

Dean, School of Engineering

The mission of the MIT School of Engineering is to educate the next generation of engineering leaders, to create new knowledge, and to serve society. The School is dedicated to creating an environment that enables its faculty, students, and staff to advance knowledge, educate students, and address today's most pressing challenges. With the Institute's values in mind, the School spearheads projects that enhance life and learning— attracting the most talented engineers, welcoming people from all backgrounds on campus, leading the next revolution in engineering education, and offering varied avenues that inspire students.

The largest of MIT's five schools, the School of Engineering comprises approximately 74% of MIT's undergraduates and 48% of graduate students. A little more than a third of MIT's faculty are in the School, and they generate more than half of the sponsored research at the Institute.

The total volume of research expenditures in fiscal year 2018 was \$397,989,522.

In 2017–2018, there were a number of leadership transitions and new appointments in the School.

- Anette “Peko” Hosoi of Mechanical Engineering was named associate dean of the School of Engineering in August 2017.
- Krystyn Van Vliet of Materials Science and Engineering was named associate provost in August 2017.
- Antonio Torralba of Electrical Engineering and Computer Science (EECS) was named director of the MIT–IBM Watson Artificial Intelligence Laboratory in September 2017; he was named director of the MIT Quest for Intelligence in June 2018.
- Asu Ozdaglar was named department head of EECS in December 2017. In January 2018, Saman Amarasinghe and Joel Voldman were named associate department heads. Nancy Lynch was named associate department head for strategic directions—a new post.
- Michael Cima of Materials Science and Engineering was named the co-director of the MIT Innovation Initiative and associate dean of innovation for the School of Engineering in March 2018.
- Vladimir Bulović of EECS was named the first director of MIT.nano in March 2018.
- Elazer Edelman was named director of the Institute for Medical Engineering and Science in April 2018.
- In June 2018, Daniel Hastings was named department head in Aeronautics and Astronautics, effective January 1, 2019. Edward M. Greitzer will serve as interim department head from July 1 to December 31, 2018.
- Evelyn Wang was named department head of Mechanical Engineering in June 2018.

The School of Engineering continues to work to maintain the excellence of its faculty. This year, the School announced that seven members of its faculty were granted tenure:

- Adam Chlipala, in EECS, works to reduce the costs of developing complex computer systems and to make them more reliable via formal program-proof methods.
- Dirk Englund, in EECS, is pursuing experimental and theoretical research toward quantum technologies using photons and semiconductor spins, combining techniques from atomic physics, optoelectronics, and modern nanofabrication.
- Kenneth Kamrin, PhD '08, in the Department of Mechanical Engineering, focuses on continuum fluid and solid mechanics, with an emphasis on highly deforming bulk materials—in particular, granular media.
- Yury Polyanskiy, in EECS, researches basic questions in information theory, error-correcting codes, wireless communication, and fault-tolerant and defect-tolerant circuits.
- David Sontag, PhD '10, the Hermann L. F. von Helmholtz Career Development Professor in EECS, is working to create AI technologies and machine-learning algorithms that can take the data in electronic medical records, reason about a patient's health, and ultimately help change health care to be proactive instead of reactive.
- Vinod Vaikuntanathan, PhD '09, in EECS, studies encryption systems that protect the privacy of data, digital signatures that protect its integrity, and cryptographic protocols that allow mutually distrustful entities to collaborate and perform meaningful tasks while maintaining individual privacy.
- Qiqi Wang, in the Department of Aeronautics and Astronautics, investigates engineering design involving chaotic dynamical systems, unsteady aerodynamics and turbulence, numerical methods for exascale computation, and design optimization under uncertainty.

Awards and Honors

Every year, members of the MIT engineering community receive numerous honors in recognition of their research, scholarship, service, and overall excellence. The reports of the School's departments, divisions, laboratories, centers, and programs make note of many of these awards. The following is a small sample of the honors and awards garnered by the School of Engineering in AY2018.

- Lallit Anand of Mechanical Engineering, Angela Belcher of Materials Science and Engineering and Biological Engineering, Stephen Graves of Mechanical Engineering and the Sloan School of Management, and Yang Shao-Horn of Mechanical Engineering and Materials Science and Engineering were elected to the National Academy of Engineering.
- Mohammad Alizadeh of EECS won the Association for Computing Machinery's SIGCOMM Rising Star Award.

