

**2017 SIEMENS COMPETITION IN MATH, SCIENCE AND TECHNOLOGY
Regional Finalists – Massachusetts Institute of Technology**

INDIVIDUAL COMPETITORS



DAVID DARROW

SCHOOL: Hopkins School, New Haven, CT

YEAR: Senior

HOMETOWN: Wallingford, CT

PROJECT: “A Novel, Near-Optimal Spectral Method for Simulating Fluids in a Cylinder”

FIELD: Mathematics

MENTOR: Alex Townsend, Ph.D., Cornell University; Grady Wright, Ph.D., Boise State University (advisor)

“Mathematics just pervades everything you do—whether it’s scientific, musical, political, or otherwise—and learning the subject sheds light on everything else.”

David developed an algorithm to simulate fluids in a cylinder, which could significantly improve our understanding of turbulent motion. There are many potential applications for this research, from better prediction of storm surges and hurricane intensity to more efficient fluid-based turbines.

From a young age, David has been interested in STEM subjects. As a child, he loved building Legos and constantly asked his parents to explain the reasons behind natural phenomena. Now, he explores those reasons himself. His current research is in the area of fluid dynamics, which he finds fascinating because it’s complex, chaotic, and not well understood, despite the fact that it’s far older than most modern fields of physics.

An Eagle Scout with an interest in teaching, David aspires to be a professor of applied math. He’s honing those instructional skills as a tutor in his school’s peer tutoring program and as a mathematics tutor for middle-schoolers. He also created a rocketry class for local students.

When David isn’t teaching or in the lab, you can find him listening to an eclectic collection of music, ranging from Talking Heads to the Brandon Marsalis Quartet, or reading. Hitchhiker’s Guide to the Galaxy is one of his favorite books because of its tongue-in-cheek humor.



NIKHIL GOPAL

SCHOOL: Lawrenceville School, Lawrenceville, NJ

YEAR: Senior

HOMETOWN: Belle Mead, NJ

PROJECT: “Portable Detection of Malaria DNA Using Microfluidic Loop Mediated Isothermal Amplification (Lamp) And A Smartphone”

FIELD: Biology

MENTOR: Linda Brzustowicz, M.D., Rutgers University; Ruben Raychaudhuri, Medical College of Wisconsin

“I love using technology to help solve big problems. And one day, I’d like to start my own biotechnology company and transform the health of rural communities.”

When Nikhil was 14 years old, his aunt, who was living in southern India, nearly died from a drug-resistant strain of malaria—an often-fatal disease carried by mosquitoes that threatens nearly 95 percent of the country. When she was brought to the hospital, her doctors suspected she had malaria, but lacked the expensive lab equipment to know for sure.

Malaria is a tricky disease and one of its hallmark symptoms—a high fever—can often masquerade as many other illnesses. Without fast, accurate diagnostic tools at-the-ready malaria can quickly turn deadly, particularly when the right treatments for the specific type of malaria are unavailable.

Fortunately for Nikhil’s aunt and her family, she survived, but Nikhil would not rest until he could develop a way to detect malaria quickly, cheaply and with equipment often seen on camping trips. Nikhil used a Meals-Ready-to-Eat (MRE) pack that generated heat, combined with a smartphone to develop a cheap, portable tool that detects malaria DNA in blood samples weeks before it can be detected using traditional lab-based methods. The speed and ease with which a device like this could be used in rural communities could mean the difference between life and death for millions of people like Nikhil’s aunt all around the world.

Nikhil hopes to continue taking big ideas and transforming them into ways to help people, perhaps someday in the form of his own biotechnology company. In his spare time, Nikhil is a member of the LEAP Club, where members discuss politics and ethics. He speaks Spanish and plays varsity squash and was once one of the top 10 junior players in the country. Nikhil has placed as a Google Science Fair Global Finalist (2016) and twice as an Intel International Science and Engineering Fair (ISEF) Grand Award Winner (2016-17).



ANDREW KOMO

SCHOOL: Montgomery Blair High School, Silver Spring, MD

YEAR: Senior

HOMETOWN: Bethesda, MD

PROJECT: "Cryptographically Secure Proxy Bidding in Ascending Clock Auctions"

FIELD: Computer Science

MENTOR: Lawrence Ausubel, Ph.D., University of Maryland

"I really like puzzles -- the more complex, the better. Cryptography in many ways is just a very complex and large puzzle."

Growing up, Andrew Komo always liked puzzles -- the more complex and convoluted, the better. So, when he discovered cryptography, the field of creating and deciphering secret codes, he knew he wanted to pursue it.

