One hundred and ten years ago this December, on a wind-swept stretch of sandy beach just south of Kitty Hawk in North Carolina’s Outer Banks, a pair of brothers from Dayton, Ohio, changed the world. Wilbur and Orville Wright’s contribution to aviation was not as the first men to take flight—plenty of others had already done that in various glider craft, sometimes with fatal results—but as the first to control flight in a motorized aircraft.

When we launch the Online Master of Science in Computer Science (OMS CS) in early 2014, Georgia Tech will likewise not be the first to offer an online degree (universities have offered distance degrees for decades, starting with correspondence courses through the mail). But what we will do, in collaboration with Udacity and AT&T, is be the first to offer a scalable solution that dramatically expands access to an elite, credentialed education not only through the medium itself but also through cost. Our degree will cost less than $7,000 for most students.

Will our OMS CS soar into the heavens? Or will it hit the ground and crumple, perhaps falling victim to the same constrained thinking that plagued many early aviators, who considered flight to be similar to surface locomotion, just on a higher surface? While brave and ambitious, they were too trapped in old ideas to succeed in something truly novel.

I can promise you that, in launching OMS CS, we will apply two trademark Georgia Tech qualities: hard work and entrepreneurial ingenuity. In these pages you’ll see evidence of those traits in everything we do, from agenda-setting research to computing education at every level from K-12 and beyond. You’ll see it in the way we go about building a GT Computing community that stretches around the globe, and in the way our faculty show tomorrow’s business leaders how to bring their commercial ideas to market. And you’ll definitely see it when OMS CS debuts next year.

Most exciting to me is the fact that we’re just getting started. Computing is the catalytic field of the 21st century—everything it touches becomes more than it was before. I invite you to become part of GT Computing. It’s our time to fly.

Zvi Galil
John P. Imlay Jr. Dean of Computing
September 2013
Structural Evolution

1990
- College of Computing

1991
- GVU Center

1998
- Georgia Tech Information Security Center

2001
- Center for Experimental Research in Computer Systems

2005
- Algorithms & Randomness Center

2006
- Robotics & Intelligent Machines Center

2007
- School of Computer Science
- School of Interactive Computing

2010
- Institute for Data & High-Performance Computing
- School of Computational Science and Engineering

2011
- Center for 21st Century Universities

2012
- Division of Computing Instruction

2013
- Center for Data Analytics
- Center for HPC

Faculty & Staff

**Academic Faculty**

- Total: 100
  - Tenure-Track Faculty: 81
  - Partial Appointments: 11
  - Lecturers: 8

**Research & Instructional Faculty**

- Total: 80
  - Research Faculty: 44
  - Instructional Faculty: 13
  - Postdoctoral Researchers: 23

**Staff**

- Total: 76
  - College of Computing: 45
  - School of CSE: 5
  - School of CS: 10
  - School of IC: 16
**Student Enrollment**

**Undergraduate**

1278 Total Students

81% Computer Science

19% Computational Media*

**Master of Science**

12% Human-Computer Interaction

15% Information Security

64% Computer Science

399 Students

9% Computational Science & Engineering*

0% Bioengineering*

**Ph.D.**

72% Computer Science

10% Human-Centered Computing

7% Computational Science & Engineering*

383 Students

0% Bioengineering*

1% Bioinformatics*

4% Algorithms, Combinatorics & Optimization*

6% Robotics*

* indicates joint degree

**Research Numbers**

$26.5 M Sponsored Awards

$35.5 M Total Expenditures

198 Proposals Submitted

68 New Grants & Contracts Awarded

Enrollment numbers from Fall 2012
GT COMPUTING: MORE THAN A DEGREE
About 50 years ago, not long after President John F. Kennedy challenged the nation to put astronauts on the moon, Georgia Tech Computing was born.

That’s when Institute officials first considered the idea of devoting faculty and classroom time to these devices called computers. “I know nothing about [them],” said Dorothy Crosland, then-director of libraries. “But I have a feeling they are going to be important for us, and I know we have to do something.”

Fast-forward five decades, and something has turned into something more—a lot more. Today GT Computing, rooted in the College of Computing, encompasses three schools, more than 100 faculty, nearly 2,000 students and some 8,000 alumni spread across all corners of the globe. It stretches over 13 degree programs and more than two dozen student organizations. Its graduates populate the labs and executive offices of computing and technology firms up and down the Fortune 500, and the products of its research help power the systems, devices and networks all around us every day.

From modest beginnings in the middle of another century, GT Computing has grown into a Top 10 academic program and leader in the world of computing, expanding the boundaries of its field while strengthening its core disciplines. Beyond the Georgia Tech campus, it serves as an ambassador for the digital world, recruiting the next generation of computing minds while opening up new areas for them to explore through partnerships with organizations public and private.

