Georgia Tech GVU Center

ENVISIONING THE FUTURE

The GVU Center at Georgia Tech is a university-wide interdisciplinary research center dedicated to understanding and improving the human condition through technology. Our researchers are pushing the boundaries of computing, and are exploring how innovative, human-centered technologies can be applied in domains as diverse as health, education, entertainment, and civic engagement, and at scales ranging from the individual to the community and even to society as a whole.

Our vision is to imagine and build computing solutions to social, scientific, and technical challenges.

Technology alone cannot solve problems. Rather, it is people working together who solve problems: by first deeply understanding the human context of the challenges we face, and then creating the technical and policy innovation needed to address those challenges within that context. Thus, for a quarter of a century, the GVU Center has created and sustained an interdisciplinary research ecosystem that spans Georgia Tech and connects our researchers and students with external partners from industry, governmental agencies, and NGOs. We are a dynamic community where faculty and students from every college at Georgia Tech come together to lend their expertise.

The future is being invented at GVU. We invite you to join us.

Letter from the Director

Keith Edwards
Director, GVU Center

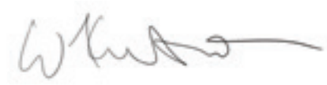
In 1992, the leadership of Georgia Tech had a vision that computing would come to permeate virtually every aspect of our lives. At this time—before smart phones, ubiquitous connectivity, or even the widespread adoption of the Web—it was often hard to imagine the exact shape this future would take, but there was a sense that computing would become crucially important in how we communicate with each other, educate our children and ourselves, live healthy lives, play and have fun, and interact with the world around us. This idea was radical at the time, because it pushed away from an inwardly facing version of computer science that focused on improving the machine itself, toward an outwardly facing vision of computing where the human, rather than the machine, is at the center. This idea of approaching technology through a human-centered lens, rather than a purely technological one, has been at the core of the GVU Center's philosophy since its beginning.

In the roughly quarter century since then, GVU has been at the forefront of exploring and helping to create the world we envisioned in 1992. Of course, the scope of the Center has changed over that time. At its founding, our name represented our primary areas of research focus: Graphics, Visualization, and Usability. Now, however, the Center's work has expanded to include virtually every aspect of how technology impacts the lives of people, from health innovations, to wearable computing, to gaming and entertainment, to new ways to socialize, to how we organize and build stronger communities. As the Center's scope has grown, so too has its faculty. GVU now comprises roughly 110 faculty researchers from all six Colleges at Georgia Tech: Computing, Sciences, the Ivan Allen College of Liberal Arts, Design, Engineering, and the Scheller College of Business.

This remarkable research depth and diversity has made the GVU Center one of the leading research organizations of its kind, both nationally and internationally. We are not the typical academic institution: rather than reinforcing disciplinary silos, we work to bring together multi-disciplinary teams alongside our partners to create new technologies that improve the human experience, and to better understand the human condition in an increasingly technologically mediated world.

As you browse these pages, you will get a sense of not just the scale of the research taking place here, but also how our projects are grounded in the real world. Human-centric work necessarily requires engagement with people, and so we work closely with a variety of partners including industry—representing not only the most important computing companies in the world, but also non-IT companies in a variety of markets—as well as NGOs, community, and government organizations (see the back of this brochure for details). These partners are a wonderful source of inspiration, as well as a source of hard problems for us to tackle.

As the Director of the GVU Center, my job is to promote the amazing research going on across the university, and to help plant the seeds of new research innovation that will one day bear fruit. If you'd like to connect with us, please consider this my personal invitation to get to know us better.



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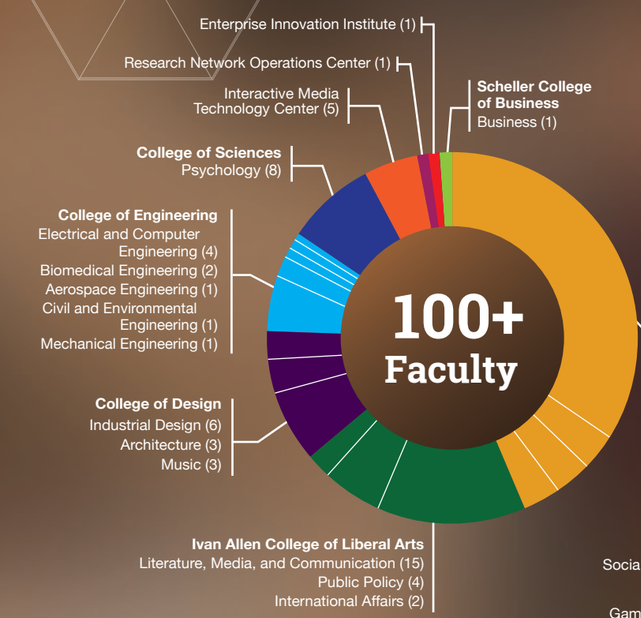
Unlocking Human Potential Through Technical Innovation

The GVU Center is dedicated to transforming computing research into innovative, relevant, and useful solutions that address the needs of people. We are focused on unlocking and amplifying human potential through innovation in a variety of interactive computing technologies. Our approach to research combines deep insight into human behavior and needs, the creativity to imagine and design the future, and the technical savvy to build it.

Explore interactive versions of the graphs online at ***gvu.gatech.edu/explore***

250 Active Projects

$9+ Million in Federal & Industry Funding



Number next to school or unit indicates the number of GVU faculty in that unit.

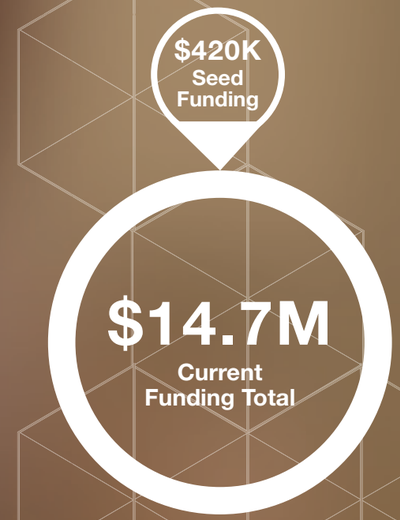
Our community of researchers from across Georgia Tech's six colleges embody a unique collaborative spirit, one that fosters dynamic, interdisciplinary teams able to address complex human challenges. Faculty from a wide range of computing, scientific, engineering, design, business, and liberal arts disciplines work together and form GVU's approach to research and innovation.

The GVU Center comprises more than 20 core research areas in approximately 50 labs. Led by top experts in their fields, these labs form a network that the GVU Center supports and brings together to tackle hard problems. As the reach of computing throughout our society has grown, the set of labs that make up GVU has likewise grown and become more diverse.

