificial intelligence, and/or software systems.
- Systems - for students interested in the design and implementation of hardware and/or software systems.
- Artificial Intelligence - for students interested in machine learning, robotics, or systems capable of “human-like” intelligence.
- Applications - for students interested in the design and implementation of interactive multimedia applications.
- Vision and Graphics - for students interested in how visual information is captured, manipulated, experienced in addition, there is an Advanced Track in which a student can study one of these tracks at an accelerated level. Admission to the Advanced Track is by invitation of the faculty.

See “ACADEMS/CSC” under the departmental website http://www.cs.columbia.edu or the SEAS Bulletin for the details of the new program.

The intermingling of skills, concepts, and algorithmic problem-solving capabilities pervades the entire program, starting with the first course. Students quickly discover that computer science is full of deep, interesting, and important ideas that can be applied to many different fields. Many senior-level courses such as Programming Languages and Translators (COMS W4110) and Operating Systems (COMS W4119) have semester-long projects in which students work in small teams to create and implement innovative new languages and systems of their own design. Through such projects students can exercise their own creativity and learn valuable project management, teamwork, and communications skills.

In short, the new Computer Science program has been designed to educate Columbia students to become leaders in the new Information Age.
The festivities opened with a dinner reception the evening of Thursday, October 21 with Peter Likins, President of the University of Arizona, reminiscing about the trials and joy of starting the CS department during his tenure as Dean of the Engineering School.

Friday began with an opening address by Robert Kahn, President of the Corporation for National Research Initiatives, who was Director of DARPA’s Information Processing Technical Office (IPTO) and was responsible for significant funding of our Department in the formative years. Dr. Kahn was introduced by Joseph Traub, the inaugural Chairman of the department.

The rest of the day was framed by technical talks by five current faculty members who have recently joined the Department, followed by a dozen former PhD, MS and undergraduate students who returned home to share their life and professional experiences, some from as far away as Australia, others from California and Texas.

The evening we enjoyed another reception, with a chance for attendees to see posters and demos of current department research. Our celebration was capped off on Saturday with a “family and friends” barbecue. Even though the temperatures were uncharacteristically chilly that final day, the department’s alumni, students, friends, and faculty celebrated with great enthusiasm. The weather was held in for a department that has grown into stature, and has become an integral and important part of Columbia University. See http://www.cs.columbia.edu/25th for more information and videos from the celebration!

Before the establishment of the Computer Science Department in 1979, there were computer science efforts in the Mathematical Statistics Department in Arts and Sciences, and in the Electrical Engineering Department in the School of Engineering.

In the academic year 1978-79 Peter Likins, the Dean of the School of Engineering (now President of the University of Arizona) persuaded the University to eliminate both these efforts and to create a Computer Science Department. The creation of the new Department was strongly supported by Columbia’s central administration.

At the time I headed the Computer Science Department at Carnegie Mellon University, universe was ranked together with Stanford and MIT as one of the premier departments in the world. Peter approached me to be the founding chair of the new department at Columbia. I agreed to come under certain conditions which included a new building for the Department, tenure faculty positions, and a teaching load competitive with leading computer science departments at private universities.

Likins agreed to all requests and I came to Columbia University on July 1, 1979. The new Department had four tenure professors (Theodore Baskow, Jonathan Gross, Stephen Unger and myself). The decision was made to recruit the best possible new PhDs, as well as a few outstanding senior faculty, which required that the existing non-tenured faculty had to be asked to leave.

The following people, who are now all senior faculty joined the department in the early years: Peter Allen, Steven Feiner, Zvi Galil, Gail Kaiser, John Kendall, Kathy McKeeon, Sal Stoifo, Henryk Wozniaikowski, and Yapham Yermiy.

Much had to be accomplished in the creation of the new department. Peter Likins was marvelously supportive at all times. Here are some of the things we had to do.

The faculty had to be built almost from scratch. One of the characteristics of computer science, as opposed to many other disciplines, is that there are many more available positions than absolutely top people to fill them. It was true at Carnegie in 1971; it’s true today. That is healthy for the discipline but makes it difficult for faculty recruiting.

For every appointment, the new Department had to compete with top academic departments and top research labs. Nonetheless, superb new faculty were hired.