And in its primary mission of computing education, the College has earned an international reputation as a tireless innovator and champion of bold ideas in service of its students. From redefining the undergraduate curriculum with Threads, to growing computing education throughout the state of Georgia, to announcing the truly revolutionary Online Master of Science in Computer Science, GT Computing blazes the educational path for others to follow.
The College of Computing extends a scientific and educational reach beyond what most of its peers are capable of, in large part due to its structure.

First and foremost, computing at Georgia Tech is elevated to its proper role among the disciplines—it is its own College, not a component of engineering or the sciences. It comprises three schools that each cover a wide breadth of research and inquiry. And its large number of tenure-track, teaching and research faculty provide both depth in major research areas and nimbleness to move into emerging fields.

More often than not, when College faculty move into those new fields, they do so via collaboration with outside organizations, be it through research contracts, joint and multi-institutional teams, or formal partnerships. The spirit of collaboration and cross-disciplinary work undergirds everything that goes on in GT Computing laboratories. College researchers are doggedly interdisciplinary, seeking out partners from across the Georgia Tech enterprise and far beyond.
In fact, of the College’s highest profile examples of leadership, all stand out as partnerships in some way. Consider:

1. **The National Robotics Roadmap**, which Professor Henrik Christensen has twice presented to the U.S. Congress, is the product of collaboration among dozens of the country’s top roboticists.

2. The annual **Georgia Tech Cyber Security Summit** is jointly sponsored by the College and the Georgia Tech Research Institute and is meant to foster greater collaboration in cyber security among academia, government and industry.

3. The **Computing for Good (C4G)** initiative partners with local, national and international agencies to devise computationally humanitarian solutions to real-world problems.

4. Our **Corporate Affiliates Program** represents a broad partnership between the College and industry, helping to sustain the vital skills pipeline in computing that enable member companies to stay competitive in today’s landscape.

5. The **Threads** curriculum, which has been extended to both College of Computing undergraduate majors, can be described as a partnership between the College and its students, empowering them to help shape their own degrees.

6. The **OMS CS**, announced in May 2013, is a collaboration among Georgia Tech, the online education provider Udacity and AT&T—to the potential benefit of thousands of students worldwide.
Global COMMUNITY

People are and always have been the engine that drives the College of Computing—brilliant, world-class faculty; sharp, tenacious students; talented and hard-working staff; loyal alumni.

“GT Computing” was coined to include the broader community outside the College walls. It refers to the worldwide network of individuals brought together not only by a shared interest in moving GT Computing forward, but also by a common belief that when one adds a computational component to nearly any aspect of 21st century life, it becomes something more. And with each new member, this community grows stronger.

Charged with maintaining and upgrading this network is the College’s Office of Outreach, Enrollment and Community, or OEC. Created in 2009, its mission is to help draw new young minds toward computing, nurture and inform those minds as they weigh their college options, support the College student community and help connect them with the professional world beyond campus, and sustain a strong connection after graduation.

Particularly with the College's youngest alumni, OEC has built real, lasting relationships with GT Computing community members, having known many of them since their high school days—or even longer, through computing summer camps or other outreach activities.
In addition, by helping to manage the College’s career-directed connections with industry, OEC brings real, tangible value to students. Besides serving as liaison between Corporate Affiliates Program companies and students, the office coordinates twice-yearly Career Fairs specifically for computing majors. In 2012–13, the fall and spring Career Fairs both were filled to capacity, with more than 100 participating companies at each event and hundreds of eager, ambitious students ready to put their hard-won knowledge and skills to use.

This is the world of GT Computing, and it’s working. In recent years, B.S. in Computer Science graduates have reported the highest starting salaries of any major at Georgia Tech. When the Wall Street Journal ranked U.S. college graduates from the opinions of corporate recruiters, Georgia Tech grads as a whole placed a very respectable 7th—just three spots behind College of Computing graduates specifically. And in September 2012, SmartMoney rated the best returns on investment among all U.S. colleges and universities: Georgia Tech sat on top at No. 1.

Fifty years removed from its intellectual origins, GT Computing is most certainly the “something” Dorothy Crosland had in mind. And as it moves boldly into its second half-century, the goal remains the same as ever: Become something more.
The School of Computer Science aims to make computing better: faster, smarter, secure, connected, reliable and mobile. The computing landscape continues to change as it faces large challenges, such as dealing with “Big Data” and computers that work together, whether on a single chip in multicore machines, or through the cloud; and the ever-increasing networking of everyone and everything. Our goal is to be ahead of the curve in tackling all of these challenges, from the very theoretical algorithms to the design of the chips themselves, and everything in between – networks to security, software engineering to systems, programming languages to parallel architecture.

