GEORGIA INSTITUTE OF TECHNOLOGY

INDUSTRIAL AND SYSTEMS ENGINEERING

FALL 2021

THE H. MILTON STEWART SCHOOL
ALUMNI MAGAZINE

Divya Pinnaka: The Mindset of an Entrepreneur

Reframe: Building Healthier Drinking Habits

Inspirit: Gaming Meets Education

ISYE:

DEVELOPING THE ENTREPRENEURIAL SPIRIT

Aerodyme Technologies: Engineering Trucking Efficiency

Gatherly: A Platform for Better Digital Engagement

Antigua Cerveza: Brewing Craft Beer in Guatemala

On behalf of all of us at the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), I am delighted to share the latest issue of the ISyE alumni magazine with you.

Even though the United States unfortunately remains in the grip of the Covid-19 pandemic, ISyE continues to find ways to excel. The entrepreneurial spirit, in particular, is alive and well at Georgia Tech, and our students enjoy exploring the many tools provided by the Institute to develop startups. As you will read in this year's magazine, some ISyE undergraduates originate companies in conjunction with their studies, while others begin their startups as alumni. These include revolutionary apps such as Reframe, designed to help curb alcohol cravings, and Inspirit, which uses 3D interactive models to reshape STEM education. We also feature innovative businesses using ISyE tools in a more traditional sense, such as engineering trucking efficiency and installing and optimizing home technology systems.

ISyE has maintained our top program rankings, which speak to the commitment of our world-class faculty and the amazing graduates we produce. However, in addition to our focus on academic excellence, we must also foster a diverse community where everyone is seen and valued. To achieve this, ISyE launched the Center for Academics, Success, and Equity (CASE) this fall, the first school-level center of its kind at Georgia Tech. In addition to supporting our existing community, CASE will work to increase the minority and female student pipeline, improving diversity within the School and its programs.

This year, ISyE also expanded its K-12 outreach efforts by significantly increasing the number of high school students participating in the Seth Bonder Camp in Computational and Data Science for Engineering. The camp was presented in five different versions, two of which were offered solely to students attending minority-serving and rural high schools. With this new foundation, the team plans to further expand the camp in the coming years.

Our faculty continue to focus their research on topics that will transform entire industries. In this issue, you will read about significant collaborations that include the future of autonomous trucking and composite materials manufacturing for the aerospace industry. We also cover projects related to the pandemic and the tools created to help move toward recovery.

Alumni involvement and philanthropy are key components to our success, and this issue highlights the impacts made through the generosity of our graduates. Many successful alumni volunteered their time this past year to mentor current students as part of the new MentIEs program, which made a significant difference in the lives of both the students and the mentors. We also include a section on recent fellowships awarded to our students, who are direct beneficiaries of alumni philanthropy. If you are interested in learning more about these programs, or the many other opportunities available to connect with the School, please reach out. I hope you enjoy this year's alumni magazine, and please stay in touch.

Take care and be well.

Edwin

H. Edwin Romeijn, Ph.D.

H. Milton and Carolyn J. Stewart
School Chair and Professor

H. Milton Stewart School of Industrial
and Systems Engineering

Georgia Tech

The *Industrial and Systems Engineering* alumni magazine is published annually by the H. Milton Stewart School of Industrial and Systems Engineering at the Georgia Institute of Technology.

Vol. 14, No. 1 • Fall 2021

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FEATURE STORIES

10 ISyE: Developing the Entrepreneurial Spirit

ISYE NEWS AND ADDITIONAL FEATURES

ISyE by the numbers

Rankings

ISyE is the No. 1 program of its kind, as ranked by *U.S. News & World Report.*

31 Number of consecutive years the ISyE graduate program has been ranked No. 1

27 Number of consecutive years the ISyE undergraduate program has been ranked No. 1

Degrees Offered

1 B.S. in IE Degree

WITH 7 CONCENTRATIONS IN:

- Advanced Studies in Operations Research and Statistics
- Analytics and Data Science
- Economic and Financial Systems
- General Industrial Engineering
- Operations Research
- Quality and Statistics
- Supply Chain Engineering

9 Master's Degrees

SPECIALTY MASTER'S DEGREES:

- Master of Science in Analytics
- Master of Science in Health Systems
- Master of Science in Quantitative and Computational Finance
- Master of Science in Supply Chain Engineering
- Master of Science in Urban Analytics

GENERAL MASTER'S DEGREES:

- Master of Science in Computational Science and Engineering
- Master of Science in Industrial Engineering
- Master of Science in Operations Research
- Master of Science in Statistics

ONLINE MASTER'S DEGREE:

- Online Master of Science in Analytics*

**Same degree as on-campus program*

6 Doctoral Degrees

- Industrial Engineering with specializations in:
  - Economic Decision Analysis
  - Statistics
  - Supply Chain Engineering
  - System Informatics and Control
- Algorithms, Combinatorics, and Optimization
- Bioinformatics
- Computational Science and Engineering
- Machine Learning
- Operations Research

Fall 2021

Enrollment

Undergraduates: **1,347***

Master's: **387** on campus

5,350 online/video

Doctoral: **193**

**Includes co-op and study abroad students*

Faculty

61 tenured/tenure-track faculty

5 academic professionals

4 research faculty

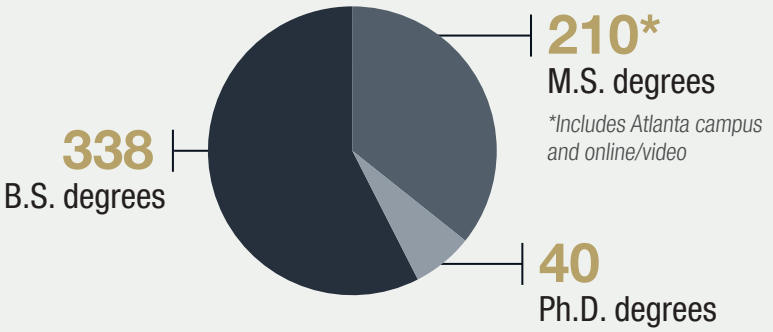
1 professor of the practice

4 lecturers

Academic Year 2020-21

588

ISyE Degrees Awarded



For undergraduates:

- **71** participated in undergraduate research
- **150** participated in an internship
- **120** participated in a co-op
- **15** participated in the Denning Technology & Management Program
- **22** were Stamps President's Scholars

Of the 338 B.S. IE degree recipients in 2020-21:

- **78%** graduated with honors
- **12%** graduated with a co-op designation
- **44%** were female
- **$74,000** was the median starting salary

The Seth Bonder Camp Expands Reach and Representation

The Seth Bonder Camp in Computational and Data Science for Engineering is a five-day summer program for high school students. The camp is supported by the generous gifts of the Seth Bonder Foundation and is led by Pascal Van Hentenryck, A. Russell Chandler III Chair and professor in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE). Like last year, the camp was held online due to Covid-19, but Van Hentenryck leveraged the virtual format to significantly increase the number of students reached, especially among underrepresented minorities.

The camp's curriculum featured several modules that were offered in four levels ranging from basic to advanced. The first module offered an introduction to the visual programming language Snap! and was followed by units in more advanced programming, as well as computational data science, optimization, machine learning, and computational biology.

Van Hentenryck used a Marvel theme for the course material, which included a movie trailer-style introduction and the Avengers theme song as an intro to each lecture; he even wore a Nick Fury costume while teaching. "The students become superheroes by learning how to code," he explained.

Thanks to the flexibility of the online format, the program expanded to include five different versions of the camp. Two were open specifically to students attending minority and rural high schools — one with Booker T. Washington High School in Atlanta and a high school in Puerto Rico, and one with Banneker High School in Fulton County and Savannah High School.

Two other camps were offered in collaboration with Kids Teach Tech, a nonprofit founded by Arjun Mulchandani, a student from California passionate about teaching other kids how to code. His team encompasses a community of children who create and teach programming classes to their peers, both in person and online — reaching youth not only across the United States but also internationally.

"The Seth Bonder Camp was a great experience because it showed me how useful and rewarding ISyE can be. I grew more interested in the power of using data to make informed decisions, especially with computer programming."

NEIL BARRY

The first camp, exclusively for students from Kids Teach Tech, prepared them to deliver the material themselves. In the following camp session, those same students hosted their own Seth Bonder Camp in conjunction with the Georgia Tech team, UC Berkeley Engineering, and the Urban League of Greater San Francisco Bay Area. The camp was a huge success, and over 80% of the attendees were underrepresented students.

"The partnership with Kids Teach Tech enabled us to reach students in California and leverage the existing ecosystem there, indicating that the Seth Bonder Camp model is replicable and can grow organically," said Van Hentenryck.

The final Seth Bonder Camp was open to all high school students. Total enrollment across all five camps reached 150 students, a huge leap from previous years that averaged 20-30 participants. To help with the camp, Van Hentenryck has a team of postdocs, Ph.D. students, and undergraduate students who serve as teaching assistants and are supported by Seth Bonder Fellowships.

The camp has already inspired high schoolers to pursue engineering. Neil Barry, who attended the camp in 2019, is now a second-year ISyE student conducting research with Van Hentenryck. "The Seth Bonder Camp was a great experience because it showed me how useful and rewarding ISyE can be," said Barry. "I grew more interested in the power of using data to make informed decisions, especially with computer programming. Professor Van Hentenryck was engaging as a teacher and is helpful as a research advisor."

Next year, Van Hentenryck wants to transform the Seth Bonder Camp into a longitudinal program that offers increasingly sophisticated camps organized by secondary school grade. He is also working on offering the camp throughout the school year and says that partnering with high schools and organizations like Kids Teach Tech is key to the future success of the camp. ▪ GRACE OBERST

To learn more about the Seth Bonder Camp in Computational and Data Science for Engineering and to partner with the camp, visit sethbondercamp.isye.gatech.edu.

ISyE Launches Center for Academics, Success, and Equity

Damon P. Williams (IE 2002) is a senior lecturer in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) and has won numerous teaching awards since he joined ISyE as a faculty member in 2012. A charismatic and demanding professor, Williams has a unique perspective stemming from his own years of walking ISyE's halls as an undergraduate. He is passionate about enhancing the student experience and has created a variety of programs to support students, including at-risk advising and the ISyE tutoring center, to name a few. In Fall 2021, the Stewart School brought together many of Williams' programs within the newly launched Center for Academics, Success, and Equity (CASE), an interdisciplinary center designed to encourage academic growth, professional development, and inclusivity for all of ISyE's constituents.

ISyE is the largest program of its kind in the nation, which contributes to its long-standing No. 1 ranking. Its size also provides countless resources to its students, faculty, alumni, and staff, such as academic and industry collaborations, networking opportunities, diverse career opportunities, and access to cutting-edge research. However, given its numerous programs, some of the School's 6,000 students find navigating the curriculum difficult.

"We created the Center to foster connection and interaction," said Williams, who also serves as CASE's director. "There are so many points at which our various groups need to interact with each other, so we really wanted to build community — with this great push that Georgia Tech has for diversity, equity, and inclusion — while supporting students academically and professionally, and bring all our programs together into one place."

Damon P. Williams

On the academic side, CASE provides student support through its tutoring center and risk advising program. "All students, including those who are struggling academically, should have a great college experience," Williams said. "While they may not be in the top 10% of their class, it doesn't mean they can't get a good education, have a successful career, and feel supported and connected during their time at the Institute."

But what really sets CASE apart from other centers on campus is its focus on success and equity, in addition to academics. For students, this includes professional development opportunities and workshops to prepare

> "All students should have a great college experience. While they may not be in the top 10% of their class, it doesn't mean they can't get a good education, have a successful career, and feel supported and connected during their time at the Institute."
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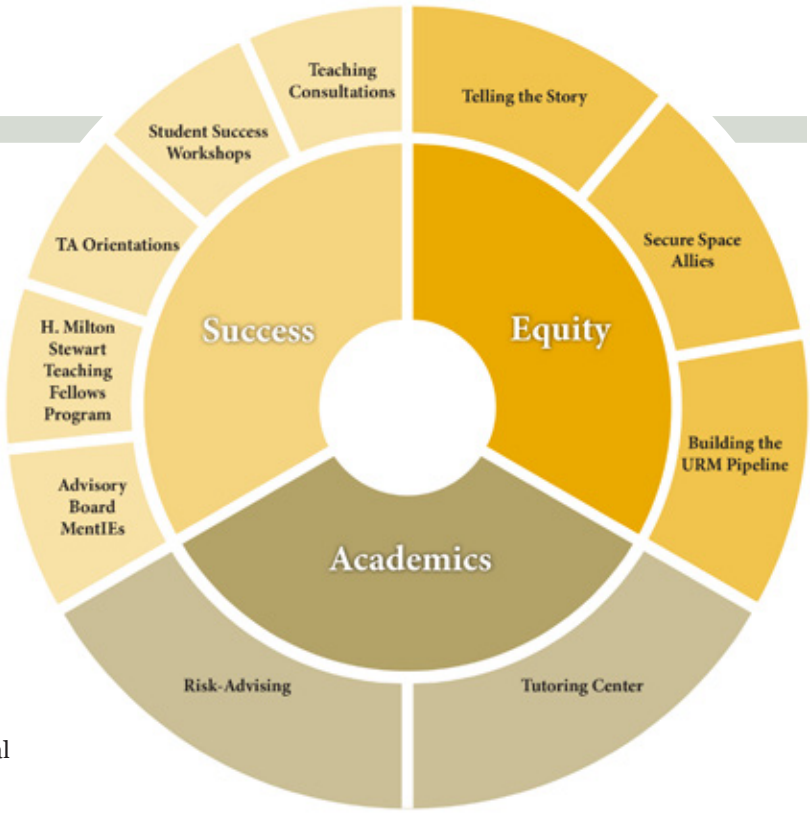
> DAMON P. WILLIAMS



CASE was created to support the entire ISyE community through a variety of programs and equity initiatives.

them for the job market. There are currently two student success workshops each year, and Williams hopes to expand this to a total of six in the 2021-22 academic year.

"Our students want more," said Williams. "They want to learn how to successfully complete a case interview to get into consulting after graduation. So we have sessions scheduled with representatives from top consulting firms to run mock case interviews and guide them on the process. But students also want to improve their soft skills and learn how to network. We're going to add additional sessions to provide them with these tools as well."

The Center also launched MentIEs, a mentoring program that pairs ISyE alumni with current students to provide real-world insight and advice complementing students' academic experience. The pilot program launched in Spring 2021 with 20 mentors and 60 mentees and was a resounding success. Williams and his team plan to double those numbers this year and beyond. *[Read more about MentIEs on page 8.]*

CASE's equity initiatives include several activities promoting equality in ISyE while providing the most vulnerable students with sanctuary and the chance to be heard. The team is also working to increase the minority and female student pipeline and improve diversity within the School and its programs.

"We're working hard to develop relationships with top-tier academic institutions across the country to help identify high-quality potential graduate students or future faculty who are underrepresented minorities or women," said Williams. "We want to make sure they know about our programs and know when we have open faculty positions so we can get those applications up."

While CASE is in its inaugural year, Williams has big plans for the future.

"My goal is that within five years, every single member of our community — faculty, staff, students, and alumni — is touched in an academic year by something that CASE does," Williams said. "And I want everyone in the ISyE network to quintuple individual networks with members of the other groups."

> "I want us to not only be the No. 1 academic industrial engineering department in the nation, but also the No. 1 industrial engineering community in the nation."
>
> DAMON P. WILLIAMS

"I want us to not only be the No. 1 academic industrial engineering department in the nation, but also the No. 1 industrial engineering community in the nation," he added.

These are lofty goals, but if you have ever personally met Williams, you know he will most certainly make them happen. ▪ LAURIE HAIGH

New MentIEs Program Connects ISyE Undergraduates and Alumni

Thanks to the world-class education they receive as students in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), many graduates have successful careers in consulting and industry. Because of this real-world experience, ISyE alumni can provide practical insights to current students about best practices for workplace professionalism and mastering teamwork, and many of them are eager to engage with the next generation of industrial engineers.

"Students who want to have a career outside academia need to learn from people who have been there and know how it is done," said Damon P. Williams (IE 2002), senior lecturer and director of ISyE's Center for Academics, Success, and Equity (CASE).