- Emilio Baglietto of Nuclear Science and Engineering, Regina Barzilay and John N. Tsitsiklis of EECS, and Rohit Karnik of Mechanical Engineering were awarded the Ruth and Joel Spira Awards for Excellence in Teaching.
- Regina Barzilay of EECS was awarded a MacArthur Fellowship.
- Martin Z. Bazant of Chemical Engineering was named a fellow of the Royal Society of Chemistry.
- Moshe Ben-Akiva of Civil and Environmental Engineering won the 2017 Robert Herman Lifetime Achievement Award in Transportation Science.
- Lydia Bourouiba of Civil and Environmental Engineering won the Smith Family Foundation Odyssey Award.
- Tamara Broderick of EECS won the Army Research Office Young Investigator Program Award and was honored with a National Science Foundation CAREER Award.
- Arup K. Chakraborty of the Institute for Medical Engineering and Science and the Department of Chemical Engineering was elected to the National Academy of Medicine.
- Gang Chen of Mechanical Engineering was elected to the American Academy of Arts and Sciences.
- Edward Crawley of Aeronautics and Astronautics won the People's Republic of China Friendship Award and was inducted as a foreign member into the Russian Academy of Science.
- Thibaut Divoux of Civil and Environmental Engineering won the 2018 Early Career Arthur B. Metzner Award of the Rheology Society.
- Elazer R. Edelman of the Institute for Medical Engineering and Science was honored with the Giulio Natta Medal in Chemical Engineering from the Department of Chemistry, and he won the 2018 Distinguished Scientist Award from the American College of Cardiology.
- Srinivas Devadas of EECS was presented the Bose Award for Excellence in Teaching.
- Shafi Goldwasser, Silvio Micali, and Ron Rivest of EECS were honored with BBVA Foundation Frontiers of Knowledge Awards in the information and communication technologies category.
- Paula T. Hammond of Chemical Engineering and the Koch Institute for Integrative Cancer Research won the 2018 American Chemical Society Award in applied polymer science.
- Daniel Jackson of EECS won the MIT Martin Luther King Jr. Leadership Award.
- Stefanie Jegelka of EECS and the Institute for Data, Systems, and Society won a Defense Advanced Research Projects Agency Young Faculty Award.
- Dina Katabi of EECS won the Association for Computing Machinery's 2017 prize in computing.

- Heather Kulik of Chemical Engineering won the American Chemical Society OpenEye Outstanding Junior Faculty Award.
- Robert Langer of Chemical Engineering won the Kabiller Prize in Nanoscience and Nanomedicine.
- Barbara Liskov of EECS won the Institute of Electrical and Electronics Engineers (IEEE) Computer Society 2018 Computer Pioneer Award.
- Muriel Médard of EECS won both the 2017 Aaron D. Wyner Distinguished Service Award at the IEEE International Symposium on Information Theory and the IEEE Communications Society Edwin Howard Armstrong Achievement Award.
- Dava J. Newman of Aeronautics and Astronautics won the American Institute of Aeronautics and Astronautics Jeffries Aerospace Medicine and Life Sciences Research Award.
- Ronald Rivest of EECS was inducted into the National Inventors Hall of Fame.
- Ronitt Rubinfeld of EECS won the Capers and Marion McDonald Award for Excellence in Mentoring and Advising.
- Julie Shah of Aeronautics and Astronautics won the 2018 Robotics and Automation Society Early Career Award.
- Yang Shao-Horn of Mechanical Engineering won the Faraday Medal.
- Michael P. Short of Nuclear Science and Engineering won the Junior Bose Award.
- Alex Slocum of Mechanical Engineering won the Ruth and Joel Spira Outstanding Design Educator Award.
- Vivienne Sze of EECS and the Research Laboratory of Electronics won an Engineering Emmy Award.
- Christopher Terman of EECS won an MIT Gordon Y. Billard Award.
- Vinod Vaikuntanathan of EECS won the Harold E. Edgerton Faculty Achievement Award.
- David Wallace of Mechanical Engineering was honored with the Ben C. Sparks Medal.
- Evelyn Wang of Mechanical Engineering won Foreign Policy's Global Thinkers 2017 Award and was awarded a Professor Amar G. Bose Research Grant.
- Bilge Yildiz of Nuclear Science and Engineering and the Department of Materials Science and Engineering won the Ross Coffin Purdy Award.
- Laurence R. Young of Aeronautics and Astronautics and the Institute for Medical Engineering and Science was awarded the 2018 de Florez Award for Flight Simulation from the American Institute of Aeronautics and Astronautics.
- Xuanhe Zhao of Mechanical Engineering and Civil and Environmental Engineering won the Young Investigator Medal from the Society of Engineering Science.