The world of computing is quickly changing and presenting new challenges to old norms. No longer can computer scientists rely on abstraction to separate the levels of computing. The programmers must be aware of the architecture of the systems they use. Computer science cannot succeed without people who can tie together different research areas. The School already has excellent faculty who cross the boundaries between security and networks, architecture and systems. We will look to expand our capabilities by finding the faculty and students able to bridge research areas within computer science and between CS and outside.

Computer science does its best not when it tackles individual problems, but when it designs platforms that drive the information revolution. We aim to excel in producing research and students that create environments that allow imaginations to run wild.

Lance Fortnow
Professor & Chair

Research Centers & Initiatives

- **Algorithms & Randomness Center (ARC)**
- **Center for Experimental Research in Computer Systems (CERCS)**
- **Georgia Tech Information Security Center (GTISC)**
- **Samsung Tech Advanced Research (STAR)**

Education

**Undergraduate Threads** managed by the School of Computer Science: Information Internetworks, Systems & Architecture, Theory

**M.S. in Computer Science** – 257 students in Fall 2012

**M.S. in Information Security** – 39 students

**M.S. in Information Security Distance Learning** – 21 students

**Ph.D. in Computer Science** – 135 students

**Ph.D. Algorithms, Combinatorics & Optimization** (with schools of Industrial & Systems Engineering and Mathematics) – 16 students

Undergraduate and M.S. degrees are awarded by the College.
Faculty Awards & Honors

Alex Orso, Associate Professor
Program Co-Chair of IEEE International Conference on Software Testing

Constantine Dovrolis, Professor
Best Research Award, 2012 Open Internet Challenge

Dana Randall, Professor
Fellow, American Mathematical Society, Inaugural Class of 2012

Ling Liu, Professor
General Program Chair, 38th International Conference on Very Large Databases; Editor, Transactions on Service Computing

Mayur Naik, Assistant Professor
Software Engineering Innovation Foundation 2012 Award; NSF CAREER Award 2013

Milos Prvulovic, Associate Professor
2013 Distinguished Alumni Educator Award, University of Illinois at Urbana-Champaign

Mustaque Ahamad, Professor
2013 IBM Faculty Award

Sy Goodman, Professor
Co-Chair, Committee on the Professionalization of the Cybersecurity Workforce

Wenke Lee, Professor
Chair, 2013 IEEE Symposium on Security & Privacy

Events

- GTISC Cyber Security Symposium
- CERCS Alumni Day & Spring IAB Meeting
- ARC RIM Industry Day
- ARC Theory Day
- ARC-Yandex Workshop
- ARC 5
- ARC Phase Transitions Workshop
- C4G Review Day
**CS Highlights**

**Bridging Systems & Architecture**

When it comes to processing units, the central (CPU) and the graphic (GPU) both have their advocates, but **Associate Professor Hyesoon Kim** finds a third way: heterogeneous architectures that combine both to produce some truly high-performance hardware that also maximizes energy efficiency.

**Keeping Mobile Computing Safe**

There are currently some 5 billion mobile devices in operation worldwide—about four times the number of desktop & laptop computers. And the more people depend on mobile computing, the more attractive a target those devices become for cyber criminals. **Assistant Professor Patrick Traynor** specializes in finding new ways to mitigate the mobile threat.

**Big Data for Disaster Management**

When hurricanes or earthquakes hit, an effective emergency response can literally mean the difference between life and death for those affected. **J.P. Imlay, Jr. Professor of Software Calton Pu** led a joint workshop between NSF and the Japan Science and Technology Agency in May 2013 to define research priorities and identify opportunities to apply Big Data analytics to enhance disaster management. The workshop was the product of a worldwide initiative, Global Research to Apply Information Technology for Disaster Management: Science Across Virtual Institutes, to foster international collaboration among IT researchers and disaster-domain scientists.

**Computing 4 Good – More Than Theoretical**

**Distinguished Professor Santosh Vempala** and **Professor Ellen Zegura** helped launch the College’s Computing for Good (C4G) initiative in 2008, and they remain two of its most passionate advocates. Through the C4G class, taught every fall, GT Computing students have built and deployed more than 40 projects meant to help those most in need around the world.

**Better Networks, More Transparent Internet**

**Associate Professor Nick Feamster** has found a way to apply his expertise in computer networking in service of a better Internet for all. Much of Feamster’s recent work focuses on “Internet transparency”: designing network measurement tools to help consumers identify when state or private actors are manipulating either the performance of their Internet service, the information delivered by it, or both.

