

GEORGIA INSTITUTE OF TECHNOLOGY

INDUSTRIAL & SYSTEMS ENGINEERING

THE H. MILTON STEWART SCHOOL OF ISYE ALUMNI MAGAZINE • FALL 2017



**ISyE: Legends
Among Us**

ON BEHALF OF ALL OF US AT THE H. MILTON STEWART SCHOOL of Industrial & Systems Engineering (ISyE), I am pleased to share the latest issue of our annual alumni magazine with you. In these pages, you will read about noteworthy students, faculty, staff, and alumni, as well as stories about our outreach programs and research projects currently underway, and the significant implications they have in improving our way of life.

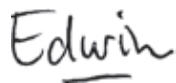
What sets ISyE apart is the people—our remarkable undergraduate and graduate students, extraordinary faculty, dedicated staff, and engaged alumni and friends. It is truly a collective effort as we work together to educate current and future generations of industrial engineers while developing the foundational basis of the field as well as application-driven research.

Two of the most influential figures in the world in optimization, A. Russell Chandler III Chair and Institute Professor George Nemhauser and John Hunter Chair and Professor Arkadi Nemirovski, are the subjects of our cover story. I invite you to read about their career paths and their outstanding contributions to the field, to the Stewart School, and to industry. They have shaped generations of students, as well as supported and inspired their colleagues at ISyE and beyond.

This issue also profiles young ISyE alumni who are making their mark in academic careers at top universities across the country. As the alumni reflect on their burgeoning careers, they talk about inspiration, the ISyE faculty members who encouraged and supported them in their endeavors, and how their educational experiences here prepared them for successful careers in academia.

While the stories and images throughout offer a glimpse into the students, faculty, and alumni who comprise the Stewart School, I hope you will see for yourself and visit the next time you're on campus. I encourage you to remain connected to ISyE and consider the many ways to get involved: Partnering on student projects or research, recruiting our students, serving as a mentor, attending a professional education course or certificate program, or providing philanthropic support are just some of the opportunities for collaboration.

Go Jackets!



H. Edwin Romeijn, Ph.D.

H. Milton and Carolyn J. Stewart School Chair and Professor
H. Milton Stewart School of Industrial & Systems Engineering





12

Feature Story

12

NemFest: Celebrating Optimization Legends George Nemhauser and Arkadi Nemirovski



26



49



52

ISyE News & Additional Features

- 2** ISyE by the Numbers
- 4** Senior Design Teams Find Solutions Using New Technologies
- 7** Educational Outreach: Mission Possible
- 8** Educational Outreach: Energy and Environmental Leadership Camp
- 9** Abe Cheung: A LEAP Success Story
- 11** ISyE Professor Jeff Wu Awarded the 2017 ENBIS Box Medal for Achievements in Statistics
- 19** Faculty at Universities Across the Country Reflect on Career Inspiration
- 26** Thoughts on Teaching Abroad
- 28** Lecturer and Pastor Damon P. Williams on His Complementary Careers
- 31** Increasing Student Engagement by Flipping the Classroom
- 32** Theory-focused Institute to Advance Foundations of Data Science
- 33** ISyE Houses Several Advanced and Interdisciplinary Degrees
- 34** Welcoming New Faculty to ISyE
- 36** Research Briefs
- 43** Brenda Dietrich, ISyE 2017 Distinguished Leadership Lecturer, Shares Perspectives on the Deployment of Operations Research Methods
- 44** ISyE Inducts Five New Advisory Board Members and New Chair at Spring 2017 Meeting
- 46** ISyE Alumna Errika Moore: Making an Impact in STEM
- 49** ISyE Alumnus Jim McClelland: A Life of Public Service
- 52** An ISyE Student at SpaceX
- 54** Empowering Young Women in STEM

ISyE by the numbers

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



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

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

Degrees Offered:

1 B.S. in IE Degree

With 6 concentrations in:

- Economic and Financial Systems
- General Industrial Engineering
- Operations Research
- Operations Research – Advanced Studies
- 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

General Master's degrees:

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

Online Master's degree:

- Master of Science in Analytics

5 Doctorate Degrees

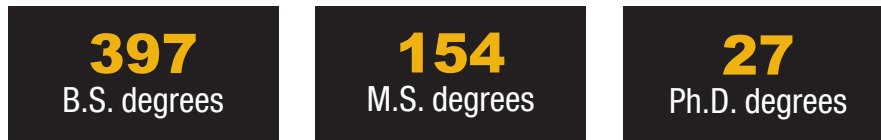
• Industrial Engineering with concentrations in:

- Supply Chain Engineering
- Statistics
- Economic Decision Analysis
- System Informatics and Control
- Operations Research
- Algorithms, Combinatorics, and Optimization
- Bioinformatics
- Computational Science Engineering

Academic Year 2016-17



ISyE Degrees Awarded



Among ISyE undergraduates...

- **37** participated in research.
- **16** participated in the Denning Technology & Management Program.
- **25** were Stamps President's Scholars.
- **227** interned or studied abroad.

Of the 397 B.S. IE degree recipients in 2016-17...

- **59%** graduated with honors.
- **24%** graduated with a co-op designation.
- **41%** were female.
- **\$68,000** was the median starting salary.

Fall 2017



*includes co-op and study abroad students



Alumni

As of September 2017...



Of all **155,427** living Georgia Tech alumni, **12% (18,361)** are ISyE degree holders.



90.74% live in the U.S. & U.S. territories;
9.26% are international.*

*for alumni with known addresses

Snapshot of Top 10 Careers of ISyE Alumni*

1. Other	2,657
2. Manager/Supervisor	1,842
3. Engineer	1,280
4. Director	845
5. Vice President	645
6. President	620
7. Consultant	604
8. Analyst	523
9. Business Owner	288
10. Professor	221

*based on employment records for 10,572 ISyE alumni

Senior Design Teams Find Solutions Using New Technologies

Thirty-one Senior Design teams from Georgia Tech's Stewart School of Industrial & Systems Engineering (ISyE) completed real-world Capstone projects for the spring 2017 semester.

"The 31 spring 2017 Senior Design projects involved 234 students and 10 faculty advisors. The projects served a broad range of clients, including manufacturing, operations, logistics, warehousing, energy, financial systems, hospitals, online business, retail, and government. Several teams explored solutions involving new technologies, such as crowd-sourcing delivery services, drone delivery of urgent orders, online collaboration services, and blue-tooth tracking of medical staff and patients," said Leon McGinnis, professor emeritus and Senior Design coordinator.

"Every team provided significant value to their client, and a significant fraction of teams projected benefits valued at six or seven figures," continued McGinnis. "As always, it was an intense and important learning experience for the students. The difficulty in narrowing down to four finalist teams for the ISyE Best of Senior Design was a testament to the high expectations, tough standards, and overall outstanding quality of our graduating seniors."

The teams presented their projects at the spring 2017 Capstone Expo. Out of this group, four teams — CDC Contact Tracing, CDC Smoke, Emory Discharge, and MBUSA Drone — were chosen as finalists to compete in the ISyE Best of Senior Design on May 3, 2017. Team MBUSA Drone was selected as the first-place winner.

First Place: Team MBUSA Drone

Mercedes-Benz USA (MBUSA) engaged this team to identify how drone delivery could be valuably introduced as the first same-day part ordering option for its dealerships. The team designed a drone delivery solution to reduce part delivery time and loaner car cost and developed a coverage optimization model to determine the optimal locations to hold the drones and parts eligible for drone delivery. MBUSA will be able to leverage the model's user interface to modify key parameters, including associated costs and drone capabilities, and view updated model results as well as their respective net present value. Implementing such a drone delivery solution will allow MBUSA to gain a first-mover advantage, an increase in customer satisfaction, and cost savings.



Vikrant Jain, Austin Proctor, Yanyang Zhao, Ryan Rodwell, Ram Bhutani, Stephen Murphey, Alvin Tight, and Santanu Dey (Advisor)



Dylan Floyd, Samuel Curtsinger, Derek Nalodka, Sean Monahan, Phillip Vetrano, Josh Kulas, Emily Smith, Rachel Thorne, and Julie Swann (Advisor)

Finalist: Team Emory Discharge

The team designed process changes and developed a unique tiered discharge procedure precipitating patient departure time from Emory Midtown Hospital. The team also implemented an expedited taxi arrangement, which indicated the viability of solutions with increased patient uptake throughout the pilot. By facilitating patient flow, solutions were shown to reduce diversion by 2.6 percent, cut boarding times by 30 minutes, and allow Emory to serve 63 more ambulance arrivals per year. Financially, the project yielded a \$306,000 increase in annual revenue and a \$1.1 million net present value, while also increasing patient quality of care.

Finalist: Team CDC Smoke

The team worked with the Centers for Disease Control and Prevention (CDC) to support a recent policy by HUD where effective February 3rd, 2017, all 1.3 million public housing units must go “smoke-free” within 18 months. They created a targeted approach to smoking cessation by estimating smoking prevalence within the public units, calculating the return-on-investment of each cessation intervention at a granular level, and prioritizing recommendations that yield the highest returns. They developed a tool, EXTINGUISH, that visualizes relevant data in order to help better utilize resources to connect smokers to cessation resources. The values of the project included greater efficiency for health departments, better connections between agencies and cessation resources, and increased support of smokers wanting to quit. With the project, the team identified approximately \$12 million to \$582 million in savings (approximately 6 percent to 20 percent in cost reductions) for the stakeholders for different smoking cessation interventions.



Aaron Ahn, Kristie Choe, Vishal Mummigatti, Connor Owen, Jose A. Rodriguez, Diem Tran, Divya Vedula, Jiali Zhao, and Julie Swann (Advisor)

Finalist and Capstone Judges' Choice: Team CDC Contact Tracing

The team developed a decision-support tool to help the CDC identify infected airline passengers during contact tracing investigations. Taking in pathogen and flight parameters, this novel application returned a transmission-risk model and analyzed alternative protocols. The application's versatility enabled comprehensive scenario coverage, and its back-end allowed for continuous improvement by health authorities nationwide. Adopting the revised protocol anticipates savings up to \$300,000 per flight.



Pinar Keskinocak (Advisor), Alexander Kenres, Yuntong Zhu, Kev Desprez, Chungjae Lee, Leah Patterson, Suphaphat Petlerkwong, and Jason Bermudez

Capstone Judges' Choice: Team Equifax

The Equifax Credit Marketing Services (CMS) team created customer information reports for client marketing efforts. The CMS team had concerns with the lack of standardization in their current staffing and project assignment process. In fact, CMS had delivered 32 percent of projects late, or past the client committed date, over the past two years. They created a labor allocation tool to help CMS efficiently assign employees to projects. In addition, they conducted a general process improvement to reduce total project completion time by implementing process manuals and training. Their tool and process improvement reduced the late project percentage by nine percent, which opens the opportunity for \$5.5 million in additional revenue for CMS.



Alexander Shapiro (Advisor), Anju Suresh, Jihwan Oh, Yeji Lee, Srida Saraogi, Maria Auslander, Shirum Agrawal, and Divya Achtani

➤ **MISSION POSSIBLE** participants enter the camp with a vague notion, if any, of what industrial engineering is. By the end of the week, they have participated in activities that help them better understand optimization, workforce agility, data analytics, supply chain, manufacturing, project management, and professional communication. Campers get to tour local businesses – like Coca-Cola and Walmart – and see how they function behind the scenes.

“At the end of the week, both the participants and their parents tell me how much fun they had and how excited they are about industrial engineering,” said Brandy Blake, Mission Possible coordinator and ISyE professional and technical communication coordinator. “This was our sixth year of Mission Possible, with 23 rising 9th-12th graders attending. The students who come to the camp continue to amaze me. We always try to accept a range of students – representing different hometowns, ages, races, genders, economic backgrounds – both to provide students from everywhere with the opportunity to enjoy the camp and to make sure that the campers understand that college is a diverse place.” ■





➤ **THE ENERGY AND ENVIRONMENTAL LEADERSHIP CAMP (EELC)**, designed by ISyE Anderson Interface Professor of Natural Systems Valerie Thomas, was held at Georgia Tech for the second year in a row with 19 rising 10th-12th graders participating. “This is an interdisciplinary camp that draws on expertise from fields such as engineering, public policy, science, and design,” said Thomas. The EELC included such activities as building and racing battery-powered cars (pictured), cooking s’mores in solar ovens, role-playing a United Nations’ climate negotiation with a climate simulation, and conducting a recycling audit for Georgia Tech Facilities Management. The EELC also included visits to research laboratories including the Heat Lab, where the attendees worked with heat detectors, and the Distributed Energy Lab, where the students experimented with solar photovoltaics and a bicycle-powered generator. Visiting these labs gave the attendees a chance to see parts of Georgia Tech’s campus that went beyond the typical campus tour. “Campers learned about a wide range of topics, from electric circuits and energy systems to making cars and ovens with their own hands, to international negotiations and rebuilding infrastructure in a war zone. These activities opened a huge array of possibilities for students thinking about their future,” added Thomas. ▪

Abe Cheung: A LEAP Success Story

Abe Cheung was a senior in high school when his business teacher approached him about enrolling in Georgia Tech's Logistics Education and Pathways (LEAP) program. Having previously taken some logistics courses as part of his high school curriculum, Cheung knew that he was interested in pursuing additional education in supply chain and logistics. Plus, he said, there was the motivation of doing work that was recognized by Georgia Tech.

Cheung enrolled in LEAP and — in addition to completing all four courses that compose the program — went on to earn national certifications in supply chain management, customer service operation, transportation operation, and warehousing operations. Perhaps the most important takeaway from the LEAP program was what Cheung learned about manufacturing, but warehousing and transportation were also key.

As he pointed out, “Without being able to move and store products, manufacturing doesn't help anyone. The main pieces are really in transportation and warehousing, because this gets products to the consumer.”

Thanks to the LEAP program and his national certifications, Cheung attained a job with Ceva Logistics, working as an operations clerk on the company's contract with Daimler Trucks North America.

“Ceva is hired out by Daimler to do their ‘milk runs’ — their daily routes,” explained Cheung. “The company delivers truck parts to all their dealers in the Southeast region.”



Cheung valued his position with Ceva, saying that when he interviewed for the role, the hiring manager asked, “Why do you want to be a clerk, when you have this [LEAP] certification from Georgia Tech?”

“My answer was that I needed experience, because logistics are ever-changing,” Cheung said. “Logistics won't be the same in 30 years, much less 10 years. It changes on the dime — it's never the same.” In this role, he scheduled trips for drivers and tracked both their hours of service and bills of lading.

Cheung plans to further build on his LEAP education. After leaving Ceva Logistics, he enrolled at the Florida Institute of Technology, working online toward a bachelor's of aviation management. Once he completes his undergraduate degree, he plans to get his master's degree in supply chain engineering.

“LEAP has helped open doors to working in many different industries,” Cheung noted. “With those baseline certifications when leaving high school, I immediately got the job at Ceva Logistics. Now as I begin my major in aviation management, the two fields will work cohesively together. People who work in aviation management deal with a variety of things: baggage handling, passenger logistics, turning the plane for the next passengers, etc.

“LEAP was a great experience,” he added. ▪

LEAP was established in 2015 with a grant from JPMorgan Chase & Co. For more information about LEAP, visit <https://www.scl.gatech.edu/LEAP>.

Georgia Tech Supply Chain & Logistics Institute

Developing Leaders & Solutions for Global Supply Chains

The Georgia Tech Supply Chain & Logistics Institute (SCL) now offers five supply chain certificate programs and courses on the Atlanta, Savannah, and Panama campuses.

Certificate Programs

- Supply Chain Management
- Distribution Operations Analysis and Design
- Supply and Demand Planning
- Supply Chain Project Management
- Health and Humanitarian Supply Chain Management

Supply Chain Fundamentals (SCF) Online Series

Gain a solid understanding of supply chain and logistics fundamentals. These eight online courses start anytime and are designed so you may work at your own pace. Register for three and get the fourth free.

www.scl.gatech.edu/fundamentals

Logistics Education and Pathways (LEAP)

These four online fundamental courses will give the knowledge needed to begin a career in many roles in logistics. SCL is currently seeking additional sponsors to help sustain and grow the LEAP program and Georgia's workforce.

www.scl.gatech.edu/leap

Interested in Custom Training?

For more information, visit www.scl.gatech.edu/custom.

Supply Chain Project Management Fundamentals

January 23-25, 2018

Supply Chain Project Management: Vendor Selection and Management

January 30-February 1, 2018

Supply Chain Project Management: Effectively Managing Transformation Projects

February 6-8, 2018

Lean Inbound Logistics

February 14-15, 2018

Material Handling 101: Fundamentals, Analysis, and Selection

March 21-22, 2018

Engineering the Warehouse

March 27-29, 2018

Transportation and Distribution Planning

May 1-3, 2018

Pre-planning Strategy for Health and Humanitarian Organizations

May 14-15, 2018

Introduction to Plan for Every Part (PFEP) and Inventory Sizing

May 15-16, 2018

Plan for Every Part (PFEP) and Inventory Sizing

May 17-18, 2018

Tactical Decision Making in Inventory and Supply Chain Management

May 16-17, 2018

Systems Operation in Health and Humanitarian Response

May 18-19, 2018



To register or for more information, call 404.894.2343 or visit scl.gatech.edu/professional-education.



