

INDUSTRIAL ENGINEERING AND MANAGEMENT SCIENCES

IEMS TRANSFORMS ADVISING AND MENTORING FOR UNDERGRADUATES

New 'GuldE' advising and mentoring system strengthens student connections to faculty, peers, and alumni

Too often, advising and mentoring meetings reduce to discussions on what courses to take in upcoming academic quarters.

A 2016-17 survey of students in Northwestern Engineering's Department of Industrial Engineering and Management Sciences (IEMS) and anecdotal feedback from IEMS alumni reveal that many former students wish they had taken advantage more fully of all that Northwestern has to offer, including the opportunity to learn from and interact with faculty outside the classroom.

To increase the department's focus on faculty mentoring for its undergraduates, IEMS introduced a new advising model in 2017-18. The system allows students to meet with a staff academic adviser to discuss curriculum matters, such as which courses to register for or a student's four-year plan, as well as a "Faculty GuldE" to address deeper discipline topics and career-related questions. Structured Faculty GuldE meetings are biannual

group luncheons with a small group of students and one faculty member mentor, and offer an environment for students to ask questions, learn from their peers, and develop a connection to faculty that encourages additional conversations throughout the year.

Central to the department's curriculum redesign is **Marita Labeledz Poll**, who joined the department in fall 2017 as an academic adviser. Labeledz Poll's past experience includes serving as associate vice chancellor for student affairs and dean of students at the University of Massachusetts, Boston, senior associate dean of students at Lake Forest College, and assistant director of residence life at the University of Rochester.

In 2018-19, IEMS will expand its roster of GuldEs for undergraduates to include "Peer GuldEs" composed of senior industrial engineering majors and "Alumni GuldEs" made up of department alumni. The department believes the new, comprehensive support system of faculty, peers, and alumni will spark multi-directional connections and new opportunities.



Marita Labeledz Poll



Advice from Marita Labeledz Poll to undergraduate students:

I always recommend that students follow their interests and be intentional about what they engage in, inside and outside of the classroom. Take time once a year to consider your opportunities because your interests will change. Look broadly across Northwestern, but don't forget your connection to IEMS. Get to know your professors outside of class and learn about their interests and research. You won't have this same opportunity after graduation.

Dear friends and colleagues,

After one year as chair of the Department of Industrial Engineering and Management Sciences (IEMS) and four years at Northwestern, my respect for and pride in the department's students, staff, faculty, and alumni continues to grow. In round numbers, one in five Northwestern undergraduates is enrolled in the McCormick School of Engineering. Of that total, more than 20 percent of Northwestern Engineering BS degrees are concentrated in industrial engineering (IE). This is the highest percentage among the top ten industrial engineering programs in the country. IE at Georgia Tech is second with about 18 percent of their engineering degrees, while Purdue University, University of Michigan, and Cornell University follow in a range between 13 to 14 percent.

While IEs have a significant footprint at Northwestern Engineering, we value quality foremost, and the high quality of our scholarship and innovation at

all levels is evidenced throughout this newsletter. Assistant Chair **Jill Wilson** earned the 2018 Charles Deering McCormick Distinguished Professor of Instruction award earlier this year, one of five University Teaching Awards awarded annually. Jill joins Professors **Bruce Ankenman**, **Barry Nelson**, and **Karen Smilowitz** in receiving this honor, a remarkable record of teaching excellence in the department.

Congratulations to Professor **Jorge Nocedal** for winning the 2017 John von Neumann Theory Prize, the foremost theory prize in operations research. Previous winners include legends such as George Nemhauser, a PhD alumnus and advisory board member; George Dantzig, the father of linear programming; Richard Bellman, the founder of dynamic programming; and six Nobel Prize winners including Ken Arrow, John Nash, and Harry Markowitz.

Our Masters of Engineering Management (MEM) program celebrated its 40th anniversary in June 2018. Over the years, MEM has been led by truly distinguished colleagues including **Al Rubenstein**,

Mark Spearman, **Wally Hopp**, **Don Frey**, **Barry Nelson**, **Bruce Ankenman**, and now **Mark Werwath**. Our Master of Science in Analytics (MSiA) program, directed by **Diego Klabjan**, continues to be a highly competitive, rigorous, and hands-on program at the intersection of information technology and data engineering, machine learning and data science, and business.

