Operations Research Center

The Operations Research Center (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 65th year of operation in academic year 2019. ORC administers its own graduate program and a varied research program of methodological and applied projects. This report summarizes the center's AY2019 activities and briefly reviews its educational, research, and outreach programs.

Faculty, Students, Staff

Professor Dimitris Bertsimas and Professor Patrick Jaillet continued to serve as co-directors of ORC.

During AY2019, ORC had 60 affiliated faculty and two staff members, with faculty drawn from the MIT Sloan School of Management and the Departments of Electrical Engineering and Computer Science, Civil and Environmental Engineering, Economics, Mathematics, Computer Science, Aeronautics and Astronautics, Mechanical Engineering, Nuclear Science and Engineering, and Urban Studies and Planning.

ORC offers two interdepartmental graduate degree programs: a doctorate and a master's degree. During the past year, these programs enrolled 80 students; there were 68 PhD candidates and 12 SM candidates. The ORC conferred five master's degrees and 17 PhDs. Several other PhD theses were in the final stages of completion in summer 2019.

ORC had an outstanding year in terms of yield in admissions. Out of 216 applications for the doctoral program, ORC offered admission to 24 candidates, 14 of whom accepted. There were 152 applications to the SM program; ORC made 10 offers, nine of which were accepted. All admitted students will matriculate for the fall 2019 term.

ORC continues to place its graduates well in both academic and industry jobs. This year, graduates found positions as assistant professors at Columbia University, the University of North Carolina at Chapel Hill, and the University of Michigan. Other graduates found positions at Lyft, Microsoft, and Google.

Academic Programs

ORC's academic programs continue to be ranked among the very best, both nationally and internationally. The programs are repeatedly cited as achieving an excellent balance between application and methodological domains.

Research Activities

Research activities spanned a wide spectrum of methodological topics and applications. These ranged from small, unsponsored projects involving one faculty member supervising a student's thesis to sponsored programs involving several faculty, staff, and students.

On the methodological side, there has been an increasing emphasis on the interface between machine learning and optimization, data-driven optimization, and algorithms for convex, discrete, stochastic, and robust optimization. On the application side,

the emphasis has been on the interface between personalized medicine, operations management, and pricing. Moreover, ORC faculty members continue to contribute to application domains as wide-ranging as manufacturing, communications, transportation, public services, logistics, marketing, financial services, and health care.

Several organizations sponsored research projects at ORC during AY2019, including the National Science Foundation, Draper Laboratory (through Draper fellowships), the Food and Drug Administration, Lincoln Laboratory, the Office of Naval Research, Sapient, Mitsubishi, Anheuser-Busch InBev, the Canadian Imperial Bank of Commerce, Swiss Reinsurance Company Ltd, ISN Software Corporation, Beth Israel Deaconess Medical Center, Hartford Hospital, and Quest Diagnostics.

Outreach and Professional Service

Seminar Series

The ORC weekly seminar series was privileged to have many distinguished speakers from industry and academia this year. The operations research professionals who made presentations included Susan Hunter (Purdue University); Lucas Janson (Harvard University); David Goldberg (Cornell University); Bart Van Parys (MIT); Jon Lee (University of Michigan); Rama Ramakrishnan (Salesforce, Inc.); Ozalp Ozer (University of Texas); Mohsen Bayati (Stanford University); Regina Barzilay (MIT); Andreas Wächter (Northwestern University); Shane Henderson (Cornell University); Negin Golrezaei (MIT); Dick den Hertog (Tillburg University); Dessi Pachamanova (Babson College); Ashia Wilson (Microsoft Research); Gad Allon (Wharton School); Ben Hansen (University of Michigan); Mohammad Fazel Zirandi (MIT); and Christian Tomasetti (Johns Hopkins University).

ORC also offered, during January's independent activities period, a full-day session called Machine Learning and Operations Research. Several talks focused on the speakers' work, research, and careers; others discussed the future of operations research. The speakers included Negin Golrezaei (MIT); Nathan Kallus (Cornell University); Bala Chandran (Lumo); Virginia Goodwin (Lincoln Laboratory); Kermit Threatte (Wayfair); Caroline Uhler (MIT), and Bartolomeo Stellato (MIT).

