

2019

GVU ANNUAL REPORT





Message from the Director

The future is being invented at GVU. Our researchers are pushing the boundaries of interactive technology, and exploring how advances in technology are impacting our society in domains as diverse as health, education, entertainment, and civic engagement. By bringing together a multidisciplinary group of faculty and students spanning all six colleges at Georgia Tech the GVU Center provides a unique home for research that crosses the boundaries of traditional academic units.

These are exciting times for GVU, and for Georgia Tech. Our faculty and students' research continues to lead the world in many areas at the intersection of computing technology and the human experience. While the news highlights in this report give a sense of the technical excellence of the work going on at GVU, I am especially proud that so much of our portfolio also demonstrates a strong social relevance. This focus on technology grounded in social impact has been a hallmark of the GVU Center since it was founded 27 years ago.

Over the past year we have launched some exciting new initiatives designed to extend our research capabilities and move into new focus areas. This report details some of the significant seed funding investments we have made, alongside our campus partners, in new research directions. We have also made major investments in our lab capabilities, especially our Prototyping Lab, a unique makerspace available to GVU and the broader Georgia Tech community.

All in all, 2019 has been an outstanding year for the GVU Center and we're looking forward to continuing these successes in 2020. Please connect with us at gvu.gatech.edu.

Keith Edwards
Director, GVU Center

2019 Research and Engagement Grants

The GVU Center and Institute for People and Technology support research initiatives committed to building on interdisciplinary research and innovation in the human experience of computing. The GVU/IPaT Research and Engagement Grants are awarded annually, and these investments help create a path for external funding as the research prospers.

From #hashtags to Movements: Performance, Collective Narrative, and Erasure, a Black Feminist Perspective
Brooke Bosley and Susana Morris (Digital Media)

Workshop on Language, Technology, and Society
Lelia Glass (Modern Languages)

Getting Good: Using esports to inspire students in developing STEM skills

Laura Levy (IMTC), Andrew Partridge (GTRI), and Sean Mulvanity (GTRI)

Detecting and Measuring the Impact of Food Insecurity at Georgia Tech

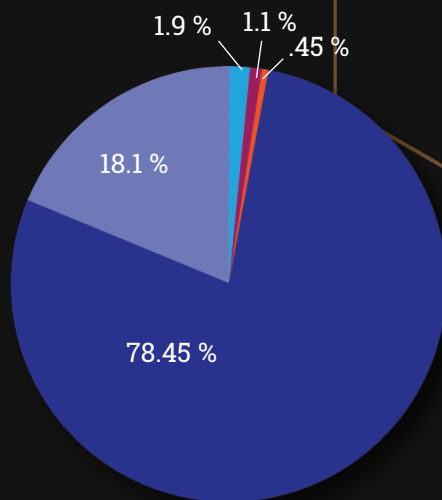
Jon Sanford (Industrial Design) and Thomas Ploetz (Interactive Computing)

Artificial Intelligence and Interactive Digital Entertainment

Anne Sullivan (Literature, Media, and Communication) and Mark Riedl (Interactive Computing)

Acoustic Sensor Deployment in the EcoCommons

Emily Weigel (Biological Sciences), Adam Beteul (Atlanta Audubon Society), David Anderson (ECE), and Matthew Swarts (GTRI)



2019 FINANCIAL REPORT

FY2019 EXPENDITURES

RESEARCH

Federal: \$7,911,213
Industry: \$1,830,965
State: \$111,460

OPERATIONS

Mixed: \$192,727

EXTERNAL RELATIONS

Mixed: \$45,813

Research: \$9,853,638

Total: \$10,092,178

Corporate Partners



Foley Scholars & GVU MASTER'S STUDENT AWARDS

'19

Congratulations Foley Scholars & GVU Distinguished Master's Student



Interdisciplinary research is part of the culture of the GVU Center. Ranging from creating cutting-edge computing innovations, to understanding the impacts that these innovations will have on our lives, the students in GVU represent the future of technology.