At the same time there was huge student demand for the Department’s graduate students took courses in the first year, 2000 the next year, and 200 a few years later. There were as many as 200 students per course. We were trying to hire the top young PhDs and yet they had to teach classes of 200 students. The Department started to hire lecturers to help with teaching, especially for the beginning courses. We hired lecturers who loved to teach and who interacted well with undergraduates.

The Department started Bachelor’s, Master’s and PhD programs. It taught computer science to Columbia University so there were majors from the Engineering College, Columbia College, Barnard, General Studies and the Graduate School. Jonathan Gross served as Vice-Chair. Among his responsibilities were creation of the curricula and oversight of various Bachelor’s programs.

Obtaining funds was crucial to building Departmental research. In the first year IBM gave the Department a six hundred thousand dollar gift. Pivotal to giving the Department a big push was a very large contract from DARPA, the Defense Advanced Research Projects Agency. DARPA was the equivalent of an Oscar or a Pulitzer Prize. To celebrate the new building, a convocation was held in 1983. There were talks by distinguished leaders in computing and Herbert Simon received an honorary doctorate. In 1979 Columbia University was fairly late in starting a Computer Science Degree Program. The Department felt it was important to demonstrate to the University the centrality of the discipline. One of the ways this was accomplished through the “Columbia University Lectures in Computer Science”.

CS@CU

Building construction ongoing, February 1982

CS@CU
Al Ahle was appointed to the Advisory Board of the Computer and Information Sciences Directorate of the National Science Foundation.

Ricardo Baratto, Shaya Potter, Feng Su, and Jason Nieh received the 2004 ACM MobCom Best Student Paper Award for their paper titled “MobiDesk: Mobile Virtual Desktop Computing.” The MobiCom PC Chairs noted that paper was also the highest rated paper of the conference.

Steve Feiner served as general chair for ACM UIST 2004 (User Interface Software and Technology), held in Santa Fe in October 2004.

Steve Feiner gave the keynote talk for ACM VRST 2004 (Virtual Reality Software and Technology), held in Hong Kong in November 2004.

Luis Gravano was Program Co-Chair for the 13th ACM Conference on Information and Knowledge Management (CIKM 2004), as well as Co-Chair of the WebDB 2004 workshop.

Toni Fleyda was Program Chair for the International Conference on Development and Learning at the Salk Institute in La Jolla, California, October 20-22 2004. http://www.idcll.org.

Toni Fleyda won a National Science Foundation grant through the KDD Program for the project “Correspondence in Learning using Permutation Algorithms.”

Gail Kaiser and Angelos Keromytis jointly were awarded a “Microsoft Research Trustworthy Computing Curriculum Grant” of $50,000, one of 10 “winners.”

Tal Malkin, Jason Nieh, and Dan Rubenstein received 2004 IBM Faculty Awards. Nieh also received a 2004 IBM SUR Award.

Tal Malkin received $70K from the NY Software Industry Association for two projects on “Securing Financial Communication On-Line.”

Vishal Misra, Dan Rubenstein, Nick Maxemchuk (EE) and Predrag Jelenkovic (EE) won the IBM SUR Award at the 2004 IEEE Conference on Computer Vision and Pattern Recognition (CVPR) for their paper titled “Programmable Imaging using a Digital Micromirror Array.”

Jason Nieh received the 2004 Distinguished Faculty Teaching Award, given annually to recognize excellence in teaching in the School of Engineering and Applied Science at Columbia University.

Jason Nieh, Gail Kaiser, and Angelos Keromytis won a highly competitive 2004 ITI Award from the National Science Foundation for their project titled “Secure Remote Computing Services.”

Ravi Ramamoorthy and Shih-Fu Chang (EE) won a three-year grant from the National Science Foundation CyberTrust program titled “Restore the Trustworthiness of Digital Photographs: Blind Detection of Digital Photograph Tampering.”

Henning Schulzrinne served as co-chair for ACM Multimedia 2004, held at Columbia University in October 2004. PhD students Weibin Zhao and Ashutosh Datta served as local arrangements and finance chairs.

Sal Stollo received an NSF award for his project “Email Mining and Cargo: Helping less-irritated E-Mail Enthusiasts.”


