INDUSTRIAL AND SYSTEMS ENGINEERING

NEWSLETTER 2017

LEHIGH UNIVERSITY | P.C. ROSSIN COLLEGE OF ENGINEERING AND APPLIED SCIENCE

A few Class of 2017 ISE students pose for the camera after their walking ceremony.

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ISE DEPARTMENT NEWSLETTER FALL 2017

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DEAR FRIENDS,

Greetings! I hope all is well with you and your family! I wanted to take this opportunity to let you know that July 31, 2017 was my last day as the Chair of the Industrial and Systems Engineering Department at Lehigh University. On August 1, 2017, Professor Ted Ralphs became the ISE Interim Department Chair and will remain in this position until a national search identifies the next ISE Department Chair. In July, our Graduate Coordinator, Rita Frey, retired and we hired her successor, Ana Quiroz, who started in early August.

I am pleased to report that throughout my nine years as chair, our department has consistently been ranked in the top 20 in the US News and World Report ranking, the only Lehigh department to accomplish this. This achievement confirms that ISE is in great shape. We have hired exceptional faculty and have attracted wonderful students at all levels. In 2010, with strong support from our alumni Advisory Council, Analytics was declared as the strategic focus of ISE. Faculty, alumni and student advisory councils worked hard to implement the strategic vision. Along with this, we have accomplished an incredible amount.

Some new programs/curriculum renewals include renewal of the curriculum of the M.Sc. in Analytical Finance program in 2009; renewal of the Management Science master's program as Management Science and Engineering in 2009-2010 (both M.Sc. and M.Eng.); the merger and redesign of the Industrial Engineering and Information Systems and Engineering master's programs as Industrial and Systems Engineering master's program in 2009-2010 (both M.Sc. and M.Eng.); the phasing out the Quality Engineering master program and replacement of it with a Quality Engineering Certificate; the development and delivery of the Healthcare Systems Engineering (HSE) master of engineering program in 2009-2011 (by now, the highest profile such program in the nation---with the coming College of Health, HSE turned out to be a great strategic move); the merger of the Industrial Engineering and Information Systems and Engineering B.Sc. programs as B.Sc. in Industrial and Systems Engineering in 2013-2014; the ABET accreditation of our B.Sc. in ISE program in 2015; the redesign with new curriculum and requirements of the Industrial Engineering Ph.D. program as a Ph.D. in Industrial and Systems Engineering in 2014-2015; the development of the Healthcare Systems Engineering and Management Science and Engineering certificate programs in 2015-2016; the development of three certificate programs for the M.Sc. in Analytical Finance program in 2016 in partnership with the Math and Finance Departments; and the Developing Career Advisory Concentrations (course packages) in the ISE undergraduate program–on going in 2016-2017.

In addition to the items above, other departmental accomplishments, include being a four-time finalist for the UPS-INFORMS George D. Smith Prize and a host of the 2015 INFORMS Conference. Along with ISE faculty serving as hosts for the conference, we were able to provide over 30 student volunteers.

The ISE Distinguished Alumni Award was established in 2009, where alumni each year are honored at our ISE Annual Banquet (established in 2009) for their expertise in academia and/or industry. We had Alumni Events in New York, Washington DC, and Palo Alto. The ISE Annual Career Fair, established in 2010, is an individualized career fair for ISE, MSE and HSE students, one day ahead of the university's annual career fair. This smaller career fair gives our own students a one-on-one interaction with top company representatives.

While every event is equally important, the Modeling and Optimization Theory and Applications (MOPTA) Conference (brought to Lehigh in 2009) is a specific one that I hold near and dear to my heart. MOPTA, a three-day conference, brings together a diverse group

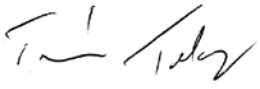
of people from both discrete and continuous optimization, working on both theoretical and applied aspects. The conference, which draws in attendees and speakers from all around the world, features close to 100 contributed talks both from the academic and industrial fields.

Throughout my nine years in this position, we have done tremendous work at lightning speed in academic standards. As you know, a leader is only as good as his team and I couldn't have climbed such mountains without the support of the incredible faculty, staff, students, and alumni of ISE. Their hard work and support allowed me to turn my dreams into reality, and allowed us to elevate ISE as one of the top ISE departments of the world.

Finally, I thank you all for your continued support. It was a great honor to serve as the Chair of ISE for nine years. Presently, I am teaching my graduate course "Introduction to Optimization", working as the Chair of the SIAM Activity Group on Optimization, preparing my three Ph.D. students for graduation, and keeping busy preparing the Department of Corrections Project Team for the finalist's presentation for the INFORMS Wagner Prize this October.

Feel free to contact me at: terlaky@lehigh.edu with any questions, concerns, or advice.

With My Very Best Regards,



DR. TAMÁS TERLAKY

DEAR ISE ALUMNI, STUDENTS, AND FACULTY,

Greetings from Mohler Lab! Let me add my own warm welcome to that of our long-time chair, Tamas Terlaky. As you have already gathered from Tamas' message as outgoing chair, an important era in ISE history has come to an end and some important changes have taken place in the ISE department. Most importantly, after nine years of stellar effort guiding the department, Tamas has stepped down as chair of the ISE department. Under his leadership, the department has risen to new heights and increased substantially in national prominence. By any measure, his efforts as chair were a smashing success and his presence in the chair's office will surely be missed. We thank him gratefully for his unwavering service to ISE and the Lehigh community over nearly a decade of service. Dr. Terlaky remains a Lehigh faculty member and you can now find him in his new office in Mohler 388. A national search for a new chair is already underway and we are optimistic that a new chair will be in place without delay. In the meantime, Dean DeWeerth has appointed me as the interim department chair, effective August 1, 2017. I am honored to step into the role of Interim Chair and to take on the mantle of ensuring a smooth transition into the next era of ISE history!

For those of you who may not know me from around ISE or through previous newsletters, I began my Lehigh career as an assistant professor in 2000 and have been witness to the incredible growth and change that has occurred in the department since that time. I've been a strong proponent of the department's shift in research focus to computation and analytics and have contributed through the co-founding of both the Computational Optimization Research at Lehigh (COR@L) Laboratory within ISE and Lehigh's Research Computing Steering Committee, among other things. My current research projects explore the theoretical and computational aspects of solving large-scale optimization problems through the exploitation of sophisticated mathematical techniques and high-performance computing technologies. In my spare time, I enjoy outdoor activities (particularly cycling and hiking), photography, and a good IPA.

Many of you are probably anxious to know how the department is weathering the storm during this time of transition, so let me assure that we are all systems go! This is an exciting time of transition not only for ISE, but also for RCEAS and Lehigh as a whole. Dean Stephen P. DeWeerth has recently launched an ambitious plan to revitalize the college's research enterprise. A key pillar of the plan is the establishment of several cross-cutting, interdisciplinary research institutes focused on theme areas identified through a faculty-driven process. The initial theme areas are Materials, Matter, and Devices; Data Science and Computational Intelligence; and Cyberphysical Energy and Infrastructure. The new institutes will help to develop a community of scholars capable of tackling large-scale interdisciplinary research challenges, while promoting Lehigh's excellence in these theme areas to external stakeholders.

As an established leader in data science and analytics, as well as a strong contributor to interdisciplinary research, ISE is expected to play a significant role in this new effort to grow the research enterprise at Lehigh. We are excited to partner with Dean DeWeerth in this effort. With ISE's focus on personalized education, it's innovative faculty, and continued excellence in teaching and research, there's nowhere to go but up!

If you have any questions or comments, please do not hesitate to contact me at ted@lehigh.edu or 610-758-4050.

Cheers,

TED RALPHS
Interim ISE Department Chair

welcome

ISE STAFF *update*

A FAREWELL TO RITA FREY

Rita Frey started her career at Lehigh University in the History Department in April 1990 as a part-time secretary and then moved to Physical Planning/ Facilities Services Department in 1992 as a full-time secretary. She began working in the Industrial and Manufacturing Systems Engineering Department on February 14, 1994 as the Graduate Coordinator.

The main duties of her job were to coordinate the graduate admissions process, provide administrative support to the ISE Department, order supplies, report maintenance issues, maintain student records, process graduate forms, course registration, graduation clearance, communicate university rules and regulations to students and faculty, and related procedures. Rita always strived to make sure students were fully aware of all upcoming deadlines and university or department news updates.

"I really enjoyed the challenges of finding better and more efficient ways of handling the numerous job duties I had," says Rita. The part of her job she found the most rewarding was working and building relationships with the many students she encountered over the 23 years in the ISE Department. "I always took the extra time to make sure their concerns were handled in a timely manner. If I didn't know the answer, I made sure to find out so I would know the next time a similar situation came up," she admits.

Rita retired from Lehigh on July 14, 2017. She felt it was time to pursue some personal interests, travel, hobbies and volunteer opportunities, along with spending more time with family and friends. She also plans to continue with her belief of a "lifetime of learning" by taking advantage of life experiences and opportunities in retirement.

Rita explains, "I loved working in the academic atmosphere and took advantage of the many opportunities we were given to better ourselves. I have many great memories from my 23 years with the ISE Department. I will miss interacting with everyone, but I am also looking forward to my next phase of life. I still have my Lehigh email address (rrf0@lehigh.edu) and would really like to hear from past students on how they're doing."

AND A WELCOME TO ANA QUIROZ

Ana Quiroz is the new Graduate Coordinator for the ISE Department. Her previous position was with the Technology Department of Easton Area School District. She is a proud mother, family-focused and very motivated. She was interested in joining Lehigh University because of it's academic standard and credibility, wonderful atmosphere, and the resources Lehigh University offers. She enjoys working in her own community, as she is a Bethlehem resident, and hopes to constantly strive towards success and to motivate others in her new position.

UNIFYING STATISTICS, COMPUTER SCIENCE, AND APPLIED MATHEMATICS

Lehigh, Stony Brook, and Northwestern team with NSF to advance machine learning

The National Science Foundation (NSF) has announced its support of a Lehigh University-led research team that will advance machine learning by tying together techniques drawn from the fields of statistics, computer science, and applied mathematics.