We have a strong incoming class of 15 PhD students, including seven women. Counting double majors and both BS and MS degrees, our new PhD students arrive with backgrounds in mathematics and applied mathematics (11), industrial engineering, operations research, and analytics (7), statistics (3), as well as applied physics, mechanical engineering, psychology, and control science and engineering.

After hiring **Matthew Plumlee** and **Zhaoran Wang** last year as assistant professors, we're excited to welcome two more outstanding hires: **Simgė Kūčūkyavuz**, who earned her PhD at the University of California Berkeley, joins us as an associate professor, and **Chang-Han Rhee**, who earned his

PhD from Stanford, joins us as an assistant professor.

Northwestern's Center for Optimization & Statistical Learning (OSL), along with Lehigh University, hosted the 11th US and Mexico Workshop on Optimization and its Applications in Huatulco, Mexico. The event included 30 participants from Northwestern, Argonne National Laboratory, Columbia University, Johns Hopkins University, NYU, Princeton, Stanford, and more.

I hope you enjoy this newsletter, as it gives you a sampling of the activities at IEMS. I look forward to connecting with many of you over the coming year.



David Morton
David A. and Karen Richards Sachs Professor and Chair

Nocedal Receives John von Neumann Theory Prize

By Amanda Morris



Jorge Nocedal

received the John von Neumann Theory Prize from the Institute for Operations Research and the Management Sciences (INFORMS). The award is widely regarded

Jorge Nocedal, Walter P. Murphy Professor of Industrial Engineering and Management Sciences at Northwestern Engineering, has

as the most prestigious theory prize in operations research.

Nocedal shares the 2017 prize with Donald Goldfarb, a professor at Columbia University. The pair was cited for "their fundamental contributions, theoretical and practical, that have, and continue to have, a significant impact on the field of optimization."

Named after John von Neumann — a mathematician, pioneer in quantum physics, and member of the Manhattan Project — the prize is awarded annually to a scholar who has made fundamental, sustained contributions to theory in operations research and the management

sciences. Nocedal officially received the prize at the annual INFORMS meeting in Houston, Texas in October 2017.

Nocedal's research lies at the interface of computer science, operations research, and applied mathematics. He has made fundamental contributions to the theory of nonlinear optimization methods and created new algorithms for a variety of applications. His nonlinear optimization software, KNITRO, is used in the energy, computer, and financial industries to optimize everything from the design of computer chips to the production and delivery of electricity.

MEM Program Celebrates 40th Anniversary

Attendees included students, alumni, faculty, and corporate guests

By Mark Werwath, MEM Director

The Master of Engineering Management (MEM) program celebrated its 40th anniversary on June 30 with an event that brought together corporate guests, students, alumni, faculty, and members of the IEEE Technology and Engineering Management Society.

Northwestern Engineering's John Rogers, the Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Neurological Surgery, showcased his groundbreaking research and highlighted the connection between technology development and business development. His talk illustrated the value proposition of MEM — the unique value that engineers



Guests attend MEM's 40th anniversary event at Northwestern's James L. Allen Center.

and technologists can bring to the marketplace of ideas, products, and platforms.

Professor **Barry Nelson**, a past director of MEM, concluded the event by presenting the history of the program. His presentation was a reminder of how rapidly the MEM curriculum has innovated in just the past year. Examples of such innovation include creating one of the first SCRUM certification workshops held on campus to bolster experiential learning, a new course

offering combining Internet of Things with business opportunities, and a new course offering in product management.

While MEM at Northwestern continues to evolve and provide new examples of how technology can enable innovation in business models and platform offerings, the tenets of MEM not only distinguish the program from traditional MBA programs, but also trace back to MEM's original roots.

