MIT Beaver Works Summer Institute

Final Challenge & Award Ceremony 2019

Lockheed Martin Project

Autonomous RACECAR Grand Prix

BAE Systems Project

Autonomous Air Vehicle Racing

KAIT. Project

Autonomous Cognitive Assistant

Medlytics

Data Science for Health & Medicine

Sierra Nevada Corp Project

Build a CubeSat

Raytheon Project

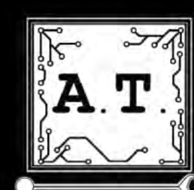
UAS-SAR

MITRE Project

Embedded Security and Hardware Hacking

Hack A 3D Printer

Remote Sensing



Assistive Technology

August 4, 2019 (Sunday): 9am to 3pm

Massachusetts Institute of Technology
MIT Johnson Ice Rink/Lobdell Dining Hall

77 Massachusetts Avenue, Cambridge, MA

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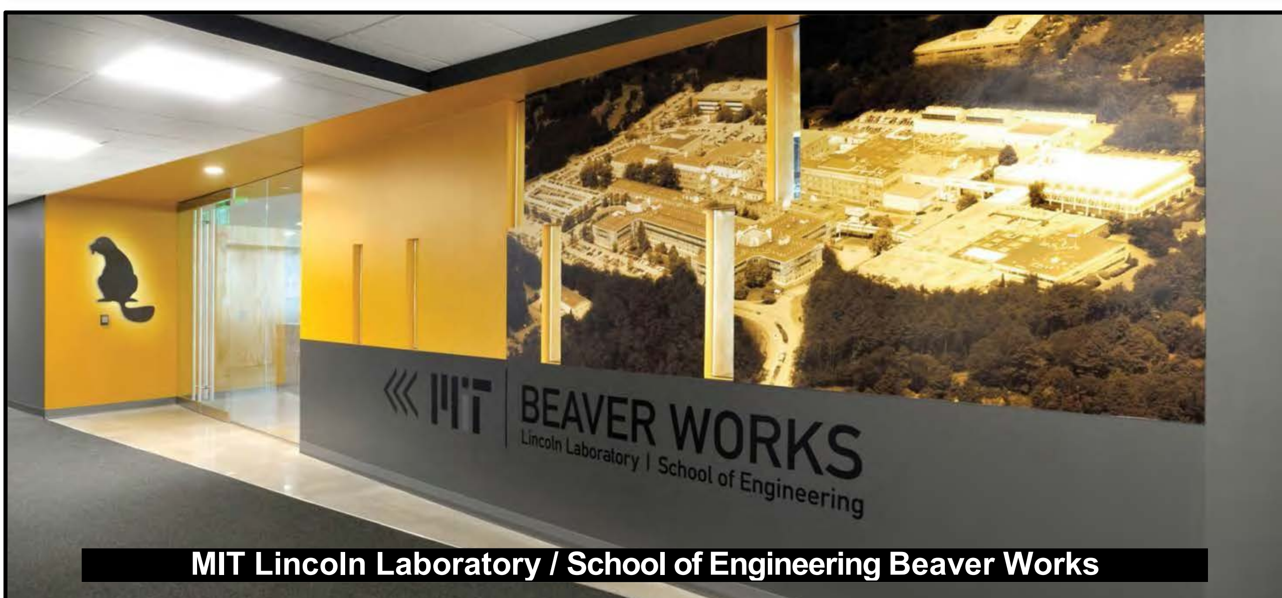

MIT Lincoln Laboratory / School of Engineering Beaver Works

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MIT Beaver Works Summer Institute

Dear Friends, Family, and Engineering Enthusiasts,

Welcome to the 2019 Beaver Works Summer Institute Final Challenge and Awards Ceremony!

The MIT Beaver Works Summer Institute is a rigorous, world-class STEM program for talented rising high school seniors. The 2019 program featured ten project-based, workshop-style courses: Autonomous RACECAR Grand Prix, Autonomous Air Vehicle Racing, Autonomous Cognitive Assistant, Data Science for Health and Medicine, Build a CubeSat, UAS-SAR, Embedded Security and Hardware Hacking, Hack a 3D Printer, Assistive Technologies Hack-a-thon, and Remote Sensing for Disaster Response.

This year's MIT Beaver Works Summer Institute was a complete success thanks to the enthusiasm of our students, the dedication of our instructors, and the hard work of our team members. We partnered with 140 high schools to recruit the future engineers who participated in our program. We had the pleasure of working with 239 high school students, 143 of whom joined our program from outside Massachusetts. We also inaugurated the first BWSI middle school class with 24 Massachusetts middle school students taking a specially tailored RACECAR course.

In the coming years, we will integrate new programs into this initiative, increasing participation substantially. We will support high school STEM teachers who use our teaching materials to help better prepare their students for college and beyond. We will also help other universities and high schools create similar programs, working to build a network of institutes to collectively improve engineering education worldwide.

Thank you for the continued support of our program. Please enjoy the challenge day!

The MIT Beaver Works Summer Institute Staff

Final Challenge and Awards Ceremony Schedule

9:00AM	Opening Remarks – Johnson Ice Rink
9:10AM – 12:00PM	CogWorks, Medlytics, 3D Printing, Embedded Hardware & Security, Remote Sensing, Assistive Technologies and CubeSat Demos – Lobdell Dining Hall (W20)
9:10AM – 12:00PM	UAV Competition – MAC Court
9:10AM – 12:00PM	UAV-SAR Demo – Building 31 rear, Viewing Area 3rd Floor
9:10AM – 1:00PM	RACECAR Competition – Johnson Ice Rink
1:00PM	Final Awards Ceremony & Closing Remarks – Johnson Ice Rink
3:00PM	Event End

What Is Beaver Works Summer Institute?

The MIT Beaver Works Summer Institute (BWSI) is a rigorous, world-class STEM program for talented students who will be entering their senior year in high school. The four-week program teaches STEM skills through project-based, workshop-style courses. BWSI began in 2016 with a single course offered to 46 students, a mix of local daytime students and out-of-state residential students. In this course, RACECAR (Rapid Autonomous Complex Environment Competing Ackermann steering), students programmed small robotic cars to autonomously navigate a racetrack.

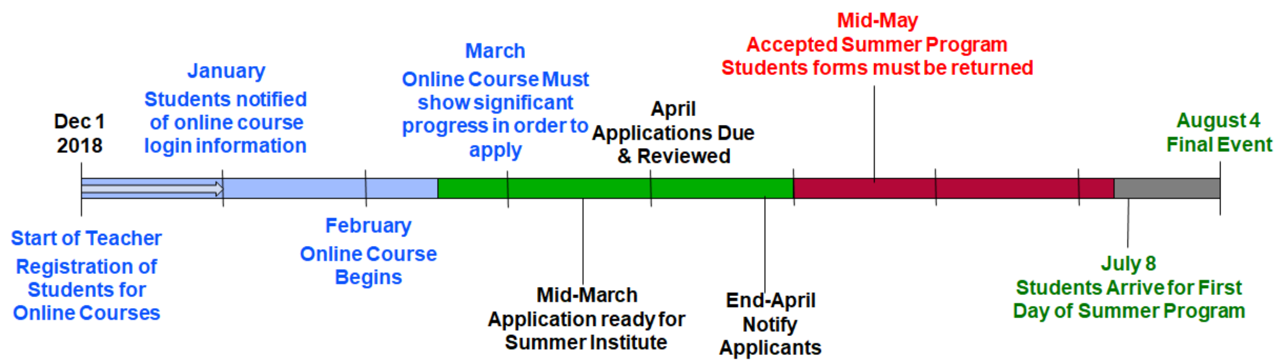
The program has expanded considerably every year since. For the summer of 2018 there were eight different courses attended by 198 students from 105 different high schools. In 2019, BWSI has expanded again to 239 students in 10 courses. In addition to the RACECAR course, there are courses on Autonomous Air Vehicle Racing, Autonomous Cognitive Assistant, Medlytics: Data Science for Health and Medicine, Build a CubeSat, Unmanned Air System–Synthetic Aperture Radar (UAS–SAR), Embedded Security and Hardware Hacking, Hacking a 3D Printer, Assistive Technologies, and Remote Sensing for Crisis Response.

For the first time in 2019, we are offering a course for Boston-area middle school students based on the flagship BWSI RACECAR course. Twenty-four middle school students are learning software programming and controls to program mini-RACECAR vehicles to autonomously navigate through a maze.

We believe we have reached an optimal enrollment number. Expansion in the coming years will focus on developing new courses and working with collaborators to scale up the program nationally and internationally. We will continue to advise high school STEM teachers who want to incorporate the BWSI concepts and materials into their classrooms. Our vision is a broad network of BWSI-like programs that will help improve engineering education, and toward that goal, we will share our work and ideas with universities and high schools worldwide.

Contact us at bwsi-admin@mit.edu for information on how to adopt this program into your school curriculum.

BWSI 2019 Timeline of Program requirements.



What is Beaver Works?

Beaver Works is a joint venture between MIT Lincoln Laboratory and the MIT School of Engineering that is envisioned as an incubator for research and innovation. Beaver Works facilitates project-based learning, a hallmark of an MIT education, and leverages the expertise and enthusiasm of MIT faculty, students, researchers, and Lincoln Laboratory staff to broaden partnerships across both institutions.

The Beaver Works center located in Cambridge, Massachusetts, provides these facilities: areas for collaborative brainstorming; workshops and tools for fabricating prototype systems; and space for classroom-style instruction. Beaver Works allows students to address real-world problems and issues, engages students in hands-on learning, and demonstrates an effective strategy for teaching complex engineering concepts.

Beaver Works supports MIT student involvement in a range of research and educational pursuits, including two-semester, course-based capstone projects; joint and individual research initiatives; and Undergraduate Research Opportunities Program internships. Students involved in these projects develop innovative solutions to real-world problems and gain an exceptional experience in hands-on learning from world-class researchers.

In addition to the Summer Institute, Beaver Works is also extending project-based learning opportunities to local K–12 schoolchildren. Among these offerings have been a robotics workshop for an all-girl FIRST (For Inspiration and Recognition of Science and Technology) LEGO League team, a hands-on camera-building activity for high-school girls, and a one-day workshop on radars for students in middle school.

MIT Beaver Works Summer Institute

2019 Summer Program:
Course Overview

The MIT Beaver Works Summer Institute 2019 Summer Program will consist of the following courses. For more information on each course, see the following pages in this brochure.

Autonomous RACECAR Grand Prix – Lockheed Martin Project
Beaver Works Summer Institute will offer 15 teams of high-school students and 12 teams of middle school students, each with its own MIT-designed RACECAR (Rapid Autonomous Complex Environment Competing Ackermann steeRing) robot, the opportunity to explore the broad spectrum of research in autonomy; learn to collaborate, and demonstrate fast, autonomous navigation in a Mini Grand Prix to ***Move... Explore... Learn...Race****!*

Autonomous Air Vehicle Racing – BAE Project
Beaver Works Summer Institute will offer students the opportunity to explore some new areas of research and to design their own autonomous capabilities for UAVs (unmanned aerial vehicles). The students will work in teams to develop algorithms for deployment to a research quadrotor, the Intel Aero Ready-to-Fly Drone. They will use the Robotics Operating System (ROS), various open-source libraries, and custom algorithms to program the quadrotors.

Autonomous Cognitive Assistance – KAIT Project
Beaver Works Summer Institute will offer students an opportunity to learn about the cutting-edge in machine learning. Cog*Works consists of project-based modules for developing machine learning apps that leverage audio, visual, and linguistic data. Students will work with experts in these fields to learn foundational mathematical, programming, and data analysis skills, which will enable them to create their own algorithms and neural networks from scratch. Ultimately, they will design their own cognitive assistants.

Data Science for Health and Medicine
Beaver Works Summer Institute will give students a chance to explore the exciting intersection of data science and medicine. Students will build a solid foundation in the fundamentals of probability and statistics, and learn the basics of coding and machine learning techniques through a series of online teaching modules. During the summer, students will work in groups alongside Cambridge-area clinicians and data scientists to gain hands-on experience applying advanced machine learning and data mining to solve

real-world medical challenges.

Build a CubeSat – Sierra Nevada Corp. Project
Beaver Works Summer Institute will offer students the opportunity to select the mission, test components and design a CubeSat. The four-week course will guide the class through the design trades, assembly, and testing of a CubeSat with an imaging payload. The design will be tested using a zip line to simulate the motion of an orbit.

Unmanned Air System–Synthetic Aperture Radar – Raytheon Project
Beaver Works Summer Institute will introduce students to radar imaging as they build and fly a radar on a small UAS and use it to image objects around campus. Students will work in small groups alongside engineer mentors to gain hands-on experience building, integrating, and processing data from a radar to generate images of objects around.

Embedded Security and Hardware Hacking – MITRE Project
Beaver Works Summer Institute will cover several cybersecurity topics with a focus on threats that are especially concerning for embedded systems. These topics include embedded software security, cryptographic protocol attacks, UART probing, side-channel analysis, and fault-injection. This background will help prepare students for the summer course, during which they will perform security assessments of multiple implementations of an embedded system to support secure firmware distribution for automotive control. Teams will compete to see who can build the most secure system, and who can find and fix the most security flaws in their classmates' systems.

Hacking a 3D Printer
Beaver Works Summer Institute will introduce students to the fundamentals of 3D printing and teach techniques for tuning hardware and software to optimize performance. Students will modify these components to do something completely new. Along the way, students will learn how to tackle difficult problems.

Remote Sensing For Crisis Response
Beaver Works Summer Institute will offer students the opportunity to explore the exciting intersection of data science and crisis response. During the course, the students will learn the basics of Python, Git, geospatial information systems (GIS), and image processing. Students will explore real world datasets including aerial imagery from drones and Civil Air Patrol, as well as various satellite sources. Students will develop experience in an area of data science that is poised to play a critical role in understanding our world.

Design of Assistive Technology
Beaver Works Summer Institute will help students develop product design, rapid prototyping, and product testing skills in the context of building a technology solution for people living with disabilities. We will tackle real problems faced by people in the Greater Boston Area, and learn to work with the end users, stepping through the engineering design process together to come up with personalized, creative solutions.