The three-year, $1.5-million grant is part of the NSF's $17.7 million in funding for 12 Transdisciplinary Research in Principles of Data Science (TRIPODS) projects, which will bring together statisticians, theoretical computer scientists, and mathematicians to advance the foundations of data science. Conducted at 14 institutions in 11 states, these projects will promote long-term research and training activities in data science that transcend disciplinary boundaries.

"Data is accelerating the pace of scientific discovery and innovation," said Jim Kurose, NSF Assistant Director for Computer and Information Science and Engineering, in the NSF's August 24 announcement. "These new TRIPODS projects will help build the theoretical foundations of data science that will enable continued data-driven discovery and breakthroughs across all fields of science and engineering."

The Lehigh project is led by three members of the University's Industrial and Systems Engineering department: principal investigator Katya Scheinberg and co-investigators Frank E. Curtis and Martin Takáč. The project is a collaborative effort with Han Liu of Northwestern University and Francesco Orabona of SUNY-Stony Brook.

"Progress in the field of machine learning requires close collaboration among optimization experts, learning theorists, and statisticians," says Scheinberg, Lehigh's Harvey E. Wagner Endowed Chair Professor of Industrial Engineering. "Machine learning draws so heavily from these areas, yet the communities supporting research in each have tended to operate separately -- each with its own vocabulary and platforms for publishing state-of-the-art research. With an emphasis on deep learning, our project aims to build bridges and foster intercollegiate and interdisciplinary collaboration among these communities."

According to the NSF, all of 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. These awards will build upon NSF's long history of investments in foundational research, contributing key advances to the emerging data science discipline, and supporting researchers to develop innovative educational pathways to train the next generation of data scientists.

The Lehigh "tripod"

Working with Orabona, a theoretical computer scientist specializing in learning theory at SUNY-Stony Brook, and Liu, an expert in statistics and machine intelligence at Northwestern, the three-pronged Lehigh team hopes to be a beacon for those who wish to learn and help advance the state-of-the-art in machine learning throughout the northeastern and midwestern U.S. The team's TRIPODS project is built upon the ongoing efforts of Lehigh's Optimization and Machine Learning (OptML) research group, founded in 2014. Research conducted by the members of the OptML group focuses on the design, analysis, and implementation of numerical methods for solving large-scale optimization problems arising in machine learning applications.

Each Lehigh researcher involved in the TRIPODS project brings to the team unique expertise in applied mathematics, particularly in topics related to mathematical optimization:

Professor Katya Scheinberg has been working on the intersection of optimization and machine learning for more than 15 years. She is especially well known for her work on kernel support vector machines, a widely applicable and powerful data science tool. Scheinberg earned her undergraduate degree in Operations Research from the Lomonosov Moscow State University and her Ph.D. in Industrial Engineering and Operations Research from Columbia University. Prior to her appointment at Lehigh, she served as a researcher at IBM's famed T.J. Watson Research Center for more than a decade, working on various applied and theoretical problems in optimization. She is currently the Editor-in-Chief of the SIAM-MOS Series on Optimization and an Associate Editor of both the SIAM Journal on Optimization and the journal of Mathematical Programming. She has other research projects supported by the U.S. Air Force, DARPA, and Yahoo, as well as the NSF.

Associate Professor Frank E. Curtis brings to the team widely recognized expertise in solving nonconvex and nonsmooth optimization problems. This expertise is essential in the context of deep learning, a main focus of the project. He earned his Bachelor's

degree in Mathematics and Computer Science (double major) from the College of William and Mary and his Master's and Ph.D. degrees from Northwestern University in Industrial Engineering and Management Science. Prior to joining Lehigh in 2009, he spent two years as a postdoctoral researcher at the Courant Institute of Mathematical Sciences. Curtis' research focuses on the design, analysis, and implementation of numerical methods for solving large-scale nonlinear optimization problems. He received an Early Career Award from the Advanced Scientific Computing Research program of the U.S. Department of Energy, and has received funding from various NSF programs. He served as the Vice Chair for Nonlinear Programming for the INFORMS Optimization Society from 2010 until 2012, is currently an Associate Editor for both the SIAM Journal on Optimization and the journal Mathematical Programming Computation, and is very active in professional societies and groups related to mathematical optimization.

Assistant Professor Martin Takáč brings to the team widely recognized expertise in designing efficient algorithms for solving large-scale optimization problems, especially those associated with deep learning, including coordinate descent and stochastic gradient-descent-type algorithms. Takáč has extensive experience in high performance computing, and has performed research using some of the world's largest supercomputers. Takáč received his B.S. and M.S. degrees in Mathematics from Comenius University, Slovakia, and his Ph.D. degree in Mathematics from The University of Edinburgh, United Kingdom. He received several awards during this period, including the Best Ph.D. Dissertation Award by the OR Society (2014), the Leslie Fox Prize (2nd Prize; 2013) from the Institute for Mathematics and its Applications, and the INFORMS Computing Society Best Student Paper Award (runner up; 2012). Since joining the faculty of Lehigh's Department of Industrial and Systems Engineering in 2014, he has pursued research in such areas as design, analysis and application of algorithms for machine learning, optimization, high-performance computing, operations research, and energy systems. He is an affiliated faculty member of Lehigh's Cognitive Science Program.

KATYA SCHEINBERG

During her sabbatical year, Professor Katya Scheinberg spent the Fall semester of 2016 as a visiting researcher in Google NYC. Aside from having great lunches at the much famed Google cafeteria, she worked on improving optimization methods for training deep neural networks. She had a chance to collaborate with some top researchers in the field and learn about state-of-the-art implementations, as well as the key challenges in the field

During the Spring and Summer of 2017, Katya visited the Mathematical Institute at Oxford University and Alan Turing Institute (ATI) in London. At Oxford, she continued an ongoing collaboration with her colleague Coralia Cartis on novel theoretical analysis of stochastic optimization methods and started a new collaboration on hyperparameter tuning for deep neural networks with another professor at Oxford. Prof. Scheinberg's visit was supported by a grant from The Leverhulme Trust and by ATI. She was also a Visiting Fellow at Balliol and Exeter Colleges. As a part of her visit Prof. Scheinberg delivered many lectures on the topic of her research, both at Oxford as well as Cambridge, U of Birmingham, U of Manchester and ATI. She focused her research and her lectures on optimization methods of deep neural networks,the subject that she had started to explore at Google. While she was still at Oxford, together with Lehigh colleagues Frank Curtis and Martin Takac, she applied for NSF TRIPODS Institute grant focusing on the same topic. The grant was awarded at the end of the summer and Katya is now looking forward to taking charge of the development of the institute.

TED RALPHS

Ted Ralphs spent the 2016-2017 academic year at the Zuse Institute Berlin (http://www.zib.de), a research institute located on the campus of the Free University of Berlin. ZIB is an interdisciplinary research institute for applied mathematics and data-intensive high-performance computing. Its research focuses on modeling, simulation and optimization with scientific cooperation partners from academia and industry. Ted worked most closely with the discrete optimization group at ZIB in developing and new methodology for solving problems of interest to ZIB's industry partners.

Ted received support for his visit from the Mathematical Optimization and Data Analysis Laboratories (MODAL) GasLab, a long-running research project aimed at optimizing various aspects of the German gas network. The experience gained in working with the energy group at ZIB will inform collaborative work Ted plans to undertake with Lehigh's own energy research group (INE). Ted taught two short courses on multistage/multilevel optimization to researchers working the GasLab project, one in the fall in Berlin and one in the spring in Erlangen.

Spending the year in Berlin was a fantastic opportunity and afforded the opportunity not only to establish long-term collaborations on a number of topics that he continues to pursue with ZIB researchers, but also to pursue a highly successful, in-depth study of the offerings of various German beer gardens.

FRANK CURTIS is spending his sabbatical year (2017-2018) at Columbia University with Professor Donald Goldfarb (in the Fall) and at NYU with Professor Michael Overton and Northwestern University with Professor Jorge Nocedal (in the Spring). Frank's research will focus on optimization, machine learning, and data science.

LARRY SNYDER is spending his sabbatical year (2017-2018) writing a new undergraduate textbook on supply chain theory, as well as working as a supply chain researcher for Opex Analytics in Evanston, IL.

LUIS ZULUAGA has been promoted to Associate Professor with tenure

KEITH GARDINER, after 30 years of teaching, retired this past summer. Dr. Gardiner served as the Director of the Center for Manufacturing Systems Engineering, and the associated cross-disciplinary Master of Science in Manufacturing Systems Engineering program, while also coordinating the first year practical engineering course.

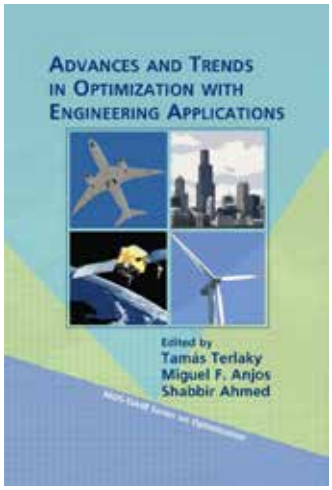
TERLAKY PRODUCES NEW TEXTBOOK ON OPTIMIZATION AND ENGINEERING

Tamás Terlaky, past chair of Lehigh University's Industrial and Systems Engineering department, along with fellow editors Miguel F. Anjos of Polytechnique Montréal and Shabbir Ahmed of Georgia Institute of Technology, has released a new textbook to "provide a solid foundation for engineers and mathematical optimizers alike who want to understand the importance of optimization methods to engineering, and the capabilities of these methods."

Advances and Trends in Optimization with Engineering Applications, as published by the Mathematical Optimization Society (MOS) and the Society for Industrial and Applied Mathematics (SIAM) is volume 24 of a prestigious MOS-SIAM series on optimization. This series, published jointly by the two organizations, includes research monographs, textbooks at all levels, books on applications, and tutorials. Topics covered by the series explore the theory and practice of optimization, discussing theory, algorithms, software, computational practice, applications, and the links among these subjects.

