“I am always thrilled to hear from members of previous SuperUROP classes about the exciting new directions they are taking, benefiting from their experience in the program. Many are now earning advanced degrees at major universities, making an impact in industry, or working as part of the team at cutting-edge early-stage startups. Their research has set very high standards.”

– Anantha Chandrakasan
Dean, School of Engineering, MIT
SuperUROP Continues to Thrive

As head of the MIT Department of Electrical Engineering and Computer Science, I’m pleased to report on the continued success of the Advanced Undergraduate Research Opportunities Program, better known as SuperUROP.

Since the program began in EECS in 2012, it has equipped hundreds of undergraduates with the research tools they need to tackle real-world problems by giving them the chance to conduct innovative, publishable research.

The 2019-2020 SuperUROP scholars — along with the program’s research supervisors, teaching staff, and administrative team — faced unprecedented challenges this spring as they moved off campus due to the COVID-19 pandemic. However, students continued to work remotely with instructors and supervisors throughout the spring term. We’re proud of, and grateful for, their ability to adapt, and we are actively planning for the 2020-2021 SuperUROP class.

SuperUROP scholars engage in yearlong supervised research projects and complete a seminar that exposes them to the essentials of research. They learn to choose and develop research topics, design experiments, collaborate, write technical papers, and present their work. They also study entrepreneurship, ethics in engineering, and other critical topics. Some publish their research results in respected journals or present them at important conferences.

SuperUROP alumni continue to thrive long after their time in the program has ended. Many go on to earn advanced degrees at top research universities, win major scholarships and fellowships, work for industry-leading companies, or join exciting new entrepreneurial ventures.

Hosted by the School of Engineering and administered by EECS, SuperUROP is a collaborative effort involving many other departments at MIT and beyond. Our students are supported by the Research and Innovation Scholars Program (RISP), a named-scholars program that funds the students’ work and provides some associated discretionary funding for the host research group. This program relies on generous support from its sponsors, including corporations, foundations, individual alumni, and friends, all of whom are committed to growing the SuperUROP program and enhancing the student experience at MIT. We’re also grateful to the anonymous donor who, for the third year, provided support for our “CS+HASS” scholars — students whose research projects combine computer science with the humanities, arts, or social sciences.

Once again, I wish to acknowledge Anantha Chandrakasan, Dean of the School of Engineering and Vannevar Bush Professor of Electrical Engineering and Computer Science. As EECS Department Head, he pioneered and oversaw SuperUROP for its first several years, and he remains among the program’s strongest champions. I’m also grateful to Ted Equi, who served as the SuperUROP Industrial Liaison for several years before moving to a different role at MIT in January, and to Tom O’Dwyer, who joined us as SuperUROP Program Administrator in February.

In the long term, I look forward to seeing where these bright young researchers go in their careers. Meanwhile, I invite you to discover more about SuperUROP in these pages and at superurop.mit.edu.

Sincerely,

Asu Ozdaglar
EECS Department Head
Deputy Dean of Academics, MIT Schwarzman College of Computing
School of Engineering Distinguished Professor of Engineering
Jordan Docter, an MIT EECS | Advanced Micro Devices Undergraduate Research and Innovation Scholar, worked on a project titled “Unlocking the Potential of Multicore Systems.”

MIT | IBM-Watson Undergraduate Research and Innovation Scholars
Karen Gu
Sule Kahraman
Wonjune Kang
Lingjie Mei

MIT QuestBridge | Undergraduate Research and Innovation Scholars
Kika Arias
Baian Chen
Christopher Hughes

MIT | Tang Family FinTech Undergraduate Research and Innovation Scholars
Madeline Abrahams
Kenneth Acquah
Rogerio Guimaraes, Junior
Claire Hsu
Yi Wang
MIT CEE | Undergraduate Research and Innovation Scholar
Joseph Noszek

MIT ChemE | Undergraduate Research and Innovation Scholars
Nathanael Assefa
Hannah Loizzo

MIT DUSP | Undergraduate Research and Innovation Scholar
Avital Vainberg

MIT EECS | Advanced Micro Devices Undergraduate Research and Innovation Scholars
Jiaming Cui
Jordan Docter
Joshua Gruenstein
Anna Kooperberg
Kevin Limanta
Elizabeth Murray
James Quigley

MIT EECS | Analog Devices Undergraduate Research and Innovation Scholars
Manning Chuor
Keshav Gupta
Jessica Quaye
Sarah Spector

MIT EECS | Angle Undergraduate Research and Innovation Scholars
Ashay Athalye
Wei-Tung Chen
Stephanie Hu
Silvia Knappe
Po-Han Lin
John Paris
Roshni Sahoo
Emily Skilling
Sachin Thapa

MIT EECS | Aptiv Undergraduate Research and Innovation Scholar
Jacob Phillips

MIT EECS | CS+HASS Undergraduate Research and Innovation Scholars
Nicholas Bonaker
Jeremy Cowham
Annika Heuser
Henry Hu
Bhavik Nagda
Aaditya Singh
Annie T. Yun
Catherine Zeng

“As an industrial sponsor, Analog Devices explores opportunities to collaborate with MIT students and faculty on research topics of continual interest and provides insights into the relevance of research to real-world applications. Analog Devices is excited to further strengthen our relationship with students and faculty through the SuperUROP program.”