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2019 Summer Program:
Autonomous RACECAR Grand Prix Challenge – Lockheed Martin Project

Program Overview

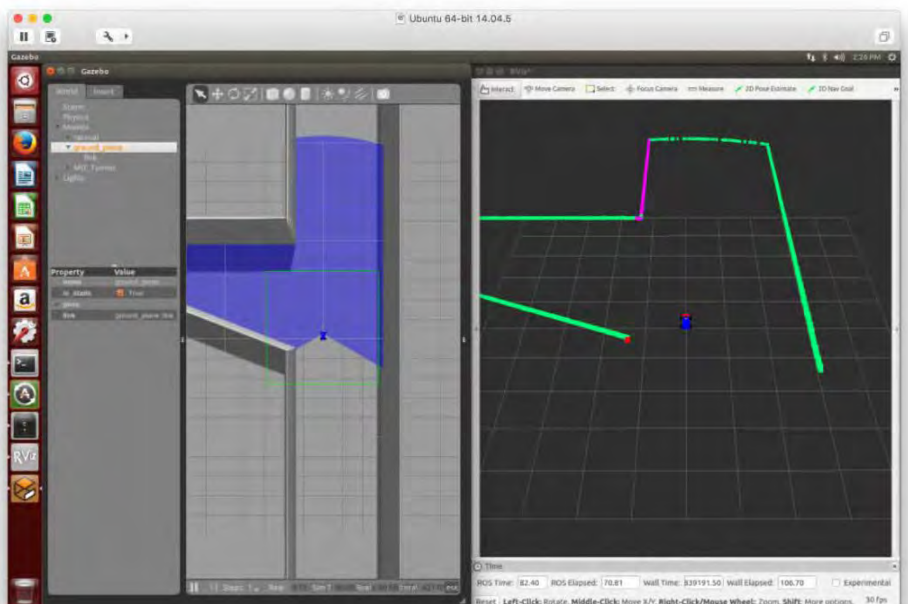
Driverless vehicle technology has been growing at an exponential pace since the DARPA Grand and Urban Challenges pushed the state of the art to demonstrate what was already possible. Commercial interest and aggressive development are being driven by Google, Toyota, Tesla, Continental, Uber, Apple, NVidia, and many other companies. There is no single technology or “killer app” available to solve the myriad perception, understanding, localization, planning, and control problems required to achieve robust navigation in highly variable, extremely complex and dynamically changing environments. This summer, Beaver Works Summer Institute will offer nine teams of five students, each with its own MIT-designed RACECAR (Rapid Autonomous Complex Environment Competing Ackermann steeRing) robot, the opportunity to explore the broad spectrum of research in these areas, and learn to collaborate, and demonstrate fast, autonomous navigation in a Mini Grand Prix to ***Move... Explore... Learn...Race***!

This program consists of two components: an online course from January to May open to all interested students and a four-week summer program at MIT from July 8 to August 4 for a select group of students. The online component gives students a background in the basic concepts and tools that will be used during the summer program. The Robot Operating System (ROS) provides a rich set of tools that may be programmed at a high level with the Python programming language. A model of the RACECAR suitable for use in the Gazebo simulator allows online students to develop skills and demonstrate the basic concepts without requiring a physical RACECAR.

Completing the online curriculum will prepare students to cover the topics of Control Systems, Computer Vision, Localization, Planning, and Navigation at a more advanced level in the summer. The RACECAR is capable of achieving speeds of 40 mph, utilizing data from real sensors processed with an onboard NVidia TX-1 embedded computer. Such a demonstration of safe, robust autonomous navigation is a significant challenge. A team of experienced MIT researchers will provide the lectures each day, covering material that reviews autonomy fundamentals and expanding on advanced topic areas in the lecturers' expertise. A series of graduated exercises, hands-on labs, and weekly challenge demonstrations will be provided to lead students through the process of developing their solutions to the fundamental problems. In addition, guest lecturers from among leading researchers in the computer science, engineering, and autonomous vehicle academic and corporate communities will provide students with insight into emerging trends in these fields.

<u>Online Course</u>

The online component for the Autonomous RACECAR course contains important introductory material to provide students with the background required to successfully complete the four-week summer course. A virtual machine image is provided for students to download and use on their own computers, with necessary tools preinstalled, so that they can work through both the introductory and more advanced topics and explore problems specific to autonomous vehicles.



RACECAR model navigating simulated Gazebo world with synthetic sensor data

Introduction and Prerequisites

- Installing and using the virtual machine
- Reviewing the overview of the Ubuntu/Linux environment
- Learning the basics of Python programming

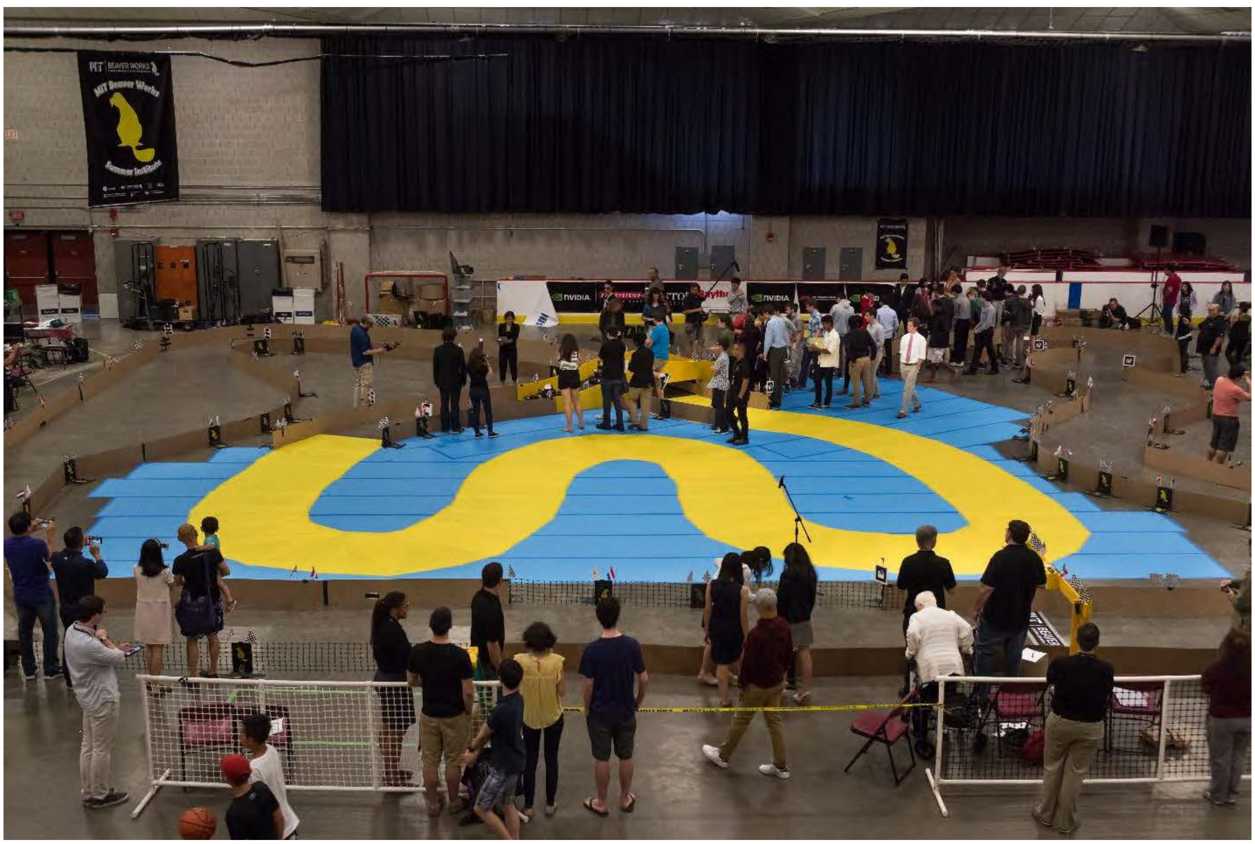
- Completing an introduction to the Robot Operating System

Autonomous Vehicles

- Using the RACECAR model in the Gazebo simulation environment
- Studying basic control systems
- Studying fundamentals of computer vision using the OpenCV library
- Acquiring elementary navigation and planning concepts

<u>Summer Course</u>

The four-week summer program is based on the BWSI 2017 course, with additional online material that prepares students to begin the summer course at a more advanced level. The curriculum is being expanded this year to emphasize the use of computer vision and machine learning techniques in autonomous navigation.



Each day in the course will consist of a mix of lectures and hands-on projects to reinforce and apply the material. The detailed topics for each week are listed below:

Week 1: Move…

- RACECAR system operation and sensors
- Robot Operating System principles
- Basic motion control and simple obstacle avoidance

Week 2: Explore…

- Computer vision techniques
- Vision-based blob, target, and object detection
- Visual navigation

Week 3: Learn…

- Mapping unknown environments
- Planning paths to achieve goals
- Navigating in dynamic environments

Week 4: Race!

The final race will be held in the MIT Johnson Ice Rink on August 4, 2019. A wide variety of challenges will require that a range of behaviors be implemented to allow the racecar to make high-level decisions based on visual perception in order to complete a circuit of the track.

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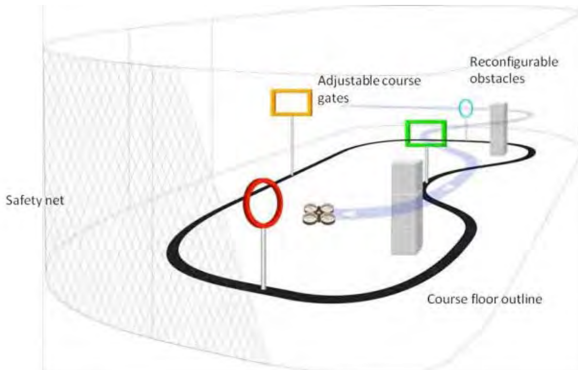
2019 Summer Program:
Autonomous Air Vehicle Racing – BAE Systems Project

Autonomous Air Vehicle Racing

Program Overview

Rapidly expanding unmanned aerial vehicle (UAV) technology has enabled a number of new application areas. The growth in UAV development is evident in the popularity of First Person View (FPV) drone racing, and interest from companies, like Amazon and others, to develop fully autonomous aerial delivery vehicles. As UAV technologies mature, they open new and exciting areas for potential research. This summer, Beaver Works will offer students the opportunity to explore some of these new areas of research, and to design their own autonomous capabilities for UAVs. The students will work in teams to develop algorithms for deployment on a commercial quadrotor, the Intel Aero Ready-to-Fly Drone. They will use the Robot Operating System (ROS), various open-source libraries, and custom algorithms to program the quadrotors.. The summer course will culminate in a competition at which the students will apply the knowledge gained from the four-week program's projects and lectures to a series of racing challenges.

This program consists of two components: an online course from January to May open to all interested students and a four-week summer program at MIT from July 8 to August 4 for a small group of students. The online component gives students a background in the course material, and provides a solid mathematical foundation that will be critical when completing the more advanced topics of the summer course. Students will demonstrate basic implementations of control and autonomy after each unit of instruction. These lessons will build upon previous instruction to enable students to develop algorithms so that a quadrotor can autonomously navigate a UAV racecourse designed for the summer program.



Conceptual UAV Race Course

Online Course

The online component for the Autonomous Air Vehicle Racing course will contain important introductory material that will provide students with the background required to successfully complete the four-week summer course. In addition to the introductory material, the online course will include more advanced, quadrotor-specific material so that students can begin to explore problems specific to autonomous aerial vehicles.

Introduction and Prerequisites

- Introduction to quadrotors
- Linear algebra
- Basics of matrix mathematics
- Introduction to probability and statistics
- Computer programming fundamentals

Autonomous Aerial Vehicles

- Flight geometry
- Actuators and control
- State estimation
- Sensing
- Basic control theory
- Computer vision
- Visual motion estimation

Summer Course

The four-week summer program will be structured to provide the students with projects and hands-on exercises. The program will apply and expand upon the online course material, leading to multiple competitive team challenges in autonomous UAV control. Each day the course will consist of a mix of lectures and hands-on projects to reinforce and apply the material. A team of experienced MIT researchers will provide the lectures, covering material that reviews UAV and autonomy fundamentals and expanding on advanced topic areas in the lecturer's expertise. Hands-on projects will enable the students to apply each lecture, working toward a capability for autonomous UAV racing by using the provided Intel Aero Ready-to-Fly Drone and associated experimentation equipment. In addition, the course is lining up guest lecturers from among leading researchers in the computer science, autonomy, and air vehicle academic and corporate communities to provide the students with emerging trends in these fields. Upon completion of the four-week course, the students will have developed an understanding of autonomous systems development; including controls, flight dynamics, navigation, and computer vision.

The course extends over four weeks of instruction and hands-on practice and one week of team challenges, culminating in the final UAV racing challenge. The detailed topics for each week are listed below:

Week 1: Flight

- Quadrotor design
- Quadrotor dynamics
- Quadrotor components

Week 2: Vision

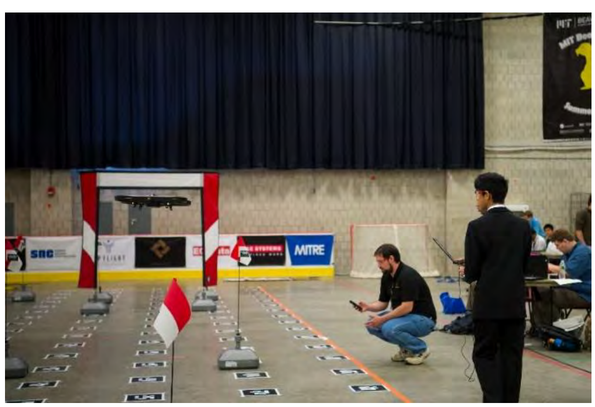
- Image formation
- Edge detection
- Image filtering
- Object detection

Week 3: Control

- Control systems
- State estimation
- Navigation and planning

Week 4: Racing Challenges

The final week of the course will focus on hands-on team projects in autonomous UAVs and racing challenges, leveraging the lessons learned from the first three weeks of the course.



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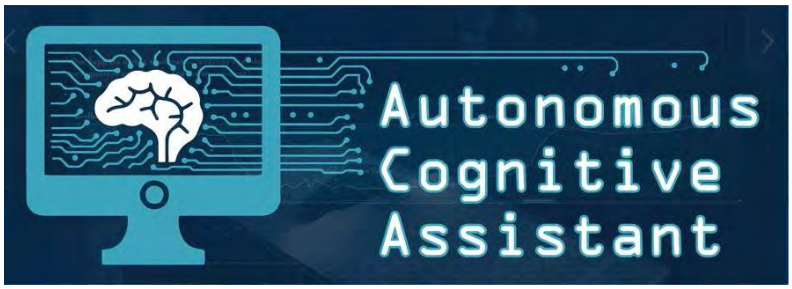
2019 Summer Program:
Autonomous Cognitive Assistant – KAIT Project



Program Overview

Artificial intelligence research has achieved a dramatic resurgence in recent years, as innovation of novel deep learning and other machine learning tools has enabled machine performance surpassing humans in specific cognitive tasks. New records in “machine thinking” seem to be set almost daily. This summer, the BWSI is offering students a chance to learn and use the state-of-the-art machine learning tools in a program called Cog*Works: Build your own Cognitive Assistant. The program will guide students in learning and applying the foundational technologies of artificial intelligence for building cognitive assistants. Students who have successfully completed the online course will be considered for participation in the summer program in which teams of students will leverage professional cognition services (e.g., Amazon Alexa/Echo) and open-source tools in conjunction with their own machine learning tools to develop cognitive systems. The program will be divided into modules during which students will implement and explore algorithms in core areas of natural language processing and machine cognition. These capabilities will be composed to create end-to-end cognitive assistants that will compete against each other at the end of the program.