Advances reviews 10 major areas of optimization and related engineering applications, providing a broad summary of state-of-the-art optimization techniques that are of crucial importance to engineering practice. "In recent years," reads the book's description, "the theory and methodology of optimization have seen revolutionary improvement. Moreover, the exponential growth in computational power, along with the availability of multicore computing with virtually unlimited memory and storage capacity, has fundamentally changed what engineers can do to optimize their designs."

"From idea to product this was a 4-year-long project," Tamás explains. "The book includes 40 chapters, and covers all major areas of optimization and includes applications of modern optimization methodology in virtually all areas of engineering. Just designing its scope, content and structure took more than a year. Then, recruiting its 70 authors, among the most renowned experts in their respective fields, and working to unify terminology and notation across the content, was itself a major operation."



The book is available via SIAM's online bookstore, and will soon be available as an eBook in the SIAM digital library package for Universities and other venues.

LEHIGH ENGINEERS OPTIMIZE INMATE ASSIGNMENTS FOR PENNSYLVANIA'S DEPARTMENT OF CORRECTIONS

A "first-of-its-kind" optimization model developed by engineers at Lehigh is helping Pennsylvania's Department of Corrections (PADOC) streamline the assignment of inmates to the state's 25 correctional institutions.

PADOC officials say the Inmate Assignment Decision Support System (IADSS) has "transformed" the inmate assignment process in Pennsylvania and can do the same for state correctional agencies across the United States. In the long run, they say, the system could shorten prison stays and reduce recidivism—the rate at which released prisoners commit new crimes—by giving inmates more timely access to the treatment programs they need to earn parole.

There are currently 46,800 inmates in the state's correctional institutions. PADOC's annual expenditures total approximately $2.5 billion, or about 8 percent of the state's total budget.

IADSS can make hundreds of inmate assignments in a few minutes, a task that requires hours when performed manually by humans. The system is the product of five years of work by graduate students and faculty members in the department of industrial and systems engineering. Its developers say IADSS represents the first application of operations research to the assignment of prison inmates.

PADOC officials have been using IADSS for 10 months to help assign inmates and they plan to switch over to it completely early next year. IADSS was also used to help reassign 2,000 inmates from the State Correctional Institute in Pittsburgh, which was recently closed, to other state prisons.

In a report released Sept. 1, PADOC officials said IADSS has enabled the corrections department to achieve cost savings and improvements in four areas:

- Shorter waiting lists for treatment programs. This will reduce the length of time inmates remain in prison past their minimum sentence date.
- Fewer prison assaults. This has resulted from an improvement in assigning the right combination of inmates to the right prisons.
- Staffing. Fewer staff members will be needed in the PADOC's Office of Population Management to oversee inmate assignments and transfers.
- Transportation. More inmates are being assigned to the most appropriate institution the first time, reducing the need later for transfers of inmates to other prisons.

"Based on these four criteria," the report said, "we believe that the IADSS has saved the PADOC, and thus saved Pennsylvania taxpayers, approximately $2.9 million during the first year, which will translate into approximately $19.2 million in savings over the next five years."

Meanwhile, the group that invented IADSS has been named a finalist for the Daniel H. Wagner Prize for Excellence in Operations Research. The international prize is awarded each year by the Institute for Operations Research and the Management Sciences (INFORMS), the premier professional association for analytics and operations research. This year's prize will be awarded Oct. 24 at the annual INFORMS conference in Houston.

"[IADSS] is the first model of its kind in the nation, and addresses an important problem that all large correctional departments face," PADOC Secretary John E. Wetzel wrote in a letter of recommendation to the Wagner Prize selection committee.

"Every year, my department receives approximately 11,000 new inmates who must be assigned to one of our 25 prisons around the state...[IADSS] has completely transformed our processes and is already leading to significant efficiency improvements and savings.

"I know that my peers around the country who direct other state correctional agencies will also benefit tremendously from [this] model."

The group that developed IADSS is led by Tamas Terlaky, the George N. and Soteria Kledaras '87 Endowed Chair Professor in the department of industrial and systems engineering. The group also includes Lou Plebani and George Wilson, professors in the department; Mohammad Shahabsafa, a Ph.D. candidate; Anshul Sharma, a graduate student; Dan Li '13 Ph.D. and Chatainya Gudapati '17 M.S.

The heart of IADSS, says Shahabsafa, who travels every two weeks to Mechanicsburg to confer with PADOC officials, is its optimization module, which can assign hundreds of inmates to correctional institutions in just a few minutes. A graphic user interface allows access to information on inmates in the PADOC database, enables users to review and approve the optimal assignment, and provides several measures to evaluate assignment recommendations.

The optimization module enables IADSS to assign inmates—and to account for a variety of relevant factors—simultaneously, says Shahabsafa. These factors include a prisoner's age, home town, offense, sentencing information, stability level, risk level, minimum and maximum dates of release, and medical and programming needs, as well the capacity and level of resources available at each institution. IADSS also accounts for inmates' functional limitations—whether they are hearing- or vision-impaired or use a wheelchair, etc.

William Nicklow, PADOC director of population management, says inmates were previously assigned to Pennsylvania's correctional institutions in a sequential process by DOC employees who consider each of these factors for one inmate at a time.

In addition to new inmates, the DOC also oversees the transfer of inmates within the state prison system, says Nicklow.

"Every year, we receive about 50,000 petitions from our correctional institutions requesting a transfer of an inmate. Before the Lehigh model was developed, we looked at each inmate individually and evaluated all the factors regarding that inmate separately. This is a pretty cumbersome process."

In assigning and transferring inmates, says Nicklow, IADSS considers the needs of each inmate and the resources—empty beds, security level, treatment programs and vacancies—that are available at each of the state's correctional institutions.

"The Lehigh model looks at everything simultaneously and holistically. It makes the most appropriate recommendation for everybody based on the resources that are available at that time.

"With the current process, it takes seven people most of a week to do this. Now the whole job can be done with the push of a button, and the outcomes are actually better. We're making better decisions and we're meeting all the requirements for the inmates' assignments."

IADSS has also helped PADOC reduce the time inmates must wait for openings in treatment programs that they are required to complete to qualify for parole or early release, says Nicklow.

"Our most difficult problem is the treatment program waiting list. The Lehigh model helps us prepare for parole hearings. We like to start programming about 10 months before the minimum sentencing date so that all the programs are completed when an inmate is released, and so that what an inmate learns from a program is fresh in his mind when he is released.

"As a result of the Lehigh model, the start time for entering programs has been decreased. The model will help us make sure that no one starts a program just before their parole. And it will help us avoid having to transfer inmates from one facility to another to get into a program."

IADSS has also helped PADOC reduce human error in assigning inmates, Wetzel wrote in his letter to INFORMS.

"Before we worked with Lehigh University on this project," he wrote, "our internal processes for making these assignments relied on human judgment, and led to many sub-optimal placement decisions."

The industrial and systems engineering department began studying inmate assignments five years ago when Li did an internship with PADOC and developed a decision tree identifying the factors involved in inmate assigning. Li earned her Ph.D. in 2013 and the project was taken up by Shahabsafa.

IADSS, says Shahabsafa, is based on mixed integer linear optimization (MILO), a method that was applied nearly three decades ago to the scheduling of airline crews and in other industries but had not previously been tried with inmate assignments in correctional institutions.

Shahabsafa is writing his Ph.D. thesis on an Air Force-funded project involving structural design optimization.

The collaboration with PADOC, he says, has been particularly rewarding.

"It has been a great opportunity for me to work on a real-world application. I have been going to PADOC on a biweekly basis for three years.

"Having spent a lot of time and energy on this project, it is an honor for me to see that the product is being used in the actual daily process of the Department of Corrections and that our paper has been recognized as a finalist for the prestigious Wagner Prize."

–KURT PFITZER

2017 ISE DISTINGUISHED ALUMNI AWARD SPRING 2017 SPENCER C. SCHANTZ LECTURERS

The ISE Department was honored, yet again, to have not only one, but two Spencer C. Schantz Lecturers during the 2017 Spring semester. While Dr. Alain Haurie delivered his Technical Talk on "Modeling Energy Transition to Sustainability in a Smart Grid/Smart City Environment," Sunil Misser delivered his Public Lecture on "Responsible Business – Rebuilding Trust and Creating Value." In addition to delivering the Spencer C. Schantz Public Lecture, Sunil was also honored with the 2017 ISE Distinguished Alumni Award.

DR. ALAIN HAURIE
PROFESSOR EMERITUS
UNIVERSITY OF GENEVA
DIRECTOR/CO-FOUNDER OF ORDECSYS

Alain Haurie began his career as a professor of Quantitative Methods at the Graduate Business School of the University of Montreal, Canada in 1963. In 1989, he left Montreal for a position as a professor of Operations Research in the department of Management Studies (HEC) of the University of Geneva, Switzerland, where he stayed until 2005. During his academic career he occupied positions of department chairman (1974-1976 in Montreal, 1989-1992 in Geneva) and was the founder and first director of a research center dedicated to decision analysis (GERAD in Montreal 1980-1989), which became one of the leading research centers in Canada for Operations Research. With Jean-Philippe Vial, he created in 1990, LOGILAB, a research laboratory that fostered Operations Research and Decision Science modeling in the domain of logistics and energy/environment.

At the University of Geneva, he taught Operations Research, Decision Science, Energy and Environmental Management in various undergraduate and graduate programs. He was also the director of a continuing education program on "Environmental Management for the Firms". He has directed several research projects dealing with the economics of energy and environmental management. From 2000 to 2005 was the director of a large project of the Swiss Virtual Campus program to implement a distance learning modular course on sustainable development. Over the same period he was the leader of a research group (NCCR-"climate") funded by the Swiss equivalent of the NSF to work on the economics of climate change.

In 1985, he participated in the creation of HALOA Inc., a consultancy firm based in Montreal, which specialized in the modeling and analysis of the interactions between energy and the environment. In 2002, he participated in the creation of ORDECSYS a consultancy firm based in Geneva, Switzerland. He is currently CEO of ORDECSYS. The company has been active in several large scale projects funded by EU FP-6 and FP-7 research frameworks, related to the economics of climate change and energy transition. The company has also participated in projects supported by the Swiss energy board, the French research program on the impacts of climate change (GICC) and the Qatar national research fund.