— Raymond S. Stata ’57, SM ’58 Chairman and Co-Founder, Analog Devices, Inc.
“I like the feeling that my work would have real-world impact. It’s been very satisfying.”
— Justin K. Lim, MIT EECS | Hewlett Foundation Undergraduate Research and Innovation Scholar

“I get a lot more supervision, more one-on-one time with my mentor, and working in CSAIL has given me access to state-of-the-art materials.”
— Kenneth Acquah, MIT | EECS Tang Family FinTech Undergraduate Research and Innovation Scholar

MIT EECS | Fano Undergraduate Research and Innovation Scholar
Malvika Joshi

MIT EECS | Hewlett Foundation Undergraduate Research and Innovation Scholars
Amir Farhat
Ariel Levy
Justin Lim

MIT EECS | Himawan Undergraduate Research and Innovation Scholars
Shreysa Balaji
Andrea Jessica Jaba
Yaateh Richardson

MIT EECS | Hudson River Trading Undergraduate Research and Innovation Scholars
Nicolas Gomez del Campo
Soo Jung Jang
Gabriel Schneider

MIT EECS | Keel Foundation Undergraduate Research and Innovation Scholars
Tim Kralj
Yuan Lee
Audace Nakeshimana
Luke Qi
Alexander Root

MIT EECS | Landsman Undergraduate Research and Innovation Scholars
Quang Kieu
Bahrudin Trbalic

MIT EECS | Lincoln Laboratory Undergraduate Research and Innovation Scholars
Marwa Abdulhai
Tuomas Oikarinen
Ryan Sander
Daniel Sun

MIT EECS | Mason Undergraduate Research and Innovation Scholar
Madison Landry

MIT EECS | Nutanix Undergraduate Research and Innovation Scholar
Korina Digalaki

MIT EECS | Quick Undergraduate Research and Innovation Scholars
Alexandra Berg
Michael Silver
MIT EECS | Takeda Undergraduate Research and Innovation Scholars
Joshua Derrick
Lior Hirschfeld
Dhamanpreet Kaur
Sabrina Liu
Eshaan Nichani

MIT EECS | Texas Instruments Undergraduate Research and Innovation Scholars
Jaeyoung Jung
Chenkai Mao

MIT EECS | Undergraduate Research and Innovation Scholars
Fatima Gunter-Ruhman
Maximillian Langenkamp
Fjona Parllaku
Brent Samuels

MIT MechE | Lincoln Labs Undergraduate Research and Innovation Scholars
John Adeyeye
Collin Renae
Carson Tucker

Undergraduate Research and Innovation Scholars
Teodor Begu
Patrick John Chia
Anis Ehsani
Ahmad Mujtaba Jebran
Subhash Nalluru
Matej Novak

“AMD is excited to sponsor MIT’s SuperUROP program because it provides the best and brightest undergrads with the opportunities to tackle important, real-world problems. I grew up as a UROP student at MIT and AMD looks forward to working with our next generation of innovators through the SuperUROP program.”

— Lisa Su ’90, SM ’91, PhD ’94; President and CEO, Advanced Micro Devices
Marwa Abdulhai
MIT EECS | Lincoln Laboratory
Undergraduate Research and Innovation Scholar
Project: Multi-Agent Hierarchical Reinforcement Learning
Supervisor: Jonathan How

Nathanael Assefa
MIT ChemE | Undergraduate Research and Innovation Scholar
Project: Optimizing Electrokinetics in Nanopores
Supervisor: Martin Bazant

Madeline L. Abrahams
MIT | Tang Family FinTech
Undergraduate Research and Innovation Scholar
Project: Networks in Climate Change Misinformation And Polarization
Supervisors: Dorothy W. Curtis and Adam Berinsky

Ashay Athalye
MIT EECS | Angle Undergraduate Research and Innovation Scholar
Project: Sensor Fusion of Visual and Tactile Sensory Data for Object Localization and Robotic Manipulation
Supervisor: Alberto Rodriguez

Kenneth K. Acquah
MIT | Tang Family FinTech
Undergraduate Research and Innovation Scholar
Project: Machine Learning for Money Laundering
Supervisor: Una-May O’Reilly

Shreyas Balaji
MIT EECS | Himawan
Undergraduate Research and Innovation Scholar
Project: Modeling Measurement Drift for Supervised Learning Applications
Supervisor: David Sontag

John Adeyeye
MIT MechE | Lincoln Labs
Undergraduate Research and Innovation Scholar
Supervisor: Evelyn Wang

Teodor Rares Begu
Undergraduate Research and Innovation Scholar
Project: Modeling Concurrency Bugs in Software Using Machine Learning
Supervisor: Una-May O’Reilly

