MIT Beaver Works Summer Institute

MIT Beaver Works Summer Institute 2020

VIRTUAL HIGH SCHOOL PROGRAM

MINI GRAND PRIX CHALLENGE

Autonomous RACECAR Grand Prix

BAE Systems Project

Autonomous Cognitive Assistant

Raytheon Intelligence & Space Project

Medlytics

Data Science for Health & Medicine

Sierra Nevada Corp Project

Build a CubeSat

piPACT

A BWSI Independent Project

MITRE Project

Embedded Security and Hardware Hacking

Remote Sensing

Serious Game Design and Development with AI

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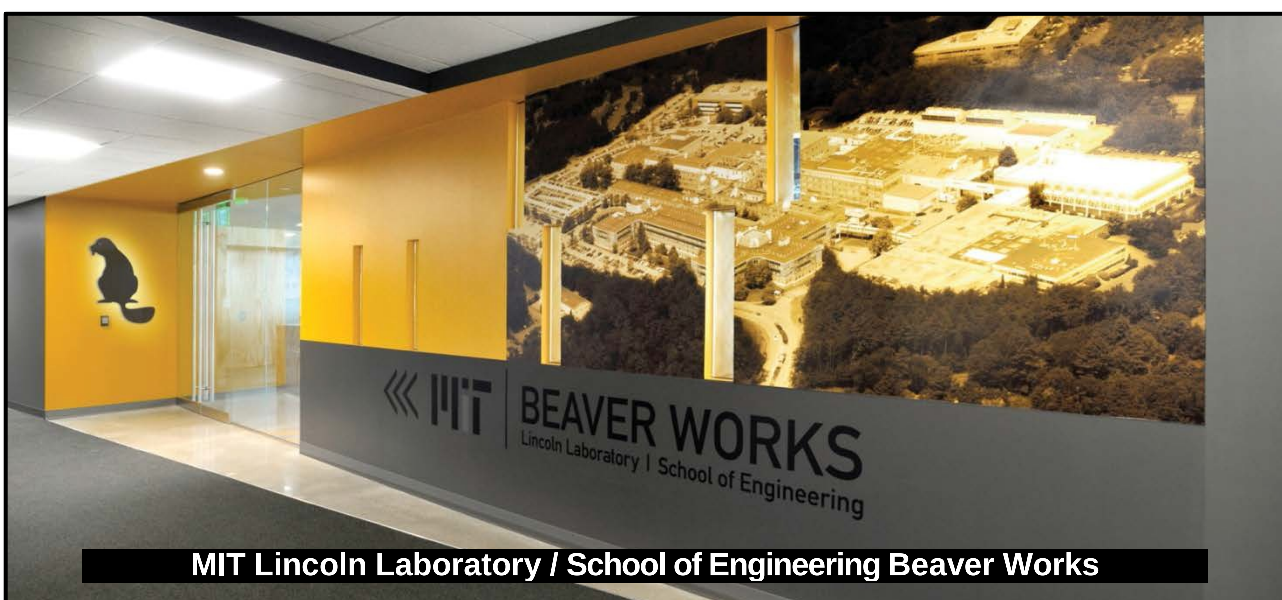


MIT Lincoln Laboratory / School of Engineering Beaver Works

MIT Beaver Works Summer Institute

Dear Friends, Family, and Engineering Enthusiasts,

The brochure below includes all the information on the 2020 Beaver Works Summer Institute, virtual program! Due to the COVID-19 situation we had to cancel the onsite portion of our program this summer, but we are excited to offer several of our most popular classes in an online only format. We are looking forward this summer to pushing the boundaries of BWSI with our instructors and students. This new format will be an important first step in making the incredible BWSI content available to broader audiences.

The MIT Beaver Works Summer Institute is a rigorous, world-class STEM program for talented rising high school seniors. BWSI started in 2016 with a single class and has grown exponentially since. 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-Synthetic Aperture Radar (UAS-SAR), Embedded Security and Hardware Hacking, Designing for Assistive Technology, Remote Sensing for Disaster Response, and Hack a 3D Printer.

The 2020 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 initially planned to offer a dozen high school courses and three middle school classes onsite at MIT campus, but when COVID-19 prevented in person participation many of our instructors were able to quickly revamp their course content for remote instruction. We partnered with many high schools to recruit future engineers to participate in our program, and had the pleasure of working with 178 students from 101 high schools across the country for the seven courses offered this year. We also offered an independent project, piPACT, focused on technology for automated contact tracing of COVID-19 transmission which ran concurrently with the BWSI courses and 175 students from 128 high schools participated.

In the coming years, we will integrate new programs into this initiative, and make the summer program content available broadly. We are supporting middle and 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. While the movement to an online only BWSI this summer was a difficult decision, it will accelerate the development of a more modular and portable course content that can be shared widely and have a greater impact on our leaders of tomorrow.

Thank you for the continued support of our program.

The MIT Beaver Works Summer Institute Staff

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 positive student reaction to our hands-on learning style led to the expansion of the program to include two new courses in 2017. To make sure students had the STEM background to participate fully in the three courses, the BWSI instructors developed online tutorials that students had to complete as a prerequisite for applying for the summer program. The new courses were Autonomous Air Vehicle Racing and Autonomous Cognitive Assistant. In 2017, 98 students from 49 high schools nationwide enjoyed BWSI.

In 2018, we grew again. This year, we had eight courses, adding five ones; each new course is developed with a requisite online tutorial. The 2018 class of BWSI boasted 198 young people from 106 high schools from across the country and Puerto Rico.

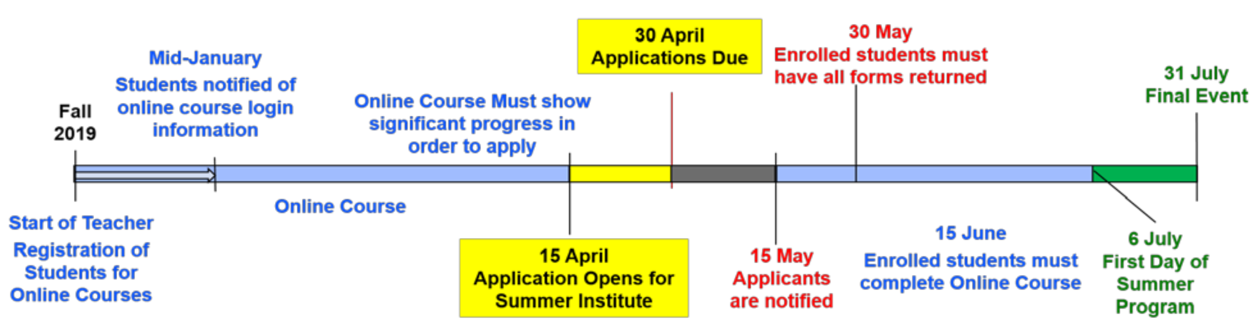
In 2019, we grew yet again and added two new courses to our eight. The 2019 class of BWSI grew to 239 students from 158 high schools across the country and Puerto Rico. As in the previous two years, we have had teams from Massachusetts and outside the United States participate in our RACECAR Grand Prix after they completed the course curriculum on their own.

In 2020, we were planning on 12 courses with additional programs in cybersecurity and game development. We will be offering 7 courses and 1 independent project virtually thanks to substantial efforts to shift the onsite program. These are described in more detail later in the pamphlet.

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 schools worldwide.

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

BWSI 2020 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 LLRISE, a one-day workshop on radars for students in middle school.

MIT Beaver Works Summer Institute

2020 Summer Program: Course Overview

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

Autonomous RACECAR Grand Prix
Beaver Works Summer Institute will offer students, each with its own MIT-designed RACECAR 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 Cognitive Assistant – BAE Systems 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.

Build a CubeSat – Sierra Nevada Corp. Project
Beaver Works Summer Institute will offer students the opportunity to design, build, and test a prototype CubeSat. Students will explore all the major subsystems of a satellite and get hands on experience with mechanical, electrical, and software engineering. The class will use these new skills to demonstrate a real CubeSat science mission in partnership with scientists from Woods Hole Oceanographic Institution.

Medlytics (Data Science for Health Medicine) – Raytheon I&S Project
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 to gain hands-on experience applying advanced machine learning and data mining to solve real-world medical challenges.

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, JTAG and UART probing, side-channel analysis, and fault-injection. This background will help prepare students for the summer course, during which

they will design and perform security assessments of multiple implementations of an embedded system. They will learn the basics of embedded security and hardware hacking by designing a secure system and performing security assessments of classmates' designs to see who can find and fix the most security flaws.

Remote Sensing For Disaster Response

Beaver Works Summer Institute Remote Sensing program will offer students the opportunity to explore the exciting intersection of data science and disaster response. The program consists of two components: (1) online course from January to May 2020, open to all interested and committed students; and (2) a four-week virtual summer program. During the course, the students will learn to understand the basics of Python, Git, GIS, machine learning, and image processing through a series of online teaching modules. Students will explore real world datasets featuring disaster imagery from both satellites and aerial platforms. Students in this course will develop experience in an area of data science that is poised to play a critical role in understanding our world.

Serious Game Development with AI

This course will introduce students to the process of game design with the application of Artificial Intelligence to game play. Very specifically, the course will focus on unconventional approaches to understand and address real world problems (e.g., designing a game about zombies to study the effects of public health policies with respect to chemical or biological terrorist threats.) The program will consist of an intensive dive into the key aspects of serious gaming including: experimental design, game design, and application development. The course will examine and categorize different types of games, how to extract useful data, an introduction to User Interface design, rules development and play testing. Students will focus on coding both a portion of the game back-end as well as self-designed extensions. With the assistance of instructors and Teaching Assistants, participants will learn about how Artificial Intelligence can impact the design of experiments and contrast with natural, human-centric game play. All students will participate in both back-end development, within a game-ready python framework, as well as coding of their own extensions.

piPACT: BWSI Independent Project

Beaver Works Summer Institute will offer students the opportunity for an independent project this year. Based on the technologies used to develop private automatic contact tracing (PACT) for minimizing the spread of diseases, like COVID-19, students can learn about the technologies behind wireless communication and radio wave propagation, while programming Raspberry Pi's and analyzing their data. This project provides real-world experience in research and development as they are developing and testing hypotheses based on what they've learned using rigorous analysis techniques to answer important questions.

MIT Beaver Works Summer Institute

2020 Summer Program
Autonomous RACECAR Remote 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 dynamic 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****!*

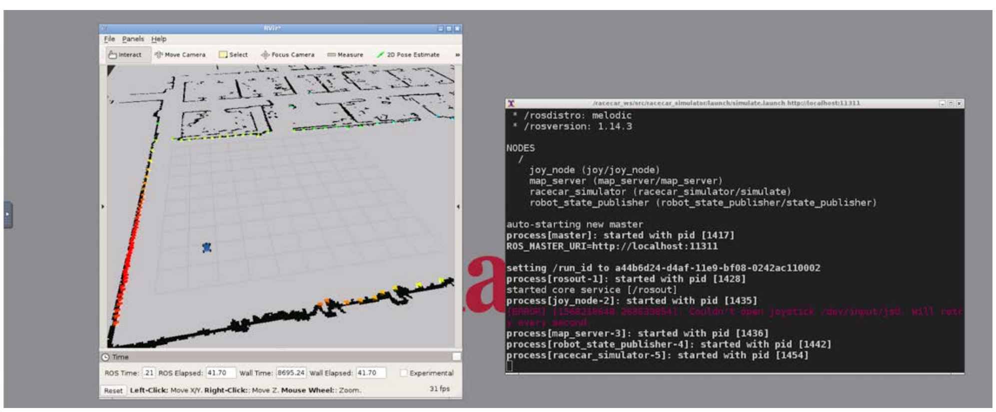
This program consists of two components, all virtual: a prerequisite, online course from January to May open to all interested students and an intensive four-week virtual program from July 6 to July 31 for a select group of students. The prerequisite component gives students a background in the basic 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. Students will also have the opportunity to program a simulated RACECAR in rviz, which will allow them to develop skills and demonstrate the basic concepts without requiring a physical RACECAR.