Members of the ISyE Advisory Board also recognized this need and offered to mentor students to help them transition from college coursework and internships into their careers. Thus, with support from School Chair Edwin Romeijn, ISyE launched MentIEs in January 2021 — a program designed to connect current students with alumni mentors.

"Our alumni have experiences to share and the passion to give back to our students," Williams said. "They can teach their mentees how to exceed expectations, be on a team, and contribute to workplace culture, because they have done it themselves."

ISyE piloted MentIEs with 20 members of its advisory board. Each mentor was paired with three undergraduate protégés for the spring semester, with the program's curriculum structured around skills discussed in Stephen R. Covey's *The 7 Habits of Highly Effective People*.

John White (IE 1992) served as a mentor during the pilot and is the retired president and chief executive officer of Fortna Inc., a leading provider of supply chain solutions.

"I've personally seen and experienced the positive impact and the power of receiving coaching from professionals that came before me," White said. "Their taking a personal interest in me had a huge impact, and I know that without them, I would not have been able to achieve a number of milestones in my career. I feel that I owe it to my mentors, and the young professionals that I mentor, to do my best to help them achieve their full potential."

John White

Groups are asked to meet monthly for one hour during the program, but White met with some of his mentees individually as well while they were navigating their last semester at Tech. He said the relationships he made with these young professionals have continued beyond the official program, and he enjoys seeing them rise to their potential, which helps keep ISyE and its graduates at the top.

"The MentIEs program offers another way for young professionals to leapfrog their peers from other universities and gain insights that they most likely would not get otherwise until they have their own experiences," White added.

White also believes mentors learn from their mentees.

"There are many situations in which I feel that I am the one benefiting from the mentor/mentee relationship, as I continue to learn and gain perspectives and insights from my mentees. It is an incredibly rewarding and mutually beneficial relationship," he reflected.

Because the program began during the Covid-19 pandemic, most MentIEs meetings were held virtually. Now that many of these restrictions have been lifted, the CASE team is also offering in-person events to enhance the networking experience.

Even with the challenges of the Spring 2021 semester, the MentIEs pilot was a resounding success. "Given the overwhelmingly positive feedback we received, we are going to double, if not triple, the number of mentor/mentee connections in 2021-22," said Williams. ▪ LAURIE HAIGH

If you are interested in becoming a mentor for the MentIEs program, contact Damon P. Williams at damon.williams@isye.gatech.edu.

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ISYE: DEVELOPING THE ENTREPRENEURIAL SPIRIT

GEORGIA TECH AND THE CITY OF ATLANTA provide a thriving and innovative ecosystem for budding entrepreneurs. The Institute offers countless ways to create and grow ventures, including such programs as VentureLab and CREATE-X, and many students in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) take advantage of these opportunities. From Aerodyme Technologies, which grew out of a Senior Design project, to virtual meeting app Gatherly, which was created in response to the pandemic, to Antigua Cerveza, which is Guatemala's third craft brewery, our entrepreneurs have taken the opportunity to innovatively apply their skills to real-world situations.

Aerodyme Technologies: Engineering Trucking Efficiency

Joy Bullington

The team behind Aerodyme Technology's FreightFin — a device attached to the back of tractor-trailers to minimize aerodynamic drag and decrease fuel consumption — is no stranger to success. Both the product and the startup grew out of a Senior Design project, led by Tyler Boone (ME 2019), that won the Spring 2019 Capstone Expo prize for the best mechanical engineering project.

After he graduated, Boone, along with Joy Bullington (IE 2020), continued to develop the product. Together with married couple Jayce Delker (ME 2019) and Victoria Delker (PP 2018), they cofounded Aerodyme. Boone provides the technical expertise while Bullington, as the startup's COO, provides the acumen from her ISyE training in how to manufacture a product and scale up a business.

The team participated in the Summer 2019 CREATE-X Startup Launch program, where they conducted customer discovery and received funding to take the product to market. The team next placed second in the 12th annual Georgia Tech InVenture Prize competition in March 2020. At the end of 2020, Bullington and Boone won the TiE University Pitch Competition when Aerodyme placed first out of 13 teams from around the world.

After multiple iterations and pilot testing with a small trucking company in Covington, Georgia, FreightFin is ready to bring to market. It provides a 4.8% increase in fuel economy, though the team is aiming for a full 5%. Because the attachment decreases fuel consumption, each truck emits less carbon into the atmosphere. What truly separates FreightFin from similar products is that the attachment automatically unfolds and folds based on a truck's speed.

The company currently has a patent pending for FreightFin.

"The work of our entire team has been the reason for our success so far," Bullington reflected. "We are eager to see where Aerodyme goes next." ▪ SHELLEY WUNDER-SMITH

Jorge Guzman, Cofounder of Craft Brewery Antigua Cerveza, on His Entrepreneurial Journey

Growing up in Guatemala, Jorge Guzman (IE 2009) was always aware of Georgia Tech's excellent academic reputation and dreamed of someday studying at the Institute. This desire was cemented when, at age 11, Guzman flew to London on a family trip and had a conversation with the businessman seated next to him: Ivan Ochoa, then a vice president for American Express, who had earned a degree from ISyE in 1980.

"There was this allure about it," Guzman recalled. "This was someone who had actually gone to the school I imagined myself attending, and he had gotten a degree in the major I was most interested in."

Guzman eventually made his own way to Georgia Tech, received his bachelor's degree from ISyE, and began his professional career — as so many ISyE graduates do — as a banker and consultant. A few years later, he began thinking about starting his own business back in Guatemala. Together with fellow ISyE graduates Taylor Virgil (IE 2009) and Jack Spehn (IE 2010), Guzman opened the first craft brewery, Antigua Cerveza, in the Guatemalan colonial city of Antigua in 2015. He discusses this experience in the following interview.

DID YOU HAVE ANY EXPOSURE TO ENTREPRENEURSHIP WHILE GROWING UP? Both of my parents are entrepreneurs. My dad runs a Spanish school located in Antigua's town center. Tourists come to visit, take language classes for a few days or weeks, and then go out to explore the surrounding area. My mom is a ceramics artist, and she began giving lessons on how to make and paint ceramics.

That led to opening a small business selling her work to tourists, and then eventually supplying

her pieces to the Guatemalan equivalent of Bed Bath & Beyond. Now she's exporting ceramic tiles to the United States and Europe.

HOW DID YOU DECIDE TO OPEN YOUR OWN BUSINESS? After graduating from Georgia Tech, I worked as an investment banker for several years. Part of what was great about that experience was getting to talk with so many company founders about how they got their start and what they had learned in the process. I was literally making notes about all this as part of my job, and eventually I had enough enthusiasm and motivation to take that step myself.

I spent some time talking about various business ideas with my friends and fellow ISyE alumni, Taylor and Jack, with whom I had studied abroad and still traveled with. Initially we thought we might start a travel business and headquarter it in Guatemala. That's where I'm from, of course, but they had also visited and loved the country. We were sitting in a brewpub in Portland, Oregon, having a freshly poured Mirror Pond Pale Ale from Deschutes Brewery, when I spontaneously asked, "What if instead we start a craft brewery?" Taylor said, "I love it, but what do you know about beer — besides drinking it?"

WHAT WAS THE PROCESS OF EDUCATING YOURSELF ABOUT BREWING BEER? I began reading as many books about brewing as

I could find, and I attended a one-week intensive on the subject at the University of California, Davis. The weekend after I flew back from that, I randomly happened to meet and play pool with the head brewer of an Atlanta brewery — I never play pool! — and he invited me to come take a look at his brewing setup. I eventually started working at Jailhouse Brewing Company (unsalaried) and began to learn that there's a real science behind brewing quality and tasty beer. So much goes into the moment when someone cracks open a beer to make it a fantastic experience for the drinker.

ON THE TOPIC OF CREATING BEERS, WHAT DOES ANTIGUA CERVEZA OFFER ITS CUSTOMERS? We barrel-age some beers. We have an American-style amber, an India pale ale (IPA), and a stout, among others. We recently won the gold medal in a local competition for our saison.

Some breweries hone in on one particular style, such as sours or IPAs, but we don't do that. We serve a little bit of everything, and that's because we're trying to educate our customers that there are, in fact, different types of beer out there. Although it's not yet the industry in Guatemala that it is in the States, craft beer is becoming more popular here. We've been able to double our sales year over year since we started.

HOW DID YOUR ISYE TRAINING, AS WELL AS THE FRIENDSHIPS YOU MADE AT GEORGIA TECH, CONTRIBUTE TO STARTING AND RUNNING YOUR OWN BUSINESS? I can't overstate how impactful it was to graduate from ISyE and Georgia Tech. Out of 33 investors in Antigua Cerveza, about 15 of them are Tech alumni, and I went to school with seven or eight of those people. We would study together for an exam and then go have a beer afterward, and they're the ones who have trusted me with their investment. You get close to the people who experience Tech's challenges alongside you.

WHAT HAS THE PAST YEAR BEEN LIKE IN TERMS OF MANAGING YOUR BUSINESS DURING A PANDEMIC? We managed to grow a business year over year and have now survived Guatemala's multiple countrywide lockdowns because of Covid-19 by deciding to double down on the business instead of scaling back. We built a beer garden in Antigua's town center so people could come have a beer in the open air, and by December 2020 we were able to bring back most of our employees at full salary. It was risky, but it was the right move.

WHAT ENTREPRENEURIAL ADVICE DO YOU HAVE FOR CURRENT ISYE STUDENTS OR YOUNG ALUMNI? The best advice I can offer is to make sure you choose your partners right. I've seen so many friends start companies without really knowing the other people with whom they're going into business. It's a kind of marriage: If things get dicey — because with startups they will — you need to know that you're in there with someone who understands and supports you and who can help you solve problems.

I have been incredibly lucky to have Taylor and Jack as my two business partners. Their strengths are where I'm weak, and vice versa. And here we are, almost nine full years from that moment in Portland — we're still here, and we're so excited about what the future holds. ▪ SHELLEY WUNDER-SMITH

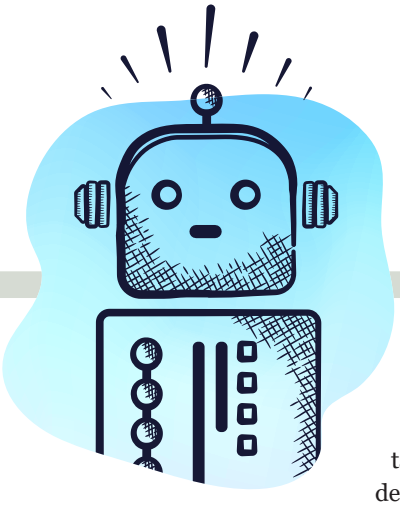
Self-Taught Entrepreneur Aaron Brown Transforms His Vintage Toy Company's Operations as an Industrial Engineer

Fifth-year Aaron Brown was only in second grade when he first founded Tin Toy Arcade (TTA), an online business that sells vintage-style toys. He steadily built the company, developing his own database and acquiring a warehouse as the operations grew too big for his childhood home. After attending a high school summer camp at ISyE, he realized industrial engineering was the perfect path to help him continue to build TTA.

By the time Brown arrived at Georgia Tech, most of the work for TTA was already automated. As a result, he could focus on high-level management while

continuing to refine the supply chain system. Brown credits his continuous improvements to TTA to the skills he has learned in his academic studies and appreciates his perspective of having real-life experience with applications of systems theories.

"It's really cool to see when it starts to click in my mind," said Brown. "I took some supply chain concentration classes — warehousing design, flow layouts, value-stream mapping — things I wouldn't have known how to do on my own. Maybe it's the right sequence of events for me to have experienced the hard way of doing everything manually because I now understand the system better."



Brown's most notable improvement was shifting from an exclusively pick-by-order system to one that includes a pick-by-item process. Previously, workers would bin products based on order. Now, to address sudden popularity spikes, they pick by item when those products' sales volumes exceed a certain threshold for the given day. The new process has resulted in tremendous overall time savings.

Tapping into the marketing side of the business, Brown created a new website for TTA — a modern upgrade to the original, more archaic design that no longer fit with current trends. Analyzing buyer trends helped him realize the increasing importance of advertising campaigns that use the right media and keywords to fully benefit from search engine optimization. Brown also decided to shift a large portion of TTA's sales to Amazon. The Amazon search algorithm favors consistency and quality on single items, and he discovered that products intentionally targeting the system saw a definite spike in sales. Since Amazon takes a large cut of the profit, he initially experimented with the platform to determine if the move was worth the investment.

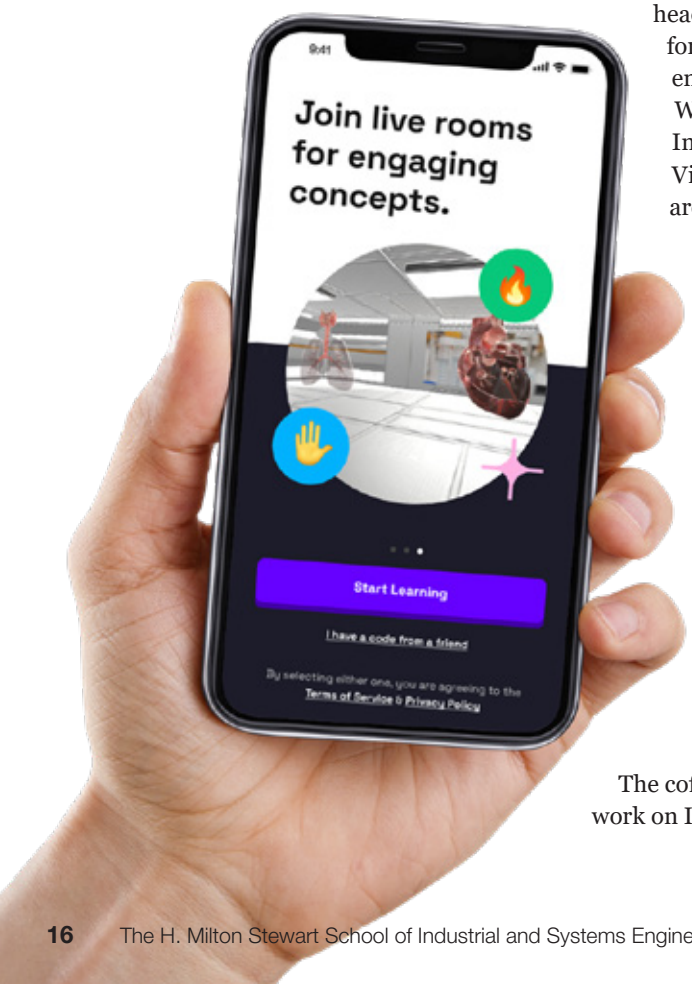
As the sole seller of many of his toys, Brown is always excited to spot them in commercials, TV shows, and more. While watching *The Good Witch*, he was thrilled to recognize a large rack of toys assembled just like the front page of the TTA website. He has even noticed his toys being used as window displays in the retro shops at Disneyland.

After graduation, Brown aims for a full-time job in global logistics or product management, but he still wants to continue his business and keep the legacy of tin toys alive. "Thanks to everything I've done, between internships and Georgia Tech classes, I can actually adapt the business and feel confident in doing so," he said. "I see a positive future for Tin Toy Arcade." ▪ GRACE OBERST

> **"Thanks to everything I've done, I can actually adapt the business and feel confident in doing so. I see a positive future for Tin Toy Arcade."**
>
> AARON BROWN

Gaming Meets Education: Inspirit Reshapes the Future of STEM Learning

Amrutha Vasan was a fourth-year student in ISyE when she and fourth-year computer science student Aditya Vishwanath began working with Neha Kumar, associate professor in the College of Computing, to develop smartphone-based virtual reality (VR) content for the classroom. They tested the effectiveness of their technology in a study involving almost 350 high school and middle school students, seeing promising results not only in improved grades but also in engagement and interest levels.



Several years later, Vasan and Vishwanath have transformed what was once a research project into the ed tech startup Inspirit. The app they designed, which teaches STEM concepts through 3D models built in the game engine Unity, combines Duolingo-style learning with the highly interactive environments of popular games like Minecraft and Fortnite. But how did they develop this technology, thus unlocking a new form of virtual learning that is changing the possibilities of education?