Kika Annette Arias
MIT QuestBridge | Undergraduate Research and Innovation Scholar
Project: Qualitative Analysis of Personalized Wellness-Based Interventions for Undergraduate Students
Supervisor: Cynthia Breazeal

Alexandra Berg
MIT EECS | Quick Undergraduate Research and Innovation Scholar
Project: Characterizing Robustness of Neural Networks for Histopathological Image Segmentation
Supervisor: Pawan Sinha
Nicholas Ryan Bonaker
MIT EECS | CS+HASS
Undergraduate Research and Innovation Scholar
Project: Nomon: A Single Switch Interface for Assistive Technology
Supervisor: Tamara Broderick

Manning Chuor
MIT EECS | Analog Devices
Undergraduate Research and Innovation Scholar
Project: Distinguishing of Energy States in Readout of 3-Level Quantum Systems
Supervisor: Terry P. Orlando

Baian Chen
MIT QuestBridge | Undergraduate Research and Innovation Scholar
Project: A Unified Framework for Robot Understanding of Goal-related Information
Supervisor: Leslie P. Kaelbling

Jiaming Cui
MIT EECS | Advanced Micro Devices
Undergraduate Research and Innovation Scholar
Supervisor: Stefanie Mueller

Wei-Tung Chen
MIT EECS | Angle Undergraduate Research and Innovation Scholar
Project: Autonomous Excavation in Granular Materials with Reinforcement Learning
Supervisor: Duane S. Boning

Joshua T. Derrick
MIT EECS | Takeda Undergraduate Research and Innovation Scholar
Project: Detection of Gut Microbiota in Human Stool Using RNA Toeholds: Predicting IBD Patient Response to Biologics
Supervisor: Jim Collins

Patrick John Chia
Undergraduate Research and Innovation Scholar
Project: Learning a 3D Representation of Objects in Scenes for Robotic Manipulation
Supervisor: Leslie P. Kaelbling

Korina Digalaki
MIT EECS | Nutanix Undergraduate Research and Innovation Scholar
Project: Boolean Functions Lacking Sparse High-Order Fourier Representations
Supervisor: Ryan Williams

Jeremy Charles Cowham
MIT EECS | CS+HASS
Undergraduate Research and Innovation Scholar
Project: Quantifying Statistical Uncertainty of Tracking Algorithms to Improve Human-in-the-Loop Analyses of Soccer
Supervisor: John Fisher

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Supervisor: John Fisher
Anis Ehsani
Undergraduate Research and Innovation Scholar
Project: Isoperimetric Profile and Medial Axis Curves
Supervisor: Justin Solomon

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MIT EECS | Hewlett Foundation Undergraduate Research and Innovation Scholar
Project: Studying Communication Patterns in Distributed Machine Learning Training
Supervisor: Manya Ghabadi

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MIT EECS | Hudson River Trading Undergraduate Research and Innovation Scholar
Project: Automating Financial Agreements on the Ethereum Blockchain
Supervisor: Lalana Kagal

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MIT EECS | Advanced Micro Devices Undergraduate Research and Innovation Scholar
Project: Reinforcement Learning for Microrobot Locomotion
Supervisor: Pulkit Agrawal

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MIT | IBM-Watson Undergraduate Research and Innovation Scholar
Project: Incremental Computational Model for Logically Complex Generic Statements
Supervisor: Roger Levy

Rogerio Aristida Guimaraes Junior
MIT | Tang Family FinTech Undergraduate Research and Innovation Scholar
Project: A Collaborative Filtering Approach to Strategy Recommendation
Supervisor: Mardavij Roozbehani

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MIT EECS | Undergraduate Research and Innovation Scholar
Project: Understanding the Molecular Mechanisms of Cognitive Reserve
Supervisor: Li-Huei Tsai

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Project: Efficient Computing for Robotics on an FPGA
Supervisor: Vivienne Sze

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MIT EECS | CS+HASS Undergraduate Research and Innovation Scholar
Project: Modeling German Language Acquisition
Supervisors: Robert C. Berwick and Suzanne Flynn

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Project: Uncertainty Quantification for Molecular Property Prediction
Supervisor: Regina A. Barzilay
Claire Hsu
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Undergraduate Research and Innovation Scholar
Project: Sparse Matrix Operations Optimization
Supervisor: Saman P. Amarasinghe

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Undergraduate Research and Innovation Scholar
Project: Analysis of Feature Cues in Speech of Children with Speech Disorders
Supervisor: Stefanie Shattuck-Hufnagel

Henry Hu
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Undergraduate Research and Innovation Scholar
Project: High-Precision Question Answering Using Wikipedia Definitions
Supervisor: Boris Katz

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Undergraduate Research and Innovation Scholar
Project: Design and Development of Soft Biomimetic Colonoscopy Robot
Supervisor: Giovanni Traverso

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MIT EECS | Angle Undergraduate Research and Innovation Scholar
Project: Designing a Ranking System for Pulmonary Edema Severity
Supervisor: Roger Mark

