I am honored to present to you a "snapshot" of the College. While "computing" has always been a part of life, it has never been what it is today. That said, we may as well use a crystal ball to try to say what it might be tomorrow.

It has been a profound honor to be the founding Dean of the College and to watch it grow and develop over the past ten years. We have been blessed with great minds who have pushed the boundaries of computing. That intellectual wealth has been a part of our faculty from the beginning, and what has characterized our students.

The rapid integration of information technology into all areas of activity in our society is driving economic development, scientific advances and social change more than any single factor. This driving force, while only becoming clearly visible in the past few years, has been gathering speed for some years. Thus, to the informed observer it is clear that we have only begun to see the impact of these technological developments.

Georgia Tech has been a leader in technology since its creation. But "technology" is now defined in a new and different way. It's about the convergence of computing and communications overlaid with the convergence of hardware and software concerns. Tech's position in these areas is already very strong and growing, and is increasingly focused on the areas of highest opportunity.

I invite you to reflect on our past, celebrate who we are today, and dream of what is to come.

Dr. Peter A. Freeman
John P. Imlay, Jr. Dean
College of Computing
The Georgia Tech College of Computing is building upon its tradition of vision and innovation to provide robust 21st century leadership in the development, application and integration of computing technology and processing.
"I know nothing about these computers, but I have a feeling they are going to be important for us and I know we have to do something." Dr. Vladimir Sramek remembers hearing those words from Dorothy Crosland back in 1963.

The late Mrs. Crosland, Tech's longtime Director of Libraries, played a crucial, if unheralded, role in the establishment of the Information Science program at Georgia Tech, which would later become the College of Computing.

According to Sramek, whose own role in the computer science discipline at Georgia Tech was pivotal, Mrs. Crosland learned through library conferences about dramatic advances in electronic information processing. Realizing the emerging technology's implications for other fields, she enlisted the help of three like-minded faculty members: Dr. Vernon Crawford, then a Physics Professor and, later, Chancellor of the University System of Georgia; Dr. Nordia Waldemar Ziegler, Chemical Engineering Professor; and Dr. William Archison, Professor of Mathematics and Director of the Rich Electronic Computer Center at Georgia Tech.

The group drafted a proposal for a master's degree program in Information Science, which at the time was defined roughly as the modern handling and processing of recorded information. Their idea was endorsed by the Tech administration; administratively the new school would be housed in the General College.

In 1964, following approval from the Board of Regents and $200,000 in startup money from the National Science Foundation, the Information Science program was ready to roll.

Sramek Accepts the Challenge—And Risk

In the meantime, Mrs. Crosland and her faculty group had set out to recruit a program director. They found him at an academic conference in Chicago, where Vladimir Sramek was presenting a paper on the theory of classification by digital computers. The Georgians liked what they heard and approached Sramek with an invitation.

"They said, 'We're starting a new program. Would you be interested in coming and looking at it and maybe joining us?" he recalls. "I think I offended them a little bit because I'd never been south of Washington before, and I knew where Atlanta was roughly, but I'd never heard of Georgia Tech." A graduate of Columbia University a little more than one year before, Sramek at the time directed pioneering research and development in non-numeric computing for a private company in Washington, D.C.

In the spring of 1964, Sramek received his introduction to Georgia Tech. During a three-day visit, he was impressed by the Southern pace of life, the campus and the potential of the Institute. Even more, he became intrigued with the proposed Information Science program—the first such program in the world.

He was about to leave his hotel room and return home to Washington, D.C., when Mrs. Crosland called to ask if he'd drop by to visit with President Edwin Harrison. In the President's Office they held a brief conversation after which the Tech chief executive turned to Mrs. Crosland and said she could hire him.

Sramek was offered a full
professorship and the director's job on the spot, at a salary of $18,000 per year. The task was to build, from scratch, programs of instruction and research in Information Science. After careful deliberation, Slamecka accepted the job a few days later in the summer of 1964.

The School of Information Science opened for business in a single room in the Electrical Engineering building. Slamecka had a secretary, but no full-time faculty besides himself—and no courses or students. He thought the opportunity was both daunting and thrilling.

"I looked at it as a challenge, not so much as a risk. It very soon became clear that it was more than a challenge—that it was indeed a risk," he recalls, smiling.

Financially, the new School was supported largely by the three-year National Science Foundation grant; Tech had made little commitment of its own. Privately, according to rumors that reached Slamecka, some Tech faculty members were betting the School would "be out of its misery" in three years.

Digital computers were coming into their own and attracting a lot of attention, but Slamecka felt the primary emphasis should be on what computers did for society—information processing—rather than on the machines themselves.

His vision was a formal academic structure where students would study the design and functioning of information and computer systems as well as the theory of information, computer and system science.

The first and biggest obstacle was designing a curriculum. Slamecka worked quickly to hire faculty who could design the courses they would teach and meet the minimum requirement of four new courses a quarter for two years. Progress was incremental, but swift.

Slamecka felt strongly that the new master's degree program should include discrete mathematics, linguistics, human psychology and machine information processing, and systems theory as well as broad coverage of computer hardware and software subjects. Not only was there no precedent to follow for information
science as a discipline, but Tech offered few academic resources—such as courses in Finite Math or Cognitive Psychology—to draw upon. Notable exceptions were Tech's Library and Computing Center; both proved rich initial resources for the new school.

Pete Jensen Joins the Faculty

Alton P. "Pete" Jensen was among the first to lend his services to the new Information Science school. A research engineer at what was then called the Rich Electronic Computing Center, Jensen taught and developed classes at the School while maintaining his job at the Computing Center. A specialist in hardware architecture and design, he is credited with single-handedly establishing and operating the School's first computer laboratory. Jensen also installed the first e-mail system at Tech, in 1965.