Experience in energy modeling: Alain initiated, with Richard Loulou in 1980, the development of MARKAL models for Canadian Provinces. Under contract with the Canadian Ministry of Energy-Mines and Resources, he further developed different versions of the model describing energy intensive sectors of the Canadian economy. He has supervised several doctoral theses concerning the modeling of economy-energy-environment interactions. Since 1988, he has supervised several theses dealing with the building of multi-country MARKAL models, regional versions of the model (at the level of a Swiss canton) and the coupling of MARKAL models with air pollution (at the local scale) or climate (at a global scale) models. He also developed several models for energy markets with uncertainty and imperfect competition. Alain Haurie has been a consultant in energy modeling for several firms and organizations in Canada, France, Switzerland and for OECD. Currently, as Director of ORDECSYS, he is involved in several applied research and consultancy projects dealing with the management of power utilities in the context of the European energy markets.

SUNIL MISSER
CEO, ACCOUNTABILITY
PAST ISE ADVISORY COUNCIL MEMBER

Sunil (Sunny) A. Misser, who is the latest addition to a distinguished club consisting of Lee Iacocca, Ambassador Richard Verma, John McGlade and others, was honored with the Distinguished Alumni Award for Industry at the 2017 ISE Banquet. Sunny, who is the Chief Executive Officer of AccountAbility, a global consulting and standards firm that works with business, governments and multi-lateral organizations to advance responsible business practices and improve long-term performance, admitted that he was deeply honored and most grateful at receiving this award. He accepted it in honor of "past, present and future Lehigh students, who will make a contribution to our country, and hopefully, this world." Sunny also extended his gratitude to his Faculty, the Board, the Chair of the Board and members of the Selection Committee for this kind honor.

When asked how he felt about winning this award, Sunny replied that he was honored, humbled and grateful. He added, "Wanting to win is a little different that wanting to be successful, and winning often implies that there are races to run, opponents to be beaten, and prizes to secure." He felt success, on the other hand, is more internal and personal. He modestly expressed his gratitude and happiness to be acknowledged for his success.

Sunny said, "Lehigh left a very significant impression on my life. In many ways, Lehigh was my introduction and first impression to America. When I landed at JFK in New York and got on a Greyhound bus and showed up at the bus terminal in Bethlehem, it was a long ride but more significant than I had ever imagined." In many ways, Sunny admits that Lehigh has shaped him in his choice of career/profession, location, business and personal relationships and later on down the road, his sense of values. "When I say values, values are what your parents give you.

There is also a shaping process as a young adult that occurs in terms of a sense of community, social issues, and contributing back at a local and a town level. In those ways, Lehigh has had a great impression on me." Sunny explains that Lehigh faculty played a huge role in his success as a student. "My Lehigh faculty exemplified two to three attributes: 1) they were accessible at every level, 2) they were knowledgeable (in their areas and pointing me to the right people), and 3) they were, above all, nice people, willing to help. The early education that Sunny had, had a strong practical undertone to it. "It had a foundation or platform where the emphasis was less about policies and more about practice. It was less about process and more about outcomes and results," says Sunny. Sunny explains that this served, in many ways, as an invaluable lesson as to what would come later in life.

Sunny, in addition to being honored with the Distinguished Alumni Award for Industry, also delivered the Spencer C. Schantz Public Lecture, entitled Responsible Business – Rebuilding Trust and Creating Value.

Sunny's lecture delved into the basic question facing us – how do we restore trust and develop business that creates value? The address focused on the growing "trust gap" in the leadership of government and business institutions and provided insight on how responsible businesses can rebuild trust and create value for their stakeholders.
The challenge in restoring trust and creating value in business is often not the lack of will or discipline or even effort – but, rather, it is the "how." In this dialog, there was a discussion of some of the "how."

Before AccountAbility, Sunny was Global Managing Partner of the Sustainability Advisory Business at PricewaterhouseCoopers (PwC). Before that, he was Global Strategy Leader for PwC's Assurance and Business Advisory Services -- the firm's accounting, risk management, and consulting operation. He also served as the New York Metro leader for the Governance, Risk and Compliance practice.

In addition to the M.S. in Industrial Engineering Mr. Misser earned at Lehigh University, he holds an M.S. in Management from the MIT/ Sloan School of Management with a concentration in International Business and Technology, and a B.S. in Mechanical Engineering from M.S. University. Mr. Misser is a strategic advisor to CEOs and senior executives at Fortune 500 companies and governments.

ISE DEPARTMENT ANNUAL BANQUET

ELISABETH OGLEVEE
major: ISE
graduation date: MAY 2018

What did you do this summer?
I worked on a project run through the Enterprise Systems Center (ESC) that helped CertainTeed, a company under Saint Gobain, categorize their shingles production line failures more accurately

What are your plans for next year?
I'm either going to work for a few years, preferably for a consulting firm, and then going to graduate school or going straight to graduate school after I finish my undergraduate degree.

What kind of research are you doing?
I'll be working on a KEEN Project throughout this academic year. KEEN focuses on enhancing the entrepreneurial mindset by rewriting the curriculum in courses that are in the engineering school.

Can you describe your latest internship and what your responsibilities were?
My latest internship was my job this past summer with CertainTeed. I was the only one working on the project so I had a lot of responsibilities, such as reporting back to my superiors about my progress and findings on a weekly basis. I was also responsible for the completion of a multi-phased project in a specified time frame.

What is something ISE has taught you?
ISE has taught me to think more creatively as to how to make processes more efficient. I have also learned how applicable this major is to the real world.

What was it like being on the ISE Council?
I absolutely loved it! Like I said above, it is something unique to this department and I really liked being able to have a say in what happens to and around Mohler. I also think my peers are able to talk to me about any issues and I feel I represent them well during meetings. Oh, and Abby is wonderful! :) I hope to be nominated again for my senior year!!

SURESH BOLUSANI
major: ISE
PH.D. STUDENT

What kind of research are you doing?
My research involves the development of both theory and practically implementable algorithms, as well as open-source software implementations for these algorithms. In particular, my current research aims at solving a class of optimization problems involving two decision-makers, with possibly competing objectives, who make decisions affecting one another at two different points in time (in economics, these problems fall under the general umbrella of game theory). Although there are many real-world applications that fit into the framework we consider, this class of problems remains difficult to solve in practice. A prototypical application is competitive facility location in which two competing firms (e.g., Starbucks and Dunkin Donuts) decide where to locate new facilities. Each must take into consideration that the desirability of a given location might change if a competitor subsequently locates another facility in close proximity.

Can you describe your latest internship and what your responsibilities were?
I was a Research Aide in the Energy Systems Division of the Argonne National Laboratory during the 2016-2017 academic year. I was working with Dr. Feng Qiu on a project aimed at more efficient solving of deterministic unit commitment problems. Unit commitment is a decision-making problem in the power industry, in which the use of generators is scheduled and generation output levels are determined. The problem is to seek an optimal schedule over a time horizon where the generation costs are minimized and certain requirements are satisfied. So, this project is a real-world application of numerous optimization concepts.

We were addressing the project with improvements to both modeling and solution technologies. We enhanced the current models to make them more realistic and have proposed a novel idea for accelerating the current solution process by utilizing information gathered during previous solution processes. This an ongoing work based on my Ph.D. research as well as previous research by my Ph.D. advisor, Dr. Ted Ralphs. Overall, the experience of working on a real-world application utilizing optimization concepts from my Ph.D. research was exciting.

What was it like being on the Lehigh INFORMS Student Chapter Board?
Lehigh INFORMS Student Chapter is a student chapter of the INFORMS organization, as well as a graduate student club at Lehigh. I was President of the Chapter during the 2016-2017 academic year and Vice-President of the Chapter during the 2015-2016 academic year. Being on the Chapter

Board, I had a unique opportunity to interact with various facets of ISE, including graduate students and faculty at Lehigh, various clubs and organizations at Lehigh, renowned researchers in academia and industry, and other INFORMS student chapters. I was part of an excellent team consisting of Mohammadreza Nazari, Yinan Liu and Kursat Kemikli, who led the Chapter wonderfully during the 2016-2017 academic year despite my in-person absence at Lehigh.

In the 2016-2017 academic year, our chapter organized numerous events including talks by distinguished researchers, Ph.D. seminar series, hands-on workshops, volunteering activities, fundraising activities and, of course, fun and recreational activities such as an annual faculty-student picnic, an annual potluck, Christmas celebrations, etc. Our Chapter was also the "Student Chapter Spotlight" of the Fall/Winter 2016 issue of the OR/MS Tomorrow magazine. Overall, it was a great experience to be able to work with different groups, manage various tasks at hand, and lead the Chapter successfully with positive recognition.

SHUBHA HAVALDAR
major: ISE

What did you do this summer? Can you describe your latest internship and what your responsibilities were?
This summer I worked for a pet food company as a data analyst. It was a summer project with the Enterprise System Center at Lehigh. My role was in synch with my interests and the current course work. I worked on identifying the key factors that affected the client's performance in production. I coordinated with the different cross functional teams on the client side which gave me a diverse exposure to work culture within businesses. It was a great experience to apply classroom knowledge to tackle real world problems.

What are your plans for next year?
I plan on pursuing learning opportunities in business and engineering. Therefore, I'll be looking for job opportunities in the industry.

What are you looking forward to in the next year?
I'm interested in learning more of business analytics, where I could use my skill set for providing data-driven insights. During this fall semester, I'll be interning within the market intelligence team at a company specializing in precision machinery and instruments. I'll be looking forward to gain more experience with data science, market research and business analytics. Further, I'd like to use this experience in a consulting role.

Who influences you the most in the department?
The ISE department is full of talented people who are extremely passionate about their work. It would be difficult to name just one influencer within the department. The professors with whom I have taken classes, as well as the fellow students with whom I have done projects, have had a positive impact on me. It has helped me better my understanding of engineering, business, and the world in general.

What is your favorite part about the department?
My favorite part about the ISE department is getting various opportunities to network and connect with alumni from diverse industries. The department also organizes career fair for its students where we are introduced to opportunities for IE graduates within their focus areas. Also, the IE advisory council is a great resource when seeking career advice and opportunities.