Interdisciplinary Research

MIT-IBM Watson Artificial Intelligence Laboratory

In September 2017, IBM and MIT announced that IBM will make a 10-year, \$240 million investment to create the MIT-IBM Watson Artificial Intelligence Laboratory in partnership with MIT. The lab will carry out fundamental research in artificial intelligence and seek to propel scientific breakthroughs that unlock the potential of artificial intelligence (AI). The collaboration will advance AI hardware, software, and algorithms related to deep learning and other areas, increase AI's impact on industries such as health care and cybersecurity, and explore the economic and ethical implications of AI for society.

The new lab is one of the largest long-term university-industry AI collaborations to date, mobilizing the talent of more than 100 AI scientists, professors, and students to pursue joint research at IBM's Research Laboratory in Cambridge, MA (co-located with the IBM Watson Health and IBM Security headquarters in Kendall Square) and on the MIT campus. The lab is co-chaired by Dario Gil, IBM research vice president of artificial intelligence and IBM quantum intelligence, and Dean Chandrakasan; its inaugural director is Professor Antonio Torralba.

IBM and MIT issued a call for proposals to MIT researchers and IBM scientists to submit their ideas for joint research to push the boundaries in AI science and technology in several areas, including:

- **AI algorithms:** Developing advanced algorithms to expand capabilities in machine learning and reasoning. Researchers will create AI systems that move beyond specialized tasks to tackle more complex problems and benefit from robust, continuous learning. Researchers will invent new algorithms that can not only leverage big data when available, but also learn from limited data to augment human intelligence.
- **Physics of AI:** Investigating new AI hardware materials, devices, and architectures that will support future analog computational approaches to AI model training and deployment, as well as the intersection of quantum computing and machine learning. The latter involves using AI to help characterize and improve quantum devices and researching the use of quantum computing to optimize and speed up machine-learning algorithms and other AI applications.
- **Application of AI to industry:** Given its location in IBM Watson Health and IBM Security headquarters in Kendall Square, a global hub of biomedical innovation, the lab will develop new applications of AI for professional use, including fields such as health care and cybersecurity. The collaboration will explore the use of AI in areas such as the security and privacy of medical data, personalization of health care, image analysis, and the optimum treatment paths for specific patients.
- **Advancing shared prosperity through AI:** The new lab will explore how AI can deliver economic and societal benefits to a broader range of people, nations, and enterprises. The laboratory will study the economic implications of AI and investigate how AI can improve prosperity and help individuals achieve more in their lives.

The initial call for proposals resulted in many proposals from departments, labs, and centers from all across campus.

In addition to IBM's plan to produce innovations that advance the frontiers of AI, a distinct objective of the new lab is to encourage MIT faculty and students to launch companies that will focus on commercializing AI inventions and technologies that are developed at the lab. The lab's scientists also will publish their work, contribute to the release of open source material, and foster an adherence to the ethical application of AI.

The MIT Quest for Intelligence

On February 1, 2018, MIT announced the launch of the MIT Quest for Intelligence (originally named the MIT Intelligence Quest). The initiative seeks to discover the foundations of human intelligence and use that knowledge to drive the development of technological tools that can positively influence virtually every aspect of society.

At a time of rapid advances in intelligence research across many disciplines, the Quest for Intelligence will encourage researchers to investigate the societal implications of their work as they pursue hard problems lying beyond the current horizon of what is known. Some of these advances may be foundational in nature, involving new insight into human intelligence and developing new methods to allow machines to learn effectively. Others may be practical tools for use in a wide array of research endeavors, such as disease diagnosis, drug discovery, materials and manufacturing design, automated systems, synthetic biology, and finance.

The Quest will be composed of two linked entities: the core and the bridge. The core will advance the science and engineering of both human and machine intelligence. A key output of this work will be machine-learning algorithms. At the same time, the core will seek to advance our understanding of human intelligence by using insights from computer science. The bridge will be dedicated to the application of MIT discoveries in natural and artificial intelligence to all disciplines, and it will host state-of-the-art tools from industry and research labs worldwide. The bridge will provide a variety of assets to the MIT community, including intelligence technologies, platforms, and infrastructure; education for students, faculty, and staff about AI tools; unique, rich data sets; technical support; and specialized hardware.

Along with developing and advancing the technologies of intelligence, researchers will also investigate the societal and ethical implications of advanced analytical and predictive tools. There are already active projects and groups at the Institute investigating autonomous systems, media and information quality, labor markets and the work of the future, innovation and the digital economy, and the role of AI in the legal system.