Scholarship Recipients



Lara Martin
Foley Scholar

Ph.D. student in human-centered computing and advised by Mark Riedl, researches interactive storytelling, the question of how computers can be made to understand, generate, and tell stories in a real-time interactive setting. Her thesis argues that computers will be better partners if they can understand and engage with people in narrative terms.



Emily Wall
Foley Scholar

Ph.D. student in computer science and advised by Alex Endert, conducts fundamental research in mitigating cognitive biases in visual analytics. The motivation for this research came from the realization that while many data-driven decisions rely on human expertise and reasoning to make sense of the data, analysts have the potential to introduce cognitive biases during interactive analysis.



Matthew Hong
Foley Scholar

Ph.D. student in human-centered computing and co-advised by Lauren Wilcox and Rosa Arriaga, has helped to bridge HCI and medical informatics through his work. He has developed extensive field studies to understand family management of adolescents' chronic conditions and created and tested novel co-design approaches to engaging patients, family members, and clinicians.



Emma Logevall
Distinguished Master's Student

MS-HCI student and advised by Ellen Zegura, has been a core member of an Institutional Transformation award under NSF's Cultivating Cultures for Ethical STEM program. She partnered with Ph.D. student Daniel Schiff to tackle the qualitative component of the project, creating interview guides and designing a research study that would allow the team to understand the student experience in ways beyond quantitative survey

Finalists



Eric Corbett
Foley Scholar



Ceara Byrne
Foley Scholar



Eshwar Chandrasekharan
Foley Scholar



Ari Schlesinger
Foley Scholar



Brianna Tomlinson
Foley Scholar



Alana Pendleton
Distinguished Master's Student



Yuhui Zhao
Distinguished Master's Student



Darsh Thakkar
Distinguished Master's Student

2019 GVV Annual Report

Computing research and advocacy takes on many forms in the GVV Center. In 2019, our researchers broke new ground in creating innovative interactive technology and pushing scientific frontiers. The GVV Center fosters an ethos of discovery and innovation that spans all six colleges at Georgia Tech. This snapshot of our community shows how this collaborative, interdisciplinary approach is transforming the future of technology.

Discover more at gvv.gatech.edu

AI Agent Breaks Down Social Barriers in Online Education



To directly address social barriers in online classes, an artificially intelligent system known as the Jill Watson Social Agent connects students quickly to their peers. It is being deployed in the institute's Online Master of Science in Computer Science program as well as two campus classes.

The social agent ultimately helps support students adapt more quickly to rigorous course requirements and foster a virtual community. The agent can immediately share results of class composition by percent of students based on location, timezone, other courses being taken, and primary interests, while maintaining student privacy.

Ida Camacho, OMSCS '19, is the lead engineer in the Design & Intelligence Lab for the Jill Social Agent.

Restoring Data's Sense of Place

Yanni Loukissas (LMC) is working to develop a design ethic that encourages a belief in the idea that "all data are local." He argues that data is just a starting point, "a way in" as he says. Loukissas set up the Atlanta Map Room to emphasize this point. A sliding overhead projector displays a map onto a large sheet of craft paper rolled out across a table. Participants interact with the map by using colored markers to trace the map contours or add data on topics of interest to them: from tax assessments, to traffic, to crime, to education.

In addition to the Map Room, Loukissas has created a data toolkit for Serve-Learn-Sustain designed to encourage students across campus to think about how they use data.



Yanni Loukissas in the Map Room

Georgia Tech's Newest AI System Explains Its Decisions to People in Real-Time to Understand User Preferences



Researchers have created an agent that can automatically generate natural language explanations in real-time to convey the motivations behind its actions. The "explanations" are designed to be relatable and inspire trust in those who might be in the workplace with AI machines or interact with them in social situations. A study was conducted to see if the AI agent could offer rationales that mimicked human responses. Spectators watched the AI agent play the videogame Frogger and then ranked on-screen rationales in order of how well each described the AI's game move. Participants preferred the human-generated rationales first, but the AI-generated responses were a close second.

Computer Science Ph.D. student **Upol Ehsan** in the Entertainment Intelligence Lab led the work.