Student-Run Programs and Activities

ORC supports activities organized by the Institute for Operations Research and the Management Sciences (INFORMS) student chapter. The student chapter held social events that fostered a feeling of camaraderie among students and helped to improve life at the center. Often these INFORMS events are used as opportunities to meet students from other MIT programs. The ORC is proud of the friendly and inclusive environment it fosters for its students. INFORMS student activities and events this year included:

- beginning of the semester lunch
- coffee and snack break events throughout the year
- social lunches throughout the year
- Canadian Thanksgiving Breakfast

- Chinese New Year Celebration Lunch
- Pi-Day event, celebrating with(pies and coffee served in the ORC lounge
- Earth Day celebration
- Cinco de Mayo event, celebrating with Mexican foods and refreshments
- Fourth of July pizza party

ORC is also very proud of the work done by its student volunteers for the Resources for Easing Friction and Stress (REFS) program volunteers. This program is run by student volunteers who complete training in conflict resolution and are familiar with other resources offered at MIT. They make themselves available as moderators for conflicts and as confidants for students who may be experiencing difficulties. They have also begun meeting with each new student just to check in and make sure that every ORC student knows REFS is there to help with any pressure or issues they may be having. Additionally, REFS volunteers have organized small lunches where students can meet with ORC faculty members. REFS is an invaluable resource to ORC students. The volunteers also organized events centered on reducing stress and tension. These include social events to increase awareness of the REFS program and to discuss student issues and concerns.

Fellowships

ORC has continued to receive fellowship support from the Sloan School of Management for doctoral students. The Henry Gabbay Endowed Fellowship continues. The center recently was also the recipient of the Vassilakis Fellowship from four prominent Greek families.

Future Plans

ORC program has been expanding. ORC has increased its total number of enrolled students and provided shared desk space for the third class of the new master's of business analytics (MBAn) degree program (44 students). It is ORC's hope that the interaction and collaboration between these new students and the current ORC students will be beneficial to all. These MBAn students work closely with companies; this should result in improved visibility for ORC and encourage research collaboration. ORC faculty supervise almost all capstone research projects for MBAn students.

ORC also plans to encourage the student INFORMS chapter and the REFS volunteers to continue planning social events and opportunities for students to help each other in their pursuits.

ORC is taking on a larger role in analytics and statistics within the Institute. In this context, ORC has offered the subjects 15.071 The Analytics Edge and 15.095 Machine Learning Under a Modern Optimization Lens. The center plans to offer a class on machine learning in health care. ORC also aspires to collaborate closely with the Schwarzman College of Computing on analytics education at the undergraduate and doctoral levels.

Diversity

ORC has always attempted to provide an environment that is responsive to the varied professional and personal needs of the operations research community at MIT, and that

builds diversity. During AY2019, the center's staff comprised one support staff member and one academic administrator, of which one is a woman. Of the graduate students, twenty-nine were women.

Awards, Honors, and Professional Activities

Faculty

Dimitri Bertsekas and John Tsitsiklis received the 2018 John von Neumann Theory Prize at the 2018 INFORMS Annual Meeting for contributions to parallel and distributed computation as well as neurodynamic programming.

Dimitris Bertsimas, Arthur Delarue, and Sebastien Martin along with Boston Public Schools were named finalists and Edelman Award Laureates at the 2019 INFORMS Annual Meeting.

Costis Daskalakis received the 2018 Rolf Nevanlinna Prize from the International Mathematical Union. The prize is awarded every four years, along with the Fields Medal, to a scientist under 40 who has made major contributions to the mathematical aspects of computer science.

Costis Daskalakis received the 2019 Association for Computing Machinery Grace Murray Hopper Award for his seminal contributions to the complexity of Nash Equilibria. The prize is awarded yearly to a computer scientist under the age of 35, on the basis of a single recent major technical or service contribution.

Costis Daskalakis received the Simons Investigator Award.

Richard de Neufville received the 2019 Robert Horonjeff Award from the Transportation and Development Institute of the American Society of Civil Engineers.

Joann de Zegher and co-author Hamsa Bastani (Wharton School of the University of Pennsylvania) received the People's Choice Award at the 2019 Early-Career Sustainable OM Workshop for their paper, "Do Policies with Limited Enforcement Reduce Harm? Evidence from Transshipment Bans."