Completing the prerequisite curriculum will prepare students to cover the topics of Control Systems, Computer Vision, Localization, Planning, and Navigation at a more advanced level in the virtual summer program. The robotic platform used in the course is the RACECAR Model Nano (RACECAR-MN), which is capable of achieving speeds of 30 mph, utilizing data from real sensors processed with an onboard NVIDIA Jetson Nano embedded computer. The RACECAR-MN is a small-scale, MIT-designed robotic system. Beaver Works will lend out a complete RACECAR-MN hardware kit to students who are accepted into the program, to participate in the first-ever, virtual RACECAR summer program. Students will receive all of the hardware and materials required to participate in the course from their own homes.

A team of experienced MIT researchers and instructors will give live lectures, covering material on 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. Additionally, guest lecturers from 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. The instructors will be available throughout the program to help with debugging.

Prerequisite Course

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 rviz world, using synthetic sensor data

Introduction and Prerequisites

- Installing and using the virtual RACECAR Docker image
- 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 rviz simulation environment
- Studying basic control systems
- Studying fundamentals of computer vision using the OpenCV library
- Acquiring elementary navigation and planning concepts

Summer Virtual Course

The four-week summer program is based on the BWSI 2019 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 tentative schedule for each week is listed below:

Week 1: Setup…

- Meet the Instructors and TAs
- Setup your laptops for virtual lectures
- Setup and test your RACECAR-MN

Week 2: Move…

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

Week 3: Explore…

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

Week 4: Learn…

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

Week 4 (End): Final Project/Competition!

At the end of the program, you will take part in a final project or competition, as facilitated by the instructors. This will give you a chance to expand on what you know and share what you've learned with your classmates across the country!

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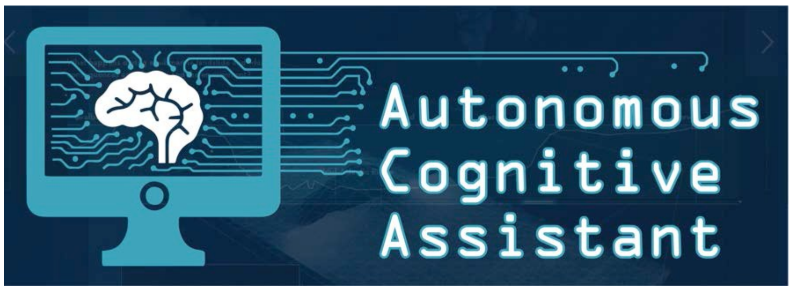
MIT Beaver Works Summer Institute

2020 Summer Program
Autonomous Cognitive Assistant – BAE Systems 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 2020, open to all interested and committed students, and (2) a four-week virtual summer program for a small group of students, July 6–July 31. 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 many industries.

Online Course

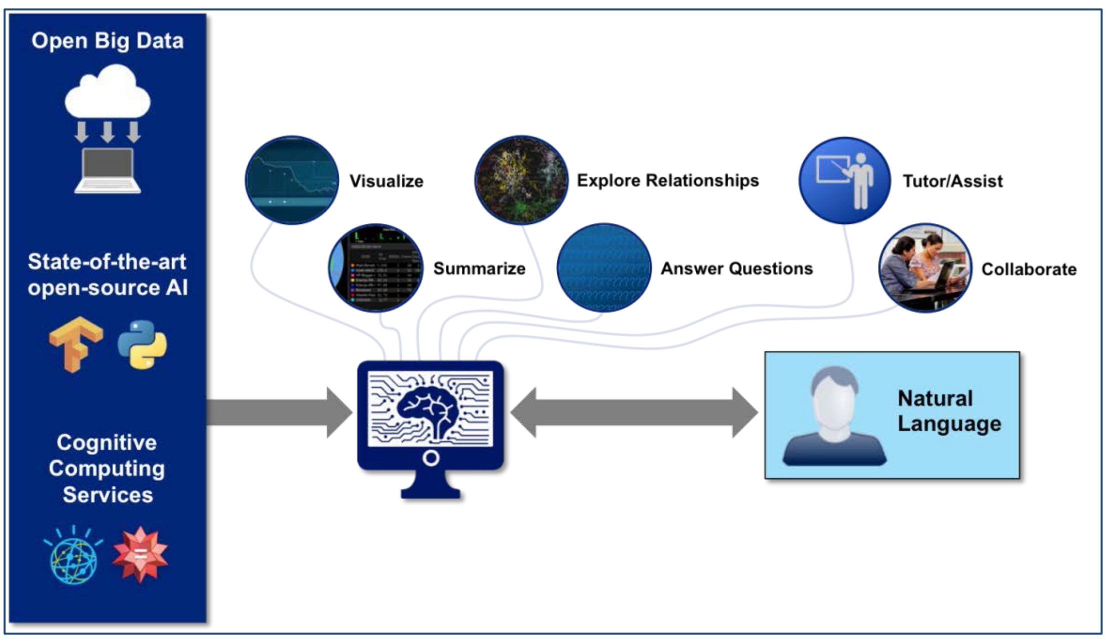
The online component for the Cog*Works course will contain important introductory material that will provide students with the background required to successfully complete the four-week summer course. In addition to the introductory material, the online course will include more advanced machine learning–specific 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 Microsoft Cortana©, and 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 neural networks
- CNNs and RNNs
- Visual capstone project

Week 3: Language

- Representing written language numerically
- Document comparison and summarization
- Training a language model
- Training word embedding
- Information retrieval
- NLP capstone project

Week 4: Challenges

- Customize your own neural network

MIT Beaver Works Summer Institute

2020 Summer Program

Medlytics – Raytheon Intelligence & Space Project

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 2020, 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 2020, open to all interested and committed students; and (2) a four-week virtual summer program hosted by MIT for a group of 20-25 students from July 6—July 31. 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 to gain hands-on experience applying advanced machine learning and data mining to solve real-world medical challenges.

Online Course

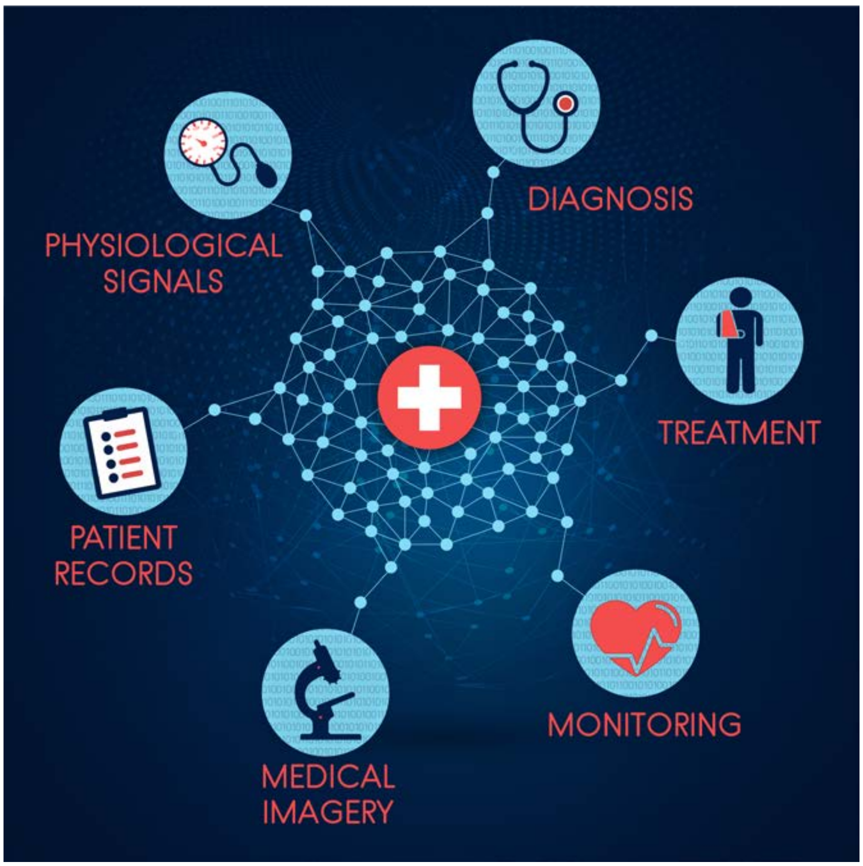
The online component for the BWSI Medlytics course contains important introductory material to provide students with the background required to successfully complete the four-week summer course. In addition to the introductory material, the online course will expose students to real-world data and machine 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. 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

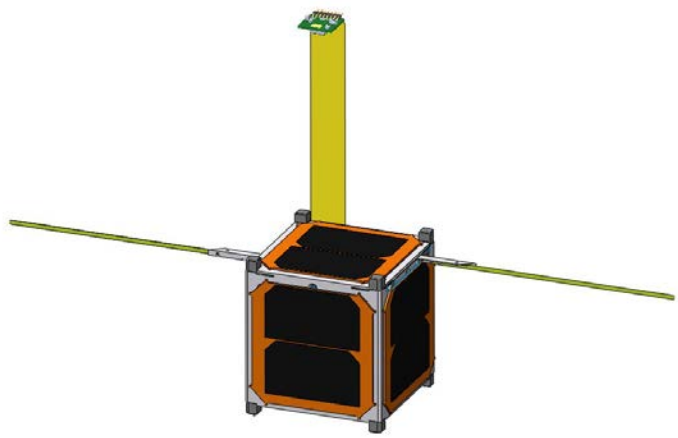
Week 3: Image Processing and Advanced Data Analytics
- Computer vision applications in medicine
- Texture classification using convolutional neural networks
- Transfer learning
- Clinical Data Challenge 3: Analyzing Mammograms

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

2020 Summer Program
Build a CubeSat – Sierra Nevada Corp. Project [1]



Program Overview

In 2020, 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 1U CubeSat (10 cm x 10 cm x 10 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 assembling and testing a working CubeSat prototype. 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.