This program consists of two components: (1) online course from January to May 2019, open to all interested and committed students, and (2) a four-week summer program at MIT for a small group of students, July 8–August 4. During the course, the students will be trained to understand the basics of Python, Git, natural language processing, and machine learning through a series of online teaching modules. Students will build services that are both functional and fun. By participating in the online and/or onsite portion of the program, students will develop experience in an area of computer science that is poised to play a critical role in shaping future technologies and applications across industries.

Online Course

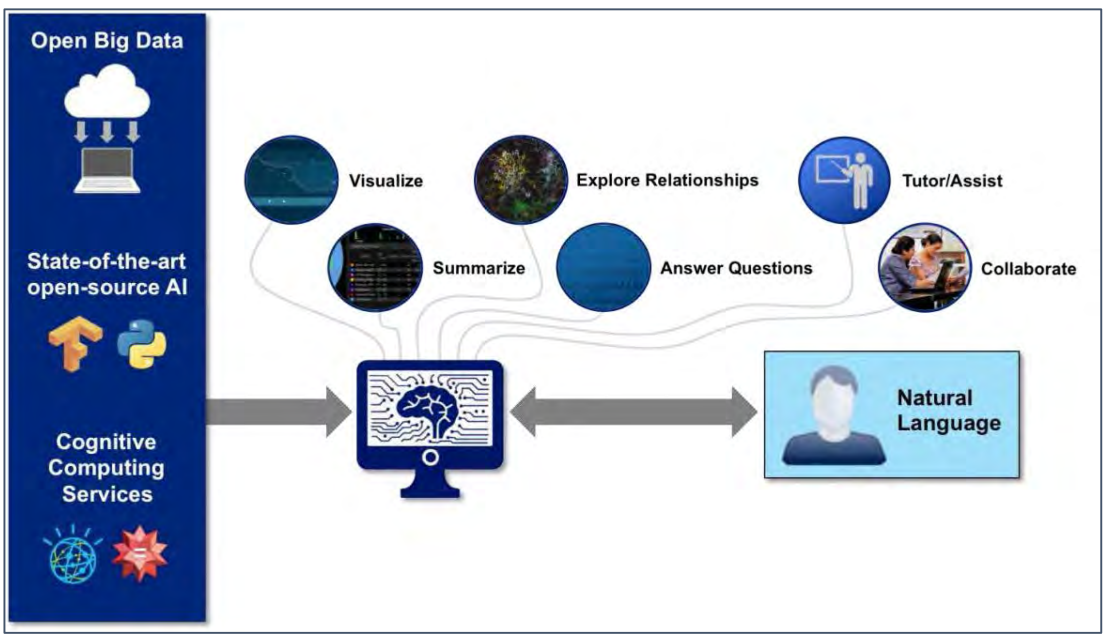
The online component for the Cog*Works course will contain important introductory material that will provide students with the background required to successfully complete the four-week summer course. In addition to the introductory material, the online course will include more advanced machine learning–specific material that will enable students to begin exploring problems specific to cognitive assistants.

Introduction and Prerequisites

- Introduction to Python
- Git & Github management tools
- Perspectives on machine learning

Autonomous Cognitive Assistants

- Advanced NumPy
- Simple image classification with Python
- Introduction to neural networks
- Introduction to Web Services
- Introduction to Amazon Alexa © services



Summer Course

The four-week summer component of the BWSI Cog*Works course aims to guide students through the process of creating their own cognitive assistants. Daily lectures from course instructors and guest speakers will solidify and expand upon the content from the online portion of the course. Students will collaborate in small groups to complete milestone projects that are based on their lecture materials. These projects will allow for creative customization and enhancements from the students, and weekly awards will be given to the group(s) with the most "interesting" projects. Ultimately, these projects will serve as the components that compose an end-to-end cognitive assistant.

The following is a rough outline for the summer course:

Week 1: Audio

- Python/NumPy/Github review
- Audio recording, sampling, and encoding
- Discrete Fourier transforms and their applications
- Pattern recognition in audio data
- Audio capstone project

Week 2: Visual

- Review of machine learning concepts
- Coding your own autograd library
- Training dense and convolutional neural networks
- Visual capstone project

Week 3: Language

- Representing written language numerically
- Document comparison and summarization
- Training language models
- Training word embeddings
- Information retrieval
- NLP capstone project

Week 4: Challenges

- Create your own end-to-end applications of machine learning

MIT Beaver Works Summer Institute

2019 Summer Program:
Data Science for Health and Medicine

Program Overview

Data mining and machine learning have become ubiquitous in the age of "big data," and for good reason: advanced learning algorithms take advantage of ever-growing compute capacity and vast amounts of data to solve complex problems that can often meet or exceed human ability. These techniques are being embraced in nearly every sector including financial trading, cybersecurity, entertainment, advertising, autonomous vehicles, and of course health and medicine. The increasing adoption of electronic health records, mobile health apps, and wearable technologies continues to generate troves of rich, real-time, high-resolution data. This data is now being used to train algorithms to help physicians build prognostic models, conduct medical image analysis, and improve diagnostic accuracy.

In 2019, the BWSI Medlytics program will offer students the opportunity to explore the exciting intersection of data science and medicine. The program consists of two components: (1) online course from January to May 2019, open to all interested and committed students; and (2) a four-week summer program at MIT campus in Cambridge, MA for a group of 20-25 students from July 8—August 4, 2019. The online course will help students build a solid foundation in the fundamentals of probability and statistics, and provide an introduction to coding and machine learning techniques through a series of online teaching modules. During the summer, students will work in groups alongside Cambridge-area clinicians and data scientists to gain hands-on experience applying advanced machine learning and data mining to solve real-world medical challenges.

<u>Online Course</u>

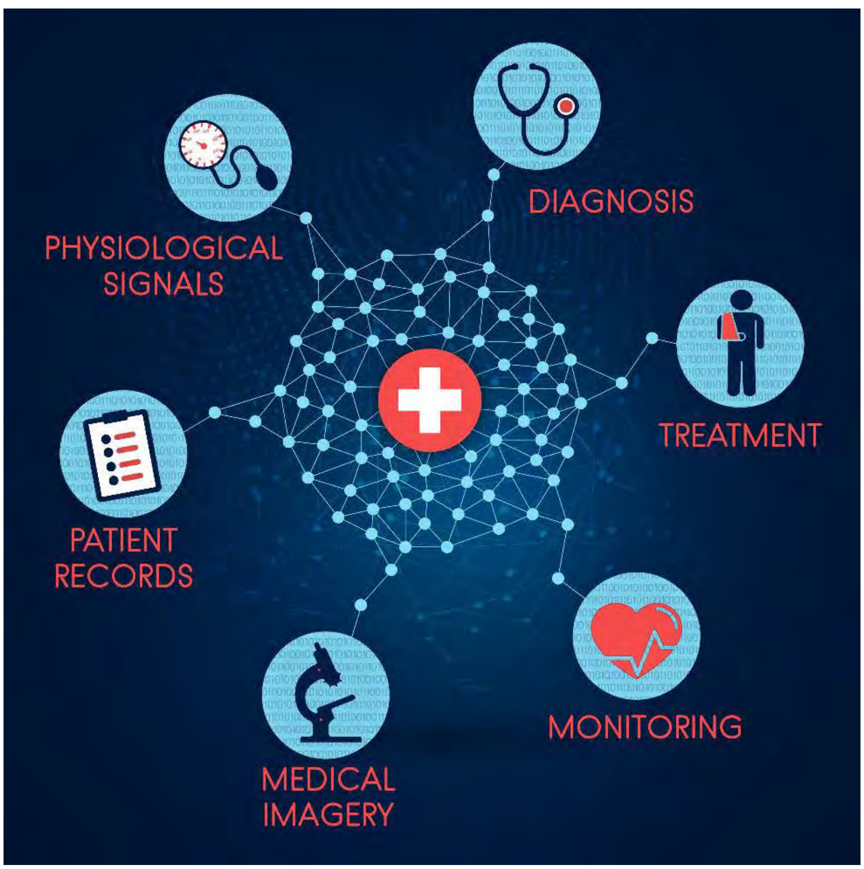
The online component for the BWSI Medlytics course contains important introductory material to provide students with the background required to successfully complete the four-week summer course. In addition to the introductory material, the online course will expose students to real-world data and machine learning techniques, and introduce some of the challenges and opportunities of combining the two.

Introduction

- Perspectives on the challenges of working with medical data
- Probability & statistics
- Introduction to coding: Python, Git, Jupyter

Data Science for Health and Medicine

- Defining a patient cohort
- Correlation and regression; noise vs. outliers
- Beginner machine learning: supervised and unsupervised algorithms
- Introduction to time series data analysis



Summer Course

The four-week summer component of Medlytics will take a deep-dive into the application of data analytics to structured data, physiological signals, and medical imagery. Prepared course material, case studies, and small-group projects will expose students to some of the challenges inherent to working with medical data and introduce them to state-of-the-art machine learning tools. Boston-area clinicians, academics, and industry leaders will visit the class to give daily guest seminars, providing valuable real-world knowledge and insights. Students will compete in weekly challenges and participate in a final capstone project from concept proposal to live demonstration.

The following is a rough outline for the summer course:

Week 1: Introduction to Diagnostic Research and Machine Learning

- Research questions, hypotheses and objectives
- Structured data processing and plotting in Python
- Classification evaluation and metrics
- Supervised machine learning
- Clinical Data Challenge 1: Diagnosing Hypothyroidism

Week 2: Signals Processing and Deep Learning

- Introduction to signals processing
- Fourier transforms
- Machine learning for time-series data
- Artificial neural networks
- Clinical Data Challenge 2: Classifying Sleep Stages

Week 3: Image Processing and Advanced Data Analytics

- Computer vision applications in medicine
- Texture classification using convolutional neural networks
- Transfer learning
- Clinical Data Challenge 3: Analyzing Mammograms

Week 4: Capstone Project

In the final week of the course, students will work in teams to propose, design, and demonstrate a health application prototype, leveraging the lessons learned from weeks 1-3.

MIT Beaver Works Summer Institute

2019 Summer Program:
Build a CubeSat [1]

Program Overview

In 2019, this BWSI course is dedicated to space but grounded in science. The course will partner with Woods Hole Oceanographic Institution (WHOI) to tackle a real world ocean science mission. Based around a 1-3U CubeSat (10 cm x 10 cm x 10 to 30 cm), the four-week course will guide the class through the design trades, assembly, and testing of a CubeSat with an imaging payload. The program will consist of two components. The first is a series of online courses teaching the basics of satellite development coupled with computer-driven exercises that will allow the class to perform key design trades for the mission involving communication, power generation and usage, size, mass, and performance. The four-week summer program will review the key points from the online course and add in lessons on how to handle and test hardware before heading into the lab to assemble and test a working satellite. During the summer course, students will work with Lincoln Laboratory staff and MIT graduate students to gain hands-on experience in building a space system.

The progression of miniature electronics coupled with the availability of launch rideshares provides access to space for a wide range of organizations that weren't able to dream of such capability 20 years ago. The advent of the CubeSat standard by Bob Twiggs and Jordi Puig-Suari in 1999 opened up real, achievable access to space for student projects that allows for hands-on development experience for the next generation of scientists and engineers.

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[1] Ozmen Foundation Fund at the Community Foundation of Western Nevada

Online Course
The online component for the BWSI CubeSat course contains important introductory material to provide students with the background required to successfully complete the four-week

Introduction and Prerequisites

- Why we go to space?
- Basics of rockets and orbital dynamics (using Systems Toolkit)
- Spacecraft subsystems

Satellite Design Work

- Spacecraft systems design trades
- Power systems
- The space environment
- Laboratory safety

Summer Course
The four-week summer component of BWSI CubeSat will focus in the lab on building and testing spacecraft hardware. Daily lectures will review the basics with the students, and guest lectures on key spacecraft systems will be given. In the lab, students will split into teams to get hands-on exposure to hardware testing, assembly, and programming. Students will be mentored by Lincoln Laboratory staff, and MIT faculty and graduate students, and WHOI engineers and scientists.

The following is a rough outline for the summer course:
Week 1: "Space, The Final Frontier" Hardware Basics and Systems Engineering

- Space systems 101
- Basic hardware safety and handling
- Software fundamentals

Week 2: Spacecraft Subsystems

- Testing and assembly of all subsystems
- Payloads and camera performance
- Communication and power
- Software, the glue that holds it all together

Week 3: "Houston We Have A Problem" Making It All Work Together

- Subsystem integration
- System and software testing
- Mission planning, attitude determination
- Debugging and testing a flight system

Week 4: Test Flights and Analysis

- Final functional testing
- Simulated “flight”
- Evaluate mission performance

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2019 Summer Program:
Unmanned Air System - Synthetic Aperture Radar – Raytheon Project

Program Overview

The recent explosion of unmanned air vehicle (UAV) technology coupled with the miniaturization of electronics opens the door to countless applications and missions. UAVs can provide unparalleled views at sporting events, images of structures are not safely accessible to construction workers, and scenic aerial photography, all using low-cost camera technology. One can also envision many applications of small UAV-based radar solutions, ranging from day/night autonomous tracking of objects of interest in all–weather conditions to change detection using radar imaging techniques to search and rescue.

In 2019, the BWSI Unmanned Air System – Synthetic Aperture Radar (UAS-SAR) program will offer students the opportunity to explore the field of radar imaging by building and flying a radar on a small UAS and using it to image objects around campus. The program consists of two components: (1) online course from January to May 2019, open to all interested and committed students, and (2) a four-week summer program at MIT campus for a small group of students from July 8–August 4, 2019. The online course will help students build a solid foundation in the fundamentals of radar; Python programming; and an introduction to SAR image formation. During the summer, students will work in small groups alongside mentors to gain hands-on experience building, integrating, and processing data from a radar to image objects around campus.

Online Course
The online component for the BWSI UAS-SAR course contains important introductory material to provide students with the background required to successfully complete the four-week summer course. In addition to the introductory material, the online course will expose students to real-world radar data and UAV motion properties.

Introduction and Prerequisites
- Introduction to Python
- Introduction to Numpy, Matplotlib, and other required Python packages
- Git and GitHub collaboration tools

Radar
- Fundamentals of radar
- Radar system components
- Ranging w/ a radar
- Doppler effect

Summer Course

The four-week summer component of the UAS-SAR course will feature a mix of lectures from radar experts, team-based system development, and real-world experiments with mini-capstone milestones at the end of each week. Lectures w/ active student participation will reinforce basic radar concepts and dive deep into the principles behind radar imaging. Students will conduct real-world experiment by defining experiment objectives and plans, executing said plans, and performing analysis on the collected data. They will also learn how to interpret radar imagery in order to assess success and areas for improvement in their systems.