Using cryptography, Andrew developed a coded system that protects online auction sellers from threats, such as cheating and fraud. His project is at the intersection of his favorite fields -- computer science, economics, and the study of human interaction.

Outside of his research, Andrew is the captain of his school's computer team and economics club and is an avid tennis player. He was a finalist in the 2017 Moody's Mega Math Challenge, a national team-based math modeling competition, and came in third in the 2016 High School Forensics Challenge, one of the largest high school cybersecurity events.

Andrew hopes to pursue a career in designing new computer algorithms and protocols that will make the world a better place.



ALEXANDER LIU

SCHOOL: Montgomery High School, Skillman, NJ

YEAR: Senior

HOMETOWN: Belle Mead, NJ

PROJECT: "Synthesis and Characterization of New Luminescent CuX Coordinate-Ionic Hybrids"

FIELD: Chemistry

MENTOR: Wei Liu, Ph.D., Rutgers University

"I'm really lucky to be in an atmosphere where everyone strives for greatness. It's not hard to push yourself when you're surrounded by people to look up to."

Having grown up with the advancement of the smartphone, Alexander Liu claims that there haven't been any huge game-changing lifestyle changes in the past few years the way radios, TV's, cell phones, and mp3 players were groundbreaking devices. Instead of revolutionary technology, Alex believes new materials are the next step in changing human lives.

He has been fascinated with graphene - a super material stronger than steel that is used in electronics, cars and planes - since middle school. Spending 400 hours in the lab, he discovered new crystals that could change the lighting market. Current LEDs require rare earth metals that are in limited supply. The crystals Alex discovered - phosphors - are made of copper salts and organic compounds and are cheaper, easier to mass produce, and are comparable to commercial LEDs in stability and efficiency.

He is an accomplished pianist and played with the Philadelphia Orchestra at Kimmel Center as a winner of the Albert M. Greenfield competition. He loves teaching peers and others about science and hopes to become a chemistry teacher and researcher at a university. Alex is also a varsity sprinter, a huge Boston Celtics' Kyrie Irving fan, and enjoys playing basketball and cooking in his spare time.



ANDREW SONG

SCHOOL: Milton Academy, Milton, MA

YEAR: Senior

HOMETOWN: Seoul, South Korea

PROJECT: “The Relative Velocity of Baryonic and Dark Matter within the Milky Way and its Implications”

FIELD: Physics

MENTOR: Zachary Slepian, Ph.D., University of California, Berkeley

“I love math because it never feels like an obligation, it’s a hobby. For me, time flies when I am solving an equation or thinking about math!”

Andrew has always been interested in astronomy and the grand scale and uniqueness of the universe. Along with his interest in math, Andrew was inspired to delve deeper into astrophysics and cosmology by the seeing the collaboration of scientists around the world on projects like the detection of gravitational waves. He also felt compelled to contribute to our understanding of dark matter’s role in the universe, because there is so much of it beyond planet Earth and so little is known about it.

Andrew set out to address the Missing Satellites Problem which predicts, based on the evolution and organization of matter in the universe, the existence of many more dwarf galaxies than we can currently observe. Dwarf galaxies are small galaxies composed of 100 million to several billion stars (compared to the Milky Way’s 200-400 billion stars). Andrew calculated that the difference in the speed at which dark matter and regular matter move through the Milky Way is large enough to potentially cause small clusters of stars with no dark matter, accounting for the lack of observed dwarf galaxies.

Active in extracurricular activities at his high school, Andrew is a co-captain of the varsity tennis team, as well as the co-head of the Asian Society and the Math Team. He was recognized in the top 1% of competitors in the American Math Competition 12 in 2016. Andrew also competed in the Princeton University Physics Competition in 2015, where his team placed 7th out of 100 teams.

Andrew hopes to continue studying astrophysics in college and eventually become a professor or an aerospace engineer.

TEAM COMPETITORS

CINDY HUANG, Thomas S. Wootton High School, Rockville, MD

JESSIE MA, Winston Churchill High School, Potomac, MD

ROBERT YANG, Montgomery Blair High School, Silver Spring, MD

PROJECT: "Towards Precision Diagnosis of Lymphoma Subtypes Using Big Data and Machine Learning Modeling"

FIELD: Biology

MENTOR: Calvin Johnson, Ph.D., National Institutes of Health

Cindy, Jessie and Robert developed a new way of determining lymphoma subtypes through their use of a computational algorithm, resulting in more accurate and impartial diagnoses. A more accurate diagnosis based on the lymphoma subtype can help doctors match patients with the correct treatment faster and avoid potentially fatal mistreatment.