The idea of Information Science as an academic discipline was slow to gain acceptance, Jensen remembers. But the head-shaking only enforced their pioneering resolve.

"We managed to corrupt the students, who then corrupted the faculty," he laughs.

Jensen formally joined the IS faculty in 1968 to, as he put it, "provide a window to reality out of the theoretical body of things." Most of the classes he taught were self-designed courses concerning the business of managing computer enterprises.

"I tried to create a situation where students understood the organization and management of the computing industry, what its role was, and the importance of it," he explains.

One of the major developments taking place when Jensen joined the Information Science school was the concept of single-function computers, devices designed to perform specific tasks.

"These were small-scale comput-ers, digital equipment, PDP-8-type machines costing $50,000 as contrasted with the larger machines that cost upward of $10 million," he recalls.

Jensen retired in 1984 after 28 years at Tech, but his departure was short-lived. In 1987, he returned to campus as Director of the School of Information and Computer Science and oversaw the transition to a College of Computing.

Another name often associated with the Information Science schools formative years was that of Professor John Goda, whose expertise was software. Students regarded him as one of Tech's best teachers, and he won many awards for his pedagogic skills.

Dr. Lucio Chiaraviglio was another faculty member whose career has bridged the Information Science school and the College of Computing. A logician and mathematician, he joined the fledgling School in 1969 to oversee the Ph.D. program. He
remembers the curriculum as oriented toward information management rather than computer science.

"The focus of the School changed as the areas of architecture, compilers, operating systems and the like became more service-oriented; that is to say, trying to take care of the customer needs," he recalls.

Chiavaglio taught the formal aspects of the program such as discrete mathematics and logic. He was later in charge of the undergraduate program, and served as interim Director of the School following Simeka's retirement. Before retiring in 1991, he worked as Assistant Director in charge of education programs.

The first students represented a spectrum of undergraduate backgrounds, Chiavaglio remembers. Most were interested in business, as opposed to scientific computing since then, as now, that's where the best job prospects were found. That, plus the growing interest in computers, fueled a shift in the computer direction than the information science direction," he says. "My feeling at the time was that this move was student-driven, and we should give the students what they needed."

Interestingly, Chiavaglio believes the situation may be coming around full circle. The advent of tremendous databases has fostered a venue for information science, he observes, "but some feel information science is lagging behind."

Others brought on board during the first years included Dr. James Gough, who taught Linguistics and Philosophy of Language; Dr. Frank George, a cybernetician; Dr. Philip Siegmund, a Psychology Professor, and Dr. Gordon Pask, another renowned cybernetician. Professor Pranas Zundel exemplified the spirit of the times. Between 1966 and 1990 he designed and taught 18 new courses in the information and systems sciences and wrote textbooks and materials to support them.

**First Students Enroll in Master's Program**

Five students enrolled in the program in the fall of 1964—all Georgia Tech employees. Two years later, Joanne Butterworth became Tech's first recipient of a Master's degree in Information Science, and the skepticism which greeted the new school began to dissipate. Industry and the military recognized the growing importance of information processing in terms of electronic computing, and started sending students to the program.

One measure of the School's increasing vitality was its research. In 1966, it received $1.3 million from the National Science Foundation to establish computer labs and an Information Science Research Center—one of the first two recipients under the new NSF program to

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### Benchmarks of Growth

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1964</td>
<td>School of Information Science (IS) founded.</td>
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<tr>
<td>1966</td>
<td>First MS in IS recipient—Joanne Butterworth.</td>
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<tr>
<td>1970</td>
<td>First PhD in IS recipient—Jesse Hubbard Poore.</td>
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<tr>
<td>1970</td>
<td>Name changed to School of Information and Computer Science (ICS).</td>
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<tr>
<td>1971</td>
<td>First PhD in ICS recipient—Robert Charles Roehlman.</td>
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<td>1973</td>
<td>UNIX installed in ICS Computer Lab—the first use of UNIX outside of Bell Labs.</td>
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<td>1974</td>
<td>First BS in IS recipient—Margaret Shippen Strode.</td>
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<td>1976</td>
<td>Replacement of Burroughs B5700 started with installation of a network of prime computers.</td>
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<td>1978</td>
<td>ICS enrollment tops 500 students.</td>
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<tr>
<td>1982</td>
<td>Two classrooms are equipped with personal computer workstations.</td>
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<tr>
<td>1989</td>
<td>ICS moves into new building on Atlantic Drive.</td>
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<tr>
<td>1990</td>
<td>College of Computing (CoC) created.</td>
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<tr>
<td>1991</td>
<td>Graphics, Visualization and Usability Center launched.</td>
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<tr>
<td>1993</td>
<td>EduTech Institute formed.</td>
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<tr>
<td>1993</td>
<td>John P. Imlay, Jr. Chair in Software established.</td>
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<tr>
<td>1997</td>
<td>CoC enrollment reaches 1,100 students.</td>
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<td>1997</td>
<td>Frederick G. Storey Chair in Computing established.</td>
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<td>1997</td>
<td>MS in Human Computer Interaction first offered.</td>
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<td>1998</td>
<td>Georgia Tech Information Security Center created.</td>
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<td>1999</td>
<td>Computer Science becomes largest single major on campus.</td>
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<tr>
<td>1999</td>
<td>John P. Imlay, Jr. Dean's Chair in Computing established, the first Dean's Chair on campus.</td>
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<tr>
<td>1999</td>
<td>David W. and Victoria C. Larsen Chair in Future Computing Environments created.</td>
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<tr>
<td>2000</td>
<td>Christopher W. Klaus makes largest outright gift in Institute history to name the new Advanced Computing Technology Building.</td>
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<tr>
<td>2000</td>
<td>Stephen Fleming Chair in Telecommunications established.</td>
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<tr>
<td>2000</td>
<td>Modeling and Simulation Research and Education Center established.</td>
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<tr>
<td>2001</td>
<td>Center for Experimental Research in Computer Systems established.</td>
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<tr>
<td>2001</td>
<td>CoC enrollment passes the 1,700 mark.</td>
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</table>
develop university "research centers of excellence." The award not only permitted Information Science to become the first School at Tech with its own computer, but also provided research scholarships for almost every graduate student.