Week 1: Let's Build a Radar
- Python review
- Radar fundamentals review
- Implement radar command and control
- UAS construction
- Milestone: Ranging and Doppler experiments w/ show-and-tell

Week 2: Let's Form an Image
- Introduction to SAR imaging
- Implementing SAR via backprojection
- Rail-SAR experiments
- Milestone: Best SAR image challenge

Week 3: Up, Up, and Away
- Integration of radar onto UAS
- UAS-SAR data collections
- Refining SAR imaging algorithms
- Milestone: Best UAS-SAR image challenge

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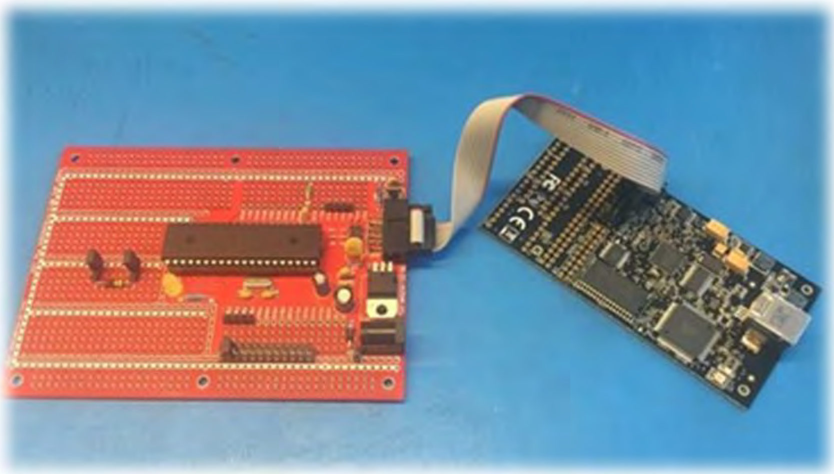
Week 4: Best Image

- Teams refine/improve their UAS-SAR
- Team develop novel capabilities for their UAS-SAR
- Teams compete to form the best image of a secret challenge scene

MIT Beaver Works Summer Institute

2019 Summer Program:

Embedded Security and Hardware Hacking – MITRE Project



Program Overview

Most of us are aware of our reliance on computers throughout our everyday lives, but what we typically think of as computers (from the servers that run our favorite websites, to our laptops and smartphones) are only the tip of the iceberg. Hidden just beneath the surface is a substantial and diverse group of computers referred to as embedded systems. Although the concept may be unfamiliar to many, embedded systems are pervasive and have existed for decades. They commonly work within larger pieces of technology, performing specific tasks, such as operating one element of a car, medical device, aircraft, or even a musical instrument. Their security affects the security of the larger system. And they are being hacked!

This program consists of two components: an online course from January to May open to all interested students, and a four-week summer program at MIT from July 8 to August 4 for a select group of students.

The online course will introduce the students to several security topics with a focus on threats that are especially concerning for embedded systems. These topics include: embedded software security, cryptographic protocol attacks, UART probing, side-channel analysis, and fault-injection. This background will help prepare students for the summer course, during which they will perform security assessments of multiple implementations of an embedded system to support secure firmware distribution for automotive control. Teams will compete to see who can build the most secure system, and who can find and fix the most security flaws in their classmates' systems.

Online Course

The online component for the embedded security and hardware hacking course contains important introductory material to provide students with the background required to successfully complete the four-week summer course.

The online course will consist of the following modules:

- Hardware
- Cryptography
- Embedded software
- C and Assembly

Summer Course

The four-week summer program is based on the MITRE 2017 Collegiate eCTF, which challenged teams of undergraduate and graduate students to design a secure system to support secure firmware distribution for automotive control. BWSI students will design their own system in teams and in the final week of the program will compete to see who can find and fix the most secure flaws in the other teams' systems. The course will consist of a mix of lectures and hands-on projects that reinforce and apply the material. The detailed topics for each week are listed below:

Week 1: Cryptography

Week 2: Embedded Software and Embedded Software Security

Week 3: Introduction to Embedded Systems

Week 4: Implementation Attacks and Capture the Flag Competition!

MIT Beaver Works Summer Institute

2019 Summer Program:
Hack a 3D Printer

Program Overview

Additive Manufacturing (AM), and in particular 3D printing, has become a powerful tool in scientific, engineering, and industrial applications. As the technology becomes more pervasive, we continually look for applications and ways to use these tools in innovative ways. One of the key advantages to the open nature of this technology is the ability to modify a printer to operate in a way that was not originally intended.

In summer 2019, BWSI will host the new Hack a 3D Printer course. The goals of this course are to introduce the fundamentals of 3D printing, show how hardware and software can be tuned for optimal performance, and teach techniques to modify these components to do something completely new. Along the way students will learn how to use engineering skills to tackle a difficult problem.

Teams of students will spend four weeks at MIT building, coding, using, and hacking their own 3D printers. The first week will be dedicated to the “nuts and bolts” of AM as students build their own printers. When the printers are complete, students will learn how to use and tune these devices. The second week is dedicated to engineering and design principles as students tackle a number of team-based challenges. Using computer-aided design (CAD) the students will need to design and 3D print their own solutions to problems inspired by real life. Week 3 will focus on hardware and software modifications to the printers they have built. Starting with small instructor-led tweaks to improve performance, the students will ultimately plan a major hardware modification to their printers. The final week is dedicated to implementing their hardware modification, and designing and printing an engineered solution with their “hacked” printer.

<u>Online Course</u>
Before arriving on campus students will be required to complete an online course on AM. The course will introduce students to key math, science, and engineering concepts that will be required on day one. A large portion of this online course will be dedicated to CAD, and students will be required to submit completed CAD drawings.

Introduction and Prerequisites
- Introduction to Additive Manufacturing
- Geometry and Coordinate Systems
- Introduction to Materials Science

Computer Aided Design (CAD)
- Introduction to CAD
- OnShape Tutorials

<u>Summer Course</u>
During the four-week on-campus course, students will learn the details of AM primarily through hands-on activities and experimentation. Daily lectures will provide information and direction, but students will need to apply sound reasoning to solve a variety of engineering challenges. Guest lecturers from MIT and Boston-area companies will help provide context and specific applications of these technologies. Visits to MIT labs using AM and other emerging technologies will be included.

Week 1: Building a 3D Printer
- 3D printer hardware build
- CAD review
- Slicing and g-code
- Printer tuning and optimization

Week 2: Engineering Design Principles
- Designing with constraints
- Limitations of material properties
- Working with a customer
- AM in the real world

Week 3: Printer Modification
- Novel materials
- Advanced CAD and slicing
- Customizing g-code

Week 4: 3D Printing Challenge

The final week will be dedicated to implementing and optimizing a major printer modification. Using the modified printers, students will develop a solution to an engineering challenge.

MIT Beaver Works Summer Institute

2019 Summer Program:
Remote Sensing For Crisis Response

https://www.af.mil/News/Article-Display/Article/116782/rescue-center-members-assist-with-saving-330-lives-in-tennessee/

Program Overview

Imagine coordinating a response after the chaos of a hurricane or the challenges of a famine lasting years; these big problems require big data to solve. With airplanes and satellites, we collect mountains of data of affected regions, but who looks at this data? How do we turn this data into a physical response? The program's goal is for participants to explore, leverage, and transform open source information and imagery collected from drones, airplanes, helicopters, and satellites to generate actionable intelligence to support a disaster or humanitarian response. Students will be exposed to three main components: 1) processing and extracting features from raw data, 2) data classification and analysis, and 3) developing data products to support decision making. The program will explore tools and techniques using real world operational data collected from across the globe.

The BWSI Remote Sensing program will offer students the opportunity to explore the exciting intersection of data science and crisis response. The program consists of two components: (1) online course from January to May, open to all interested and committed students; and (2) a four-week summer program at MIT campus in Cambridge, MA. During the course, the students will learn to understand the basics of Python, Git, machine learning, and image processing. Students will explore real world datasets of aerial and satellite imagery. By participating in the online and/or onsite portion of the program, students will develop experience in an area of data science that is poised to play a critical role in understanding our world.

Online Course

Prior to the summer course at MIT campus, students will be required to complete an online course which contains important introductory material. The online course will give the students a strong foundation required to successfully complete the four-week summer course. In addition to foundational introductory material, the online course includes discussion of different use cases and expose students to real world challenges and applications of the coursework.

Introduction

Computer Science

- Getting started with Python
- Git & GitHub management
- Geospatial information systems (GIS)

Data Science (Python)

- GDAL, NumPy, Pandas, GeoPandas, Rasterio
- Simple image classification
- Introduction to Web Services & Flask

Real World Data

- Civil Air Patrol
- Landsat-8
- OpenStreetMaps

Summer Course

The four-week summer component of aims to guide students through the processing of designing experiments and analyzing commonly used for data for disaster response. Daily course material, case studies, guest lectures, and small-group projects will expose students to challenges across technical domains.

Week 1: Foundation

- Introduction to Remote Sensing for Humanitarian Assistance and Disaster Relief
- Review of online Python course
- GIS and networks in Python
- Field trip to MIT Lincoln Laboratory

Week 2: Data Science and Analysis

- Introduction to engineering design and data science principles
- Images, metadata, and image processing
- Field trip to Massachusetts Task Force One (MA-TF1)

Week 3: Aerial Imagery and Sensing

- Civil Air Patrol and Aerial Imagery
- Internet of things and analyzing aerial images
- Building a hardware multispectral sensor
- Kite photography
- Field trip to Draper Laboratory

Week 4: Optimization Decision Making

- Network optimization and class optimization formulations
- Guest lectures from Swissnex and Red Cross Red Crescent Climate Centre
- Final exercise of disaster tabletop simulation

MIT Beaver Works Summer Institute

2019 Summer Program: Assistive Technologies (AT)

Program Overview

There are many members of our communities who live with physical and cognitive disabilities, some of whom may be helped by assistive technologies (AT). However, these technologies often need to be customized for the individual, making it difficult to simply use off-the-shelf products. This course will help students develop product design, rapid prototyping, and product testing skills in a user co-design manner to understand how to produce these kinds of solutions.

We will first go over product design processes and exercises in general, and then bring those into the context of working in the assistive technology space. Using example problems and working with community co-designers with disabilities, we will learn how to conduct co-designer interviews to develop product requirements, and how to develop those requirements into prototypes. With early prototypes, we then look at how to iterate over different designs, taking user feedback into account in order to arrive at AT solutions that work well for the end-user.

Online Course

Before arriving on campus students will be required to complete an online course introducing assistive technology, product design, and specific technical skills. The course will introduce students to key math, science, and engineering concepts that will be required on day one. The latter portion of the online course will be an open-ended design activity that will integrate the lessons on design thinking and the technical skills they learned in the earlier portions of the course.

The online course will consist of the following modules:

- What is assistive technology?
- Design thinking
- Design processes
- Technical skills development
- Open-ended design activity

<u>Summer Course</u>

The four-week summer component of BWSI AT will give students a chance to use and further develop what they learned through the online course, with lectures and hands-on design exercises, culminating with teams of students developing two AT solutions for challenges posed by a community co-designer with a disability. The first challenge will have the teams carefully stepping through the design process, working towards a known solution, while the second will be more open-ended, and push teams to work creatively to build something completely novel in an iterative way.

A team of MIT researchers and students will help students through these materials and activities, using previous AT solutions developed at MIT as guiding examples. Co-designers will also be present to help students evaluate their products and provide additional feedback. By the end of this course, students will have developed an understanding of the engineering process that it takes to build an AT solution, be able to identify engineering requirements from user interviews, be able to identify potential solutions and the skills required to implement the solutions, and build their own prototype solutions.

This course is new for the summer of 2019 and is still under development. The focus of the technology skills component in particular will depend on the co-designer's challenge and is subject to change, but may include areas such as computer-aided design, 3D printing, and electronics. Past projects that have come out of a similar MIT class and hackathon have included all-terrain walkers, jackets that can be zipped up with one hand, a device to control smartphones using sip-and-puff breath inputs, and others.

Week 1: Product Design Introduction

- Interviewing users and identifying requirements
- Working with people with different disabilities
- Rapid prototyping using basic materials

- User testing and learning from tests
- Documenting designs

Week 2: First Challenge
- Co-designer introduction
- Examining proposed solutions and required skills
- Build and present solutions

Weeks 3-4: Second Challenge
- Co-designer introduction
- Brainstorming, planning, and presenting initial ideas
- Build and present solutions
- Prototype testing and evaluation by co-designer
- Tweak, rebuild, refine, reevaluate
- Present final products

MIT Beaver Works Summer Institute

2019 Summer Program:
Autonomous RACECAR Mini Grand Prix Challenge

Program Overview

Driverless vehicle technology has been growing at an exponential pace since the DARPA Grand and Urban Challenges pushed the state of the art to demonstrate what was already possible. Commercial interest and aggressive development are being driven by Google, Toyota, Tesla, Continental, Uber, Apple, NVIDIA, and many other companies. There is no single technology or “killer app” available to solve the myriad perception, understanding, localization, planning, and control problems required to achieve robust navigation in highly variable, extremely complex and dynamically changing environments.

This summer, Beaver Works Summer Institute will offer twelve teams of two students, each with their own MIT-designed RACECAR-MN (Rapid Autonomous Complex Environment Competing Ackermann steering Model Nano) robot, the opportunity to explore the broad spectrum of research in these areas, and learn to collaborate, and demonstrate fast, autonomous navigation in a Mini Grand Prix to ***Move... Explore... Learn...Race****!*

This program consists of a four-week summer program at MIT from July 10 to August 4 for a select group of students. Completing the curriculum will prepare students to cover the topics of **Python, Computer Vision, and Control Systems**.

The Mini-RACECAR is capable of achieving speeds of 30 mph, utilizing data from real sensors processed with an onboard NVIDIA Jetson Nano embedded computer. Such a demonstration of safe, robust autonomous navigation is a significant challenge.

A team of experienced MIT researchers will provide lectures each day, covering material that reviews autonomy fundamentals, and expanding on advanced topic areas in the lecturers’ expertise. A series of graduated exercises, hands-on labs, and weekly challenge demonstrations will be provided to lead students through the process of developing their solutions to the fundamental problems. In addition, guest lecturers from among leading researchers in the computer science, engineering, and autonomous vehicle academic and corporate communities will provide students with insight into emerging trends in these fields.