CINDY HUANG

YEAR: Junior

HOMETOWN: Rockville, MD

"I hope that by working hard towards improving the accuracy of diagnosis and thus clinical outcomes, more people will have the opportunity to live their lives and make their own difference in the world."

Cindy has a passion for medicine. Her team's project focused on improving care for patients with lymphoma, which is the leading cancer in teenagers and young adults. They hope to improve the outcome for patients with this disease. Her interest in biology, her favorite subject, and STEM fields started at a young age and was sparked by her parents' love of science and their careers scientific research.

Cindy's interest in helping patients extends outside of academics as well. As the co-founder of "Art with a Heart," she has helped to bring interactive visual arts classes to children in the local hospital. This organization has provided hundreds of pieces of art to these children in an effort to improve their experience in the hospital.

In addition to producing art and studying biology, Cindy plays viola and has participated in orchestra for many years. She speaks Chinese and is also an active member of her school's National Chinese Honor Society, where she serves as treasurer.



JESSIE MA

YEAR: Junior

HOMETOWN: Potomac, MD

“Frequent trips to the NIH labs were my connection to the science world; it was a place where I felt as if I really belonged and really could discover. It inspired me to seek deep understanding of the nature and behavior of living organisms, and find the best way to protect the health and wellness of our society.”

Jessie’s passion for science grew out of her fascination with “roly polys” or “pill bugs” - the small insect more formally known as Armadillidiidae. As a child, she collected these insects and through conversations with her father learned about basic biology. Over the years, her questions became more complicated and she volunteered at NIH doing molecular experiments and bioinformatic analyses as well as in hospitals to learn genetic diseases in children. Jessie is a member of the National Science Honors Society.

Outside of the lab, Jessie enjoys playing piano and volunteering at a homeless shelter and a senior home where she helps in many ways, including playing the piano.

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ROBERT YANG

YEAR: Senior

HOMETOWN: Potomac, MD

"I find that both STEM and music motivate me to do better in each respective field. I hope that I can even combine the two in my studies and career, perhaps through the field of acoustics, physics or music technology."

Robert's interests in biology and technology met in this project when his team combined biology with the emerging field of machine learning. As the son of two researchers, Robert grew up looking forward to take-your-child-to-work day at the National Institutes of Health, watched Bill Nye and Mythbusters and has long followed emerging science fields, with a special interest in nanotechnology. He was a regional finalist in the 2016 Siemen Competition.

Robert's other passion is music. He has played violin for years and was accepted into the Maryland All-State Orchestra and is a Frank Sinatra fan. When he's not studying science and playing music, Robert enjoys volunteering--he received the Maryland Governor's Youth Service Award--as well as reading, writing and gaming. He loves books by British novelist Jasper Forde and the Trenton Lee Stewart's Mysterious Benedict Society series.

TEAM COMPETITORS

NADINE MEISTER, Centennial High School, Ellicott City, MD

ANDREW ZHAO, Centennial High School, Ellicott City, MD

PROJECT: “Exploring Borophene for Spintronics”

FIELD: Materials Science

MENTOR: Xuan Luo, National Graphene Research and Development Center

Nadine and Andrew discovered a new material that can potentially improve the speed, size and efficiency of electronic devices. Their modified borophene gives the potential for faster processing and data storage, the core functions of the computer, possibly resulting in more powerful and compact computers.



NADINE MEISTER

YEAR: Sophomore

HOMETOWN: Ellicott City, MD

“There are always new and interesting discoveries in STEM waiting to be revealed by our curious minds.”

Nadine has always been interested in making an impact in today’s technology.

Nadine and her partner Andrew worked together modifying a 2-dimensional material called borophene to enhance its properties and improve its potential for use in spintronics - which takes advantage of the spin of electrons in addition to the electron’s charge - to enable computers and other electronic devices to work faster and more efficiently.

Nadine speaks Chinese and German, runs cross country, and plays the clarinet and piano. Her favorite subject is math, and she enjoys coaching the MATHCOUNTS Club in her community and competing in a variety of national mathematics competitions. She also participates in her school’s Science Olympiad team, math team, and other coding clubs. She’s also a fan of science fiction novelist Marie Lu.



ANDREW ZHAO

YEAR: Sophomore

HOMETOWN: Ellicott City, MD

"I am passionate about solving and contributing to some of the greatest problems facing our generation, overcoming challenge after challenge, and the ultimate prospect of a better future."