We are proud to welcome Professor Etan Grinspun to the Columbia Vision and Graphics Center. Professor Grinspun’s focus on the mathematical foundations of computer animation and scientific computing complements our strengths in the areas of graphics, vision, inference, facing, and robotics.

Professor Grinspun is interested in representations of physical systems on a computer. This includes modeling the geometry (shape) as well as mechanics (behavior) of everyday objects such as light bulbs, straw hats, air bags as well as tissues such as the human brain. Since he is interested in both theoretical and practical engineering, design, medical training, and computer-aided surgery. He is particularly interested in elegant, efficient mathematical representations of such systems, thus explaining his focus on adaptive computation and on discrete models.

Adaptive computation is using computational resources where they are most needed. For example, in the simulation of an inflating air bag (right), the computer can allocate more variables (shown as red dots) at the positions where wrinkles are likely to form. www.cs.sunysb.edu/~ezk.

Discrete models refers to simple, elegant descriptions of physical systems that we are able to represent from first-principles in a “discrete world” consisting of points, lines, and triangles. For example, a straw hat may be represented as a collection of triangles. In making the bending of the hat may be computed from the angles formed by adjacent triangles. Etan Grinspun completed the Engineering Science program at the University of Toronto in 1999, Canada in 1997, a Masters in Science for his work on Asynchronous I/O at the California Institute of Technology (Caltech) in 2000, and a PhD for his development of a general method for adaptive physical simulation, also at Caltech, in 2003. While at Caltech, he received an NVIDIA fellowship in 2001, and was chosen as a Everett Distinguished Graduate Lecturer in 2003. Following graduation he joined the Courant Institute of Mathematical Sciences at New York University as a research scientist. He has served on various program committees including the ACM/Eurographics Symposium on Geometry Processing and the ACM Siggraph/Eurographics Symposium on Computer Animation. His research, published in both the engineering and graphics literature, covers a diverse agenda spanning simulation, discrete differential geometry, geometric modeling, subdivision surfaces, parallel architectures for interactive simulation applications, and streaming computation using graphics hardware.
Luis Gravano Receives Tenure

The Computer Science Department is extremely happy to announce that, in May 2004, Professor Luis Gravano was awarded tenure at Columbia. Professor Gravano is a leader in the field of web search, an interdisciplinary area sitting at the intersection of database systems and information retrieval. His early work on database selection exploits statistical summaries of data bases to allow a metasearcher to select the most relevant databases to search for a query. He has also been widely used and cited within the database and digital library communities.

His more recent research addresses a critical limitation of current web search, the inability to automatically access the hidden web (also known as the “deep web”). The hidden web contains petabytes of unindexed online data lying behind proprietary interfaces, research that facili- tates online access of this data. In the most part untapped, repository of data will have tremendous impact on research and development of the personal world. Professor Gravano has done pioneering work on automatic classifica- tion by topic of hidden web sites and on automatic extrac- tion of content summaries to facilitate automatic database selection. This aspect of his work provides techniques for accessing unstructured data that lies behind the hidden web. He also contributed to more tradi- tional database problems by showing how top techniques from information retrieval can be extended to database searching and in developing techniques to create structured data from unstructured data, populating online databases.

Professor Gravano’s research is characterized by rigorous experimen- tal design to validate results, demonstrating accurate results at low computational cost; it has provided dramatic speed- ups over previously known algorithms, sometimes as much as a ten-fold improvement. For example, the system QProber, developed by Professor Gravano and his team, is the most scala- ble and efficient state-of-the-art text database classification strat- egy in the literature. His work fuses theoretical and practical systems approach, a methodolo- gy that yields sound and scalable results. This approach has led to an impressive publication record in extremely selective conferences and journals. Since coming to Columbia in September 1992, Professor Gravano has received several honors in recognition of his excellence. He received an NSF CAREER Award, was appointed as Associate Editor of ACM Transactions and of ACM Transactions on Database Systems, and was selected to co-chair both the WebDB 2004 International Workshop and the 13th ACM Conference on Information and Knowledge Management. He has served on the program committee of over 20 leading conferences in databases, information retrieval, and related fields. Professor Gravano has obtained substantial funding for research from sources such as Microsoft Research, the National Science Foundation, and Lucent Technologies. He has participated in many large scale RFPs and often multi- disciplinary grants. These include an NSF DL2-Phase2 project for a federated digital libraries where his research involved access to dis- tributed, heterogeneous data- bases, along with an NSF Digital Government Grant also involving research into access to hetero- geneous databases. He has recently collaborated with natural language researchers at Columbia on a large scale project where he is looking at efficient search of summarization resources, providing the ability for up-to-date, incremental provision of summarized news.