Malvika Raj Joshi
MIT EECS | Fano Undergraduate Research and Innovation Scholar
Project: Nondeterministic SETH: Short Unsatisfiability Proofs for Boolean Formulas
Supervisor: Ryan Williams

Christopher Loren Hughes
MIT QuestBridge | Undergraduate Research and Innovation Scholar
Project: Augmented One-Shot Learning
Supervisor: Nick Roy

Jaeyoung Jung
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Undergraduate Research and Innovation Scholar
Project: Gallium Nitride Complementary MOS Microprocessor for High-Temperature Applications
Supervisor: Tomas A. Palacios

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Undergraduate Research and Innovation Scholar
Project: Improving the Explainability of CNN-Based Image Classifiers for Scene Recognition
Supervisor: Lalana Kagal

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MIT | IBM-Watson Undergraduate Research and Innovation Scholar
Project: Investigating Representations of Malicious PowerShell
Supervisor: Una-May O’Reilly
Wonjune Kang  MIT | IBM-Watson Undergraduate Research and Innovation Scholar  
**Project:** Certified Robustness of Neural Networks for Top-k Predictions  
*Supervisor:* Luca Daniel

Tim Kralj  MIT EECS | Keel Foundation Undergraduate Research and Innovation Scholar  
**Project:** Interoperability Between OpenCilk and Pthreads  
*Supervisor:* Charles E. Leiserson

Dhamanpreet Kaur  MIT EECS | Takeda Undergraduate Research and Innovation Scholar  
**Project:** Dynamic Bayesian Networks for Generation of Synthetic Electronic Health Records  
*Supervisor:* Amar Gupta

Madison Landry  MIT EECS | Mason Undergraduate Research and Innovation Scholar  
**Project:** Training the COIN  
*Supervisor:* Cardinal Warde

Quang Kieu  MIT EECS | Landsman Undergraduate Research and Innovation Scholar  
**Project:** Electronic Development & Miniaturization of a Prototype Hydration Monitoring Device  
*Supervisor:* Martha L. Gray

Maximilllian S. Langenkamp  MIT EECS | Undergraduate Research and Innovation Scholar  
**Project:** Dual System Morality: A Reinforcement Learning Approach  
*Supervisor:* Josh Tenenbaum

Silvia Elena Knappe  MIT EECS | Angle Undergraduate Research and Innovation Scholar  
**Project:** Active SLAM Implementations for Indoor Navigation  
*Supervisor:* Tomas Lozano-Perez

Yuan Lee  MIT EECS | Keel Foundation Undergraduate Research and Innovation Scholar  
**Project:** Discrete Event Simulation for Quantum Networks  
*Supervisor:* Dirk R. Englund

Anna Kooperberg  MIT EECS | Advanced Micro Devices Undergraduate Research and Innovation Scholar  
**Project:** Manipulating Symbols with Recurrent Neural Networks  
*Supervisor:* Constantinos Daskalakis

Ariel Skye Levy  MIT EECS | Hewlett Foundation Undergraduate Research and Innovation Scholar  
**Project:** Large-Scale Clinical Text Annotation  
*Supervisor:* David Sontag
Justin K. Lim  
MIT EECS | Hewlett Foundation Undergraduate Research and Innovation Scholar  
Project: Learning Optimal Treatment Policies for Chronic Disease  
Supervisor: David Sontag

Chenkai Mao  
MIT EECS | Texas Instruments Undergraduate Research and Innovation Scholar  
Project: Electrical and Optical Properties of Gallium Nitride Under Applied Stress  
Supervisor: Tomas A. Palacios

Kevin Limanta  
MIT EECS | Advanced Micro Devices Undergraduate Research and Innovation Scholar  
Project: Analog Memory-Based Devices for Deep Learning  
Supervisor: Tomas A. Palacios

Lingjie Mei  
MIT | IBM-Watson Undergraduate Research and Innovation Scholar  
Project: Zero-Shot Visual Concept Captioning  
Supervisor: Joshua Tenenbaum

Po-Han Lin  
MIT EECS | Angle Undergraduate Research and Innovation Scholar  
Project: Machine-Learning Based Model to Predict Intensive Care Unit Length of Stay  
Supervisor: Amar Gupta

Elizabeth Murray  
MIT EECS | Advanced Micro Devices Undergraduate Research and Innovation Scholar  
Supervisor: George C. Verghese

Sabrina Liu  
MIT EECS | Takeda Undergraduate Research and Innovation Scholar  
Project: A Sensor Fusion Algorithm for Reliable Estimation of Physiological Parameters  
Supervisor: Thomas Heldt

Bhavik V. Nagda  
MIT EECS | CS+HASS Undergraduate Research and Innovation Scholar  
Project: Inductive Human Bias Via Human-Based Learning  
Supervisor: Joshua Tenenbaum