ISyE Professor Jeff Wu Awarded the 2017 ENBIS Box Medal for Achievements in Statistics

Stewart School of Industrial & Systems Engineering
Coca-Cola Chair in Engineering Statistics and
Professor Jeff Wu received the 2017 Box Medal
Award from ENBIS, the European Network for
Business and Industrial Statistics.

The Box Medal is named after George Box, the late British statistician who is considered one of the greatest statistical minds of modern times. Box was extremely influential on Wu's work during his formative years as a young academic at the University of Wisconsin, Madison, where Box was also a professor.

According to ENBIS, the Box Medal honors the legacy of George Box and is awarded each year to "an extraordinary statistician who has remarkably contributed with his work to the development and the application of statistical methods in European business and industry."

ENBIS announced that Wu was chosen as this year's Box Medal recipient for his many contributions to the study of statistics, as well as "his ability to clearly explain complex concepts ... and for systematically passing on his knowledge." (Wu has supervised

45 Ph.D. students in the course of his career, many of whom are active researchers in the statistical sciences.) "With the medal, the link between two great statisticians is strengthened even further."

Wu accepted the Box Medal in early September at the ENBIS conference in Naples, Italy.

He is known for his work on the convergence of the EM algorithm, resampling methods, nonlinear least squares; sensitivity testing and industrial statistics, including design of experiments, robust parameter design, and computer experiments; and has been credited for coining the term "data science" as early as 1997.

Wu has received several prominent awards, including the COPSS Presidents' Award (1987), the Shewhart Medal (2008), the R.A. Fisher Lectureship (2011), and the Deming Lecturer Award (2012). He is an elected member of Academia Sinica (2000) and the National Academy of Engineering (2004), and has received many other awards and honors, including an honorary doctorate from the University of Waterloo. ■



NemFest:

Celebrating Optimization Legends

GEORGE NEMHAUSER
&
ARKADI NEMIROVSKI

IT'S COMMON FOR FRIENDS AND FAMILY TO COME TOGETHER TO CELEBRATE MILESTONE BIRTHDAYS. For the Stewart School's George Nemhauser, A. Russell Chandler III Chair and Institute Professor, and Arkadi Nemirovski, John Hunter Chair and professor, more than 200 people traveled from across the globe to convene in Atlanta for a birthday celebration unlike all others: NemFest, a two-day optimization conference held May 11-12, 2017, at Georgia Tech's Historic Academy of Medicine. Leading experts in the field, colleagues, and students gathered for Nemirovski's 70th birthday and Nemhauser's 80th birthday, celebrating what the organizers called a collective "150 years of contributions to optimization."

It is not an overstatement to say that the two colleagues and friends have made an extraordinary impact on their specialties within optimization, and as a result have advanced not only the field, but also ISyE and Georgia Tech.

Unexpected Paths

Neither Nemhauser, a native of the Bronx, New York, nor Nemirovski, a native of Moscow, Russia, ever expected that they would land in Atlanta or at Georgia Tech.

Nemhauser said, “I never thought I would have achieved what I’ve achieved. I was a pretty ordinary kid, and being a professor was not on my mind early on.” After earning his undergraduate degree in chemical engineering from City College in New York, he began his graduate studies in chemical engineering at Northwestern University at the urging of his parents because, he said, “I needed to do something practical.” He didn’t begin to consider operations research until he encountered Jack Mitten, a professor who had an enormous influence on him. “I had no idea of what professors were like or what they did, and he took me into his home, and I got to know his family,” said Nemhauser.

Nemhauser entered the emerging field of operations research and went on to join the faculty of Johns Hopkins University in 1961. He was appointed professor of operations research and industrial engineering at Cornell University in 1970 and served as school director for a number of years.

Nemhauser came to ISyE in 1985 as the A. Russell Chandler III Professor and was appointed Institute Professor in 1991. He also has held visiting faculty positions at the University of Leeds, United Kingdom; the Catholic University of Louvain, Belgium; and the University of Melbourne, Australia. At Louvain, he worked at the Center for Operations Research and Econometrics, serving as research director for two years.

Similar to Nemhauser, Nemirovski did not anticipate a career in academia. When he was 15 years old, Nemirovski’s parents transferred him to a high school that focused on mathematics. While his interest in mathematics was firmly established, he said, “I never thought about academia before my move to Israel.”

After earning his Ph.D. in mathematics from Moscow State University, Nemirovski began his career as a research associate for the Institute for Automatic Equipment and the Central Economic and Mathematical Institute of the USSR/Russian

Academy of Sciences, both in Moscow. In 1993, he left Russia to take a position as a professor at the Israel Institute of Technology in Haifa, where he served on the faculty of the industrial engineering and management department. Twelve years later he relocated once again, this time to Atlanta, where he joined ISyE as the John Hunter Jr. Chair and professor in 2005.

Nemirovski said, “Two years prior to my departure to Israel, I was absolutely sure I would never leave Russia. When I came to Tech for a sabbatical in 2003, it was two years prior to accepting the position here. I was absolutely sure I would never live here. So, the conclusion is you should never say never.”

Describing his decision to join the Stewart School, Nemirovski said, “One of the reasons I was attracted to ISyE is that the School has come to be highly regarded as a magnet for talented researchers, largely due to the direct or second-order influence of George Nemhauser. ISyE’s environment and enthusiasm for fundamental research have clearly made it a go-to destination for scholarly work.”

Unparalleled Careers, Extraordinary Impact

It’s been said that to make decisions optimally is one of the basic desires of humankind. Optimization, the mathematically rigorous methodology for seeking a best action among a multitude of alternatives, is a key design and operational tool in many critical applications including energy, finance, health, transportation, and manufacturing systems; social networks; and supply chains.

Although Nemhauser and Nemirovski focus on different areas of optimization, they are similar in that the breadth and depth of their contributions to the field are unparalleled. Both are pioneers in their areas of research, and both have fundamentally shaped the field as a result of their work—and the Stewart School. ISyE boasts the largest single-program concentration of faculty with optimization as their primary area of research expertise in the world—an achievement directly related to the influence of Nemhauser and Nemirovski.

Describing Nemhauser and Nemirovski as “two towers in the field of optimization,” ISyE



Above: Attendees of NemFest at the Historic Academy of Medicine

Assistant Professor Andy Sun said, “George and Arkadi are amazing figures. Any one of their achievements could be a lifetime achievement for somebody, but they have made all of these very fundamental contributions.”

Nemhauser works in integer programming, which is the name for optimization models and algorithms in which some variables are required to have integer values. Integer programming has a big impact on solving important problems in industry. Most Fortune 500 companies use integer programming in some aspect of their business. Current software is capable of solving models with thousands, and sometimes millions, of variables and constraints.

With more than 200 publications and over 25,000 citations to his name, Nemhauser co-authored what is considered *the* textbook on integer and combinatorial optimization since its publication more than 25 years ago.

In 1986, he was the first sitting professor at Georgia Tech to be elected to the National Academy of Engineering (NAE), and for a time, Nemhauser was the only NAE member not only at Georgia Tech but also in the state of Georgia. He has won every major award in his field of optimization, including the field’s first-ever Khachiyan Prize for lifetime achievement in 2010. More recently, in 2015 he received the Class of 1934 Distinguished Professor Award, the highest recognition accorded to a faculty member at Georgia Tech.

Nemhauser’s impact on industry is equally extraordinary. From scheduling in the airline industry to the sports industry, his optimization techniques have been widely adopted. He has made contributions in applications as diverse as political districting, facility location, portfolio management, supply chain optimization, maritime inventory routing, military resource allocation, semiconductor manufacturing,

and float glass manufacturing, among other areas. Nemhauser is also one of the developers of MINTO, a software system used in integer programming research.

Since he joined the faculty at Georgia Tech more than three decades ago, Nemhauser has been critical to ISyE's rise in national undergraduate and graduate rankings and its ability to remain there for 23 and 27 continuous years, respectively.

Similarly, Nemirovski has enjoyed a remarkable career. His research interests focus on optimization theory and algorithms, with emphasis on investigating complexity and developing efficient algorithms for nonlinear convex programs, optimization under uncertainty, applications of convex optimization in engineering, and nonparametric statistics.

Throughout the course of his long career, Nemirovski has made significant contributions in several areas. At the age of 27, while on vacation, he invented the ellipsoid method, which is one of the most fundamental developments in optimization.

Later, with Yurii Nesterov, Nemirovski developed the interior point method—a second game-changer and breakthrough in the field. This is an algorithm that has been used for solving convex optimization problems and is used as a tool to classify problems.

Yet another contribution of his centers on the development, with Ronny Ben-Tal, of the field of robust optimization, which is a modeling contribution. Here, they created a framework that is able to handle uncertainty in problem data.

According to Anderson-Interface Chair and Professor at ISyE Shabbir Ahmed, the significance of some of the general optimization theory Nemirovski developed was not recognized early on. Ahmed said, "But with the growth of analytics, machine learning, and data, more and more of these convex optimization problems are occurring, and there is a need for solving optimization problems with very large data sets." He described Nemirovski as ahead of his time, anticipating the solution to a problem that was yet to exist.

In recognition of his seminal and profound contributions, Nemirovski has been awarded the

top prizes in the field: the 1982 Fulkerson Prize from the Mathematical Programming Society and the American Mathematical Society (joint with Leonid Khachiyan and David Yudin); the Dantzig Prize from the Mathematical Programming Society and the Society for Industrial and Applied Mathematics in 1991 (joint with Martin Grötschel); and the 2003 John von Neumann Theory Prize by the Institute for Operations Research and the Management Sciences (along with Michael Todd).

Nemirovski was elected to the NAE in February 2017, the first year he was eligible for induction. In announcing his election to the prestigious organization, the NAE commended Nemirovski for his work in "developing efficient algorithms for large-scale convex optimization problems."

Describing Nemirovski's many contributions, Nemhauser said, "His influence in terms of the quality of work is just amazing. In the area of nonlinear optimization, he is the world's No. 1 leading researcher and has been for quite a while. He is just an enormous influence on the field."

While Nemhauser and Nemirovski are renowned for their contributions to the field, they are also admired for their humbleness, generosity, and support of colleagues and students at ISyE.

Ahmed said, "This is a unique feature of ISyE—people like George and Arkadi set the tone for the faculty. People of their stature are superstars, but they would never give you that impression and will always have time for you. They are willing to help whomever seeks their help."

Both Nemhauser and Nemirovski have taught undergraduate and graduate courses, and Nemhauser played a critical role in revamping how optimization is taught at the undergraduate level at ISyE.

Nemhauser has worked with approximately 70 Ph.D. students, more than any other professor in the field of operations research. Today, his former students are on the faculty of almost every top operations research department in the country, including MIT, Berkeley, Cornell, and Georgia Tech.

ISyE Professor Natasha Boland is a former postdoctoral student of Nemhauser, and she credits him with changing the course of her career. Boland said that from him, she has learned that "it's important to motivate the theory from

your applications” — meaning that inspiration comes from working on real problems with industry.

What Lies Ahead

Nemhauser and Nemirovski continue to actively make seminal contributions to their ever-developing fields. Describing emerging areas of optimization, Nemhauser said, “The issues that we are still struggling with are how to deal with uncertainty. You don’t know all the data when you try to optimize something.

“The second big area that is emerging is what’s called online optimization. More and more, we are getting into issues where we have to make decisions in real time. Think of the driverless car. That means you’re not going to have much time at all to optimize, because you’re going to look at the data and maybe a second later, you have to make a decision. Those are the two biggest problems, together with the problem that happens all the time: As we are able to solve bigger problems and solve them faster, more problems keep coming that will get bigger and bigger, and you need solutions faster and faster.”

Looking ahead, Nemhauser is also interested in focusing on the fundamental problem that first got him involved in integer programming: political districting, which is dividing a state into districts based on a set of criteria.

Currently, Nemirovski is working on the first-order algorithm he developed in the 1970s and 1980s in relation to machine learning and extending that into statistics. He said, “I’m trying to bridge



Beyond Their Legendary Careers: Getting to Know George Nemhauser and Arkadi Nemirovski

Beyond their legendary careers and achievements are two people who are equally renowned for their personalities. Nemhauser is famous for his sense of humor and his personable nature. An avid sports fan, he dedicated his second book (with Robert Garfinkel), *Integer Programming*, to the New York Knicks basketball team.

Nemirovski, too, has a dry wit and a humble, kind nature. He used to write poetry and has even authored a play. Coincidentally, the two colleagues are neighbors and live on the same block in midtown Atlanta. Here they share more about their lives and interests.

On spare time

Nemhauser: “My wife and I for years would go on organized hikes, hiking in a pleasant way all around the world. Probably the most exciting place we hiked in was Bhutan and some other places around Europe. Travel has been a very big part of our lives. I’m a sports fan, and I’m also a wine collector. I have a serious cellar of wines that I enjoy drinking.”

Nemirovski: “This is something I struggle with. In my spare time, I do what I do here — work.”

On advice for students interested in entering academia

Nemirovski: “I believe they should do what is interesting to them. Their immediate role is to master some set of skills which is important today ... they should realize that this knowledge will serve them for their entire lives.”

Favorite book

Nemirovski: “*The Master of Ballantrae: A Winter’s Tale* by Robert Louis Stevenson. I know it more or less by heart and have read it in both Russian and English.”

Proudest achievement

Nemhauser: “Personally, what I’m most proud of is that I have been married to the same woman for almost 58 years, and my wife has had a lot to do with my success. That’s been a very big thing in my life.”

convex optimization theory with statistics,” which has important implications for high-dimensional statistics.

NemFest: A Once in a Lifetime Event

The idea of NemFest was conceived by Nemhauser’s and Nemirovski’s ISyE colleagues as a way to celebrate their significant contributions and discuss current research activities in discrete and continuous optimization.

By all accounts, NemFest was special. Boland described the two-day workshop as a “once in a lifetime event” that was a celebration of “what great people Nemhauser and Nemirovski are and how they have grown and shaped the field.”

To appreciate the international reach and influence of Nemhauser and Nemirovski, you only need to look at who attended NemFest. From undergraduate and graduate students to young faculty to leading experts, attendees as well as speakers and panelists represented major research universities from across the nation and the world. Participants traveled from distances across the United States in addition to Canada, Israel, and several countries in Europe. Sun said, “It was probably one of the most significant optimization conferences, just judging from the speakers—a who’s who in optimization

for both continuous and discrete optimization—and also the number of attendants. I think it will have a lasting impact on everyone who was there.”

The speakers discussed some of the ways in which they have collaborated with Nemhauser or Nemirovski over the years, as well as their current research activities. The first day included a panel comprised of current and previous colleagues of Nemhauser for a discussion on reflections of his work; the second day ended with a panel discussion on Nemirovski and his contributions.

Describing the event, ISyE Associate Professor Santanu Dey said, “NemFest was very personal for a lot of us. It was a way of saying thank you, and it was so inspirational to listen to their life stories and the kind of things that they have done. George and Arkadi are truly giants in their fields, and have started areas that have made a great impact on people all over the world.”