What made you choose Lehigh?
MS in ISE at Lehigh is one of the top engineering programs in the United States. The faculty, various learning resources, a great alumni network and the diverse career opportunities offered post graduation made Lehigh an obvious choice for me. Lehigh has an amazing campus environment which offers an all-round enriching experience to its students.

What is something ISE has taught you?
ISE has taught me to look at problems from technical as well as managerial perspective. It has taught me to always look for a better way to address situations with an optimal utilization of resources.

A REVOLUTION IN POLYNOMIAL OPTIMIZATION

The modern "smart" city, says Jie Liu, is a web of networks that should run like a healthy, well-tuned circulatory system.

This is especially true, says Liu, a Ph.D. candidate in industrial engineering, for the power grid, which delivers electricity from power stations to consumers. Electric power should flow through the grid in a way that utilizes as efficiently as possible the resources that are used to produce the power.

This streamlined flow, says Liu, is made possible by machines that process large quantities of data in real time and make optimal decisions.

Liu and his colleagues, Martin Takáč, assistant professor of industrial and systems engineering and Liu's Ph.D. adviser, and Jakub Mareček of IBM Research, have made considerable progress in solving optimal power flow problems in the past two years.

For his contributions, Liu recently received IBM's Ph.D. Fellowship Award, one of the industry's most competitive sources of funding for Ph.D. students.

A power system, say the researchers, often contains many power stations, which produce electric power. A central entity, called the transmission system operator, coordinates the production and transmission of power.

The goal of the operator is to transmit electricity from power stations to customers with maximum efficiency and reliability. If a wire carries too much electric current, it incurs losses and could overheat, possibly causing a blackout.

Operators of power plants and transmission systems cannot choose directly how much current will flow where, say the researchers, because power follows the laws of physics. But they can decide where to generate power and how to set the transformers along the way.

The physics of the alternating-current model of power flows makes these decisions difficult to make, says the group. But they correspond to polynomial optimization problems (POPs), which are a hot topic in the field of mathematical optimization.

Until recently, researchers could apply the so-called Newton method to POPs to obtain a solution quickly. Or, as suggested by Mareček and his colleagues, they could solve a sequence of surrogate problems to obtain the best possible solution.

The second approach often took too long, though, causing Liu, Mareček, and Takáč to seek conditions under which one could switch from the surrogate problems to the Newton method without obtaining solutions that would be wrong. Using recent developments in numerical algebraic geometry, the group has developed such conditions and designed methods to test them efficiently. One can therefore solve the surrogate problems quickly and, when it is safe, switch to the Newton method.

"This revolutionizes the field of polynomial optimization," says Mareček.

The first in a series of papers by the group, "Hybrid Methods in Solving Alternating-Current Optimal Power Flows," has just been accepted in IEEE Transactions on Smart Grid. That article is coauthored with Alan Liddell of the University of Notre Dame.

–KURT PFITZER

ISE MSAF Student Awards

The Lehigh M.S. in Analytical Finance (MSAF) program is a cutting-edge, 30 credit-hour program designed to provide students with a strong education in advanced finance and quantitative financial analysis tools using key concepts from financial theory, applied mathematics, and engineering. The curriculum is intended for career opportunities in areas such as portfolio management, securities trading, investment banking, risk management, and financial information systems. (Source: LU website program description)

One of the key requirements that each student must complete in the MSAF program, is the completion of the Financial Engineering Projects Course. This course entails the analysis, design and implementation of solutions to problems in financial services using information technology, mathematical modeling, and other financial engineering techniques. Emphasis is placed upon on real world problem solving, problem definition, implementation and solution evaluation. (Source: LU website project course description)

Every year, awards are given to the student teams who perform exceptionally well in their MSAF Projects. Awards are based upon the ingenuity, the usefulness and the applicability of the research that will make the resulting project report worthy of submission to reputable professional journal in the field of Analytical Finance.

For this year, the student team winners and project topics are the following:

1ST PLACE
XIXI CHEN, DENIS HALVADZHIEV, JIALI DU

Topic: High Dividend Yield Equity Screening Strategy with a Focus on Value and Quality.

In their work, Chen, Halvadzhiev, and Du focus on coming up with new portfolio selection strategies for investors who are looking for high yields even in times of low interest rates. They also look at how these portfolios perform in different asset universes in Europe.

2ND PLACE
YINI GAO, YINGQIAN REN, XINGKAI WANG

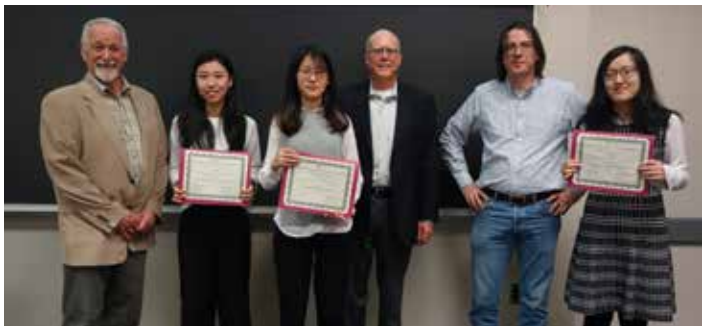
Topic: High Yield Portfolio Analysis - Looking Beyond Yield Advantage Strategy

Similar to the 1st place work above, in their work, Gao, Ren, and Wang, focus on coming up with new portfolio selection strategies for investors who are looking for high yields even in times of low interest rates. In particular, this is done so by considering also the 1-year dividend growth rate as a factor in constructing the desired portfolio.

3RD PLACE
XIANZI JIANG, LIN MAO, YUNSHENG XIAO

Topic: Will Risk Parity Outperform? Comparison Between Risk Parity Strategy and Other Portfolio Allocation Strategies

In their work, Jiang, Mao, and Xiao, went beyond the popular strategy of constructing portfolios having equal contributions to the risk of the portfolio, when the portfolio's risk is measured by the variance-covariance of the portfolio returns. Specifically, they considered the case in which the portfolio's risk is measured by the more robust Conditional Value-at-Risk and Value-at-Risk of the portfolio returns.



HONORABLE MENTION
PUXIN XU, YUHENG HUANG

Topic: Risk Parity with graph: PCA Cluster Risk Parity Portfolio.

In their work, Xu and Huang, tested the impact of using different clustering techniques in portfolio selection strategies in which the desire is to obtain a portfolio in which each position has an equal impact in the overall risk of the portfolio.

The students are currently working on submitting their project reports to a prestigious journal such as the Wealth Management practice journal of the Investment Management Consulting Association (IMCA). Last year, a paper based upon a student's team work in the area of Wealth Management Optimization was published in IMCA's Investments & Wealth Monitor, namely, The Effect of Life Expectancy on the Bucketing Strategy by Andrew Dunkers, Yabin Shen, Dong Yang, Wilson Yale, PhD and Luis F. Zuluaga, PhD.

GLEMSER TECHNOLOGIES CORPORATION RECOGNIZED AS AN INNOVATION AWARD WINNER

The Ben Franklin Technology Partners of North Eastern Pennsylvania recently assigned top Incubator Graduate Honors to Dr. Raymond G. Glemser II (Lehigh '83, '84, and '91). This occurred at its annual iXchange event. Ray's company, Glemser Technologies Corporation, was formed and incorporated in 1987 while he was transitioning from completion of work on his Masters in Industrial Engineering and undertaking research for his PhD, also Industrial Engineering. At this time, he was asked by Dr. Zimmers if he would consider forming a start-up business with others who had an aptitude for computer software. Glemser and Zimmers were convinced that this would be an effective way to transfer research conducted under a grant from IBM and its Thomas J. Watson Research Center into IBM production facilities. This business formation was accomplished utilizing the resources of what is now the Enterprise Systems Center as the initial base of operations. To many ISE faculty and friends it may seem hard to believe, but this is the year that Ray's company is celebrating its 30th Anniversary.

The grant, with Professor Zimmers serving as Principal Investigator, concentrated on research in computer-aided design and computer-aided manufacturing (CAD/CAM). Glemser's focus area in the research project was the software design and coding to perform automatic tolerancing for major computer hardware products based on a solid modeling system, which included:

(1) The development of a solid model assembly mechanism for capturing positional relationships between components,
(2) An automatic method of finding all components, along with their positioning tolerances and mating locations which contribute to a given design function, and interactive assistance with incompletely assembled products,
(3) The automatic finding of dimensions on a part between two mating positions on a component in the assembly, and interactive assistance with incorrectly dimensioned parts, and
(4) The calculation of worst- case (dependent) and rootsum-square (independent) tolerancing accumulation in the final assembly positional tolerances.

An additional objective of the collaborative research grant was IBM's desire to reach students in the engineering colleges major universities. It served to encourage them to understand and use IBM mainframes as the basis for their undergraduate and graduate educational and research undertakings.

Dr. Glemser, who has also served on the Industrial and Systems Engineering Department's Advisory Board, credits Dr. Zimmers with helping him to learn to enjoy creating software solutions that solve problems for companies. All this was occurring at a time when both the hardware and software to undertake computer-aided design and manufacturing projects was very expensive. The multi-year collaborative working arrangement with IBM and the Enterprise Systems Center (ESC), with Professor Zimmers serving as Director, permitted hundreds of students to gain valuable experience as part of their Lehigh education.

As a part of the great agreement, IBM allowed educational use of millions of dollars' worth of mainframe computer resources to be utilized as part of the education related project work with partner companies. Often these projects were conducted in collaboration with the Ben Franklin Technology Partners competitive grant programs utilizing the Enterprise Systems Center. In addition to the project work, the Center conducted dozens five-day training seminars titled "the President's class on CIM" (Computer Integrated Manufacturing). These seminars were conducted at Lehigh and multiple IBM sites primarily on the East Coast United States. Faculty from the Industrial Engineering Department as well as other engineering departments contributed other expertise. Another Lehigh alumnus and Industrial Systems Engineering Advisory Board member, Keith Krenz ('79), played a key part in these state of the art educational programs.