Number of Faculty 1-20

Innovation Grant Program Seeds New Research Initiatives

Each year, the GVU Center provides seed funding to launch new research projects in nascent areas, alongside other campus partners such as the Institute for People and Technology. This seed funding is often crucial to starting new efforts, especially in risky or unproven fields. However, once launched by GVU, the projects often accelerate and obtain their own funding support. For example, for the period 2008-2013, the GVU Center invested approximately $420,000 in research seed grant funding. These projects have since garnered more than $14.7 million in extramural funding from both industry and federal sources, including the National Science Foundation, Intel, the National Endowment for the Arts, Proctor & Gamble, Google, and more. This growth is a testament to the quality of research going on at the GVU Center as well as the relevance of that research to have impact on individuals, communities, and society as a whole.



James D. Foley GVU Center Endowment Builds Foundation for Expanding People-Centered Technology Research

The James D. Foley GVU Center Endowment supports the students and research activities of the GVU Center and allows the center to build on its commitment to expand research in people-centered technology at Georgia Tech. Through the generous support of donors, the endowment provides for the GVU Graduate Student Awards—including the Foley Scholar Fellowships and the GVU Distinguished Master's Student Award—given annually to student researchers whose work tackles complex challenges in a connected world. Established in honor of computing pioneer James D. Foley in 2007, the endowment positions the GVU Center to continue its investment in future generations of Georgia Tech innovators.

Representing the wide range of research being pursued across Georgia Tech's six colleges, the Foley Scholars represent the best of our community. Working closely with faculty advisors, these students embody GVU's commitment to improving the human condition through technology. They have created innovative new technologies that address important societal challenges, and have contributed to a deeper understanding of our society in an increasingly technologically mediated world.

Support for this research can be made through the James D. Foley GVU Center Endowment with a one-time or annual gift. Contact us at gvu@gatech.edu for more information.

GVU Graduate Student Award honorees include recipients from all six colleges at Georgia Tech. Foreground: Tanushree Mitra, Computer Science; Jessica Pater, Human-Centered Computing; Monet Spells, MS HCI 16; Briana Morrison, Human-Centered Computing; Maia Jacobs, Human-Centered Computing; Lauren Margulieux, Engineering Psychology. Top Back: Barbara Ericson, Human-Centered Computing; Mariam Asad, Digital Media; Laura Barg-Walkow, Engineering Psychology. Discover the work of these innovators at ***gvu.gatech.edu/foley-scholars****.*

Transforming Communities and Building Civic Participation

Civic Computing is the application of technology toward the creation of stronger communities, more robust civic discourse, and increased political engagement. Georgia Tech research in this space aspires to deeply understand modern engagement with the civic and political spheres, and develop new technologies that can enhance participation. Creating thriving spaces for where we live, work or travel is vital to our future culture and infrastructure. GVU researchers in civic computing tackle the work from many perspectives, from food production, public transit, and technology design for neighborhoods, to effective technology solutions for government, civic groups, and beyond.

In the face of large-scale social problems, **Keith Edwards** (Interactive Computing) is exploring how to build connectedness within civic networks to shore up efforts by government agencies and expert service organizations combating persistent social issues, such as human trafficking. New understanding in how community-based organizations connect through technology shows the need to configure these tools to better support groups of *groups*, rather than just groups of individuals. Edwards' work also extends to explorations of how computing systems can enhance existing neighborhood ties and create new social ties in community settings.

Cycle Atlanta, led by **Kari Watkins** (Civil & Environmental Engineering) and **Chris Le Dantec** (Literature, Media and Communication), is a component of a larger vision by the Atlanta Regional Commission for sustainable growth in the metro area. Cycle Atlanta creates a better view of how people move through the city in their daily lives by utilizing a mobile app, which collects crowd-sourced data reported by bicycle riders. The app records routes in real-time and lets users report problems such as potholes or obstructed bike lanes. The data enables Atlanta officials to make strategic improvements to bicycle infrastructure. Visit the online interactive map at **http://cycleatlanta.org/rides** to see where and why Atlantans are biking. In other work, Le Dantec partners with the Historic Westside Cultural Arts Council, collaborating on technologies that help cultivate a shared community identity. Learn more at **http://communityhistorians.net**.

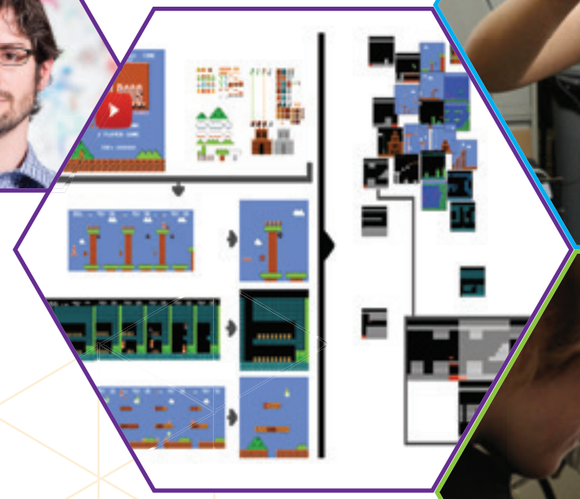

Credit - Kevin Dowling

Hackathons are becoming a cultural phenomenon, and **Carl DiSalvo** (Digital Media) is leading research into issue-oriented hackathons with a focus on food and food systems. His group conducted the first Atlanta Food Data Hack, bringing together stakeholders to conceptualize and prototype new uses of information and communication technologies related to food production and distribution. Attendees devised ways that digital media could be used to support local food initiatives and to grow a community of producers and stakeholders committed to open government.

Augmented reality is being used by **Jay Bolter** and **Nassim Jafarinaimi** (Digital Media) to immerse people in a cultural experience of the Auburn Avenue Historical District, the cultural center of African-American life in Atlanta in the first part of the 20th century. That era is brought to life when visitors view Auburn Avenue through their mobile devices and see historic photos overlaid on the scene for a panoramic trip through time. Researchers are working in collaboration with Central Atlanta Progress and the History Preservation Division of the Georgia Department of Natural Resources to bring this history to thousands of visitors and residents through an integrated media experience. See an interactive view at **http://citysaga.gatech.edu**.

Gaming Research Redefines Boundaries of Interactivity and AI Systems

Gaming research in the GVU Center embodies a vision for not only creating new interactions and immersive experiences, but also in redefining the role that games play in our lives. Artificial intelligence in gaming explores an almost limitless number of paths for creativity and enhanced play experiences. New ideas that go beyond conventional game controls are also being pioneered in GVU's lab spaces. These innovations and many more are coalescing into a gaming research hub that is poised to spark the next evolution of interactive gameplay.