Among the School's R&D accomplishments were the design of the first fully operational remote multimedia self-instruction program and a prototype of a patient record database—now one of the largest in the world—that anticipated the concept of data mining.

The program's physical surroundings increased, too, when it moved first to the top floor of the Physics Building, and later to share the Rich Electronic Computer Center.

Rapidly, the School began to expand its educational offerings. In 1968 a Ph.D. program was added, along with the requisite new faculty. In 1970, when its name was changed to the School of Information and Computer Science (ICS) to reflect better its broad orientation, an Institute-wide graduate "minor" in Information and Computer Science was established. And in 1972, in a major milestone for the Institute, ICS opened an undergraduate degree program in the discipline. The latter would secure the School's presence at Tech and increase its state funding.

In addition, a joint graduate degree program in Biomedical Information and Computer Science was developed with Emory University's School of Medicine. This collaboration was unique for its time, and presaged further cooperation between the two institutions in other areas in the years to come.

The addition of Dr. Philip Enslow to the ICS faculty in 1973 would prove a pivotal event in the School's
history. Enslow brought a prescient vision of the convergence of computing and telecommunications, and with it a broad new direction in terms of computer systems research.

"We had research going on in networking and telecommunications before almost any other computer science school in the country," says Dr. Richard LeBlanc, who joined Tech in 1978 and worked closely with Enslow in the development of distributed-systems research.

"Phil had great foresight about distributed systems, since that’s the way we now think of computing—a collection of computers on a network," LeBlanc explains. "In the late 70s, for the most part, computers were dealt with as individual machines."

The 70s closed with Slamecka’s retirement as the school’s Director after 14 years of nurturing the ICS program at Tech. He could look back with justified pride on his determined and successful efforts to cement a new discipline on campus. Over the years, Tech’s groundbreaking development of the field had been adapted in one form or another by universities around the country. But the best was yet to come.

**Ray Miller Takes the Helm**

Under the leadership of the new ICS Director, Dr. Ray Miller, the 1980s were a period of continued growth for the School, in terms of both reputation and facilities.

"The position was not only a great challenge, but also a great opportunity, as I saw it, to build a high-quality program which would be stronger in the computer science discipline," says Miller, who had served as IBM’s Assistant Director of its Mathematical Sciences Department in Yorktown Heights, N.Y., before coming to Tech. "At that time we had few faculty steeped in computer science, and a curriculum that needed considerable revision. There were many things to do. We revised the undergraduate and graduate programs, I worked very hard on hiring new faculty—and it is a pleasure to see that many of those that we hired in those times are now senior members of the college faculty today."

Miller’s administration marked a trend away from information science and toward computer science. That shift accelerated with the arrival of Dr. Janet Kolodner in 1980. Hired as an Assistant Professor, at 26 Kolodner was young and future-oriented with a background in artificial intelligence and cognitive science. A graduate of one of the world’s premiere computer science departments, at Yale, she was also Tech’s first full-fledged computer scientist.

"There was a tremendous amount of enthusiasm and optimism about bringing the ICS school up among the top ranks," recalls Kolodner, who also lauds the "visionary" roles of Miller, Slamecka and the early faculty members who set a tone that guides the College to this day.

"If we’re going to be leaders, we have to take risks," Kolodner says. "We simply can’t wait for somebody else to be first with something, then copy it.

"It has taken a long time," she adds, "but now we’re there."

A 1982 survey by the Conference Board of Associated Research Councils ranked the ICS school as “most improved” among the 57 computer-science departments examined.

Research was another area that gained prominence during the early 1980s. Key to the research efforts by ICS faculty was the high-quality computing power available through the School’s DEC VAX 11/780, which provided access to the national computer science network, CSNET, and ARPANET, forerunner to the Internet. Specialized equipment such as a Symbolics 3600 LISP machine augmented the School’s general-purpose computing systems.
“I remember the shocked response of the Dean to my saying that as we hired new faculty, we needed to supply them with offices and furniture, and part of this ‘furniture’ included a terminal on their desk connected to the computer and network,” Miller chuckles. “Nevertheless, we did it.”

Among the new phrases heard around ICS in the ‘80s was “human-computer interaction,” or HCI.

The concept may be traced to Dr. Al Badre, who joined the ICS faculty in 1973. He taught a course called “Philosophy of Mind” which he says “concerned human information processing and models of human information processing.” He also initiated a course called “Models of Human Information Processing,” offered jointly with the School of Psychology. The course led to his professorial appointment in both Schools.

Intrigued with the relationship between humans and computers, Badre introduced an undergraduate and graduate course in the subject in 1979. Two years later he sponsored a workshop on the human side of computing.

“It was one of the first workshops of its kind,” Badre says. “In fact, all those who came to the workshop are among the senior people in HCI today.”