**Startups & Industry Ties**

In addition to its many research collaborations with industry, School of Computer Science faculty have spun off some highly successful companies of their own, lately with the help of Georgia Tech’s newest and most innovative effort at entrepreneurial support: Flashpoint. Launched in 2011 by Distinguished Professor Merrick Furst, Flashpoint teaches “startup engineering” to cohorts of ambitious startup founders. A few of the School’s entrepreneurial home runs include BISmark (**Nick Feamster**), Pindrop Security (**Patrick Traynor, Mustaque Ahamad**) and Security Axioms (**Wenke Lee**).
From the Chair

I am a proud three-time alumna of Georgia Tech and excited to begin my second year as chair of the School of Interactive Computing. Our school has the distinction of being the first of its kind in the country, focusing on interactions between computing machines and people. Over the past five years, we have made significant accomplishments in our academic programming. At the doctoral level, we participate fully in the College of Computing’s computer science Ph.D. program and take the lead in the human-centered computing and robotics Ph.D. programs. Our M.S. in HCI program provides exceptional research opportunities for students and offers a flexible curriculum with strong industry ties. At the undergraduate level, we lead the Media, Intelligence, People and Devices Threads for CS majors. In addition, IC has several internationally recognized research groups in robotics and computer vision, graphics, human-computer interaction, and learning sciences and technology.

We are proud of these accomplishments and of being at the forefront of forging a new discipline in interactive computing. Our faculty pursue research agendas that advance the possibilities for interactions between computing technology and the world – including interaction with the physical environment, with individuals and with society and culture at large. We continue to partner with leaders in industry, government and academia to further these goals.

At the School of Interactive Computing, we are pursuing a vision of the future of computing that combines deep technical strengths with diverse disciplinary perspectives. Our world-class faculty and students are uniquely equipped to revolutionize the human experience of technology.

Annie I. Antón
Professor & Chair

Research Numbers

$10.5M Sponsored Awards
$12.1M Total Expenditures

79 Proposals Submitted
21 New Grants & Contracts Awarded

82% Funding from Government Awards
18% Funding from Industry Awards

Research Centers & Initiatives

• GVU Center
• Robotics and Intelligent Machines Center (RIM)

Education

Undergraduate Threads managed by the School of Interactive Computing: Media, People, Devices, Intelligence

75% of undergrad CS majors complete at least one IC thread; 25% do both in IC

B.S. Computational Media (awarded by the College), joint with School of Literature, Media and Communication, went from zero to 300 students within five years. 234 students in Fall 2012

M.S. in Human-Computer Interaction (with GT schools of Psychology and Literature, Media & Communication) – 63 students in Fall 2012

Ph.D. in Computer Science, included are specializations in graphics, visualization, perception, ubiquitous computing, machine learning – 61 students in Fall 2012

Ph.D. in Human-Centered Computing – 30 students in Fall 2012

Ph.D. in Robotics (with schools of Electrical & Computer Engineering, Mechanical Engineering, Aerospace Engineering and Biomedical Engineering) – 19 students in Fall 2012

Undergraduate and M.S. degrees are awarded by the College.
Faculty Awards & Honors

Beki Grinter, Professor
Induction into ACM CHI Academy 2013

Greg Turk, Professor
SIGGRAPH Computer Achievement Award 2012

Karen Liu, Associate Professor
ACM Significant New Research Award 2012

John Stasko, Associate Chair and Professor
IEEE VGTC Visualization Technical Achievement Award 2012

Thad Starner, Professor
“Invention of the Year” by Time magazine for Google Glass; Georgia Tech Class of 1934 Outstanding Innovative Use of Education Technology Award

Andrea Thomaz, Associate Professor
Popular Science magazine’s “Brilliant 10 List, 2012”

Mark Guzdial, Professor
IEEE Computer Society Undergraduate Teaching Award 2012

Jim Rehg, Professor
Method of the Year Award 2012 from Journal of Nature Methods

Ron Arkin, Regents’ Professor
Distinguished Lecturer 2012, IEEE Society of Social Implications of Technology

Amy Bruckman and Kurt Luther
Best Paper at 17th ACM Conference on Computer Supported Cooperative Work and Social Computing for “Redistributing Leadership in Online Creative Collaboration”

Henrik Christensen, Distinguished Professor
Elected to College Industry Council for Material Handling

Nancy Nersessian, Regents’ Professor
2012 William James Book Award from the American Psychological Association for Science as Psychology: Sense-making and Identity in Science Practice
IC Highlights

Bridging the Animated Uncanny Valley

*Associate Professor Karen Liu* blends biomechanical physics with computer animation to create digital figures that move more realistically. Be they amorphous “soft bodies” or fully humanoid bipeds, the animated characters in Liu’s lab walk, leap, bump, stumble, dance and scamper off their screens with all the verisimilitude of real life.

Virtual Storytelling

Narrative is one of the most fundamental modes of human communication. *Assistant Professor Mark Riedl* builds algorithms capable of replicating what *H. sapiens* has been doing for millennia: Spinning out complex, immersive scenarios that can be applied in everything from video games to virtual training simulations.