AI 'Performers' Take Center Stage and Get Creative with People in Public Spaces

Researchers are seeking to improve “artificial intelligence literacy” and give people opportunities to engage directly with AI systems in order to understand the potential and capabilities of the technology. The Expressive Machinery Lab has developed exhibitions where AI agents are front-and-center and people are able to create with them in public spaces. These AIs have included a dance partner, visual storyteller, music maker, and comedic improv performer.

Exhibitions involving live interactions between people and AIs were developed over several years and the result is a design blueprint that shows how to build AI experiences for public spaces where audiences or performers can create with an AI partner.

Human-Centered Computing Ph.D. student **Duri Long** is the primary researcher on the work.



Duri Long with advisor Brian Magerko

Robot Uses Near-Infrared Light to Instantly Identify Household Materials



Robot Classifies Materials of Household Objects Using 'Light-Reading' Device

Researchers have devised a way future domestic bots might recognize materials around the home. Using near-infrared light, similar to what's used in TV remotes, the robot can identify common materials used in household objects to better inform its actions. This might allow mobile machines, for example, to ensure that the right bowl makes it into the microwave.

Researchers first determined hundreds of light wavelengths reflected from five common materials – paper, wood, plastic, metal, and fabric – then trained a neural network on 10,000 examples in order to create a machine-learning model that could be used to quickly identify a material. The robot would not have to come into contact with objects to identify them.

Robotics Ph.D. student **Zackory Erickson**, in the Healthcare Robotics Lab, led the work.

Adriana Alvarado Garcia Selected as UN Global Data Fellow

Digital Media Ph.D. student **Adriana Alvarado Garcia** attended the inaugural workshop of the United Nations (UN) Global Pulse Data Fellows initiative in 2019 and was selected to join the first cohort of the UN Data Fellows, who work to promote awareness of the opportunities big data presents for sustainable development and humanitarian action.

The Data Fellows initiative began with an exercise where Ph.D. candidates with specific expertise in AI, data science, computational social science or data and design are matched to work with one of 40 UN departments on a specific subject area. Alvarado was chosen to work with the Accelerator Labs, a project of the United Nations Development Programme (UNDP) designed with the goal of becoming the world's largest and fastest learning network around development challenges.



Alyssa Rumsey with advisor Christopher Le Dantec

Firefighters Have Mixed Response to Wearable Tech for Emergency Work

A new study shows how advanced computing tech worn by firefighters impacts the nature of work for emergency responders, and how front-line firefighters and their commanders view its usefulness. The wrist-worn device allowed managers to identify personnel who were pushing too hard and those who weren't pushing hard enough based on heart rate spikes and overall activity during fire exercises.

Digital Media Ph.D. student **Alyssa Rumsey** found that the device clashed with some firefighters' sense of identity, one that valued getting the job done and putting the safety of others above their own. The device was viewed favorably in training as a way to improve physical fitness, reduce obesity, and generate comradery, but some participants rejected the idea of using the wearable tech in a real emergency fire.

FairVis is Helping Data Scientists Discover Societal Biases in their Machine Learning Models

Researchers have developed a data visualization system called FairVis that can help data scientists discover bias in machine learning algorithms by identifying and comparing different populations in their data sets.

Fairvis can group similar items together in the training data set, calculate various performance metrics like accuracy, and then show users which groups of people the algorithm may be biased against. A second technique uses statistical divergence to measure the distance between subgroups to allow users to compare similar groups and find larger patterns of bias. Fairvis is designed to specifically discover and show intersectional bias, bias that is found when looking at populations defined by multiple features.

Alex Cabrera, CS '19, is the primary investigator, and worked with **Polo Chau** (CSE).



IC Researchers Seek to Improve Treatment for Schizophrenia Under New \$2.7 Million NIMH Grant

Munmun De Choudhury (IC) is pursuing research that gathers insights about mental health through digital traces individuals leave behind on social media. Under a new \$2.7 million grant from the National Institutes of Mental Health she and collaborators will work to improve mental health treatments. It is one of the first opportunities for computing researchers and psychiatry experts to work together to influence how treatment can be delivered harnessing patient-contributed data.