Hannah Loizzo  
MIT ChemE | Undergraduate Research and Innovation Scholar  
Project: Understanding the Stability and Elemental Interdiffusion Between Solid-State Electrolytes and High-Capacity Cathodes with Utilization of Li3BO3 as a Sintering Agent  
Supervisor: Jennifer Rupp

Audace Nakeshimana  
MIT EECS | Keel Foundation Undergraduate Research and Innovation Scholar  
Project: Learned Intermediate Input Representation with Task-Independent Fairness Guarantees  
Supervisor: Richard Fletcher
**Subhash Naga Sri Nalluru**  
Undergraduate Research and Innovation Scholar  
**Project:** Cloud Based Semi-Supervised GANs Training  
**Supervisor:** Una-May O’Reilly  

**John Ramhorst Paris**  
MIT EECS | Angle Undergraduate Research and Innovation Scholar  
**Project:** Nature Inspired Super-Maneuverability  
**Supervisor:** Michael Triantafyllou  

**Eshaan Nichani**  
MIT EECS | Takeda Undergraduate Research and Innovation Scholar  
**Project:** Gradient Descent, Implicit Regularization, and Alignment in Deep Linear Autoencoders  
**Supervisor:** Caroline Uhler  

**Fiona Parllaku**  
MIT EECS | Undergraduate Research and Innovation Scholar  
**Project:** Acoustic Phonetic Variation in Speech Recognition  
**Supervisor:** Stefanie Shattuck-Hufnagel  

**Joseph Robert Noszek**  
MIT CEE | Undergraduate Research and Innovation Scholar  
**Project:** Visualization of Global Road Quality Data to Decrease Environmental Impact  
**Supervisor:** Franz Ulm  

**Jacob Phillips**  
MIT EECS | Aptiv Undergraduate Research and Innovation Scholar  
**Project:** Utilizing Discriminatory Networks and Expert Data in Training Reinforcement Learning Agents  
**Supervisor:** Daniela L. Rus  

**Matej Novak**  
Undergraduate Research and Innovation Scholar  
**Project:** Data for Refugees: Analysis of Refugee Migration Data in Colombia  
**Supervisor:** Alex Pentland  

**Luke Qi**  
MIT EECS | Keel Foundation Undergraduate Research and Innovation Scholar  
**Project:** Ion-Motion Protocols for a Large-Scale Ion Trap Quantum Computer  
**Supervisor:** Isaac L. Chuang  

**Tuomas Petteri Oikarinen**  
MIT EECS | Lincoln Laboratory Undergraduate Research and Innovation Scholar  
**Project:** Training Verifiably Robust Deep Reinforcement Learning Agents  
**Supervisor:** Luca Daniel  

**Jessica Ayeley Quaye**  
MIT EECS | Analog Devices Undergraduate Research and Innovation Scholar  
**Project:** Wildcard: Spreadsheet-Driven Customization of Web Applications  
**Supervisor:** Daniel Jackson
James Quigley
MIT EECS | Advanced Micro Devices Undergraduate Research and Innovation Scholar
Project: Molecular Clock: Ultra-Stable Frequency Reference on a CMOS Chip
Supervisor: Ruonan Han

Collin Bradley Renae
MIT MechE | Lincoln Labs Undergraduate Research and Innovation Scholar
Project: Can Batch Reverse Osmosis Systems Reduce the Cost of Seawater Desalination?
Supervisor: John Lienhard

Yaateh Henry Richardson
MIT EECS | Himawan Undergraduate Research and Innovation Scholar
Project: Learned Bloom Filters
Supervisor: Tim Kraska

Alexander James Root
MIT EECS | Keel Foundation Undergraduate Research and Innovation Scholar
Project: High Performance Image Processing with Fixed Point Types
Supervisor: Frederic P. Durand & Jonathan M. Ragan-Kelley

Roshni Sahoo
MIT EECS | Angle Undergraduate Research and Innovation Scholar
Project: Developing Models Resilient to Feature-Dependent Label Noise
Supervisor: John V. Guttag

Brent Carlton Samuels
MIT EECS | Undergraduate Research and Innovation Scholar
Project: NB: The Future Textbook
Supervisor: David R. Karger

Ryan Matthew Sander
MIT EECS | Lincoln Laboratory Undergraduate Research and Innovation Scholar
Project: Deep Reinforcement Learning and Game-Theoretic Control for Autonomous Navigation in Multi-Agent Settings
Supervisors: Daniela L. Rus and Sertac Karaman

Gabriel Joseph Schneider
MIT EECS | Hudson River Trading Undergraduate Research and Innovation Scholar
Project: Analysis of Feature Cues for Diagnosis of Speech Impairment
Supervisor: Stefanie Shattuck-Hufnagel

Michael Sol Silver
MIT EECS | Quick Undergraduate Research and Innovation Scholar
Project: Question Answering from Wikipedia
Supervisor: Boris Katz

Aaditya Singh
MIT EECS | CS+HASS Undergraduate Research and Innovation Scholar
Project: Understanding How the Brain Parses Language
Supervisor: Boris Katz
Emily Skilling  
MIT EECS | Angle Undergraduate Research and Innovation Scholar  
Project: Instrumented Crutch for Adaptive Balance Assistance  
Supervisor: Neville Hogan