Cyber Semantics

What do our digital communications teach us about how humans use language? That’s the question *Assistant Professor Jacob Eisenstein* asks in his Computational Linguistics Lab, where social media, natural language processing and machine learning converge to yield new insights into how digital media both reflect and influence natural language.

The World of Social Media

Want to attract more Twitter followers? Use email more “courteously?” Get a hint of how people use email in your organization? *Assistant Professor Eric Gilbert* studies all this and more in research that encompasses both design and analysis of social media.

My Robot, My Helper

If robots are to work side by side with humans, they will have to interact—they will need to talk to and learn from each other. That’s the world envisioned by *Associate Professor Andrea Thomaz*, whose signature robot Simon represents a big step toward more seamless human-robot interaction.

CS Education for the World

*Professor Mark Guzdial* and *Research Scientist Barb Ericson* form a powerhouse duo in the campaign to bring computing front and center in U.S. education. The husband-and-wife team work to facilitate more widespread CS education in the K-12 arena while also examining the most effective teaching methods and leveraging their impact with colleagues across the country.
Faculty Awards & Honors

Beki Grinter, Professor
Induction into ACM CHI Academy 2013

Greg Turk, Professor
SIGGRAPH Computer Achievement Award 2012

Karen Liu, Associate Professor
ACM Significant New Research Award 2012

John Stasko, Associate Chair and Professor
IEEE VGTC Visualization Technical Achievement Award 2012

Thad Starner, Professor
"Invention of the Year" by Time magazine for Google Glass; Georgia Tech Class of 1934 Outstanding Innovative Use of Education Technology Award

Andrea Thomaz, Associate Professor
Popular Science magazine’s "Brilliant 10 List, 2012"

Mark Guzdial, Professor
IEEE Computer Society Undergraduate Teaching Award 2012

Jim Rehg, Professor
Method of the Year Award 2012 from Journal of Nature Methods

Ron Arkin, Regents’ Professor
Distinguished Lecturer 2012, IEEE Society of Social Implications of Technology

Amy Bruckman and Kurt Luther
Best Paper at 17th ACM Conference on Computer Supported Cooperative Work and Social Computing for “Redistributing Leadership in Online Creative Collaboration”

Henrik Christensen, Distinguished Professor
Elected to College Industry Council for Material Handling

Nancy Nersessian, Regents’ Professor
2012 William James Book Award from the American Psychological Association for Science as Psychology: Sense-making and Identity in Science Practice
From the Chair

Our school provides an academic home for a community devoted to Computational Science and Engineering (CSE), a discipline concerned with the systematic study and application of computer-based models of natural and engineered systems. Our core research areas include “Big Data,” high-performance computing, and modeling and simulation. With fewer than a dozen professors, we are proud to have established major research programs, totaling more than $53 million in research funding since the creation of the CSE division in 2005. Our interdisciplinary research centers crisscross the Georgia Tech campus and Georgia Tech Research Institute, with projects such as developing new treatments for cancer, creating more sustainable cities and secure societies, and developing new materials to increase national competitiveness in a global economy. And our interdisciplinary undergraduate and graduate education programs are creating a new type of scholar, one who is well versed in synthesizing principles from mathematics, science, engineering and computing to attack important, real-world problems.

Richard Fujimoto
Regents’ Professor & Chair

Research Numbers

<table>
<thead>
<tr>
<th>Sponsored Awards</th>
<th>$4.4M</th>
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</thead>
<tbody>
<tr>
<td>Total Expenditures</td>
<td>$8.8M</td>
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<tr>
<td>Proposals Submitted</td>
<td>31</td>
</tr>
<tr>
<td>New Grants &amp; Contracts Awarded</td>
<td>11</td>
</tr>
<tr>
<td>Funding from Government Awards</td>
<td>82%</td>
</tr>
<tr>
<td>Funding from Industry Awards</td>
<td>18%</td>
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Research Centers & Initiatives

- Institute for Data & High-Performance Computing (IDH)
- Center for High-Performance Computing
- Center for Data Analytics (CDA)
- Keeneland National Institute for Experimental Computing

Faculty Awards & Honors

David A. Bader, Professor
Chair, SIAM Activity Group on Supercomputing, 2012

Richard Fujimoto, Regents’ Professor and Chair
Selected as Chairman of the Policy Committee (Board of Directors), National Modeling and Simulation Coalition

Haesun Park, Professor
2013 Fellow of the Society for Industrial and Applied Mathematics (first Korean SIAM Fellow and only woman in 2013 group)

Aparna Chandramowlishwaran, CSE Ph.D. Student
Recipient of 2012-2013 Intel Ph.D. Fellowship

17 keynote addresses at conferences & symposia
Education

Undergraduate Threads managed by the School of Computational Science & Engineering: Modeling & Simulation