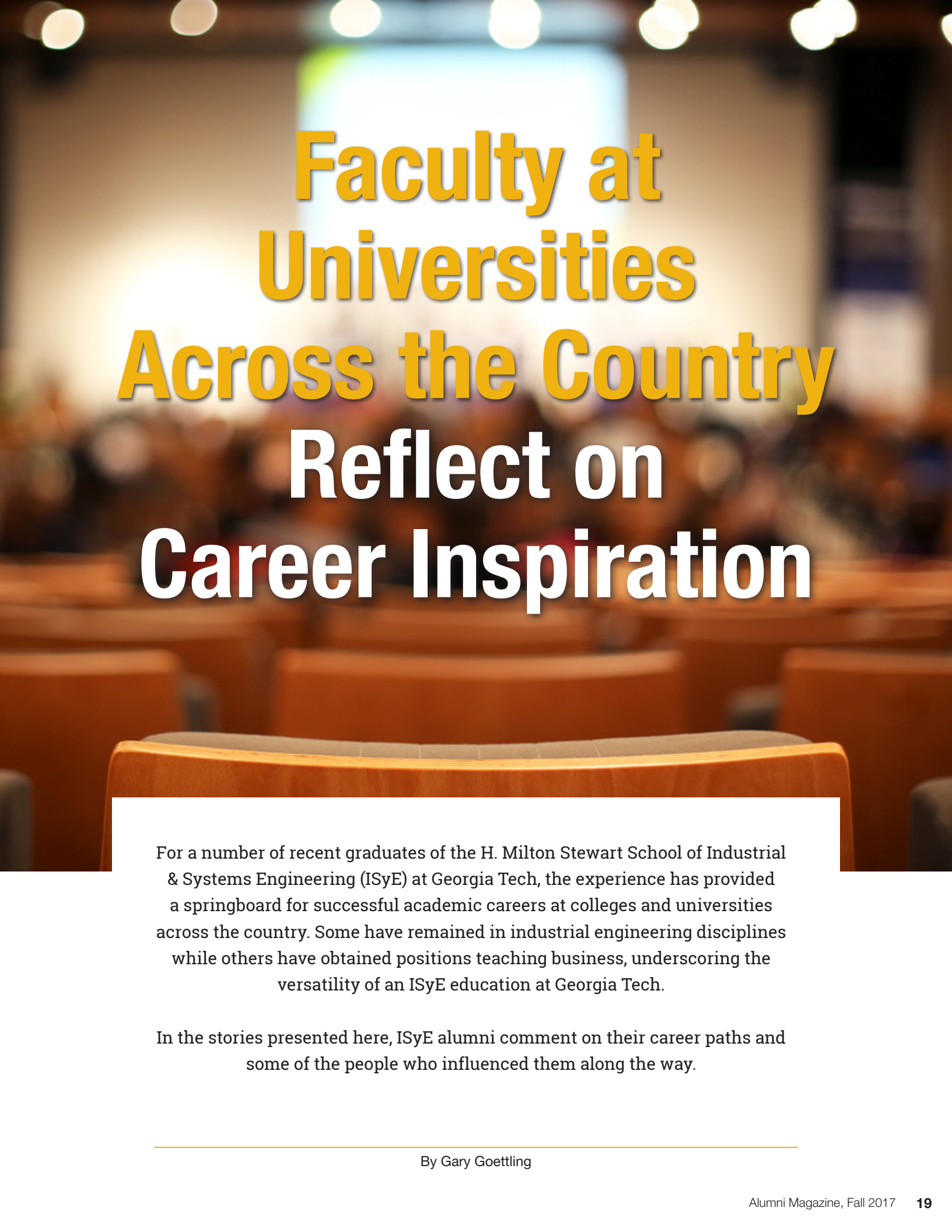
What did the honorees think of NemFest? Nemhauser said, “As a scientific conference, it was very high quality, and of course, it was great just having all my friends back. It was extremely well done, and I enjoyed it a lot.”

“I very much appreciate those people who organized it,” said Nemirovski. “And I am extremely thankful for them and for those who came.” True to his humble nature, he added, “It would be good to celebrate something different.” ■

Building on NemFest

Extending the momentum of NemFest, the Stewart School is organizing and hosting additional workshops that celebrate ISyE’s strengths in both theory and applications in order to explore new areas of research and collaboration with industry, focusing on areas such as machine learning, health care, and energy, where industrial engineering and operations research can make a difference.

The first of these follow-up events was the Workshop on Electric Energy Systems and Optimization, hosted by ISyE on November 9-10, 2017. To address the challenges in electric energy systems, multidisciplinary research is needed to make fundamental breakthroughs. The workshop was an initial step toward building a platform for researchers, practitioners, and students from electric energy systems and operations research to come together for discussions on challenges facing the nation’s electric systems. Consisting of research talks, presentations, and a panel discussion, topics focused on dealing with uncertainty in power systems; new ways to solve complex optimization problems in power system operations and planning; data analytics for power systems; and how to promote collaborations between academia and the energy industry.



Faculty at Universities Across the Country Reflect on Career Inspiration

For a number of recent graduates of the H. Milton Stewart School of Industrial & Systems Engineering (ISyE) at Georgia Tech, the experience has provided a springboard for successful academic careers at colleges and universities across the country. Some have remained in industrial engineering disciplines while others have obtained positions teaching business, underscoring the versatility of an ISyE education at Georgia Tech.

In the stories presented here, ISyE alumni comment on their career paths and some of the people who influenced them along the way.

By Gary Goettling



From left: Kris Johnson Ferreira, Alejandro Toriello, Jim Luedtke

Connecting Research and Practice

Kris Johnson Ferreira (BSIE 07) might not be indulging her passion for teaching and research were it not for the encouragement of Associate Professor Joel Sokol, one of her undergraduate industrial engineering professors at ISyE.

“I’d never really thought about getting a Ph.D. and what life would be like as an academic until Joel brought it up as a possibility,” said Ferreira, an assistant professor of business administration at Harvard Business School. “He told me about his experience getting a Ph.D. and what it was like to be a professor and what he enjoyed the most about it. I knew from talking to him that I would love the teaching and research aspects, and that definitely helped me make the decision to get a Ph.D. and go into academia.”

She was among a cohort of undergraduates who assisted Sokol with his well-known research in the application of data analytics to build predictive models of the NCAA men’s basketball tournaments.

The decision to apply to Georgia Tech was a “no brainer,” she continued. “It

has the best IE program in the country with amazing students and faculty from around the world.”

After Tech, she spent three years working as a consultant before enrolling at MIT, where she earned a doctorate in operations research in 2015. Later that year, she joined the Harvard faculty.

“I really love teaching,” she said, “and Harvard Business School has a lot of resources to help new faculty succeed in the classroom.”

Another plus is that Harvard Business School offers the freedom to perform new research and apply industrial engineering to a variety of business applications, said Ferreira.

“I work in partnership with companies and use their data to help them make better revenue-management decisions, and I really enjoy this connection between research and practice.”

A President’s Scholar at Tech, Ferreira’s awards include a Revenue Management and Pricing Section Practice Award from the Institute for Operations Research and the Management Sciences (INFORMS) and an MIT Graduate Student Award for

Excellence in Engineering Systems Teaching.

As for the future, she said that you never know what opportunities will come along, but right now, “I really love my job. I’m following my path and passion and doing what I love to do.”

A “Fun and Exciting Career”

ISyE’s Leo and Louise Benatar Early Career Professor and Associate Professor **Alejandro Toriello** (BSIE 03, Ph.D. IE 10) wasn’t thinking about an academic career when he entered Georgia Tech as an undergraduate. As a matter of fact, “I thought, ‘OK, I’ll do my four years and get out of here and never look back.’”

But after graduating and spending almost two years working as a consultant, graduate school started looking better and better.

“My job wasn’t a good fit for me,” recalled the Guatemalan native, “so I talked to some professors here at Georgia Tech — particularly my undergrad optimization professor, Özlem Ergun — about my interests and what I considered doing career-wise. Their advice helped me decide to pursue a

Ph.D. Once I got started, I realized that academia might be a fun and exciting career."

Toriello's thesis advisor was A. Russell Chandler III Chair and Institute Professor George Nemhauser, whom he credits with invaluable guidance not only through five years of doctoral studies, but also for sharing considerable insight into the nuts and bolts of an academic career.

"George was always available with an open ear and always found time to give me professional advice, and advice on strategizing and other aspects of entering academia. He's truly a fountain of knowledge in those regards."

Ph.D. in hand, in 2010 Toriello accepted an offer from the University of Southern California in Los Angeles as an assistant professor of industrial and systems engineering. It was a wonderful experience, he said, but three years later, when the opportunity arose to join the Georgia Tech ISyE faculty, "I jumped at it.

"The professional opportunities offered by Georgia Tech are tremendous as is the Stewart School's reputation in industrial engineering," he explained, "so I couldn't resist coming back and joining these people I know well and regard so highly.

"I joke sometimes that I'm like a bad cold — they can't get rid of me," he laughed.

Toriello notices a difference between the students he teaches and his own time as an ISyE undergrad in that the former are even better prepared for success in the classroom and beyond.

"Our students are very well-rounded and bring a much wider breadth of experience and skill sets," he said. "They are really impressive in that regard, so it's quite heartening to interact with our students."

The recipient of a National Science Foundation (NSF) CAREER Award, To-

riello reached a professional milestone this past summer when he was awarded tenure. His next step is promotion to full professor.

"I'll continue to do work in my field and aim for a major research breakthrough," added Toriello, whose research interests encompass transportation, logistics, and operations, as well as related topics in mathematical optimization.

Learning to Solve Difficult Problems


For **Jim Luedtke** (MSOR 04, Ph.D. IE 07), accepting a position as an assistant professor at the University of Wisconsin-Madison in 2008 was something of a homecoming. A Wisconsin native, he earned a bachelor's degree in IE at UW-Madison in 2001. When he decided to continue his education at graduate school, Georgia Tech topped the list of possibilities.

"I was interested in operations research," said Luedtke, who is now an associate professor and also serves as associate chair of graduate affairs. "Georgia Tech is a national research leader in that field, so Tech was a natural choice to obtain the background I needed to do good research."

Luedtke's research interests include stochastic optimization, mixed linear and nonlinear integer optimization, and optimization applications. His work has been recognized with an NSF CAREER Award and the INFORMS Optimization Society Prize for Young Researchers.

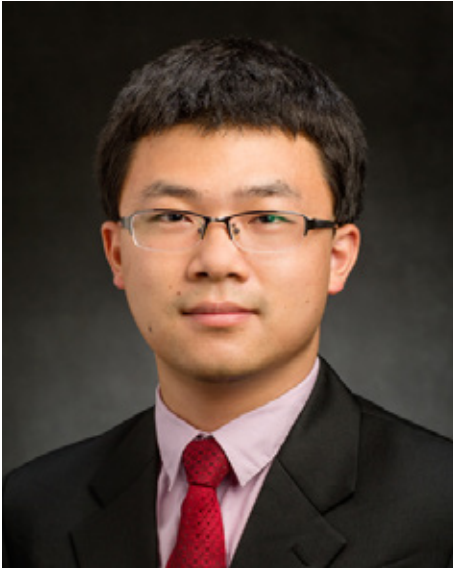
Had he not pursued an academic career, Luedtke imagines he probably would have found a position in a company research lab, "applying the operational research tools that I learned at Georgia Tech to solve difficult applied problems."

One of the major strengths of the Stewart School, according to Luedtke, is



"The professional opportunities offered by Georgia Tech are tremendous as is the Stewart School's reputation in industrial engineering, so I couldn't resist coming back and joining these people I know well and regard so highly."

— ALEJANDRO TORIELLO



Linwei Xin

“I wanted to see how to apply my knowledge of pure math to solve real-world problems.”

— LINWEI XIN

the curriculum’s shared emphases on both theory and application.

“There are exceptional people on both sides at ISyE, and they’re working together all the time.”

Two professors in particular stand out for Luedtke: George Nemhauser and Anderson-Interface Chair and Professor Shabbir Ahmed.

“I had co-advising with them,” he elaborated. “George has a very high-level, broad vision of the IE field, and that was very beneficial for me. Shabbir worked with me ‘in the weeds’ a little more with some difficult research questions. To have had both of them as mentors was a unique opportunity, and I was very happy to have had that chance.”

Helping Students Thrive

Linwei Xin (MS MATH 10, Ph.D. OR 15) calls his transfer to ISyE “one of the best decisions I have made in my life.”

Two years into his doctoral work in mathematics at Tech, he switched to operations research.

“I wanted to see how to apply my knowledge of pure math to solve real-world problems,” explained Xin, a 2008 graduate of Zhejiang University, in Hangzhou, China, where he earned a bachelor’s in mathematics. “ISyE has world-wide esteemed faculty in operations research and many outstanding students, and I thrived quickly in this environment. Without this decision to study operations research, I might not have ended up in academia.”

Xin is an assistant professor of operations management at the University of Chicago Booth School of Business. He joined the Chicago faculty in July 2017 following a two-year stint as an assistant professor in the Department of Industrial and Enterprise Systems Engineering at the University of Illinois.

“Academia means more freedom,” he said. “Basically I am working for myself.”

“I love conducting research, and especially love proving theorems and writing academic papers,” he added. “I also like teaching. I can reach many students at a university, and when I see their academic improvement, I feel that I’ve accomplished something impactful.”

An ongoing objective is to “see my students thrive, graduate, and have successful careers.”

Xin credits a measure of his own career success to guidance and advice from his professors in operations research, the advanced operations research courses he took, and interaction with his Ph.D. peers at Tech. In particular, Xin points to ISyE Professor Alexander Shapiro and Adjunct Associate Professor David Goldberg as playing key roles in his development as a researcher.

“I was very fortunate and honored to work with them on several exciting research topics during my Ph.D. studies,” he said. “I am extremely grateful for their dedication, generosity, and patience, and I learned tremendously from them.”

Xin’s honors include a Chinese Scholars Association for Management Science and Engineering Best Paper Award, first place in the INFORMS George E. Nicholson Student Paper Competition, second place in the INFORMS Junior Faculty Interest Group Paper Competition, and finalist in the Manufacturing and Service Operations Management Student Paper Competition. He also won an NSF grant as a principal investigator.

Engineering Logistics Saves Lives

Jessica Heier Stamm (Ph.D. IE 10) is interested in many things: teaching, solving problems, advancing humani-

tarian efforts, and learning new skills and subject areas. "Being a professor allows me to combine all those interests in one profession," she observed.

Since 2010 she has been an assistant professor in the Department of Industrial and Manufacturing Systems Engineering at Kansas State University (KSU), where she earned her undergraduate degree in IE in 2004. For her doctorate, "I chose ISyE at Georgia Tech because of its excellence in operations research and, in particular, in supply chain and logistics applications."

Even before graduate school, the Kansas native knew she wanted to work in the area of humanitarian logistics to improve the effectiveness of disaster preparedness and response.

As luck would have it, what is now called the Center for Health & Humanitarian Systems (CHHS) was established shortly after her arrival at Tech, which proved to be an excellent match for her research goals.

"I took classes from leaders in the field," she continued. "I also had the opportunity to assist in writing proposals, an experience that contributed to my receiving an NSF CAREER Award and other grants."

Heier Stamm's additional honors include the KSU College of Engineering Outstanding Assistant Professor Award, two Outstanding Teacher Awards, the INFORMS Transportation Science and Logistics Society dissertation prize, and the Best Doctoral Thesis Award from the Humanitarian Logistics and Supply Chain Research Institute.

Heier Stamm noted that while many ISyE faculty influenced and inspired her, three mentors stand out: CHHS co-directors Özlem Ergun, Julie Swann, and Pinar Keskinocak, William W. George Chair and ADVANCE Professor and Interim Associate Dean for Faculty Development & Scholarship, College of Engineering.

"They taught me how to balance my work's impact for social good with its scholarly contribution."

Heier Stamm's long-term career goal is to transform disaster preparedness and response supply chains "by developing contextually appropriate models and solution methods, and by preparing a diverse community of industrial engineers to address interdisciplinary challenges."

Bringing Logistics Expertise Back to Alma Mater

Raised in central Arkansas, **Ashlea Bennett Milburn** (Ph.D. IE 09) didn't know she wanted to be a professor until she was an undergraduate at the University of Arkansas (UA). After participating in a number of internships, she realized she was not applying her IE skills as much as she would like.

"I knew that staying in academia would be a way to really dig in with those skills."

Milburn left Arkansas in 2003 with a bachelor's degree in IE, hoping to return to her alma mater one day as a professor and, perhaps one day down the road, an administrator. Her first stop was Virginia Tech, where she received a master's in industrial and systems engineering. Then Milburn began looking for a school for her Ph.D.

"I wanted to do logistics work, and a lot of Georgia Tech faculty were doing that," she said. "Plus, Tech has a great reputation and is the top-ranked IE program in the country."

Her focus on logistics made practical sense, given its importance to many Arkansas companies and, consequently, to UA.

"We have a really strong emphasis on logistics, and a lot of our employers



Top: Jessica Heier Stamm
Bottom: Ashlea Bennett Milburn



Juan Pablo Vielma

are looking for logistics engineers,” she said, citing the example of her undergrad internship with the J.B. Hunt trucking company. “Walmart is headquartered here, and at its core, it’s a logistics company.

“I knew Georgia Tech would equip me with the logistics skills and expertise I needed to come back here and be competitive.”

Even before arriving on campus, Milburn knew she wanted Associate Chair for Graduate Studies and Coca-Cola Professor Alan Erera as her Ph.D. advisor.

“His research interests appealed to me,” she explained. “His work is deeply theoretical, but he applies it to solving real-world, practical problems. I learned how to do that from him.”

Milburn’s honors and recognitions include an NSF CAREER Award; a Best Paper Award from *IIE Transactions on Healthcare Systems Engineering*; the IIE Logistics and Supply Chain Division Teaching Award; and Outstanding Teacher, Outstanding Researcher, and Outstanding Faculty Advisor awards from the UA Department of Industrial Engineering.

A Strong, Positive Influence

The best part about working as a professor at MIT is “interacting with extremely smart and driven young people,” said **Juan Pablo Vielma** (Ph.D. IE 09). “It keeps you on your toes and forces you to keep your tools current.”

The Richard S. Leghorn (1939) Career Development Associate Professor of Operations Research at MIT’s Sloan School of Management, Vielma said he had aspired to become either a professor or a researcher since attending the University of Chile, where he received a B.S. and M.S. in mathemati-

cal engineering. He joined the MIT faculty in 2012 after serving as an assistant professor at the University of Pittsburgh and a Herman Goldstine Postdoctoral Fellow at the IBM Thomas J. Watson Research Center.