Carson I. Tucker  
MIT MechE | Lincoln Labs Undergraduate Research and Innovation Scholar  
Project: Permeate Quality and Scaling in Batch Reverse Osmosis  
Supervisor: John Lienhard

Sarah Spector  
MIT EECS | Analog Devices Undergraduate Research and Innovation Scholar  
Project: Electromagnetic Actuation of Electronic Microsystems  
Supervisor: Tomas A. Palacios

Avital Vainberg  
MIT DUSP | Undergraduate Research and Innovation Scholar  
Project: Visualizing Spatio-Temporal Patterns  
Supervisor: Joseph Ferreira

Daniel Sun  
MIT EECS | Lincoln Laboratory Undergraduate Research and Innovation Scholar  
Project: Compositionality for Robot Instruction Following  
Supervisor: Boris Katz

Yi Wang  
MIT | Tang Family FinTech Undergraduate Research and Innovation Scholar  
Project: Automating Online Experiments: Algorithmic Creation of Online Virtual Environment  
Supervisors: Dorothy W. Curtis and Adam Berinsky

Sachin Thapa  
MIT EECS | Angle Undergraduate Research and Innovation Scholar  
Project: Ingestible Robots for Long Lasting Gastric Monitoring  
Supervisor: Giovanni Traverso

Annie Yun  
MIT EECS | CS+HASS Undergraduate Research and Innovation Scholar  
Project: Congressional Redistricting Through Graph Partition Sampling  
Supervisor: Justin Solomon

Bahrudin Trbalic  
MIT EECS | Landsman Undergraduate Research and Innovation Scholar  
Project: Assembly of Hybrid COIN  
Supervisor: Cardinal Warde

Catherine Zeng  
MIT EECS | CS+HASS Undergraduate Research and Innovation Scholar  
Project: Associative Memory Using Quantum Systems  
Supervisor: Robert C. Berwick

For full student project abstracts, please visit: superurop.mit.edu/scholars-2019-2020
At halfway point, SuperUROP scholars share their initial research results

In a lively poster session, dozens of undergraduates discussed their yearlong research projects on everything from machine learning to political geography.

By Kathryn O’Neill
Contributor, Department of Electrical Engineering and Computer Science

MIT undergraduates are rolling up their sleeves to address major problems in the world, conducting research on topics ranging from nursing care to money laundering to the spread of misinformation about climate change — work highlighted at the most recent SuperUROP Showcase.

The event, which took place on the Charles M. Vest Student Street in the Stata Center in December 2019, marked the halfway point in the Advanced Undergraduate Research Opportunities Program (better known as “SuperUROP”). The yearlong program gives MIT students firsthand experience in conducting research with close faculty mentorship. Many participants receive scholar titles recognizing the program’s industry sponsors, individual donors, and other contributors.

This year, nearly 100 students participated in SuperUROP, with many of their projects focused on applying computer science technologies, such as machine learning, to challenges in fields ranging from robotics to health care. Almost all presented posters of their work at the December showcase, explaining research to fellow students, faculty members, alumni, sponsors, and other guests.

“Every year, this program gets more and more impressive,” says Anantha P. Chandrakasan, dean of the School of Engineering and Vannevar Bush Professor of Electrical Engineering and Computer Science. “What’s especially noteworthy is the incredible breadth of projects and how articulate students are in talking about their work. Their presentation skills seem pretty remarkable.”

SuperUROP, administered by the Department of Electrical Engineering and Computer Science (EECS), includes a two-term course, 6.UAR (Undergraduate Advanced Research), designed to teach students research skills, including how to design an experiment and communicate results.

“What’s different about SuperUROP [compared to other research opportunities offered to undergraduates] is the companion class that guides you through the necessary writing and speaking,” says Anis Ehsani, a senior majoring in EECS and mathematics, whose project centered on the geometry of drawing political districts. “If I want to pursue a research career, it’s nice to have those skills,” adds Ehsani, an MIT EECS/Nutanix SuperUROP scholar.

Beyond the lab and classroom
Participants present their work at showcases in the fall and spring, and they are expected to produce prototypes or publication-worthy results by the end of the year.

“All these presentations help keep us on track with our projects,” says Wei-Tung Chen, an EECS junior whose project focuses on automating excavation for mining applications. He explains that the inspiration for his SuperUROP work was a real-world problem he faced when trying to build a startup in automated food preparation. Scooping tofu, it turns out, is surprisingly difficult to automate. At the showcase, Chen — an MIT EECS/Angle SuperUROP scholar — explained that he is trying to create a simulation than can be used to train machines to scoop materials autonomously. “I feel really accomplished having this poster and presentation,” he said.

Launched by EECS in 2012, SuperUROP has expanded across the Institute over the past several years.