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

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

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
- The space environment
- Satellite engineering tools
- Laboratory safety

Summer Course

The four-week summer component of BWSI CubeSat will focus 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. With hardware kits at home, 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
- Fundamentals of systems engineering

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

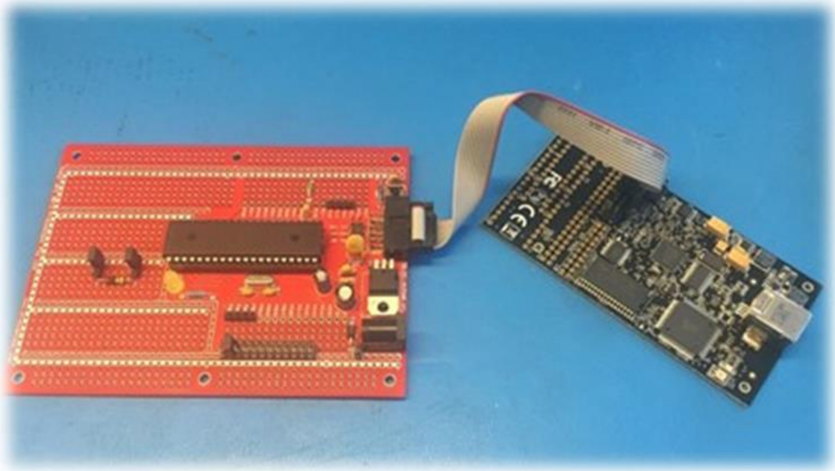
Week 3: "Houston We Have A Problem" Making It All Work Together
- Subsystem integration
- System and software testing
- Mission planning, attitude determination
- Debugging and testing a flight system

Week 4: Test Flights and Analysis
- Final functional testing
- Simulated "flight"
- Evaluate mission performance

MIT Beaver Works Summer Institute

2020 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 virtual summer program from July 6 to July 31 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, JTAG and UART probing, side-channel analysis, and fault-injection. This background will help prepare students for the summer course, during which they will design and perform security assessments of multiple implementations of an embedded system. They will learn the basics of embedded security and hardware hacking by designing a secure system and performing security assessments of classmates' designs to see who can find and fix the most security flaws.

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
• Embedded Software
• Programming in Python
• C programming
• Assembly
• Cryptography Basics

Summer Course

The four-week summer program is based on the MITRE Collegiate eCTF, which challenges teams of undergraduate and graduate students to design a secure system. Teams of BWSI students will design and implement their own secure systems based on a previous eCTF challenge and then hunt for security flaws in other teams' designs. The course will consist of a mix of lectures and hands-on labs and projects that reinforce and apply the material. The detailed topics for each week are listed below:

Week 1: Cryptography and Security
• Overview of cryptography and secure design fundamentals
• Introduction of the design challenge

Week 2: Embedded Software
• Components of embedded systems
• Embedded software security basics

Week 3: Hardware Analysis
• Hardware and interface analysis
• Introduction to side-channel analysis and fault attacks

Week 4: Hack!
• Teams will compete to see who can score the most points – earned by capturing virtual "flags", by demonstrating flaws in the target systems, and by fixing the flaws to secure the system.

MIT BeaverWorks Summer Institute

2020 Summer Program
Remote Sensing for Disaster 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) feature extraction from raw data, 2) classification via machine learning techniques, and 3) data products for decision makers. The program will explore tools and techniques using real world operational data collected from across the globe.

In 2020, this BWSI Remote Sensing program will offer students the opportunity to explore the exciting intersection of data science and disaster response. The program consists of two components: (1) online course from January to May 2020, open to all interested and committed students; and (2) a four-week virtual summer program. During the course, the students will learn to understand the basics of Python, Git, GIS, machine learning, and image processing through a series of online teaching modules. Students will explore real world datasets featuring disaster imagery from both satellites and aerial platforms. Students in this course 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 virtual summer course, 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 and Prerequisites

Computer Science
- Getting started with Python
- Git & GitHub management
- Machine learning perspectives

Data Science
- Advanced NumPy
- Simple image classification
- Introduction to Web Services

Real World Data
- Civil Air Patrol
- USGS Landslide Assessment
- Zanzibar Mapping Initiative

Summer Course
The four-week summer component of aims to guide students through the processing of designing experiments to evaluate primarily text-based content. Daily course material, case studies, guest lectures, and small-group projects will expose students to challenges across technical domains.

The following is a rough outline for the summer course:

Week 1: Introduction to GIS
- Review of Python fundamentals
- Introduction to pandas, geopandas, geospatial information systems
- Research questions, hypotheses and objectives
- Working with open source tools and data

Week 2: Analysis of Geospatial Data
- Introduction to classifiers and data science
- Spatial analysis and networks
- Geospatial data sources and how to work with them

Week 3: Introduction to Image Processing
- Fundamentals of images and metadata
- Multispectral imaging
- Satellite images and analysis

Week 4: Image Classification and Decision Making
- Classify images based on contents
- Intro to optimization
- Data-driven decision making

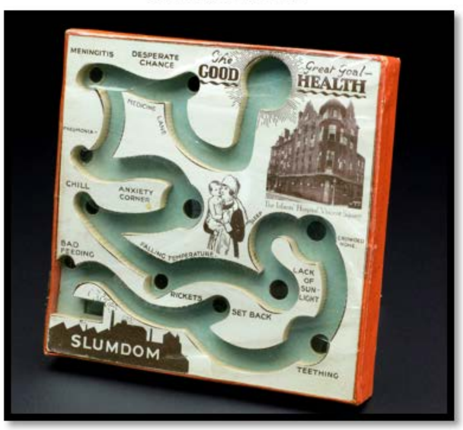
MIT Beaver Works Summer Institute

2020 Summer Program
Serious Game Design and Development with AI

Course Overview

This course will introduce students to the process of game design with the application of Artificial Intelligence to game play. Very specifically, the course will focus on unconventional approaches to understand and address real world problems (e.g., designing a game about zombies to study the effects of public health policies with respect to chemical or biological terrorist threats.)

Historical



Game depicting physical and social influences on infant health circa 1900

Modern

2019 BWSI students participating in hurricane disaster simulation

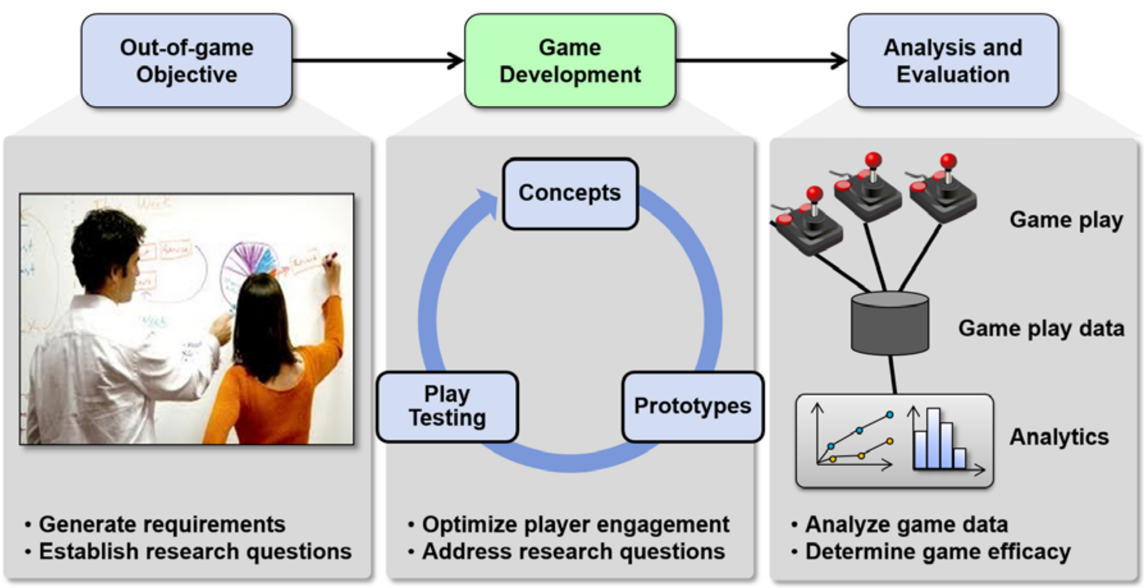
The recent interest in gaming as a method for acquiring data on human-machine interaction, decision making and human factors has helped establish an emerging area of research called “Serious Games”. Examples of Serious Games can include:

- Training for dangerous, expensive, or rare situations
- Evaluation of critical factors in decision making
- Cognitive assessment for injuries and diseases that affect the brain
- Systems analysis

Examples, such as Foldit, a game which adds to the body of bioinformatics knowledge by challenging users to fold proteins, can actually make a significant scientific impact. Output from the game helped scientists understand the inherent structure of a key protease in a virus which causes HIV-like symptoms. As personal computing platforms become more prevalent (who, today, doesn’t own a cell phone?) the opportunity to help tackle critical challenges by harvesting the brainpower of millions while generating fun is tantalizing.

The program will consist of a one-month, intensive dive into the key aspects of serious gaming including: experimental design, game design, and application development. The course will examine and categorize different types of games, how to extract useful data, an introduction to User Interface design, rules development and play testing.

Students will be provided a basic introduction to Agile management, and coached as they follow the timeline for development. Completing the course will provide students with an understanding of software development, project management, human factors, game design, and technical collaboration as well as the emerging fields of artificial intelligence and serious games.



Prerequisites:

- Python

Topics covered in this course:

- Systems modeling
- AI for gaming
- Ethics for AI
- Backend game development
- Game mechanics and input interfaces
- Human systems and user interfaces
- Data logging and data analysis
- Undead domain modelling
- Agile team and software practices

Course Outline:

Week 1

- Overview of serious games and their role in systems analysis and human factors
- Introduction to design of experiments
- Dev team formation
- Agile software development, healthy teams
- Backend software development starts

Week 2

- Backend software development continued
- Exploring zombie-based contamination/disease propagation models
- Role and ethics of AI in game design and development
- Novel game extension to baseline game proposal
- Public health policy overview

Week 3

- Modeling undead disease propagation
- Novel game extension development
- Human Systems Interfaces, User Interface Design, Visualizing Information,
- Data logging and analysis

Week 4

- Game code finalization
- Run the experiment (play the developed game) with data collection and analysis
- Game debut
- Final presentations and results

Expectations:

Students will focus on coding both a portion of the game back-end as well as self-designed extensions. With the assistance of instructors and Teaching Assistants, participants will learn about how Artificial Intelligence can impact the design of experiments and contrast with natural, human-centric game play. All students will participate in both back-end development, within a game-ready python framework, as well as coding of their own extensions. Introduction to supporting topics, including software development best practices for small teams, how to create user interfaces, bug and issue management, data visualization, public health and disease control, and technical presentation will be included.

Game Theme:

A single player game, which can also be played as by committee, describes the outbreak of a highly-contagious disease threatening a densely populated, urban area. Individuals who have contracted the disease have formed a zombie population which can be categorized into different architypes. These architypes may have different capabilities, propagation models, needs, and goals. The objective of the game will be to explore the efficacy of public health policies designed to deal with traditional disease outbreaks as applied to different infection models, methods and rates. Data analysis, such as the rate of infection compared against the implementation of different human or AI-enabled policy decisions, will provide an opportunity to visualize the results of different decision-making styles in remediating the humanitarian disaster.

MIT BeaverWorks Summer Institute

2020 Summer Program

piPACT: BWSI Independent Project

piPACT: BWSI Independent Project

Overview

The BWSI 2020 piPACT Project will provide students an opportunity to explore the technology of Bluetooth and its application to proximity detection for COVID-19 Contact Tracing. We are hoping that you will find this independent project exciting, and expect that students will learn about hypothesis development and testing, data collection and analysis, and maybe some about RF waves and digital communications.

The Primary tasks involved in this project are

1. Building a Raspberry Pi based Bluetooth signal collection platform,
2. Collecting data using this platform,
3. Developing of processing algorithms that perform the proximity detection.

As an independent project, this is driven by the student, but we have provided general project guides so that students can create a report in time for our BWSI final event. Unique to this project is that the students must develop their own hypothesis about using Bluetooth for contact tracing and determine their test regime for collecting the data to test their hypothesis.

The course ends with students submitting final reports as they would for a technical journal and these get reviewed based on meeting technical standards. The best reports will have an opportunity to present their paper at the BWSI Final Event.

Prerequisite Course

The required/taught skills for this project are basic Python skills (satisfied by the BWSIX Python online course), basic computer literacy, ability to document experimental results in a disciplined fashion, and ability to conduct independent research/exploration based on broad directions.