Undergraduate Minor in Computational Data Analysis (beg. Fall 2013)

Undergraduate Minor in Scientific and Engineering Computing (beg. Fall 2013)

CRUISE (Computing Research Undergraduate Intern Summer Experience) – Offered each summer to encourage undergraduates, particularly women and underrepresented minorities, to consider a Ph.D. in computing

M.S. in Computer Science (with schools of Computer Science and Interactive Computing) – 47 CSE-based students in Fall 2012

M.S. in Computational Science & Engineering (with GT colleges of Engineering and Sciences) – 36 students in Fall 2012, including distance-learning program

M.S. in Bioengineering (with GT colleges of Engineering, Sciences, Architecture & Emory University School of Medicine) – No CSE-based students in Fall 2012; 13 in overall program

Ph.D. in Computer Science – 19 CSE-based students in Fall 2012

Ph.D. in Computational Science & Engineering (with GT colleges of Engineering and Sciences) – 25 students in Fall 2012

Ph.D. in Bioengineering (with GT colleges of Engineering, Sciences, Architecture & Emory University School of Medicine) – No CSE-based students in Fall 2012; 93 in overall program

Ph.D. in Bioinformatics (with schools of Mathematics, Biology, Chemistry & Biochemistry, Biomedical Engineering and Industrial & Systems Engineering) – 3 CSE-based students in Fall 2012; 3 in overall program

Undergraduate and M.S. degrees are awarded by the College.
CSE Highlights

Scalable Analytics and Data-Processing Technology

XDATA, a new four-year research effort led by Professor Haesun Park, is underway to develop new computational techniques and open-source software tools for processing and analyzing data with an emphasis on the integrated treatment of visualization and data. Regents’ Professor Richard Fujimoto and Professor Hongyuan Zha are involved, as well as collaborators in the Georgia Tech Research Institute.

How Much Time, Energy and Power Will Your Computation Need?

Associate Professor Richard Vuduc is leading the High-Performance Computing (HPC) Garage in exploring ways to design algorithms and software that are not just fast, but also power- and energy-efficient. This work aims to help supercomputers and data centers run “greener” and mobile batteries last longer.

A Library for (Machine) Learning

Together with colleagues at Oak Ridge National Laboratory and Drexel University, Associate Professor Alexander Gray has built an open-source software library called MLPACK to provide a suite of advanced algorithms ready to put to use in massive data analysis. By the end of 2015, Gray and his team expect to offer as many as 100 distinct algorithmic methods for use by anyone, anywhere.

Social Behavior Modeling and Optimization of Information Diffusion

Professor Hongyuan Zha and Assistant Professor Le Song are working to build a set of robust machine learning methods that allow for a predictive modeling framework for leveraging large-scale historical social interaction data, and can adapt to the complexity and heterogeneity of digital social interactions.

Advanced Chemistry Through Computation

CSE/Chemistry Professor David Sherrill and Associate Professor Edmond Chow are working to scale the open-source PSI4 algorithm for quantum chemistry up to handle some of the largest computations ever performed in this area.

Energy-Efficient High-Performance Computing

Professor David Bader and Research Scientist Jason Riedy are creating the algorithmic framework for supercomputing systems that require much less energy than traditional high-speed machines in order to enable devices in field operations to perform calculations that currently require room-sized supercomputers.
Discovery happens every day in the College of Computing across dozens of individual labs that collectively stretch the boundaries of computing research. Serving to marshal these forces of inquiry are seven major research centers, intellectually based in the College but reaching out to accommodate faculty from all of Georgia Tech.
The Algorithms & Randomness Center (ARC) hosts world-renowned and emerging researchers, funds competitive student research projects and offers a "think-tank" consulting service to scientists and engineers across campus, as well as to industry, in the theory of computing, optimization and related areas. These activities, along with one-day events such as Theory Day and Industry Day, feature expert lectures and contribute to the educational mission of Georgia Tech. Notable projects include:

- **Nimble Algorithms** – These computing low-rank approximations help formulate a solid theoretical basis for cloud computing, where the notion of efficiency is measured by the amount of communication between servers.

- **Joint ARC-RIM Project** – A team of students and faculty from ARC and the Robotics & Intelligent Machines Center won the Mixed Palletizing Challenge in the 2013 Virtual Manufacturing and Automation competition, held during the 2013 International Conference on Robotics & Automation in Karlsruhe, Germany.

The Center for 21st Century Universities (C21U) is Georgia Tech’s living laboratory for fundamental change in higher education. The Institute is committed to leading initiatives that will define the next generation of educational practices and technologies. Working in tandem with campus administrators and faculty, the center develops and tests new educational platforms and techniques—such as Tech’s 2012 partnership with Coursera to offer massive open online courses (MOOCs). Notable projects include:

- **Online Education** – Led innovation in online education that helped Georgia Tech quickly become a national leader in MOOC production and deployment, including 20 Coursera MOOCs to date, and helped spearhead the University System of Georgia’s MOOC offerings.