The workshop resulted in a book titled, Directions in Human-Computer Interaction.

“That was probably the first time the term ‘human-computer interaction’ was used in the title of a book,” notes Badre, who still teaches and conducts research in HCI. He also coordinates the master's program in the discipline—only the second such degree in the U.S. at the time it was started.

“It's a huge field now that seems to grow as time goes on,” he adds. “We have 80 applications for the fall of 2001.”

Miller resigned in 1987 to accept an offer from the University of Maryland. He left an ICS school that had grown to include 25 faculty members and highly respected graduate and undergraduate programs.

“I felt, and still feel, a great deal of pride in what we were able to accomplish,” Miller says. “I say ‘we’ because I always considered it a joint effort with the faculty. When I stepped down as Director I felt that we had reached a respectable plateau, and I am pleased to see that the School—even its transformation to the College of Computing—has been able to continue to improve.”

**Changes Reshape ICS School**

Pete Jensen was coaxed out of retirement to become Director of the School of ICS. In that capacity, he served as Chairman of the restructuring committee charged with defining the long-term role of computer science within Georgia Tech. Jensen retired for the second time four years later as Associate Dean of the College of Computing. He has remained involved with the college and serves on its National Advisory Board.

In July 1988, Georgia Tech President John Patrick Creecy initiated the most thorough academic reorganization at Georgia Tech in 40 years. The plan included establishment of the College of Computing replacing the ICS school, with the addition of several interdisciplinary activities. At the time, only one other university organized computer science with an interdisciplinary focus at the college level—Carnegie-Mellon. The restructuring plan was approved unanimously by the Board of Regents the following year.

Dr. Michael E. Thomas, Executive Director of the restructuring, described the changeover from School to College in a contemporary interview.

“The College of Computing transition team will address a broad vision of computing and the College’s role with respect to the academic, research, and service function of Georgia Tech,” he explained.

“Computing is extremely important to a technological institution like Georgia Tech. This College will interact strongly with the other academic areas. Computing pervades all that goes on at Tech. This group is to look outward and build bridges. We expect many joint appointments between the College of Computing

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**Pursuing a Dream**

*The Christopher W. Klaus Advanced Computing Technology Building will be the keystone of the information technology complex at Georgia Tech. Development began with a generous commitment from Georgia Tech alumnus Christopher Klaus and is ongoing. When built, the facility will house the most forward-looking elements of the College of Computing and the School of Electrical and Computer Engineering. It will focus on research, graduate education and interaction with industry.*
and other academic departments."

By 1990, the transition was complete with the installation of Dr. Peter Freeman as Dean of the new College. Formerly Director of the National Science Foundation's division of Computer and Computational Research, Freeman's academic credentials included nearly 20 years on the faculty of the University of California, Irvine in the Department of Information and Computer Science. He also spent a year as a Distinguished Professor at George Mason University.

"Our objective is to strengthen a core computer science program, which the Institute had in the form of the Information and Computer Science School, and expand into new areas—new to Tech and new to the world—that involve computer science and other disciplines," Freeman said in an interview shortly after arriving on campus.

"What it means to be a College is that we can more easily offer new and expanded courses of instruction, and we can undertake new and expanded research programs. We want to be entirely cooperative and help everybody on campus utilize computing more effectively. It's a win-win situation. If we can help integrate computer science and other disciplines, we know that means all the engineering disciplines, science disciplines, management and architecture will benefit."

The College's first handbook in 1990 underscored the need for the College and the relevance of its higher profile:

"Computing is now at the heart of many of the most critical activities of modern society, ranging from the design of aircraft to control of the economy to medical diagnosis and treatment. Indeed, without the most advanced computing capabilities, research and education these critical activities cannot take place."

In 1990, the College included 37 academic faculty and four research faculty, 100 students each in the master's and Ph.D. programs, and 500 undergraduates. Its programs included Software Engineering, Cognitive Science, Artificial Intelligence, Distributed Systems and Databases, Graphics and Visualization, Telecommunications and Networking, Parallel Architectures, Computational Science, and Information Systems Analysis and Design.

**Positioned for Leadership**

Today, with more than 1,400 undergraduate students, almost 200 Ph.D. and 100 master's students, the Computer Science degree has become the single largest major at Tech, and the College is the second-largest in number of students, behind only the College of Engineering.

With a broad emphasis on computing rather than computer science, the College aggressively pursues a multidisciplinary approach to instruction and research. This direction is evident in several joint faculty appointments with the College of Architecture, the Schools of Electrical and Computer Engineering, Industrial and Systems Engineering, International Affairs, Mathematics and Public Policy.

A program called Undergraduate Research Opportunities in Computing encourages bachelor's degree students to participate in an experiential new dimension to their classroom experience.

To stay abreast of industry's computing needs and expectations, the College maintains an Industrial Partners Association. The program not only develops productive, long-term relationships between the College and business, but often leads to collaborative projects with faculty and students.

**Looking Toward the Future**

Each advance in computing technology, while extending the capability of processing and managing information, also expands the definition of information a little further. Thus the evolution of technology depends upon an educational foundation that is itself forward-looking, responsive and evolutionary.

If history is a guide, Georgia Tech's College of Computing is well-positioned to lead those evolutionary changes into the new century.
Cognitive Science

Cognitive Science develops models of the human mind. This is a new discipline that combines methods from Computer Science, Psychology, Linguistics, Anthropology and Philosophy, among other disciplines. Our focus is in practical cognition—cognition in the context of real-world tasks. We address issues of consequence for everyday living; for example, cognition in the classroom, in the home and in the workplace. We study both individual and group cognition, concentrating on the thinking and learning that are natural and essential parts of what we do every day. We are concerned with the cognition of people, the cognition of machines and the cognition of people interacting with machines. Our work is related to research on Intelligent Systems, Human-Machine Interaction, and Learning Science and Technology.