Like the online courses, students use a dedicated piazza forum for discussion as well as posting questions with answers and feedback from instructors as well as other students.

Project Supplies

Students are supplied two Rasberry Pi computers, cables, power supplies and the software to get started running and developing their hypotheses and algorithms. They are expected to be able to supply a laptop and a monitor to be able to program the pi's for the data collection and analysis.

Project Schedule

Each week there will be Q&A discussions driven by students' questions, both live and submitted through piazza. There will be additional webinar providing technology overviews as well as speakers who are experts and leaders in this area.

- **Week 1:** Project Introduction
    - Introduction to piPACT project goals, approach, logistics, and core technologies (e.g., Bluetooth)
- **Week 2:** piPACT Webinar: Dr. Marc Zissman (MIT Lincoln Laboratory)
    - Weekly Discussion setup of Raspberry Pi
- **Week 3:** piPACT Webinar: Dr. Louise Ivers (MGH)
    - Weekly Discussion : Bluetooth and RF technology
- **Week 4:** piPACT Webinar Joel Linsky, VP of Techology, Qualcomm
    - Weekly Discussion : Detection Theory
- **Week 5:** piPACT Webinar: Dr. Emily Shen (MIT Lincoln Laboratory)
    - Weekly Discussion : Data collection and analysis, hypothesis formation, and testing
- **Week 6:** Final Report Discussion: requirements and format
- **Final Event: July 31, 2020**
    - Select students will be given a chance to present their results.

BWSI Online Program Application Process for High School Student

The Beaver Works Summer Institute is pleased to announce our program offerings for virtual program for summer 2020. The following programs will be offered:

- Autonomous RACECAR Grand Prix
- Medlytics
- Build a Cubesat
- Cog*Works: Build Your Own Cognitive Assistant
- Embedded Security and Hardware Hacking
- Remote Sensing for Disaster Response
- Serious Games Design and Development with AI

To apply to one of these summer programs, you must complete the BWSI Online Education Program, designed to prepare students for the technically rigorous BWSI summer programs. To participate in the online course, a student must submit the following:

1. A nomination by a school technical point of contact (POC), typically a STEM teacher or school administrator familiar with the student's schoolwork and technical abilities. The nomination form for the teacher/recommender can be found at https://mit-bwsi.formstack.com/forms/bwsi_nomination_onlinecourse_2020

2. The application form for the student will be sent to them once the request comes in from the teacher/recommender. Once we receive your application if your application is approved, the student will receive an email containing a user ID and password as well as instructions on how to access the online course website.

Teachers, prior BWSI students, and teaching assistants (TAs) can also apply for online course access by using the same BWSI online course request link and filling out the form.

BWSI Virtual Summer Program Application Process

Application for the BWSI Summer Program is separate from the online course application. The Summer Program application will be available Mid April 2020, with decisions expected Mid May 2020. The selection criteria for the Summer Program include, but are not limited to,

1. Demonstrated technical ability (determined through recommendation by school official and other supporting information, such as test scores, completed coursework, and grades collected in the application).
2. Demonstrated commitment to extracurricular learning via participation and completion of the online course (participation/progress are tracked by the instructors).

Students must make significant progress in the online course by Summer Program application to ensure that they are ready and well prepared for participation in the BWSI programs. Students may participate in one or more of the online courses to determine which they are interested in, but note that the online courses are time-intensive, and we suggest down selecting to a single course as early as possible.

MIT Beaver Works Summer Institute

2020 Summer Program Seminar Series

12:30pm EDT, Webinar

July 7 (Tue): Prof. Leslie Pack Kaelbling, MIT Computer Science and Engineering
Doing for our Robots What Nature did for us

July 8 (Wed): Prof. Daniela Rus, Director, MIT Computer Science and Artificial Intelligence Laboratory
Unleashing Your Inner Maker

July 9 (Thu): Dr. Jerry Wohletz, BAE Systems
Autonomous Intelligence: The AI You Don't Know

Dr. Francesca Scire-Scappuzo, BAE Systems
One Story, Three Messages: Determination, Flexibility and Purpose

July 14 (Tue): Prof. Amos Winter, MIT Mechanical Engineering
Leveraging Technical and Socioeconomic Insights to Create Products for Developing and Global Markets

July 15 (Wed): Chris Peterson, MIT Admissions Office
How to apply to MIT (and other colleges) as a Maker

July 16 (Thu): Dr. Eric Evans, Director, MIT Lincoln Laboratory
MIT Lincoln Laboratory Overview

July 21 (Tue): Jennifer Benson, Raytheon Intelligence & Space
Laser Communications, Artificial Intelligence and Machine Learning

Major General Michael Schmidt, U.S. Air Force
Science and Technology in the U.S. Air Force: A Personal Perspective

July 22 (Wed): Dr. Simon Verghese, Waymo
Self-Driving Cars and Lidar

July 23 (Thu): Prof. Anant Agarwal, CEO, edX
A New Normal for Education

July 28 (Tue): Natalia Guerrero, MIT Kavli Institute
Worlds Beyond Our Own: New Exoplanet Discoveries by NASA's TESS

July 29 (Wed): Prof. Julie Shah, MIT Aeronautics and Astronautics
Enhancing Human Capability with Intelligent Machine Teammates

MIT Beaver Works Summer Institute

2020 piPACT Independent Project Seminar Series

12:30pm EDT, Webinar

June 22 (Mon): Dr. Marc Zissman, MIT Lincoln Laboratory
PACT Program

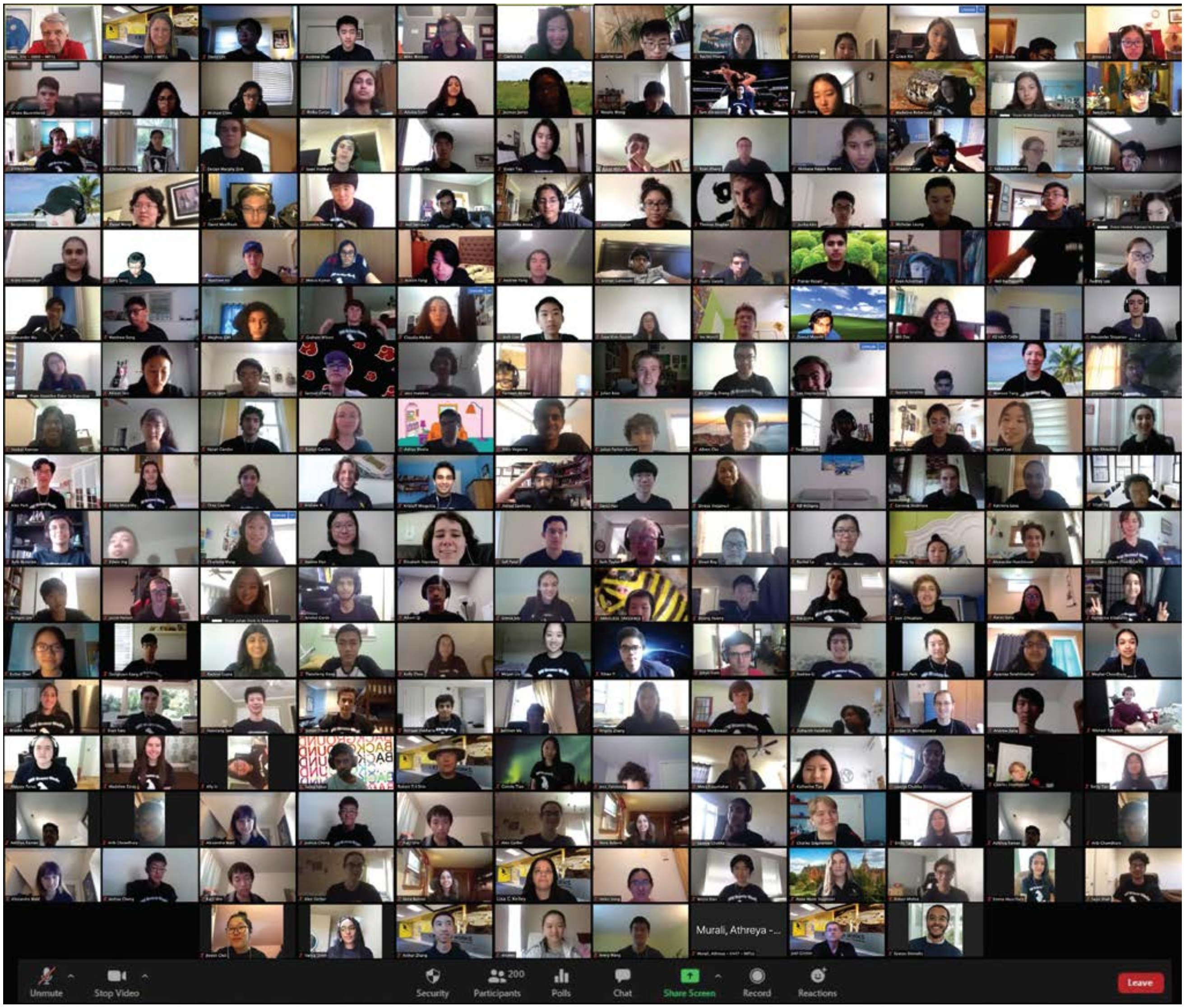
June 29 (Mon): Dr. Louise Ivers, Massachusetts General Hospital
PACT: A Public Health Perspective

July 6 (Mon): Joel Linsky, Qualcomm
Bluetooth Technology

July 13 (Mon): Dr. Emily Shen, MIT Lincoln Laboratory
Privacy and Security for PACT

BEAVER WORKS
Lincoln Laboratory | School of Engineering

MIT Beaver Works Summer Institute
Class of 2020



MIT Beaver Works Summer Institute

2020 Virtual Summer Program (July 6 – 31, 2020)

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; Deputy Dean of Research, MIT Schwarzman College of Computing; 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)
Jenn Watson (MIT Lincoln Laboratory)

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 Department of Aeronautics and Astronautics)
Eyassu Shimelis (MIT Lincoln Laboratory)

Communication Instructor

Jane Abbott (MIT Writing, Rhetoric and Professional Communication)

Health Professional

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)
Jay Couturier (MIT Lincoln Laboratory)
Erin Lee (MIT Lincoln Laboratory)
Anne McGovern (MIT Lincoln Laboratory)
Dorothy Ryan (MIT Lincoln Laboratory)

Photographers

Glen Cooper (MIT Lincoln Laboratory)
Niki Fandel (MIT Lincoln Laboratory)

IT Coordinator

John Bilodeau (MIT Lincoln Laboratory)

Publications

Rich Bushey (MIT Lincoln Laboratory)

MIT Video Productions Virtual Event Production

Clayton Hainsworth (Director, MIT Video Production)
Rod Lindheim (Production Manager, MIT Video Production)
Kevin Tierney (Streaming Manager, MIT Video Production)
Barry Pugatch (Technical Director, MIT Video Production)
Tom White (Technical Director, MIT Video Production)
Wes Richardson (Technical Director, MIT Video Production)
Tom Stift (Editor, MIT Video Production)
Alex Sachs (Editor, MIT Video Production)
Joe McMaster (Senior Producer, MIT Video Production)
Dawn Morton (Client Services Manager, MIT Video Production)

Autonomous RACECAR Grand Prix

Lead Instructors

Matthew Calligaro (Harvey Mudd College)
Emi Suzuki (Harvey Mudd College)
Eyassu Shimelis (MIT Lincoln Laboratory)