Ray also contributes as a guest lecturer to the Industrial and Systems

Engineering Department's Leadership Development course taught by Professor Zimmers. During his lecture, Ray discusses entrepreneurial insights and shares stories of the evolution of his company with primarily ISE seniors and graduate students. Both Ray and Emory essentially agree that in today's global competitive environment, engineers are increasingly called upon to utilize technical skills in their capacity as leaders and decision makers. While engineering proficiency remains a prerequisite, it is this expertise combined with leadership skills that will help create our next generation of technologically competent leaders and executives.

Working with additional alumni including John McGlade (G '76 & '80), Scott Hartz ('68), Robert Gustafson ('74), Dan Mulholland ('74), Keith Krenz ('79), Fedja Buzancic ('12), Christine Burke, Joe Feskanin, Doug Sunday, as well as Lehigh thought leaders including Aarsenio Perry and Henry Odi, the leadership course was developed and continuously improved over the past 20 years. It seeks to provide students with a structure for exploring and understanding effective leadership theories, principles, and processes. Traditional lectures, coupled with guest leader presentations and case studies help the student understand leadership and apply this knowledge to their personal and professional lives. These Lehigh personnel teaming with successful alumni are convinced that students who combine the development of leadership skill sets with scientific education tend to be set apart from their counterparts and experience a high level of career success.

Since around the time of Ray's start-up, the Enterprise Systems Center has employed more than 2,000 Lehigh students to support industry projects and research programs. Many conducted in collaboration with the Ben Franklin Technology Partners. The ESC has provided course-related hands-on experience to an additional 1,250 students. Many of these students were undertaking the Industrial and Systems Engineering 254 Senior Project Course. Enterprise Systems Center (ESC) has been a long-time economic development partner of Ben Franklin and the organizations have worked together for more than 30 years. The proximity of Ben Franklin Technology Partners / Northeaster Pennsylvania's Ben Franklin TechVentures® headquarters and award-winning business incubator on Lehigh's Mountaintop Campus facilitates the mutually beneficial relationship among Ben Franklin client companies and university faculty, students, industry mentors, and consultants. The partnership helps companies by providing them with student workers who are bright, driven, and ambitious, and challenge assumptions. And the partnership provides students with real-world working experience in commercializing technology that prepares them to become the next generation of industry leaders in key technical sectors.

LAWRENCE E. WHITE FELLOWSHIP RECIPIENT

The Industrial and Systems Engineering Department was pleased to present the Lawrence E. White '64, '65 G, '69 Ph.D. Fellowship for Master of Management Science and Engineering to Paul Greenfield at the annual ISE Banquet in April. The scholarship, made possible by the generosity of Lehigh and department alumnus, Lawrence E. White ('64, '65 G, '69 Ph.D.) provides full tuition support toward 30 credits of master's degree study. Lawrence E. White earned a bachelor's degree in engineering from Lehigh in 1964, followed by a master's degree in Management Science in 1965 and a Ph.D. in Industrial Engineering in 1969. While a student, White was a member of the wrestling team and Theta Delta Chi. White has long supported initiatives at Lehigh, and is a member of the Asa Packer Society and Tower Society

THE VAN HOESEN FAMILY BEST PUBLICATION AWARD

The ISE Department was pleased to announce the winner of the second annual Van Hoesen Family Best Publication Competition at the 2017 ISE Banquet. This year's winners were Ph.D. students, Sahar Tahernejad and Chenxin Ma. This competition was made possible due to an extremely generous gift from the Van Hoesen family. Three years ago, Everett Van Hoesen '55 was the recipient of the 2014 Distinguished Alumni Award in Industry. Everett and his family of almost ten Lehigh graduates, created the competition, which is open to all ISE Department students. We congratulate Sahar and Chenxin!

Welcome our four new Advisory Council members...

RALPH BOHNENBERGER '89

Ralph Bohnenberger graduated from Lehigh University in 1989 with a Bachelors in Industrial Engineering. Over the next 15 years, he held various positions in Manufacturing as a traditional Industrial Engineer. Plant layout, Time Studies, and job analysis were key parts of those positions. During that time, he also acquired experience working in union environments with Teamsters, Machinists, IBEW, and the Textile Workers Unions. Ralph served on successful negotiating committees, putting in place contracts in the midst of rapidly changing environments and collapsing healthcare providers.

Over the last 13 years, Ralph has switched his focus from manufacturing to construction to construction in Healthcare. His role at New York – Presbyterian has allowed him to play a key role in the previous $2.6B Capital Investment Plan and in todays $3.3B Capital Investment Plan.
Most recently, Ralph has completed his MBA in Information Services and Operations Management and the Zicklin School of Business at Baruch College in New York City. Ralph is also a member of Alpha Iota Delta, the Decision Management honor society.

Prior to that, Ralph served as a volunteer and paid EMT with the Berkeley Heights NJ Volunteer Rescue Squad, the Watchung Rescue Squad, and with Old Bridge Township Raceway Park Emergency Services. He held many operational positions as high as Captain and First Lieutenant over his 22 year career in EMS.

SCOTT DENEGRE '05 G, '11 PH.D.

Scott DeNegre, PhD, vice president of Operational Excellence, has several years of experience helping healthcare organizations manage their operational and strategic challenges and developing innovative solutions to increase efficiency, improve clinical outcomes, and enhance patient experience.

In his role as the leader of Operational Excellence at HSS, Scott oversees Transformation & Process Improvement, Perioperative Logistics, and Quality Information Systems and collaborates with other HSS leaders to manage performance improvement across the enterprise. Prior to joining HSS, Scott was a consultant with The Chartis Group, an advisory services firm that provides management consulting and applied research to leading healthcare organizations. In this role, he provided client support in the areas of enterprise strategic planning, capacity management, merger & acquisition planning, care coordination, cost and clinical performance improvement, and service line strategy. Scott holds a BS in Mathematical Sciences from Johns Hopkins University, an MS in Management Science from Lehigh University, and a PhD in Industrial & Systems Engineering from Lehigh University.

KATHLEEN J. HALL '82

Kathleen J. Hall is an accomplished business executive with a broad range of management and functional experience with responsibility for global business units of respected multinational corporations. She is recognized as a dynamic and engaging leader, communicator, mentor and team builder who inspires energy and commitment within organizations while delivering bottom line results.

Kathleen is currently the Chief Operating Officer of FARO Technologies, the world's most trusted source for 3D measurement, imaging and realization technology. She leads the Company's global operations and provides strategic leadership to the business that is executing an aggressive transformation and growth strategy.

Prior to joining FARO, Kathleen was Vice President and General Manager of several businesses at Avery Dennison Corporation. Additionally, Kathleen held multiple advancing leadership positions spanning over 26 years with the E.I. DuPont De Nemours & Company.
Ms. Hall holds a Bachelor of Science degree in Industrial Engineering from Lehigh University. While at Lehigh she was Captain of the Varsity Volleyball team and a proud member of the Dean of Students' Gryphon Society for 3 years.

JACK KLOEBER '77

Jack Kloeber is a retired US Army Lieutenant Colonel with experience in R&D portfolio management, decision analysis, modeling and simulation, technology selection, and strategy development. Jack taught mathematics at West Point and graduate level decision analysis and systems simulation at the Air Force Institute of Technology.

His work has supported decisions for various superfund sites within the Department of Energy, and many technology organizations within the Departments of Army, Air Force, and Navy. After retiring from the US Army, Jack was the head of Portfolio Management for Bristol-Myers Squibb followed by head of Portfolio Management for J&J Pharma Services where he coordinated the portfolio management efforts across multiple R&D companies.

Jack became a Senior Partner at KROMITE for 5 years and now 7 years as KROMITE's Principal. Jack led the analytics team for Syngenta as they won the Edelman Award in 2015.

He received his Ph.D. from Georgia Institute of Technology and MSIE('88) and BSIE('77) from Lehigh University. Jack is a Past-President and Fellow of the Society of Decision Professionals, a member of the Decisions Analysis Society, a 25-year member of INFORMS, and Chair of the Business Analytics Conference in 2018.

...As we say goodbye to three ISE Advisory Council members.

J. BOB BAUM '64
Professor Emeritus,
University of Maryland
Past Chairman, Board of Highmark

SUNIL A. MISSER '88G
CEO, AccountAbility

SCOTT NESTLER '89
Assoc. Professional Specialist,
University of Notre Dame, MC
Adjunct Research Staff Member
Institute for Defense Analyses

DANIEL BRIAN MULHOLLAND, 64, of Palm Beach, FL and Easton, PA passed away at home with his wife, Donna, on January 3, 2017 after a hard fought struggle with pancreatic cancer. He was born May 29, 1952 and was raised in Pittsburgh, PA, graduating from Bethel Park High School in 1970. Dan graduated from Lehigh University in 1974 Magna Cum Laude with a Bachelor of Science degree in Finance and then earned an MBA from The Ohio State University. At Lehigh University, he started three-years as an offensive lineman, was named to the Small College All- American Football Team and was awarded the Wall Street Journal Student Achievement Award as the outstanding Finance Major. In 2004, Dan was recognized with Lehigh University's Alumni of the Year award. At The Ohio State, Dan met his wife of 39 years. They celebrated their son Scott, daughter-in-law Kate, and grandchildren Decker and Isla.

Dan began his business career in June, 1974 at the J.T. Baker Chemical Company in Phillipsburg, NJ. After managing every functional department (except R&D) he was named President of the company. During his ten years as president, Dan negotiated the sale of the company to Procter & Gamble, Mallinckrodt Baker and Tyco International while maintaining continuous growth in revenue, profit and employment. Following his 2002 retirement, Dan became a senior consultant to the Enterprise Systems Center (ESC) of Lehigh University.

At ESC, Dan was a regular speaker for the Leadership Development Course as well as at the evening meetings of the National Society for Leadership and Success. He also mentored over a hundred student-industry projects. In all, he impacted the lives of at least 1000 students. Testimonials to Dan may be found on YouTube by searching Dan Mulholland Enterprise Systems Center and Dan Mulholland Last Lecture.