Joann de Zegher and co-authors Dan Iancu PhD '10 and Erica Plambeck received an honorable mention for the 2018 George Nicholson Student Competition for their paper, "Sustaining Rainforests and Smallholders by Eliminating Payment Delay in a Commodity Supply Chain: It Takes a Village."

Patrick Jaillet won the ICAPS 2019 Best Applications Paper Award for the paper, co-authored with M. Lowalekar and P. Varakantham, "ZAC: A Zone pAth Construction Approach for Effective Real Time Ride Sharing."

Rob Freund was elected as an INFORMS Fellow, Class of 2018. This award honoring lifetime achievement recognizes "distinguished individuals who have demonstrated outstanding and exceptional accomplishments and experience in operations research

and the management sciences" and who have also provided outstanding service to the profession and to INFORMS. Rob was recognized in particular "for sustained contributions to OR (operations research) education and mathematical optimization."

Negin Golrezaei was a finalist in the 2018 INFORMS Data Mining Best Theoretical Paper competition for her paper, "Boosted Second Price Auctions."

Negin Golrezaei received a 2018 Google Faculty Research Award in Algorithms and Optimization.

Andrew Lo won the 2018 Pinnacle Achievement Award from CME Group and BarclayHedge. This is the highest recognition of outstanding achievement among the Managed Futures Pinnacle Awards honoring top managed futures industry leaders.

Andrew Lo, along with Kara Blackburn, won the 2019 Jamieson Prize for Excellence in Teaching from the Sloan School of Management.

Thomas Magnanti was named the president emeritus of the Singapore University of Technology and Design. He will receive the Public Administration Medal (Gold). The award citation says that his visionary leadership drove SUTD to organize itself in a novel way—the university is organized by clusters, which supports the interdisciplinary nature of SUTD's programs and strengthens the university's research capabilities.

Nikos Trichakis won the 2018 INFORMS Optimization Society Young Researchers Prize for his paper, co-authored with Dan Iancu PhD '10, "Pareto Efficiency in Robust Optimization."

Nikos Trichakis won the INFORMS 2018 Best Paper Award from the Manufacturing Service Operations Management, Interface of Finance, Operations, and Risk Management Special Interest Group. His winning paper, co-authored with Dan Iancu PhD '10, and Gerry Tsoukalas (Wharton School), is titled, "Is Operating Flexibility Harmful Under Debt?"

Nikos Trichakis won third place for the 2018 INFORMS Technology, Innovation Management, and Entrepreneurship Section Best Working Paper Award, for his paper "Blockchain and the Value of Operational Transparency for Supply Chain Finance," co-authored with Jiri Chod (Boston College), Gerry Tsoukalas (Wharton School), Henry Aspegren '17, MNG '18 (Tsinghua University), and Mark Weber (MIT-IBM Watson Artificial Intelligence Laboratory).

Nikos Trichakis won Second Prize for the 2018 Best Paper Award from the Production and Operations Management Society (POMS) Humanitarian and Crisis Management section, for the paper "Designing Response Supply Chain Against Bioattacks." The paper's co-authors were David Simchi-Levi and Peter Yun Zhang.

John Tsitsiklis received an honorary doctorate from Harokopio University in Greece.

John Tsitsiklis received the 2018 IEEE Control Systems Award for "contributions to the theory and application of optimization in large dynamic and distributed systems."

Students

Lennart Baardman and Elaheh Fata were finalists in the 2018 INFORMS George Nicholson Student Paper Competition. Their paper, co-authored with Abhishek Pani (Adobe) and Georgia Perakis, was "Learning Optimal Advertising Portfolios with Periodic Budgets."

Lennart Baardman and Divya Singhvi were finalists in the 2018 INFORMS Service Science Section Best Student Paper Award Competition. Their paper, co-authored with Igor Levin (Johnson & Johnson) and Georgia Perakis, was "Leveraging Comparables for New Product Sales Forecasting."

Lennart Baardman and Tamar Cohen-Hillel won first prize in the POMS Supply Chain Best Student Paper Competition for their paper, "Detecting Customer Trends for Optimal Promotion Targeting." The paper was co-authored with Setareh Borjian Boroujeni, Kiran Panchamgam, and Georgia Perakis.