After graduating from Georgia Tech in 2018, Vasan took a job at Procter & Gamble (P&G), and Vishwanath headed to Stanford University for a Ph.D. in learning sciences and technology design. Working in the Virtual Human Interaction Lab at Stanford, Vishwanath's studies centered around improving learning outcomes, engagement, and retention. Through this experience, the pair realized that above all they needed to tap into core pedagogical principles.

"It wasn't really the VR that mattered, it was the interaction — that's what drove the learning outcomes," said Vasan. "STEM education is supposed to be experiential, and students should be driven by curiosity."

The cofounders continued to work on Inspirit for another year and started pitching the company to venture capital firms in the summer of 2019. After signing with their first investor, Vasan quit her job at P&G and moved back to her home country of India to build a team of employees and work full time on the startup.

The Inspirit smartphone app now includes over 1,000 accurate, 3D interactive models that facilitate learning through an immersive experience. Students can break apart the human respiratory system, travel inside a plant cell, or explore the DNA replication process, taking quizzes to unlock new levels. Inspired by games like Candy Crush and Minecraft, features such as leaderboards, lives, avatars, and forums incentivize players to keep learning.

Inspirit's first full curriculum, advanced placement (AP) biology, was released this fall. The self-serve aspect of the app means that students whose schools do not offer AP biology can learn the coursework entirely through Inspirit, and it can also act as a supplement for those who need extra help.
A second function of the app is the community portal, which offers live classroom sessions. The Inspirit team's goal is to enable students to enter the

Inspirit founders Amrutha Vasan (left) and Aditya Vishwanath

> **"STEM education is supposed to be experiential, and students should be driven by curiosity."**
>
> AMRUTHA VASAN

environment on their phones without the app crashing, which is one of the main challenges for these types of applications. During the virtual classroom sessions, teachers have access to the 3D models and can use them as part of their instruction.

However, the goal of Inspirit is not to supersede in-person learning. "I don't think you can replace the human touch with technology," said Vasan. "To me, education still needs to be driven by a good teacher, but you can give teachers access to the tools they need to teach specific concepts."

Deciding what type of technology to use was not an easy process. The Inspirit team tried building out true VR experiences using systems like Google Cardboard and Oculus Go, but determined a phone app would be the most accessible option for high school students.

Understanding the customer base was crucial, so Vasan and Vishwanath went directly to their target demographic: Gen Z. Inspirit has a Discord channel where students can be part of the development process by joining protocol design calls and beta-testing the app. Right now the startup has a community of about 250 students, which they hope to grow significantly as the app progresses.

Young people are not the only ones supporting the vision. This year, Inspirit attended the South by Southwest Education Conference & Festival and entered the Launch, a competition for early-stage startups to pitch their company and mission. As first-time founders, Vasan and Vishwanath didn't expect to win — but ended up first out of five finalists from across the U.S. The accomplishment was an incredible PR boost that resulted in many new investors reaching out to them.

In the future, Inspirit will work toward making the app, currently available on iOS, also available on Android, and expanding the curriculum to include chemistry, physics, and other subjects. Further on, the team wants students to be able to develop their own content on the platform because they believe education should also be about creation, not just consumption.

But is there a future for true VR in education, as Vasan and Vishwanath experimented with in the early stages of the startup? Vasan says VR technology hasn't hit the mainstream market yet. But when it does, Inspirit will be ready to make the shift. ▪ GRACE OBERST

Engineering Alumni Create Mobile App to Reduce Alcohol Abuse

Studies show that the stress of the Covid-19 pandemic significantly contributed to rising alcohol consumption. Two alumni of the Georgia Institute of Technology have responded by offering an increasingly popular solution to curb or eliminate alcohol abuse: a sobriety app called Reframe. Since the launch of its app in fall 2020, Reframe has drawn more than 3,000 paid subscribers. The company, which received key support from Georgia Tech's CREATE-X program for developing startups, has also attracted the attention of investors, recently completing a $1.4 million round of seed funding.

Reframe's cofounders are Ziyi Gao, who earned a bachelor's degree in industrial engineering in 2017, and Vedant Pradeep, who graduated two years later with bachelor's degrees in chemical engineering and computer engineering.

BRAINSTORMING

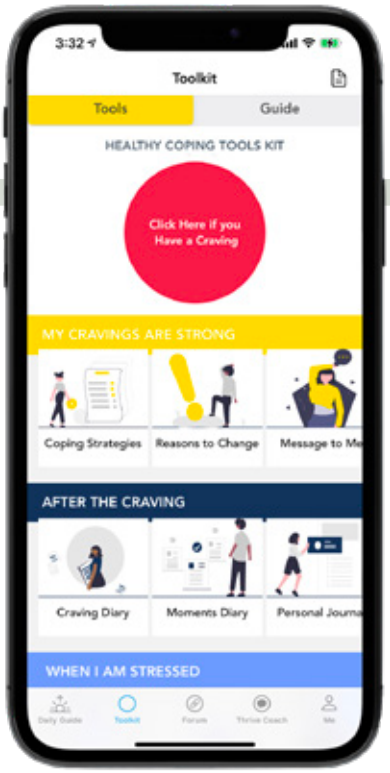
The two first got the idea for the app during an introductory Chemical Process Principles class in the School of Chemical and Biomolecular Engineering. Initially they targeted hypoglycemia detection but switched course when they realized that a similar product already existed.

They then turned their focus to obsessive-compulsive disorder (OCD), which Pradeep has struggled with, driving him into repetitive behaviors such as rechecking the locking of doors. "When I'm in the middle of a compulsion, I don't know when it will stop, but cognitive behavioral research shows that it typically ends in 20 minutes," he said.

EXPERT INPUT

Designing an app that would distract users during the negative habit loop of OCD episodes, Gao and Pradeep showed a product prototype to doctors at Emory University and

Opposite page: Reframe founders Ziyi Gao (right) and Vedant Pradeep (center) promote the app at a CREATE-X event.



> "We've received hundreds of emails from people whose lives have been transformed, and that's what we're really proud of at this point."
>
> ZIYI GAO

Johns Hopkins University — who believed the technology would better help with alcohol addiction, which in addition is a much larger market.

"We realized early on that we were out of our depth, but we drew strength from reaching out to experts in this space, talking to at least 500 people," Gao said.

With a team of advising doctors and mentors from CREATE-X, the Reframe app has gone through multiple iterations since mid-2019.

INTERRUPTING URGES

The app's 120-day program provides diversions that interrupt users from the urge to consume alcohol during a typical 20-minute craving. Features include games, messages, meditations, breathing exercises, and a journaling component.

"When you're in the middle of a craving, your judgment is clouded," Pradeep said. "But it's easy to click a button and distract yourself. Reframe helps break bad habits by replacing them with good things that bring balance into life. Integrating fitness, nutrition, and self-care, we want to help users create lives where drinking alcohol is not considered helpful or attractive anymore. On their journeys, they can track their progress and how much money they've saved by not drinking."

Gao and Pradeep said that many people who use the app would never go to recovery centers, which are often expensive, or a program like Alcoholics Anonymous, which they might consider stigmatic.

While many of their app's users might not want to seek out professional help, they still want structured guidance, which is what the app provides, Pradeep said. "People want to be told what to do more than we expected." The two entrepreneurs note that their app can put a recovery center in the user's pocket at "one thousandth of the comparable cost" of a physical facility.

GOAL-SETTING

About 50% of Reframe's users initially said they wanted to cut back on alcohol instead of quitting. "There haven't been many options for that middle ground," Gao said.

But what the Reframe cofounders noticed is that many people ultimately decide to quit entirely, with about 49% ceasing alcohol consumption in the first 30 days.

"As the program progresses, the goal becomes how to rebuild your life, addressing core issues," Pradeep said. "It's about the whole journey, not just about drinking. You better understand why you drink, as your triggers become more obvious."

CHANGING LIVES

The app, which currently has a near-perfect rating on the App Store, has generated a lot of positive feedback for its creators. "We've received hundreds of emails from people whose lives have been transformed, and

continued on page 21

The Mindset of an Entrepreneur

Even as a young child, I always asked myself "how?" and "why?" Whether it was a new app or a product in the grocery store, I would wonder how it came to fruition. I would read stories about successful tech founders and keep up to date with exciting innovations, hoping to create something of my own one day.

In my first year at Georgia Tech, I joined the Grand Challenges Living Learning Community, a one-year course designed to teach students design thinking and problem-solving. I worked with a team to brainstorm solutions preventing the sharing of "fake news" and improving media literacy. We subsequently developed an algorithm to flag bots and disinformation on social platforms. During Grand Challenges, I was chosen to represent the program in Washington, D.C., and to meet with senators to learn more about public policy issues. At the end of the year, our team presented our project solution at the Fox Theater to the greater Atlanta community.

In my second year, I became involved with CREATE-X at Georgia Tech. When I was a senior in high school, I was very frustrated with being unable to tour colleges in person; existing virtual tours didn't do them justice. I was determined to find a solution for students in a similar position, so I joined the CREATE-X Idea to Prototype program. I was paired with a mentor and began customer discovery for my virtual tour startup idea, Unitour. I later interviewed with and was accepted into the CREATE-X Startup Launch Summer Accelerator Program.

CREATE-X enabled me to connect with an incredible network of startup teams and mentors whom I met with weekly for guidance. I conducted more than 150 customer discovery interviews to understand the target customer and problem that I was trying to solve. My minimum viable product was a YouTube video tour of Georgia Tech that reached over 20,000 views. At CREATE-X Demo Day, I presented Unitour to a select group of investors and entrepreneurs.

During my third year, I leveraged my background in industrial engineering, as well as my entrepreneurial mindset, to interview for internships. In one interview, I was asked, "When was the last time you worked to find a solution to a problem?" I shared my story of participating in CREATE-X, my frustration with existing virtual tours, and how I worked to implement my idea. The recruiter loved my story — I received an offer as an operations manager intern with Amazon for summer 2021.

Female representation in the entrepreneurial community is low, with women-led startups receiving only 2.3% of venture capital funding. The Female Founders Program with Georgia Tech VentureLab connected me with an incredible like-minded

> **"My journey at Georgia Tech has been a paradigm shift: I now view entrepreneurship as a mindset and problems as opportunities."**
>
> DIVYA PINNAKA

group of entrepreneurs. As an Indian American woman, I have sometimes wondered where I belong — and if I belong in the industry. During the program, mentors guided us through our startups while having open conversations about tackling imposter syndrome and how to be fearless in the workplace.

I plan to continue to be involved with entrepreneurship on campus during my fourth year as an executive member of Startup Exchange, the largest student-led entrepreneurial community at the Institute. From studying abroad in France to working on new startups in Atlanta, my journey at Georgia Tech has been incredible. It has been a paradigm shift: I now view entrepreneurship as a mindset and problems as opportunities. ▪ DIVYA PINNAKA

Divya Pinnaka, a third-year student in ISyE, is business-minded and well versed in design thinking. She has been involved in entrepreneurship since high school and has continued to follow her passion at Georgia Tech.

Reframe, continued from page 19

that's what we're really proud of at this point," Gao said.

The two alumni originally called the app Digital Sponsor, inspired by Alcoholics Anonymous' use of experienced human sponsors to guide participants. But they decided to change the name after realizing the app isn't only for those who've hit rock bottom.

"We didn't want to focus only on survival," Pradeep said. "The goal is not just to survive, but to thrive — to 'reframe' from the fear of loss to the potential for gain."

GROWTH FACTORS

Reframe's cofounders attribute the fast growth of their company to the large increase in alcohol abuse caused by the pandemic, as those struggling with drinking problems felt increasingly isolated with limited remote options for seeking help.

Kimberly French, an assistant professor in Georgia Tech's School of Psychology, shared insights into this phenomenon.

"Generally, people are certainly more stressed and lonely during the pandemic. In terms of alcohol use specifically, the story is a bit more complicated in that some people have increased consumption while others have decreased," French said. "The data suggests that people who are most vulnerable — those with job insecurity, reduced job hours, unemployment, and pandemic-related stress; women; and those who were already consuming alcohol — tended to increase their alcohol use during the pandemic."

French went on to explain that research studies into the motivations of increased alcohol use cite coping with stress, loneliness, boredom, and a lack of structure coupled with more time.

In helping reach this population with their Reframe app, Gao and Pradeep are grateful for Tech's CREATE-X program, which aims to empower students with the knowledge, skills, and experience to launch successful startups and pursue future entrepreneurial opportunities during their careers. CREATE-X supported Reframe's idea in 2018 with $20,000 in preseed funding. Until the recent infusion of $1.4 million in seed funding, Gao and Pradeep had operated on $120,000 from family and personal funds, saving money by handling as much of the research and development as possible by themselves.

FUTURE OPPORTUNITIES

Gao and Pradeep have plans to modify their app to address other addictions, starting with binge eating and later opioid abuse.

"In five years, we see Reframe as a mainstream solution that combats substance use and behavioral addictions in the same way that Weight Watchers [now WW] helps with weight loss," Pradeep said.

"We want to provide tools that anyone can use for any negative behavioral habit," Gao added. ▪ BRAD DIXON

Next Gen Integration: From Side Hustle to Successful Business

The summer after his junior year of high school, Jonathan Fitch was looking for something to do. At the suggestion of his mom, he decided to start a side hustle helping people with tech devices in their homes and businesses. Now, as a fourth-year in ISyE, Fitch's side hustle has evolved into a successful business called Next Gen Integration, LLC.

Next Gen Integration uses custom software to integrate and automate the security, lighting, and audio systems in large homes and businesses. The open-system software requires certification to work with and install, and Fitch designs and tailors the software to each client. Because the business focuses on efficiency, Fitch has been able to incorporate many of his ISyE skills.

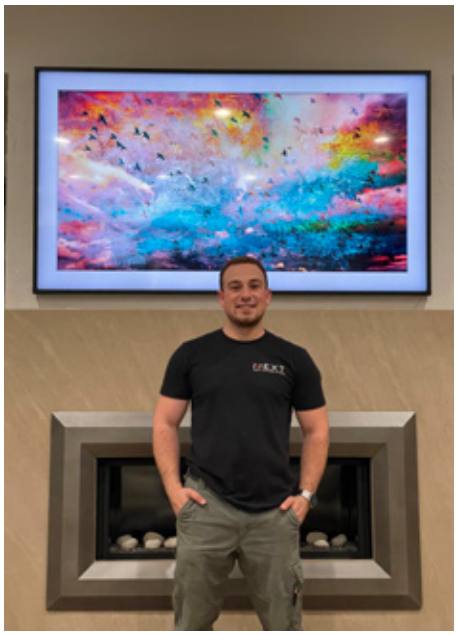
"The goal in what I do is to optimize and make these systems as integrated as possible, so there are no bugs and glitches within the program files, and the client is able to easily operate the system," Fitch said. "I found ISyE to be the right major for me, as it is all about streamlining and optimization. Within my business, the entire premise is integrating buildings and streamlining the systems within them."

Growing by word of mouth, Next Gen Integration manages over 50 client and business accounts in the Atlanta area, and Fitch has been able to hire five part-time employees.

All this keeps him busy juggling both school and work. He frequently works odd hours including weekends, early mornings, and late nights. Fitch also tries not to accept new jobs outside a certain radius to minimize travel time; he also plans his academic schedule as tightly as possible to create a more efficient day with less downtime between study and work.

Though he has not yet decided if he will make Next Gen Integration his full-time job after graduation, Fitch is keeping the option in mind. He has considered taking the company to the next level by doing more general contracting, designing and constructing integrated homes and buildings from the ground up.

"In the beginning there were times where I would go weeks without a job, and it was a bit demotivating. However, sticking with it and being persistent got me to where I am now," he said. "There is nothing better than having your own business." ▪ ANGELINE FU



Left: Next Gen Integration system installation

Right: Company founder Jonathan Fitch

Gatherly: A Platform for Better Digital Engagement

In early 2020, ISyE fourth-year Carl Liu was on a team of Georgia Tech students designing gym hardware as part of the CREATE-X Startup Launch program. When Covid-19 arrived in the U.S. that March, forcing lockdowns across the country, gyms closed and the team was forced to rethink its product idea. The awkwardness of online classes inspired the team — in Liu's words — "to build a better solution for online interaction."