Mark Riedl (Interactive Computing) is developing artificial intelligence approaches for automated story generation and interactive storytelling for entertainment, education, and training. One such system, an AI for game level design, watches gameplay videos on YouTube to teach itself basic rules about how video games are designed; the system can then create its own levels for such games and can even act as a consultant and give suggestions to human game designers. Another AI system, one for interactive storytelling, crowdsources basic story elements to build a whole narrative. This method is designed to be used in "branching" games, where players choose how their game experience unfolds.

Blair MacIntyre (Interactive Computing) develops games that explore the potential of augmented reality for creating new kinds of mobile gaming and interactive media experiences. The games created in his Augmented Reality Game Studio explore interaction mechanics in augmented reality and leverage handheld AR interfaces. Some of these game mechanics are a fundamental departure from current touch-screen interaction and seek to broaden the possibilities of interactive gameplay through mobile technologies. MacIntyre is also co-director of the Georgia Tech Game Studio, which provides students with opportunities to rapidly prototype game ideas and develop these into full-fledged games.

Maribeth Gandy (Interactive Media Technology Center) merges her experience in product design and mobile technology solutions to understand user needs in the gaming space. She has developed a variety of augmented reality systems for mobile phones and gaming devices, created high-level AR authoring tools, studied how to enhance and measure user immersion, and applied AR technologies to STEM education. Her work includes using augmented reality technologies as a pathway for an immersive and intuitive mobile interface for massively multiplayer online systems, such as Second Life and World of Warcraft. Gandy's collaboration to develop cognitive-training games for older adults seeks to help this population stay engaged and active for a higher quality of life and is indicative on the broader impact of her gaming research.

Ian Bogost (Literature, Media and Communication; Interactive Computing) develops videogames not just as entertainment, but as social and political vehicles, with topics ranging from airport security and consumer debt to the petroleum industry and pandemic flu. The work has shed new light on social issues, allowing a new perspective on cultural challenges through games. Bogost recently led development of the Georgia Tech Game Studio, a new space where student game developers conceptualize, develop, and ship original games. The studio is a bid to bring together various innovations in how Georgia Tech conceives gaming and create a direct pipeline for games that can help further shape the landscape of interactive entertainment.

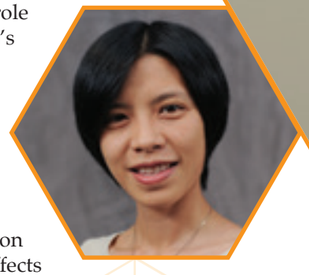
Michael Nitsche (Literature, Media and Communication) explores how people express themselves through interaction in hybrid spaces, such as real-time, three-dimensional virtual environments as well as physical locations, using digital media. Nitsche has a nuanced approach to gaming and researches many facets of design, immersion, and performance. One project heightens the drama of a game experience by exploring if it is possible to algorithmically manipulate sounds to describe and enhance the dynamic environment of a video game. His research into 3D platformer-style games investigates automatically adjusting camera views that react to a player's performance based on individual game situations in a custom-built environment.

Shaping Computer Graphics and New Media for How We See (and Hear) the World

New forms of interactive media are creating opportunities for expression that have the potential to transform how we experience and interact with the world and with each other. Computer graphics research is going beyond the computer and the movie screen, and is now shaping scientific discovery, entertainment, health care, and more. Georgia Tech experts are also using the algorithms of computer graphics and animation to advance robotics through new modeling and simulation techniques that will enable a near future with synthetic counterparts in the home and workplace. New forms of interactive media are also changing how we entertain ourselves. Innovative explorations of new media are changing how we consume and create video, music, and art; these and other media are being imagined in wildly different ways at Georgia Tech.

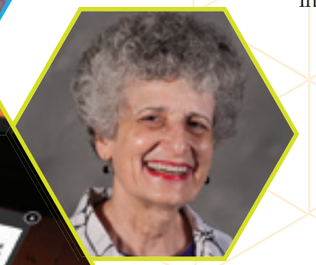
Greg Turk's (Interactive Computing) work in computer graphics, biology simulations, and scientific visualization have led to new ways to study sea creatures and replicate how they move in their environments. Recreating these water-based conditions in computer models has led to a better understanding of the natural world and resulted in animation techniques that can be adopted to a variety of animals for scientific studies and even entertainment. By using realistic biomechanical simulation, Turk's algorithms determine how a long-extinct marine dinosaur, the plesiosaur, would have moved in the water. Turk's work helped solve a long standing debate of how they used their four flippers (results show they were likely forelimb-dominant). Another modeling technique reproduced the various vegetation patterns observed in wetland ecosystems, helping to better understand the mechanisms that drive the formation and development of natural habitats.

Gil Weinberg (Music) is shaping how musical artists envision—and how audiences experience—music through the use of computing technology. His cyborg drummer (*pictured left*) and musical robot ensemble have demonstrated new forms of cooperative musicianship, in which both artificial and human intelligences work together in real time to shape musical expression. His research has yielded new approaches to robotic musicianship, as well as entirely new types of musical instruments and new algorithms for sonification. With his improvisational robotic musicians, Haile and Shimon, he has traveled worldwide to dozens of concerts and festivals. Weinberg's work has introduced audiences to the possibilities of synthesizing new music with technology in unexpected, deeply meaningful ways.



Karen Liu (Interactive Computing) is pushing the boundaries of robotics through her research in computer graphics and animation. Using the same physics-based simulation and computational biomechanics algorithms that play a key role in computer animation, Liu's work advances robots' capabilities to allow them to work more effectively alongside humans. In one project, Liu created a physically realistic tool that allows virtual humans to get dressed; this simulation can accommodate for the effects of different fabric types, gravity and human biomechanics. She is now applying these same algorithms to robots so they might efficiently and safely dress those who need assistance. Liu also developed a way to simulate softer landings for robots by mimicking the techniques employed by cats. The constraints of robot hardware don't allow them to make the softest of landings, so Liu has modified the algorithms to suggest a sequence of contacts enabling the robot to slow down and minimize any damage.

Jarek Rossignac's (Interactive Computing) computer modeling work in complex, three-dimensional geometry has led to a number of breakthroughs in design and analysis techniques that allow for the creation of a wide range of innovative new tools. For example, Rossignac's work has made possible medical devices with complex shapes, derived from models he pioneered. One such tool, Twister, provides an intuitive tool for deforming 3D models and has inspired several prototypes for health care use. Designers use the tool to manipulate a shape and deform it in real time by moving, bending, and twisting the shape to make a prototype to their specifications.