Instructor

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

Associate Instructors

Jaden Clark (Stanford University)
Roman Herrera (Harvey Mudd College)
Kobe Lin (Harvey Mudd College)
Alina Saratova (Harvey Mudd College)
Valentina Vallalta (Harvey Mudd College)

Guest Lecturers/Instructors

Michael Berger (Madison Park Technical Vocational High School)
Malay Bhatt (East Lake High School)
Prof. Luca Carlone (MIT Department of Aeronautics and Astronautics)
Prof. Christopher Clark (Harvey Mudd College)

Autonomous Cognitive Assistant
BAE Systems Project

Lead Instructor

Ryan Soklaski (MIT Lincoln Laboratory)

Head Associate Instructor

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

Associate Instructors

Vaishnavi Addala (MIT, BWSI 2019 Alum)
Sam Carpenter (Duke University, BWSI 2018 Alum)
Megan Frisella (Brown University, BWSI 2019 Alum)
Vishnu Penubarthi (MIT, BWSI 2018 Alum)

Guest Lecturers/Instructor

David Mascharka (Covariant)

Special Student

Darshawn Krishnaswamy (BWSI 2019 Alum)

Medlytics: Data Science for Health and Medicine
Raytheon Intelligence & Space Project

Lead Instructor

Jordan Montgomery (MIT Lincoln Laboratory)

Instructors

Jeffrey Arena (MIT Lincoln Laboratory)
Thomas Curtis (MIT Lincoln Laboratory)
Marianne Procopio (MIT Lincoln Laboratory)

Head Associate Instructor

Emily Tan (Georgia Institute of Technology, BWSI 2017, 2018 Alum)

Associate Instructors

Ujwal Pandey (Rensselaer Polytechnic Institute)
Sharvil Trifale (University of California, Berkeley, BWSI 2019 Alum)

Guest Lecturers/Instructors

Andreea Bondari, PhD (Google)
Dr. Leo Celi (Harvard Medical School)
Dr. Abdullah Chahin (Brown University)
Manya Ghobadi, PhD (MIT Computer Science and Artificial Intelligence Laboratory)
Undina Gisladottir (Blatvatnik Institute of Biomedical Informatics at HMS)
Edmarie Guzman-Velez, PhD (Harvard Medical School)
Jim Harper, PhD (Sonde Health)
Dr. Kevin Hughes (Harvard Medical School)
Dr. Paul Montgomery (Scripps Health)
Chirag Patel, PhD (Blatvatnik Institute of Biomedical Informatics at HMS)
Adam Yala (MIT Computer Science and Artificial Intelligence Laboratory)

Embedded Security and Hardware Hacking
MITRE Project

Lead Instructors

Gabriel Pascualy (MITRE)
Jake Grycel (MITRE)

Instructors

Ted Clifford (Worcester Polytechnic Institute, BWSI 2018 Alum)
Ed Krawcyzk (MITRE)

Associate Instructor

Arthur Zhang (MITRE, BWSI 2019 Alum)

Guest Lecturers/Instructors

Rachel Bainbridge (MITRE)
Eric Kedaigle (MITRE)

Build a CubeSat
Sierra Nevada Corp. Project

Lead Instructors

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

Instructors

William Blackwell (MIT Lincoln Laboratory)
Prof. Kerri Cahoy (MIT Department of Aeronautics and Astronautics)
Andrew Dahir (MIT Lincoln Laboratory)
Paul Lawson (MIT Lincoln Laboratory)
Adam Shabshelowitz (MIT Lincoln Laboratory)
Jonah Tower (MIT Lincoln Laboratory)

Associate Instructors

Mary Dahl (MIT Department of Aeronautics and Astronautics)
Jack Fox (Virginia Polytechnic Institute and State University)
Max Mazzarese (Needham High School, BWSI 2019 alum)
Joseph Patton (University of Maine)

Guest Lecturers/Instructors

David Arenson (Lockheed Martin Space Systems)
Bruce Strickrott (Woods Hole Oceanographic Institution)
Dr. Maurice Tivey (Woods Hole Oceanographic Institution)
Dr. Collin Ward (Woods Hole Oceanographic Institution)

Remote Sensing for Disaster Response

Lead Instructor

Jeffrey Liu (MIT Lincoln Laboratory)

Instructor

Rene Andres Garcia-Franceschini (MIT Department of Civil and Environmental Engineering)

Associate Instructors

Omkar Bhalerao (Cornell, BWSI 2019 Alum)
Pratyush Das (University of California, Berkeley, BWSI 2019 Alum)
Andrew Mascillaro (Olin College, BWSI 2018 Alum)
Anne Marie Stupinski (University of Vermont)

Guest Lecturers/Instructors

Chad Council (MIT Lincoln Laboratory)
Dan Ribeirnha-Braga (MIT Lincoln Laboratory)

Serious Game Design and Development with AI

Lead Instructor

Amna Greaves (MIT Lincoln Laboratory)

Instructors

Joel Kurucar (MIT Lincoln Laboratory)
Rob Seater (MIT Lincoln Laboratory)

Associate Instructors

Athreya Murali (RPI, MIT Lincoln Laboratory Student Research Assistant)
Christian Vanderloo (RPI, MIT Lincoln Laboratory Student Research Assistant)
Michael Vanderloo (Lafayette College)

Guest Lecturers/Instructors

Ben Ervine (MIT Lincoln Laboratory)
Jay Couturier (MIT Lincoln Laboratory)
Ned Rothstein (MIT Lincoln Laboratory)

Serious Game Design and Development with AI
BWSI Kwajalein

Lead Instructors

Amna Greaves (MIT Lincoln Laboratory)
Sarah Willis (MIT Lincoln Laboratory)

Instructors

Karyn Lundberg (MIT Lincoln Laboratory)
Jon Schoenenberger (MIT Lincoln Laboratory)
Tommy Sebastian (MIT Lincoln Laboratory)

piPACT - BWSI 2020 Independent Project

Lead Instructor

Ramu Bhagavatula (MIT Lincoln Laboratory)

Instructors

John Orthoefer (MIT Lincoln Laboratory)
Jenn Watson (MIT Lincoln Laboratory)

Guest Lecturers

Dr. Louise Ivers (Massachusetts General Hospital)
Joel Linsky (Qualcomm)
Emily Shen (MIT Lincoln Laboratory)
Marc Zissman (MIT Lincoln Laboratory)

MIT Beaver Works Summer Institute

2020 Summer Program

Class of 2020

Brooke Abeles
Samuel Abramson
Evan Ackerman
Fardeen Ahmed
Anoushka Arora
Rebecca Ashmore
Julian Bain
Avik Banerjee
Drake Bauernfeind
Aditya Bhatia
Nora Bulovic
Thea Caplan
Ke Hao Chen
Michael Chen
Joshua Cheng
Samuel Cheng
Jiyoon Choi
Meghai Choudhury
Arib Chowdhury
Albert Chu
Laasya Chukka
Jinzi Danjul
Mili Das
Dmitri Demler
Vanya Dimri
Alexander Du
Hannah Epstein
Madeline Estey
Hasan Gandor
Anshul Garde
Evelyn Gaskin
Sriman Gattepalli
Hitaansh Gaur
Alex Gerber
Meghna Gite
Benjamin Graham
Gabriel Guo
Rachna Gupta
Ritika Gurjar
Henry Gussis
David Han
Nadine Han
Matthew Ho
Sidhanth Holalkere
Nuri Hong
Rachel Huang
Siyong Huang
Isaac Hubbard
Thomas Hughes
Alexander Hutchinson
Joonha Hwang
Sazzad Ibrahim
Edwin Ing
Anisha Jain
Jazmyn James
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He Jiang
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Wonjun Lee
Nicholas Leung
Katriona Lexa
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Olivia Ma
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Claudia Markel
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Emily McCarthy
David McElfresh
Aidan Melvin
Ray Min
Rohan Mishra
Kristoff Misquitta
Nico Moldovean
Ian Morrill
Zawad Munshi
Declan Murphy Zink
Akshaya Naapa Ramesh
Jacob Nelson
Bronwen Olson
Sam O'Nuallain
Aleksey Panas
Nitya Parida
JuWon Park
Julian Parker-Sartori
Safi Patel
Clarice Pranyoto
Albert Qi
Jerry Qian
Adithya Raman
Madeline Robertson
Shruti Roy
Michael Rybalkin
Neil Sanipara
Anhad Sawhney
Yash Saxena
Aparnaa Senthilnathan
Allison Seo
Sajiv Shah
Esther Shen
Ria Sinha
Rishi Sinha
Savitta Sivapalan
Corinna Skidmore
Sadiq Sobur
Gary Song
Karen Song
Matthew Song
Advika Sonti
Nidhi Sonwalkar
Charles Stephenson
Leo Stephenson
Alexander Stoyanov
Haoxiang Sun
Anneliese Takeshige
Katherine Tan
Wenson Tang
Vivian Tao
Seth Taylor
Connie Tian
Simon Traub
Kaiji Uno
Armaan Vakharia
Elizabeth (Lily) Vaysman
Nitin Vegesna
Shreya Vinjamuri
Johan Vonk
Alexandra Wald
Avery Wang
Charlotte Wang
David Wang
Romario Williams
Graham Wilson
Michael Wimmer
Natalie Wong
Alexander Wu
Alice Wu
Weijia Xiao
Grace Xin
Andrew Yang
Austin Yang
Christine Yang
Jessica Yatvitskiy
Emre Yavuz
Ethan Yen
Tiffany Yu
Angela Zhang
Jin Cheng Zhang
Ryan Zhang
Andrew Zhao
Kelly Zhou
Rebecca Zhu

Brooke Abeles
Building a CubeSat
Sierra Nevada Corp. Project
Fieldston School
(New York, NY)

Samuel Abramson
Autonomous RACECAR Grand Prix
Montville Township High School
(Towaco, NJ)

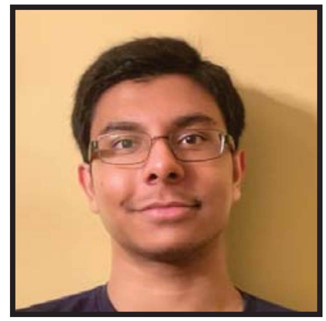
Evan Ackerman
Serious Gaming
Governor's School for Science &
Mathematics
(Greenville, SC)

Fardeen Ahmed
Autonomous RACECAR Grand Prix
Bronx High School of Science
(Sunnyside, NY)

Anoushka Arora
Remote Sensing for
Disaster Response
Dr. Ronald E. Mcnair Academic
High School (Jersey City, NJ)

Rebecca Ashmore
Serious Gaming
Blackstone Valley Technical
High School
(North Grafton, MA)

Julian Bain
Serious Gaming
Hellgate High School
(Missoula, MT)



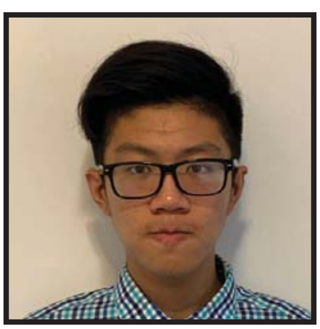
Avik Banerjee
Building a CubeSat
Sierra Nevada Corp. Project
Academies of Loudoun
(Ashburn, VA)

Drake Bauernfeind
Medlytics
Raytheon I&S Project
North Carolina School of Science
and Mathematics (Tampa, FL)

Aditya Bhatia
Autonomous RACECAR Grand Prix
North Carolina School of Science
and Mathematics
(Cary, NC)