Class Overview

- Learning the basics of Python programming
- Using Jupyter Notebooks
- Studying fundamentals of computer vision using the OpenCV library
- Studying basic control systems
- Acquiring elementary navigation and planning concepts

Each day in the course consists of a mix of lectures and hands-on projects to reinforce and apply the materials learned.

The detailed topics for each week are listed below:

Week 1: Move…

- Introduction to Python
- Using Jupyter Notebooks

Week 2: Explore…

- Introduction to OpenCV
- Computer vision techniques
- Basic motion control and simple obstacle avoidance

Week 3: Learn…

- Vision-based blob, target, and object detection
- Visual navigation

Week 4: Race!

The final race will be held in the MIT Johnson Ice Rink on August 4, 2019. A wide variety of challenges will require that a range of behaviors be implemented to allow the racecar to make high-level decisions based on visual perception in order to complete a circuit of the track.

MIT Beaver Works Summer Institute

2019 Summer Program Seminar Series

11:30am, MIT Room 34-101

July 9 (Tue):	Prof. John Hart, MIT Mechanical Engineering *Adventures in Extrusion Additive Manufacturing*
July 10 (Wed):	Don Kieffer, MIT Sloan School of Management *Dynamic Work Design: Principles, Structures, Methods*
July 11 (Thu):	Dr. Jerry Wohletz, BAE Systems *Autonomous Intelligence: The AI You Don't Know*
July 12 (Fri):	Katie Rae, The Engine *Inspiring the Next Generation of Tough Tech Founders*
July 15 (Mon):	Dr. Jalal Khan, MIT Lincoln Laboratory *3D Imaging using Photon-counting Laser Radars*
July 16 (Tue):	DJ Rock, MIT Admissions Office *Applying to Highly Selective Colleges*
July 17 (Wed):	Prof. Kerri Cahoy, MIT Aeronautics and Astronautics *Using Weather Balloons and CubeSats to Learn About Space Exploration*
July 18 (Thu):	Prof. Hamsa Balakrishnan, MIT Aeronautics and Astronautics *Lean, Green, Flying Machines – Control and Optimization Algorithms for Better Air Transpotration Systems*
July 19 (Fri):	Prof. Neil Gershenfeld, MIT Media Lab *How to Make (almost) Anything*
July 22 (Mon):	Prof. Sanjay Sarma, MIT Open Learning *How We Learn*
July 23 (Tue):	Dr. Eric Evans, Director, MIT Lincoln Laboratory *MIT Lincoln Lab Overview*
July 24 (Wed):	Prof. Cynthia Breazeal, MIT Media Lab *Toward Human-Friendly AI*
July 25 (Thu):	Joonhee Won, CEO, KAIT Solutions *The Future of Learning: Changing Paradigm of School*
July 26 (Fri):	Prof. Evelyn Wang, MIT Mechanical Engineering *Nanoengineered Materials for Advanced Energy and Water Technologies*
July 29 (Mon):	Prof. Fikile Brushett, MIT ChemE *Building an Electrochemical Future: Innovators Needed!*
July 30 (Tues):	Natalia Guerrero, MIT Kavli Institute *Worlds Beyond Our Own: New Exoplanet Discoveries by NASA's TESS*
July 31 (Wed):	Dr. Mark Russell, Raytheon *The Future, Arriving Today: Advanced Technology, Cyber and Machine Learning*
August 1 (Thu):	Keith Lynn, Lockheed Martin *Artificial Intelligence: AI in Every Domain*

MIT Beaver Works Summer Institute

Class of 2019

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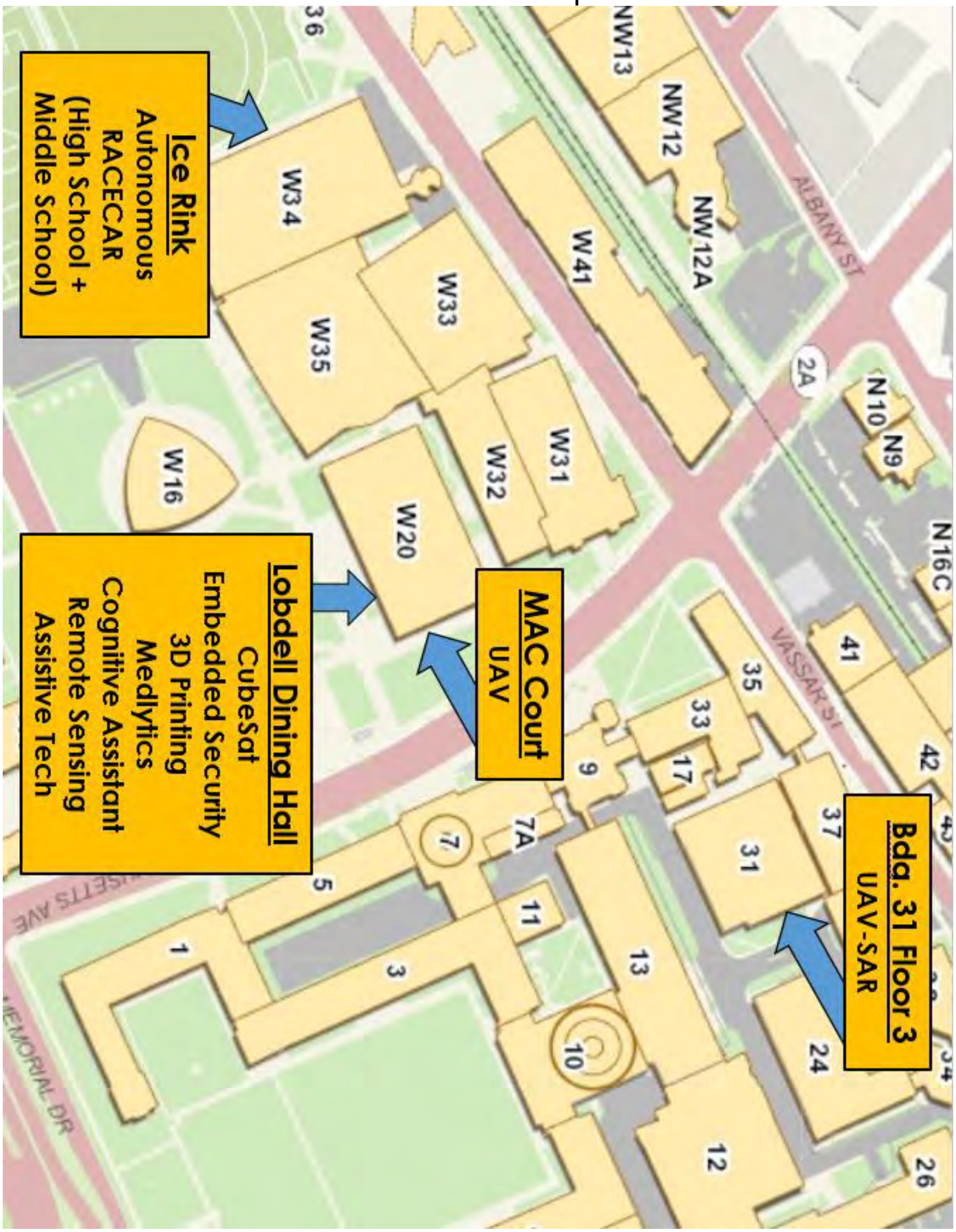
MIT Beaver Works Summer Institute

Final Event Map



MIT Beaver Works Summer Institute
2019 Summer Program

MIT Advisors

Robert Bond (Chief Technology Officer, MIT Lincoln Laboratory)

Prof. Anantha Chandrakasan (Dean, MIT School of Engineering)

Dr. Melissa Choi (Assistant Director, MIT Lincoln Laboratory)

Prof. Dan Hastings (Department Head, MIT Aeronautics and Astronautics)

Prof. Asu Ozdaglar (Department Head, MIT Electrical Engineering and Computer Science)

Prof. Daniela Rus (Director of Computer Science and Artificial Intelligence Laboratory at MIT; Electrical Engineering and Computer Science)

Prof. Sanjay Sarma (Vice President for Open Learning, MIT; Mechanical Engineering)

Prof. Evelyn Wang (Department Head, MIT Mechanical Engineering)

Staff

Program Coordinators

Robert (Bob) Shin (Beaver Works Director, MIT Lincoln Laboratory)

Lisa Kelley (Beaver Works Summer Institute Manager, MIT Lincoln Laboratory)

Joel Grimm (Beaver Works Manager, MIT Lincoln Laboratory)

William Barnard (Beaver Works Summer Institute Administrative Assistant, Boston University)

Robert Finnegan (Beaver Works Summer Institute Intern, Minuteman Technical High School)

David Granchelli (MIT Lincoln Laboratory)

Anthony Zolnik (MIT Department of Aeronautics and Astronautics)

Academic Directors

Prof. Sertac Karaman (MIT Department of Aeronautics and Astronautics, LIDS, IDSS)

Scott VanBroekhoven (MIT Lincoln Laboratory)

International Collaborations

Prof. Paulo Lozano (MIT Department of Aeronautics and Astronautics; Faculty Director, MIT MISTI-Mexico)

Outreach Coordinator

Andrew Fishberg (MIT Lincoln Laboratory)

Communication and Project Management Instructors

Jane Abbott (MIT Writing, Rhetoric and Professional Communication)

Don Kieffer (MIT Sloan School of Management)

Health Professionals

Dr. Charmain Jackman (Health Professional)

On-Line Course Coordinators

Julie Mullen (MIT Lincoln Laboratory)

Michael Houle (MIT Lincoln Laboratory)

Lisa Morelli (MIT Lincoln Laboratory)

Media/Public Relations Coordinators

David Granchelli (MIT Lincoln Laboratory)

Dorothy Ryan (MIT Lincoln Laboratory)

Erin Lee (MIT Lincoln Laboratory)

Anne McGovern (MIT Lincoln Laboratory)

Glen Cooper (MIT Lincoln Laboratory)

Jay Couturier (MIT Lincoln Laboratory)

IT Coordinators

John Bilodeau (MIT Lincoln Laboratory)

Andy Kalenderian (MIT IST)

Publications

Rich Bushey (MIT Lincoln Laboratory)

Audio-Visual Recording & Production

Greg Eaton (MIT Video Productions)
Clayton Hainsworth (MIT Video Production)
Dawn Morton (MIT Video Productions)
Barry Pugatch (MIT Video Production)
Kevin Tierney (MIT Video Production)

UNIST (Ulsan National Institute of Science and Technology) Supervisors

Youngje Moon (UNIST)
Changju Oh (UNIST)

Residential Counselor

Parker Leap (Boston University) - Lead
Elvis Alvarado (Boston University)
Gayatri Bajaj (Boston University)
Aishwayra Chitoor Subash (Boston University)
Mikayla Conway (Boston University)
Peter Huynh (Boston College)
Edward Maloney (Boston College)
Gisselle Martinez (Boston University)
Manon Michel (Boston University)
Rebeckah Muratore (Boston University)
Abigail O'Brien (Boston College)
Anna O'Doherty (Westfield State University)
Julianna Ratcliffe (North Carolina State University)
Caroline Yates (Boston University)

Autonomous RACECAR Grand Prix

Lockheed Martin Project

Lead Instructors

Andrew Fishberg (MIT Lincoln Laboratory)
Prof. Sertac Karaman (MIT Department of Aeronautics and Astronautics, LIDS, IDSS)

Instructors

Brian Plancher (Harvard University)
Eyassu Shimelis (MIT Lincoln Laboratory)

Associate Instructors

Benjamin Bracker (Harvey Mudd College)
Divya Iyengar (Georgia Institute of Technology)
Chris Lindland (Northwestern University, BWSI 2018 Alum)
Berlin Paez (Harvey Mudd College)
Nam Tran (Harvey Mudd College)
Avalon Vinella (Harvey Mudd College)

Visiting Associate Instructors

Jun Gu Han (Ulsan National Institute of Science and Technology)
Hyeon Bin Lee (Ulsan National Institute of Science and Technology)
Jeong Ha Shin (Ulsan National Institute of Science and Technology)

Autonomous Air Vehicle Racing

BAE Systems Project

Lead Instructors

Ross Allen (MIT Lincoln Laboratory)
Mark Mazumder (MIT Lincoln Laboratory)

Instructors

Prof. Luca Carlone (MIT Department of Aeronautics and Astronautics, LIDS, IDSS)
Prof. Sertac Karaman (MIT Department of Aeronautics and Astronautics, LIDS, IDSS)

Associate Instructors

Nick Bobronnikov (Purdue University, BWSI 2018 Alum)
Phoebe Taylor (Tufts University, BWSI 2017 Alum)
Aimee Van de Berg (Northwestern University, BWSI 2017 Alum)
Peter Wilson (Georgia Institute of Technology, BWSI 2017 Alum)

Visiting Associate Instructors

Min Chan Kim (Ulsan National Institute of Science and Technology)

Tae Yoon Kim (Ulsan National Institute of Science and Technology)

Guest Instructor

Dr. Steven Kalik, BAE Systems

Autonomous Cognitive Assistant

KAIT Project

Lead Instructors

Ryan Soklaski (MIT Lincoln Laboratory)

Instructors

Zachary Ravichandran (MIT Lincoln Laboratory)

Michael Yee (MIT Lincoln Laboratory)

Associate Instructors

Peter Griggs (Harvard University Department of Mathematics, BWSI 2017 Alum)

Lilian Luong (MIT Department of Electrical Engineering and Computer Science, BWSI 2017 Alum)

Vishnu Penubarthi (MIT, BWSI 2018 Alum)

Medlytics: Data Science for Health and Medicine

Lead Instructors

Kajal Claypool (MIT Lincoln Laboratory, Harvard Medical School)

Instructors

Amy Chen (MIT Lincoln Laboratory)

Adam Lammert (Worcester Polytechnic Institute)

Christopher Smalt (MIT Lincoln Laboratory)

Associate Instructors

Andy Kong (Carnegie Mellon University)
Emily Tan (Georgia Institute of Technology, BWSI 2017, 2018 Alum)
Jeanette Varela (Harvard Chan School of Public Health)

Guest Instructors

Ed Argenta (Defense Threat Reduction Agency)
Dr. Sweta Batni (Defense Threat Reduction Agency)
Dr. Avika Dixit (Boston Children's Hospital)
Undina Gisladottir (Harvard Medical School)
Yixuan He (Harvard Medical School)
Piyali Mukherjee (IBM Watson Health)
Dr. Chirag Patel (Harvard Medical School)
Dr. Thomas Quartieri (MIT Lincoln Laboratory)
Dr. Hrishikesh Rao (MIT Lincoln Laboratory)

Hack A 3D Printer

Lead Instructors

Derek Straub (MIT Lincoln Laboratory)

Instructors

Trevor Ashley (MIT Lincoln Laboratory)
Conor Galligan (MIT Lincoln Laboratory)
David Radue (MIT Lincoln Laboratory)

Associate Instructors

Ayub Farah (University of Massachusetts - Amherst)
Tim Kuzmenkov (Northeastern University)