The idea will be to build machine learning algorithms based on data that patients share with clinicians at Northwell Health and De Choudhury's Social Dynamics & Wellbeing Lab. They hope to identify different risk markers and symptom changes that appear in social media posts to identify changes and trends in an individual over time.

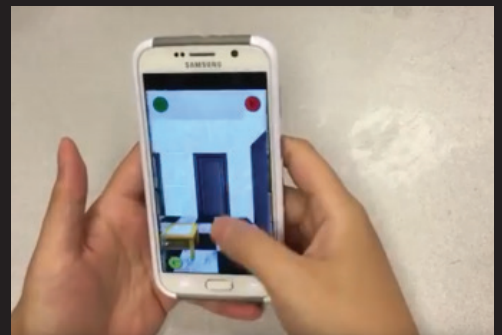


Keep Forgetting Your Password? Try This Novel Virtual Authentication Technique



Sauvik Das (IC) and his SPUD Lab are using an old memory technique coupled with technology to offer users a more effective authentication method for recovering lost passwords. Known as the "Memory Palace," the new tool is a three-dimensional virtual labyrinth navigated in the first-person perspective.

Users create their own personal path with multiple left or right turns through a maze, similar to the one found in the old Windows three-dimensional labyrinth screensaver. If they navigate it correctly the next time they have to log in to an account, they gain access. Voila. No more keeping up with pet names + special character + number.



AIs and Humans Become 'Creative Equals' with New Design Tool

Researchers created software with a built-in AI agent that works alongside human designers in real-time to create game levels. The software, dubbed MorAI Maker in a nod to Nintendo's game Mario Maker, uses new machine learning techniques for game content generation that allows humans and an AI agent to work in a turn-based fashion on the same digital canvas.

Matthew Guzdial, CS Ph.D. '19, observed four major categories of roles that people assigned their AI partner: Some participants viewed the AI as a friend. Others wanted an equal design partner (collaborator), and some seemed to expect the AI to adhere to their specific design beliefs or instructions (student). Game designers also followed the AI's lead or expected to be evaluated on their design (manager).

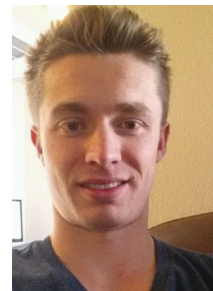


ML Helps Wearable Devices Get Better at Diagnosing Sleep Disorders and Quality

Wearable devices offer cost-effective sleeping monitoring, but the data can be inaccurate or imprecise due to electrical ambient noise that is emitted by other devices, such as a TV or washing machine.

Researchers have employed adversarial training in tandem with spectral regularization to filter out the ambient “electrical noise” and accurately assess sleep stages even when an EEG signal is corrupted. The machine learning model can also compress the amount of time it takes to gather and analyze data, as well as increase energy efficiency of the wearable device.

Machine Learning Ph.D. student **Scott Freitas** and Computer Science Ph.D. student **Rahul Duggal**, both advised by **Polo Chau**, co-led the research.



Startup Connects Job Seekers with Autism to New Opportunities

Applying for jobs can be one of the biggest challenges for people with autism, one that a new mobile app, Mentra, is designed to address. The app pairs autistic people with others not on the spectrum to help them navigate the job hunt. Once the algorithm matches a team, they can meet and develop a mentorship together.

Computational media student **Jhillika Kumar**, the app’s developer, worked with **Gregory Abowd** (IC) to better understand an approach to helping those with autism. One of the main problems people with autism face isn’t a lack of technology, but that there often aren’t enough people willing to help. Kumar decided her role would be to connect people through mobile technology, which she saw greatly helped her autistic brother in his ability to socialize.

New \$1.2 Million NSF Grant Aims to Improve Treatment for PTSD Patients



A four-year, \$1.2 million grant from the National Science Foundation will help fund the development of a computational assessment toolkit for post-traumatic stress disorder patients and clinicians, called PE Collective Sensing System (PECSS). PECSS, which will sit atop the PE Coach App developed by the Veterans Health Administration and the Department of Defense, will aim to improve current treatment practices and increase the number of veterans who seek treatment.