His decision to obtain a doctorate at Georgia Tech was based on his examination of the Stewart School’s courses, professors, and students. “I did consider ISyE’s top ranking, but more important was learning from friends who were already studying at ISyE that this ranking was not just a number,” he noted.

In terms of his academic career, one of the important takeaways from his Tech experience was “learning how important it is to work hard on research you enjoy,” Vielma said. “I learned this both from the professors and my classmates.”

Vielma’s research interests include theory and technology for linear, nonlinear, and stochastic mixed integer programming; and optimization models in sustainable natural resource management, marketing, and statistics.

His work has earned for him numerous awards including a Presidential Early Career Award for Scientists and Engineers, an NSF CAREER Award, and first prize in the INFORMS Junior Faculty Interest Group Paper Competition.

At Tech, Vielma received valuable encouragement and support from “pretty much all professors I interacted with, particularly my advisors, Shabbir Ahmed and George Nemhauser,” he said. “It would take forever to go over the different ways they inspired and influenced me. However, I think Professor Emeritus Gary Parker deserves a special mention. He was associate chair for graduate studies while I was at ISyE, and he was crucial in creating an academic environment that facilitated the strong positive influence I received from my professors and classmates.” ■



Casey Wood, a sophomore, chose the AE/ISyE Limerick Summer Program because her mother's extended family is from Ireland, and she was interested in learning more about their culture. Wood said, "It was cool to learn Irish history from the locals and imagine how my ancestors would have fit into those stories. What impacted me the most while abroad was how applicable our studies were to any country or culture. It was interesting to be able to pick out optimization problems in Ireland's bus system, or listen to the aerospace engineering students discuss pros and cons of the different airplanes we took when traveling. The experience definitely broadened the scope of my education."



Thoughts on Teaching Abroad

By Dawn Strickland

I first traveled to Ireland’s Cliffs of Moher with my father and sister a decade ago. It felt like we were walking in a cloud that day. It was foggy, rainy, and gray — weather typically associated with Ireland. While we couldn’t see beyond the clouds, we could hear the unmistakable sounds of the Atlantic Ocean below. And we paid attention to the signs — none of us wanted to be like the stick figure plunging into the sea.

When I returned to the Cliffs of Moher this past July, the skies were clear, the sun was shining, and I could finally observe what I had only heard the first time: breathtaking views of the sky and ocean as far as the eye can see. And of course I had to take a picture of the stick figure sign for my family back home as a reminder of our past trip.

For this visit, I was in Ireland not for vacation but for work. For five weeks, I served as the faculty lead for a dozen industrial engineering undergraduate students in Georgia Tech’s Daniel Guggenheim School of Aerospace Engineering and the Stewart School of Industrial & Systems Engineering faculty-

led summer study abroad program at the University of Limerick. I taught ISYE 3133 (Engineering Optimization) and MATH 2603 (Discrete Mathematics) concurrently, and the students and I worked hard. For five weeks, we met four days a week for classes that lasted from 9 AM until 3 PM, with office hours and academic advising included as well.

Oftentimes, I would arrive in the classroom in the morning only to find my students already there, studying. We all lived in an apartment-style dormitory 20 minutes from the city center. Living abroad in that environment and having such an intense class schedule made it easy to really get to know and connect with the students, who had been in Ireland for five weeks taking aerospace engineering classes prior to my arrival. They gave me solid advice related to the cafeteria: Be sure to sample the multiple types of potatoes at every meal. Chips (french fries), mash (mashed potatoes), and roasties (roasted potatoes) were among the varieties—it wasn’t unusual to have all three on your plate at once.

We commiserated about the lack of air conditioning on warm days and about water issues in our



"It can be challenging for engineering students to study abroad since many programs require sequential coursework at varying levels of rigor. This is what makes Georgia Tech faculty-led programs so special. The experience may not be quite as immersive as if you were taking a course directly from the University of Limerick, but the rigor is guaranteed and the opportunity to have an international experience is priceless. "

— Dawn Strickland

apartments, but those inconveniences didn't slow down my students. Every weekend they traveled to different parts of Ireland or Europe. They traveled cheaply — budget airlines and youth hostels — and they definitely brought an industrial engineer's perspective to planning their adventures. They were hyper-scheduled, and I admired how well they packed a lot of cultural experiences and travel into a short amount of time.

It can be challenging for engineering students to study abroad since many programs require sequential coursework at varying levels of rigor. This is what makes Georgia Tech faculty-led programs so special. The experience may not be quite as immersive as if you were taking a course directly from the University of Limerick, but the rigor is guaranteed and the opportunity to have an international experience is priceless. In the academic office, we always encourage students to study abroad as long as it doesn't prohibit them from moving along in the curriculum.

It's safe to say that at times we all missed the comforts of home. We missed our families, pets,

top sheets, firm pillows, and normal-sized towels. But I also observed a great group of engaged students comprehend the concepts covered in these foundational classes while taking advantage of exploring not only the country where we were based, but also different countries throughout Europe.

When it came time for advising the group and planning their schedules from now until graduation, it became clear that this would be the first of many international experiences they will undertake. There are so many international opportunities for them at Georgia Tech, and this program encourages them to take that next step to pursue an exchange or a completely immersive experience like working abroad. ▪

Dawn Strickland (MSOR 99, Ph.D. OR 02) is an academic professional and director of student services in the Stewart School of Industrial & Systems Engineering.

Lecturer and Pastor Damon P. Williams on his Complementary Careers

The way Damon P. Williams (BSIE 02) tells it, he was destined to come to Georgia Tech — and destined to return years after he graduated. A Maryland native, Williams was a high school senior when he first considered engineering for his college major. This meant, he reflected in a recent interview, choosing between the “two best engineering schools in the country: northward to MIT and southward to Georgia Tech.”

It was 1998, two short years after the Centennial Olympic Games in Atlanta, and Georgia Tech’s campus had been spiffed up to welcome the world. Williams remembered touring the Institute, seeing the brand-new dorms and swimming pool, and becoming enamored with the campus. “Georgia Tech was where I wanted to go,” he said. And industrial engineering was a natural fit, because he’s always been the type of person interested in solving problems and improving on solutions.

While an undergraduate student at the Stewart School of Industrial & Systems Engineering (ISyE), he completed two co-ops for a company that manufactured cell phones. Williams’ co-op experiences were enlightening, to say the least, as he became disheartened by the company’s “get it done as fast as possible” approach to solving problems, which favored employees who came up with quick solutions, regardless of whether the solutions were the right ones.

These experiences eventually led Williams to the realization that he wanted to stay in academia. After graduating from Tech, he went on to the University of Michigan, Ann Arbor, for his M.S. and Ph.D. in industrial engineering.

In Michigan, Williams’ career path took what some might consider to be an unusual turn: In 2006, while working on his Ph.D., he entered the Christian ministry. After Williams finished his dissertation, his pastor told him it was time for him to go to seminary.

What brought Williams back to Atlanta is ultimately what brought him back to ISyE, where

he is now a lecturer and advisor in the academic office. He enrolled in a small Presbyterian seminary, Columbia Theological Seminary, in Decatur, Georgia. After his experiences with two large universities — Tech and Michigan — for his industrial engineering degrees, Williams was looking for a program that could offer an intimate community.

Seminary demanded skills that William hadn’t used since early in his undergraduate career. “My brain is wired for math and science,” he said, laughing. “Seminary was a lot of group work, a lot of reading, a lot of writing. I hadn’t written a paper outside my dissertation since English class my freshman year. Doing so much writing was difficult for me, and I decided to do something that would take me back to my Ph.D.”

Williams reached out to then-ISyE School Chair Chip White (now the Schneider National Chair in Transportation and Logistics), who had also been a professor at Michigan during William’s time there, to find out if there were any teaching opportunities within the School. White directed him to Chen Zhou, the associate chair for undergraduate studies, who immediately contacted Williams about teaching. The School was beginning to admit a larger number of ISyE majors, and as a result, needed to hire additional lecturers.

Williams agreed to teach two ISyE undergraduate courses, took a part-time post-doctoral appointment with Tech’s then-Center for Enhancement of Teaching and Learning (CETL), and continued with his seminary studies until he graduated with his master’s degree in divinity in 2012. “I like my plate to be full,” Williams said.

As Williams was about to graduate from Columbia, the pastor of his Atlanta church asked him, “Do you think you’re ready to lead a church?”

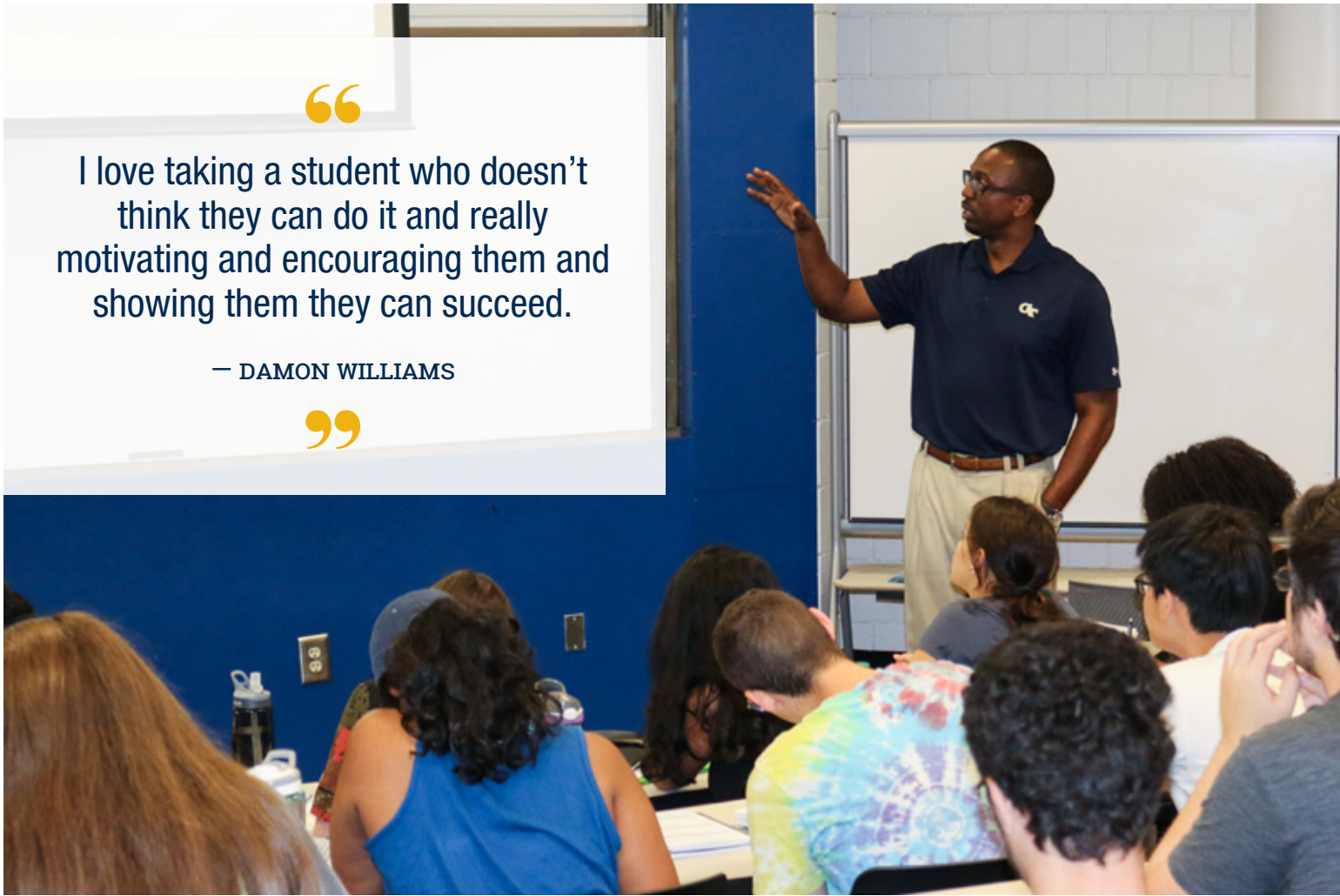
“Because I was a good Baptist associate minister,” Williams remembered, “I did as I was told and applied for the senior pastoral position at Providence Missionary Baptist Church,” which is a large, historic African American church in southwest Atlanta.

“

I love taking a student who doesn't think they can do it and really motivating and encouraging them and showing them they can succeed.

— DAMON WILLIAMS

”



“There was no way they were going to hire me,” added Williams. “At the time I wasn’t married, I didn’t have any pastoring experience, I wasn’t ordained, and I had not yet graduated seminary when I applied. Top people in the field were applying for the job.” But over the next eight months, Williams went through the application and interview process, and Providence Missionary called him to be their pastor in September 2012.

At this point, Williams had three jobs: serving as senior pastor, as an instructor for ISyE, and as a full-time assistant director of CETL. He resigned from CETL but continued teaching for ISyE. He explained, “I love teaching, I love students, I love the ‘ah-ha!’ experience. I love taking a student who doesn’t think they can do it and really motivating and encouraging them and showing them they can succeed.”

Williams’ weekly schedule is packed: Sunday is a work day, with two church services and Sunday School in between. He



spends Monday, Wednesday, and Friday mornings teaching early ISyE classes, then heads directly to his church from campus. Wednesday afternoons are spent at multiple church-related activities; Thursdays and Fridays are generally for sermon preparation; and Saturdays are for any church- or ISyE-related work. In between shuttling from ISyE to church activities, Williams reserves blocks of time to spend with his wife and 21-month-old son.

“Then the week starts over again on Sunday,” Williams reflected. “It’s a seven-day-a-week workweek. But the old adage is true: ‘If you love what you do, you’ll never work a day in your life.’”

Currently, Williams teaches three ISyE undergraduate classes: Operations Analysis (ISYE 3104), which is a breadth engineering elective; Introduction to Probability (ISYE 2027), which is required for all ISyE students; and Probability & Statistics (ISYE 3770), which is for non-ISyE majors. As an advisor for ISyE, he also has recently added student success initiatives — such as study techniques and time management — to his roster, specifically focusing on ISyE students who are struggling in their classes. He aims to increase students’ capacity for academic success.

“We have the best professors at the best college and the best resources. So students should get the best education,” Williams said. “If they’re not, I want to slide in there and figure out what can be done to make sure they’re getting the best education and the best experience.”

When asked if his two roles complement one another, Williams agrees. “At ISyE I study how to optimize large-scale systems. What is a church? A church is a large-scale system in a community. It has to be optimized and improved. People’s lives have to be improved; people’s relationships have to be improved. Are people widgets? Absolutely not. But can I apply some of the principles that I teach and have learned from my engineering degrees to create better solutions for my church? Yes.

“And then, my students find out I’m a pastor, and they show up at my church to hear me preach. I’ll see them sitting out there in the congregation. There’s definitely overlap — but not because I’m ministering to the students when I step on campus. I’m very aware to keep the two roles separate. But our society has some significant problems, and these millennials who I teach are going to get out there and solve those problems. So I’d better teach them well and love on them hard so they get out there and want to fix health care or our international relations with other countries, for example.”

Williams is passionate about building relationships with the people who cross his path. “Whether I’m on campus or at church, loving people is universal. I feel like I have two churches: a congregation in southwest Atlanta, and every semester — as they rotate through — a congregation of ISyE students. And I care about people and love on people and pour into people.” ■

Like Us, Follow Us, Stay in Touch!

Stay in touch and stay up to date on all things ISyE by finding us on social media or subscribing to our e-News.



-  facebook.com/GeorgiaTechISyE
-  twitter.com/GeorgiaTechISyE
-  youtube.com/GeorgiaTechISyE
-  instagram.com/gt_isye

isye.gatech.edu

Increasing Student Engagement by Flipping the Classroom

Good professors are always thinking about new ways to increase student interest and critical thinking in the courses they teach. ISyE Assistant Professor Kamran Paynabar is no exception. As an instructor of ISYE 2028, Basic Statistical Methods (BSM), which is a core course required for all ISyE undergraduates, Paynabar was looking for creative ways to help his students learn and apply the statistical theories introduced in the class.

When he first taught the class, he brought in a few group activities and games — for example, using Vernier calipers to measure bolts of different lengths, and then applying data analysis techniques to evaluate the measurement process.

But the class was really a traditionally structured course, as Paynabar recently reflected. “What do you do in a traditional classroom?” he asked. “The teacher lectures while the students listen, take notes, then go home and complete exercises.”

By using the traditional model, Paynabar was unable to incorporate as many engaging activities as he wanted to. So in spring 2017, when he had the opportunity to teach BSM again, he decided to try an increasingly popular teaching model called “flipping the classroom.”

In the flipped classroom, the students watched an instructional video created by Paynabar prior to class. When the class met, the students applied what they learned from the video by working in pairs to complete hands-on learning activities such as group quizzes and games. These interactive activities represented real-world problems that could be solved via the statistical theories and methods the students learned on their own time.

For his flipped class, Paynabar created engaging in-class activities, one of which included a

comparison study of National Basketball Association stars Kobe Bryant and LeBron James.