MEM Students Launch Startup that Makes a Difference

NUMiX technology solidifies metals, purifies water

By Katie Kollhoff (MEM student) and Matt Heise (MEM '18)



The NUMiX team (from left): Jonathan Pfluger, Laurelle Banta, Katie Kollhoff, Matt Heise, Olivia Lugar

Global water quality has become a highly-publicized topic in recent years. Crises in Flint, Michigan, water scarcity in Cape Town, South Africa, and harmful algal blooms in the Great Lakes have fueled a public outcry for innovation in water treatment technologies that can keep water supplies safe while also protecting the environment.

We launched NUMiX with the goal of finding a way to help improve water quality. The startup leverages a Northwestern-patented water purification product that works by solidifying dissolved toxic and precious metals. By turning them solid, the metals are easily filtered and removed so they can be disposed of or recovered, leaving clean water behind.

In April, NUMiX received the US Department of Energy's \$50,000 Clean

Energy Prize at the Rice Business Plan Competition. The following month, we earned the top prize at Northwestern's VentureCat, an annual competition where 29 different student startups competed for a \$30,000 grand prize. The awards have enabled us to support one co-founder working full-time on the project. We are in the process of purchasing raw materials and production and testing equipment so we can evaluate material performance with potential early adopters of the technology. We hope to scale rapidly to support a pilot by the end of next year.

MEM has equipped the team with tools to creatively solve new and bigger problems. We've received amazing support from MEM's network of classmates, alumni, and faculty and look forward to what's next.

IEMS 2018 GRADUATION

The McCormick School of Engineering graduated 780 master's and 190 PhD students over three ceremonies in June in the Technological Institute. Undergraduates participated in the Northwestern ceremony at Ryan Field, where world-renowned soprano Renée Fleming provided the address for the 160th Annual Commencement. After the main commencement, IEMS also celebrated its undergraduates and PhDs in dedicated events.

PhD GRADUATES

In 2017-18, IEMS graduated 10 PhD candidates: **Sina Ansari, Mehmet Basdere, Vikram Kilambi, Francisco Jara-Moroni, Alexandros Nathan, Jacqueline Ng, Baiyang Wang, Joseph Warfel, Papis Wongchaisuwat, and Chenguang Wu.**

SENIOR CEREMONY

On June 22, IEMS held a department ceremony for 89 graduating seniors and their families and friends. The event highlighted special student awards and achievements and provided time for students to connect with faculty members and families and share their body of work through student-led presentations.



Dear friends,

The last academic year has brought a number of exciting changes to our undergraduate program. We improved the advising experience for our students, worked with a faculty committee to improve our student design course, and began actively cultivating connections and stronger relationships with our young alumni.

Marita Labeledz Poll joined IEMS in September 2017 as our academic adviser. Since then, Marita has brought her considerable expertise in student affairs and enthusiasm for understanding what motivates engineering students to bear on our advising processes. In her short time in IEMS, she has measurably increased student engagement outside the classroom and developed or improved many

advising resources to support students. Beginning this academic year, students will have access to alumni and peer mentors to provide answers to questions that move beyond the direct experience of our faculty. Through our work, I have been reminded of just what dedicated faculty we have who continue to devote substantial time and energy to ensuring high-quality advising experiences for our students.

Charged by our chair, the Designing Senior Design Committee evaluated the IEMS Senior Design course, focusing on course goals and its placement within the curriculum. This evaluation led to condensing our two-quarter "Senior Design" experience into a single junior-year course called "IE Client Project Challenge." Students will experience client-facing projects they can further develop during their summer internships

and leverage for full-time job recruitment during their senior year. The Committee also recommended expanding our probability and statistics sequence from two quarters to a full year, with the addition of a statistical learning requirement. I am grateful to **Bruce Ankenman**, **Barry Nelson**, and **Mark Werwath** for the time they devoted to this work, and to the faculty who devote time to advising senior design projects. We begin the new IE Client Project Challenge course this year, which calls for twice as many projects to accommodate juniors and seniors in the transition. We could use your help! If your company or nonprofit has a project that could benefit you and our students, please reach out at jill.wilson@northwestern.edu.