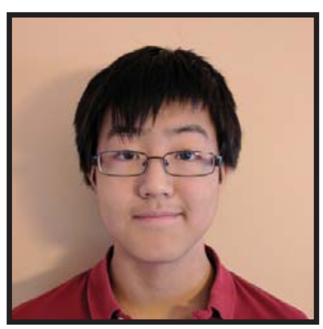
Nora Bulovic
Autonomous Cognitive Assistant
BAE Systems Project
Lexington High School
(Lexington, MA)

Thea Caplan
Embedded Security and Hardware
Hacking – MITRE Project
Westford Academy
(Westford, MA)

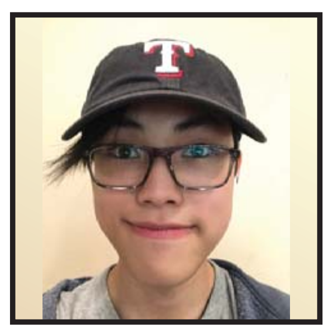


Ke Hao Chen
Serious Gaming
Bronx High School of Science
(Oakland Gardens, NY)

Michael Chen
Remote Sensing for
Disaster Response
Bronx High School of Science
(Bayside, NY)

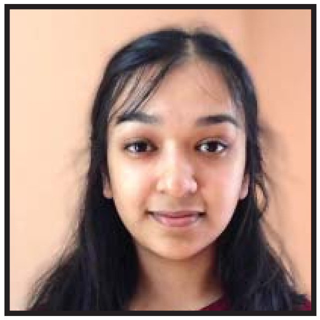


Joshua Cheng
Building a CubeSat
Sierra Nevada Corp. Project
Algonquin Regional High School
(Northborough, MA)

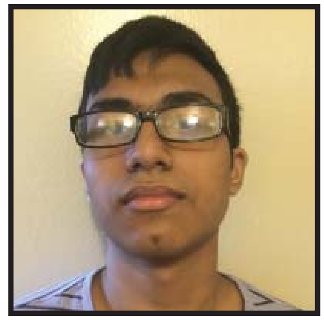


Samuel Cheng
Medlytics
Raytheon I&S Project
School for the Talented and Gifted
at the Yvonne A. Ewell Townview
Magnet Center (Dallas, TX)

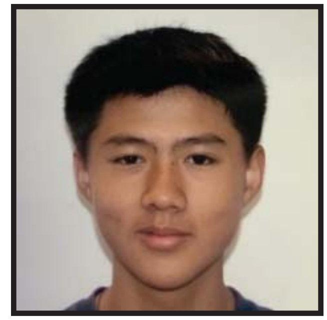
Jiyoon Choi
Serious Gaming
Lexington High School
(Lexington, MA)



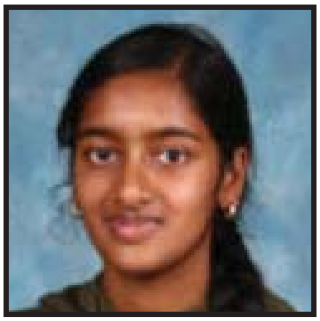
Meghai Choudhury
Embedded Security and Hardware Hacking – MITRE Project
Fairfield Warde High School
(Fairfield, CT)



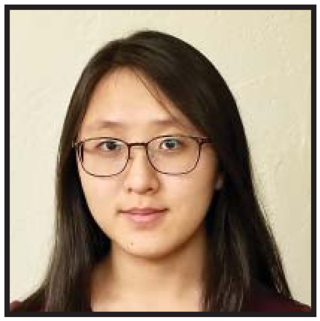
Arib Chowdhury
Serious Gaming
Stuyvesant High School
(Far Rockaway, NY)



Albert Chu
Building a CubeSat
Sierra Nevada Corp. Project
Phillips Exeter Academy
(Sunnyvale, CA)



Laasya Chukka
Autonomous RACECAR Grand Prix
Lynbrook High School
(Santa Clara, CA)



Jinzi Danjul
Serious Gaming
Independence High School
(Frisco, TX)

Mili Das
Autonomous Cognitive Assistant
BAE Systems Project
Sachem High School North
(Holbrook, NY)

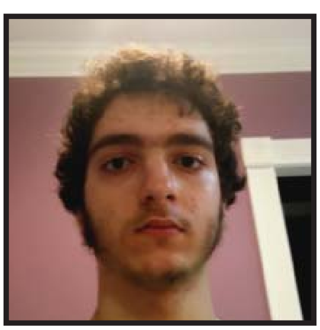
Dmitri Demler
Remote Sensing for Disaster Response
Boston University Academy
(Newton, MA)

Vanya Dimri
Building a CubeSat
Sierra Nevada Corp. Project
Redmond High School
(Redmond, WA)

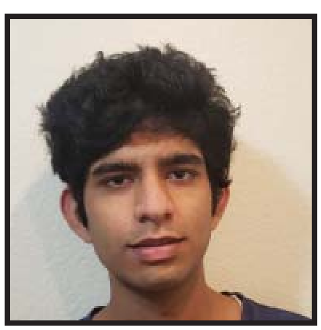
Alexander Du
Serious Gaming
The Hotchkiss School
(Branford, CT)

Hannah Epstein
Building a CubeSat
Sierra Nevada Corp. Project
Noble & Greenough School
(Needham, MA)

Madeline Estey
Embedded Security and Hardware Hacking – MITRE Project
Kent Place School
(Morristown, NJ)

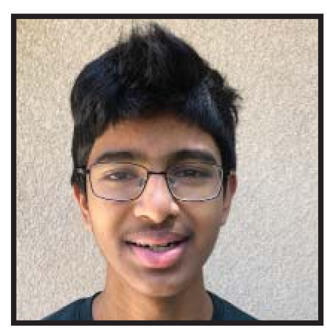


Hasan Gandor
Building a CubeSat
Sierra Nevada Corp. Project
Shrewsbury High School
(Shrewsbury, MA)

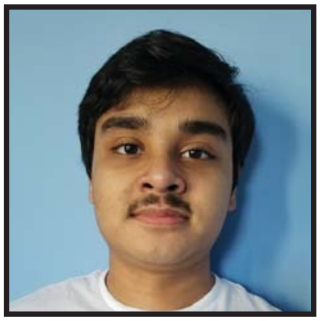


Anshul Garde
Remote Sensing for Disaster Response
American High School
(Fremont, CA)

Evelyn Gaskin
Remote Sensing for Disaster Response
Henry M. Gunn High School
(Palo Alto, CA)



Sriman Gattepalli
Embedded Security and Hardware Hacking – MITRE Project
Evergreen Valley High School
(San Jose, CA)

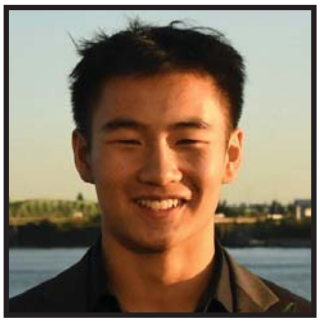


Hitaansh Gaur
Autonomous RACECAR Grand Prix
Thomas Jefferson High School for
Science and Technology
(Springfield, VA)

Alex Gerber
Remote Sensing for
Disaster Response
Evanstan Township High School
(Evanston, IL)

Meghna Gite
Embedded Security and Hardware
Hacking – MITRE Project
Arlington High School
(Arlington, MA)

Benjamin Graham
Building a CubeSat
Sierra Nevada Corp. Project
Middlesex School
(Bristol, VT)

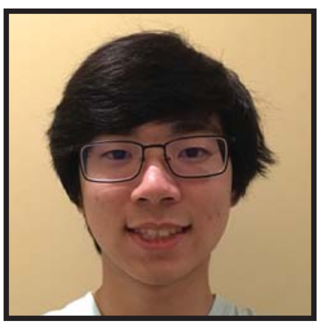


Gabriel Guo
Remote Sensing for
Disaster Response
Camas High School
(Camas, WA)

Rachna Gupta
Autonomous Cognitive Assistant
BAE Systems Project
Illinois Math & Science Academy
(Hoffman Estates, IL)

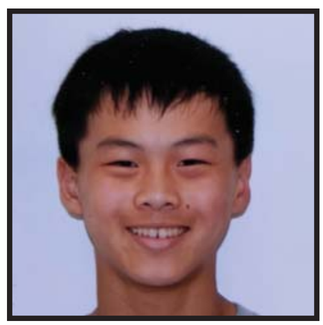
Ritika Gurjar
Embedded Security and Hardware
Hacking – MITRE Project
Arlington High School
(Arlington, MA)

Henry Gussis
Serious Gaming
Niles West High School
(Lincolnwood, IL)

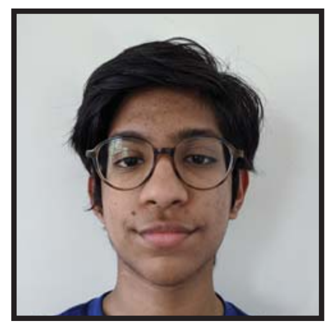


David Han
Autonomous Cognitive Assistant
BAE Systems Project
Thomas Jefferson High School for
Science and Technology (Vienna, VA)

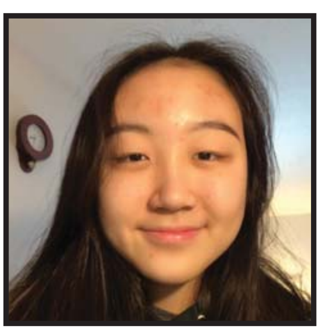
Nadine Han
Autonomous Cognitive Assistant
BAE Systems Project
Boston Latin
(Boston, MA)



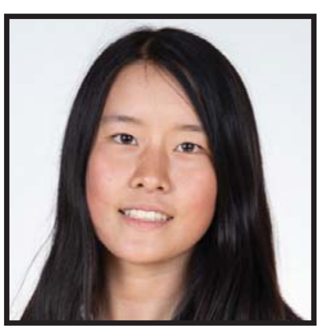
Matthew Ho
Autonomous Cognitive Assistant
BAE Systems Project
Palo Alto High School
(Palo Alto, CA)



Sidhanth Holalkere
Autonomous Cognitive Assistant
BAE Systems Project
Commonwealth School
(Sharon, MA)

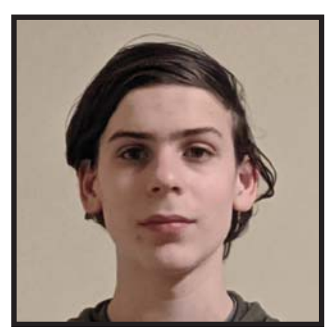


Nuri Hong
Building a CubeSat
Sierra Nevada Corp. Project
Lexington High School
(Lexington, MA)



Rachel Huang
Medlytics
Raytheon I&S Project
Monta Vista High School
(Saratoga, CA)

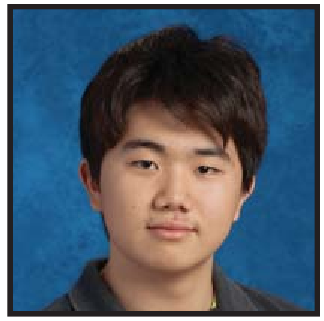
Siyong Huang
Medlytics
Raytheon I&S Project
Homestead High School
(Sunnyvale, CA)



Isaac Hubbard
Serious Gaming
Weston High School
(Weston, MA)