Visiting Associate Instructors

Ji Yeong Min (Ulsan National Institute of Science and Technology)
Ga Eun Yim (Ulsan National Institute of Science and Technology)

Embedded Security and Hardware Hacking

MITRE Project

Lead Instructors

Rachael Bainbridge (MITRE)

Instructors

Jacob Grycel (MITRE)
Gabriel Pascualy (MITRE)
Kazi Alom (MIT, BWSI 2017 Alum)

Associate Instructors

Charlotte Fries (University of St. Andrews, BWSI 2018 Alum)
Edward Clifford (Worcester Polytechnic Institute, BWSI 2018 Alum)

Build a CubeSat

Sierra Nevada Corp. Project

Lead Instructors

Rebecca Arenson (MIT Lincoln Laboratory)
Paul Fucile (Woods Hole Oceanographic Institute)

Instructors

Prof. Kerri Cahoy (MIT Department of Aeronautics and Astronautics)
Jim Clark (MIT Department of Aeronautics and Astronautics)
Jillian James (MIT Lincoln Laboratory)
Paul Lawson (MIT Lincoln Laboratory)
Jonah Tower (MIT Lincoln Laboratory)

Associate Instructors

Uche Okwo (MIT Department of Aeronautics and Astronautics)
Kelli Therrien (Northeastern University)
Scott VanBroekhoven (MIT Lincoln Laboratory)

Guest Instructors

David Arenson (Lockheed Martin Space Systems)
Dr. Glenn Gawarkiewicz (Woods Hole Oceanographic Institute)
Dr. Collin Ward (Woods Hole Oceanographic Institute)

Assistant

Dominic Fucile (Woods Hole Oceanographic Institute)

UAS-SAR
Raytheon Project

Lead Instructor

Ramu Bhagavatula (MIT Lincoln Laboratory)

Associate Instructors

Amelia Littrell (MIT Lincoln Laboratory)
Greg Lyons (MIT Lincoln Laboratory)
Fiona McEvilly (Worcester Polytechnic Institute, BWSI 2018 Alum)
Jordan Shibley (MIT Lincoln Laboratory)
Sean Turner (MIT Lincoln Laboratory)
Ethan Wang (Carnegie Mellon University, BWSI 2017 Alum)

Guest Instructor

Jennifer Watson (MIT Lincoln Laboratory)

Remote Sensing for Crisis Response

Lead Instructors

Andrew Weinert (MIT Lincoln Laboratory)
Jeffrey Liu (MIT Lincoln Laboratory)

Associate Instructors

Andrew Mascillaro (Olin College, BWSI 2018 Alum)

Cameron Mastoras (Northwestern University, BWSI 2017 Alum)
Marie Tessier (Worcester Polytechnic Institute, BWSI 2018 Alum)

Guest Instructors

Sean Anklam (MIT Lincoln Laboratory)
Chad Council (MIT Lincoln Laboratory)
Grace Kessenich (MIT Lincoln Laboratory)
Dan Ribeirnha-Braga (MIT Lincoln Laboratory)
David Strohschein (MIT Lincoln Laboratory)

Design of Assistive Technology

Lead Instructors

Ho Chit (Hosea) Siu (MIT Lincoln Laboratory)
Kyle Keane (MIT Department of Materials Science and Engineering)

Associate Instructors

Abhinav Gandhi (Worcester Polytechnic Institute)
Sarah Gonzalez (MIT Department of Aeronautics and Astronautics)

Guest Instructor

Ellen Kornmehl (co-designer)

Autonomous RACECAR Grand Prix - Middle School

Lead Instructor

Sabina Chen (MIT Department of Electrical Engineering and Computer Science)

Instructors

Andrew Fishberg (MIT Lincoln Laboratory)
Prof. Sertac Karaman (MIT Department of Aeronautics and Astronautics, LIDS, IDSS)

Associate Instructors

Alex Hadley (Harvey Mudd College)

Nishanth Mankame (Virginia Polytechnic and State University, BWSI 2017 Alum)

Wendy Zhang (Scripps College)

Dan Bi (Buckingham Browne & Nichols High School)

Daniel Wang (Buckingham Browne & Nichols High School)

MIT Beaver Works Summer Institute

2019 Summer Program

Class of 2019

Rumaisa Abdulhai
Adham Abji
Vaishnavi Addala
Emily Amspoker
Manu Amundsen
Abigail Angwin
Rebecca Ashmore
Sabrina Atkin
Swanyee Aung
Valentina Avilés
Maria Azcona Baez
Christian Baduria
Alexander Bao
Daniel Barnett
Joshua Bass
Serena Behera
Andrew Behling
Zachary Bernheimer
Ryan Berry
Omkar Bhalerao
Neel Bhalla
Pratik Bharadwaj
Beka Bililign
Solomon Birmakher
Puloma Bishnu
William Blankenship
Sravani Boggaram
Aneesh Boreda
Cooper Bosch
Andre Bouchard
Penny Brant
Gregoire Brougher
Zachary Brunet
Harris Bubalo
Shuyu Cao
Wyatt Carbonell
Daniel Carr
Mariela I. Nazario Castro
Alan Cervantes
Govind Chada
Brandon Chao
Nicole Cheetham
Aaron Chen
Angeline Chen
Michael Chen
Serena Chen
Vincent Chen
Charles Cheng
Jessie Cheung
Vineet Chinthakindi
Russell Chiu
Matthew Cho
Yuen Ler Chow
Elaine Chu
Matthew Chun
Esteban Cintrón
Daniel Coble
Jacob Consalvi
Julian Crowley
Hanfei Cui
Pratyush Das
Tanvika Dasari
Upamanyu Dass-Vattam
Eshaan Datar
David Del Valle
Niall Devlin
Olivia Dias
Abigail Dillon
Wyatt Ellison
Mohammad Eshan
Albert Farah
Saad Farooqui
Aimee Feng
Hayden Ferguson
Victoria Franklin
Matthew Freestone
Megan Frisella
Graham Galts
Sean Gao
Steven Gao
Ashanah Gayden
Joseph Gilbert
Suat Giray
Isabelle Grenier
Roberto Groza
Yilan Gu
Arnav Gupta
Luc Harbers
Anna He
Naoki Heginbotham
Mitchell Henderlong
Anna Hilburgh
Yashas Honnavalli
Samiul Hoque
Brian Hu
Jason Huang
Peter Huggins
Peter Huryn
Jan Jacob
Manik Jain
Shreya Jain
Christy Jestin
Saketh Jonnalagadda
Ajit Kadaveru
Justin Kamal
Minsoo Kang
Sydney Karimi
Jasmeen Kaur
Colin Kelly
Mikail Khan
Daniel Khoshkhoo
Alexey Khotimsky
Jiin Kim
Jospeh Kim
Briana Kohl
Nicholas Koran
Sriram Krishnamoorthy
Darshan Krishnaswamy
Aditya Kumar
Aparna Kumar
Vishal Kumar
Zachariah Lafeer
Josef LaFranchise
Brian Lai
Michael Lang
Abigail Lau
Jonathan Lee
Joseph Lee
Allen Li
Christina Li
Ai-Wen Joy Lim
Darren Lin
Jennifer Lin
Emily Liu
Jamin Liu
Longchao Liu
Winston Liu
Stephanie Lu
Berke Lunstad
Ashvatth Maheriya
Yeriel Maldonado
Briana Malik
Joshua Martinez
Emma Mascillaro
Chacko Mathai
Maxwell Mazzarese
Luca Mehl
John Mendez
Taneim Miah
Tatiana Michel
Afnan Mir
Sara Modiano
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Varun Nair
Akash Nayar
Sreya Nimmagadda
Matthew Pak
Dylan Pham
Claudia Pillot
Kemal Pulungan
Jacob Pustilnik
David Qian
Santino Ramos
Pranav Ravella
Charles Richards
Neel Roy
Justin Ruiz
Michael Rybalkin
Alison Ryckman
Sergio Saab
Prajeet Sangamnerkar
Aaron Sarnevitz
Jacqueline Schellberg
Bailey Segall
Frederick Sell
Anuj Sesha
Rohan Sharma
Thomas Shaw
Jacob Shin
Nathan Shin
Daniel Simpson
Megan Sin
Archit Singh
Jasmeet Singh
Nalin Sinha
Grace Smith
Katherine Stevo
Eliza Stokes
Harsheni Sudakar
Casey Taitel
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Rohan Thakur
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Odessa Thompson
Shantanu Thorat
Alexander Towfigh
Sharvil Trifale
Ethan Tse
Margaret Tseng
John Turner
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Bernice Wang
Caroline Wang
Ethan Wang
Qifa Wang
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Prazul Wokhlu
Justin Wong
Louis Wong
Charles Wu
Haona Wu
Shuen Wu
Sean Xia
Brian Xiang
Jiaying Xu
Jocelyn Xu
Rashi Yadav
Edward Yan
Erin Yan
Breanna Yang
Brion Ye
Emily Ye
Sophie Ye
Federick Yeh
Alex Yu
Ayush Zenith
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Max Zhang
Cara Zheng
Katherine Zhou
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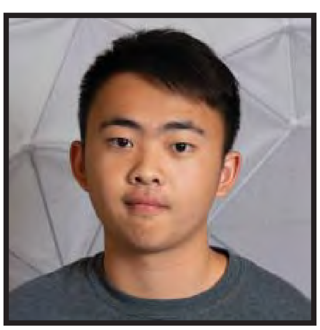
(Nashua NH)



Alexander Bao
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Daniel Barnett
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Mountain Lakes High School
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Vancouver School of Arts and Academics (Vancouver, WA)

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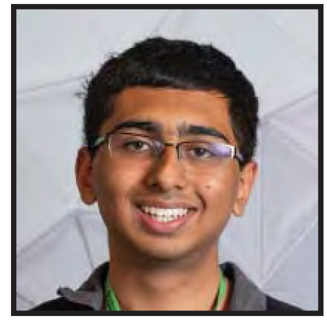

Omkar Bhalerao
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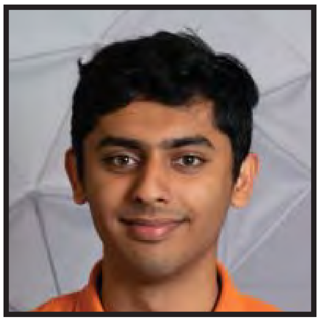
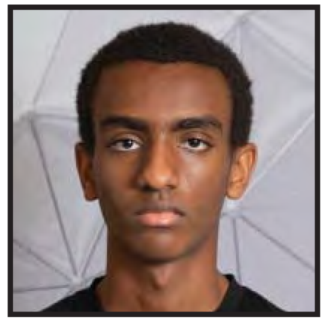
Thomas Jefferson High School (Alexandria, VA)



Neel Bhalla
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Lexington High School (Lexington, MA)

Pratik Bharadwaj
Data Science for Health and Medicine
Acton-Boxborough Regional High School (Acton, MA)



Beka Bililign
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The Early College at Guilford (Greensboro, NC)

Solomon Birmakher
Embedded Security and Hardware Hacking - MITRE Project, Brooklyn Technical High School (Brooklyn, NY)

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Hack a 3D Printer
West Limestone High School (Lester, AL)

Sravani Boggaram
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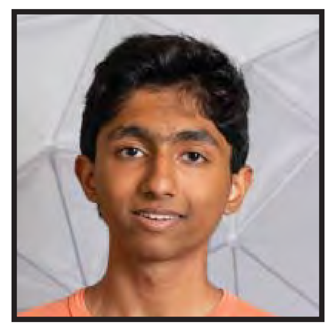
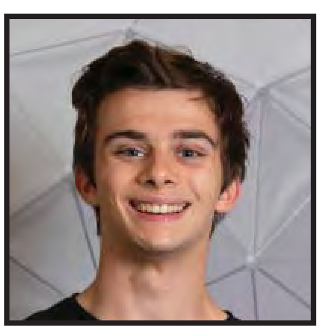
School of Science & Engineering (Dallas, TX)



Aneesh Boreda
Autonomous Cognitive Assistant - KAIT Project
Thomas Jefferson High School (Alexandria, VA)

Cooper Bosch
Autonomous Cognitive Assistant - KAIT Project
Boston Latin (Boston, MA)



Andre Bouchard
Assistive Technology
Saint John's School (Houston, TX)

Penny Brant
Assistive Technology
PHillips Exeter Academy (Exeter, NH)

Gregoire Brougher
Autonomous Air Vehicle Racing - BAE Systems Project
The Nueva School (San Mateo, CA)

Zachary Brunet
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Princeton International School of Mathematics
(Princeton, NJ)

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Brookline High School
(Brookline, MA)

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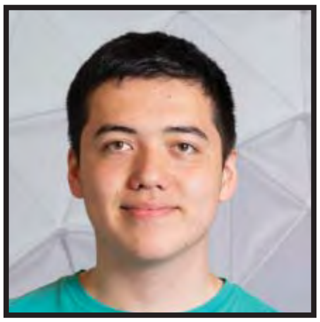
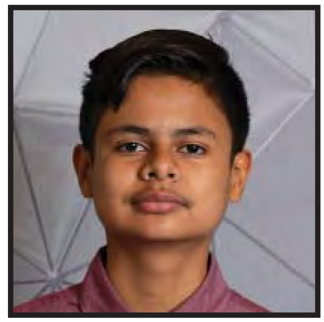
Remote Sensing for Crisis Response
Bronx High School of Science
(The Bronx, NY)

Wyatt Carbonell
Embedded Security and Hardware Hacking - MITRE Project, Barnstable High School (Hyannis, MA)



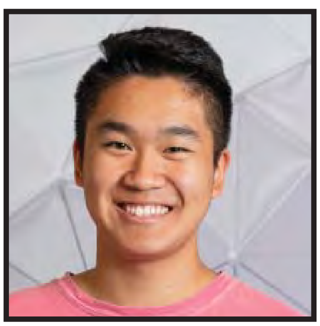
Daniel Carr
Hack a 3D Printer
Thomas Jefferson High School
(Alexandria, VA)

Mariela Nazario Castro
Data Science for Health and Medicine
Escuela Secundaria de la Universidad de Puerto Rico (San Juan, PR)



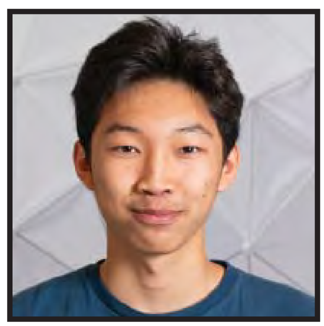
Alan Cervantes
Autonomous RACECAR Grand Prix - Lockheed Martin Project
La Mirada High School
(La Mirada, CA)

Govind Chada
Data Science for Health and Medicine
Cypress Woods High School
(Cypress, TX)