Adam Berinsky, the Mitsui Professor of Political Science, is working with SuperUROP students for the first time this year, an experience he’s enjoying. “What’s really cool is being able to give undergraduates firsthand experience in real research,” he says. He’s been able to tap students for the computer science skills he needs for his work, while providing them with a deep dive into the social sciences.
Madeline Abrahams, an MIT/Tang Family FinTech SuperUROP scholar, says she especially appreciates the program’s flexibility: “I could explore my interdisciplinary interests,” she says. A computer science and engineering major who is also passionate about political science, Abrahams is working with Berinsky to investigate the spread of misinformation related to climate change via algorithmic aggregation platforms.

Nicholas Bonaker also enjoyed the freedom of pursuing his SuperUROP project. “I’ve been able to take the research in the direction I want,” says Bonaker, a junior in EECS, who has developed a new algorithm he hopes will improve an assistive technology developed by his advisor, EECS Associate Professor Tamara Broderick.

Exploring new directions in health care
Bonaker said he particularly values the health-care focus of his project, which centers on creating better communications software for people living with severe motor impairments. “It feels like I’m doing something that can help people — using things I learned in class,” says Bonaker. He is among this year’s MIT EECS/CS+HASS SuperUROP scholars, whose projects combine computer science with the humanities, arts, or social sciences.

Many of this year’s SuperUROP students are working on health-care applications. For example, Fatima Gunter-Rahman, a junior in EECS and biology, is examining Alzheimer’s data, and Sabrina Liu, an EECS junior and MIT EECS/Takeda SuperUROP scholar, is investigating noninvasive ways to monitor the heart rates of dental patients. Justin Lim, a senior math major, is using data analytics to try to determine the optimal treatment for chronic diseases like diabetes. “I like the feeling that my work would have real-world impact,” says Lim, an MIT EECS/Hewlett Foundation SuperUROP scholar. “It’s been very satisfying.”

Dhamanpreet Kaur, a junior majoring in math and computer science and molecular biology, is using machine learning to determine the characteristics of patients who are readmitted to hospitals following their discharge to skilled nursing facilities. The work aims to predict who might benefit most from expensive telehealth systems that enable clinicians to monitor patients remotely. The project has given Kaur the chance to work with a multidisciplinary team of professors and doctors. “I find that aspect fascinating,” says Kaur, also an MIT EECS/Takeda SuperUROP scholar.

Roshni Sahoo, an MIT EECS | Angle Undergraduate Research and Innovation Scholar, discusses her SuperUROP research with Anantha Chandrakasan, Dean of the School of Engineering, at the SuperUROP Showcase, December 2019.
As attendees bustled through the two-hour December showcase, some of the most enthusiastic visitors were industry sponsors, including Larry Bair ’84, SM ’86, a director at Advanced Micro Devices. “I’m always amazed at what undergraduates are doing,” he says, noting that his company has been sponsoring SuperUROPs for the last few years.

“It’s always interesting to see what’s going on at MIT,” says Tom O’Dwyer, an MIT research affiliate and the former director of technology at Analog Devices, another industry sponsor. O’Dwyer notes that supporting SuperUROP can help companies with recruitment. “The whole high-tech business runs on smart people,” he says. “SuperUROPs can lead to internships and employment.” [Editor’s Note: Early in 2020, O’Dwyer joined EECS as the SuperUROP program administrator.]

Real-world research results
SuperUROP also exposes students to the work of academia, which can underscore a key difference between classwork and research: Research results are unpredictable.

Junior math major Lior Hirschfeld, for example, compared the effectiveness of different machine learning methods used to test molecules for potential in drug development. “None of them performed exceptionally well,” he says.

That might appear to be a poor result, but Hirschfeld notes that it’s important information for those who are using and trusting those tests today. “It shows you may not always know where you are going when you start a project,” says Hirschfeld, also an MIT EECS/Takeda SuperUROP scholar.

EECS senior Kenneth Acquah had a similar experience with his SuperUROP project, which focuses on finding a technological way to combat money laundering with Bitcoin. “We’ve tried a bunch of things but mostly found out what doesn’t work,” he says.

Still, Acquah says, he values the SuperUROP experience, including the chance to work in MIT’s Computer Science and Artificial Intelligence Laboratory (CSAIL). “I get a lot more supervision, more one-on-one time with my mentor,” the MIT EECS/Tang Family FinTech SuperUROP scholar says. “And working in CSAIL has given me access to state-of-the-art materials.”
Scenes from the SuperUROP Showcase, December 2019.
Thank you to our sponsors and donors!

SuperUROP is made possible by the generous support of the following industrial sponsors and donors:

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- Robert M. Fano ’41, ScD ’47
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SuperUROP also thanks the following for their support:

- The Hewlett Foundation
- Tang Family Catalyst Fund
- MIT-IBM Watson AI Lab
- MIT QuestBridge
“SuperUROP and MIT play an important role in preparing Aptiv’s future talent with the skills needed to deliver solutions to some of society’s biggest challenges. We are happy to sponsor the SuperUROP program, as it provides our future scientists and engineers the expertise needed to develop safer, greener, and more connected solutions that enable the future of smart mobility.”