In all its activities, the Quest is intended to take advantage of—and strengthen—the Institute's culture of collaboration. It will connect and amplify existing excellence across labs and centers already engaged in intelligence research and establish shared, central spaces conducive to group work. The Quest's resources will directly support research. Building on the model that was established with the MIT-IBM Watson Artificial

Intelligence Laboratory, the Quest will also raise financial support through corporate sponsorship and philanthropic giving. MIT researchers will collaborate with each other and with industry on challenges that range in scale from the very broad to the very specific.

MIT has more than 200 principal investigators whose research bears directly on intelligence. Researchers at MIT's Computer Science and Artificial Intelligence Laboratory and the Department of Brain and Cognitive Sciences—along with the McGovern Institute for Brain Research and the Picower Institute for Learning and Memory—collaborate on a range of projects. Faculty from across the Institute will participate in the initiative, including researchers in the Media Lab, the Operations Research Center, the Sloan School of Management, the School of Architecture and Planning, and the School of Humanities, Arts, and Social Sciences.

David Siegel, a member of the MIT Corporation who earned a PhD in computer science at MIT in 1991 pursuing research in MIT's Artificial Intelligence Laboratory, was integral to the vision and formation of the Quest. So, too, was Eric Schmidt, former executive chairman of Alphabet Inc. In February, Schmidt joined MIT as a Visiting Innovation Fellow. They will both continue to help shape the effort.

In June 2017, Antonio Torralba was named the inaugural director of the MIT Quest for Intelligence. Aude Oliva, a principal research scientist at the Computer Science and Artificial Intelligence Laboratory, was named executive director. James DiCarlo, head of the Department of Brain and Cognitive Sciences, was named director of the core; Daniela Rus, professor of EECS and director of the Computer Science and Artificial Intelligence Laboratory, will be associate director. The core's scientific directors are Josh Tenenbaum, leader of the Computational Cognitive Science Group, and Leslie Kaelbling, professor of computer science and engineering. Its founding scientific advisor is Tomaso Poggio, professor of brain and cognitive sciences and director of the Center for Brains, Minds, and Machines. Nicholas Roy, professor of aeronautics and astronautics, is the director of the bridge. Its associate director of strategic initiatives will be Cynthia Breazeal, an associate professor of media arts and sciences at the Media Lab.

The MIT–SenseTime Alliance for Artificial Intelligence

The SenseTime Corporation, an industry leader in AI, was the first company to join the MIT Quest for Intelligence, to aid in efforts to define the next frontier of human and machine intelligence. SenseTime was founded by MIT alumnus Xiao'ou Tang PhD '96, who is also a professor of information engineering at the Chinese University of Hong Kong.

The MIT–SenseTime Alliance on Artificial Intelligence supports faculty research in AI by funding new avenues of discovery across MIT in areas such as computer vision, human-intelligence-inspired algorithms, medical imaging, and robotics. It also drives technological breakthroughs in AI that have the potential to confront some of the world's greatest challenges and empowers MIT faculty and students to pursue interdisciplinary projects at the vanguard of intelligence research.

Dean Chandrakasan serves as the chair of the MIT–SenseTime Alliance.

Educational Activities

New Engineering Education Transformation

Launched in academic year 2017, the New Engineering Education Transformation (NEET) program is a cross-departmental project-centric effort to rethink in a fundamental way what and how students learn across the School of Engineering. NEET aims to educate young engineers to build the new “machines” that will address societal needs. They pursue so-called threads, that is, cross-departmental pathways of subjects and projects in areas that address the “machines” of the future and that are likely to be in demand when the students graduate. By participating in the pilot program, students earn an SB degree from the department they are majoring in and a NEET certificate naming the thread, within the usual four-year duration.

In its first year, NEET attracted 39 students. In each of its four threads, students choose a sequence of explicitly interdepartmental projects, while they continue to learn fundamentals in departmentally offered subjects. Students are coached in personal and interpersonal skills and are challenged to develop their ability to learn by themselves. The four threads are:

- *Advanced materials machines*: Additive manufacturing, 3D printing, powder and casting processes, and advanced polymer processing approaches, applied to the aerospace, automotive, energy, and health care sectors. This thread crosses the departments of Materials Science and Engineering and Mechanical Engineering.
- *Autonomous machines*: Autonomy and robotics. This thread crosses the departments of Aeronautics and Astronautics, Mechanical Engineering, and EECS.
- *Clean energy systems*: Energy supply systems with lower carbon dioxide emissions. This thread crosses the departments of Nuclear Science and Engineering, Civil and Environmental Engineering, and Mechanical Engineering.
- *Living machines*: Organs on a chip. This thread crosses the departments of Biological Engineering, Mechanical Engineering, Chemical Engineering, and others.