In September 2017, we hosted 20 graduates since 2012 at the Chicago Athletic Club, where we learned about their career successes and

shared opportunities for continued involvement in IEMS. In October 2018, we held the second annual Young Alumni Reception at Five & Dime in Evanston with more than 30 graduates in attendance.

I continue to be both grateful and humbled by the interest of our alumni and friends in our undergraduate program. Thank you for all the ways you support us.



Jill Wilson
Assistant Department Chair
for Undergraduate Studies

IEMS Reimagines Design Course

Students tackle industry projects in 'IE Client Project Challenge'

The process of working on projects for external clients is essential to the IEMS undergraduate curriculum.

Formerly called "Senior Design," IEMS' reimagined IE Client Project Challenge course tasks students to work in teams on a client-sponsored, open-ended project, leveraging both their creativity and industrial engineering skills learned throughout their studies.

Led by Professor **Mark Werwath**, the required course will be taken by junior industrial engineering majors beginning in the 2018-19 academic year.



Companies including FEW Spirits, AbbVie, and the Chicago Cubs have worked with students in the IE Client Project Challenge course, formerly called Senior Design.

To support cultivating organizational partnerships for the course, the department will host a series of Industrial Partner Kickoff Meet-and-Greet events with clients, students, and faculty. To learn more about

the course and to watch a video in which past students and clients discuss their experiences, visit mccormick.northwestern.edu/industrial/undergraduate-program/client-project-challenge/.

FACULTY NEWS

Karen Smilowitz led a team that won the INFORMS Innovative Applications of Analytics Award. She was also named associate editor of the journal *Operations Research* and was appointed the James N. and Margie M. Krebs Professor in Industrial Engineering and Management Sciences.

Omid Nohadani received the 2018 Best Paper Award from *IIE Transactions on Healthcare Systems Engineering* for his paper titled “Robust Optimization with Time-Dependent Uncertainty in Radiation Therapy.”

Jill Wilson received the Charles Deering McCormick Distinguished Professor of Instruction award, one of five University Teaching Awards for undergraduate education given annually at Northwestern. **Bruce Ankenman, Barry Nelson, and Karen Smilowitz** previously won the award.

Simge Küçükyavuz was named chair-elect of INFORMS Computing Society and associate editor of *Mathematical Programming*.

Noshir Contractor received the 2018 Distinguished Alumnus Award from the Indian Institute of Technology Madras. **Ajit Tamhane** previously received the same award from the Indian Institute of Technology Bombay.

Jorge Nocedal gave the MIT Distinguished Lecture in Computational Science and Engineering in February.

Barry Nelson delivered the 50th Anniversary Keynote at the Winter Simulation Conference in December 2017. He also gave the 2018 Alan B. Pritsker Scholars Distinguished Lecture at Purdue University and was a plenary speaker at the 13th International Conference in Monte Carlo & Quasi-Monte Carlo Methods in Scientific Computing.

Ed Malthouse gave a series of lectures on “Big Data Analytics” to students from across Europe on behalf of the Centre for Consumer Marketing at the Stockholm School of Economics. He also received the Thomas P. Hustad Best Paper Award from the *Journal of Product Innovation Management* for his paper titled, “Identifying New Product Ideas: Waiting for the Wisdom of the Crowd or Screening Ideas in Real Time.”

A research team including **David Morton** earned the 2018 ENRE Best Publication in Energy Award for the paper “Forward thresholds for operation of pumped-storage stations in the real-time energy market.” He also received the 2017 INFORMS Fellow Award.

SPONSORED AWARDS

Bruce Ankenman received a grant from Naval Supply Systems Command Fleet Logistics Center titled “Gradient Based Criteria for Sequential Experiment Design.”

Noshir Contractor received an award from Raytheon BBN Technologies and DARPA for his project “ACCESS – Agent-based Causal Simulator with Cognitive, Environmental, and Social System Factors.”

Seyed Iravani received funding from the National Science Foundation for his project “Decision-Flow Queueing Networks for Analysis of Knowledge-Based Service Operations Systems.”

Diego Klabjan received three new awards this year from industry sponsors. He earned support from AbbVie Inc. for “Risk Calculator,” Allstate Corporation for “Auto Claims Analysis from Video Frames,” and Semiconductor Research Corporation for “Unsupervised Data Extraction from Graphs and Data Plots.”