Computer Graphics

Computer Graphics is the process of creating images from 3D representations of real-world objects and scenes. Our research spans the full range of tasks involved in this process, including building the 3D models, determining how to animate the objects and creating the synthetic images of the scene. Some of our research is also aimed at putting these capabilities to use for particular applications, including Medical and Scientific Visualization, Augmented Environments and Virtual Environments. Projects include compression of 3D models, constructing models using implicit surfaces, creating animated sequences from video, virtual reality exposure for phobia therapy, deformable models for surgical simulation and using augmented environments in the office. Many of the research goals in Computer Graphics are also shared by those doing Computer Vision research in the College, and thus there is a fair amount of collaboration between these closely related areas.

Database Systems

The general research theme of the Database group has emphasized the needs of engineering and science applications as the driving forces behind the development of new database technology. The interdisciplinary focus of the Database group has been strong, as evidenced by collaborations with colleagues from other areas within the College of Computing such as Systems and Artificial Intelligence; from other units within Georgia Tech such as GTRI, Management and Environmental Sciences; and from other universities such as Emory University. General research problems investigated by Database group members have included important problems and significant contributions in modeling, design and processing of large databases as
well as problems related to database system implementation. Specific research thrusts have included mobile databases, databases with a time dimension, storage structures for large data warehouses, data mining of retail and medical data, storage and retrieval of genome information, parallel algorithms, concurrent reorganization, incremental computation and caching, data logging, electronic commerce applications, database integration with the World Wide Web and XML, quality-of-service guarantees for Internet systems and notification of data change through continual queries, and performance evaluation enhancements of large distributed data-intensive systems.

Future Computing Environments

Our research strives to understand how current and future computing technologies can result in the development of aware environments to serve humans in their everyday lives. We build living laboratories to explore the impact of ubiquitous computing in the classroom, office, home, car and on the body. We represent expertise in computational perception, wearable computing, software engineering and human-computer interaction. We develop models and representations for a new generation of interactive systems that reside mainly off the desktop, embedded in the environment and on the individuals within that environment. We are concerned with designing the right kind of informal interactions with pervasive technologies that enhance rather than detract from our everyday activities. We succeed when we are able to design, evolve and evaluate services in some authentic environment that use awareness of implicit human activity and provide some perceivable benefit to a targeted user community.

We have successfully developed an automated capture service for university lectures (the eClass project). Over the next five years, we will be investigating the office and home domains.
**HCI**

Human Computer Interaction derives from three well-established fields. These include Computing Technology, where the focus is on modeling and inventing technological solutions for human interaction problems; Behavioral Science, where the emphasis is on insight discovery and the quality of the method used to derive the insight; and Design, which focuses on virtuosity of expression. Our goal is to meld those three areas by focusing on understanding both human interaction behavior and ubiquitous interaction technologies. We engage in modeling, inventing and evaluating computing technologies as they relate to the development of aware environments to serve humans in their everyday lives. We study the relationships between user behavioral profiles and design expressions. The HCI research agenda includes developing models and representations for a new generation of interactive systems that reside mainly off the desktop and are embedded in the environment.

**Information Security**

A wide range of research activities in the Information Security area are conducted under the umbrella of the Georgia Tech Information Security Center (GTISC), which is one of the centers in the College of Computing. The problems being explored range from securing of future applications and environments such as the Aware Home, to policy issues that pertain to the protection of the critical infrastructure. Current research projects include novel access control and authentication models, mechanisms for combating denial-of-service and denial-of-information attacks, secure multicast communication, intrusion detection, tamper-resistant embedded devices, and policy and legal dimensions of the defense of the national critical infrastructure.

**Intelligent Systems & Robotics**

One goal of research on Intelligent Systems is to design and build systems which use intelligence to interact with the world, making computer controlled systems more autonomous and ubiquitous. Intelligent systems perceive, plan, act and learn from experience. Systems based on silicon,
including computing, communication and sensing, are becoming ever cheaper, and we are planning for a future where every device is smart and on a global network. Our tools, homes, offices and factories will become our intelligent partners: perceiving our needs, anticipating our actions, learning our habits. The design and analysis of intelligent systems builds on work in Artificial Intelligence, Computational Perception, Graphics, Animation, Machine Learning, Real-time Computing, Distributed Systems, Ecological Systems, Economics, and Mechatronics and Bionics. At Georgia Tech we are pursuing the application of intelligent systems to robotics, design, control and maintenance of physical processes, and future computing environments. A major theme in robotics is reactive control in which percepts are directly mapped into actions.

Another goal of the Intelligent Systems group is to understand and describe higher-level reasoning processes such as problem solving, learning and language understanding. The advent of the World Wide Web presents new challenges and opportunities for this enterprise. The rapid growth of the Internet has led to a need demand for making the Web useful for humans. This requires both new theories of how humans think and learn, and new software technologies for managing large libraries of information, building large-scale knowledge systems, accessing relevant information easily and transferring the knowledge to human users. The design and analysis of models of reasoning builds on research on Artificial Intelligence, Machine Learning, Cognitive Science, Knowledge Systems, Software Engineering, Database Systems and Information Retrieval.

At Georgia Tech, we are building theories of reasoning ranging from decision making, planning, and problem solving, to visual representations and analogical reasoning in engineering design and scientific modeling. A special interest is in the processes of creativity.