Janet Murray (Literature, Media and Communication) helped to pioneer interactive narrative, and her work in interaction design specializes in digital media and the humanities. Her current work has led to the creation of prototypes for new narrative genres that integrate television and computation. Her StoryMap project (*pictured left*) helps television viewers navigate a world of on-demand entertainment, with a second-screen companion app providing distraction-free annotations, character maps, and more for multi-episode story arcs of TV series. Another project, "Don't Open That Door," immerses viewers by allowing them to perform gestures while watching a suspenseful TV narrative and becoming a part of the experience.

Enabling Independence and Promoting Physical and Mental Health and Wellness

GVU researchers are using a variety of high-tech solutions—including robotics, digital medical records, and new network capabilities in home devices—to solve some of the biggest health care and wellness challenges facing people today.

Breakthroughs have also come through social data, which researchers have used to find indicators of mental illness and seek new intervention methods with clinicians. Other populations are benefitting from new ways technology is being applied to address health challenges, such as social networks designed to encourage youth to exercise more, and new technologies that provide earlier diagnosis and improved quality of life for those with chronic disease or disability.

Elizabeth Mynatt's (Interactive Computing) research in personal health informatics explores solutions for chronic disease management and the design of better health interfaces and treatments. Using social media, a four-year study uncovered self-harm behavior (e.g. eating disorders) among minority youth in one Atlanta neighborhood; this work is being used to inform the creation of better treatments that take into account the social media context of teenage patients. In a breast cancer study, Mynatt developed a customized tablet to let patients better understand and manage their treatments. For overweight youth, she examined how "exergames" could be implemented to become a meaningful part of their lives and effect health behaviors.

Lauren Wilcox (Interactive Computing) studies a range of health information technology design issues to help patients better participate in their own health care. Her research in electronic information delivery to patients includes work on a custom inpatient personal health records portal infrastructure that delivers timely, patient-accessible information. Using interactive tools, patients can access organized views of medication information and be aware of scheduled and completed medication therapies. They can also engage more deeply in their treatment by learning about their prescriptions with educational summaries.

Brian Jones (Interactive Media Technology Center) leads the Aware Home Initiative, a 5,000-square-foot facility designed as a residence and embedded with a host of technologies for both short- and long-term studies. Researchers develop a real-world understanding of how in-home technology can be adopted for many different health and wellness scenarios. This may include technology that supports aging-in-place or the caregivers of children with developmental disabilities, such as autism.

Magic Window, which could be used to monitor patients, turns control of installed video cameras over to the viewer who can select what to view and change perspectives on the feed.

Rosa Arriga (left) and Agata Rozga (right) in the Child Study Lab, which improves early screening for autism and other developmental delays.

Wendy Rogers (Psychology) focuses on psychological factors in how people adapt to and use robots and other technologies that benefit them in the home. Understanding the needs and preferences of older adults regarding technology can help lead to better-designed systems in the home with higher adoption rates. She has studied a variety of robotic systems and topics such as emotional expression of agents, user acceptance of robots, and the role of robot autonomy in human-robot interaction.

Charlie Kemp (Biomedical Engineering; pictured above with PR2 Robot) is breaking new ground with semi-autonomous mobile robots that physically manipulate objects and help those that have limited or no mobility. His research has shown how robots can help with everyday tasks that can improve quality of life. Robot for Humanity is a project that used a robot as a surrogate to help a mute, quadriplegic person do everyday tasks, such as shaving or scratching. It demonstrates how people with severe physical disabilities could use personal robots to gain independence.

Scalable and low-cost technologies for medical interventions are a primary research focus of **Gregory Abowd** and **Rosa Arriaga** (Interactive Computing). Their work aims to improve the quality of life for those with chronic illness and disability and often involves support for both the patient and clinician.

Abowd's 3D Eye Gaze Tracking project allowed adults to were glasses with a tiny camera as they played with children. A computational analysis of the footage helped to identify the level of eye contact the children made with the adults, an indicator to help diagnose autism at an early age.

For pediatric asthma patients, Arriaga pioneered an intervention by using simple SMS texts to provide better treatment for children. Doctors needing to reinforce treatments with these patients could deliver medication reminders and facts about asthma via text; the technique proved to effectively help improve asthma patients' health outcomes.

Informing Social and Regulatory Policy

Georgia Tech is a leader at the intersection of technology and policy. Our faculty work with policymakers to inform legislation, regulation, and social initiatives that are grounded in the latest research and help lead our society toward a better future. Technology solutions supported by governments and NGOs have the potential to increase both social justice and quality of life. Our work in this space ranges from social media use in the electoral process, to technology for making highways safer, to informing privacy policy for medical data.

Peter Swire (Business) has been central to national-level efforts that address emerging privacy and security issues in public policy, academia and industry. Most recently, he was one of five members appointed in 2013 to President Barack Obama's Review Group on Intelligence and Communications Technology. The recommendations he made as a member of this team helped to influence important policy changes for the U.S. intelligence community. He also co-chaired the global process to develop a Do Not Track standard for Internet users. Under President Bill Clinton, Swire was the Chief Counselor for Privacy in the U.S. Office of Management and Budget, where he was the White House coordinator for the HIPAA medical privacy rule.

Autism is the nation's fastest growing developmental disability, but many insurance providers, including Medicaid, do not cover autism services or early intervention services for Autism Spectrum Disorders (ASD). **Nassim Jafarinaimi** (Literature, Media and Communication; on left) and **Kim Isett** (Public Policy; on right) are building communication tools—so-called "digital boundary objects"—that aid the public and legislators in understanding the negative economic impact of late intervention and provide an evidence base for the passage and implementation of early intervention services in ASD. The first set of communication tools is aimed at policymakers to improve the continuum of care and interagency system of support for children with autism. An interactive version of this tool allows users to explore different costs over time.

In developing countries, social media have the potential to not only connect people, but improve the quality of life. **Mike Best** (International Affairs and Interactive Computing) and his students developed new technology to analyze social media in real time to monitor the electoral process during elections in Nigeria and Liberia. Results from this deployment showed how social media can serve an important role as a grassroots election watchdog, providing increased transparency and helping to defuse tensions around credibility of election results. Best's expertise in communication technology and international affairs has led him to be named the director of the new United Nations University Institute on Computing and Society (UNU-CS), based in Macau, China.