Professor Gravano has graduated three PhD students: Nicolas Bruno (now at Microsoft Research), Panagiotis (now at NTU), and Eugene Agichtein (now also at Microsoft Research).

Digital Systems Group

The Digital Systems Group includes faculty members Luca Carloni, Stephen Edwards, and Steven Nowick.

Professor Luca Carloni joined Columbia University in Fall 2004 as an Assistant Professor of Computer Science after completing his PhD in Electrical Engineering and Computer Science at UC Berkeley. Luca also holds a Laureate in Electrical Engineering from the University of Bologna, Italy, and a MS in Engineering from UCB where he graduated. His research interests include design technologies for electronic systems, embedded systems design, computer architecture and engineering, and combina- torial optimization. In particular, Luca is interested in designing new design methods for high performance integrated circuits and for distributed-embedded systems based on rigorous mathematical reasoning. During his PhD studies, Luca has developed the theory of latency-insensitive design and the companion methodology for integrated circuits. This is a correct-by- construction approach that handles latency’s increasing impact on modern technologies and facilitates the reuse of intellectual-property cores for building complex integrated circuits-on-chip, thereby reducing the number of costly iterations in the design process. The concept of latency-insensitive design is now under close investigation by major semi-conductor companies for the design of the next generation integrated circuits.

http://www.cs.columbia.edu/~luca

Professor Stephen Edwards is an Assistant Professor of Computer Science, who joined the department in 2001. His group works on applying compiler technology to problems in embedded system design. The long-term goal is to simplify the task of creating such systems by supplying tools that raise the level of abstraction presented to a designer. Recent projects include the first open-source compiler for the Esterel real-time language able to produce both hardware and software from the same specification, domain-specific languages and compilers for device drivers and hardware/software-inter- faces, and program analysis algorithms for pointer analysis and incremental automatic- based program verification.

http://www.cs.columbia.edu/~soeadm

Professor Steven Nowick is an Associate Professor of Computer Science, who joined the department in 1993. His research focuses on the develop- ment of asynchronous and mixed-timing digital systems. Asynchronous circuits are those which have no global clock. Unlike synchronous systems, which are governed by centralized control, asynchronous circuits have an inherent degree of concurrent distributed sys- tems: composed of separate hardware ‘objects’, which operate at their own rates, and which coordinate and synchron- ize through channel-based communication. There has been a recent resurgence of interest in industry and acade- mia in asynchronous design as a modular and scalable style, as synchronous design- ers confront formidable challenges of managing chip design complexity, high-speed clock distribution, and power dissipation. Professor Nowick’s research is supported by 2 medium-size NSF ITR grants for $2.5 million (joint with Prasanna Mohapatra, Kenneth Shepard at Columbia EE Department). His main research projects include CAD tools for the synthesis and optimization of asynchronous systems using asynchronous pipelines, interface circuits for mixed-timing design, and design issues in embedded systems.

http://www.cs.columbia.edu/~nowick
Message from the Chair (continued from page 10)

news as it happens, by subscribing to our mailing list at http://lists.cs.columbia.edu/mailman/listinfo/cucs-news. We are also experimenting with a departmental blog to provide links and comments on topics of general interest in computer science (http://columbiacs.blogspot.com). Alumni can find our new portal at http://alum.cs.columbia.edu, where they can look up fellow alumni, see job listings received by the Department and share their current whereabouts and activities. We always look forward to hearing from our former students, faculty and staff. We plan to provide more opportunities to meet other alumni, as well as other alumni-oriented web services. Please get in touch with me if you have ideas for alumni-related services and events. Regards, and best wishes for 2005.