A paper written by Lennart Baardman, Tamar Cohen-Hillel, Setareh Borjian Boroujeni, Kiran Panchamgam, and Georgia Perakis was a finalist at the POMS-JD.com 2019 Best Data-driven Research Paper Competition.

Max Biggs and Rim Hariss received the 2018 Data Mining Best Theoretical Paper award for their paper, "Optimizing Objective Functions Determined from Random Forests."

Tamar Cohen-Hillel, Kiran Panchamgam (Oracle), and Georgia Perakis received the 2018 INFORMS Best Paper of the Service Science Section Cluster Award for their paper, "High-Low Promotion Policies for Peak-End Demand Models."

Tamar Cohen-Hillel was a finalist in the Collaborative for Business and Operations Management competition for best junior researcher in behavioral operations management. Her paper, "High-Low Promotion Policies for Peak-End Demand Models," was co-authored by Hillel, Kiran Panchamgam and Georgia Perakis.

Kayla Cummings received the 2018 Undergraduate Operations Research Prize. The Undergraduate Operations Research Prize Competition is held each year to honor a student or group of students who conducted a significant applied project in operations research or management science, or original and important theoretical or applied research in operations research or management science, while enrolled as an undergraduate student.

Arthur Delarue and Sebastien Martin won second place in the 2018 INFORMS Doing Good with Good OR Student Paper Competition.

Nicolas Guenon des Mesnards received the 2018 INFORMS Social Media Analytics Section Best Student Paper Award for the paper, "Detecting Influence Campaigns in Social Networks Using the Ising Model."

Anna Papush received honorable mention for her PhD thesis, "Data Driven Methods for Personalized Product Recommendation Systems," from the Revenue Management and Pricing Section at the 2018 INFORMS conference.

Divya Singhvi received honorable mention in the POMS Supply Chain Best student paper competition for the paper, "Sequential Learning of Product Recommendations with Customer Disengagement" co-authored with Hamsa Bastani, Pavithra Harsha PhD '09, and Georgia Perakis.

Jessica Zhu was named one of "Tomorrow's Technology Leaders: The 20 Twenties" by *Aviation Week* in January 2019.

Alumni

Amine Anoun SM '17, was included in the Forbes 30 under 30 list along with Harvard University graduates Jerry Ting and Jake Sussman. The three co-founded a company, Evisort, to use artificial intelligence to automate contract reviews for attorneys. The company was named to the law and policy category.

Andrew Armacost PhD '00 was elected as an INFORMS Fellow, Class of 2018. Andrew was recognized in particular "for sustained contributions to the application of operations research to military and transportation planning and for significant leadership in operations research education."

Maxime Cohen PhD '15, along with C. Daniel Guetta and Wenqiang Xiao, took first place in the 2018 INFORMS Case Competition. The purpose of this annual competition is to encourage the creation, dissemination, and classroom use of new, unpublished cases in operations research and the management sciences.

Maxime Cohen, along with Michael D. Fiszer and Baek Jung Kim, won the 2018 INFORMS Best Cluster Paper Award for the paper, "Frustration-Based Promotions: A Field Experiment in Ride-Sharing."

Chong Yang Goh PhD '18, Chiwei Yan PhD '17, and Patrick Jaillet were finalists for the POMS-JD.com 2019 Best Data-driven Research Paper Competition for their paper, "Estimating Primary Demand in Bike-Sharing Systems."

Chiwei Yan PhD '17, received the 2018 INFORMS Aviation Applications Dissertation Prize for "Airline Scheduling and Air Traffic Control: Incorporating Uncertainty and Passenger and Airline Preferences." The Aviation Applications Section of INFORMS awards a prize for the best dissertation in any area related to aviation operations research (air traffic management operations research and airline operations research).

Chiwei Yan PhD '17, received an Honorable Mention for the 2018 INFORMS Transportation Science and Logistics Society Best Dissertation Award.

Dimitris Bertsimas
Co-director
Boeing Professor of Operations Research

Patrick Jaillet
Co-director
Dugald C. Jackson Professor of Electrical Engineering and Computer Science