“PECSS will allow clinicians to use automated predictions to deliver better therapeutic treatment and individualized feedback, and patients to better understand the progress they are making and how to improve their exposure exercises,” says **Rosa Arriaga** (IC), the principal investigator on the project.

Lab Built Tech Square’s Coda in the Digital World Years Ahead of Real Building

Researchers in the IMAGINE Lab were able to use their expertise in digital imaging, 3D modeling, and augmented reality technologies to create Tech Square in a digital model that included the Coda Building in its earliest concept. The building opened in 2019, but was visualized years earlier in an augmented reality app on mobile devices that allowed users to point the screens at a 2D physical map of Tech Square and watch a 3D model of the space come to life on the screen. Users could tap the screen to start with a 20-story building and tap twice more to end up with a structure twice the height (Coda eventually ended up with 21 levels).

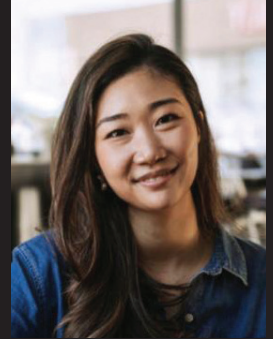
Miro Malesevic, digital designer at the IMAGINE Lab, helped lead the effort.



Early Coda Concept in Augmented Reality

Jill Watson Now Fielding Questions on New AI-enabled Research Tool

A new artificially intelligent (AI) research tool that harnesses the power of the Smithsonian Institution's massive Encyclopedia of Life (EOL) ecological database debuted in 2019 at Georgia Tech. The virtual ecological research assistant, known as VERA, was developed at Georgia Tech and enables students to perform virtual experiments to explain existing ecological systems or to predict possible outcomes based on variables they input into the tool.



Sungeun An - Human-Centered Computing Ph.D. Student

Getting to Know VERA

"People using VERA have access to the EOL and can test a hypothesis using countless organisms, make as many changes to variables as they want, and study the effects on any ecosystem through real-time modeling," said Sungeun An, human-centered computing Ph.D. student and lead developer of the AI system. "This is a unique opportunity that doesn't exist anywhere else."

Although the EOL has extensive data entries for more than two million species, An says that VERA has an intuitive user interface and design that is relatively easy to use.

"Students don't need extensive scientific knowledge or programming and math skills to use VERA. They can build a conceptual model with simple visual cues on the computer screen, such as dragging elements or selecting input options," said An.

Combining the Strength of Two AIs

However, to get the most out of VERA, An says there can be a learning curve. To flatten the curve and help students optimize their experience with VERA, An and her fellow researchers turned to Jill Watson, the famed AI-enabled virtual teaching assistant (TA) that premiered in 2016 supporting Georgia Tech's online Master of Science in Computer Science (OMSCS) program.

Jill Watson answers student questions about VERA via the collaborative messaging app, Slack. These range from technical questions about the tool – "How do I add a new project" – to subject matter questions – "What is consumption rate?"

"Leveraging the Jill Watson virtual TA and VERA together is a powerful demonstration of how to scale technology to serve more populations and provide access to the world's scientific knowledge," said Ashok Goel, professor of Interactive Computing and director of the Design & Intelligence Lab, which created both AI agents. Combining the strength of the two AI agents, said Goel, is part of an intentional approach to rethinking instructional design for online learning.

"VERA is a significant advancement for artificial intelligence in science education and meant to be used anywhere by anyone interested in science exploration, so making it as accessible as possible is key to the system's adoption," Goel said.

Students and others using VERA – it's also publicly available and linked on the Smithsonian's EOL homepage – can learn more through a video series produced by Georgia Tech. The videos demonstrate VERA's capabilities using kudzu growth in the southeastern United States as an example. The videos are co-hosted by Emily Weigel, School of Biological Sciences instructor for the biology course using VERA, and College of Computing faculty member Spencer Rugaber. VERA research is funded by a grant from the National Science Foundation, #NSF-1636848.