Learning Sciences and Technology

Research in Learning Sciences and Technology in the College of Computing looks at ways computer technology can be used to support and enhance learning. Our development efforts are aimed at creating environments for learning, both embodied and virtual, that reflect our knowledge of the cognition and social cognition behind learning. Complex Our two target populations are undergraduate engineering students and middle-school science, math and history students, but we are also committed to finding ways to facilitate life-long learning and learning across distances for all populations. We strive to bridge the gap between experimental studies of learning and education and implementation in the messiness of real classrooms and other learning contexts. For example, we know that collaborative learning facilitates understanding, but we also know that groups can get bogged down in details without some external support. Thus, we investigate how the computer can provide support for collaboration without getting in the way of natural reasoning. We also know that abstract concepts are hard to understand, but that understanding can be facilitated by concrete illustration of the concept. We address this principle by seeking ways to use graphics and animation technology to present visual representations of concepts and by designing representations and access procedures for libraries of concrete cases that students can examine while they are learning and solving problems. Our Learning by Design project aims to help middle-school students learn science through engaging in design activities. It draws on cognitive science research on case-based reasoning and
Networking and Telecommunications

The development of the Internet as a ubiquitous information infrastructure is perhaps the most noteworthy development of the past. Our research considers fundamental issues that will be the foundation upon which future networking infrastructure will be built. This new infrastructure will make considerable use of technologies that were not available at the time the current Internet architecture and protocols were conceived more than 25 years ago. A central theme of our work is that the networking infrastructure needs to be viewed in the context of the applications and services it is enabling. Such an integrated view allows for innovation in the domains of the networked application as well as the supporting network infrastructure. Current projects include:

1. Work in the area of active networking which represents a paradigm shift in the design of wide-area networks.
2. Investigation of support for multi-point communication in future networks and the how applications will make use of this support.
3. Research into multimedia applica-
tions and their required support within future networks.
4. Design and evaluation of architectures and systems for scalable content distribution over the current Internet and future network infrastructures.
5. Protection and security issues in content distribution networks.

Systems Research

The Systems group at Georgia Tech has a distinguished history in the areas of operating systems research, starting with the Clouds operating system developed for networked machines and continuing with basic research on topics like distributed shared memory and objects, as well as the runtime adaptation and specialization of operating systems to meet the performance demands of dynamic applications. Ongoing research efforts concern quality of service management for multimedia, real-time and high performance applications; the customization and runtime specialization of operating system kernels like Linux and of communication co-processors and routers; and the development of new abstractions and principles for operating and communication systems that run on wired and wireless laptop or palmtop devices.

Research in the area of parallel and cluster systems has made significant and often pioneering contributions including basic research in memory consistency models and cache coherence protocols; performance evaluation and scalability studies of parallel systems; development of monitoring and tuning the performance of parallel programs; and development of synchronization, resource management and novel experimentation techniques for interactive parallel and distributed simulation systems. By aligning their work to strategic application domains (drawn from science, engineering, optimization, multimedia games, and streaming video/audio) the Systems group has been successful in increasing the impact of their research. Recent research has focused on developing high-level computational abstractions and runtime systems for using clusters as high-performance computing engines, as well as improving the operating systems and communications hardware used by cluster machines.

Simulations of large, complex systems often require so much computation time and memory that they are rendered useless. Our research attacks this problem by exploiting computing systems containing many processors to complete the simulation computation. Further, distributing the execution across many geographically distributed machines connected by a wide-area network enables the realization of distributed virtual environments for training, entertainment, or test and evaluation of distributed hardware components. Current research is focused on applications such as the design and management of large-scale telecommunication networks (e.g., the Internet), design of mixed-signal electronic circuits, and deployment of missile defense systems. Impacts of our work that has been adopted by virtually all modeling and simulation programs in the U.S. Department of Defense, and use of our software to realize fast simulators of the national air space to reduce delays in the U.S. air transportation system.

Our programming languages and compilers research focuses on design and implementation aspects of modern programming languages. Specific research topics include the design of multiparadigm programming languages, implementation of efficient runtime systems, program analysis, program specialization, compilation for embedded architectures, parallel and distributed programming environments and tools, and optimizations for ILP processors.

Applications addressed by our real-time and embedded systems work include the control of robotic devices, remote sensing and sensor data evaluation, multimedia applications like video/audio transfers, multimedia kiosks, distributed games and ubiquitous systems. For these domains, notable research results include the development of object-oriented real-time operating systems, the creation of novel resource management techniques, including adaptive methods for CPU and communication scheduling, and most recently, the experimentation with OS abstractions that make open source systems like Linux real-time capable.

Research in distributed systems and security addresses new challenges that arise in the wide-area distributed environments that have become...
Software Engineering

Our goal is to improve the development of software. Our work covers most areas of software engineering research, emphasizing the recognition that few systems are developed from scratch and that the intelligibility of complex systems and development processes determine their quality. We view research in software engineering as being subdividable into two (not necessarily disjoint) parts. Classical research in software engineering has been devoted to the development of languages and tools to support the development of programs. Much of our research evolves from that model, including investigations of requirements analysis, software architecture, programming languages and software testing. In addition, we conduct research into the evolution of existing software, including investigations of feature evolution, reverse engineering and program analysis.