Thus Gatherly was born: a spatial video chat platform that supports better digital engagement. Attendees can easily navigate from large keynote presentations to breakout "rooms" for one-on-one conversations or group huddles. As the pandemic grinds onward, the Gatherly team's goal is to redeem digital interactions by demonstrating that the platform provides a great accompaniment to in-person events, which can be time-consuming and expensive. Rather than replace in-person connection, Gatherly wants to complement and augment it.

Liu, self-described as "the team mom," does a little bit of everything for the startup — from building the front end to running payroll. When asked what he learned from the CREATE-X experience, he said, "Lean on your advisors! We are very blessed to have experienced entrepreneurs and investors from the Georgia Tech community who are always willing to lend their time to us, and they've helped us tremendously."

So far Gatherly has hosted over 4,000 events, and the startup recently crossed $1 million in revenue. You can check out the platform, including a demo video, at *gatherly.io*. ▪ SHELLEY WUNDER-SMITH

ISyE Senior Design Team Prototypes Energy Prediction Software for CREATE-X Capstone

On average, convention centers use 22 million kilowatt-hours of energy annually, which translates to an enormous $2.6 million spent on electricity. However, with no efficient way to track this expense, they are unable to charge clients for power usage, which can lead to unprofitable events. That problem motivated one Senior Design team to consult with the Georgia World Congress Center (GWCC) to develop Enercast Solutions, a software platform based in Amazon Web Services that provides a tool for convention centers to predict electricity consumption.

The entrepreneurial nature of the project made it a great fit for the team to join Georgia Tech's CREATE-X Capstone to complete its Senior Design project. This was the first time students from ISyE had participated in CREATE-X Capstone. It also gave them an opportunity to diversify their skill set by adding two computer science (CS) majors to the team.

The creators of Enercast Solutions are members of the team Helluva Energy-neers (advised by ISyE Professor Craig Tovey): Abdulhafiz Abdullahi, Ronnie Bian, Jackson Burke, Aarushi Khajuria,

PHOTO COURTESY OF GEORGIA WORLD CONGRESS CENTER

Sonakshi Mishra, Junzhe Ruan, Laura Zhang, and Sam Zimmerman from ISyE, as well as CS students Jordan Rodrigues and Vale Tolpegin.

"We were interested in learning about entrepreneurship, and this seemed like a really good opportunity," said Zhang about their decision to join CREATE-X Capstone. "With traditional Senior Design, your scope of impact is just one client, but in the CREATE-X entrepreneurship path, we had the potential to influence several hundred convention centers across the United States."

Led by mechanical engineering Professor Craig Forest, this special Capstone design section is dedicated to developing entrepreneurial prototypes and exploring market demand. The multidisciplinary program, running for several years now, is open to students from the departments of biomedical engineering, mechanical engineering, computer science, electrical and computer engineering, and now ISyE.

The ISyE students' high potential for entrepreneurship was identified by Dima Nazzal, ISyE director of professional practice and leader of the Senior Design program. "ISyE students are increasingly interested in entrepreneurship and multidisciplinary projects, which motivated us to explore this pathway," said Nazzal. "It turned out to be a successful experiment with excellent potential for expansion and continuity."

The group's energy prediction tool uses machine-learning techniques to model energy consumption with several input factors: square footage utilized, forecasted attendance, whether special equipment will be used, and event dates. Based on predicted electricity usage, the tool outputs a baseline cost for the convention center, as well as upper and lower bounds on how much the event will cost. Convention centers can use these estimates to decide the appropriate amount to charge clients for the increase in electricity use during their events.

Enercast Solutions topped the competition by winning the CREATE-X best project award across 13 teams, and its creators were invited to present their prototype pitch at the ISyE Best of Senior Design presentations.

"With traditional Senior Design, your scope of impact is just one client, but in the CREATE-X entrepreneurship path, we had the potential to influence several hundred convention centers across the United States."

LAURA ZHANG

"Despite their lack of experience in the course compared to the other majors, the ISyE students jumped to the fore because they had already explored customer relationships over the preceding semester and had identified a client as their first customer," said Forest. "They were able to use this as a springboard, meeting dozens or hundreds more potential customers who had the same problem, enabling them to assess the size of the market."

Although pre-Senior Design gave the team a head start, choosing CREATE-X Capstone came with many challenges. "CREATE-X is a different mindset than a lot of the other design projects," said Tolpegin. "You have to find a problem, and people discount the difficulty of that — that's why 95% of startups fail. Early in the semester, we came up with two different project ideas, and it was a very challenging decision to figure out what path to go down."

PHOTO COURTESY OF GEORGIA WORLD CONGRESS CENTER

Customer discovery was instrumental in finding a relevant problem space, which meant ensuring that the product would be applicable to most, if not all, convention centers. Team members leveraged GWCC partners, cold-called event spaces, and messaged convention center personnel through LinkedIn to secure interviews. In total, they consulted 55 event spaces across the United States and globally. By performing market research and analyzing data from GWCC, they were able to identify electricity consumption as one of the highest expenses for convention centers.

In addition to customer discovery, user testing was an important step in prototype creation. "We were able to get user feedback very early on in the process, and that gave us the ability to adapt and grow our solution based on customer needs," Tolpegin explained.

Throughout the development cycle, the students conducted a series of tests to refine the Enercast Solutions website. User testing involved recording the number of mouse clicks and time needed to accomplish various tasks on the website. They also interviewed the testers about their experience and had them fill out a system usability scale — a basic questionnaire to get feedback on a prototype. Employing standard industry metrics for evaluating software products ensured they obtained objective data.

Another crucial hurdle to overcome was coordination; with 10 members, the team was larger than the typical Senior Design team. "Meeting and ensuring everyone is on the same page can be a lot to do, because you want to make sure that everyone feels like their voices are being heard," said Khajuria. A framework to split the members into smaller subteams for the second half of the semester proved successful.

Though team organization was challenging, members cited working in an interdisciplinary team as a valuable opportunity. "We've had experience building prediction models with other ISyE students, but this time — working with the CS students — we could see the different ways we approach forecasting," said Abdullahi.

Ultimately this hard work and dedication paid off, enabling Helluva Energyneers to deliver a top-notch product solution that gave GWCC access to information it had never been able to collect before. "We appreciate how easy this tool is to use," said Vince Almoina, national sales manager at GWCC. "It's a very simplified platform that delivers exactly the information needed with minimal steps." In addition to GWCC, two other convention centers also expressed interest in Enercast Solutions services, though the team ultimately decided not to continue with the company.

With its commitment to the challenge and impressive win in the CREATE-X Capstone competition, this team sets a high bar for future students. "I was especially impressed by the students' professionalism, clear communication, and energy throughout the semester," said Forest. "If this team, which was named best in the entire class, is representative of what ISyE students bring to the table, then I can't wait to have more in the class in Fall 2021 and beyond." ▪ GRACE OBERST

ISyE Ph.D. Students Join Scheller College's TI:GER Program

Georgia Tech offers many resources for students interested in entrepreneurship, and one exciting opportunity is TI:GER, a 12-credit, three-semester program that teaches students how to transform ideas into successful technology innovations. It prepares students to work with the Creative Destruction Lab, a mentoring program for science-based startups directed by the Scheller College of Business.

In Spring 2021, two ISyE Ph.D. students — Jana Boerger and Emma Wu — joined TI:GER. Their first semester included an innovation analysis course and a virtual lab about research methods, both focused on the beginning stage of building a business idea: customer discovery. As part of the process, they reached out to Georgia Tech alumni and others in relevant industries to assess the market potential of their products.

"Understanding the customer discovery process is a valuable skill — not just if you want to become an entrepreneur, but in any environment where you need to test your hypotheses," said Boerger.

Her project, related to her research, centered around an algorithm that improves decision-making in warehouses and is tailored to a customer's warehouse management system. Wu's project, also based on her research, addressed reinforcement learning in quantitative trading.

Each group in the program combined Georgia Tech Ph.D. and MBA students with Juris Doctor (J.D.) students from the Emory University School of Law. Wu's team consulted with the J.D. students on the process for filing patents and steps to licensing a hedge fund or capital management fund.

"It's amazing to be able to collaborate with [the MBA and J.D. students] because they all bring their own specific and unique perspectives," said Wu. "I highly recommend this program to anyone who wants to explore how to commercialize technological innovations."

Though Boerger transitioned out of TI:GER to complete internships with Boston Consulting Group and Shopify, Wu is continuing with the rest of the program. For both, TI:GER has been an incredible learning experience, and they hope to apply the skills they acquired to future endeavors, entrepreneurial or otherwise. ▪ GRACE OBERST

Emma Wu (left) and Jana Boerger

Autonomous Trucking Collaboration Could Lead to a More Resilient, Affordable Supply Chain

Most public transit systems in the U.S. have a significant first- and last-mile problem. "If you don't pick up people within a quarter of a mile of where they live and drop them off very close to their final destination, you lose 90% of your ridership," explained A. Russell Chandler III Chair and Professor Pascal Van Hentenryck.

The human component of mobility is a problem Van Hentenryck and his team of students and postdoctoral researchers in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) have studied for years. Their goal is to address the first- and last-mile problem and provide equitable, efficient, and low-cost public transportation options. Increasing the use of public transit will not only decrease reliance on personal vehicles and reduce traffic congestion and greenhouse gas emissions; it will also increase accessibility to jobs, healthcare, education, and fresh food.

Van Hentenryck, who also serves as associate chair for innovation and entrepreneurship and leads the Socially Aware Mobility Lab in ISyE, has developed a multimodal approach in which small on-demand vehicles take riders to and from their locations to high-frequency bus and rail hubs. He has conducted successful case studies using this methodology in the midsized cities of Canberra, Australia, and Ann Arbor, Michigan, which resulted in significant decreases in cost and passenger wait times. He is currently working on scaling the optimization and machine-learning algorithms used in Ann Arbor and Canberra for Atlanta. However, when executives from Ryder System, Inc., a leading logistics and transportation company with more than 235,000 vehicles and 8,600 professional truck drivers, reached out to Van Hentenryck about a collaboration, the research team began to look at the model through a different lens.

"We have been focusing on people mobility and had not looked at other types of transportation," said Van Hentenryck. "So when Ryder came to us, we were very interested to see if the techniques that we were using for people could apply more generally to freight. In this project specifically, we are looking at how adding autonomous vehicles could unlock additional value."

Van Hentenryck and his team met with Ryder to better understand the company's goals and to determine if this multimodal approach could be applied to another system. Working with a company like Ryder gave the team access to large amounts of data and to logistics experts who understand the industry's current and future challenges.

"There is a lot of back-and-forth between researchers and company representatives in a project like this," explained Van Hentenryck. "Sometimes the solutions we come up with in the lab will not work in the field, and so you have this iterative process in transforming the research idea into something that is applicable in the field."

Ryder operates a network of dedicated fleets for its customers, and even with high levels of performance, inflexible transportation lanes and schedules often lead to inefficiencies.

"We learned that sometimes these trucks are traveling many miles completely empty, which is not cost effective," Van Hentenryck said. "We started looking at how we can avoid these 'empty miles.'"

To meet customer needs, Ryder must execute a large number of freight movements across the country. The team realized that by breaking each trip into three sections — origin-to-hub, hub-to-hub, and hub-to-destination — it could organize a network using both regular and autonomous trucks. The first and last segments would rely on smaller human-operated vehicles, since these will typically occur in more densely populated locations. Connections between hubs would rely solely on autonomous trucks (those without a human driver), generally in sparsely populated, controlled environments like highways and exit ramps.

> **"We have been focusing on people mobility and had not looked at other types of transportation. So when Ryder came to us, we were very interested to see if the techniques that we were using for people could apply more generally to freight."**
>
> PASCAL VAN HENTENRYCK

"Safety is especially important to our researchers and to Ryder, and we take it very seriously," said Van Hentenryck. "Keeping the autonomous trucks on the longer-haul middle leg, and human drivers in the first and final legs, schedules autonomy on lengthy, often overnight trips, and places drivers in dense environments where there are many other variables at play like left-hand turns, stop signs, pedestrians, etc."

The autonomous hub-to-hub aspect allows Van Hentenryck's model to be optimized in a whole new way because it doesn't depend on having drivers available — autonomous trucks are extremely flexible. This can deliver significant projected savings for Ryder if the model is implemented.

"The whole team was stunned by the projected savings from this project," said Van Hentenryck. "I have worked on many different transportation problems during my career, and 1% improvement is magical. In this case improvement goes from 29% to 40%, depending on the price of autonomous trucks and the cost of operating them. Also, the flexibility to move these autonomous trucks around gave us the ability to optimize the business model in ways people didn't even consider before."

The agility of the new model also provides better reactions to supply chain disruptions, because it can adapt more quickly to a new situation.

"Autonomous driving technology is poised to be incredibly disruptive to our industry in safety, service, and cost. As such, it was clear to us that this was not something we could wait to figure out or be handed a playbook. This collaboration with Georgia Tech was an advancement in our commitment to becoming a leader in fostering innovation and bringing it to our customers," said Michael Plasencia, group director of new product strategy at Ryder.

"We are designing a much more resilient supply chain logistics system, and that is because we are thinking differently," Van Hentenryck added. "This technology provides more resilience, more flexibility, and is more affordable.

"This project is only a first step. The whole field of transportation, logistics, and supply chains is being transformed by technology, automation, and the changes in attitudes and expectations that emerged during Covid-19. We are looking forward to working with Ryder on many of these."

▪ LAURIE HAIGH

From left: Postdoctoral Fellow Kevin Dalmeijer, Professor Pascal Van Hentenryck, and undergraduate student Samuel Baskin
PHOTO: CANDLER HOBBS

Valerie Thomas Leads Environmental Analysis of Capturing CO_2 From the Atmosphere — and Making It Into Fuel

Rows of photobioreactors containing blue-green algae hang in the sun. CO_2 is captured from the air and pumped into the photobioreactors, where the cyanobacteria use sunlight to convert the carbon dioxide to fuel.

Climate scientists have determined that carbon dioxide — the chief gas contributor to global warming — has swelled to atmospheric levels not seen in more than 3.6 million years. This surge is largely due to human action, in particular the use of fossil fuels such as gasoline for cars, jet fuel for airplanes, diesel for trucks and ships, and coal and natural gas for power plants.

Given the increasing urgency of addressing climate change, researchers are exploring different ways to reduce carbon dioxide's ubiquity. One of them is Valerie Thomas, Anderson-Interface Chair of Natural Systems and professor in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE). She is working on a project funded by the U.S. Department of Energy (DOE) to pull CO_2 directly from the air and deliver it to cyanobacteria, or blue-green algae, which use the CO_2 to make transportation fuel. The fuel can be used immediately in automobiles, or with further processing as diesel or jet fuel. Because the algae grow in compact containers, the process doesn't need much space.

"With this project, we are looking at three different ways to integrate capturing carbon dioxide and having the algae make the fuel, to determine which setup is most cost effective and energy efficient," Thomas explained. "What we want is a process that pulls a lot of CO_2 out of the air and makes a low-carbon fuel that can substitute for gasoline, jet fuel, and diesel."

Together with ISyE Ph.D. student Jaden Johnston and chemical and biomolecular/public policy master's student Shavonn D'Souza, Thomas is performing the project's environmental analysis as part of a larger interdisciplinary, interinstitutional collaboration. This includes the carbon capture company Global Thermostat, the DOE National Renewable Energy Laboratory, and School of Chemical and Biomolecular Engineering Professor and project director Christopher Jones, as well as others in the College of Engineering.

Thomas's team has been studying this project since 2018 and has already drawn some conclusions — chiefly, that combining the carbon capture technology and the algae fuel technology makes both systems more efficient. Now it is applying classical industrial engineering techniques to find the most effective way to physically build and connect these systems.

For the environmental analysis, Thomas, Johnston, and D'Souza use material flow analysis and mass and energy balances to track the flow of carbon atoms through the system, and track energy use and greenhouse gas emissions through the entire lifecycle — all the way to combustion of the fuel in vehicles. Working with engineers at Global Thermostat, they have developed methods to use waste heat from the fuel production process to provide the heat needed to collect the captured CO_2, and they have also devised ways to consider each stream of carbon dioxide in the facility to find the best combination of carbon efficiency and energy efficiency.

This is one of several direct air capture projects in progress at the Institute.