DR. GARY EDWARD WHITEHOUSE, 78, passed away Friday March 31, 2017 in Bonita Springs, Florida. After taking his education in Industrial Engineering at Lehigh University and Arizona State University, Dr. Whitehouse enjoyed a long and distinguished career in higher education. He was professor of Industrial Engineering at Lehigh University from 1965-1978; he continued his career as a faculty member and administrator at University of Central Florida from 1978-2004. As university administrator, Dr. Whitehouse helped lead and guide UCF through a period of rapid growth and development. He served as the Department Chair of Industrial Engineering 1978-1983, as Dean of Engineering 1988-1993, and finally as Provost and Vice President for Academic Affairs at UCF 1993-2003. Dr. Whitehouse was a pioneer of microcomputer use in classroom and IE professional practice, he authored four books in the area of operations research and industrial engineering, wrote more than 100 technical journal articles, won numerous teaching and service awards, and was an active member of the Institute of Industrial and Systems Engineers. Gary was preceded in death by his wife of 53 years, Marian G. Whitehouse, and is survived by his children Gail DePuy and her husband Wynand, and Glenn Whitehouse and his wife Marianne; and by three grandchildren, Daniel Whitehouse, Meredith DePuy, Drew DePuy.

The Sheibleys

For decades, Lehigh and the ISE department have seen many members of the same families come across campus. Fathers, sons, mothers, daughters, brothers, sisters, aunts, uncles, grandchildren – you name it, we see the same last names appear over and over again. This clearly shows what the department and Lehigh have meant to these families.

This section of the newsletter is dedicated to ISE legacy families and the impact that the department and Lehigh have made on their lives.

JOHN SHEIBLEY '41

"My father, John Sheibley, was a 1941 Lehigh graduate," explains Philip Sheibley. I wasn't particularly aware of his Lehigh background or the fact that he was a Metallurgical Engineer however." John got a job with Bethlehem Steel right after graduation, but was drafted six months later into the Army Air Force (he had a pilot's license). He left the military at the end of WWII as a Captain, and immediately enrolled in Princeton Theological Seminary, getting an M-Div (Masters of Divinity), and later a Doctorate. "So, he was 'Dad the minister' when I was growing up (and probably the only minister in America with a Metallurgical Engineering Degree)," says Philip.

PHILIP SHEIBLEY '81

Following his father's footsteps, Philip, with his love of math and science, ended up looking at engineering schools/programs. "My dad didn't push, but suggested I add Lehigh to my list of colleges," says Philip. With the last two finalists being Lehigh and Cornell, it was Lehigh's reputation and campus that sold it for him.

Philip thoroughly enjoyed his experience at Lehigh, admitting he greatly appreciated the intellectual challenge of working with top students and dedicated faculty, such as Professors George Kane, who was his academic advisor, and Mikell Groover, "who always had great real-life stories due to his outside consulting," which Philip says probably influenced his career decision. His fraternity, Delta Phi, "was a great opportunity in developing my leadership skills, which helped me understand group dynamics while creating some of my most lasting friendships."

Upon graduation, Philip started working with the consulting division of Arthur Andersen (which became Andersen Consulting, and eventually Accenture). He rose through various levels to become a Partner in the firm, and before "semi-retiring" (after 29 years) he became the Industry Director for Accenture's Global Life Sciences practice. After leaving Accenture in 2010, Philip joined several of his similarly "retired" Accenture Partners in a venture capital investment group. He explains, "We take positions (or ownership) of early-stage companies in a number of industries (e.g. renewable energy, life sciences, nutrition) and are highly active in helping the founders/management of the companies to develop scalable models for success. I've also been able to involve some of my Lehigh colleagues in several of our venture companies which has been great." Philip notes that his Lehigh education was perfect for both his consulting and VC endeavors in that he had the structured analysis, problem solving, and creative solution-development skills, combined with effective teaming and economics, which were critical to the roles he played.

In addition to Philip's other responsibilities, he also has been on the Lehigh University Board of Trustees for six years. "It has been an amazing opportunity to reconnect with my Alma Mater, and make a modest contribution as a steward of the institution." He notes that with the challenges facing our world today, "the skills Lehigh graduates obtain are more critical than ever. The board is made up of some of our most dedicated alumni, so it's an inspiring group to work with, and I think we have a great relationship with the administration and senior faculty. With the exciting plans President Simon and the board have in store for Lehigh, it's a great time to be involved with the university!"

MALLORY SHEIBLEY '19

Mallory Sheibley admits that she was a little against the idea of coming to Lehigh, based on her father's involvement. "I wanted to do my own thing," she says. Although not knowing where she wanted to go, she didknow one thing for sure - she had a love of engineering. "I ended up applying to the most random group of schools that were anywhere from Florida to California. I visited Lehigh and ended up going on an engineering tour." Although Mallory had been on campus countless times before, seeing it from a potential student's standpoint convinced her that this was the school for her. "It was easy to pick Lehigh not only for its environment, proximity to both New York and Philadelphia and social scene, but also because I was choosing between Lehigh's engineering school and a school with a three-classroom hallway dedicated to my major of choice. As much as college is about the experience, I was going first and foremost to learn, and I ended up having the best experience with all aspects of it. After that, it was really clear that this was the place for me."

Mallory didn't initially like the idea of being a third-generation student, especially with her father's continued involvement with Lehigh as a trustee. Now that Mallory is a student, she admits that there's a very good reason why there are so many legacies. "Once someone is exposed to Lehigh, they don't want to go anywhere else."

Mallory has always had a knack for math and physics due to their having concrete answers and clear explanations. "I like things that are logical and calculated. I excelled in those areas in high school, and I knew that these would be the subjects I would want to study further in college. I also realized that a degree in engineering would take me the farthest in terms of a career that I'd like to pursue - and Industrial Engineering would give me the widest range of possibility (along with a business minor)."

Mallory is a member of the sorority, Alpha Gamma Delta, for which she is the Social Chair. Through Alpha Gamma, she's part of a group that does community service with the Broughal Middle School (running an after-school cooking club for the kids). She's also part of the Society of Women Engineers and club volleyball on campus.

Mallory is in the Engineering Co Op program, so she is currently in Erie, PA for the semester working as an Industrial Engineering intern for GE Transportation.

ENTERPRISE SYSTEMS CENTER'S PROJECT PARTNER, SIMPLEX INDUSTRIES INC., RECOGNIZED FOR MANUFACTURING ACHIEVEMENT

Simplex Industries employees and its President Patrick A. Fricchione, Jr. were recently given special recognition by the Governor's Action Team, the Department of Community Economic Development and the Ben Franklin Technology Partners of Northeastern Pennsylvania (BFTP/NEP). A formal award was conveyed at the recent iXchange BFTP/NEP event in Zoellner Arts Center.

Over the past several years the Enterprise Systems Center (ESC) at Lehigh University has been working with Simplex primarily through a series of matching grants competitively awarded. Undergraduate and graduate students from Industrial and Systems Engineering worked on the project along 8 graduate students from ISE and Mechanical Engineering and 11 undergraduate ISE students.

Dr. Emory Zimmers, Professor of Industrial and Systems Engineering and ESC Director explains that the overall project objective was to develop a method for linking additive manufacturing technology directly to the CAD engineering programs used to design modular housing units. This served to create an exact model of the as-designed final structures. Benefit to the company was twofold. First, it permitted verifying the exact fit and match of all modular structural components. Secondly, it provided an exact 3-D model for the customer to view and approve.

Additional types of work undertaken included assisting Simplex Industries in the analysis of their core processes. This work at three major phases: 1.) analyzing cost data to estimate and rank opportunities for cost reduction, 2.) presenting pertinent data to the Simplex/ESC team members in visual formats and brainstorming options for improvement, and 3.) analyzing and presenting quantified recommendations

One of the major tasks undertaken in conjunction with the Enterprise Systems Center was the conversion of traditional 2-D drawings to a three-dimensional database. This work was undertaken by a collaborative team involving personnel from the Simplex Engineering Group as well as several teams of ISE students and engineers from other Lehigh departments.

Concurrently with the 3-D database conversion, plant simulations were conducted to identify net value added operations as well as bottlenecks. Once bottlenecks were identified return on investment for various factory automation approaches were evaluated. Students had the opportunity to contribute significantly to the definition and the development of opportunities to streamline material flow, storage and handling, the reduction of waste and the improvement of inventory control systems to free up operating capital.

Dr. Emory Zimmers, Professor of Industrial and Systems Engineering, credits Enterprise Systems Center, Managing Director, Robert "Gus" Gustafson and Research Scientist, Doug Sunday with guiding the project in a highly successful manner. Gus and Doug not only provided overall organizational support, but also provided extensive mentoring to the student teams.

Domenico Demarco, one of the students working on the project, told us, "I gained an invaluable experience interning at Simplex for the summer thanks to Gus Gustafson, Doug Sunday, and the ESC, which provided the opportunity and guidance for me to participate in the project."

In addition to providing important experience based learning opportunities for Industrial Systems Engineering students at both the undergraduate and graduate level. Chirag Rana from the Mechanical Engineering Department, successfully completed the transition to engage in full-time employment.

The Enterprise Systems Center (ESC) has been viewed by many a national center of excellence in systems engineering and leadership development through experiential learning for several decades. Over the past several decades more than 3000 students have benefited from opportunities provided by the industrial and service sector companies working with the Center, The ESC engages students, professors, senior fellows, subject matter experts, community of practice executives, and industry partners to help companies develop new technologies or apply existing technologies to help them compete in a global marketplace.

Since its inception, the ESC has engaged in more than 1,000 research and development projects with more than 400 industry partners. Research and development efforts are driven by industry needs and focus on manufacturing systems, product and process innovation, supply chain and logistics, analytics, operations research and sustainability. Dr. Emory Zimmers, Center Director, states "Our primary mission is twofold. The Enterprise Systems Center (ESC) is committed to helping students learn and develop leadership skills, while simultaneously providing value for our clients."

Q & A WITH HSE STUDENT, SONJA GORMAN

Why did you choose Lehigh for your undergraduate degree? What made you continue into the HSE graduate program?