Theoretical Computer Science

The explosive growth of the Internet and breakthrough advancements of biology at the genome level introduce new computational paradigms and problem instances of unprecedented scale. We are developing a theory of approximation algorithms that scales and provide solutions with proven performance guarantees. This theory introduces novel extensions of mathematical programming and has found applications in network design and computational economics. We are active on cryptography and information security. We are developing stochastic models to predict and simulate local and global behavior of distributed systems, with applications ranging from the dynamics of agents and data over the Internet, to randomized approximations in statistical physics and potential extensions to the organization of genetic interactions of metabolic networks. We have developed biological experiments that solve classical computational and cryptographic problems at the level of DNA, and are developing computational innovations to improve the performance of biological operations at the laboratory.
Georgia Tech College of Computing

Current Faculty

As of March 2003

Gregory Abowd, Associate Professor; 95-D.Phil., Oxford (England). Software Engineering and Human-Computer Interaction

Mustafar Ahamad, Professor; 86-Ph.D., SUNY at Stony Brook. Distributed Operating Systems and Distributed Algorithms

Mustafa Anwar, Professor; 86-Ph.D., Waterloo (Canada). Computer Networks and Communication Protocols

Ronald Arkin, Professor; 88-Ph.D., University of Massachusetts. Artificial Intelligence, Computer Vision and Mobile Robotics

Chris Atkeson, Associate Professor; 94-Ph.D., MIT. Intelligent Systems and Robotics

Albert N. Badre, Professor; 74-Ph.D., University of Michigan. Human Computer Interaction, Usability, Interaction Design

Sungata Basu, Assistant Professor; 00-Ph.D., Courant Institute, NYU. Computational algebra and geometry, Theoretical Computer Science

Aaron Bobick, Associate Professor; 00-Ph.D., M.I.T. Computer Vision

Amy S. Brunskill, Assistant Professor; 97-Ph.D., MIT. Virtual communities; technology and education

Andre Dos Santos, Assistant Professor; 00-Ph.D., UCSB. Systems and Security

Chuck Eastman, Professor; 95-M.S., Berkeley. Joint appointment with College of Architecture

Computer-based Design Environments and Geometric Modeling

Irfan Essa, Inlay Fellow and Assistant Professor; 96-Ph.D., MIT. Computer Vision, Graphics, Animation, HCl, and Computational Perception

Norberto F. Ecevarra, Associate Professor; 91-Ph.D., Florida State. Medical Informatics and Computer Vision

James D. Foley; Associate Dean; Professor and Stephen Fleming Chair in Telecommunications; 91-Ph.D., University of Michigan. Computer Graphics, Human-computer Interaction, Information Visualization, Management of R&D and Technology Transfer

Peter Freeman, John P. Inlay, Jr. Dean of Computing and Professor; 90-Ph.D., Carnegie Mellon. Software Engineering, Design Processes, and Science and Technology Policy

Richard Fujimoto, Professor; 89-Ph.D., Berkeley. Parallel and Distributed Simulation systems, Networking Modeling and Simulation

John Goda, Assistant Professor; 71-M.S., Georgia Tech. Computer Programming and Programming Languages

Ashok Goel, Associate Professor; 89-Ph.D., Ohio State. Artificial Intelligence and Cognitive Science

Seymour Goodman, Professor; 92-Ph.D., California Institute of Technology. Joint Appointment with The Sarna Nunn School of International Affairs

International Information Technology, Information Security, Global Diffusion of the Internet

Mark Guzdial, Associate Professor; 93-Ph.D., Michigan. Learning Sciences and Technologies, Collaborative DynaBooks

Mary Jane Harrold, Associate Professor; 90-Ph.D., University of Pittsburgh. Software Engineering

Larry F. Hodges, Associate Professor; 88-Ph.D., North Carolina State. Virtual Environments, 3D HCl, Computer Graphics

Jessica K. Hodges, Associate Professor; 92-Ph.D., Carnegie Mellon. Computer Graphics, Computer Animation, and Robotics

Sven Koenig, Associate Professor; 98-Ph.D., Carnegie Mellon. Artificial Intelligence

Janet Kolodner, Professor; 80-Ph.D., Yale. Learning Sciences and Technology, Cognitive Science, Artificial Intelligence

Richard Leblanc, Professor and Director of Education for Varnacra. 78-Ph.D., Wisconsin-Madison. Software Engineering, Programming Languages and Compilers

Richard J. Lippton, Professor; 00-Ph.D., CMU. Algorithms and Complexity Theory, DNA Computing

Ling Liu, Associate Professor; 99-Ph.D., Tilburg University. Database systems, Internet Computing, System Support for Wide-Area Applications, Workload and Extended Transaction Systems

Blair MacIntyre, Assistant Professor; 99-Ph.D., Columbia. HCI, Computer Graphics, Augmented Reality, and Virtual Environments

Kenneth Mackenzie, Assistant Professor; 98-Ph.D., MIT. Computer Architecture and Systems

Leo Mark, Associate Professor; 93-Ph.D., Aarhus (Denmark). Database Architecture and Systems

W. Michael McCracken, Principal Research Scientist, M.S., Georgia Tech, 84-Software Engineering

Milena Mihail, Associate Professor; 99-Ph.D., Harvard. Theory of Algorithms, Applied Probability, Large Scale Networks, Large Scale Data

Beth Mynatt, Assistant Professor; 98-Ph.D., Georgia Tech. Everyday and Ubiquitous Computing, HCI, Audio Interfaces, and Augmented Reality

Shan Naveh, Professor; 92-Ph.D., University of Michigan. Database Modeling and Database Design

Nancy Nesbett, Professor; 93-Ph.D. Case Western Reserve. Joint Appointment with Literature, Communication, and Culture

Philosophy and History of Science, Conceptual change, Creativity, Learning

Ed Omiecinski, Associate Professor; 86-Ph.D., Northwestern. Database Systems

Krishna Palen, Professor; 99-Ph.D., Univ. of Texas, Austin. Joint appointment with ECE