"This is a new area of research excellence for Georgia Tech," noted Thomas. "Right now, we are working to improve the technology for this process. Eventually, it could become a new industry that captures CO_2 and uses it to make fuels and chemicals. Given the rising levels of atmospheric carbon dioxide, the hope is that this technology will succeed and have a big impact." ▪ SHELLEY WUNDER-SMITH

Georgia Tech Leads Industry Effort to Tackle the Composite and Hybrid Materials Challenge

Composites and hybrid materials will define the future of manufacturing — and with good reason: These strong yet lightweight materials that comprise half of all commercial twin-aisle airplanes and most electric vehicles are lighter and more fuel efficient, lessening their carbon footprint.

However, because composites are unique (combining different materials), it is difficult to model how they will degrade and fail during use. Impact damage may not be visible or may be barely visible, making it harder to detect than damage to metallic structures. Furthermore, repairing these materials and structures is both time-consuming and expensive due to the complexity of composite parts and lack of experience or knowledge and data.

The Georgia Tech-based Center for Composite and Hybrid Materials Interfacing (CHMI) intends to dramatically improve how composite and hybrid structures are joined and repaired. Center director Chuck Zhang, Harold E. Smalley Professor in the H. Milton Stewart School of Industrial and Systems Engineering, will drive CHMI's vision to transform the current labor-intensive, experience-based joining and repair practice into fast, automated, and reliable processes.

According to Zhang, the concept for CHMI originated in 2015, when Georgia Tech received a National Institute of Standards and Technology grant to identify top challenges and R&D needs facing aerospace companies, and then develop a 10-to-15-year technology roadmap focused on research in that area. More than 50 companies and government organizations, including Boeing, Lockheed Martin, Airbus, and component manufacturing suppliers were polled on their top five technology challenges, and "composite joining and repair was one of the top three technology areas cited," Zhang recalled.

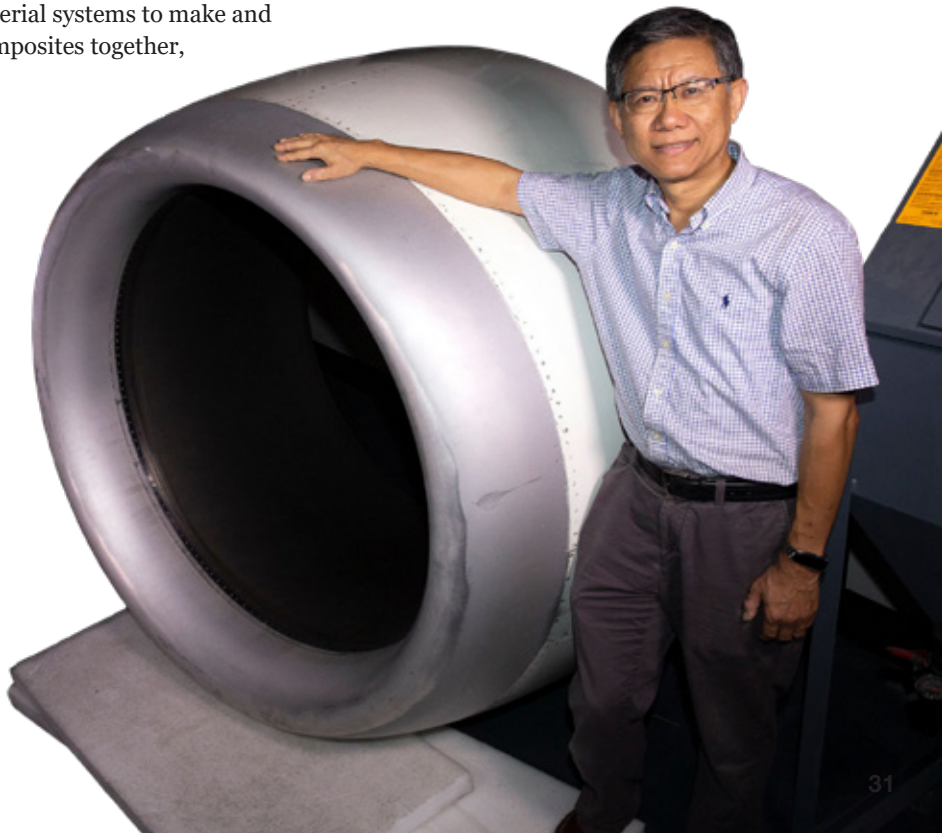
CHMI will solve key issues facing industries that rely on composite materials. To illustrate, a bird striking a plane can damage a composite structure on the wing of the aircraft. The airline company or maintenance provider must then deploy specialized, expensive patches — often to remote locations. These present training challenges for technicians, along with the high cost of grounding a plane. Pulling an Airbus A350 out of service for a single day costs an airline an estimated $100,000 or more in lost revenue.

Joining Zhang from Georgia Tech are co-principal investigators Christopher Muhlstein and Donggang Yao, both professors in the School of Materials Science and Engineering. Yao focuses on creating materials and developing material systems to make and join composites together, while Muhlstein studies the mechanical behavior of these materials.

The team considers the deep materials and analytics expertise at Georgia Tech a key strength of the Center. And, involving industry ensures that "we as researchers get great problems to work on," said Muhlstein. "This Center allows us to create a convergent platform where industry comes together with academia in both a structured and targeted way to advance manufacturing in the U.S."

Zhang's background in multifunctional composites, additive manufacturing, and applications of data analytics ties it all together.

"Using advanced computation, experimental data analytics, and digital techniques and tools, we hope to reduce by 50% the overall cost, cycle time, and variation of these processes in the next 10 years," Zhang concluded. ▪ ANNE WAINSCOTT-SARGENT



Chuck Zhang
PHOTO: CANDLER HOBBS

The research team behind the Georgia Covid-19 Vaccine Dashboard: (from left) Dima Nazzal, CHHS research director, and Ph.D. students Akane Fujimoto and Tyler Perini; not pictured: Pinar Keskinocak, co-founder and director of CHHS; M.S. health systems students Joshua Rosenblum and Emma Baubly; and M.S. student Saurabh P. Doodhwala
PHOTO: ALLISON CARTER

Vaccine Dashboard Breaks Down Vaccination Trends at County Level

Covid-19 vaccination uptake, though slowing, continued nationwide this summer. And 62.3% of the total U.S. population had received at least one vaccine dose as of September, according to the Centers for Disease Control and Prevention Covid Data Tracker. However, disparities have been noted in vaccination rates across races and geographic areas. A dashboard created by H. Milton Stewart School of Industrial and Systems Engineering (ISyE) students and faculty members — including Emma Baubly, Akane Fujimoto, Tyler Perini, Joshua Rosenblum, Pinar Keskinocak, and Dima Nazzal – highlights differences in vaccination rates by race across Georgia's counties.

In June 2021, the Georgia Covid-19 Vaccine Dashboard indicated that vaccination rates of white residents were higher than those of Black residents in around 70% of all Georgia counties. As of late September, the gap narrowed to 51.6%. However, the most populous counties in Georgia — namely Fulton, Gwinnett, DeKalb, Cobb, Clayton, and Chatham — are in the county group where white vaccination rates considerably exceed Black vaccination rates by 20%-50%.

"There has been considerable variability in Covid-19 vaccination rates in different regions of the state, so we wanted to take a closer look from an equity perspective," said Keskinocak, William W. George Chair and professor in ISyE. She has focused her career on the application of operations research and management science with societal impact, particularly in health and humanitarian applications, and cofounded and directs the Center for Health and Humanitarian Systems (CHHS), an interdisciplinary research center at Georgia Tech. Keskinocak's most recent work addresses infectious disease modeling, including Covid-19: projecting disease spread geographically and over time, evaluating intervention strategies, and investigating resource allocation.

The Georgia Tech team set up the dashboard, working closely with partners at the Georgia Department of Public Health (DPH). The team shared early demos of the dashboard with both DPH and the Georgia Covid-19 Health Equity Council.

According to CHHS Research Director Dima Nazzal, Georgia Tech's dashboard shows high vaccination rates across both racial groups in some counties, and low rates in those below the poverty level, compared with the national average. Some counties currently have higher vaccination rates among white residents, including some of the large metro counties, while in a few counties the vaccination rate is higher among Black residents. The researchers acknowledge the multifaceted outreach efforts of DPH and local health departments to increase vaccination rates across the state and hope that the dashboard will support these efforts.

▪ ANNE WAINSCOTT-SARGENT

The information in this article is current as of late September 2021. For the most up-to-date percentages, visit chhs-gt.shinyapps.io/georgiavaccines.

Researchers Study Potential Covid-19 Spread at Football Games

Last fall, when the NFL and the NCAA both decided to go ahead with the football season despite the pandemic, public health experts warned that these events could cause a spike in Covid-19 cases within the communities where these games were played.

An interinstitutional team that includes Turgay Ayer, George Family Foundation Early Career Professor and associate professor in the H. Milton Stewart School of Industrial and Systems Engineering, studied these games to determine whether they were, in fact, Covid superspreader events. Operating under the hypothesis that the events would contribute significantly to community spread, the team compared 2020-21 data in U.S. counties where games were held in person to counties where games were played without any spectators. Further, the researchers matched counties that had similar population sizes, as well as similar Covid-19-related restrictions and Covid-19 incidence trends.

After examining a total of 528 football games — 101 NFL games and 427 NCAA games — to the researchers' surprise, they found no significant statistical difference in community spread where games had an audience versus those that did not.

"Before conducting the study, our conjecture was that football games would cause an explosion in the number of Covid-19 cases; however, it turns out this is not the case, and the games did not lead to a major increase in case numbers," noted Ayer.

The investigators theorized that limited in-person attendance, required face coverings, and open air helped prevent the spread of Covid-19 following NFL and NCAA events. For the 2021-22 football season, the team is continuing to track Covid-19 spread following the games, especially now that many colleges and professional teams have returned to games played as normal, with stadiums full of spectators and no mask requirements.

"While our research did not identify any strong effect of football games on community spread, this finding may not hold as new variants pop up and as risk behaviors change in the community. I am particularly worried that mask use has been reduced recently, despite the increase in Covid-19 cases, which indicates a false sense of security," Ayer said.

Ayer's team, which includes researchers from Massachusetts General Hospital, Harvard Medical School, and Boston Medical Center, has developed the Covid-19 Football Tracker, which is part of its Covid-19 Simulator website. The interactive football tracker tool displays NFL- and NCAA-related football information and predicted Covid-19 surge data. ▪ SHELLEY WUNDER-SMITH

> **"While our research did not identify any strong effect of football games on community spread, this finding may not hold as new variants pop up and as risk behaviors change."**
>
> TURGAY AYER

PHOTO: DANNY KARNIK

Team Develops Decision-Support Tool for Equitable Covid-19 Testing Center Allocation

When the coronavirus began to take hold across the U.S. last spring, public health experts quickly began highlighting how Covid-19 disproportionally affects communities of color. In contrast to wealthier and white Americans, who largely can protect themselves by working and shopping from home, Black and Hispanic people compose the majority of frontline and essential workers, with incomes at or near the poverty level. These populations also lack available healthcare, which during the pandemic significantly correlated with unequal, limited access to Covid-19 testing centers.

To address this inequity, Kamran Paynabar, Fouts Family Early Career Professor and associate professor in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), used machine learning and optimization techniques to help policy-makers and public health officials determine effective testing center distribution in the state of Georgia.

Paynabar and Lance Waller, a professor in Emory University's Rollins School of Public Health, developed a decision-making tool that uses Covid-19 rates in specific communities, along with disease progression modeling, to locate test centers in places that will enable the greatest number of people to be tested. Inputs included population and demographics by county, number of available testing sites, and the testing capacity of each site.

"The problem we're solving is quite complex," noted Ribhu Sengupta, an ISyE master's student working with Paynabar on this project. "At the beginning of the pandemic, public health decision-makers clearly did not know where to put testing centers, and the racial inequality that exists in public health to begin with contributed enormously to disparities in access to Covid testing. This was particularly true for Black urban populations, which are most affected by the virus; most testing sites were being placed in predominantly white suburban communities."

Accordingly, the team not only sought to identify the best locations for testing centers based on demand. It also considered how varying social contexts impact demographic groups, to help public health experts place testing centers more equitably across racial lines. To accomplish this, the team recommended using mobile testing centers to supplement static ones.

"Using a multi-objective optimization scheme, the decision-support tool tries to find a balance among three important criteria: population coverage, fairness and equity, and the uncertainty of the prediction model for disease spread," said Paynabar. "The equity component of the model ensures that the likelihood of having access to the test, given racial and socioeconomic factors, is similar across different demographics."

In addition to addressing social and racial inequalities, equitable testing center allocation reveals a more complete picture of how disease is spreading throughout a community. This allows decision-makers to deploy such measures as social distancing, mask mandates, school closures, telecommuting, and lockdowns, and to evaluate their effectiveness for reducing Covid spread.

The team's web-based application is available online. Along with informing decisions about test center allocation, the tool helps policymakers use "what-if" analysis to assess the impact of the number and capacity of test centers on test coverage and equity. The model is flexible, meaning it can be adapted for optimal vaccination site distribution. Paynabar said that this is especially important given that vaccination rates vary widely by state and region of the country, and the highly contagious delta variant is now the predominant Covid strain in the U.S. He also sees a use for the tool in future disease outbreaks, epidemics, or pandemics. ▪ SHELLEY WUNDER-SMITH

To view the decision-making tool, visit https://bit.ly/GACovidTestAllocation.

ISyE Students Respond to Covid-19

PHOTO COURTESY OF SMILE

JOHN RAJ

During the Spring 2021 semester, John Raj (IE 2021) signed up for the Emory/Georgia Tech Covid-19 Hackathon. The theme of the event was "Hack Covid-19: Back to Work & School Solutions." Raj's team, Sentinel, developed a Covid-19 vaccine and testing management system related to campus building access.

The system was designed so students, faculty, and staff could upload their Covid-19 test results, which would be sent to an administrator for review. The administrator then could grant or revoke a person's access to campus buildings based on whether they were getting tested regularly, or if they tested positive for the virus. Once a user was accepted by an administrator, a personalized QR code could be generated to allow the user to enter buildings.

"This system would incentivize users to regularly get tested, so they could move freely around campus," Raj explained. "Our software also has the ability to show statistics of positive and negative cases of Covid-19 within the system, which would allow administrators to respond more flexibly to facility management."

THE COVID CONVERSATION

Throughout his time at Georgia Tech, ISyE third-year Mihir Kandarpa has been involved in public health activities, serving as chair of health and well-being for the Student Government Association and as secretary of the Undergraduate Public Health Association.

"Watching the pandemic unfold, I felt helpless about improving the situation, so I looked for a way to give back to my community while also advocating for change," he said. Kandarpa joined The Covid Conversation (TCC), a Georgia-based organization that provides fact-based, nonpolitical information about Covid-19. Through its Instagram account, @thecovidconversation, TCC disseminates information and awareness of its hosted service activities to its target demographic, Gen Z.

Kandarpa's first role at TCC was director of Georgia outreach, organizing fundraisers. Now, as the organization's chief of staff, he strives to improve its operational efficiency and develop a long-term strategic plan as TCC works toward becoming a nonprofit.

"I want to use my ISyE skill set to help shape our global health policies, making sure that we're better prepared [for another pandemic]," he said.

SMILE

In early March 2020, Covid-19 was just starting to surge in the United States, marking the beginning of a completely different college experience that left many students feeling isolated from their instructors and peers.

Around the same time, the Georgia Tech organization Spreading Messages in Love and Encouragement (SMILE) was formed. SMILE creates initiatives to bring positivity and joy to the Georgia Tech community.

Given its mission, many of SMILE's efforts are geared toward combating the effects of the pandemic, such as giving quarantine encouragement bags to sick students and posting uplifting messages around campus — including Post-it notes on the Wreck and chalking up walkways.

Two ISyE students, third-year Vignesh Sekar and fourth-year Hannah Tracy, have been active members of SMILE since Fall 2020.

"First of all, the message, the initiative itself, what SMILE stands for — why wouldn't you want to join it? It's spreading positivity on campus," said Sekar.

"I can tell that the things that SMILE's doing are really making a difference on campus," reflected Tracy. "Even if it's bringing people a few moments of happiness, that can go a long way." ▪ ANGELINE FU

Carolina Howell

After completing a project with the Fresh MARTA Market in her supply chain economics class (ISYE 4301), ISyE fifth-year Carolina Howell was inspired to find a sustainability internship. “This project helped me see that industrial engineers can use their skills for social impact,” she said. Fresh MARTA Market provides fresh produce to Atlanta commuters, which made interning at the Small Bites Adventure Club (SBAC) a fitting choice for Howell.