Brandon Chao
Autonomous Air Vehicle Racing - BAE Systems Project
Canyon Crest Academy
(San Diego, CA)

Nicole Cheetham
Autonomous Cognitive Assistant - KAIT Project
Shenendehowa High School
(Clifton Park,NY)



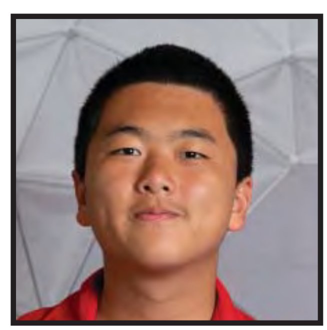
Aaron Chen
Remote Sensing for Crisis Response
Northwood High School
(Irvine, CA)

Angeline Chen
Embedded Security and Hardware Hacking - MITRE Project, Governor's School for Science & Mathematics
(Hartsville, SC)

Michael Chen
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Wayland High School
(Wayland, MA)

Serena Chen
Assistive Technology
Bronx High School of Science
(The Bronx, NY)

Vincent Chen
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Cambridge Rindge and Latin
(Cambridge, MA)



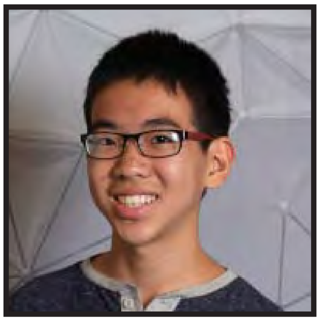
Charles Cheng
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Troy High School
(Fullerton, CA)

Jessie Cheung
Autonomous Cognitive Assistant - KAIT Project
Talented and Gifted Magnet High School (Dallas, TX)

Vineet Chinthakindi
Data Science for Health and Medicine
Homestead High School
(Cupertino, CA)

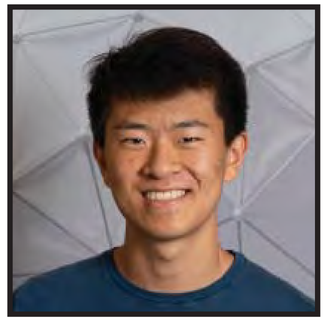
Russell Chiu
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Science & Mathematics Academy at Aberdeen, MD (Aberdeen, MD)

Matthew Cho
UAS-SAR - Raytheon Project
Monta Vista High School
(Cupertino, CA)



Yuen Ler Chow
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Brookline High School
(Brookline, MA)

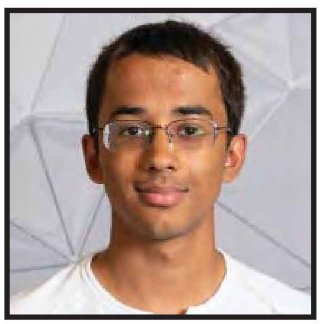
Elaine Chu
Data Science for Health and Medicine
Henry M. Gunn High
(Palo Alto, CA)



Matthew Chun
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Sacred Heart Schools, Atherton
(Atherton, CA)

Esteban Cintrón
Data Science for Health and Medicine
University of Puerto Rico High School
(San Juan, PR)

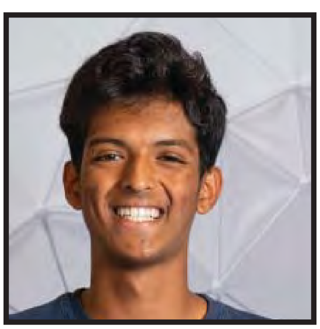
Daniel Coble
Build a CubeSat - Sierra Nevada Corp. Project
Governor's School for Science & Mathematics (Hartsville, SC)



Jacob Consalvi
Autonomous Air Vehicle Racing - BAE Systems Project
Thomas Jefferson High School
(Alexandria, VA)

Julian Crowley
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Buckingham Browne & Nichols
(Cambridge, MA)

Hanfei Cui
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Cambridge Rindge and Latin School
(Cambridge, MA)



Pratyush Das
Remote Sensing for Crisis Response
Northwood High School
(Irvine, CA)

Tanvika Dasari
Autonomous RACECAR Grand Prix – Lockheed Martin Project
Cupertino High School
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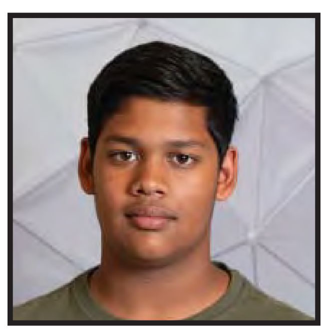

Upamanyu Dass-Vattam
Data Science for Health and Medicine
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Eshaan Datar
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Burlington High School
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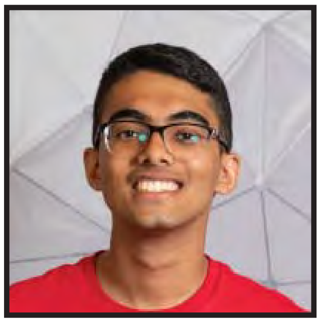
Build a CubeSat - Sierra Nevada Corp. Project
Acton Boxborough Regional High School (Acton, MA)

Wyatt Ellison
Autonomous Cognitive Assistant - KAIT Project
Noble & greenough School (Dedham, MA)



Mohammad Eshan
Embedded Security and Hardware Hacking - MITRE Project, Thomas A. Edison Career and Technical Education High School (Jamaica, NY)

Albert Farah
Build a CubeSat - Sierra Nevada Corp. Project
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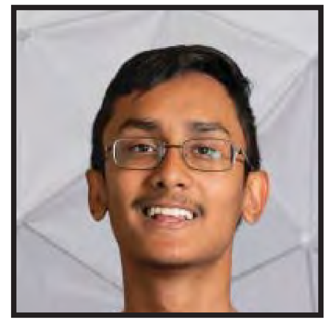

Saad Farooqui
Hack a 3D Printer
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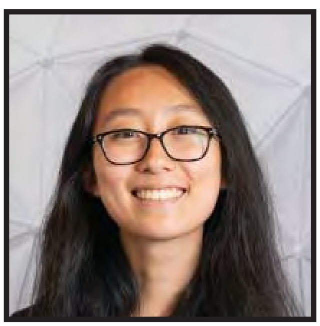

Aimee Feng
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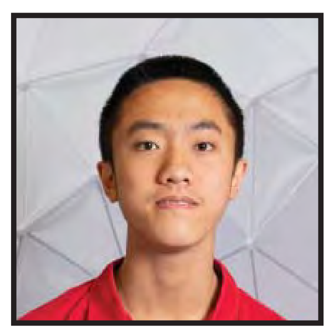

Steven Gao
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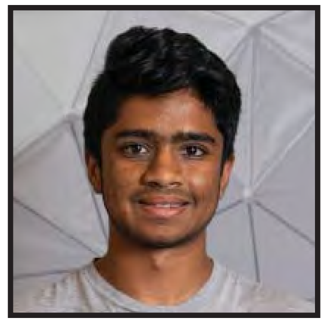

Arnav Gupta
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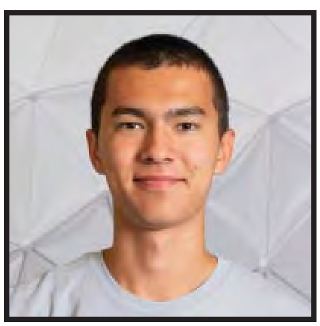

Naoki Heginbotham
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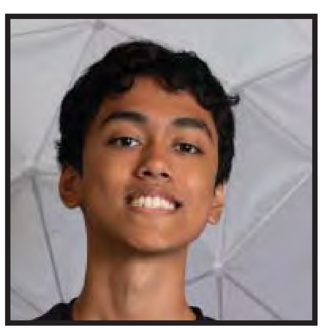

Samiul Hoque
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Bronx High School of Science
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Thomas Jefferson High School
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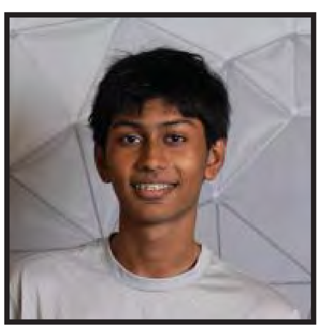

Mikail Khan
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Thomas Jefferson High School
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Daniel Khoshkhoo
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Science & Mathematics Academy at Aberdeen (Aberdeen, MD)

Alexey Khotimsky
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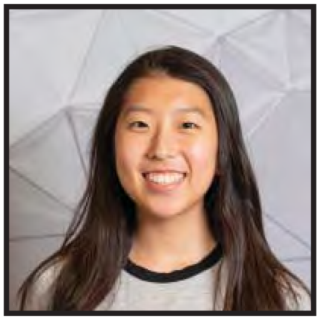
Westborough High School
(Westborough, MA)



Jiin Kim
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Aliso Niguel High School
(Aliso Viejo, CA)

Jospeh Kim
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Needham High School, MA
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Mattawan High School
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Longmeadow High School
(Longmeadow, MA)

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Billerica Memorial High School
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Darshan Krishnaswamy
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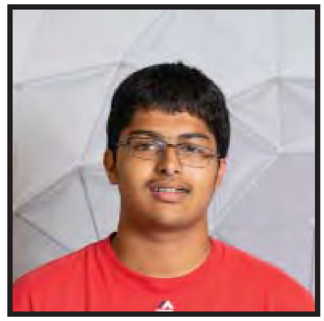
Chelmsford High School
(North Chelmsford, MA)



Aditya Kumar
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Aparna Kumar
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High Technology High School
(Lincroft, NJ)

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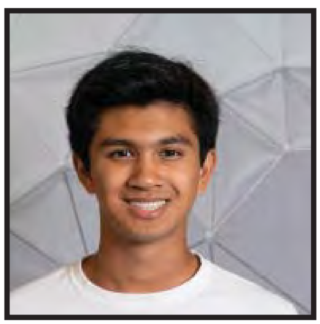
Kingswood Oxford
(West Hartford, CT)



Zachariah Lafeer
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Thomas Jefferson High School
(Alexandria, VA)

Josef LaFranchise
UAS-SAR - Raytheon Project
Newburyport High School
(Newburyport, MA)

Brian Lai
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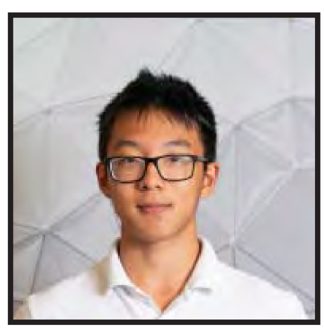
Bronx High School of Science
(The Bronx, NY)

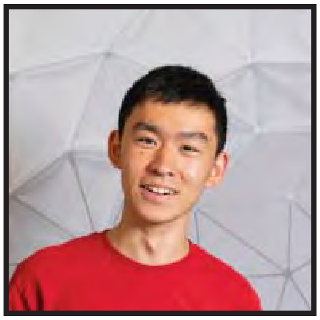
Michael Lang
UAS-SAR - Raytheon Project
Boston University Academy
(Boston, MA)

Abigail Lau
Build a CubeSat - Sierra Nevada Corp. Project
Newton North High School
(Newton, MA)



Jonathan Lee
UAS-SAR - Raytheon Project
Ashland High School (Ashland, MA)

Joseph Lee
Remote Sensing for Crisis Response
Thomas Jefferson High School
(Alexandria, VA)

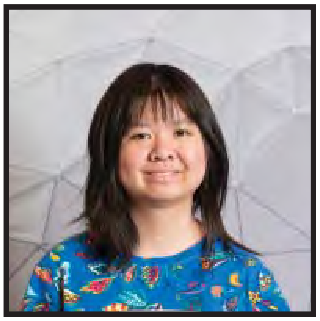


Allen Li
Embedded Security and Hardware Hacking - MITRE Project, Monta Vista High School (Cupertino, CA)

Christina Li
Assistive Technology
Woodbury High School
(Woodbury, MN)

Ai-Wen Joy Lim
Data Science for Health and Medicine
Massachusetts Academy of Math & Science (Worcester, MA)

Darren Lin
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Bronx High School of Science
(The Bronx, NY)

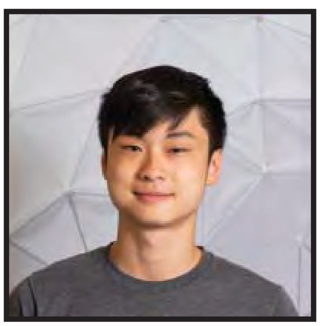


Jennifer Lin
Autonomous RACECAR Grand Prix - Lockheed Martin Project
York High School
(Yorktown, VA)

Emily Liu
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Acton-Boxborough
(Acton, MA)

Jamin Liu
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Newton South High School
(Newton Center, MA)

Joy Liu
Data Science for Health and Medicine
PHillips Exeter Academy
(Exeter, NH)



Winston Liu
UAS-SAR - Raytheon Project
Lynbrook High School
(San Jose, CA)

Stephanie Lu
Build a CubeSat - Sierra Nevada Corp. Project
Lincoln-Sudbury Regional High School
(Sudbury, MA)

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Ashvatth Maheriya
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Saint Francis High School
(Mountain View, CA)

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Data Science for Health and Medicine
University High School
(San Juan, PR)

Briana Malik
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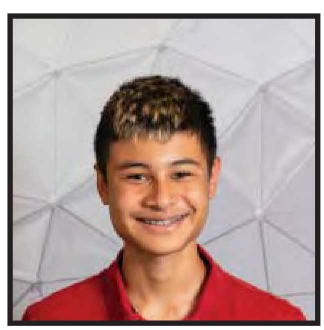
Parkland High School
(Allentown, PA)



Joshua Martinez
Embedded Security and Hardware Hacking - MITRE Project, Laguna Hills High School (Laguna Hills, CA)

Emma Mascillaro
Hack a 3D Printer
Manalapan High School
(Manalapan, NJ)

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Tatiana Michel
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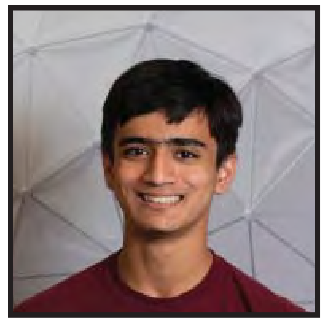

Afnan Mir
Assistive Technology
Plano Senior High School
(Plano, TX)

Sara Modiano
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Newton South High School
(Newton, MA)

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Lexington High School
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Stoneham High School
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Claudia Pillot
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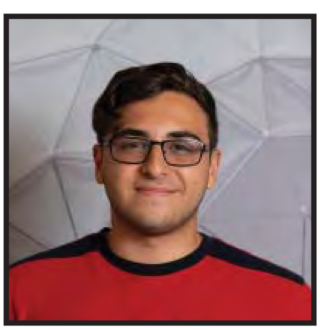