Children in lower-income countries who are separated from their parents when the parents seek opportunities abroad potentially become high-risk populations. **Beki Grinter** (Interactive Computing) seeks to strengthen relationships within the separated families by using technologies that allow parents and children to communicate and that also involve the extended care network of educators and relatives in the community. The research shows hybrid approaches to designing social spaces—merging voice-based and online platforms—in an effort to improve access and affordability to meet the users' differing needs and build trust.

Bruce Walker (Psychology) leads research in driving safety focusing on the design of auditory prompts and systems to let drivers keep their eyes on the road. His work shows that enhanced auditory cues can allow a driver to operate the menus of in-vehicle technologies more efficiently while driving safely. His work also examines emotions while driving; in one study, a vehicle simulator recreated various road conditions designed to induce different emotions in drivers. The results showed that anger and happiness both lowered perceived safety levels and produced more driving errors when compared to fear or neutrality. The work advances the development of a model for regulating emotions and creating adaptive interfaces for drivers to improve road safety.

Increasing Expertise and Opportunity through Creativity, Education, and Learning

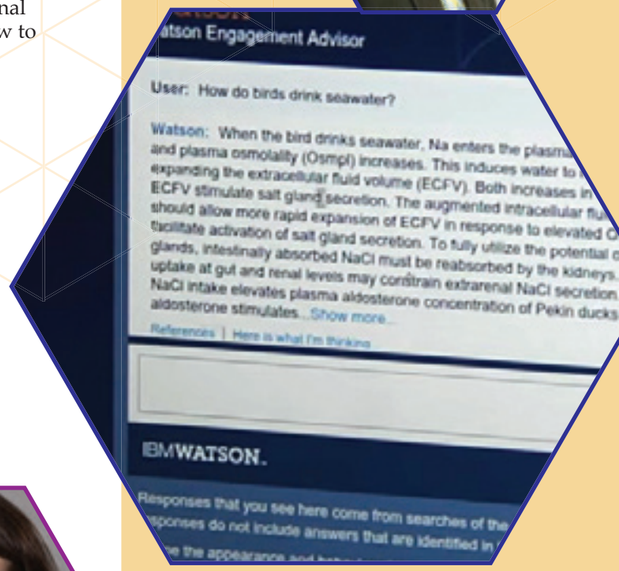
Georgia Tech's research on how to equip current and future generations with the skills they will need in life spans a wide spectrum of efforts, from basic research aimed at understanding how best to approach computer science education (for both students as well as educators), to new educational technologies, to entirely new approaches to engage kids with computing at earlier ages. Computing skills are becoming a form of basic literacy for an informed citizenry, as well as being a requirement for an increasing range of professions. This means that broadening access to computing education in school systems is a necessity, especially for underrepresented minorities and women.

Mark Guzdial (Interactive Computing) has shaped a wide range of efforts to advance models for computer science education and their implementation into school curricula nationally and across the world. The contextualized "media computation" approach he developed for introductory computer science eschews the abstract, algorithmic approach used in the past and instead allows students to write programs that manipulate and create digital media, such as pictures, sounds, and video. He has taught hundreds of high school and college teachers how to teach with media computation across the United States, and it is now used in nearly 200 schools around the world. His work on CS pedagogy is breaking new ground on how to design instructional material for current teachers to teach computer science and how to shape a professional identity for this growing group.

Barbara Ericson (College of Computing) is helping to solve the challenge of preparing secondary education teachers to teach Advanced Placement Computer Science, allowing students to acquire advanced CS skills at an earlier age. One solution involves creating innovative computer science e-books for teachers and students; these books embed interactive features that both help teachers learn the material more quickly as well as help keep introductory computer science students more engaged. Her model for computing camps has been replicated across Georgia and other states and has increased participation in computing education—especially among minority youth and girls—including a more than threefold increase (427 to 1,500) in the number of Georgia students taking the AP CS exam from 2006 to 2014.

Through their work with the NSF-funded Georgia Computes, Ericson and Guzdial (top of page) have increased the number and diversity of computing students in Georgia.

Jason Freeman (Music; above) and **Brian Magerko** (Literature, Media and Communication; above right) are bridging the love of music with computer science by providing students and teachers a powerful set of new tools to compose their own musical creations through coding. EarSketch is a web-based, pop culture approach to engaging a generation of learners to discover computer science in a fun environment. The program allows users to remix creations from famous artists or start from scratch, by using core topics in computer science such as iteration and functional decomposition, and combining these skills with music and music technology. Users learn to code in Python or JavaScript while manipulating loops, composing beats, and applying effects to a multi-track digital audio workstation. Modular lesson plans for secondary education and college instructors are available to help students start rocking out in class while learning to code.



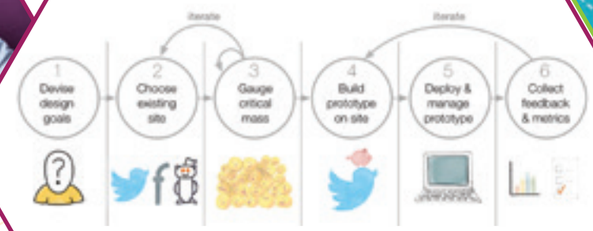
Ashok Goel (Interactive Computing) is pushing the boundaries of artificial intelligence to advance how computers could help humans creatively solve problems in a wide range of domains by simply chatting with an AI system. A custom version of IBM's Watson, called GT-Watson Plus and developed through student projects, is able to immediately respond to complicated questions and provide insight into technical topics, much as a human expert would. The system can provide multiple answers to complex questions, representing multiple perspectives on a topic; this allows the user to decide which best applies to his or her project. This use of AI promises to lead to discoveries for diverse groups of researchers and professionals who can use the AI to "train up" and seek out inspiration for big design challenges in areas such as engineering, architecture, systems, and computing. Another of Goel's systems, Jill Watson, is a virtual teacher's assistant, designed to reply to basic questions from students.

Richard Catrambone's (Psychology) work in educational technologies explores how the rise of online learning, through MOOCs (massively open online courses) and similar methods, are impacting the learning outcomes for students. One aspect of his research has found that the effectiveness of online video and other multimedia increases when the technology uses prompts to guide users who are having a hard time grasping concepts. Catrambone is designing interactive technology that caters to these users in order to improve their learning outcomes. In the design of mobile technologies, his group has found that digital text rivals printed text in terms of reading comprehension by students but still may not yet facilitate deeper learning through methods such as note-taking. In the age of MOOCs, Catrambone has looked at the various approaches to online learning and developed the first taxonomy of online learning courses to help better understand their effectiveness.