- **Breakthrough Delivery Models** – provided program evaluation expertise to the Gates Foundation on a variety of models of delivering postsecondary educational content and degree-completion efforts.

The Center for Experimental Research in Computer Systems (CERCS), joint with Ohio State University, aims to build the interactive information systems of the future and to create the intellectual capital that can advance these technologies and fuel future developments. To achieve this mission CERCS has three strategic thrusts: (1) Scientific/technical computing that focuses on Big Data and scalable, reliable access; (2) Embedded systems/computer architecture with a focus on multicore; (3) Enterprise computing with a focus on clean information: adaptive, trusted, sustainable. Notable projects include:

- CERCS researchers completed seven long-term research projects and presented or published 65 papers in 2012-13.

- Through a multi-year collaboration with **VMWare**, CERCS has created technology for advancing virtualization infrastructures for data-center systems highlighted at the company’s 2012 Academic Research Summit.
The Georgia Tech Information Security Center (GTISC) focuses on research, education and outreach programs for securing information technology-based systems at a time when the growing scale and sophistication of threats against such systems creates new challenges that require better understanding of emerging threats and novel ways to counter them. GTISC founded the annual Georgia Tech Cyber Security Summit which, along with its attendant Emerging Threats Report, helps mobilize and direct cybersecurity professionals in the research, industry and government sectors. Notable projects include:

- **Attribution and Traceback of Botnet Attacks** – Clustering and correlation analysis algorithms pinpoint commonalities in malware and help identify botnets—and the attackers behind them. GTISC’s work with law enforcement has resulted in multiple arrests of botnet operators.

- **Applied Cryptography** – Efficiently searchable encryption can enable efficient and secure search on remotely stored encrypted data.
### GVU Center

**Director:** Keith Edwards

The GVU Center is dedicated to developing innovative interactive computing technologies to advance the human condition. The center started as a home for fundamental research in computer graphics and animation, scientific data visualization and human-computer interaction. Over two decades, GVU has expanded that vision from three to more than 20 research areas. The center has also changed the academic landscape of Georgia Tech itself through the formation of new academic research groups, programs and units, and new interdisciplinary partnerships. In short, GVU is creating the technologies that will shape how we live tomorrow. Notable projects include:

- **BrailleTouch** – An application for iOS devices (free in the App Store) that turns a touchscreen into a soft-touch keyboard programmed for Braille.
- **FIDO** – “Facilitating Interactions for Dogs with Occupations”—looks to leverage Georgia Tech’s expertise in wearable computing to equip dogs with a way to add specificity to those telltale barks and jumps, with applications in home assistance, military and disaster-response environments, health care and more.

### Institute for Data & High Performance Computing

**Interim Director:** Richard Fujimoto

The Institute for Data & High Performance Computing (IDH) is a catalyst for Georgia Tech innovation in Big Data applications, providing a conduit for research by investing in new, collaborative work and nurturing growth in priority research endeavors. IDH is funding researchers working to create scalable machine learning library software, quantum chemistry software, seismic-detection algorithms and GPU-enabled tools for nuclear reactor designs. IDH’s two lead research groups include the Center for Data Analytics and the Center for HPC: From Big Data to Exascale Computing. Notable projects include:

- **Computing-Enabled Advanced Transportation Systems** – Explores novel distributed simulation techniques that incorporate online sensor and crowd-sourced data to create more effective transportation systems.
- **Keeneland** – Georgia Tech led the effort to build the Keeneland heterogeneous high-performance computing system at partnering Oak Ridge National Laboratory, along with team members University of Tennessee-Knoxville and the National Institute for Computational Sciences.

### Robotics & Intelligent Machines Center

**Director:** Henrik Christensen

The Robotics & Intelligent Machines Center (RIM) has a strong tradition of robust, interdisciplinary research and a reputation for innovation and entrepreneurship. Emphasizing personal and everyday robotics, as well as industry and defense automation, RIM helps define the future role of robots in society. Working with industry partners, RIM develops practical solutions to real-world challenges. As the flagship for Tech’s robotics efforts, the research center has an integral relationship with the interdisciplinary Ph.D. in robotics. Notable projects include:

- **National Leadership** – As part of the National Robotics Initiative, RIM led the creation and presentation to Congress of the updated *Roadmap for U.S. Robotics* and launched the Robotics Virtual Organization, an online consortium of robotics researchers.
- **Novel Solutions for Tech Transfer** – RIM engaged in 60 industrial research partnerships in FY13, including collaborations with Boeing, which contributed to Georgia Tech’s receiving a 2012 Boeing Performance Excellence Award.
On May 14, 2013, the College sent a shock wave around the world when it announced that it would offer, in collaboration with Udacity and AT&T, the first Online Master of Science in Computer Science (OMS CS) available entirely through the “massive online” platform—and priced at less than $7,000 for most students.