Sergio Saab
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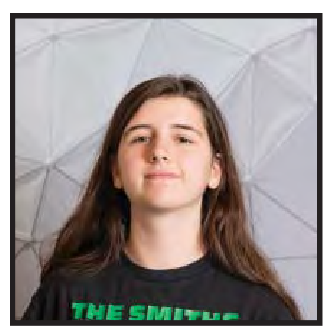

Jacqueline Schellberg
UAS-SAR - Raytheon Project, Governor's School for Science & Mathematics
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(Lexington, MA)

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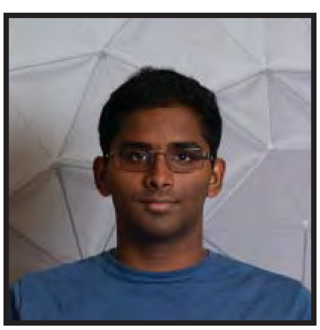
Medford High School
(Medford, MA)

John Turner
UAS-SAR - Raytheon
ProjectGovernor's School for Science
& Mathematics (Hartsville, SC)



Aditya Vidyadharan
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Bernice Wang
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Hacking - MITRE Project
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Project
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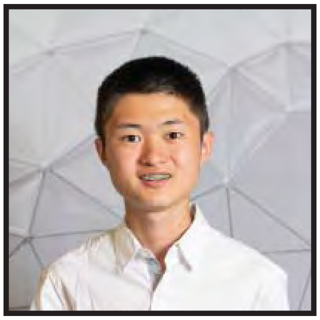
(Scarsdale, NY)

Prazul Wokhlu
Autonomous Cognitive Assistant -
KAIT Project
Centennial High School
(Frisco, TX)

Justin Wong
Autonomous RACECAR Grand Prix -
Lockheed Martin Project
Cosumnes Oaks High School
(Elk Grove, CA)



Louis Wong
Hack a 3D Printer
Troy High School
(Fullerton, CA)

Charle Wu
UAS-SAR - Raytheon ProjectThomas
Jefferson High School (Alexandria, VA)

Haona Wu
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BAE Systems Project
Syosset High School (Syosset, NY)

Shuen Wu
Data Science for Health and
Medicine
Homeschool (Woodbury, MN)

Sean Xia
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Bronx High School of Science
(Bronx, NY)

Brian Xiang
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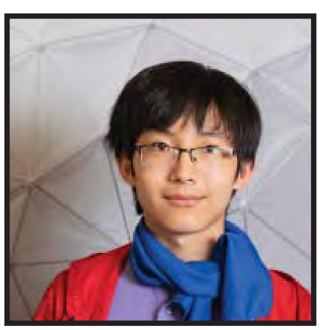
Westford Academy
(Westford, MA)

Annie Xu
UAS-SAR - Raytheon Project
Brooklyn Technical High School
(Brooklyn, NY)

Jocelyn Xu
Hack a 3D Printer
Meridian School
(Round Rock, TX)

Rashi Yadav
Autonomous Air Vehicle Racing -
BAE Systems Project
Weiss High School
(Pflugerville, TX)



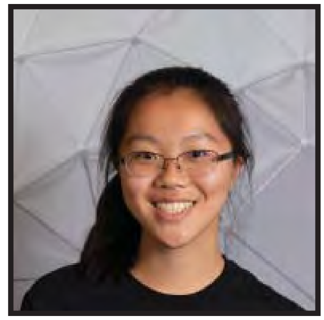
Edward Yan
Data Science for Health and Medicine
Boston Latin, MA (Boston, MA)

Erin Yan
Hack a 3D Printer
Bronx High School of Science
(The Bronx, NY)

Breanna Yang
Autonomous RACECAR Grand Prix -
Lockheed Martin Project
Illinois Mathematics and
Science Academy (Aurora, IL)

Brion Ye
Embedded Security and Hardware Hacking - MITRE Project, Palo Alto High School
(Palo Alto, CA)

Emily Ye
Autonomous Cognitive Assistant - KAIT Project
Thomas Jefferson High School
(Alexandria, VA)



Sophie Ye
Assistive Technology
Monta Vista High School
(Cupertino, CA)

Frederick Yeh
Autonomous Cognitive Assistant - KAIT Project
Bronx High School of Science
(The Bronx, NY)

Alex Yu
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Thomas Jefferson High School
(Alexandria, VA)

Ayush Zenith
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(Andover, MA)

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Carol Zhang
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Thomas Jefferson High School
(Alexandria, VA)

Max Zhang
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Thomas Jefferson High School
(Alexandria, VA)

Cara Zheng
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(Hoschton, GA)

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Arlington High School
(Arlington, MA)

Zachary Zlomek
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Portage Central High School
(Portage, MI)

Rubin Zou
Autonomous Air Vehicle Racing - BAE Systems Project
Nashua High School South
(Nashua, NH)

MIT Beaver Works Summer Institute

2019 Summer Program

Class of 2019

Autonomous RACECAR Grand Prix - Middle School

Lead Instructor

Sabina Chen (MIT Department of Electrical Engineering and Computer Science)

Instructors

Andrew Fishberg (MIT Lincoln Laboratory)

Prof. Sertac Karaman (MIT Department of Aeronautics and Astronautics, LIDS, IDSS)

Associate Instructors

Alex Hadley (Harvey Mudd College)

Nishanth Mankame (Virginia Polytechnic and State University, BWSI 2017 Alum)

Wendy Zhang (Scripps College)

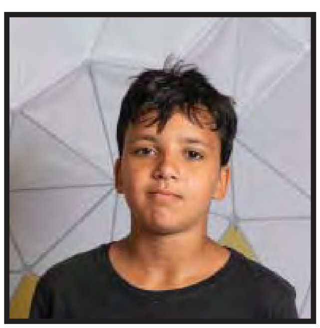
Dan Bi (Buckingham Browne & Nichols High School)

Daniel Wang (Buckingham Browne & Nichols High School)

Students

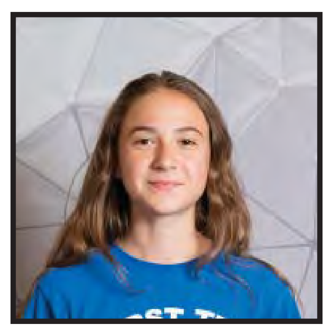
Mariana Abad
Nasr Almohammadi
Chibuzo Zoe Awa
Ellen Borges
Abderrahmane Boutemtam
Vishant Chawla
Daniel Cho
David Cho
Carter Dambreville
Yavuz Er
Troy Gayle
Patrick Hall
Ryan Herbeck
Cole Kelley
Alexandra Lopez
Adamaris Merida Cruz
Srinidhi Mukundan
Pranaya Paudyal
Edmya St Loth
Fadil Teisir
Radwan Teisir
Nathaniel Tesfamicael
Senay Tesfamicael
Vivek Varanasi

Mariana Abad
Autonomous RACECAR Grand Prix - Middle School
Eliot School (Boston, MA)



Nasr Almohammadi
Autonomous RACECAR Grand Prix - Middle School
Garfield Middle School (Boston, MA)

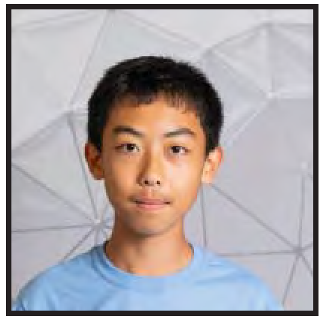
Chibuzo Zoe Awa
Autonomous RACECAR Grand Prix - Middle School
Roxbury Prep Charter School, Lucy Stone Campus (Dorchester, MA)



Ellen Borges
Autonomous RACECAR Grand Prix - Middle School
Pioneer Charter School of Science (Everet, MA)

Vishant Chawla
Autonomous RACECAR Grand Prix - Middle School
Melrose Middle School (Melrose, MA)

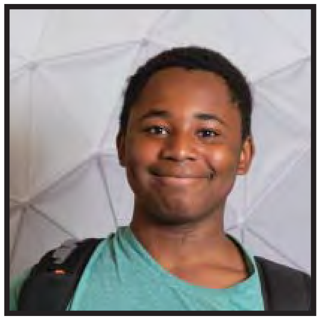
Daniel Cho
Autonomous RACECAR Grand Prix - Middle School
Belmont Hill School (Belmont, MA)



David Cho
Autonomous RACECAR Grand Prix - Middle School
Belmont Hill School (Belmont, MA)

Carter Dambreville
Autonomous RACECAR Grand Prix - Middle School
Home School (Boston, MA)

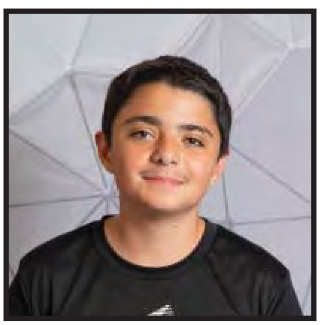
Yavuz Er
Autonomous RACECAR Grand Prix - Middle School
Chenery Middle school (Belmont, MA)



Troy Gayle
Autonomous RACECAR Grand Prix - Middle School
Boston Collegiate Charter School (Boston, MA)

Patrick Hall
Autonomous RACECAR Grand Prix - Middle School
Marshall Middle School (Billerica, MA)

Ryan Herbeck
Autonomous RACECAR Grand Prix - Middle School
Stoneham Central Middle School (Stoneham, MA)



Cole Kelley
Autonomous RACECAR Grand Prix - Middle School
Marshall Middle School (Billerica, MA)

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Pioneer Charter School of Science (Everett, MA)

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Boston Latin School (Boston, MA)

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Pioneer Charter School of Science (Everett, MA)

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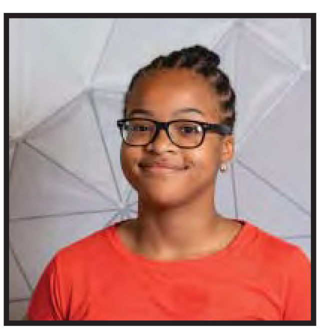
Pioneer Charter School of Science (Everett, MA)



Edmya St Loth
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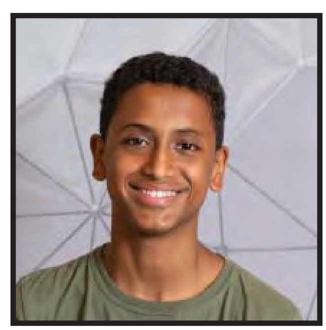
Fadil Teisir
Autonomous RACECAR Grand Prix - Middle School
Pioneer Charter School of Science (Everett, MA)



Radwan Teisir
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Abderrahmane Boutemtam
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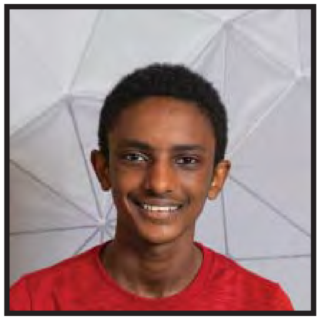
Pioneer charter school of science (Everett, MA)



Nathaniel Tesfamicael
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Senay Tesfamicael
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Wendy Zhang
Scripps College

Dan Bi
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Daniel Wang
Buckingham Browne & Nichols High School

MIT Beaver Works Summer Institute

2019 Nauset Warrior Works Summer Program

Class of 2019

Students

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Christian Chung
Luke McCarthy
Henry Thrasher
Brennan Townsend

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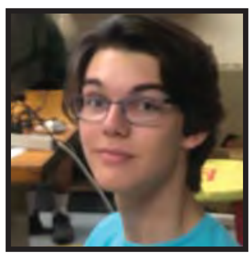
Edward Rohmer, Director
Harry Terkanian

Student Teaching Assistants

William Brister
Benjamin Ellis

Edward Rohmer
Director
Nauset Regional High School (Eastham, MA)

Harry Terkanian
MIT Alumni
Nauset Regional High School (Eastham, MA)



William Brister
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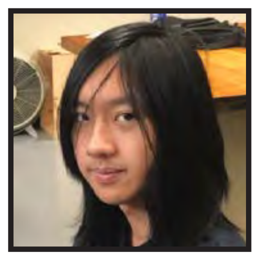

Christian Chung
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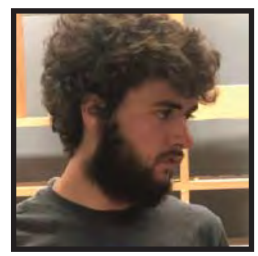

Benjamin Ellis
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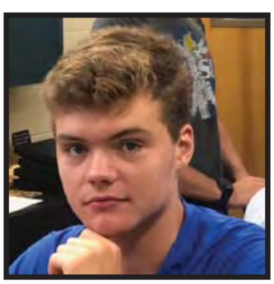
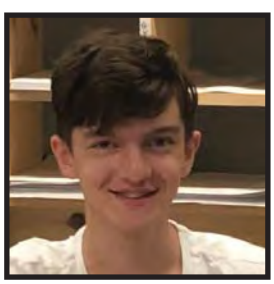


Luke McCarthy
Autonomous RACECAR Grand Prix - Lockheed Martin Project
Nauset Regional High School (Eastham, MA)



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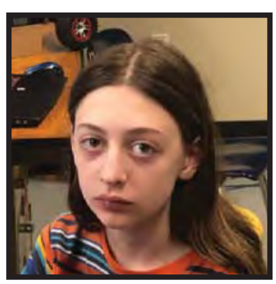

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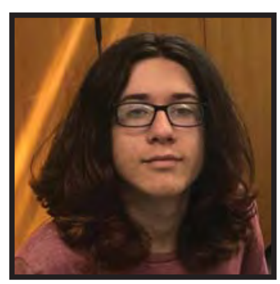

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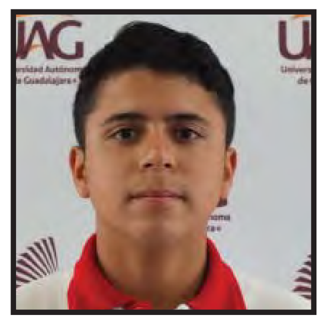

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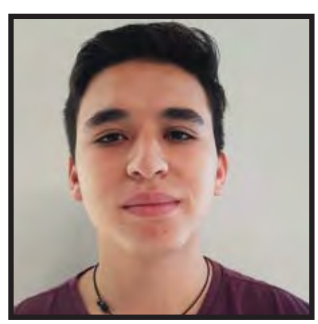

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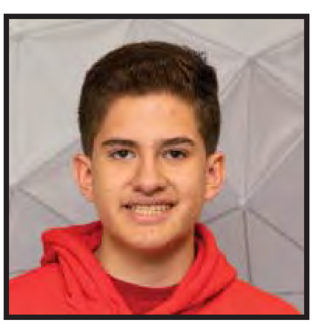

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