Incoming faculty **Simge Küçükyavuz** was awarded funding from the National Science Foundation to support student travel to attend the 2018 Mixed Integer Programming Workshop.

Sanjay Mehrotra received funding for a National Science Foundation Innovation Corps project titled “I-Corps: Clinical Workforce Schedule Optimization Technology.” He also received funding from the Office of Naval Research for “Properties and Methods for Distributionally Robust Optimization with Decision Dependent Uncertainty.”

Jorge Nocedal received awards from Intel for “Stochastic Second Order Methods for Machine Learning” and the Office of Naval Research for “Methods for High-Dimensional Nonlinear Optimization.” Along with co-principal investigator **Ermin Wei**, he also received a grant from the DARPA Lagrange program for “Novel Methods for Stochastic Data-Driven Nonconvex Optimization.”

Ohad Perry received funding from the National Science Foundation for “GOALI: Modeling and optimizing patient-flow dynamics in hospitals and hospital networks.”

Karen Smilowitz received two related awards from NSF: “Exploiting Network Structure in Routing Problems: Applications to School Bus Routing,” and “Participant Support Costs for Exploiting Network Structure in Routing Problems,” used to fund the undergraduate students and Evanston school district teachers collaborating on the project.

STUDENT NEWS

The Northwestern Student Chapter of INFORMS received the INFORMS 2018 Student Chapter Annual Award at the cum laude level.

Sina Ansari was featured in an INFORMS “What’s Your StORy?” interview in March, where he discussed his research interests in patient experiences in hospital emergency departments.

Dipayan Banerjee was awarded a Northwestern Summer Undergraduate Research Grant. He also received a scholarship from the INFORMS Scholarship Committee to attend the annual INFORMS Conference, where he will present “Reducing Bus Transportation Cost Through School Start Time Optimization,” research based on joint work with PhD student **Liwei Zeng** and faculty **Karen Smilowitz** and **Jill Wilson**.

Moses Chan and **Zhe Su** each received the Arthur P. Hurter Award, given annually to the most outstanding first-year PhD student.

Connor Hanley, Hyo Joo Lee, Ipek Kirali, and Alana Wertheimer received the department’s Thompson Senior Design Awards for “Lurie Children’s Hospital Clean Room Demand Forecast and Staffing Model.” **Peter Beer, Caleb Han, Batuhan Kesoglu, Erkan Kilic, and Sinan Tuna** also received awards for “Enhancing Experience at Phenix.”

Aditya Jain, Devon Buckingham, Batuhan Kesoglu, Mingren Wang, and Brian Saunders received 2018 Academic Excellence Awards. Jain also received the Hurter Award as the most outstanding graduating senior.

Jessica Li and **Nikita Jain** each received the IEMS Student Leadership Award.

Linda Pei received the Outstanding Teaching Assistant Award.

Likuan Qin received the Nemhauser Award for Best Dissertation for “The Recovery Theorem and Long-Term Factorization of the Pricing Kernel.”

Aaron Schecter earned the J. Richard Hackman Award for his PhD dissertation at INGRoup 2018.

Kartikey Sharma received the Nemhauser Award for Best Paper for “Optimization Under Decision-Dependent Uncertainty.”

Jonathan Shenkman received the IEMS Department Award for his dedicated work to the undergraduate program.

ALUMNI NEWS

James Utterback (BS '63, MS '65) received the 2018 IEMS Distinguished Alumni Award. He is the David J. McGrath, Jr. (1959) Professor of Management and Innovation, Emeritus and professor of technological innovation, entrepreneurship, and strategic management at MIT's Sloan School of Management.

DEPARTMENT NEWS

The department is excited to welcome four new postdoctoral fellows for 2018-19: **Oscar Dowson**, who received his PhD in engineering science from Auckland University; **Merve Merakli**, who received her PhD in industrial and systems engineering from the University of Washington; **Reut Noham**, who received her PhD in industrial engineering from Tel-Aviv University, and **Hamed Rahimian**, who received his PhD in integrated systems engineering from The Ohio State University.