Andrew's interest in STEM was fueled by playing with LEGOs in his childhood and computers, which he discovered at a young age and has always liked – playing games, programming, drawing, and exploring the countless things one can do with them. He enjoys the process of problem-solving, and is fascinated with the development of artificial intelligence driverless cars and various other futuristic technologies.

In 2016, Andrew was named an International Space Apps Challenge global finalist. He participates in the Science Olympiad and the educational game show *It's Academic*. Outside of his academic pursuits, Andrew plays the viola and swims for the Columbia Clippers.

Andrew's role model is Steve Jobs because he believes that Jobs was one of the most creative and innovative men in America, and helped to create products that captured the imagination of the world.

TEAM COMPETITORS

ANUSHA MURALI, Bishop Brady High School, Concord, NH

EVAN CHANDRAN, Phillips Exeter Academy, Exeter, NH

PROJECT: "Optimizing Interplanetary Travel Using a Genetic Algorithm"

FIELD: Physics

MENTOR: Dr. Murali Thiagarajan

Anusha and Evan developed a method to quickly find short paths for efficient interplanetary space travel. Their method can be used for exploring far away solar systems, mining asteroids for natural resources and eliminating space junk.



ANUSHA MURALI

YEAR: Junior

HOMETOWN: Concord, NH

"Physics allows me to apply my mathematical intuition in explaining natural phenomena."

Anusha was inspired to pursue her research after delving deeply into genetics during her AP biology class last year. She stumbled into genetic algorithms while working on an assignment and found the opportunity to apply them to the field of astrophysics.

She said her "lightbulb went off" moment occurred when her program went haywire after she doubled the mutation rate - a variable in her program. This led her to the discovery that there was an ideal value or "goldilocks" variable - not too big, but not too small - for the program to work correctly.

Her proudest accomplishments included qualifying for MATHCOUNTS Nationals 3 years in a row and obtaining perfect scores on the Fermat and the ACT tests.

She's passionate about teaching and spreading knowledge. In her free time, Anusha enjoys drawing and writing and volunteering. She speaks Tamil, loves music by Kesha and watching her friends play on their school sport teams.



EVAN CHANDRAN

YEAR: Sophomore

HOMETOWN: Durham, New Hampshire

"I find science fascinating because it describes how the world works."

Evan's passion for math and science started early with long conversations with his dad about problem solving. For the Siemens Competition, he and his teammate Anusha created a computer program for quickly traveling through a solar system, which could help explore new solar systems, mine asteroids, or clean up space junk.

Evan is a member of his high school math and chess clubs at Phillips Exeter Academy. He was invited to the 2014 MATHCOUNTS National Competition in Orlando, FL and qualified for the American Invitational Mathematics Exam in 2015 and 2016.

Outside of academics, Evan loves music and plays piano in his school's Jazz Combo. He also plays tennis, squash, and ultimate frisbee. He's a Pink Floyd fan and his favorite book is "The Impossible Fortress" by author Jason Rekulak.

Evan says he is dabbling with the idea of pursuing a career in computer science, chemistry, or physics but is still undecided.

TEAM COMPETITORS

JINHYUNG “DAVID” PARK, The Hill School, Pottstown, PA

ERIC LIN, Thomas Jefferson High School for Science & Technology, Alexandria, VA

PROJECT: “Protecting User Privacy: Obfuscating Discriminative Spatio-Temporal Footprints”

FIELD: Computer Science

MENTOR: Andreas Züfle, Ph.D., George Mason University

Eric and Jinhyung developed a new way to obscure geolocation data on cell phones. This protects users from hackers who may otherwise been able to follow the trail of user’s data and capture their personal identities.



JINHYUNG “DAVID” PARK

YEAR: Senior

HOMETOWN: McLean, VA

“Computer Science - it is a world of infinite potential, and I am able to realize anything I want as long as I try.”

While in middle school, David created and added new programs to his calculator, like pong and tic-tac-toe. He enjoyed learning how to program, and this experience coupled with his fascination with artificial intelligence and machine learning led to his research journey.

Later, David realized that when he opened a new app on his phone, it asked for his location data. He questioned this method of personal data collection, and realized the security threat it posed. With this new-found awareness, David began his research at George Mason University to develop new ways of protecting users’ private information.

David is a co-leader for the Eco-Action Club and Community Service at the Hill School. He also plays violin and assists fellow students to improve their writing.

David is inspired by his father’s journey from a poor community in rural South Korea to attain a college education, become a CEO, and support his entire family. His father’s journey instilled the belief in David that he can do anything if he works hard and puts in his best effort. David aspires to be a researcher in the field of Artificial Intelligence and working for a company to apply his research.