Algorithms, Combinatorial Optimization, Embedded Systems, Optimizing Compilers

Santoosh Pande, Associate Professor; 00-Ph.D., North Carolina State Compilers, Architecture, Embedded and Mobile Systems

Golin Pata, Associate Professor; 92-Ph.D., Sheffield (England). User-Centered Software Engineering and Cognitive Science

Calton Pu, Professor and John P. Inlay, Jr. Chair in Software; 99-Ph.D., University of Washington. Systems Software, Operating Systems, Transaction Processing, Internet Data Management

Ashwin Ram, Associate Professor; 89-Ph.D., Yale. Artificial intelligence, Cognitive Science, Intelligent Systems

Unakshor Ramachandran, Professor; 86-Ph.D., Wisconsin-Madison. Parallel and Distributed Systems, Computer architecture, Operating Systems

Dana Randall, Assistant Professor; 96-Ph.D., Univ of California, Berkeley. Theory

William Rihak, Senior Research Scientist, Ph.D. University of Cincinnati, 90. Data Visualization, information visualization methods

Jarek Roszignac, Professor; 96-Ph.D., University of Rochester. 3D Modeling, Geometry Compression, and Graphics Acceleration

J. Spencer Robust, Senior Research Scientist, Ph.D. Yale, 98-Software Engineering

Leonard Schuman, Professor; 94-Ph.D., MIT. Theory of Computation


Olin Shivers, Associate Professor; 99-Ph.D., Carnegie Mellon. Programming Languages, Systems

Yannis Smaragdakis, Assistant Professor; 92-Ph.D., University of Texas. Programming Languages, Software Engineering, and Operating systems

Thad Starner, Assistant Professor; 96-Ph.D., MIT. Wearable Computing, Perceptually Enabled Intelligent Agents

John T. Stasko, Associate Professor; 98-Ph.D., Brown. Information Interfaces, HCI, Visualization

Andrei Szymczak, Associate Professor; 96-Ph.D., Georgia Tech. Geometric Computing, Visualization

Craig Tovey, Professor; 81-Ph.D., Stanford. Joint Appointment with Industrial & Systems Engineering

Industrial and Systems Engineering

Greg Turk, Assistant Professor; 96-Ph.D., Univ of North Carolina (Chapel Hill). Computer Graphics, Scientific Visualization, and Computer Vision

Vijoy V. Vazirani, Professor; 95-Ph.D., Univ of California, Berkeley. Design of Algorithms, especially approximation and randomized. Algorithmic coding theory and theory, complexity theory and cryptography

H. Venkateswaran, Associate Professor; 86-Ph.D., Washington (Seattle). Theoretical Computer Science and Computational Complexity

Jun Xu, Assistant Professor; 00-Ph.D., Ohio State University Network Security and High-Speed Networks

Ellen Zegura, Assistant Dean and Associate Professor; 93-Ph.D., Washington University (St. Louis). Wide-Area Networking Support for Complex Applications
Current Research Faculty, Full-Time and Part-Time Instructors

Butler, Jim
Camp, Paul
Clark, Russell
Colesstock, Dan
Crismond, David
De Braal, Levien
Dey, Anind
Eisenhauer, Greg
Eisele, Barbara
Ferenczi, Steve
Friend, Bill
Gayler, Dick
Gray, Jackie
Greenlee, Jim
Holbrook, Jennifer
Hutto, Phillip
Hybinette, Maria
Hyser, Sarah
Jiang, Frank
Kidd, Cory
Krishnamurthy, Raj
Leahy, Bill
Li, Tongyu
Mandoli, Ion
Nelso-Palmer, Mike
Orso, Alessandro
Perumalla, Kalyan
Plele, Beth
Prince, Lisa
Riley, George
Ryan, Michael
Sanders, Matt
Shaw, Christopher
Shaw, Jonathan
Smith, David
Subramanian, Mani
Sweat, Monica
Wellborn, Pete
Wolf, Allison
Wolf, Matt
Zakstein, Zeke

Former Academic Faculty, Research Faculty
Full-Time and Part-Time Instructors

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Ian F. Akylidz, 87-93
Amihid Amir, 91-97
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Kenneth L. Calvert, 91-97
Ann Chevernak, 95-96
Pin-Yee Chin, 83-86
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N. Jon Lissay, 80-83
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H. M. Wadsworth, Jr., 67-69
Thomas W. Wanner, 72-74
Robert L. Winner, 72-75
Franz Zunde, 64-97

College Management Team

Peet A. Freeman, Dean
Kurt Eiselt, Associate Dean
James D. Foley, Associate Dean
Thomas D. Fish, Assistant Dean, Continuing Education and Special Programs
Ellen Zegura, Assistant Dean, Space Planning
Mary Alice Isele, Director, Development and Communications
David Leonard, Director, Computing and Network Services
Eric Trevena, Director, Administration and Finance
Linda Williams, Assistant to the Dean
Advances in the technology and application of computers are driving many sectors of society and the economy. The College of Computing has fashioned a leadership role in this breathtaking progress for the past 10 years. Through education, collaboration and research we continuously explore new frontiers in technological innovation designed to improve the quality of life. As a focal point for cooperation among industry, government and the academic community, the College is helping facilitate the economic progress brought about by this innovation. The College operates in an ever-changing environment. Like technology itself, an educational institution cannot remain on the cutting edge by standing still. By attracting the best minds, both as students and faculty, and the key support of industry, we can ensure that our pursuit of progress continues.

For more information contact:

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