After compiling several years of performance data for the two professional basketball players, the students completed the comparison using hypothesis testing, focusing on three-point shots to determine which player had the best performance. For another activity, the students used the statistics for the Atlanta Braves baseball team to determine whether there was a difference in the team’s scores

for home versus away games. The students also applied their skills to a study of M&Ms, comparing the number of red versus yellow candies to determine whether the two colors were present in statistically proportional numbers. (And then they ate the candy, of course.)

Although flipped classroom instruction requires more effort and time on both the part of the instructor and the students, Paynabar said that the experience was worth it. When he surveyed the students at the end of the semester, 71 percent of the class said they preferred the flipped style over the traditional style of instruction. In addition, when Paynabar compared the results of the first exam of the flipped classroom versus the traditional, on average flipped classroom scores were 10 points higher. “So that shows the effectiveness of the flipped classroom,” he said. Paynabar plans to continue flipping classrooms in future courses he teaches, including Basic Statistical Methods in the spring 2018 semester. ■



Theory-focused Institute to Advance Foundations of Data Science

The Georgia Institute of Technology will direct a new cross-disciplinary institute established with a \$1.5 million National Science Foundation (NSF) award. The new Transdisciplinary Research Institute for Advancing Data Science (TRIAD) will bring together statistics, mathematics, and theoretical computer science to develop the foundations of data science.

Efforts to launch the theory-focused institute were supported by the Institute for Data Engineering and Science (IDEaS) with 39 faculty members from the Colleges of Engineering, Sciences, and Computing. Xiaoming Huo, principal investigator and professor in the H. Milton Stewart School of Industrial & Systems Engineering (ISyE), will serve as the executive director of TRIAD.

“The establishment of TRIAD is tremendously beneficial considering data science is a phenomenon that brings with it so many opportunities. There is a lot of research that needs to be conducted in this emerging field, and we will focus on building the theoretical foundations to establish the principles of data science,” said Huo.

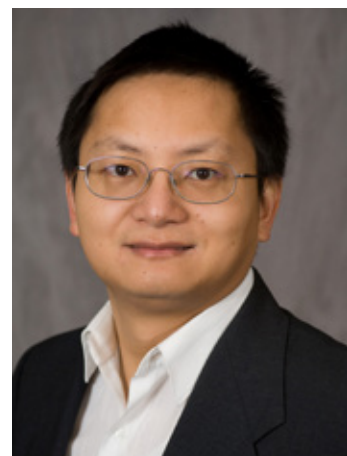
Co-principal investigators of TRIAD include Jeff Wu, Coca-Cola Chair in Engineering Statistics and professor in ISyE; Prasad Tetali, Regents' Professor in the School of Mathematics and School of Computer Science; Srinivas Aluru, co-executive director of IDEaS and professor in the School of Computational Science and Engineering; and Dana Randall, fellow co-executive director of IDEaS and ADVANCE Professor in the School of Computer Science.

The analysis of massive, dynamic, noisy, and complex data arising in virtually every sphere of human activity is a pressing problem of our time. NSF is responding by dedicating \$17.7 million in funding for 12 Transdisciplinary Research in Principles of Data Science (TRIPODS) institutes, including the aforementioned TRIAD.

Encompassing 14 institutions in 11 states, these projects will promote long-term research and

training activities in data science that transcend disciplinary boundaries.

According to NSF, the TRIPODS awards will enable data-driven discovery through major investments in state-of-the-art mathematical and statistical tools, better data mining and machine-learning approaches, enhanced visualization capabilities, and more. They also support innovative educational pathways to train the next generation of data scientists.



Xiaoming Huo

TRIAD will bring together senior, mid-career, and junior faculty members; postdoctoral fellows; graduate and undergraduate students; and data science practitioners-at-large using focused working groups, national and international workshops, and organized innovation labs. It will build an intellectual atmosphere to connect stakeholders from across the nation and the world on a regular basis.

Initially, TRIAD will focus on four research topics: advanced mathematical modeling for contemporary data; new inferential strategies that can be both scalable and decentralized; efficient optimization tools with theoretical guarantees; and applications in the context of large datasets from domains including biology, design, manufacturing, logistics, and sustainability.

NSF's award establishes TRIAD as a Phase I investment. It may be subsequently expanded to Phase II through a second competitive proposal process. ■

ISyE Houses Several Advanced and Interdisciplinary Degrees

The Master of Science in Supply Chain Engineering (MSSCE) is a graduate degree program created to meet growing demand for business-savvy engineers who can design and synchronize highly-complex global supply chains. The program began in fall 2010 with an initial cohort of 12 transfer students from Panama. The first full class began in fall 2011, with 46 students who graduated in 2012. The program now graduates about 50 students each year, with approximately 275 program alumni as of summer 2017.

In August 2016, Amazon partnered with Georgia Tech and ISyE to introduce the MSSCE Systems Design track. The Systems Design track is designed to provide students with a deeper knowledge of designing systems both within the walls of a logistics facility and across facilities in a complex, ever-changing supply chain network. With \$665,000 in funding over five years, the Systems Design track includes courses in mechatronics and robotics through Tech's Woodruff School of Mechanical Engineering, ranked second nationally, as well as a course in industrial systems design.

The Amazon partnership funds four fellowships per year for students, who also receive priority for Amazon internships. The eight fellowship recipients thus far include an international contingent — one from Mexico, one from Belgium, and three from India — as well as two students from the U.S. Half of the recipients are female.

ISyE also is partially home to the new Online Master of Science in Analytics (OMSA). The OMSA, Georgia Tech's second degree-at-scale, was announced in January 2017 on the edX platform. A collaboration between the Scheller College of Business and the Colleges of Engineering and Computing, the program is produced by Georgia Tech Professional Education and is offered for less than \$10,000 tuition. Designed to be completed in one to two years, the OMSA offers the same interdisciplinary curriculum as the on-campus program, leveraging Georgia Tech's strengths in statistics, operations research, computing, and business.

The first OMSA cohort began in August 2017, welcoming approximately 300 adult learners of which 26 percent have graduate degrees. The average age of this first cohort is 34, and 47 percent of the candidates are Georgia residents. This summer, Georgia Tech and edX also launched an Analytics MicroMasters® Program.



The program has over 13,500 learners, 169 of which are in the verified track, progressing toward a completion certificate.

The machine learning (ML) Ph.D. program is a collaborative venture between Georgia Tech's Colleges of Computing, Engineering, and Sciences through the Center for Machine Learning at Georgia Tech, an Interdisciplinary Research Center that is both a home for thought leaders and a training ground for the next generation of pioneers.

The ML Ph.D. began in August 2017. The initial class has 19 students, all drawn from incoming and current Ph.D. students from eight schools across three colleges at Georgia Tech: the Schools of Computational Science and Engineering, Computer Science, and Interactive Computing in the College of Computing; the Coulter Department of Biomedical Engineering, the School of Electrical and Computer Engineering, the Guggenheim School of Aerospace Engineering, and ISyE in the College of Engineering; and the School of Mathematics in the College of Sciences.

ML Ph.D. students are required to complete courses in five different areas: mathematical foundations, intermediate statistics, machine learning theory and methods, data models, and optimization. They are also required to take 15 hours of electives chosen from at least two of the following: statistics and applied probability, advanced theory, applications, computing and optimization, and platforms. ■

Welcoming New Faculty to ISyE

The Stewart School of Industrial & Systems Engineering has recently welcomed a number of young faculty to its ranks.

Rachel Cummings

Rachel Cummings joined ISyE as an assistant professor in August 2017. Cummings' research interests lie primarily in data privacy, with connections to machine learning, algorithmic economics, optimization, statistics, and information theory. Her work has focused on problems such as strategic aspects of data generation, incentivizing truthful reporting of data, privacy-preserving algorithm design, impacts of privacy policy, and human decision-making.

Prior to coming to ISyE, Cummings received her B.A. in mathematics and economics from the University of Southern California (2011), her M.S. in computer science from Northwestern University (2013), and her Ph.D. in computing and mathematical sciences from the California Institute of Technology (2017).

Cummings won the Best Paper Award at the 2014 International Symposium on Distributed Computing, and she was the recipient of a Simons Award for Graduate Students in Theoretical Computer Science.

She serves on the ACM U.S. Public Policy Council's Privacy Committee.

George Lan

A. Russell Chandler III Early Career Professor and Associate Professor George Lan joined ISyE in January 2016. Lan's research 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. Lan is actively pursuing the applica-



tion of stochastic and nonlinear optimization models/algorithms in large-scale data analysis, such as machine learning and image processing.

Lan received his Ph.D. from ISyE in 2009 and served as a faculty member in the Department of Industrial and Systems Engineering at the University of Florida from 2009-15. His research has been supported by the National Science Foundation (NSF) and the Office of Naval Research.

His academic honors include an NSF CAREER Award, first place in the INFORMS JFIG Paper Competition, finalist in the Mathematical Optimization Society Tucker Prize, second place in the INFORMS George Nicholson prize, and first place in the INFORMS Computing Society Student Paper competition.

Lan serves as an associate editor for *Computational Optimization and Applications* (2014-present), *Mathematical Programming* (2016-present), and *SIAM Journal on Optimization* (2016-present).

Siva Theja Maguluri

Assistant Professor Siva Maguluri is interested in the broad area of optimization and performance analysis of various stochastic systems, with a particular focus on scheduling, resource allocation and pricing problems for data centers, cloud computing, and communication networks. His research spans and uses tools and techniques from queuing theory, stochastic networks, control theory, game theory, stochastic processes, and optimization.

He received his Ph.D. in electrical and computer engineering in 2014 from the University of Illinois at Urbana-Champaign. Prior to that, he earned two master's degrees from the University of Illinois at Urbana-Champaign — one in applied mathematics (2014) and the other in electrical and computer engineering (2011). In 2008, he earned his B. Tech. degree in electrical engineering from the Indian Institute of Technology Madras.

Before coming to ISyE in January 2017, Maguluri was a research staff member in the Mathematical Sciences Department at the IBM T.J. Watson Research Center.



Mohit Singh

In January 2017, Mohit Singh joined ISyE as the H. Milton Stewart Early Career Professor and associate professor. Prior to this, he served as a researcher in the Theory Group at Microsoft Research in Redmond, Washington.



Singh's research interests include discrete optimization, approximation algorithms, and convex optimization. His research focuses on optimization problems arising in cloud computing, logistics, network design, and machine learning.

Singh received the Tucker Prize in 2009 given by the Mathematical Optimization Society for an outstanding doctoral thesis, "Iterative Methods in Combinatorial Optimization." He also received the best paper award for his work on the Traveling Salesman Problem at the Annual Symposium on Foundations of Computer Science in 2011.

Previously, Singh was an assistant professor at McGill University in Montreal, Canada, and a postdoctoral researcher at Microsoft Research, New England. He obtained his Ph.D. in 2008 from Tepper School of Business at Carnegie Mellon University.

He Wang

He Wang joined ISyE as an assistant professor in January 2017. Wang's research interests are in the areas of revenue management, supply chain and logistics, and statistical learning. His current research focuses on the interface between machine learning and operations management, where he develops data-driven methods for applications including inventory management and dynamic pricing.

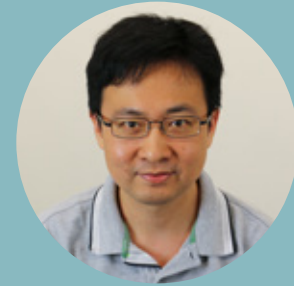


He was a finalist for the 2015 IBM Service Science Best Student Paper Award and a second-place recipient of the 2013 CSAMSE Best Paper Award.

Wang received his Ph.D. in operations research in 2016 and his M.S. in transportation in 2013, both from the Massachusetts Institute of Technology. In 2011, he received a B.S. in industrial engineering and a B.S. in math from Tsinghua University in China.

Huan Xu

Since August 2016, Huan Xu has served as an assistant professor at ISyE. Xu's current research interest focuses on data, learning, and decision-making. Specifically, he is interested in machine learning, high-dimensional statistics, robust and stochastic optimization, sequential decision making, and application to large-scale systems.



He is currently an associate editor of both *IEEE Transactions on Pattern Analysis and Machine Intelligence* and *Computational Management Science*.

Xu received his B. Eng. from Shanghai Jiaotong University in 1997, his M. Eng from the National University of Singapore in 2003, and his Ph. D. from McGill University in 2009. Before joining ISyE, he was an assistant professor at the National University of Singapore, after a postdoctoral appointment at the University of Texas at Austin.

Tuo Zhao

Assistant Professor Tuo Zhao joined ISyE in January 2017, and his current research focuses on developing a new generation of optimization algorithms with statistical and computational guarantees, as well as user-friendly open source software for machine learning and scientific computing.



He received his Ph.D. in computer science from Johns Hopkins University (JHU) in 2016 before joining ISyE. He was a visiting graduate scholar in the Department of Biostatistics at Johns Hopkins Bloomberg School of Public Health from 2011-12, and the Department of Operations Research and Financial Engineering at Princeton University from 2014-16.

Zhao has received several awards and scholarships for his work. He was the core member of the JHU team winning the INDI ADHD 200 global competition on fMRI imaging-based diagnosis classification in 2011. Zhao received the Google Summer of Code awards from 2011 to 2013. He received the Siebel Scholarship in 2014, the Baidu Fellowship in 2015-16, and a Chinese Government Scholarship for Outstanding Graduates Abroad in 2016. Zhao also was the co-recipient of the 2016 American Statistical Association Best Student Paper Award on Statistical Computing and the 2016 INFORMS SAS Best Paper Award on Data Mining. ■

ISyE Researchers Use Analytics-based Methods to Improve Blood Collection

A team from Georgia Tech's Stewart School of Industrial & Systems Engineering (ISyE), which includes George Family Foundation Assistant Professor Turgay Ayer, Schneider National Chair in Transportation and Logistics Chelsea "Chip" White III, Professor Roshan Vengazhiyil, ISyE Ph.D. alumnus Chenxi Zeng, and ISyE Ph.D. student Can Zhang, has been recognized for their project "American Red Cross Uses Analytics-based Methods to Improve Blood Collection Operations."

They have proposed and analyzed an alternate blood collection model to increase the amount of whole blood that can be processed into a critical blood product, cryoprecipitate (cryo), while reducing per-unit collection costs. Cryo plays a critical role in clotting and controlling massive hemorrhaging, and is often used in the treatment of massive trauma and many major diseases, including metastasized cancers, cardiac diseases, hepatic failures, and organ transplants. After reviewing blood collecting and processing schedules, collection locations, historical yield rates, and donor-related factors, the researchers developed an advanced analytics-based approach that allowed them to study the potential benefit of the proposed alternate collection model.

The promising findings from this analysis later led to a decision support tool (DST) implemented by the Red Cross Southern Region, which serves more than 120 hospitals in the Southern U.S. The



Turgay Ayer and Chip White

implementation of the DST resulted in a significant increase in the number of whole blood units satisfying the tight collection-to-process completion time constraint for cryo production. In particular, during the fourth quarter of 2016, the Red Cross Southern Region was able to process approximately 1000 more units of cryo per month (an increase of 20 percent) at a lower collection cost, resulting in a 40 percent reduction in the per-unit collection cost for cryo. This DST was presented to the executives at the national level of the Red Cross, and plans are in place to extend the implementation of the DST to the 11 other American Red Cross regions in the future.

Earlier this year, the Georgia Tech/Red Cross team was selected as a finalist for the 46th annual Franz Edelman Award for Achievements in Operations Research and Management Science by the Institute for Operations Research and the Management Sciences (INFORMS), the leading international association for professionals in operations research and analytics. In July 2017, the group also received first prize in the 2017 Manufacturing & Service Operations Management (INFORMS) Practice-based Research Competition for "Analysis and Improvement for Blood Collection Operations." ■



CHRISTOPHER MOORE

Connecting Crimes Algorithmically

By Alyson Powell

Late last year, Yao Xie, Harold R. and Mary Anne Nash Early Career Professor in the Stewart School of Industrial & Systems Engineering, began working with the Atlanta Police Department (APD) to test an algorithm that finds connections between crime incidents. The algorithm examines both structured data captured by 911 operators — the type of crime, and when and where it happened — and unstructured, or free text data. This type of data is gathered by police officers at the scene of the crime and includes detailed narrative descriptions from the officer, victims, and witnesses.

The tricky part for police investigators is manually analyzing thousands upon thousands of reports — including new reports that are coming in every day — to find patterns between cases, which could help solve serial crimes. It's nearly an impossible task. Xie's algorithm automates this process by dissecting incident reports and learning the similarities between words and common patterns in how crimes occurred. It has to be smart enough to recognize that two or more crimes could be related.

"This is an artificial intelligence way of processing police reports," said Xie. "It's a way of investigating cases much faster, and more effectively."

APD provided three years of data to process, with more than 24,000 cases. The algorithm analyzed that data within hours.