Understanding Societal and Cultural Connections with Social Computing

GVU's social computing research explores the design and analysis of social media and its growing impact in daily life. Our researchers are focused on problems such as using social media to gain insight into the behaviors of various groups, exploring how online interactions reflect and shape offline culture and norms, creating new social media platforms and applications, and developing new techniques to analyze data from large social networks.

Eric Gilbert's (Interactive Computing) research into social computing systems has revealed meaningful insight into our online lives. His lab, which has also become a testbed for building experimental social media systems, has made several discoveries on the social web. A sample of these includes the phrases that predict Kickstarter success; bad weather as an indicator for poor restaurant reviews; habits that lead to more Twitter followers; effects of e-mail gossip in the workplace; and the ugly outcomes of political discussions on Facebook. His work also tackles how to design new social media prototypes that can deliver new interactive experiences online. Gilbert is at the forefront of a major initiative to explore the ethics of using publicly available data in studying the social dynamics of online groups and websites.



Gilbert's technique, called "piggyback prototyping," helps developers design new social computing systems on top of existing ones, such as Twitter or Facebook. This allows researchers to focus on what people do on their system rather than how to attract people to it.

Research from **Amy Bruckman** (Interactive Computing) on how people collaborate to create online content has led to advancements in social computing, particularly for educational applications. Her research group studies the design of online communities that encourage individuals to create and share content. In researching online creativity, her work has revealed tensions between copyright and the social norms and policies users adopt to understand creators' rights. Her recent research has brought awareness to the role of online communities in social issues: Communication technologies can help domestic abuse survivors find support, but can also contribute to further harassment. In another thread of her work, she has explored the use of game development as a way to introduce minority youth to computing education and encourage them to pursue technology careers.

Large-scale online social data, coupled with computational methods from machine learning, have allowed **Munmun De Choudhury** (Interactive Computing) to investigate fundamental questions relating to social living. Her recent work has delved into how medical information is searched and shared online, anonymously and publicly, to create better health outcomes for people. One Twitter study examined identity and how major life changes shape one's online identity. Her work on Facebook recently showed how the posting habits of new mothers experiencing postpartum depression changed, pointing toward the possibility of automated ways to detect the early onset of depression. Through scalable models and algorithms informed by her research, De Choudhury seeks to improve quality of life at the individual and collective social levels with an emphasis in health care.

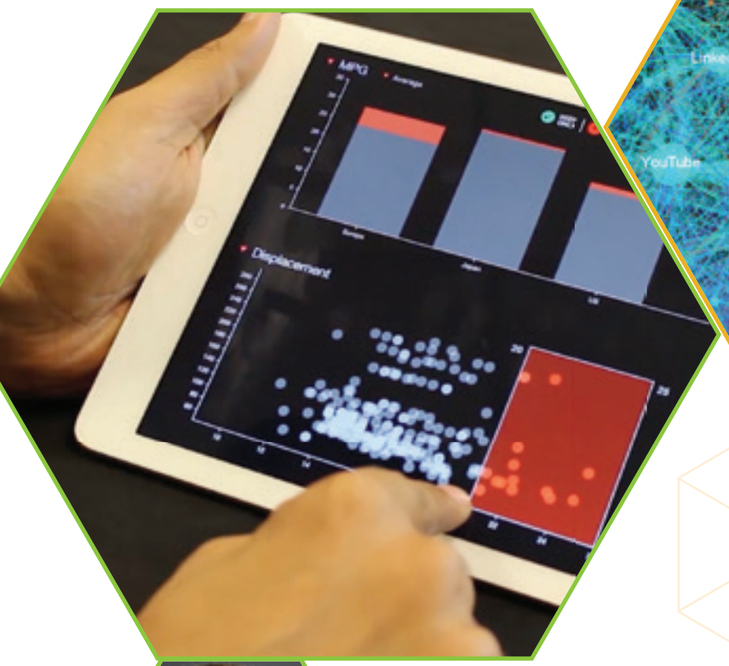
New expressions on social media are found to be geographically concentrated. Some of the less colorful language on the maps show Twitter slang as it spreads: "ion" (I don't); "ikr" (I know, right?); "ard" (alright).

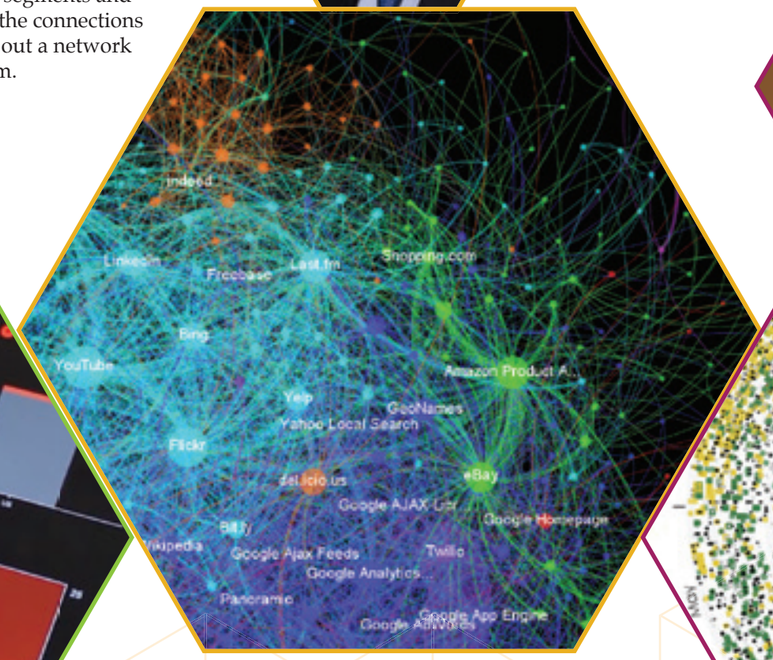
Computer-mediated communication and its dominance in society are driving fundamental changes in the nature of written language, a phenomenon **Jacob Eisenstein** (Interactive Computing) examines in order to understand the nature of these changes. His research on Twitter has found that, rather than moving towards a single unified "netspeak" dialect, language evolution in computer-mediated communication reproduces existing fault lines in spoken American English. Social media produces a continuous flow of casual conversations, and with these large data sets, Eisenstein has identified coherent dialect regions and the words that distinguish them. When it comes to how men and women speak on Twitter, he found that people who talked differently than their own sex had significantly fewer same-sex social connections.