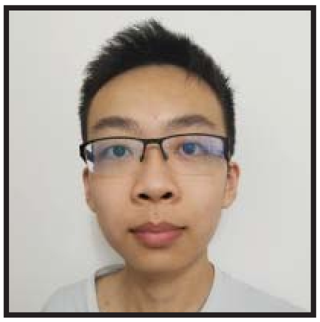
Thomas Hughes
Embedded Security and Hardware Hacking – MITRE Project
Bronx High School of Science
(New York, NY)

Alexander Hutchinson
Remote Sensing for Disaster Response
Arlington High School
(Arlington, MA)

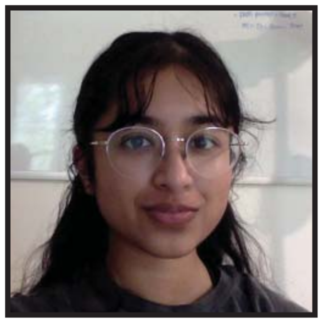


Joonha Hwang
Serious Gaming
Lynbrook High School
(San Jose, CA)

Sazzad Ibrahim
Embedded Security and Hardware Hacking – MITRE Project
Brooklyn Technical High School
(Brooklyn, NY)



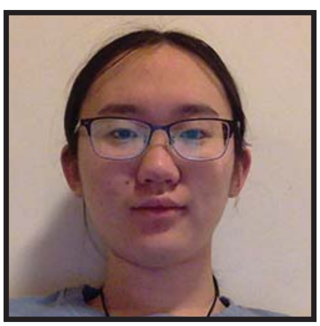
Edwin Ing
Serious Gaming
Walter Payton College Preparatory High School
(Chicago, IL)



Anisha Jain
Embedded Security and Hardware Hacking – MITRE Project
Thomas Jefferson High School for Science and Technology (Oakton, VA)

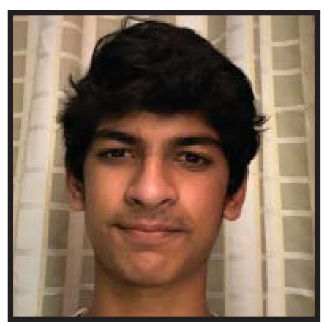
Jazmyn James
Remote Sensing for Disaster Response
South Fork High School
(Palm City, FL)

Andrew Jiang
Embedded Security and Hardware Hacking – MITRE Project
Stuyvesant High School
(New York, NY)

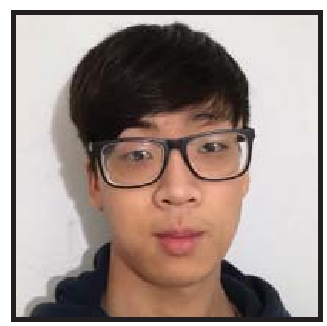


He Jiang
Medlytics
Raytheon I&S Project
Princeton International School of Mathematics (Princeton, NJ)

Emma Joly
Building a CubeSat
Sierra Nevada Corp. Project
Alabama School of Math and Science (Spanish Fort, AL)



Neil Kachappilly
Medlytics
Raytheon I&S Project
Nashua High School South
(Nashua, NH)



Dongkyun Kang
Embedded Security and Hardware Hacking – MITRE Project
Bowling Green High School
(Bowling Green, KY)

Venkatraghavan Kannan
Autonomous Cognitive Assistant
BAE Systems Project
Detroit Country Day Upper School
(Novi, MI)

Evan Katz
Autonomous RACECAR Grand Prix
Staples High School
(Westport, CT)

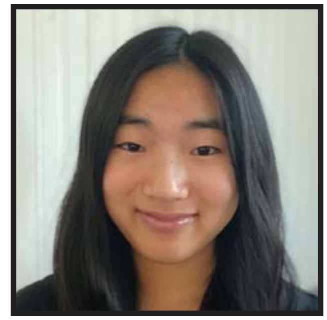
Pranav Kesani
Autonomous Cognitive Assistant
BAE Systems Project
Dougherty Valley High School
(San Ramon, CA)

Ines Khouider
Autonomous Cognitive Assistant
BAE Systems Project
St Margaret's School
(Victoria, British Columbia)

Katherine Kibatullin
Autonomous RACECAR Grand Prix
Stuyvesant High School
(New York, NY)

Elenna Kim
Medlytics
Raytheon I&S Project
Bloomington South High School
(Bloomington, IN)

Junha Kim
Autonomous Cognitive Assistant
BAE Systems Project
Troy High School
(Irvine, CA)



Saya Kim-Suzuki
Autonomous Cognitive Assistant
BAE Systems Project
Fieldston School
(New York, NY)

Tiancheng Kong
Embedded Security and Hardware
Hacking – MITRE Project
Boston University Academy
(Cambridge, MA)

Meera Kumar
Remote Sensing for
Disaster Response
Andover High School
(Andover, MA)

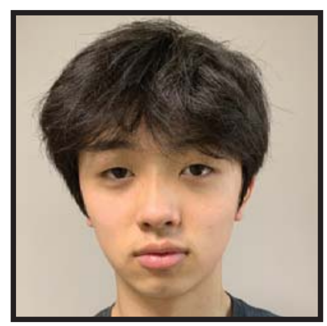
Maya Kusumakar
Serious Gaming
Carroll High School
(Southlake, TX)

Ethan Ky
Remote Sensing for
Disaster Response
Governer's School at Innovation Park
(Manassas, VA)

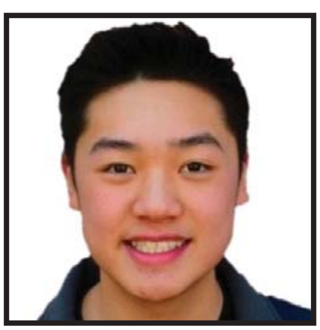
Audrey Lee
Autonomous Cognitive Assistant
BAE Systems Project
Mira Costa High School
(Manhattan Beach, CA)

David Lee
Medlytics
Raytheon I&S Project
Shrewsbury High School
(Northborough, MA)

Ingrid Lee
Embedded Security and Hardware
Hacking – MITRE Project
Lynbrook High School
(San Jose, CA)

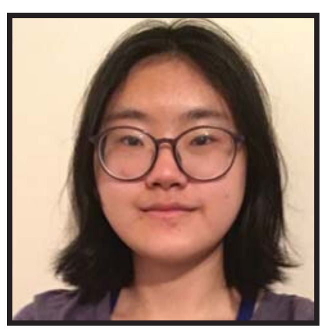


Wonjun Lee
Serious Gaming
Bergen County Academies
(Old Tappan, NJ)



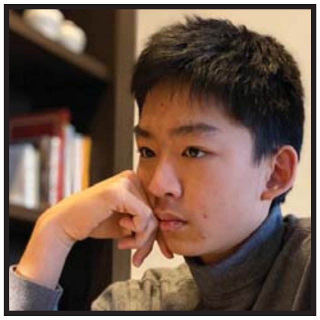
Nicholas Leung
Building a CubeSat
Sierra Nevada Corp. Project
Haverhill High School
(Haverhill, MA)

Katriona Lexa
Building a CubeSat
Sierra Nevada Corp. Project
Brookline High School
(Brookline, MA)



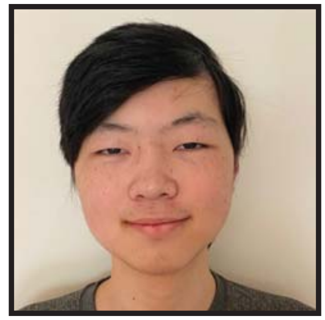
Ally Li
Autonomous RACECAR Grand Prix
Northview High School
(Johns Creek, GA)

Andrew Li
Medlytics
Raytheon I&S Project
Newton South High School
(Waban, MA)

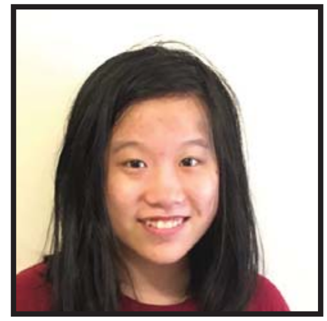


Joshua Lian
Building a CubeSat
Sierra Nevada Corp. Project
Thomas Jefferson High School for
Science and Technology (McLean, VA)

Alice Liu
Embedded Security and Hardware
Hacking – MITRE Project
John L. Miller Great Neck North High
School (Great Neck, NY)



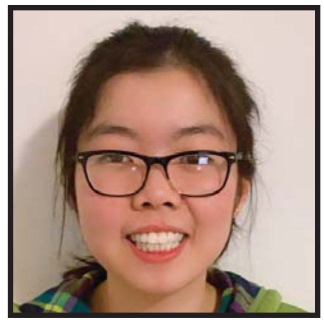
Benjamin Liu
Embedded Security and Hardware
Hacking – MITRE Project
Lexington High School
(Lexington, MA)



Clarise Liu
Medlytics
Raytheon I&S Project
Massachusetts Academy of Math &
Science (Worcester, MA)

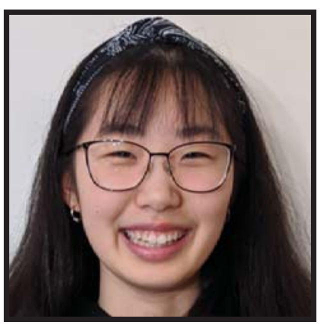
Jessica Liu
Remote Sensing for
Disaster Response
Kinkaid School
(Houston, TX)

Megan Liu
Serious Gaming
Lexington High School
(Lexington, MA)



Rachel Lu
Serious Gaming
Bronx High School of Science
(College Point, NY)

Jamisen Ma
Building a CubeSat
Sierra Nevada Corp. Project
Henry M. Gunn High School
(Palo Alto, CA)

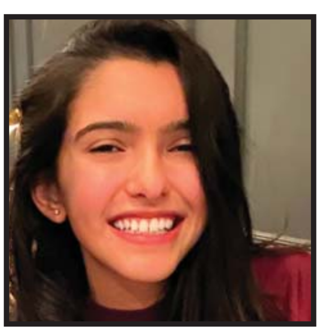


Olivia Ma
Autonomous Cognitive Assistant
BAE Systems Project
Thomas Jefferson High School for
Science and Technology (Vienna, VA)

Alexander Malakov
Serious Gaming
Needham High School
(Needham, MA)

Praneeth Malyala
Serious Gaming
Thomas Jefferson High School
for Science and Technology
(Ashburn, VA)

Claudia Markel
Building a CubeSat
Sierra Nevada Corp. Project
Layfayette High School
(Lexington, KY)

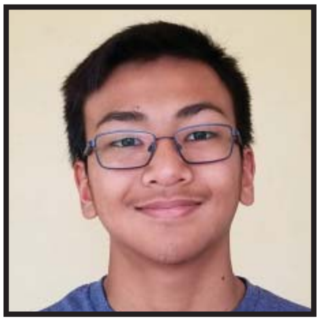


Emma Mascillaro
Autonomous RACECAR Grand Prix
Manalapan High School
(Freehold, NJ)

Emily McCarthy
Building a CubeSat
Sierra Nevada Corp. Project
Belmont High School
(Belmont, MA)

David McElfresh
Serious Gaming
Derry Area High School
(Latrobe, PA)

Aidan Melvin
Embedded Security and Hardware
Hacking – MITRE Project
Science & Mathematics Academy
(Joppa, MD)