"Our partnership with Georgia Tech has the potential to truly transform the speed and manner in which we currently analyze crime data," said former APD Sergeant Frank Ruben, who is now with the department of Atlanta Information Management. "The ability this gives our investigators to proactively compare notes and identify trends will aid tremendously in furthering Chief Erika Shields' priority of reducing violent crime through innovative technology."

There are challenges with this method, explained Xie, including typos, grammatically incorrect sentences, and differences in how individual officers write their reports. "The reports are very different from one to the next; in fact, they're never the same. The algorithm has to be robust enough to see errors."

Xie is receiving financial support for her research from the Atlanta Police Foundation. ■

ISyE Professor Martin Savelsbergh on Research Team Awarded a NASA Early Stage Innovation Grant

Every detail — every moment — of a space mission is scripted. The plan for a four-hour spacewalk can exceed 50 pages and will list what an astronaut is supposed to do almost to the second. If something goes awry or deviates from the plan, Mission Control back on Earth makes the decisions about how the astronaut should respond.

As human spaceflight inches closer to launching a Mars mission, onboard planning and mission adjustments loom large as potential issues. On a Mars flight, the communications lag time with Mission Control will be between four and 22 minutes, and astronauts need to be able to make some decisions independently, especially in the event of an emergency.

When the best-laid plans need to be adjusted, how do astronauts reconnoiter?

This question is at the heart of “Technologies for Mixed-initiative Plan Management for Human Space Flight,” interdisciplinary research conducted by three Georgia Tech engineering professors: Martin Savelsbergh, James C. Edenfield Chair and professor in the Stewart School of Industrial & Systems Engineering; Karen Feigh, an associate professor in the Daniel Guggenheim School of Aerospace Engineering (AE); and Amy Pritchett, David S. Lewis Professor of Cognitive Engineering in AE.

This research — which the team is just beginning to explore — received a two-year, \$600,000 NASA Early Stage Innovation (ESI) grant. Together Feigh, Pritchett, and Savelsbergh are working toward developing technology that will allow on-board astronauts to develop their own short- and long-term plans for accomplishing mission objectives.

Savelsbergh, who works on scheduling algorithms in ISyE, said, “The idea here is to explore mechanisms that support more autonomous decision making. The aspect that I’m interested in most is the algorithms that make decisions or suggest decisions, i.e., automatically compute plan changes.”

This task is especially demanding because plan changes have to be generated and evaluated by taking into account multiple considerations and multiple criteria,

e.g., whether an astronaut is more productive in the morning or in the afternoon, whether the astronaut had an exhausting day the previous day, the impact of reducing an astronaut’s exercise regime from four hours to three and a half hours, and the impact of moving a low priority task to the next day.

“Taking all of these considerations into account in a more automated way is going to be challenging,” Savelsbergh said. “Because we are dealing with astronauts, there is also the question of how we interact with that individual. Our algorithms suggest changes to the plan; how do we communicate those decisions to the astronauts, especially if we offer choices? Can they overrule what we propose? How can they convey information about what’s happening? In other words, how can the team structure, represent, and visualize information so that communication with the astronaut goes smoothly?”

There are two other academic teams in the U.S. also funded by NASA to study this scheduling problem. Recently, NASA held a videoconference for all three teams plus the NASA planners who traditionally schedule astronauts’ activities. From that conversation, Savelsbergh said, “It was very insightful to see the scope of the challenges the planners have — far greater than we had originally anticipated, and it also helped us to understand why they actually have very few tools to help them solve these challenges. This is hopefully what we’re going to change.

“For my part, I’m starting to think about how to model such complex environments so we can at least describe situations and tasks that need to be completed — the relationships, the constraints, the impact, and the preferences. The challenge, in part, is in thinking about how to model the human element in the process.”

Because of the human factor, the problem the team is trying to solve isn’t as simple, for example, as Amazon scheduling a truck to deliver a package.

“We know we have to be creative in terms of thinking about what to do and how we can apply some of the techniques we traditionally use. It’s certainly an interesting problem,” said Savelsbergh. ■

The Promise of Blue-green Algae: An Environmentally Friendly Source for Producing Biofuels and Other Products

Many people are familiar with ethanol — a popular biofuel mixed with gasoline — and how it's made in the United States: from corn. Second-generation biofuel is also coming on to the market, made from inedible plant materials such as corn stalks, leaves, and cobs. Now, thanks to a \$6.25 million grant from the U.S. Department of Energy (DOE), a third generation of biofuel is being developed via blue-green algae, or cyanobacteria.

The three-year grant was jointly awarded to Algenol, an industrial biotechnology company; Georgia Tech; the National Renewable Energy Laboratory; and Reliance Industries under the DOE's Advancements in Algal Biomass Yield, Phase 2 (ABY2) program to produce biocrude and co-products. Valerie Thomas, the Stewart School of Industrial & Systems Engineering's Anderson Interface Professor of Natural Systems, and Matthew Realff, the School of Chemical & Biomolecular Engineering's Professor and David Wang Sr. Fellow, are the lead researchers from Georgia Tech.

This grant will enable the team to explore the environmental process and impacts of cyanobacteria-produced biofuels and other high-value chemicals. The ethanol is extracted from the algae's water and nutrient bath in a process that is similar to whiskey distillation. Algenol has developed a process that produces pure ethanol from very dilute ethanol in a way that is highly energy efficient.

Why is cyanobacteria as a source for ethanol so promising? Principally, cyanobacteria-produced biofuel is environmentally friendly — for a number of reasons.

As Thomas explained, "The algae are grown in photobioreactors, which are basically large plastic bags, along with water and nutrients. The plastic bags hang in rows out in the sun, and there's no reason for the land to be good agricultural land. It can be in desert areas or near the coast for shipping. It's also quite productive per acre compared with land plants [that can be used to make first- or second-generation biofuel]."

In addition, the carbon dioxide that the algae need to grow could be siphoned-off fossil fuel power plant emissions and piped into the photobioreactors. A number of other carbon capture and utilization scenarios for biorefineries have been studied by the



Algenol-Georgia Tech team, including stand-alone systems where carbon dioxide is generated on-site. Many of those scenarios show competitive economics and very low carbon footprints compared to gasoline.

Thomas — an expert on greenhouse gas emission evaluation — and Realff — an expert in chemical process modeling and optimization — have been working with Algenol on its biofuel production processes for a number of years. Thomas works in environmental systems analysis, with a main area being life-cycle assessment. This means that she looks at the entire supply chain for producing and using this biofuel. She said that this includes "what kind of fertilizer it uses, how the production facility is built, and the energy used in the facility — how much is used and where it comes from. All the emissions need to be taken into account."

To proceed to commercial-scale production, the process needs to be both environmentally sound and cost-effective. It's challenging to make third-generation biofuel that can match today's historically low petroleum prices. However, Algenol technology can yield other products, including natural food colorants and fertilizers, that are well along in the pipeline. Expanding on the multi-product approach, the grant team is evaluating additional biofuel components that can be made within an Algenol biorefinery that would be cost-effective and have low environmental impact. ■

Adaptable Model Recommends Response Strategies for Zika Virus and Other Public Health Pandemics

Recent outbreaks of Zika virus, SARS, bird flu, H1N1, and Ebola underscore the importance of being prepared for and responding quickly to infectious diseases. Zika poses unique challenges, since its associated birth defects and lack of preventive treatment currently threaten over 60 countries.

Eva Lee, a professor in the H. Milton Stewart School of Industrial & Systems Engineering and director of the Center for Operations Research in Medicine and Health-care, has developed a biological-behavioral-operational computer model to help policymakers choose the best intervention strategies to rapidly contain an infectious disease outbreak. Her analysis covers the dynamics of disease transmission across different environments, and gives on-the-ground policymakers critical information about how to mitigate infection, monitor risk, and trace disease during a pandemic.

“The containment of pandemics is fundamental to preventing a global epidemic,” said Lee. “This computational modeling tool is designed for real-time support. By accepting real-time data, the model produces predictions that reflect a specific environment, policy, and human behavior on the ground.”

The tool, RealOpt-ASSURE, can use many types of data, including biosurveillance, as well as environmental, climate, viral, host, human behavior, and social factors. If genetic information for the disease carriers is available, it also can be incorporated. The modeling system provides the ability to predict disease spread, assess risk, and determine effective containment methods. In addition, it can help public health leaders optimize deployment of limited resources to help prevent and reduce the extent of future outbreaks.

For example, using data related to the Zika outbreak in Brazil, Lee has determined which containment approaches are most effective there. Her model shows that the easiest and most productive way to contain the outbreak in Brazil is to reduce the biting rate of mosquitoes by using insect repellents/mosquito repellent wristbands, wearing long-sleeved shirts and long pants, and employing air conditioning and window/door screens to keep mosquitoes out.

The result is practical. For example, the model demonstrates that only 20 percent compliance can reduce the total infection by half. This strategy is more successful than just widely applying insecticide and lasers to kill mosquitos. The model offers policymakers a decision-support framework to estimate the cost-effectiveness of each prevention measure.

The modeling system also underscores the importance of early intervention by revealing the timing of different



interventions and associated outcomes. “Knowing when to respond and how it affects the outcome is essential,” Lee said.

Lee has shared some of these findings with federal officials, who recommended implementation of her resulting policies and strategies for Puerto Rico. She is also working with public health leaders in Houston, Texas, to identify high-risk areas and to optimize local surveillance and intervention. The mosquito population is expected to explode after Hurricane Harvey left behind countless pools of stagnant water, creating perfect breeding conditions.

Lee’s system can be applied to help contain a wide variety of epidemics, including not only Zika but also dengue, Ebola, and many other types. “The modeling framework accommodates various transmission mechanisms. This allows public health officials to adapt rapidly to changing disease environments and different emerging epidemics,” said Lee. The research has been sponsored in part by the National Science Foundation and the Centers for Disease Control and Prevention (CDC).

As part of a continuing research effort, Lee is working with vaccinologists on vaccine immunity prediction to permit faster design and evaluation of new and emerging vaccines and to identify individuals either most likely or least likely to be protected by a vaccine.

An applied mathematician and modeling innovator, Lee has traveled to hot spots around the world as an advisor in response to public health catastrophes. She has long partnered with the CDC on medical preparedness and emergency response. Since 2015, she has served on the National Preparedness and Response Science Board, the federal committee that provides advice and guidance to the U.S. Department of Health and Human Services. ■

ISyE Part of Interdisciplinary Team Fielding the DARPA Spectrum Challenge

To the average person, the Wi-Fi spectrum may seem like sunshine or the wind — an unlimited natural resource that anyone can access at any time for any reason. In reality, the radio frequency (RF) spectrum is finite. In fact, because of military usage, as well as the proliferation of cellphones, laptops, computers, and the internet of things — such as Wi-Fi enabled home devices — the RF spectrum is beginning to run out of room.

To find a way to alleviate this problem, DARPA (Defense Advanced Research Projects Agency), an agency of the U.S. Department of Defense, is hosting the second Spectrum Collaboration Challenge, or SC2. The goal of the challenge is to increase the possibility of access to Wi-Fi for both military and civilian wireless devices. According to the SC2 website, this will be accomplished when “radio networks autonomously collaborate and reason about how to share the RF spectrum, avoiding interference, and jointly exploiting opportunities to achieve the most efficient use of the available spectrum.” The challenge is designed to encourage sharing between networks through a combination of machine learning and communications engineering.

Enter Georgia Tech Agile Communication Architectures, one of 30 original teams selected to participate in SC2. Spearheaded by two Georgia Tech professors — Matthieu Bloch, an associate professor in the School of Electrical and Computer Engineering (ECE), and Sebastian Pokutta, David M. McKenney Family Associate Professor in the Stewart School of Industrial & Systems Engineering — the team comprises graduate students from both schools and comes out of the

interdisciplinary Center for Machine Learning at Georgia Tech (ML@GT). The team is self-funded, but Bloch and Pokutta have received some support from the National Science Foundation in the form of a \$99,877 EAGER grant, which supports the team’s initial efforts.

In terms of solving the challenge through machine learning, Pokutta said, “If you look at machine learning in general, it’s a very powerful technique. At the same time, it’s probably overhyped. You have to create tangible value: applying it to real-world problems and solving them to have impact. It’s like having a hammer. A hammer is a great tool, but if you have nothing to apply it to, it’s completely worthless.”

The goal of the challenge is collaboration. Collaboration is important for solving SC2, but for Bloch and Pokutta, the collaborative aspect includes training graduate students to be interdisciplinary — to understand not only the nuances of machine learning or communications engineering, but also to be fluent in both fields.

Something else sets the Georgia Tech team apart: While Bloch and Pokutta are the professors heading up the challenge — Pokutta compared Bloch and himself to investors in a startup company — the day-to-day work of solving the challenge is led by graduate students in ECE and ISyE.

Jana Boerger (MSIE 17), a current ISyE Ph.D. student, oversees management of the project. From an ISyE perspective, Boerger said, “The challenge shows that the optimization methods we learn in ISyE can be applied to very technical real-world problems.”



From top: Matthieu Bloch, Sebastian Pokutta, and Jana Boerger

Like Pokutta and Bloch, Boerger sees the value of an interdisciplinary approach. She added, "What's also interesting is that while our team is all students, the other teams in SC2 are companies — heavyweight teams with a lot of money behind them. I think we as students can be successful if we work together, because we have this interdisciplinary team. Innovation happens when you combine two different fields together, like we're doing. You need to look outside the box and see what's there and take the tools and the knowledge and combine what you have."

Pokutta elaborated, "The challenge is a learning experience that encourages creativity. We don't just want to take something that's out there and enhance it. Our strategy is to break with the current paradigms, start in the physical area, and redo everything from scratch with collaboration and spectrum-sharing built in from the start, not just as an afterthought to the technology.

"What has been surprising to us is the complexity of the problem," he added.

Over the course of the DARPA Spectrum Collaboration Challenge, the 22 teams now remaining will compete in three preliminary competitions — in December of 2017, 2018, and 2019 — with a final competition in 2020, taking place in the recently constructed DARPA Colosseum. The Colosseum is a 30-foot by 20-foot server room located on the campus of the Johns Hopkins University Applied Physics Laboratory in Maryland. The teams have a chance to win as much as \$3.5 million in prize money.

Thanks to the interdisciplinary nature and approach of the Georgia Tech Agile Communication Architectures team, the group is uniquely positioned for success in developing and executing an integrated solution to the DARPA Spectrum Collaboration Challenge as it navigates the multi-year, multi-phase competition. ▪

Honor your favorite Yellow Jacket by creating a
GEORGIA TECH LEGACY
in their name.

Consider establishing an endowed legacy gift to honor someone special in the Georgia Tech community. Perhaps you would like to honor:

- **Your graduating daughter, son, or grandchild.**
- **Your favorite ISyE faculty member from your time as a student.**
- **A deceased loved one through a permanent memorial fund.**

A gift of \$25,000, payable over five years, will establish a permanent endowment fund in the name of your honoree and will provide resources for ISyE students, faculty, and programs for years to come. You and your honoree will receive annual reports on the impact of the fund. You, other family members, and friends can easily add to the fund throughout the years.

To learn more, contact Nancy Sandlin at 404.385.7458 or nancy.sandlin@isye.gatech.edu.

Brenda Dietrich, ISyE 2017 Distinguished Leadership Lecturer, Shares Perspectives on the Deployment of Operations Research Methods

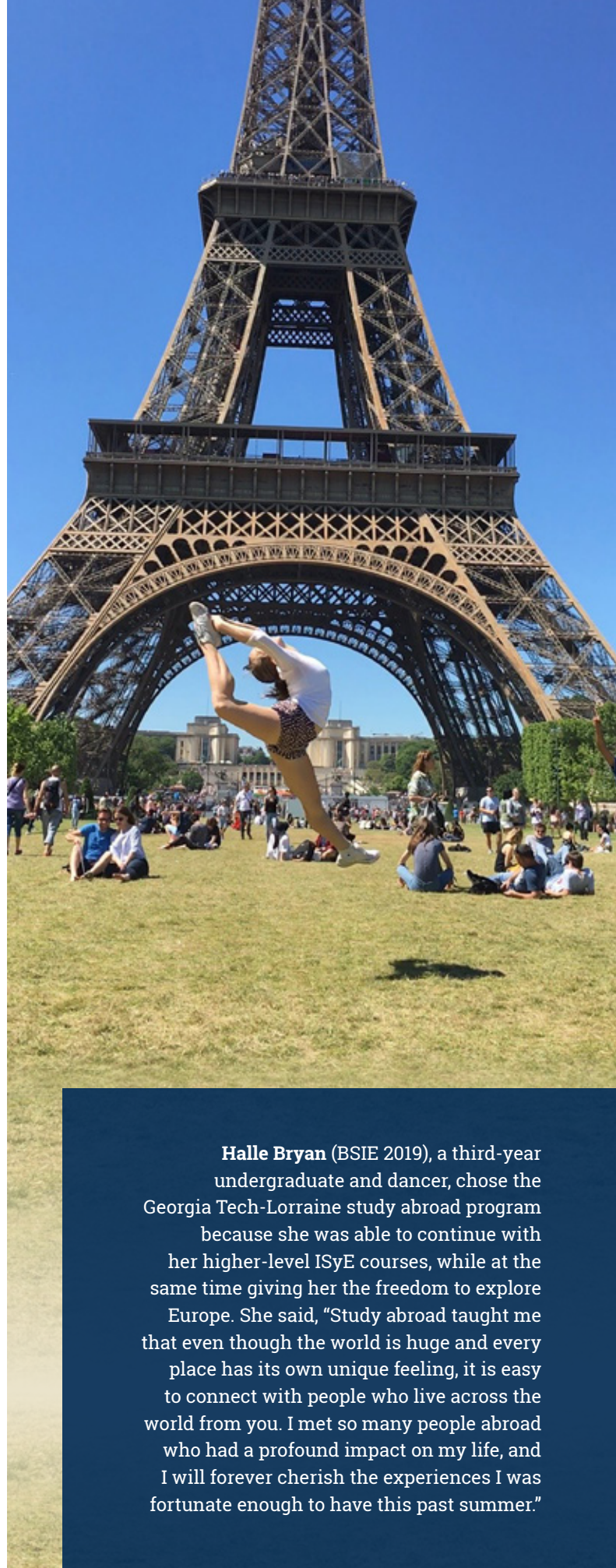
ISyE's Distinguished Lecture program promotes discussion on critical issues in the field by bringing in leading scholars who engage and share their expertise with ISyE faculty, students, and alumni.