ERIC LIN

YEAR: Senior

HOMETOWN: Falls Church, VA

"I am most passionate about giving back to my community."

Ever since he was young, Eric wanted to make an impact on the world. He remembers watching a news segment about a man cleaning up the streets in his community and saying, "Mom, I want to do that when I grow up." Eric's passion to make a difference is an integral part of who he is. His research project carries this theme, as he aims to use coding in conjunction with engineering to improve society. After noticing how often his friends used their social media apps on their phones and he learned about social media privacy and the dangers of leaving a social media footprint, Eric dove into research at George Mason University to find ways to protect users' personal information.

Outside of his outstanding academic achievements, Eric is also an accomplished pianist. He has won many international and national piano competitions and has performed as soloist with five symphony orchestras nationwide, including the National Symphony Orchestra at the Kennedy Center in Washington, D.C. He also holds leadership positions for the nonprofits Multicultural STEAM Education and Project BEST. In these leadership roles, he promotes STEM and inspires younger students to achieve their goals.

Eric hopes to become an entrepreneur in the artificial intelligence field. He looks forward to making a difference in the lives of people through continued computer science research.

TEAM COMPETITORS

KATHERINE TIAN, The Harker School, San Jose, CA

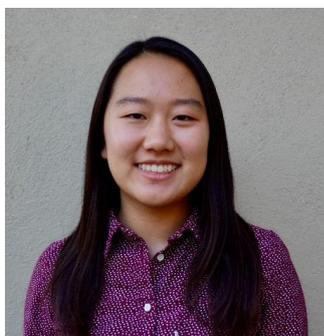
SWAPNIL GARG, The Harker School, San Jose, CA

PROJECT: “Automated Clear Cell Renal Carcinoma Grade Classification with Prognostic Significance”

FIELD: Bioinformatics

MENTOR: Jan Heng, Ph.D., Beth Israel Deaconess Medical Center, Harvard Medical School

Using computational techniques and machine learning, Katherine and Swapnil developed a way to classify kidney cancer tumors as high- or low-grade—an important indication of how fast the cancer might spread. This provides an extremely valuable second opinion for pathologists, helping them make more accurate diagnoses and thus better treatment plans.



KATHERINE TIAN

Year: Junior

HOMETOWN: Cupertino, CA

“I’m really passionate about using STEM concepts to figure out how the world works—from proving abstract theory to understanding real-world phenomena.”

Ever since she was a young child, the creative insights and rigorous logic required of the science, technology, engineering and math subjects have fascinated Katherine. She began participating in math competitions in elementary school, and eventually used what she calls her “mathematical mindset” to branch out into programming, algorithms, physics and biology in middle and high school.

But it was the opportunity to attend a summer program in artificial intelligence (AI) at Stanford University that solidified her interest in scientific research—particularly the way she learned she could combine seemingly disparate areas like AI algorithms and classifying leukemia tumors.

When cancer struck both her great uncle and a beloved family friend, she was inspired to join scientists working to combat the disease—channeling her interest in programming and AI to help make cancer diagnosis more accurate and efficient.

Someday, Katherine would like to pursue a career in applied math, machine learning and AI. Katherine has competed in the platinum level in the USACO (USA Computing Olympiad), qualified for the USAJMO (USA Junior Mathematical Olympiad) and the USAPHO (USA Physics Olympiad). She is co-president of the programming club, vice president of the math club, and a research mentor. She also plays violin, dances, swims and runs.



SWAPNIL GARG

YEAR: Senior

HOMETOWN: Sunnyvale, CA

"I'm most passionate about math—what's really cool about it is that you can use it to find patterns, and what often starts out as complicated problems can be reduced to simple formulas."

Swapnil was inspired to pursue this research when he saw how dependent cancer treatment was on something as prone to human error as the type of tumor classification. He wanted to develop an automated way to determine what type of treatment to pursue, and used his lifelong love of math to guide the way.

Swapnil has been passionate about math since he joined the MATHCOUNTS club in middle school. Today he is fascinated with its patterns, formulas and theories and generally just finds that it "clicks" with him. Indeed, he received an honorable mention on the USA Math Olympiad and coaches his math club's Princeton University's math competition team. He would like to be a math researcher one day.

Swapnil also cofounded the Science Competitions Club, is the co-president of the Quiz Bowl, a member of the Science Bowl, the Programming Club, the Linguistics Club, the Philosophy Club, and was a top 10 finalist for the USA Computing Olympiad. He also plays trumpet in his high school orchestra and tennis.