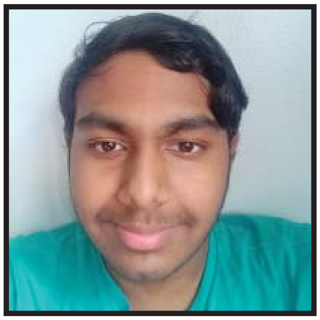
Ray Min
Serious Gaming
Pine View High School for the Gifted
(Sarasota, FL)

Rohan Mishra
Autonomous Cognitive Assistant
BAE Systems Project
Thomas Jefferson High School for
Science and Technology (Herndon, VA)

Kristoff Misquitta
Medlytics
Raytheon I&S Project
Stuyvesant High School
(Forest Hills, NY)

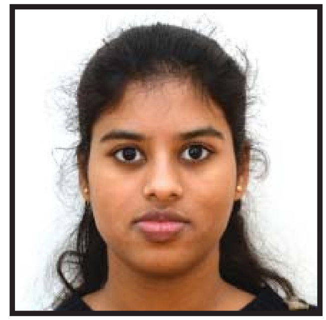
Nico Moldovean
Building a CubeSat
Sierra Nevada Corp. Project
Boston University Academy
(Wenham, MA)

Ian Morrill
Autonomous Cognitive Assistant
BAE Systems Project
Science & Mathematics Academy
(Bel Air, MD)



Zawad Munshi
Embedded Security and Hardware
Hacking – MITRE Project
Bronx High School of Science
(Bronx, NY)

Declan Murphy Zink
Remote Sensing for
Disaster Response
Choate Rosemary Hall
(West Simsbuty, CT)



Akshaya Naapa Ramesh
Medlytics
Raytheon I&S Project
Littleton High School
(Littleton, MA)

Jacob Nelson
Autonomous Cognitive Assistant
BAE Systems Project
Chantilly High School
(Chantilly, VA)

Bronwen Olson
Embedded Security and Hardware
Hacking – MITRE Project
Needham High School
(Needham, MA)

Sam O'Nuallain
Building a CubeSat
Sierra Nevada Corp. Project
Needham High School
(Needham, MA)

Aleksey Panas
Autonomous RACECAR Grand Prix
Brooklyn Technical High School
(Staten Island, NY)

Nitya Parida
Remote Sensing for
Disaster Response
Round Rock High School
(Cedar Park, TX)

JuWon Park
Medlytics
Raytheon I&S Project
Illinois Math & Science Academy
(Bloomington, IL)

Julian Parker-Sartori
Serious Gaming
Buckingham Browne & Nichols
(Belmont, MA)

Safi Patel
Autonomous RACECAR Grand Prix
Montville Township High School
(Montville, NJ)

Clarice Pranyoto
Embedded Security and Hardware Hacking – MITRE Project
Flintridge Preparatory School
(Arcadia, CA)

Albert Qi
Embedded Security and Hardware Hacking – MITRE Project
Noble & Greenough School
(Needham, MA)

Jerry Qian
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Raytheon I&S Project
Ithaca High School
(Ithaca, NY)

Adithya Raman
Autonomous RACECAR Grand Prix
Northview High School
(Johns Creek, GA)

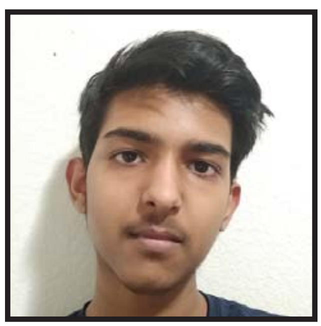
Madeline Robertson
Building a CubeSat
Sierra Nevada Corp. Project
Governor's School for Science & Mathematics (Greenville, SC)

Shruti Roy
Remote Sensing for Disaster Response
Bridgewater-Raritan High School
(Bridgewater, NJ)

Michael Rybalkin
Autonomous RACECAR Grand Prix
Central Bucks High School East
(Jamison, PA)

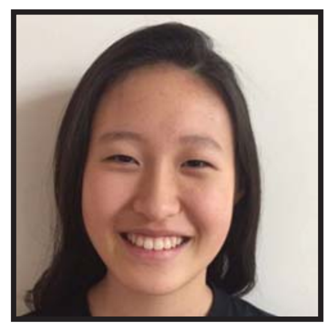
Neil Sanipara
Remote Sensing for Disaster Response
Mississippi School for Math & Science (Vicksburg, MS)

Anhad Sawhney
Autonomous RACECAR Grand Prix
Lexington High School
(Lexington, MA)



Yash Saxena
Remote Sensing for Disaster Response
Plano West Senior High School
(Plano, TX)

Aparnaa Senthilnathan
Autonomous Cognitive Assistant
BAE Systems Project
Bronx High School of Science
(South Richmond Hill, NY)



Allison Seo
Remote Sensing for Disaster Response
Thomas Jefferson High School for Science and Technology (Springfield, VA)

Sajiv Shah
Building a CubeSat
Sierra Nevada Corp. Project
Saratoga High School
(Saratoga, CA)

Esther Shen
Autonomous Cognitive Assistant
BAE Systems Project
Boston Latin
(Boston, MA)

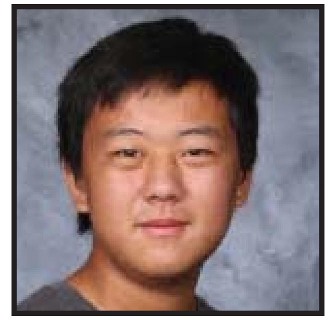
Ria Sinha
Autonomous Cognitive Assistant
BAE Systems Project
BASIS Independent Silicon Valley
(San Jose, CA)

Rishi Sinha
Remote Sensing for Disaster Response
John P. Stevens High School
(Edison, NJ)

Savitta Sivapalan
Autonomous RACECAR Grand Prix
Bronx High School of Science
(Bronx, NY)

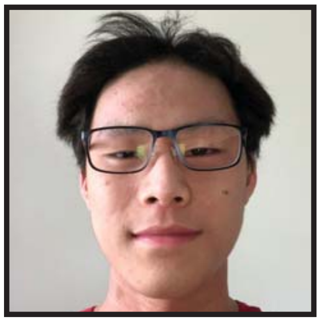
Corinna Skidmore
Embedded Security and Hardware
Hacking – MITRE Project
Brookline High School
(Brookline, MA)

Sadiq Sobur
Serious Gaming
Bronx High School of Science
(Bronx, NY)

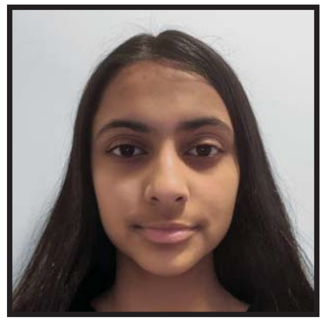


Gary Song
Embedded Security and Hardware
Hacking – MITRE Project
Martin Luther King High School
(Riverside, CA)

Karen Song
Medlytics
Raytheon I&S Project
Thomas Jefferson High School for
Science and Technology (McLean, VA)



Matthew Song
Serious Gaming
Westford Academy
(Westford, MA)



Advika Sonti
Medlytics
Raytheon I&S Project
Massachusetts Academy of Math &
Science (Boylston, MA)

Nidhi Sonwalkar
Building a CubeSat
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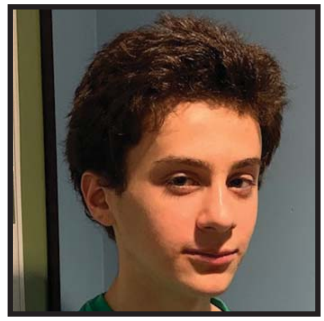

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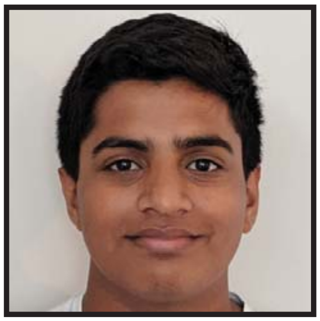

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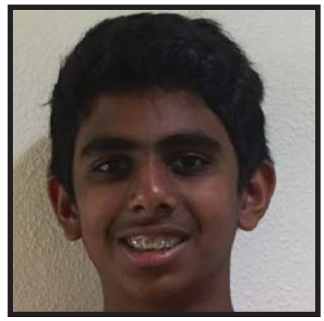

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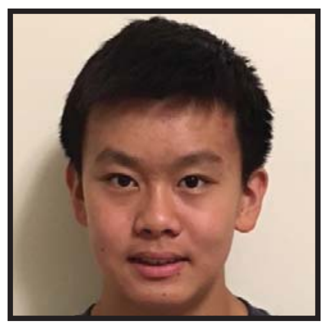

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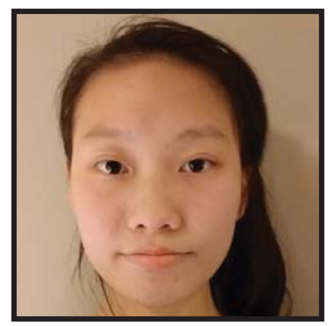

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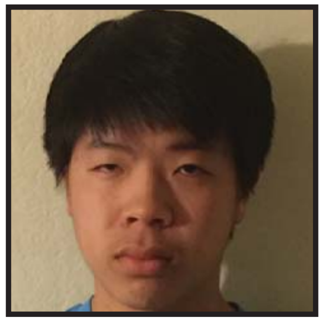

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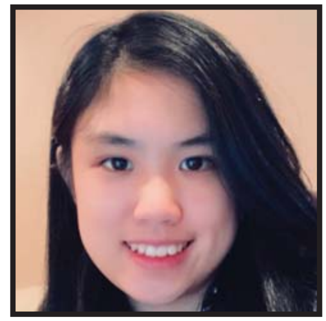

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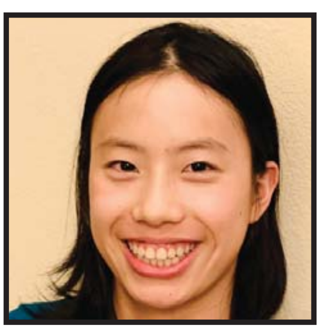

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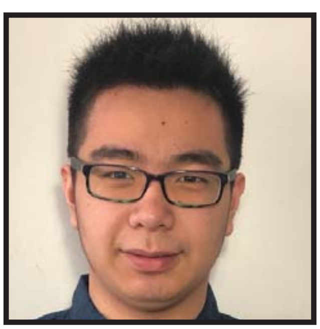

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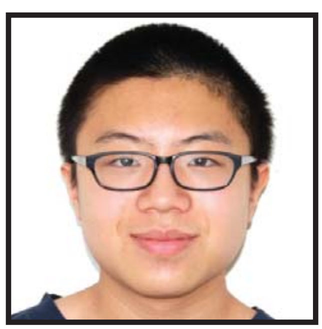

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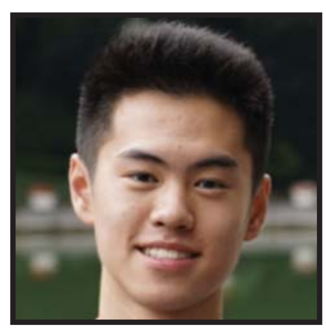

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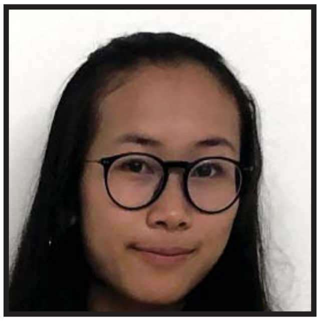

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