In March, ISyE hosted IBM Fellow and Vice President Brenda Dietrich for its 2017 Distinguished Leadership Lecture. Dietrich joined IBM in 1984 and has worked in the area now called “analytics” for her entire career, applying data and computation to business decision processes throughout IBM. For over a decade, she led the mathematical sciences function in the IBM research division, where she was responsible for both basic research on computational mathematics and for the development of novel applications of mathematics for both IBM and its clients. A member of several university advisory boards, Dietrich has been the president of INFORMS and has served on the Board of Trustees of the Society for Industrial and Applied Mathematics. She was elected to the National Academy of Engineering in 2014.

Dietrich's talk, “Riding Technology Waves: Perspectives on the Deployment of Operations Research Methods,” included an overview of five decades of information technology, beginning with its use to automate business processes and extending to its current role in intermediating social processes. The resulting “data exhaust,” together with the availability of low-cost computing capacity, spawned the age of analytics, the rise of big data, and the birth of cognitive computing. She also discussed the past, current, and potential role of operations research in these technology waves.

If you were unable to attend the ISyE Distinguished Leadership Lecture given by Brenda Dietrich, the presentation is now available on video here: <http://b.gatech.edu/2vxECdk>. •



Halle Bryan (BSIE 2019), a third-year undergraduate and dancer, chose the Georgia Tech-Lorraine study abroad program because she was able to continue with her higher-level ISyE courses, while at the same time giving her the freedom to explore Europe. She said, “Study abroad taught me that even though the world is huge and every place has its own unique feeling, it is easy to connect with people who live across the world from you. I met so many people abroad who had a profound impact on my life, and I will forever cherish the experiences I was fortunate enough to have this past summer.”

ISyE Inducts Five New Advisory Board Members and New Chair at Spring 2017 Meeting

Alfredo Boratto, Kim Felix, John McKenney, Steve Necessary, and Ronda Sides joined Georgia Tech's Stewart School of Industrial & Systems Engineering (ISyE) Advisory Board in the spring of 2017. These five alumni are joining 15 other distinguished professional and community leaders, serving as a sounding board for the School Chair in an advisory capacity, as well assisting with the School's development goals. Each member will serve a four-year term (2017-21). Major General Kelly McKeague was inducted as the Advisory Board's new chair. He will lead the board for a one-year term.

Kelly McKeague, Advisory Board Chair

Kelly McKeague (BSIE 81, MSIE 87) serves as director of the Defense POW/MIA Accounting Agency, whose global mission encompasses the historical research and investigation, search and recovery, and forensic operations to account for American service members missing from World War II to the first Persian Gulf War. Following his 1981 commission from Georgia Tech's Air Force ROTC program, McKeague served in several industrial engineering positions at a number of bases including the Pentagon. At the culmination of his 34-year military career, he retired as a major general in 2015. McKeague and his wife, Nancy, reside in Alexandria, Virginia.

Alfredo Boratto

Alfredo Boratto (BSIE 89, MSIE 91) is an accomplished entrepreneurial executive with experience across top-tier companies valued for driving multimillion-dollar new business growth and investment programs in the technology, health care, and life sciences industries by leading investment, strategy, new business development, and sales and marketing teams.

Previously, Boratto was the segment leader for IBM responsible for new business opportunities and the creation of strategic relationships (including equity positions) with venture-funded emerging technology companies in the health care and life sciences arena. His prior positions at IBM included business development, sales, and strategy

formulation roles for the health care and life sciences business units. Boratto has also worked for The Wilkerson Group; Tenix, a health care management firm in Australia; and Merck & Co.

In addition to his degrees from ISyE, Boratto earned an MBA from the Executive Program at Columbia Business School, and he is a graduate of The Wharton School General Management Program at the University of Pennsylvania.

Kim Felix

Kim Felix (BSIE 88) is vice president of information technology for UPS. Felix currently leads the enterprise computer, collaboration, and data services portfolio responsible for global computer operations; technology support; collaboration tools and services; IT practices; data strategy and services; and advanced analytics. Prior to her current assignment, Felix led the transportation technology group portfolio responsible for UPS airline, global brokerage, and global transportation technology solutions. She began her UPS career in the customer technology portfolio, leading teams in the expansion and build out of internet-based applications on UPS.com, including the development of web services and tools used for customer integration services, shipping, and visibility solutions.

In addition to her degree from ISyE, Felix has a bachelor's degree in computer science from Spelman College, a master's degree in computer science from the University of Southern California, and a master's certificate in project management from the Stevens Institute of Technology.

Community engagement is a priority for Felix. She serves on the Overseers Board for NJIT and the United Way Bergen County Board. Felix is executive advisor for the IS African American Business Resource Group. She has a particular interest in STEM-based programs that encourage young men and women to enter the science and technology fields and supports and sponsors multiple activities, including the VEX Robotics International Competition hosted in Louisville, Kentucky.

John McKenney

John McKenney (BSIE 90) is president and chief executive officer for McKenney's, Inc., a third-generation, employee-owned business headquartered in Atlanta, Georgia. He

began his career with Trane. During his successful six-plus years with Trane, he served as a sales engineer working with consulting engineers, mechanical contractors, and industrial owners to design and sell commercial and industrial air conditioning equipment and controls. He joined McKenney's, Inc. in 1997, and has held the positions of project manager, senior project manager, and vice president of Atlanta Construction, all before his current role as president and chief executive officer.

McKenney is recognized as a Distinguished Engineering Alumnus by the College of Engineering at Georgia Tech. He serves as a trustee for the Atlanta Plumbers & Steamfitters Health and Welfare Fund. A member of the Atlanta Rotary Club, McKenney is a 2014 Graduate of Leadership Atlanta. He is past president, past board member, and current treasurer of the Mechanical Contractors Association of Georgia and board member of the Atlanta Area Council Boy Scouts of America. He served as an elder at St. Luke's Presbyterian Church in Dunwoody and is an Eagle Scout.

Born and raised in Atlanta, McKenney and his wife, Janine, reside in Sandy Springs, and have two children in college.

Steve Necessary

Steve Necessary (BSEES 78) is executive vice president of product development and management for Cox Communications, where he has worked since 2005. He directs new development and lifecycle management for all products across residential and business portfolios. Previously, Necessary served as vice president of video product strategy, development, and management, and oversaw the conception, development, and deployment of new video products, including the company's flagship Contour service.

Necessary is a member of Cable & Telecommunications Association for Marketing, the Society of Cable Telecommunications Engineers, and Cable Pioneers. He is an emeritus member of the board of the Atlanta Ballet and Christians in Cable and is active at Mt. Pisgah United Methodist Church.



Top row: Kelly McKeague, Alfredo Boratto, Kim Felix
Bottom row: John McKenney, Steve Necessary, Ronda Sides

In addition to his degree from Georgia Tech, Necessary earned his MBA from Harvard Business School. He and his wife, Debbie, have three daughters and four grandchildren.

Ronda Sides

Ronda Sides (BSIE 83) and her husband, Alan (BSME 83), are pleased to return to the United States after living in Singapore, the United Kingdom, Japan, and China since 1997. Sides' professional experience includes computer software customer and sales support with Management Science America; investment banking with Bear Stearns & Co.; and corporate valuation consulting with Morris and Associates. She is the co-founder of Omni Technology Centers (later Extreme Logic), a computer software training and consulting firm and Microsoft reseller.

Sides and her husband have 33 consecutive years of Roll Call support, and both established scholarships in 2000 during the Campaign for Georgia Tech. Additionally, she served on the Georgia Tech Alumni Association Board of Trustees, was named to the Council of Outstanding Young Engineering Alumni, and served as Georgia Tech Student Government Association president.

Sides and her husband live in Alpharetta, Georgia, with their two daughters. In addition to her degree from ISyE, Sides holds an MBA from The Wharton School of the University of Pennsylvania. ■

ISyE Alumna Errika Moore: Making an Impact in STEM

Since Errika Moore (BSIE 96) was in high school, she has followed the mantra “making an impact, making a difference.” Throughout her distinguished career, Moore has remained engaged with Georgia Tech through several boards, as well as the Stewart School of Industrial & Systems Engineering, providing volunteer leadership and service while abiding by her personal philosophy.

In this interview, Moore discusses her particular passion for supporting female and minority participation in STEM fields, why she made the career move from corporate to nonprofit work, and how she continues to give back to Georgia Tech and ISyE — including serving on the ISyE Advisory Board — in what she calls “a lifestyle of servant leadership.”

You contribute considerable time to organizations in support of increasing minority participation in STEM-related fields. When did your passion for this begin, and how has it developed along with your career?

It actually began when I was at Tech. [In the early 1990s] women made up 10 percent of the student body. That’s in comparison with the 40 percent female population today. In addition, in my time at Tech, minorities represented about 10 percent of the student population.

As a result, I wanted to ensure that others could either have the same opportunities — or ideally, opportunities with even greater access. It became a personal passion that whenever I could specifically be involved with an organization that would increase access for women and minorities — such as my being president of the Georgia Tech Black Alumni Organization or serving on the board of the Georgia Tech Women Alumnae Network — I would raise my hand and join in.

For women in technology, there’s been a significant decline in the number of women graduating in STEM



fields since the 1970s. And when you look at the upcoming job opportunities — by 2022, there will be 1.2 million tech-sector jobs — I want women and minorities to fill those jobs.

Previously you were the vice president of member services & external affairs at IT Senior Management Forum (ITSMF), a nonprofit organization that promotes African American representation in senior technology positions within Fortune 500 organizations. Currently, you’re the executive director for the Technology Association of Georgia Education Collaborative (TAG-Ed). Describe what you’ve done in these roles.

I opted to come out of corporate to specifically focus my energy on nonprofits, hoping to make a difference and be an advocate. At ITSMF my responsibilities included everything from identifying to recruiting to supporting black technology executives.

"You may not immediately realize when you're graduating from Tech the phenomenal foundation you've received, but the moment you do realize that, you also realize the responsibility of making sure you're supporting the students there now."

— ERRIKA MOORE

Because black tech executives only represent six percent of the technology population, I had a huge opportunity for increasing and supporting the technology pipeline from higher education to career and to change the narrative that black tech execs don't exist.

I cultivated strategic relationships with organizations like the National Society of Black Engineers (NSBE) or INROADS or Per Scholas — organizations that feed that executive pipeline. These organizations are tapped into the 18-30 age demographic. This gave ITSMF the opportunity to plant seeds, provide career literacy, and help to ensure the likelihood that they'll transition into executive opportunities.

This provided the perfect segue into my new role at TAG-Ed where we are responsible for strengthening Georgia's future workforce by providing students with relevant, hands-on STEM learning opportunities by connecting TAG-Ed resources with leading STEM education initiatives.

You've said before that serving and volunteering are an integral part of your lifestyle. Why is that?

I'll explain it this way. I have two sons: Jordan, who is 13, and Jaylen, who is 15. Wherever I've served, they've served, whether it's the American Diabetes Association, the Gifted Education Foundation, or the Georgia Tech Alumni Association Board of Trustees. My sons have been part of who I am and what I do, and it's not something I compartmentalize.

There's no delineation between being a mom, serving on a board, or serving as a STEM Advocacy

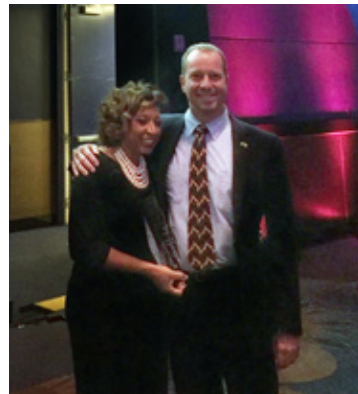
executive. I want Jaylen and Jordan to see it and be an active part of it.

You're involved in the Million Women Mentor initiative as well as the Georgia Tech Alumni Association's Mentor Jackets program. Why is mentoring so important?

When I was at Tech, there were alums who actively created a support mechanism for those of us who were students. They set the example of "paying it forward." You may not immediately realize when you're graduating from Tech the phenomenal foundation you've received, but the moment you do realize that, you also realize the responsibility of making sure you're supporting the students there now.

I had the honor and pleasure of being recognized in 2016 by the Georgia Tech Society of Black Engineers (GTSBE), which graciously gave me the Alumni Trailblazer award. GTSBE said, "Whenever we call, you're there. Whenever we need support, you're there." And as much as I appreciated the recognition, I shared with them my perspective that this is what we're supposed to do because someone did the same for us.

Since I'm in nonprofit, I don't have the checkbook that other people have to give financially, but I can add value by giving my time. I can give my support. And I can share my experiences. Because if we're all doing what we can, how we can, then hopefully we're creating opportunities where someone can trump whatever we've achieved. And we're collectively making a difference and making an impact.



Top: Moore with her family
 Bottom: Moore receiving the Woman of the Year award from Women in Technology in 2016, and Moore with ISyE School Chair Edwin Romeijn at the event

Who was an influential ISyE professor for you?

Augustine Esogbue, who is now professor emeritus. He was the first black professor at Tech and was like a surrogate father to me. Today he continues to be one of my greatest champions, confidants, and supporters.

He was also an advisor for the GTSBE, which was one of the first chapters of NSBE. He went on to influence hundreds of lives by serving as an advisor for the national organization.

In fall 2016 you received the Woman of the Year award from Women in Technology (WIT). What did winning this award mean to you?

To say it's a huge and humbling honor is honestly an understatement. WIT is an organization that is highly committed to empowering women in every stage of life — from young women in high school and college to seasoned professionals.

My other mantra in my life is "to whom much is given, much is required." So the Woman of the Year Award was not only a phenomenal recognition, but it was also a phenomenal responsibility to both uphold receiving the recognition and to ensure I'm doing something positive for the women I come in contact with through that recognition.

Where do you see yourself in the next three to five years? What would you like to be doing?

I have decided to stay committed to the nonprofit sector. There's a saying that "only a life lived in the service to others is worth living," so I've decided that's the space for me. I'm fulfilling the purpose that was given to me 20 years ago. Now, how I will continue to serve in that capacity — that may be the question mark. As long as I can be an advocate and a champion, that's what's most fulfilling for me, from a career perspective and from a volunteer leadership capacity.

I also give thanks for having the opportunity to serve on the ISyE Advisory Board. [Former School Chair and Professor Emerita] Jane Ammons asked me to serve on the board, and coming from her, it was quite the honor to be asked. And the honor continued by serving under current School Chair Edwin Romeijn's leadership as well. Being asked to serve and represent the department that shaped who I have become has been one of the most fulfilling opportunities I've had while serving Tech. ▪

ISyE Alumnus Jim McClelland: A Life of Public Service

Jim McClelland (BSIE 66) has spent a lifetime devoted to helping others both professionally and personally. Describing why public service is so important to him, McClelland said, "That was just the value system I grew up with."

McClelland served as the president and CEO of Goodwill Industries of Central Indiana for 41 years prior to assuming his current role as Indiana's executive director for drug prevention, treatment, and enforcement. He also has remained involved in the life of his alma mater via volunteer leadership and service through appointments on the ISyE Advisory Board and the Georgia Tech Grand Challenges Advisory Board.

McClelland graduated from Georgia Tech during the Vietnam War and served a three-year military tour of duty. His last assignment was in Washington, D.C., and during his free time he volunteered as a tutor for a church-based program that served children in low-income neighborhoods. The church also had a Saturday program for children with disabilities, and McClelland volunteered to transport the kids participating in the program.

"I got more satisfaction out of those volunteer experiences than anything I had done up to that point," McClelland reflected. "I started wondering if there was a place where I could use my IE skills in a paid position and get a similar kind of satisfaction. So I started calling nonprofit organizations headquartered in D.C., and the one that really expressed interest in me was Goodwill Industries."