NEET has three core objectives. The first is to grow, refine, and adjust its program using continued feedback from students, faculty, and industry mentors. The second is to define, collect, and analyze criteria that track and measure success, again using continued feedback from the NEET community. The third objective is to articulate and disseminate the positive outcomes of the NEET program so that it can benefit the global education community. NEET is co-led by Ed Crawley and Anette “Peko” Hosoi.

New Course 6 Degree-Option Partnerships

In September 2017, the departments of Economics and EECS began offering a joint major: Course 6-14: Computer Science, Economics, and Data Science. The new major aims to prepare students to think at the nexus of economics and computer science, so they can understand and design the kinds of systems that are coming to define modern life.

In June 2018, the departments of Urban Studies and Planning and EECS began offering a new major: Course 11-6: Urban Science and Planning with Computer Science. Combining urban planning and public policy, design and visualization, data analysis, machine

learning, artificial intelligence, pervasive sensor technology, robotics, and other aspects of both computer science and city planning, the program will reflect how urban scientists are making sense of cities and urban data in ways never before imagined—and using what they learn to reshape the world in real time. The urban science major proposes a comprehensive pedagogy, adding new material and integrated coursework. A centerpiece of this integration will be the degree’s urban science synthesis laboratory requirement, where high-tech tools will be brought to bear on solving real-world problems.

MIT Sandbox Innovation Fund Program

Now in its third year, and accessible to all MIT graduate and undergraduate students, the MIT Sandbox Innovation Fund Program provides seed funding of up to \$25,000 for student-initiated entrepreneurship ideas. It offers mentoring from within MIT and from a broad network of committed partners, and tailored educational experiences. To date, the program has engaged hundreds of participants on dozens of teams.

Advanced Undergraduate Research Opportunities Program

In 2012, the Advanced Undergraduate Research Opportunities Program (SuperUROP) was launched in the Department of Electrical Engineering and Computer Science. SuperUROP is a specialized version of the Undergraduate Research Opportunities Program that involves a year-long opportunity for students to tackle challenging problems and conduct publication-worthy research. Students are paired with a faculty member or MIT researcher and then take a two-semester course on research methodology and best practices. At the end of the year-long program, the students’ projects evolve into graduate theses, start-up plans, or industry positions.

Now a School-wide program, SuperUROP engaged more students last year through its expansion across the departments of Aeronautics and Astronautics, Biological Engineering, Civil and Environmental Engineering, Chemical Engineering, EECS, and Nuclear Science and Engineering.

StartMIT

During the 2014 Independent Activities Period, the Department of Electrical Engineering and Computer Science initiated a three-week entrepreneurship training program for MIT students. Now called StartMIT, the program was adopted School-wide in AY2016. It offers practical sessions to help students with the nuts and bolts of starting a company and interacting with the world of commerce.

Communications and Development

In AY2018, the School’s communications office focused on the transition to the new dean, new initiatives, fostering stronger communications between the dean and alumni of its academic programs, and increasing its development-related activities.

Highlights for academic year 2018 included the announcements and launch events for the MIT Quest for Intelligence, the MIT-IBM Watson Artificial Intelligence Laboratory, and other initiatives for which the dean was the lead organizer or the MIT chair. The dean’s office also launched a monthly email from the dean to approximately 55,000 alumni and friends of the School. This has been an effective means of highlighting the dean’s priorities and accomplishments.

Under the leadership of the new dean, School of Engineering resource development activities and fundraising totals reached unprecedented levels in AY2018. In addition, School development officers based in academic departments led or supported a range of new programs, activities, and engagement opportunities for School alumni and friends. Their efforts were critically important to the successful second year of the MIT capital campaign.

Staff from both communications and development remained in close collaboration during AY2018, with activities that included:

- Support for the Campaign for a Better World (in particular, the traveling Road Show events)
- Presentations on key topics to fundraisers across MIT and at key events, including the launch of the Infinite Series in Palo Alto, CA, focused on the intersection of AI, engineering, and health
- Support for visiting committees and Dean's Advisory Council meetings
- Engagement with alumni through timely and compelling information (the dean's quarterly e-letter, specialized events, and club-based visits)

Statistics for Academic Year 2018

Undergraduate Enrollment

- Total: 2,471
- Women: 1,134
- International students: 255

Graduate Enrollment

- Total: 3,267
- Women: 1,001
- International students: 1,374

Degrees Awarded

- Bachelor of science: 772
- Master's degrees: 708
- Doctoral degrees: 355

Faculty

- Full professors: 256
- Associate professors with tenure: 43
- Associate professors without tenure: 28
- Assistant professors: 51

Anantha P. Chandrakasan

Dean

Vannevar Bush Professor of Electrical Engineering and Computer Science