Cindy Nguyen joined the Master of Science in Analytics program as a program assistant.

Lauren Jones joined the Master of Engineering Management program as a program assistant.

Simge Küçükyavuz joined the department as an associate professor after holding the same position at the University of Washington. Her research expertise is in discrete and stochastic optimization. The recipient of an NSF CAREER Award, she has deep technical expertise in polyhedral theory for integer programming, and a strong eye toward computation.

Chang-Han Rhee joined the department as an assistant professor after postdoctoral positions at Georgia Tech and Centrum Wiskunde & Informatica in Amsterdam. His research interests are in applied probability and simulation, including construction of more uniform experimental designs for computer experiments as well as analysis and simulation of heavy-tailed rare-events.

Colleen Sweeney Walker joined the department as a financial coordinator.

Zhaoran Wang joined the department as an assistant professor after being hired in 2017 and working as a postdoctoral researcher with Tencent's Artificial Intelligence Lab. His research expertise is at the interface of machine learning, statistics, and optimization.

IEMS WELCOMES McCARTER FELLOWS



Frank Curtis and Bernardo Pagnoncelli

The Patrick and Amy McCarter Fellow in Residence program supports a visiting professor of instruction to spend part or all of an academic year with IEMS, teaching undergraduate courses and interacting with researchers.

Frank Curtis served as the inaugural McCarter Fellow in 2017-18. A professor of industrial and systems engineering at Lehigh University, Curtis earned his BS in mathematics and computer science from the College of William and Mary and an MS and PhD in industrial engineering from Northwestern Engineering, where he was advised by Professor **Jorge Nocedal**.

Curtis co-taught the IEMS 351: Optimization Methods in Data Science course with Professor **Andreas Wächter**. In the course, students learned theoretical foundations and fundamental algorithms

of nonlinear optimization, applied to problems in supervised machine learning.

Bernardo Pagnoncelli is serving as the department's McCarter Fellow for 2018-19. He arrives on sabbatical from the School of Business at Adolfo Ibáñez University in Santiago, Chile, where he heads the school's operations group. Pagnoncelli earned his BS in pure mathematics and an MS and PhD in applied mathematics, all from Pontifical Catholic University of Rio de Janeiro.

Pagnoncelli will teach IEMS 313: Foundations of Optimization, a required course in the undergraduate curriculum. An advocate of experiential learning, he will also advise multiple student projects in the IEMS 394: Client Project Challenge course.

Wasserstrom Lecture Explores Air Transportation

Cynthia Barnhart, chancellor and Ford Foundation Professor of Engineering at MIT, presented "Air Transportation Optimization" as IEMS's 2018 Wasserstrom Family Distinguished Lecture. Supported by the Wasserstrom Family Endowment, Barnhart's talk reviewed the history of operations research models in air transportation, describing how models have grown more sophisticated over time and the effects these advanced techniques have had on passengers, airlines, and the aviation system.

MSiA Students Collaborate with Chicago Botanic Garden and IBM

Students in the Master of Science in Analytics (MSiA) program use their data science skills to produce real solutions. This year, MSiA students **Jamie Chen**, **Michael Gao**, **Ethel Zhang**, and **Wei Li** participated in a pro bono project on behalf of the Chicago Botanic Garden.

With nearly 50,000 members and more than 1 million yearly visitors, the Garden sought to leverage a systematic analytical approach to derive recommendations to engage its members and strengthen members' connections with the Garden.

Working with IBM, including data scientist and MSiA alumnus **Ahsan Rehman** (MS '15), the student team conducted an exploratory data analysis to help the Garden better understand its portfolio of members. They used data science techniques, including clustering analysis, to discover natural groupings of members based on their past giving patterns. These insights could inspire future community outreach initiatives.



From left: Chicago Botanic Garden's Gwen Vanderburg, student Jamie Chen, student Michael Gao, student Ethel Zhang, IBM's Ahsan Rehman, IBM's Andrew Warzecha, IBM's Jane Chu, and Chicago Botanic Garden's Carolyann Kotlarski.