Creating New Visualization Techniques for Large Data Sets

Access to an unprecedented volume of digital data is enabling visualization and data analytics researchers to discover new insights and identify new opportunities for technology. GVU researchers are leveraging datasets to better understand both natural and engineered systems, with goals of advancing business and the humanities, yielding scientific insight, promoting environmental conservation, and more. Visualization research has been a pillar of the GVU Center since its founding, and includes a vibrant community of researchers from across the university. Find out more at ***vis.gatech.edu****.*

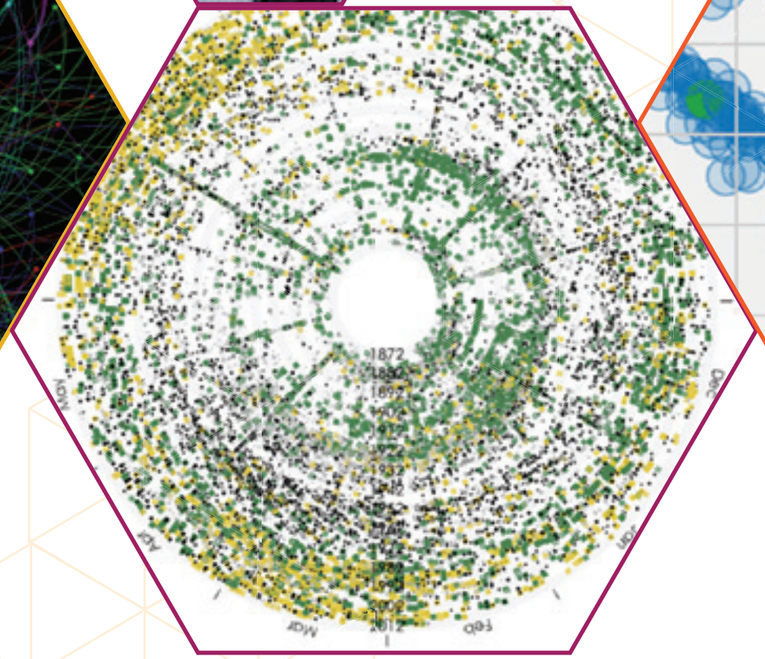
Rahul Basole's (Interactive Computing) work helps to advance business intelligence practices in complex enterprise ecosystems and drive innovation by using data in a growing number of industries, including technology, health care, energy, and global manufacturing. He leads development of ecoxight, a visual analytics tool to provide systemic insight into the dynamics of corporations working together to innovate in converging markets. "ecoxight" (*right*) is driven by socially curated and proprietary data and supplemented by corporate-specific information. Visualizing all market segments and companies in the dataset at once, Basole's tool shows the connections and competitive position of each company, and maps out a network of industries that reveal core players in each ecosystem.

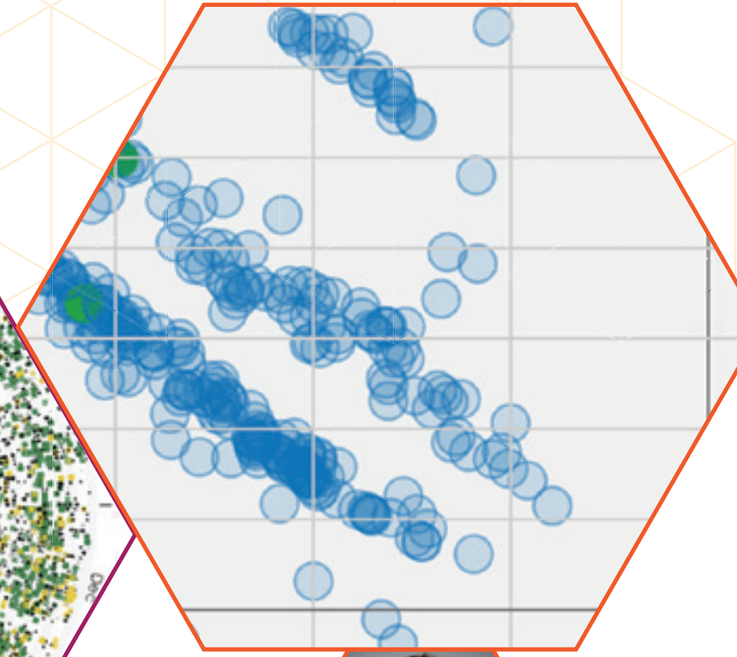




John Stasko (Interactive Computing) has developed an extensive collection of visual analytics tools that explore, analyze, and understand large data sets to help people more easily make informed decisions based on data patterns. As part of work with the Department of Homeland Security, his Jigsaw visual analytics system helps investigators manage unstructured and semi-structured text documents such as case reports, news articles, and suspicious activity reports. Jigsaw pairs computational analysis of the documents with a collection of visualizations that each portray different aspects of the documents, including connections between different entities, and allows for a more holistic approach to data discovery.

Yanni Loukissas (Literature, Media and Communication) uses a combination of ethnography and visualization to study big data as a cultural form. In collections of scientific and cultural history that are too big to see, metadata provides a way to explore rare and delicate artifacts from the past. This approach is represented in his visualization of 142 years of history of 70,000 plant species at the Arnold Arboretum in Boston (*below*). The work shows how metadata from the collection of plant species from more than a century can teach us about the social and material history of such a collection.





Alex Endert (Interactive Computing) is developing ways to enhance the user experience of interacting with visualizations of large datasets, by leveraging people's own mental models for how they interpret and explore information. His interaction techniques also leverage new approaches for more expressive forms of visual analysis tools. Endert's InterAxis is a versatile tool that can be used for a range of datasets to display the most important attributes in a single view and allow people to make more informed decisions. InterAxis allows for rapid, interactive exploration of high-dimensional, multivariate data in ways that would be impossible using common visualization approaches.

Imagining New Interaction Techniques with Wearable Computing Research

Georgia Tech is home to many of the world's leading innovators in wearable computing. The new technologies they are creating are addressing the key challenges in making advanced wearable computing possible. They are exploring new wearable devices and applications that address the needs of specific user populations, as well as demonstrate how wearables will be integrated into future consumer products and business models. Georgia Tech's broad and growing portfolio in wearables shows how these technologies will permeate our everyday lives.

Melody Jackson (Interactive Computing) directs a highly specialized effort in the wearable computing world that involves creating technology to let animals communicate with humans, an area Georgia Tech is helping to pioneer. She leads the Animal Computer Interaction Lab, where her FIDO project (Facilitating Interactions for Dogs with Occupations) has shown the efficacy of allowing two-way communication between humans and service dogs through wearable devices. The project involves a vest worn by dogs with sensors that the dogs can activate through normal abilities, such as biting, tugging or just touching with their nose, in order to communicate a signal to their handler. The vests could be useful for medical alert dogs, search and rescue dogs, bomb-sniffing dogs and other working canines. The work also opens up opportunities for new insight into the natural world and communication with other animal species.