Located in Atlanta, SBAC is a women-owned startup that creates activity kits for children to learn about, grow, and cook with fruits and vegetables. Howell’s position was sponsored through Georgia Tech’s academic initiative Serve-Learn-Sustain. In her role, she worked directly under SBAC’s co-founders, assisting with operations and sales.

Howell’s projects included standardizing the packing process, analyzing orders, and creating a parent survey to find possible areas for growth. One of her most impactful experiences was speaking to customers and seeing various farmers work toward a more sustainable community at local farmers markets.

“Aside from learning a ton of cool veggie facts, I also realized that it takes a community of partners, not a single organization, to make real change,” she said. “I saw firsthand how staying focused on our mission and involving a diverse set of players can empower members of the community and bring value to your product.”

Not only did ISYE 4301 inspire Howell’s choice of internship, it also helped with her work. “This course helped me expand my way of thinking and has been an integral lesson as I approached my internship,” she said. “Industrial engineering is all about tackling a problem considering various factors, like how picky eating and exposure to fruits and vegetables at a young age can play into creating a generation that supports fresh food and local farming.” ▪ ANGELINE FU

Two ISyE Alumnae Included in GTAA's 40 Under 40

Ashley Elleby, IE 2008

Head of Growth — Devices & Services, Brand, Privacy, & Google Ads, Google

Recognizing a void in the fashion industry for tall women, Elleby started Alyssa Vermell Apparel in 2011, a fashion company to help tall women who struggle to find affordable clothes that fit. Later, she invested in and served as vice president of marketing for a new restaurant concept in Brooklyn, N.Y. In 2018, Elleby joined Google to build a new marketing function that would drive revenue growth for Google Search and Chrome through digital advertising and grassroots marketing tactics. Within the first year, she drove record product installs and ad revenue. Google expanded her role to include all of Google Ads, hardware devices, and subscription services as well as its Privacy & Security division. Now as head of growth, she leads a global team that leverages data science and predictive algorithms to better understand consumer behavior. In 2020, Elleby helped pivot Google apps and products to be more inclusive and helpful to the Black community. She also helped create the company's first digital Juneteenth celebration, partnering with artists like LeVar Burton and Loveis Wise.

"Georgia Tech was the first educational institution that challenged me," Elleby says. "It required me to not only focus on my studies, but it pushed me to make a decision early on about the kind of person I wanted to be."

Fun fact: Elleby is a real estate investor. She "house-hacked" her building, putting the money she saved on rent toward a down payment on another multifamily building.

Kendall Rankin, IE 2017

Program Manager, Venture All Raise

During her time at Tech, Rankin founded The Diamond Campaign (TDC), a nonprofit with the mission to empower Black women to embrace their unique cut (body image), color (personal brand), carat (self-worth), and clarity (vision for the future). Rankin leads a team at TDC that has impacted more than 1,500 Black women and girls across the United States. In 2018, she expanded the nonprofit from Atlanta to Chicago. McKinsey & Company selected TDC as one of 40 nonprofits across the globe to receive a financial contribution as part of its $5 million commitment to empowering Black communities. In addition to her work with TDC, Rankin recently joined All Raise, a startup nonprofit with a two-part mission: significantly increase the amount of venture capital funding going to female founders from 11% to 23% by 2030, and double the percentage of female decision-makers at U.S. tech venture firms with more than $25 million in assets under management by 2028. She was hired to help broaden All Raise's presence in the Midwest, as well as build and scale the nonprofit's programs.

"We each have a specific purpose in this world, and being a student or recent graduate of Georgia Tech sets us up so well to begin uncovering what that may be," Rankin says.

Fun fact: One of Rankin's ultimate travel goals is to cross the Drake Passage and make it to Antarctica.

Content provided by the Georgia Tech Alumni Association. To view all 40 honorees in the Class of 2021, visit gtalumni.org.

Get to Know ISyE's Newest Advisory Board Members

Ron Beerman, Laticia Khalif, Jennifer McKeehan, Evren Ozkaya, and Amy Wheelus joined the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) Advisory Board in the summer of 2021.

These five, along with 15 other distinguished professional and community leaders, serve as a sounding board for the school chair in an advisory capacity and assist with development goals. Each new member will serve a four-year term (2021-25). Scott Herren (IE 1984), executive vice president and chief financial officer of Cisco, was named the advisory board's new chair, and Catherine Cooper (IE 1990), president of World Connections, was named vice chair. Both will serve a one-year term in these roles.

Ron Beerman (IE 1973) is founder and chairman of the board for Profitmaster Displays, Inc., a company that has grown to become the leading supplier of merchandising and point-of-purchase displays for the soft drink and packaged beverage industry. Prior to this role, he was employed by Anheuser-Busch, The Coca-Cola Company, and Mead Corp. in a variety of engineering, marketing, and planning positions. In addition to his ISyE degree, Beerman holds an MBA from Harvard Business School.

What was your takeaway from the ISyE undergraduate experience? *"The IE program provided me with a great technical and analytical background on which to build a career. It taught me how to define, approach, and solve a problem, and the value of having a system for everything — disciplines that I know I apply every day, even if sometimes subconsciously."*

Laticia Khalif (IE 1988, M.S. IE 1991) is director of quality, medical device for Aptar CSP Technologies. In this role she is responsible for ensuring compliance with all internal and external requirements, as well as for monitoring the effectiveness of Aptar's quality management system through maintenance, assessment, and improvement. Prior to this role, she worked at well-established medical device manufacturers as well as startup companies, which have collectively led to an extensive, well rounded, and focused career as a quality professional in the medical device industry.

Who was your favorite professor and why? *"My favorite professor was Augustine Esogbue. Not because of the courses he taught, but because of what he represented to African American students at the Institute during those first 25 years of African American students on campus. It was his role modeling, mentorship, and encouragement as the faculty advisor for the National Society of Black Engineers. It was knowing how proud he was going to be when we 'got out' of GT. Those are the things that pushed me forward, made me excel, and caused me to dig deep — because I wanted to make my favorite professor proud."*

Jennifer McKeehan (IE 2005) is senior vice president, integrated supply chain, for Peloton Interactive. In this role, she and her team are leading the supply chain transformation to scale and support an incredible growth trajectory across people, process, and technology. Prior to this role, McKeehan was vice president, supply chain for The Home Depot, leading the inventory planning and replenishment supply chain functions for all fulfillment channels across stores and online, and managing over $15 billion of inventory.

What was your favorite class and why? *"I loved probability and statistics — it is the foundation to so many things we use in everyday life. I still bust out my textbook in a meeting every now and then."*

Evren Ozkaya (Ph.D. IE 2008) is the founder and CEO of Supply Chain Wizard, LLC, a management consulting and digital solutions firm helping clients establish and execute cost-effective and scalable digital transformation programs via data-driven decision-making by leveraging state-of-the-art technology. Prior to starting Supply Chain Wizard, Ozkaya was a consultant and led various business transformation programs in industries such as pharmaceuticals, healthcare, consumer goods, industrial, logistics, and private equity.

Who was your favorite professor and why? *"Pinar Keskinocak. She was my primary Ph.D. advisor, and she presented me with lots of cool opportunities at ISyE from internships to research and teaching. She also later became a lifelong friend, collaborator, and a person I look up to as she continues to excel in every aspect of her career as a globally recognized leader."*

Amy Wheelus (IE 1990) is vice president of architecture and strategic planning for AT&T's consumer technology platforms. In her career at AT&T, she has done everything from building buildings to launching new businesses, and has held various technology leadership roles across business units, including AT&T Labs. She currently serves as board chair for Tech Titans, a forum that connects the regional technology community of north Texas. In addition to her ISyE degree, Wheelus holds an MBA from Emory University.

What is your best ISyE memory? *"My best ISyE memory comes not from when I was a student, but rather after I started working at AT&T and submitted a project proposal for Senior Design. Having the opportunity to work with students from ISyE to solve real problems for my company is a great memory."*

New Fellowships Support Graduate Research

Alumnus Funds ISyE's First President's Fellowship

Ronald J. Beerman, IE 1973, and Carol T. Beerman believe strongly in the value of higher education, particularly at the graduate level. "My wife and I both pursued graduate degrees, and we want to create similar opportunities for others," he said. Beerman went on to earn an MBA from Harvard, and Carol earned a master's in education. Both have had successful careers in their chosen fields, and both give a lot of credit to their educational experiences.

Now the Beermans are giving back in the form of four endowments, two of which support faculty and graduate students in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE). Their support is directed toward "keeping the brightest graduate students — particularly Ph.D. candidates — at Georgia Tech through endowed research and teaching assistantships, and an endowed flexible faculty support fund," Beerman said. "Georgia Tech's ISyE School is perennially ranked No. 1 in the country for both its undergraduate and graduate programs. It is a tremendous resource, and it just makes sense to support and expand the School."

Haden Boone, Beerman Fellow

The Ronald J. and Carol T. Beerman President's Fellowship enables and enhances ISyE's ability to attract and retain graduate students to pursue their degrees and facilitate their work at the Stewart School.

Advisor: Assistant Professor Mathieu Dahan
Focus Area: Operations Research

Haden Boone is researching optimization techniques to solve a network inspection problem where a defender places a number of sensors according to a probability distribution to detect attacks on targets of varying criticality from a strategic opponent. The assumption is that detection is imperfect, and that detectors have a probability of failure associated with both the location of the sensor and the monitored target. To put it into perspective, this research could be used to devise a police patrol routing system with limited resources that minimizes the number of undetected crimes or attacks on critical targets such as banks, schools, or other high value/populated areas.

"The furthering of math and statistics, and in particular their practical application to unintuitive areas, has always been an aspiration of mine. From the moment I took my first ISyE class, I fell in love with the major, and after realizing that I had the potential and the opportunity to make an impact in the field, the decision to stay at Georgia Tech — the most prestigious institution in optimization — was a no-brainer," said Boone. "Perhaps more impactful, however, is my desire to teach at the collegiate level. After spending four years surrounded by some of the best and brightest engineers, how could I not want to stick around if it meant I had the chance to shape the most brilliant minds in the industry?

"Receiving the inaugural Beerman Fellowship is a huge honor, and it serves to validate my hard work over the past four years at Georgia Tech. This fellowship will give me the opportunity to bring my passions and ambitions in the ISyE field to reality, and I hope to give back to the industry, the Institute, and the ISyE program what they have given to me tenfold."

Jorge Huertas, Ryder Fellow

The Ryder Fellowship supports graduate students working on innovative ISyE efforts to analyze and address problems and challenges that affect the safety of autonomous vehicles.

Advisor: A. Russell Chandler III Chair and Professor Pascal Van Hentenryck
Focus Area: Operations Research

Jorge Huertas is analyzing how to optimize middle-mile freight transportation with autonomous vehicles and coordinate it with first- and last-mile logistics. To accomplish this, potential transportation costs are reduced by using real operations data as input to an optimization model that minimizes total empty driving miles. Research currently underway focuses on decomposing this optimization model into a column-generation algorithm that obtains high-quality solutions efficiently, and the ability to scale them nationwide.

Hanyu Zhang, Seth Bonder Fellow

The Bonder Fellowship supports graduate and postdoctoral students working with Professor Pascal Van Hentenryck's outreach programs in ISyE, including the Seth Bonder Camp in Computational and Data Science for Engineering and associated activities.

Advisor: A. Russell Chandler III Chair and Professor Pascal Van Hentenryck
Focus Area: Machine Learning

Hanyu Zhang is interested in modeling and forecasting large dynamic systems, particularly transportation systems and electrical grids. Her research includes ridership prediction and traffic flow prediction, capturing the intrinsic spatiotemporal behavior of transportation systems. She is currently working on forecasting renewable energy production for electrical grids.

Alumnus H. Milton Stewart Recognized With Honorary Ph.D. From Georgia Tech

At the Spring 2021 Commencement ceremony, H. Milton Stewart (IE 1961) received an honorary doctorate from Georgia Tech in recognition of his tremendous and longtime service to the Institute.

A leader in the telecommunications industry for most of his career, Stewart is the retired CEO of Standard Telephone Company. He has served on numerous boards including the Georgia Tech Alumni Association, the Georgia Tech Foundation, and the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) Advisory Board. Stewart and his wife, Carolyn, served as honorary chairs of the public phase of Campaign Georgia Tech. They are members of The Hill Society.

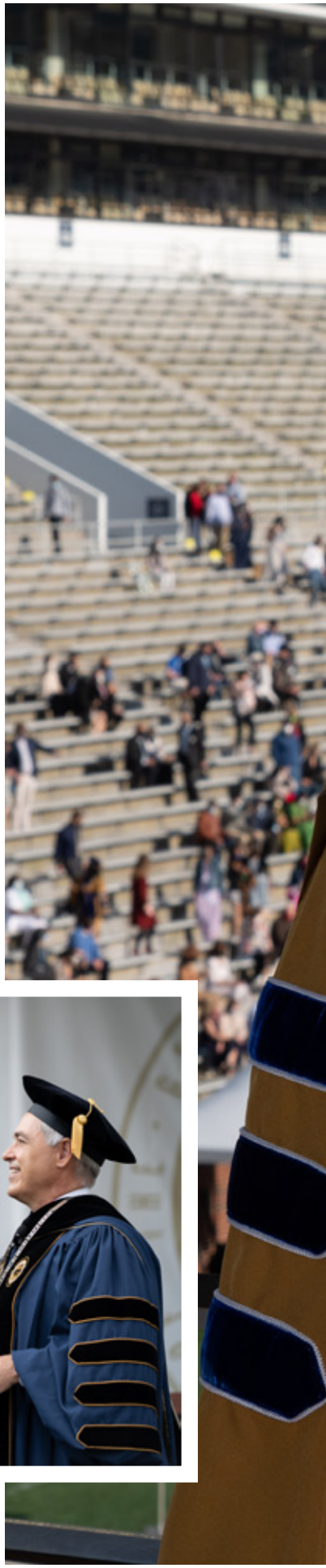
Stewart decided to attend Georgia Tech when George Griffin, then the dean of students, visited his rural Georgia high school. Stewart entered the Institute as an electrical engineering major, then switched to industrial engineering (IE) when he realized the IE curriculum was better suited to his interests in telecommunications and the outdoors.

"I loved statistics," Stewart recalled in a 2006 interview. "Statistics was material to 20th-century telecommunications in order to optimize electromechanical switching equipment to handle busy-hour call volume."

Other IE coursework that he found helpful throughout his career included plant design and layout, material handling, and engineering economy, in addition to numerous interdisciplinary engineering classes. A highlight of Stewart's college career was working as a student assistant in the IE office, helmed at the time by Colonel Frank Groseclose.

The School that bears his name has benefited immeasurably from Stewart's philanthropy. In 1995 he established the H. Milton Stewart Endowment Fund for ISyE programs, and in 1999 he endowed the H. Milton and Carolyn J. Stewart School Chair, the first such chair at the Institute. In 2006 Stewart provided a permanent endowment, which named the School and impacted and enhanced the entire ISyE program.

"ISyE always makes us proud," Stewart said. "Receiving the honorary Ph.D. was a wonderful thrill and is a recognition both humbling to and greatly appreciated by Carolyn and me and by our incredibly supportive family." ▪ SHELLEY WUNDER-SMITH



Right: Stewart receives his hood alongside Georgia Tech President Ángel Cabrera
Opposite page: Milt and Carolyn Stewart at the Spring 2021 Doctoral Commencement Ceremony
PHOTO: ROB FELT

Etienne Batiste visits Berlin Cathedral during her summer internship at Technical University Dortmund in Germany.

Etienne Batiste

One of Etienne Batiste's greatest passions is traveling. Given this, Batiste — a fourth-year math/industrial engineering major dual-enrolled at Spelman College and Georgia Tech — was immediately interested when she heard of an overseas research opportunity. This is how she ended up spending the summer working at the office of corporate logistics at Technical University (TU) Dortmund in Germany.