“Game-changer.” “Revolutionary.” “The future of higher education.” Virtually the moment the news began to spread, the superlatives started to appear. Even those skeptical of the program acknowledged that—if Georgia Tech could deliver on its promise to build a curriculum every bit as rigorous as its on-campus M.S. program, and if students start migrating to the program in significant numbers—the OMS CS program could be a tipping point for online education.

“Before our announcement, there were MOOCs [massive open online courses] but they were, to quote one writer, ‘education for the unwashed masses’ because there was no payoff—there was no degree,” says Dean Zvi Galil. “Now we are offering students anywhere in the world the opportunity to get a bona fide master’s degree from an elite institution, to complete their coursework on a schedule that fits into their lives, and to do it all for a fraction of the typical cost.”

Galil and his colleagues, both in Atlanta and at the Udacity headquarters in Palo Alto, Calif., spent the rest of Summer 2013 working feverishly to ramp up toward the OMS CS program launch in early 2014. Faculty were recruited to produce the first six courses, and prospective OMS students were informed of eight degree specializations to be offered upon launch.

“In the United States alone, we have 2 million open jobs in high tech and more than 11 million unemployed people,” says Udacity founder and CEO Sebastian Thrun. “If we only educate 1% of underemployed Americans to become proficient in computer science through the OMS CS program, we will vastly exceed our enrollment projections.”

omscs.gatech.edu
Startup Accelerator

Leave it to Georgia Tech to coin (and prove) a new axiom: Successful businesses aren’t born—they’re engineered. The phrase may not yet be taught in business schools across the country, but if the Institute’s 2-year-old Flashpoint program continues its spectacular early success, it soon will be.

What is Flashpoint? It is a “startup accelerator,” with the intent of teaching fledgling entrepreneurs what they need to know to get their (very) early-stage business models off the ground—including access to seed funding.

Central to Flashpoint is the idea, now gaining currency in entrepreneurial circles, that startups are such an entirely different animal from functioning businesses that many concepts taught in business schools simply don’t apply. Startups are special. They must be engineered. They must be approached like any other research question. And that’s exactly what Director Merrick Furst, along with dozens of eager startup founders, has attempted through Flashpoint. Early returns say he’s succeeded. Over three cohorts, Flashpoint has “graduated” 37 startups who together have raised more than $40 million in funding from some of the country’s best-known venture capital firms.

“The process of engineering a startup is the process of intentionally and efficiently bounding uncertainties and risk, the net result of which is validated discovery of opportunity,” says Furst, Distinguished Professor in the School of Computer Science. “Once you have that, it’s something people can fund, something they can come work for, something you can build into a business. Focusing on that very early stage is what startup engineering is all about.”
Think Global

Everyone knows the world is shrinking, in large part due to computing technologies. Direct, hands-on experience with diverse cultures plays an increasingly important role in the workplace—not only does it expand someone’s perspective, it can also help develop a number of traits that are critical to professional success, such as leadership, self-confidence and adaptability.

Traveling abroad—for a year, a semester or even a few weeks during the summer—is one way students can pursue their academic goals while developing these real-life skills that will help them throughout their careers—and have the time of their lives while doing it.

Georgia Tech offers an array of international options, and the College of Computing also manages several computing-specific programs, such as its summer program in Barcelona, Spain. The Barcelona Summer Study Abroad program provides undergraduate students of all disciplines with an opportunity to spend 11 weeks in a vibrant, cosmopolitan, Mediterranean port city while taking courses under Georgia Tech faculty.

The College also participates in Georgia Tech-Lorraine, sending both students and professors to the Institute’s campus in Metz, France, and offers several other programs to undergraduate and graduate students, including dual-degree programs with leading European universities.

Whether it’s Europe or Asia, Australia or South America, GT Computing can find an international program option for just about any destination that captures a students’ imaginations while equipping them with skills that last a lifetime.
At its core, the College of Computing’s Corporate Affiliates Program (CAP) is an acknowledgement of two 21st century facts: First, computing and digital technologies dominate today’s commerce and figure only to become more important in the future. And second, as home to one of the United States’ Top 10 computing programs, Georgia Tech produces the kind of talent that can help companies not just ride the digital wave, but shape it.

So what is CAP? It’s a partnership of opportunity, for both Georgia Tech and our corporate partners. We help connect CAP companies to the top computing talent in the world, while gifts from those partners help support and sustain the GT Computing pipeline. Another way to spell CAP might be “win-win.”

2012–13 CAP PARTNERS

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