–Statement from Aptiv

“We are pleased to sponsor SuperUROP because the program provides undergraduates with unparalleled opportunities to immerse themselves in research. It’s exciting to know that they’re gaining the knowledge and skills needed to succeed in our industry. We look forward to seeing what these young scholars accomplish this year — and in the future.”

–Prashant Lal ’99, Partner, Hudson Riving Trading Co.

“As an alumnus, I was happy to extend an existing donation to assist the SuperUROP program. It’s gratifying to know that a small additional gift can do so much to support undergraduate research opportunities. I look forward to hearing about the results of the SuperUROP scholars’ work – and to seeing where they go in their future careers.”

–R. Franklin Quick Jr. ’70, SM ’70

Yaateh Henry Richardson, an MIT EECS | Himawan Undergraduate Research and Innovation Scholar, worked on a SuperUROP project exploring learned Bloom filters.
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Sarah Spector, an MIT EECS | Analog Devices Undergraduate Research and Innovation Scholar, describes a SuperUROP project involving the electromagnetic actuation of electronic microsystems.
SuperUROP Teaching Assistants, 2019-2020
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“Our undergraduates have the opportunity to work shoulder-to-shoulder with researchers and tackle the toughest problems on the planet. SuperUROP and related efforts are a hallmark of an MIT education. These programs deliver skills, build confidence, and foster a life of learning.”

–Ian A. Waitz, Vice Chancellor and Jerome C. Hunsaker Professor of Aeronautics and Astronautics, MIT
“The SuperUROP program brings students and faculty together to work on a yearlong research project. It’s a great opportunity for students to take the lead on a project that they care deeply about, and to see it through to a meaningful conclusion.”

– Dennis Freeman, EECS Education Officer and Henry Ellis Warren (1894) Professor of Electrical Engineering
Front Cover Photos

Top row
Left: Jessica Quaye, an MIT EECS | Analog Devices Undergraduate Research and Innovation Scholar, worked on a SuperUROP project involving spreadsheet-driven customization.

Right: Alexandra Berg, an MIT EECS | Quick Undergraduate Research and Innovation Scholar, worked on a SuperUROP project involving digital histopathology, the machine-aided processing of human tissue samples.

Photos: Gretchen Ertl

Middle row
Left: Avital Vainberg (seated), an MIT DUSP | Undergraduate Research and Innovation Scholar, worked on a SuperUROP project that involved visualizing and analyzing daily activity patterns of citizens in Singapore. Also pictured: Basu Rounaq (standing, left), a graduate student in the Department of Urban Studies and Planning (DUSP), and DUSP Professor and SuperUROP supervisor Joseph Ferreira. Photo: Scott Brauer

Right: SuperUROP Showcase, December 2019. Photo: Gretchen Ertl

Bottom row
Left: Marwa Abdulhai, an MIT EECS | Lincoln Laboratory Undergraduate Research and Innovation Scholar, worked on a SuperUROP project involving multi-agent hierarchical reinforcement learning.

Photo: Gretchen Ertl

Right: Jaeyoung Jung, an MIT EECS | Texas Instruments Undergraduate Research and Innovation Scholar, worked on a SuperUROP project to develop a microprocessor based on gallium-arsenide semiconductor technology resilient to extremely high temperatures. He’s pictured here with EECS Professor and SuperUROP supervisor Tomas Palacios (left) and EECS graduate student Nadim Chowdhury SM ’18.

Photo: Scott Brauer

“SuperUROP embodies MIT’s learning-by-doing ethos. When students participate in frontline research, they touch the future – and by providing a structured way to learn the ropes of research with faculty mentors, SuperUROP gives them a head start on their own futures, too. I am inspired by the program’s impact on our students and by the way it inspires them to help make a better world.”

–L. Rafael Reif
President, MIT

“SuperUROP in its design is so quintessentially MIT, particularly because it builds on MIT’s tradition of *mens et manus* [“mind and hand”], and it is aligned with the Institute’s priorities of discovery, innovation, and making the world a better place.”

–Cynthia Barnhart
Chancellor
Ford Professor of Engineering
SuperUROP is an expanded version of MIT’s flagship Undergraduate Research Opportunities Program (UROP). SuperUROP scholars undertake a yearlong supervised research project and enroll in a seminar covering research fundamentals. In both the lab and the classroom, students learn the essentials of research, from designing experiments to writing technical papers to presenting at conferences.

The Department of Electrical Engineering and Computer Science (EECS) launched SuperUROP in 2012 and continues to administer the program. The program was later extended to juniors and seniors from throughout the School of Engineering and beyond.

As of May 2019 (at the time of the photo above), 833 students had graduated from the program.

This year, the program included students from the following schools:

- School of Engineering
- School of Architecture + Planning
- School of Humanities, Arts, and Social Sciences
- School of Science

For more information, please visit superurop.mit.edu.

Photo: Gretchen Ertl

2018-2019 SuperUROP students, faculty, and staff.