After going through an executive training program and running a Goodwill organization in Texas, McClelland was recruited to Indianapolis, Indiana, to serve as vice president of operations for Goodwill of Central Indiana. In less than a year, he was promoted to president and CEO, and he spent the next four decades helping to transform lives through the organization.



"It turned out to be an incredible experience," McClelland said. "We had the freedom to try lots of ways to grow our businesses and accomplish our mission. As importantly, we had a board that gave us the freedom to fail at some of what we tried and learn and grow from the experiences."

Under McClelland's leadership, Goodwill of Central Indiana grew to over 3,200 employees with an annual revenue of more than \$130 million.

McClelland and his team began examining the links between poverty, low education levels, crime rates, births to young unwed mothers, and a myriad of health issues. They found "an enormous amount of data showing how these issues are all interrelated; they reinforce and compound each other," McClelland said. "And yet, as a society, we don't tend to treat these issues as if they're related. The public sector tends to operate in silos, while

Jim McClelland, in his role as Indiana's drug czar, makes a presentation to a group of law enforcement officers and community leaders from across several northwestern Indiana counties.



Above: Jim McClelland with a group of Goodwill employees at the Noblesville, Indiana store. In preparation for stepping down as CEO of Goodwill of Central Indiana, McClelland went on a "farewell tour" of all the region's facilities in spring 2015.

the not-for-profit sector is incredibly fragmented. Neither sector is structured to deal effectively with complex social problems. A lot of organizations are very good at dealing with a piece of a much larger issue, but we've done a lousy job of connecting the pieces. So we began exploring how we could bring some of the pieces together for much greater long-term impact."

This wealth of information eventually led to the 2010 opening of The Excel Center, a diploma-granting high school Goodwill designed for older youth and adults who had dropped out of high school. There are now 13 Excel Centers operating throughout Indiana, and the model is being licensed to organizations in other states.

In 2011, Goodwill began implementing the Nurse-Family Partnership (NFP) in Indiana. NFP is a home-visiting program

for first-time mothers in low-income households. Expectant moms voluntarily enroll, and a registered nurse then visits the home on a weekly or biweekly basis until the child is two years old. "While the nurses address health issues," McClelland explained, "they also teach parenting skills and how to create the kind of environment in the home that's conducive to the proper health and development of the child."

Goodwill links the young moms (median age 20) with education opportunities in The Excel Centers and employment opportunities at Goodwill or other companies. They also help connect families with other services they might need in a holistic, two-generation approach that has lasting impact.

McClelland noted that his IE skills have come into play throughout this process: "We've taken a systems approach to it.

It's important for organizations to see themselves in a larger context. They need to understand where they fit in the larger community and the fields they operate in. They need to understand how what they're doing relates to what others around them are doing and look for ways they can leverage their resources and capabilities with those of others to cause some good things to happen that otherwise aren't likely to happen."

After stepping down as CEO in 2015, McClelland thought he was transitioning into retirement. Then he had a conversation about the impact of the opioid epidemic in Indiana with the chief of staff for Governor-elect Eric Holcomb. That fateful conversation turned into a job offer to become Indiana's drug czar. He reports directly to the governor.

"The opioid epidemic is destroying lives, devastating families, and damaging communities. It cuts across all socioeconomic lines. It's an incredibly complex problem, and the only way we're going to substantially reduce it is through a systems approach that includes complementary public health and public safety approaches. My job is to coordinate, align, and focus the relevant resources of nine state agencies and to leverage the state's resources

with those of other sectors — business, higher education, health care, philanthropies, and faith-based organizations for greater impact," McClelland said.

He added, "We've got a lot of work to do. And while there's no short-term solution, we must act with a strong sense of urgency."

When asked if there is anything about his life's direction that has surprised him, McClelland paused. "I certainly never set out to follow the path that I took. My career with Goodwill was much more than I ever imagined. One of the most enjoyable aspects of it was getting to know and work with people at every level of society and in all parts of a community. I also never expected to be doing the kind of work I'm now doing, but I'm grateful for the opportunity."

As he forges ahead in this second inspiring career, McClelland continues on his path of helping others while embracing lifelong learning. "I have a very low need to be entertained but a strong need to learn. You just have to keep learning," he said. ■

Emma Heaslet is an ISyE fifth-year with a concentration in supply chain who will graduate in December 2017. This past summer, she worked as a global supply chain intern at Starbucks in Seattle, Washington — the first IE from Georgia Tech to intern there.

Her project focused on database optimization and design to support Starbucks' supply chain strategy and deployment team. Starbucks is "performance-driven through the lens of humanity," meaning they are committed to creating quality products while maintaining an optimal level of corporate responsibility.

Heaslet was excited to have the chance to make an impact. She said, "I was chosen to work here because of my experience designing databases with Python and SQL, which is part of the IE curriculum, as well as my background in the tech industry through my co-op. Culture fit is also important to Starbucks; I believe they could sense that I was passionate about their products, and about coffee as a whole. Partners (as all employees are called) are expected to immerse themselves in the history and art of coffee, not only because it is fascinating but because it drives the business."



An ISyE Student at SpaceX

For the past two summers, Daniel Kurniawan, an ISyE senior, has had what might possibly be considered one of the coolest internships an industrial engineering student could have: He worked for SpaceX, the company founded by entrepreneur Elon Musk (also of Tesla fame), with the ultimate goal of sending people to live on other planets.

As a high school senior, Kurniawan — who is originally from Maryland — visited Georgia Tech two days before his college decision was due. After his official campus tour, he and his family went to an Indonesian restaurant on Atlanta’s Buford Highway. It was there that he happened to meet Moorissa Tjokro (BSIE 14), an ISyE student who was about to graduate a few days later. As it turned out, Tjokro was a family friend from the Indonesian city where Kurniawan’s family originates.

In a recent interview, Kurniawan said he noticed throughout the course of their conversation how “Tjokro carried herself — I could tell she was an accomplished student, someone willing to go the extra mile to think of innovative approaches to the most complex problems.” This, he added, was what convinced him to come to Tech: “I felt that if this was the kind of person — the kind of leader — ISyE produces, that’s where I wanted to be. You could say I was drawn to ISyE first and to Georgia Tech second.”

Kurniawan has taken this attitude and perspective on leadership to his internships at SpaceX, where he has worked to develop a proof-of-concept for machine learning. In December 2017, he’ll join the company as a full-time employee after he graduates from Tech (in fewer than four years, in fact). And in addition to working for SpaceX, he’ll continue traveling the world. He has visited six continents and plans to check off the seventh — Antarctica — within the next few years.

For the last couple of years, you’ve been interested in data science and machine learning. What appeals to you so much about these fields?

There are infinite amounts of ways that you can solve machine-learning problems. At its heart, machine learning is simply teaching computers to learn. The idea is to use algorithms to decipher other patterns and correlations in a data set.

What I like so much about machine learning is that each problem has a different solution. I have never come across a situation where I’ve solved two problems the same exact way. Each problem requires in-depth analysis to understand what the data is saying, and as a result I found that even the most similar problems may have completely different approaches.

Another thing I like about machine learning is that nowadays I see applications of it everywhere. “Discover Weekly” on Spotify is essentially a recommender system that uses collaborative filtering to recommend a list of songs you may like based on similar user behavior. When you Google something, PageRank is used to rank websites in the search engine based on relevance and importance of sites. Facebook uses image detection to predict who is pictured in an uploaded photo. These are all examples of how machine learning is used in our everyday lives.

Interning for SpaceX is outside the typical ISyE industry or company. What led to your initial internship at SpaceX last year?

I happened to pass by SpaceX at their career fair booth while looking for my first internship my sophomore year. I quickly learned that this wasn’t a typical corporate job: SpaceX has big plans to reinvent space access, satellite telecommunications, and colonize Mars. I knew I would be working long hours, challenged with new problems, and faced with tight deadlines. I was sold knowing what kind of pressure and responsibility I would have in changing the future of humanity.

In the summer of 2016, I met Justin Hey (BSIE 16), a fellow ISyE student, and roomed with three other Georgia Tech interns. Georgia Tech is actually a primary target school for SpaceX recruiting.

What did you do in your first SpaceX internship, and how was your internship this past summer different?

Last year I worked in data analytics to support our production planning team. That role mainly involved mining and analyzing data to develop a strategy for outsourcing parts. In 2017, I took the lead in creating machine-learning applications for the business, which had me doing significantly more software development than last year.

At SpaceX, no matter what department you're in, you're part of the mission for getting to Mars and rocket reusability. Everything you do directly affects the rocket. This year's project focused on meeting launch deadlines and ensuring that the rockets are safe. My project looked at potential problems — the rocket or the launch going wrong — and tried to resolve these before the launch.

Machine learning in my department is very new — it was just myself and one other person — and we were pioneers trying to show use-value in its applications.

What unique perspective did you have to offer as an ISyE student in these internships?

As a machine-learning engineer with an ISyE background, the perspective that I had to offer is the ability to code, as well as an understanding of the manufacturing process. Since SpaceX is a rocket manufacturing company, it makes it easier for me to understand business requirements and translate those into applications due to ISyE's strong emphasis on manufacturing.

Have you been to the launch facility?

I have not been to SpaceX's launch sites at Cape Canaveral, Florida, and Vandenberg Air Force Base in California. However, mission control is located at the headquarters in Hawthorne, California, so on launch days everyone goes downstairs to see and hear the launch as it's happening. Everyone watching outside mission control erupts into cheers after every checkpoint in the launch sequence. My favorite part is when the first stage of the rocket lands back on Earth!

You'll graduate at the end of the fall 2017 semester, and you plan to return to SpaceX in a full-time capacity. What will you be doing?



I'll be coming back as a machine-learning engineer. Some of the projects I may be working on include image classification, natural language processing, recommendation engines, ranking systems, anomaly detection, and various other learning techniques. It's all part of the process to help us get to Mars.

What advice do you have for ISyE students who might want to strike out on an atypical college or career path as you have done?

Find something you're passionate about and commit to it. I've found that it is so much easier to do your job well when you love what you do. ISyE at its heart is a problem-solving major, and because it's so broad, there are many different areas to which we can apply that mindset. The trick is finding what area you want to focus on and equipping yourself with the knowledge and resources to be successful in that field — a step that becomes so much easier when you have the passion and drive for a particular subject. ■

Empowering Young Women in STEM

By Kaitlin Rizk, ISyE Undergraduate

When I was in elementary school, three boys and I were the best at math in our class. We formed the “Dream Team” for math competitions and won multiple awards. As the end of grade school approached, I envisioned taking advanced math and science classes in middle and high school, ultimately following in my dad’s footsteps to become an engineer.

On the day we got our school schedules for the following year, I learned that I was placed in regular math, while the three boys were placed in advanced algebra. My heart sank, and for the first time, I doubted my ability. My male math teacher indicated that I was not ready for advanced math, while the boys were. My parents disputed his judgment about me, and in spite of the teacher’s resistance, they made sure that I was enrolled in advanced algebra.

My father and mother, an engineer and a nursing professor, respectively, had always encouraged me to pursue studies in STEM fields. I also took inspiration from my paternal grandparents, an engineer and a chemist, who had immigrated to the United States from Egypt. Their legacy made me aware of the abundant opportunities in STEM, and their stories inspired me to follow a similar path. As I grew up, my parents told me I could try anything. My dad taught my sister and me how to build wooden racing cars and encouraged me to participate in physics competitions. We often visited electronics shops and assembled circuit kits. He even took me on a trip to Niagara Falls so I could learn about Nikola Tesla and his famous effort to harness the power of the falls.

Despite my father’s ongoing encouragement, my confidence was again shaken when I decided to enroll in an AP computer science course. I entered the course fearing coding, which was further heightened when I realized that I was only one of three girls in the course. I soon noticed that the boys were continually praised for being the best programmers. I began to dread going to class and felt anxiety every morning before school. I wanted to drop out, but my dad did

not allow it. I learned later that the boys who were the best in the class had been programming since they were eight. However, girls typically do not have the same exposure to coding; they are already a step behind in the classroom.

My experiences doubting my abilities now motivate me to help other girls have better experiences with STEM. Today, I am the chief executive officer of Stempower, a global nonprofit, which offers a long-term STEM mentorship program for 10- to 12-year-old girls. We provide more than 300 girls with access to role models and STEM materials, and develop communities of support and training for girls through our hands-on programs. Female mentors from Georgia Tech visit biweekly with Girl Scout troops and conduct activities such as building rockets, making circuits, building mechanical arms, or teaching coding. Our curriculum focuses on using important life lessons to build the girls’ self-confidence—lessons including “perseverance is powerful” and “mistakes are valuable.” Through an Institute-approved study on girls in Stempower, we demonstrated that our program improves girls’ self-efficacy by 60 percent and increases their interest in STEM by 80 percent.

After starting Stempower in the United States, I traveled to Uganda where I attended an innovation event and met Grace Nakibaala, a strong, passionate STEM entrepreneur. Grace inspired me to take Stempower to a global level, and we started a Stempower chapter in Kampala, Uganda. Through a partnership with the World Association of Girl Scouts and Girl Guides, Stempower provides mentorship to girls in the U.S. and Uganda, and recently expanded into Nairobi, Kenya.

Georgia Tech has provided me with a niche community where I met my co-founding team — a group of talented, smart women all motivated to empower girls. We have been successful through our partnerships on campus with Grand Challenges and the Center for the Study of Women, Science, and Technology.



Throughout my time at Georgia Tech, male dominance in my academic environment has inspired me to research women's barriers to success in STEM fields. Through Stempower, I have also conducted research about young women facing barriers in STEM fields in the U.S., Uganda, and Kenya, and have developed a curriculum recognizing self-confidence as a path toward reducing these barriers. I hope to grow this curriculum and take Stempower to more nations, including Egypt, where my family is from.

Currently, my co-founders and I are working on developing a model so students at other universities can start Stempower chapters at their own schools. Additionally, we want to create a support network for our college-age mentors and help them to also succeed in STEM. This semester, we have invited corporate sponsors to provide career development events for our mentors.

When I graduate, I want to leave an impact on the Georgia Tech community and support women right here. Stempower is on the forefront of increasing female representation in STEM at Georgia Tech. ■

Above: Grace Nakibaala and Kaitlin Rizk
Top: Kaitlin with the group of girls she helped mentor in a small Ugandan village

George Qu, a fourth-year student majoring in biology and industrial engineering, is enrolled in the Georgia Tech-Emory University dual-degree program. This past summer, he attended the Beijing/Singapore Summer Program for ISyE students, which he said was one of the best experiences he has had at Tech. As a result of the program, Qu said that he learned to “respect, appreciate, and quickly adapt to local cultures in different countries during weekend travels” around China and Singapore. He also developed meaningful relationships with students, professors, and staff in the program, as well as students from other schools, through class projects, sightseeing, and social events.



Connect with the Stewart School of ISyE

Are you interested in collaborating with ISyE? The School welcomes your engagement and offers many ways to get involved: ISyE works closely with business and industry leaders as collaborators on a variety of research and projects as well as student enrichment activities. You can also connect with the School through sponsorships and philanthropy, bringing the best education possible to our students and supporting our faculty as they address research issues that improve the quality of life for all.

ISyE faculty, students, and alumni are creative, analytical, and engaged, and by working together, we can provide the best academic experience for our students.

Partnership Opportunities

isy.e.gatech.edu/about/partnerships

ISyE Core Research Areas

isy.e.gatech.edu/research

K-12 Outreach

isy.e.gatech.edu/about/partnerships/k-12-outreach

GENERAL INQUIRIES

Anne Stanford

Communications Manager

404.385.3102

communications@isy.e.gatech.edu

ACADEMIC ENGAGEMENT

Dawn Strickland

Director of Student Services

404.385.3983

dawn.strickland@isy.e.gatech.edu

INDUSTRY COLLABORATION AND RESEARCH OPPORTUNITIES

Alan Erera

Associate Chair for Graduate Studies and Coca-Cola Professor

404.385.0358

alan.erera@isy.e.gatech.edu

UNDERGRADUATE CURRICULUM AND RECRUITMENT

Chen Zhou

Associate Chair for Undergraduate Studies and Associate Professor

404.894.2326

chen.zhou@isy.e.gatech.edu

PROFESSIONAL EDUCATION

Meka Wimberly

Customer Service Manager

404.385.8663

meka@gatech.edu

PHILANTHROPY AND SPONSORSHIPS

Nancy Sandlin

ISyE Director of Development

404.385.7458

nancy.sandlin@isy.e.gatech.edu

H. Milton Stewart School of Industrial & Systems Engineering

755 Ferst Drive • Atlanta, GA 30332-0205



President G.P. "Bud" Peterson greets Harrison Butler (BSIE 2017) as he crosses the stage at Spring 2017 Commencement. Butler, who was Georgia Tech's place kicker, is the Institute's all-time leading football scorer. He now plays in the NFL for the Kansas City Chiefs.