Thad Starner is a curator of the History of Wearable Computing Exhibit, which includes early prototype devices from Georgia Tech and elsewhere that show the progress of the field.

Thad Starner (Interactive Computing) is one of the original pioneers in the field of wearable computing and has helped shape its burgeoning growth, most visibly with his role as technical lead on Google Glass, a device that has been informed by his own experiences using wearable prototypes on a daily basis for over two decades. His research seeks to create computational interfaces and agents for use in everyday mobile environments, using techniques from wearable and ubiquitous computing, artificial intelligence, pattern recognition, and human-computer interaction. Starner's current work allows users wearing haptic gloves to quickly learn tasks, such as playing piano or typing Braille, with vibration sequences and audio cues. His group is also exploring how to increase the speed of interaction with wearable devices, by developing unique device form factors and leveraging new methods of on-body sensing.

The Pixi Dress changes colors on the fly based on a user's preference. Developed by Zane Cochran, Sonia McCall (pictured), Summer Cao and Kara Kenna.

Clint Zeagler's (Wearable Technology Center) research in electronic textiles and on-body interfaces examines how to create technology-enhanced garments that incorporate both a high degree of functionality and fashion, and that are also durable in real-world environments. His experiences as a fashion designer trained in Milan give him a unique perspective on how to incorporate wearable technology into unique garments, and have informed his work with NASA and others. His Electronic Textile Interface Swatchbook is another prototype that shows the merging of craft-based design disciplines like fashion with computer science and engineering. Using non-traditional conductive materials—like metallic thread, fabric, and Velcro—the Swatchbook suggests ways that designers can incorporate soft circuits into clothing, to interface with or control other electronic devices around us.

Jim Budd (Industrial Design) considers design to be one of the most critical disciplines necessary for wearable computing to transition out of the lab and become a transformative cultural presence, much as smartphones have become. His group's work focuses on understanding the way people use emerging wearable interfaces and on designing new technology that enhances people's lives and the way they work. Under his guidance, the Interactive Product Design Lab has produced cutting-edge designs in wearables for performing artists, including the award-winning Ballet Hero for those learning dance. The project uses light bands on the arms and legs of a garment to track a learner's movements and provide visual feedback in real time, signaling when the dancer is in or out of sync. Other projects range from a haptic mirror therapy glove for stroke victims to wearable tech accessories that encourage recreation and social interaction. The Interactive Product Design lab has won the Jury Award two years running at the International Symposium on Wearable Computing.

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Autism Spectrum Disorders

Steve Rushing
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Health Services

Matt Sanders
Research Network Operations
Mobile Applications

Jon Sanford
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Universal Design

Jonathan Shaw
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Developmental Language & Cognition

Valerie Sitterle
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Music Technology

Lauren Wilcox
Interactive Computing
Personal Health Informatics

Clint Zeagler
Interactive Media Technology
Wearable Computing

Ellen Zegura
Computer Science
Humanitarian Computing

Find out more about our experts at gvu.gatech.edu/faculty

Industry Partners

The GVU Center works closely with some of the world's most innovative companies to explore, develop, and deliver technical innovation that can impact their businesses. As one of Georgia Tech's top research centers, the GVU Center is committed to conducting basic research that advances our fundamental understanding of the world, and leads to new interactive technology.

Adobe · Alcatel-Lucent · Apple · BMW · Bosch · Cisco · John Deere · Dell · Disney Research · EA · ESPN · ETRI · GE · Google · Humana · IBM · Intel · Kodak · Linksys · Lockheed Martin · Microsoft Research · Motorola · Newell Rubbermaid · Nokia · npr · NVIDIA · P&G · Panasonic · Qualcomm · Raytheon · RoundArch · SAIC · Samsung · Siemens · Steelcase · Symantec · Texas Instruments · The Weather Channel · Toyota · Turner · Willow Garage · Yahoo! · Zynga

Partnership Benefits and Opportunities

Depending on the level of involvement, partners enjoy many benefits from their affiliation with the GVU Center including:

- Access to social scientific research, which can yield insights into customer practices, needs, and desires
- Insight into new technical innovations that will shape the future of interactive technology and media
- Customized strategy to increase corporate visibility across Georgia Tech through association with the GVU Center, including recruiting opportunities to reach GVU'S 400+ affiliated students

Learn more about the program at: **gvu.gatech.edu/industry-partners-program**

Government and Community Partners

GVU researchers are working closely with governmental and NGO partners to apply the power of computing to strengthen communities and build civic engagement. At scales from the local neighborhood, up to the nation as a whole, GVU and its partners are helping to solve some of the most complex and challenging societal problems that we face today.

A selection of past and current government and community partners that GVU works closely with:

Atlanta Bike Coalition
Atlanta Community Food Bank
Atlanta Regional Commission
Atlanta Streetcar
CARE
Carter Center
Center for Civic Innovation
Centers for Disease Control
Central Atlanta Progress
City of Atlanta
Cure Autism Now Foundation
Georgia Department of Education
High Museum of Art
Historic Westside Cultural Arts Council
iLab Liberia
Latin American Association
Marcus Autism Center
Midtown Alliance
NASA
USAID
U.S. Department of Health and Human Services
Veteran's Administration
WABE 90.1

GVU Advisory Board

GVU's industry advisory board provides guidance on strategic direction for the center. Some past and present advisory board members include:

Laurie Baird
Managing Director
You.i TV

Genevieve Bell
Director, Interaction and UX
Intel Corporation

Krishna Bharat, PhD CS 96
Principal Scientist
Google, Inc.

Kelly Braun, CS 84
Principal
Braun Gordon Research

Mary Czerwinski
Senior Researcher, Manager
Microsoft Research

Miguel Encarnaçao
Chief Innovation Officer
ACT, Inc.

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Shwetak Patel, PhD CS 08
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Alan Warren, Math/Physics 78
Director of Engineering
Google, Inc.

Terence West
Director, Research (Retired)
Steelcase, Inc.

Wayne Wooten, PhD CS 98
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Pixar Animation Studios

Jay Wright
Director, Corporate R&D
Qualcomm, Inc.

EMERITUS MEMBER
Andy Aftelak
VP, Advanced Research Center
Arris

Georgia Tech's wearable computing exhibit is a curation of more than 60 devices chronicling the history of on-body technology. It has been shown at various locations in North America, Europe, and Asia, including at the World Economic Forum. A special showing of the exhibit took place in 2015 at the Computer History Museum in Mountain View, California, where alumni gathered to help celebrate the College of Computing's 25th birthday.

Explore the virtual exhibit at **wcc.gatech.edu/exhibition**.

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