At TU Dortmund, Batiste's role was to plan and simulate a bicycle factory using a simple mixed-model assembly line model. Her model was then compared against a matrix production model worked on by a fellow college intern from Nepal. "My research allowed me to use my classroom experience with simulation and optimization for a real-world project, and it was a fun way to exhibit my skills gained from class," she said. "I will be able to use this knowledge now that I've returned to the States and apply it to other projects for school and the future."

Though navigating a foreign country alone was challenging, Batiste had a largely positive time in Germany. In her free time, she was able to travel to other countries, like Spain, where she met up with family and relaxed on the beach. "Not knowing German made things difficult at times, but in all it was a good experience," she said. "I enjoy being in a new environment, and I welcomed the differences. Being able to travel, meet new people, and learn more about industrial engineering was the highlight of my trip." ▪ ANGELINE FU

Nick Sahinidis Joins ISyE as Inaugural Butler Family Chair

Professor Nick Sahinidis joined Georgia Tech's H. Milton Stewart School of Industrial and Systems Engineering (ISyE) as the inaugural Gary C. Butler Family Chair in August 2020, with a joint appointment in the School of Chemical and Biomolecular Engineering.

As an undergraduate, Sahinidis studied chemical engineering at Greece's Aristotle University, where he first realized that he particularly enjoyed math and writing code. Through these interests he discovered optimization and its many applications. Then, in graduate school — earning a doctorate in chemical engineering at Carnegie Mellon — Sahinidis encountered the academic journals *Operations Research* and *Management Science*, and he read every past issue he could get his hands on. He also took business classes in mathematical programming, which led him to integer and linear programming.

"I tried out optimization and I loved it, so I stuck with it. By the end of my graduate studies, I was firmly entrenched in systems engineering, and my first faculty appointment was at the University of Illinois Urbana-Champaign in the industrial engineering program, where I taught basic operations research classes," Sahinidis reflected.

He had learned that optimization is helpful for efficiently planning and scheduling chemical processes — and much more: supply chain management, airline scheduling, and device designs. He explained, "The math underneath is the same. Application-agnostic algorithms can be applied by many people in different domains, and that was what particularly fascinated me."

Sahinidis spent 13 years as a professor at his alma mater as the John E.

Swearingen Professor of Chemical Engineering. During his tenure at Carnegie Mellon (where he still holds a courtesy appointment), he continued the development of BARON (Branch-and-Reduce Optimization Navigator), a global optimization software system. BARON solves challenging nonconvex optimization problems, including continuous, integer, and mixed-integer nonlinear problems. Sahinidis also created ALAMO (Automated Learning of Algebraic Models), which is a black-box modeling tool that generates simple yet accurate algebraic models from data.

Given his unstinting interest in optimization, it is perhaps unsurprising that Sahinidis would eventually arrive at the No. 1-ranked Stewart School, with its renowned optimization researchers.

"ISyE has the world's best optimization group — and a top machine learning group too. I am excited that I am working with [Institute Emeritus Professor] George Nemhauser and [A. Russell Chandler III Professor] Santanu Dey on some problems — linear, mixed, and nonlinear — that our field has struggled for decades to solve," said Sahinidis. "There's a famous collection of challenging test problems in this area that originate from applications, including nuclear reactor management, facility location, pipeline design, and other engineering problems. When I first started working on them, we were able to solve about 5%-10%. Now we can solve about two-thirds of those problems, and I'm hoping that what we're researching with Santanu and George will push the capabilities of optimization-solvers for these problems close to 100%."

Sahinidis' current research activities are at the intersection of computer science and operations research, with applications in various engineering and scientific areas including theory, algorithms, and software; informatics problems in chemistry and biology; and process and energy systems engineering.

The ability to perform significant interdisciplinary work with other Georgia Tech faculty members also drew Sahinidis to ISyE, and his affiliate appointments at the Institute underscore this: He is involved with the Algorithms, Combinatorics, and Optimization Program; the Institute for Data Engineering and Science; the Parker H. Petit Institute for Bioengineering and Bioscience; the Manufacturing Institute; and the Strategic Energy Institute.

"Optimization is ubiquitous in applications in science and engineering. With the recent advances in machine learning, optimization is fueling developments in areas we never imagined we could address before. It is truly exciting to be at Georgia Tech, where I can collaborate with world-class colleagues and graduate students on optimization and its applications," Sahinidis concluded. ▪ SHELLEY WUNDER-SMITH

ISyE Welcomes New Faculty

The H. Milton Stewart School of Industrial and Systems Engineering (ISyE) welcomed five new faculty members in 2021: Assistant Professor Diego Cifuentes, Assistant Professor Gian-Gabriel Garcia, Assistant Professor Vidya Muthukumar, Assistant Professor Ashwin Pananjady, and Assistant Professor Juba Ziani.

ASSISTANT PROFESSOR DIEGO CIFUENTES joined ISyE in July 2021. His research centers around the development of mathematical optimization methods and the application of these methods in engineering areas such as machine learning, statistics, robotics, power systems, and computer vision. He also works in the theoretical analysis of optimization methods, leveraging geometric and combinatorial information to improve efficiency and robustness. Prior to joining ISyE, he served as an applied math instructor at MIT and as a postdoctoral researcher in the Max Planck Institute for Mathematics in the Sciences. He earned his Ph.D. and M.S. in electrical engineering and computer science from MIT, and his B.S. in mathematics and B.S. in electronics engineering from Universidad de los Andes.

ASSISTANT PROFESSOR GIAN-GABRIEL GARCIA joined ISyE in August 2021. Garcia's research integrates data-driven prediction and decision models to address high-impact problems in health policy and personalized medicine. He is especially interested in how equity considerations and social/behavioral dynamics impact optimal decision-making. This research spans applications to concussion, opioids, and chronic diseases and he has been awarded a National Science Foundation Graduate Research Fellowship, an INFORMS Bonder Scholarship, the Society for Medical Decision Making Lee B. Lusted Prize, and first prize in the INFORMS Minority Issues Forum Paper Competition. Before joining ISyE, Garcia was a postdoctoral fellow at Harvard Medical School. He received his Ph.D. and M.S. from the University of Michigan and his B.S. from the University of Pittsburgh. He is also passionate about supporting underrepresented students in engineering through mentorship and outreach.

ASSISTANT PROFESSOR VIDYA MUTHUKUMAR joined ISyE in January 2021. She also holds a joint appointment with the School of Electrical and Computer Engineering. Prior to Georgia Tech, she spent Fall 2020 at the Simons Institute for the Theory of Computing as a Simons-Berkeley Research Fellow for the Theory of Reinforcement Learning Program. Muthukumar is particularly interested in designing learning algorithms that provably adapt in strategic environments and deep learning theory. Her honors include an IBM Research Science for Social Good Fellowship, and the University of California, Berkeley EECS Outstanding Course Development and Teaching Award. Muthukumar serves on the senior program committee for COLT 2021. She received a B.Tech in electrical engineering from Indian Institute of Technology (IIT) Madras and a Ph.D. in electrical engineering and computer sciences from UC Berkeley.

ASSISTANT PROFESSOR ASHWIN PANANJADY joined ISyE in January 2021. He also holds a joint appointment with the School of Electrical and Computer Engineering. His research interests lie broadly in statistics, optimization, and information theory, as well as their applications in data science, machine learning, and reinforcement learning. Pananjady received his Ph.D. in electrical engineering and computer sciences from UC Berkeley and a B.Tech in electrical engineering from IIT Madras. He is an inaugural recipient of the Lawrence D. Brown Ph.D. Student Award from the Institute of Mathematical Statistics; the David J. Sakrison Memorial Prize for his dissertation research from EECS at Berkeley; a Simons-Berkeley Research Fellowship in Probability, Geometry, and Computation in High Dimensions; and the Governor's Gold Medal from IIT Madras.

ASSISTANT PROFESSOR JUBA ZIANI joined ISyE in August 2021. He studies the optimization, game theoretic, economic, ethical, and societal challenges that arise from transactions and interactions involving data. In particular, his research focuses on the design of markets for data; on data privacy with a focus on differential privacy; on fairness in machine learning and decision-making; and on strategic considerations in machine learning. Before coming to Georgia Tech, Ziani was a Warren Center Postdoctoral Fellow at the University of Pennsylvania. He received his Ph.D. in computing and mathematical sciences from the California Institute of Technology, his M.S. in operations research from Columbia University, and his B.S. in engineering, energy, and information sciences from Ecole Supérieure d'Electricité (now Centrale-Supélec).

Faculty Awards, Appointments, and Promotions

FACULTY AWARDS

Professor Christos Alexopoulos received the 2020 INFORMS Simulation Society Distinguished Service Award, given "to recognize individuals who have provided long-standing, exceptional service to the simulation community. ... This award is for sustained service to the simulation community over at least 15 to 20 years or longer, and acquitted with distinction."

Alexopoulos also received the 2020 James R. Wilson WSC Board of Directors Award from the Winter Simulation Conference (WSC). The award is given to an individual who has given long-standing, exceptional service to the WSC.

Alexopoulos' research interests center on applied probability, statistics, and optimizations of stochastics systems. His recent work involves problems related to the optimal design of telecommunications and transportation networks. He is the first person to receive both awards in a single year.

A. Russell Chandler III Professor Santanu Dey was the inaugural recipient of the INFORMS Optimization Society Egon Balas Prize. The Egon Balas Prize was established in 2020 and is awarded annually to an early-career individual for significant contributions to the field of optimization. Dey's research interests focus on nonconvex optimization, in particular mixed-integer linear and nonlinear programming. His research is partly motivated by applications of nonconvex optimization arising in areas such as electrical power engineering, process engineering, civil engineering, logistics, and statistics.

A. Russell Chandler III Chair and Professor Roshan Joseph was elected a Fellow of the American Society for Quality (ASQ), which cited Joseph "for outstanding contributions to statistical theory and methods for quality improvement; for dedicated teaching and service to the profession."

Joseph's research interests cover the broad areas of applied and computational statistics. A major focus of his research is developing novel statistical methods for solving complex engineering problems. He has several years of consulting experience in solving quality-related problems in industries.

William W. George Chair and Professor Pinar Keskinocak has been appointed to the National Academies of Sciences, Engineering, and Medicine (NASEM) Committee on Addressing Issues of Vaccine Distribution Supply Chains to Advance Pandemic and Seasonal Influenza Preparedness and Response. The committee will examine "supply chain and distribution challenges related to vaccines and vaccinations during the Covid-19 response and explore their implications for pandemic and seasonal influenza."

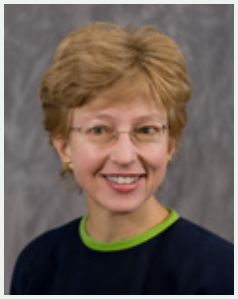
Keskinocak has dedicated her career to the applications of operations research and management science with societal impact, particularly health and humanitarian applications and supply chain management. Most recently, she has focused her efforts on vaccine distribution and infectious disease modeling during the Covid-19 pandemic. She was also named one of *Motherboard*'s 2020 Humans of the Year for her work in this area.

Carolyn J. Stewart Chair and Professor Jianjun "Jan" Shi received the 2021 Walter Shewhart Medal from ASQ. It cited Shi for "his

creative development and implementation of engineering-driven data fusion methodologies to achieve in-process quality improvements in manufacturing systems." The Shewhart Medal is given to individuals who have made outstanding technical contributions and provided leadership in the field of modern quality control and improvement.

Shi was also the 2021 recipient of the NAMRI/SME 2021 S.M. Wu Research Implementation Award. The award — named for Shi's dissertation advisor — honors outstanding original research presented as a paper at the annual North American Manufacturing Research Conference that, upon implementation, has had a significant commercial/societal impact.

Shi's work focuses primarily on the development and application of data-enabled manufacturing. His methodologies integrate system informatics, advanced statistics, and control theory for the design and operational improvements of manufacturing and service systems by fusing engineering systems models with data science methods.



Anderson-Interface Chair of Natural Systems and Professor Valerie Thomas has been appointed chair of the NASEM Committee on Current Methods for Life Cycle Analyses of Low-Carbon Transportation Fuels in the United States. The committee will "assess current methods for estimating lifecycle greenhouse gas emissions associated with transportation fuels (liquid and nonliquid) for potential use in a national low-carbon fuels program." Thomas' research covers environmental lifecycle analysis, energy systems analysis, industrial ecology, and sustainability. Recent work has included evaluation of the environmental impacts of biofuels, direct air capture of carbon dioxide, and production of platform chemicals from biomass; comparison of electric vehicle technologies; and smart-grid approaches to reducing health impacts from power plants, infrastructure resilience, and international electricity development pathways. *[Learn more about Thomas' research on page 30.]*

Professor of the Practice Ron Johnson was named to *CORE Magazine*'s Core 100 Most Influential Blacks Today 2021, along with U.S. Vice President Kamala Harris and Barack and Michelle Obama.

Director of Professional Practice Dima Nazzal has been awarded a Curriculum Innovation Award from Georgia Tech for her development of the ISyE Cornerstone Design course.

A. Russell Chandler III Chair and Professor Pascal Van Hentenryck received the 2021 Georgia Tech Teaching Excellence Award for Online Teaching, which "recognizes a full-time faculty member for strong commitment to engaged online teaching and student success."

Coca-Cola Chair in Engineering Statistics and Professor Jeff Wu delivered the 2020-21 Distinguished Lecture Series in Statistical Sciences at the Fields Institute.

Professor Srinivas Peeta, who holds the Frederick R. Dickerson Chair in the School of Civil and Environmental Engineering and a joint appointment in ISyE, received the 2020 Matthew G. Karlaftis Best Paper Award.

FACULTY APPOINTMENTS

Professor Dave Goldsman, who also directs ISyE's master's degree programs, has been appointed to a Coca-Cola Foundation Professorship, which was established to enhance ISyE's ability to attract and retain eminent teacher-scholars to positions of academic leadership. Goldsman's research interests include simulation output analysis; statistical ranking and selection methods; and medical and humanitarian applications of operations research. The professorship will allow Goldsman to attract students and bring visitors to ISyE.

Professor Roshan Joseph has been appointed to an A. Russell Chandler III Chair, which was created to enhance the School's ability to attract and retain eminent teacher-scholars to a position of academic leadership. Broadly, Joseph's research focuses on applied and computational statistics. Specifically, he studies experimental design, statistical modeling, Bayesian computation, quality engineering, uncertainty quantification, machine learning, and big data analysis. This appointment will help Joseph advance his research activities.

Professor George Lan has been appointed to an A. Russell Chandler III Professorship, created to enhance ISyE's ability to attract and retain eminent teacher-scholars to a position of academic leadership. Lan's research and teaching interests lie in theory, algorithms, and applications of stochastic optimization and nonlinear programming. Most of his current research concerns the design of efficient algorithms with strong theoretical performance guarantees and superior practical performance for solving challenging optimization problems. He is actively pursuing the application of stochastic and nonlinear optimization models in large-scale data analysis, including machine learning, image processing, and simulation input/output analysis. The professorship will support Lan and his students in various research and learning activities.

Professor Jing Li has been appointed to a Harold E. Smalley Professorship, created to enhance the Stewart School's ability to attract and retain eminent teacher-scholars to academic leadership in the field of health systems. Li's research develops statistical machine learning algorithms for modeling and inference of complex-structured datasets with high dimensionality (e.g., 3D/4D images), multimodality, and heterogeneity. These methodological developments aim to provide capacities for monitoring, diagnosis, and prediction and prognosis. The professorship will facilitate broader research collaborations, advanced scholarly contribution, and use-inspired impacts in health and medicine.

Professor Renato Monteiro has been appointed to a Coca-Cola Foundation Professorship, established to enhance the Stewart School's ability to attract and retain eminent teacher-scholars to positions of academic leadership. Monteiro's research interests lie in continuous optimization and complexity of algorithms. More specifically, he is interested in the theory, complexity analysis, and implementation of algorithms for solving large-scale linear programming, convex quadratic programming, semidefinite programming, complementarity problems, convex programming, saddle-point problems, variational inequalities, and general nonlinear programming. He is also interested in computational optimization with specific interest in the development of numerical codes for solving large-scale optimization problems. This appointment will enable Monteiro to further support student research assistants, travel, equipment, and interaction with industry and research community leaders in his field.