I chose Lehigh when I was 18 and knew nothing about what life in Bethlehem would entail. I actually hadn't visited campus, except for a weekend visit through the D-Life program after I was accepted. I was interested in neuroscience because I wanted to better understand the phenomenon of consciousness and had also considered going to medical school. At the end of my undergraduate degree I had completed a great array of health-related experiences including a minor in HMS; a semester-long study abroad program contrasting healthcare systems in Vietnam, South Africa, and Argentina; a GELH-funded project exploring disparities in United States primary care services; 120 hours of physician shadowing at St Luke's Hospital through the biomedical externship; research on the structure of Cystic Fibrosis Transmembrane Receptor; and interning with the medical device manufacturer Becton Dickinson at its China HQ. The HSE program was an opportunity to expand my skillset in a new and different way. Where I had previously focused on the biological and policy underpinnings of health, HSE focused on business and process solutions. With some planning, it was feasible to complete an entire Master's program in 12 months.

Can you explain the duties as the President of the HSE Council?

As President of the HSE council, I focused on (1) building a community within a small, transient graduate program and (2) providing professional development opportunities through seminars, trips, and exposure to industry employers. I was a Resident Assistant for 4 years and therefore knew the inner functioning and social dynamics of Lehigh well. I myself was new to engineering, so many of the development opportunities were experiences that I felt were useful to gain broad exposure and help students differentiate between possible areas of focus. Some of our accomplishments as a council (some of our own planning and some in collaboration with HSE, Director, Ana Alexandrescu, and HSE Coordinator, Linda Wismer) were:

- Company tour and presentations from executives at BBraun in Allentown, December 2016
- Tour and presentations at Blue Cross insurance and its affiliated healthcare startup, Geneia, in Harrisburg, May 2017
- An HSE Alumni Panel
- Social events, including a spring semester kick-off to bring together distance and campus students; happy hours; off-campus gatherings.
- SAS analytics training, FlexSim, and Six Sigma green belt trainings
- HSE biweekly seminar series in spring semester

How did you feel when you won the 2017 HSE Student of the Year Award?

The Student of the Year award was a surprise to me! Lehigh has been a special place for me because I've been a student for five years. It was really nice to leave with special honors from my graduate program.

Can you explain your experience at the Mayo Clinic?

The experience was made possible thanks to Industry Advisory Council member, Gary Sieck, who is a distinguished researcher at Mayo Clinic. After meeting Dr. Sieck at the fall 2016 capstone presentations, I reached out to him in person and then via email to set up a professional experience. He connected me to Dr. Curry and Alison Knight from the department of Anesthesiology (in which Dr. Sieck is a professor).

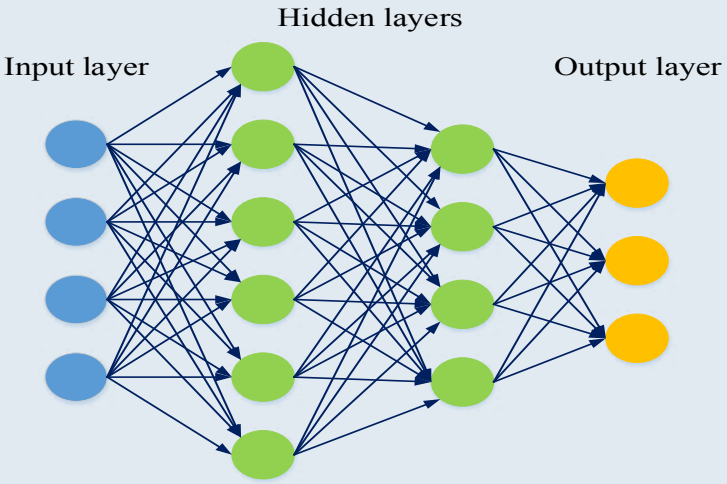
I had an incredible experience at Mayo Clinic. I learned so much both from my mentorship relationships there and by working with Professor of Practice, Terry Theman, and HSE Director, Ana Alexandrescu. It truly felt like the "capstone" of my HSE program experience. Dr. Curry and Alison are very happy with my work and will likely help me publish the results of the analysis.

With that said, it was not without challenges. I learned the importance of balancing the time allocated to various parts of a project.

MACHINE LEARNING APPROACHES FOR SUPPLY CHAIN DECISION-MAKING

ISE Professors Martin Takáč and Larry Snyder recently received an NSF grant to develop a new approach for using machine learning (ML) as a tool for optimizing and analyzing supply chains. Supply chain refers to the system that moves goods from where they are produced to where they are consumed. This system includes manufacturing, assembly, warehousing, transportation, and retailing processes. Classical supply chain models require the decision maker to make assumptions about the probability distributions of the demands, lead times, and other random elements. Fortunately, today's supply chains capture huge volumes of data about these parameters. However, the prevalent approach for utilizing this data, both in research and in practice, involves two stages: Statistics, ML, or another tool are used to estimate each random parameter (often as only a point forecast); and second, estimates are plugged into a classical supply chain model, as though the estimates were perfectly accurate. Principal Investigator (PI) Martin Takáč argues that this is the wrong approach. "Doing forecasting and optimization as two separate steps leads to suboptimization and to introducing both prediction error and modeling error," he says.

Instead, the researchers propose an integrated approach that combines the data-analysis and supply-chain-optimization stages into a single ML algorithm. Their NSF-funded project studies how to improve the efficiency and robustness of the supply chain by using novel ML techniques to make decisions within the supply chain automatically. The project specifically focuses on the development of decision-making strategies to deal with uncertainties and correct disruptions in the supply chain system. In collaboration with an industrial partner, Siemens,



the project is focusing on a real supply chain application related to the production and distribution of radiopharmaceuticals (an important component in health diagnostics) and early warnings and corrective actions for stochastic supply chains. In addition, the project will make methodological contributions to the theory and implementation of ML algorithms, including new loss functions, techniques for using deep learning as a preprocessing step for reinforcement learning, adaptive strategies to handle non-stationary data, and improved initialization methods for ML. The tools and concepts developed will be generalizable more broadly, both within and beyond supply chain.

These advancements in supply chain and machine learning resulting from this project benefit a wide range of industries, including healthcare, manufacturing, transportation, and electronics. "Supply chain managers have huge amounts of data at their disposal," says co-PI Larry Snyder. "They are beginning to leverage this data for predictive analytics -- basically, forecasting. But little research has been done on how to use it for prescriptive analytics -- that is, better decision-making. This project addresses that gap."

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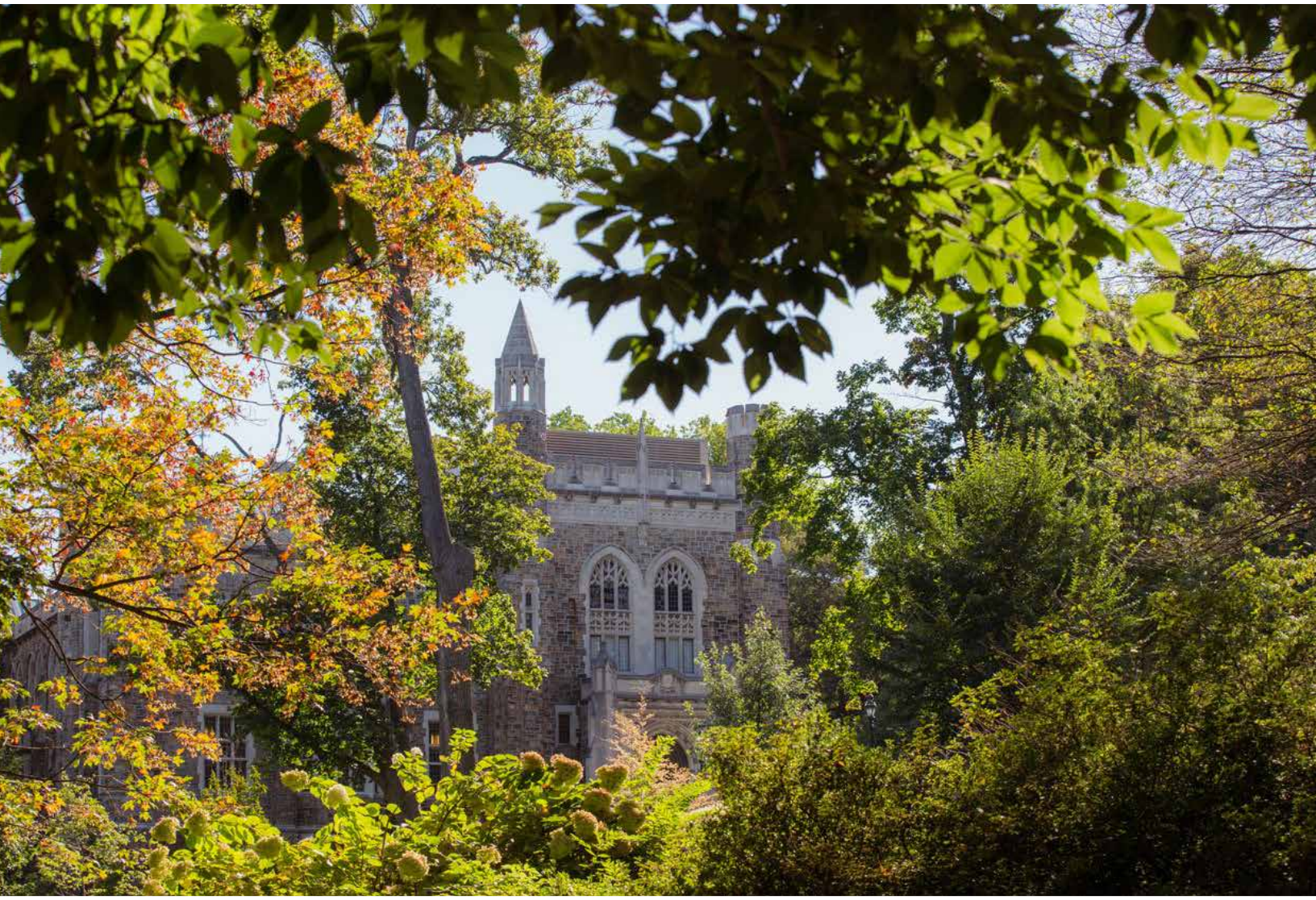

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