Professor Valerie Thomas has been appointed to the Anderson-Interface Chair of Natural Systems, created to enhance the Stewart School's ability to attract and retain eminent teacher-scholars who provide academic leadership in research on natural systems, sustainability, energy, and climate. Her research focuses on energy and materials efficiency, sustainability, industrial ecology, technology assessment, international security, and science and technology policy. Current research projects include the environmental impacts of biofuels and electricity system development, assessment of renewable electricity options, and evaluation of alternative vehicle technologies. This appointment will help Thomas focus on higher-profile projects that examine the role of land and forests in the combined systems of industry, energy, climate, nature, and people.

FACULTY PROMOTIONS

Associate Professor Mohit Singh has received tenure.

A. Russell Chandler III Professor George Lan has been promoted to professor.

Damon P. Williams has been promoted to both senior lecturer and director of the Center for Academics, Success, and Equity.

ISyE Doctoral Student Spotlight

ARDEN BAXTER // Ph.D. student, Operations Research

With innovative research projects in healthcare, it is no surprise Arden Baxter received a prestigious Graduate Research Fellowship from the National Science Foundation. Her work in humanitarian logistics explores how to allocate scarce resources to meet the most demand, specifically in disaster management scenarios where different resource types must work in coordination. "In a hurricane setting, you could have flooding in an area but also people who are hurt and need EMS [emergency medical services], necessitating coordination between water rescue services and EMS to get those people out of their homes and treated," Baxter explained. She has also been involved in disease modeling for Covid-19, studying the benefits and consequences of nonpharmaceutical interventions, such as voluntary quarantine and school closure, and how they affected the people who were homebound. "I knew that I wanted to do something where I felt like I was making a difference," said Baxter. "I've always had this passion for service, and operations research is a great way to combine math and service into one."

HENRY YUCHI // Ph.D. student, Machine Learning

After studying at the University of Cambridge to earn his undergraduate and master's degrees in engineering, Henry Yuchi was drawn to Georgia Tech by the diversity of ISyE research and his interest in the interface of engineering, data science, and statistics. "Across the country, and Europe as well, it is very rare to find a data science or machine learning program in the engineering department," said Yuchi. He is studying low-rank matrix completion as well as computer experiments with multiple mesh density variables — work that earned him a student paper award from the American Statistical Association. His research tackles the engineering problem of using computer simulation software to separate a very large model into mesh cells, or boxes, to make estimates of items such as flow speed and velocity. "I'm trying to find a scheme where we can use different sizes of cells to run different experiments, then combine all the solutions together to improve the accuracy of the experiments, while using fewer computational resources," Yuchi explained.

JIALEI CHEN // Ph.D. 2021, Industrial Engineering

Jialei Chen has been a research assistant at the Georgia Tech Manufacturing Institute, taking part in interdisciplinary research focused on data analytics and its applications to manufacturing and healthcare. One of his projects, a collaboration with Piedmont Heart Institute, proposes a surgical planning framework to treat aortic stenosis, a severe heart disease caused by the narrowing of the aortic valve. The current procedure, which involves inserting a stent, is a standardized treatment with limited customization. "Our ambition is to personalize this surgery procedure for the specific patient," said Chen. "We try to understand through computer simulations and 3D printing experiments which surgery procedure is the best for the patient." His work across multiple research areas has earned him the Ellis R. Ott Scholarship from the American Society for Quality, as well as many first-place awards in student paper competitions. Now that his Ph.D. is completed, he will continue his path in academia as an assistant professor in the department of statistics at the University of Georgia. ▪ GRACE OBERST

Fall 2020 Senior Design

The ISyE Senior Design team Emission Experts took home the Fall 2020 Capstone Expo People's Choice Award. This team, working with UPS to help redesign the company's carbon reporting process, consisted of Wages Carroll, Natalie Lucco, Maggie Monahan, Geneva Rumer, Michael Saia, William Salzano, Joseph Stapf, and Joshua White. They were advised by A. Russell Chandler III Chair and Professor Alexander Shapiro.

The Swing Space Champs won the Capstone Expo award for Best ISyE Project, and they were also selected as a finalist for the Fall 2020 ISyE Best of Senior Design competition from among 18 ISyE teams. They worked with Georgia Tech's Capital Planning and Space Management to evaluate how campus spaces are allocated during renovations. Locating sufficient swing space shortens renovation timelines, potentially realizing millions of dollars in savings for the Institute over the next decade. The team was advised by Associate Professor Steve Hackman.

The other two ISyE Best of Senior Design finalist teams — ultimately selected as joint winners — were Should It Stay or Should It CIS-GO and Don't Go Breaking My Hartsfield. Should It Stay or Should It CIS-GO worked with Cisco Systems to evaluate and optimize Cisco's global supply chain network. The team explored network design alternatives, investigating trade-offs among costs, carbon emissions, and lead time. They proposed enhancements to Cisco's current network that projected savings of up to $29 million and a reduction in carbon emissions of 76,000 tons. They were advised by Professor Craig Tovey.

Don't Go Breaking My Hartsfield worked with Delta Air Lines to reduce wait times at the domestic TSA checkpoint of Atlanta's Hartsfield-Jackson International Airport, which is the busiest airport in the world. The team analyzed the service rate of the TSA checkpoint to create a scenario-based approach for recommending the number of checkpoint lanes, which will reduce average wait times by 12%, and the number of passengers waiting over 15 minutes by 20%. They were advised by Associate Professor Steve Hackman.

SWING SPACE CHAMPS Top row (from left): Prerna Balaji, Savannah Chunn, Zach Hess, and Chidambaram Kadiresan; bottom row (from left): Makala Muhammed, Abbey Nannis, Sarah Poff, and Sena Sennaroglu

SHOULD IT STAY OR SHOULD IT CIS-GO Top row (from left): Jay Patel, Deep Patel, Parth Patel, and Karim Layoun; bottom row (from left): Isabel Jaffoni, Karen Loscocco, Ishita Date, and Amanda Nima

DON'T GO BREAKING MY HARTSFIELD From left: Zach Connolly, Ricardo Estrada, Vinay Dalal, Jose Correia, Yuhe Chen, Marcel Mensch, and Valentina Betancourt

Spring 2021 Senior Design

Tied Winning Teams and National Competition Winners

NEW HOMES FOR RADOMES Top row (from left): Vishal Hansalia, Rahil Manji, and Matthew Oswald; bottom row (from left): Kathryn Otte, Harper Power, and John Raj

Senior Design team New Homes for Radomes, the ISyE Spring 2021 Capstone Expo winner, worked with the 402 Commodities Maintenance and Electronics Maintenance groups at Robins Air Force Base, which repair and test aircraft radomes (enclosures that house radar and other electronics). The goal was to design a process flow and workstation layout for a new facility to decrease cycle times, increase capacity, and add capability for managing demand variation. The facility layouts and trade-off analysis provided a customizable solution that will meet increasing demands on time and remain adaptable as Air Force requirements change. They were advised by ISyE Professor Emeritus Gunter Sharp.

The Capstone Expo's People's Choice Award went to Senior Design team Forecasting MoDELL, which worked to improve client Dell Technologies' drive return process to decrease overage and shortage costs. They were advised by A. Russell Chandler III Chair and Professor Alexander Shapiro.

Out of 26 ISyE teams, three were chosen to participate in the virtual ISyE Best of Senior Design competition.

One of the two winning teams, The Fastest Picker-Upper, partnered with NAPA, an aftermarket automotive parts provider, to improve labor productivity at its newest distribution center in Nashville, Tennessee. The team's solution strategies addressed the putaway, picking, and consolidation operations and delivered three tools that NAPA can integrate into its warehouse management system. NAPA can expect to

FORECASTING MODELL Top row (from left): Jianzhe (Andy) Xu, Haolin Ye, Juan Redondo Albertos, and Mukram Aljandali; bottom row (from left): Joan Saheb, Marc Al Haj, and Heewon (Eden) Jeong

THE FASTEST PICKER-UPPER From left: Michael Tang, Jay Lee, Isabella Pappaterra, Paulina Cucalon, Camila Pozo, Ved Mohan, Sofia Carvajal, and Ethan Channell

improve productivity by more than 7%. They were advised by Associate Professor Steve Hackman.

The other winning team, Watt-lanta, worked with the Atlanta Department of Transportation (DOT) to provide a data-driven methodology that maximizes investments in streetlights, with the goal of reducing overall crashes and crime. The team's approach centered around building a sociodemographic-conscious priority model of roads and a costing tool to give Atlanta DOT the ideal level and order of intervention. This will ultimately transform the city's installation of streetlights from a reactive to a proactive system. As a result of this project, the mayor's office has announced a historic expansion of 10,000 streetlights in the city. They were advised by ISyE Professor Emeritus Leon McGinnis.

WATT-LANTA Top row (from left): Isaac Hergott, Andres Farach, Jordi Sabria, and Esteban Ulloa; bottom row (from left): Gabriella Marenco, Willem Hartog, Monica de Armas, and Alyssa Sullivan

The third finalist team, Cold Chain Soul Train, worked with Amazon Freight to create a cold chain design for the company. Despite offering a variety of refrigerated goods to customers, Amazon does not currently have the capability to transport refrigerated goods without contracting with third parties. The team developed a computational engine that provides recommendations about the strategic acquisition and operational deployment of a cold chain fleet. The proposed solution will reduce both total system cost and reliance on third-party logistics. They were advised by Associate Professor Steve Hackman.

COLD CHAIN SOUL TRAIN Top row (from left): Matthew Link, John Browning, Shrey Udhaya, and Charlie Howard; bottom row (from left): Thomas Culwell, Viviana Osorio, Isabelle Liffiton, and Riley Martin

ISyE Teams Win IISE National Competition and CREATE-X Capstone

Cold Chain Soul Train and New Homes for Radomes also competed in the IISE Outstanding ISE Capstone Senior Design Project competition with 21 other teams from across North America. Cold Chain Soul Train was selected as the overall winner, and New Homes for Radomes placed third.

In addition, for the first time ever, ISyE students joined the CREATE-X Capstone course to complete their Senior Design project. Team Helluva Energy-neers, an ISyE-dominated team with the Georgia World Congress Center (GWCC) as its client, won the Best Project award across 13 teams. The team worked with GWCC to more accurately predict an event's electricity usage and cost, which could lead to an estimated increase in annual profit of 17%. Team members included Abdulhafiz Abdullahi, Ronnie Bian, Jackson Burke, Aarushi Khajuria, Sonakshi Mishra, Junzhe Ruan, Jordan Rodrigues, Vale Tolpegin, Laura Zhang, and Sam Zimmerman. *[Learn more about this project on page 24.]*

2021 LeeAnn and Walter Muller Distinguished Lecture: Industrial Internet of Things and Smart Personalized Manufacturing

On Sept. 23, 2021, ISyE hosted University of Georgia's (UGA's) S. Jack Hu as the 2021 LeeAnn and Walter Muller Distinguished Lecturer. Hu currently serves as the UGA Foundation Distinguished Professor of Engineering, and senior vice president for academic affairs and provost at UGA. Prior to joining UGA, he was vice president for research, the J. Reid and Polly Anderson Professor of Manufacturing, professor of mechanical engineering, and professor of industrial and operations engineering at the University of Michigan.

During the lecture, Hu discussed how the Industrial Internet of Things enables the connection of sensors, devices, and systems, and the rapid communication of data among them. He also explained how such data provide unprecedented opportunities for smart manufacturing, including real-time monitoring and optimal decision-making.

Hu has authored or co-authored nearly 200 peer-reviewed journal articles related to his research in manufacturing systems, assembly, and engineering statistics. He holds six patents and has worked closely with several industry partners to enhance manufacturing quality and productivity.

Hu is a member of the U.S. National Academy of Engineering and a foreign member of the Chinese Academy of Engineering. He is a Fellow of the American Society of Mechanical Engineers (ASME), the Society of Manufacturing Engineers (SME), and the International Academy for Production Engineering. He has received the ASME William T. Ennor Manufacturing Technology Award, the SME Gold Medal, and several best paper awards.

In 2008, the Stewart School established the Distinguished Lecture Series to promote discussion on critical issues in the fields of industrial and systems engineering by bringing in prominent scholars and business leaders who engage and share their expertise with students, faculty, and alumni. In 2018, thanks to a generous gift from LeeAnn and Walter Muller, it became the LeeAnn and Walter Muller Distinguished Lecture Series.

Maxim Geller

Before this past summer, ISyE third-year Maxim Geller had never been to Western Europe. Having grown up learning about Europe's different cultures and arts, he was immediately interested when he discovered the Georgia Tech-Lorraine (GTL) study abroad program in Metz, France. Through GTL, Geller spent the summer taking classes at Georgia Tech's European campus and traveling to various countries on the weekends.

"I learned a lot about the way people live and interact with each other and with foreigners, and more importantly, learned how to make myself comfortable in unfamiliar situations where communication can sometimes be a massive barrier," he said. "Over time, it became easier for me to get around as I became more comfortable with French and the locale."

Some of Geller's favorite memories from studying abroad include wandering the streets of Montmartre in Paris, hiking in the Swiss Alps, and traveling to Neuschwanstein Castle in Germany with his friends from Georgia Tech's swim club. But his most cherished adventure from his summer in Europe was watching the European Football Championship quarterfinals in Piazza del Popolo (The People's Square) in Rome when Italy beat Belgium to propel themselves to the semifinals. "You could feel the energy of the fans in the historic square as if we were at the stadium itself," he said. ▪ ANGELINE FU

Morgan Knowlton Honored for Academic Achievements

Morgan Knowlton (IE 2021) was a standout student during her college career at the H. Milton Stewart School of Industrial and Systems Engineering (ISyE). She served in multiple leadership roles for ISyE and the Institute, all while maintaining a 4.0 GPA. Just before she graduated, Knowlton was selected as Georgia Tech's representative for the University System of Georgia (USG) Academic Recognition Day and received a prestigious Fulbright English Teaching Assistantship for the 2021-22 academic year.

Knowlton, a Stamps President's Scholar, served as an ISyE Ambassador and was also a member of the Georgia Tech Honors Program and three honor societies. Along with her ISyE degree, she graduated with a minor in business and engineering through the Scheller College of Business Steven A. Denning Technology & Management Program.

During her busy college career, Knowlton studied abroad at Georgia Tech-Lorraine and through the ISyE Summer in Asia program. She also completed two internships at Walt Disney World, including one as an industrial engineer in the costuming department.

Being chosen as the Georgia Tech representative for USG's Academic Recognition Day was especially significant for Knowlton.

"Being selected for this award is very personal to me. I have always felt at home at Georgia Tech," she said. "I truly believe that this is where I am supposed to be. Being selected as the Institute's honoree feels like confirmation that I belong here."

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>
> MORGAN KNOWLTON

As part of her Fulbright teaching assistantship, Knowlton is living in La Rioja, Spain, where she teaches math and science. One of the most meaningful aspects of this opportunity is sharing in the daily life of the community around her. Knowlton enjoys "meeting, working, living with, and learning from the people of my host country."

For Knowlton, her Fulbright experience combines her passion for teaching — developed during three years of working as an undergraduate teaching assistant — with a chance to further connect with her Hispanic identity. Knowlton's abuela (grandmother) was born in Cienfuegos, Cuba.

After she returns to the United States, Knowlton plans to pursue a graduate degree in industrial engineering.

▪ LAURIE HAIGH

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Are you interested in collaborating with us? The H. Milton Stewart School of Industrial and Systems Engineering (ISyE) welcomes your engagement and offers many ways to get involved. ISyE works closely with business and industry leaders on a variety of research efforts and other projects, as well as student enrichment activities. You can also connect with ISyE through sponsorships and philanthropy that both bring the best education possible to our students and support our faculty as they tackle research issues that improve the quality of life for all.

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In December 2020, after finishing his last-ever finals as an ISyE undergraduate student, **Ali Amirfazli** (IE 2020) hopped on his bike and rode 2,228.4 miles from Marietta, Georgia, to Los Angeles, California.

With a rough goal of biking 100 miles a day, Amirfazli hoped to complete his cross-country trip in about four weeks, arriving in time to celebrate his birthday in the Golden State. En route he dealt with broken bicycle parts and multiple flat tires, as well as snowy conditions and temperatures in the single digits. He cycled into LA after 24 intense days.

Now back at Georgia Tech, Amirfazli still bikes about 200 miles weekly while studying for his master's degree in computational science and engineering.