



**STUY PULSE TEAM 694**



**2015-2016**





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## WELCOME

Welcome to the Stuyvesant Robotics Team's 2015-2016 Magazine!

This magazine is jam-packed about details about StuyPulse's (Team 694) build season, competitions, and events, as well as information about Team 310 and 479's season. A lot of time was spent on it, and we hope you enjoy the year in review as you look back at all the things that our team did this year, and even learn about things you didn't know about!

Sincerely,  
The Editorial Board

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Meet The STRATosphere

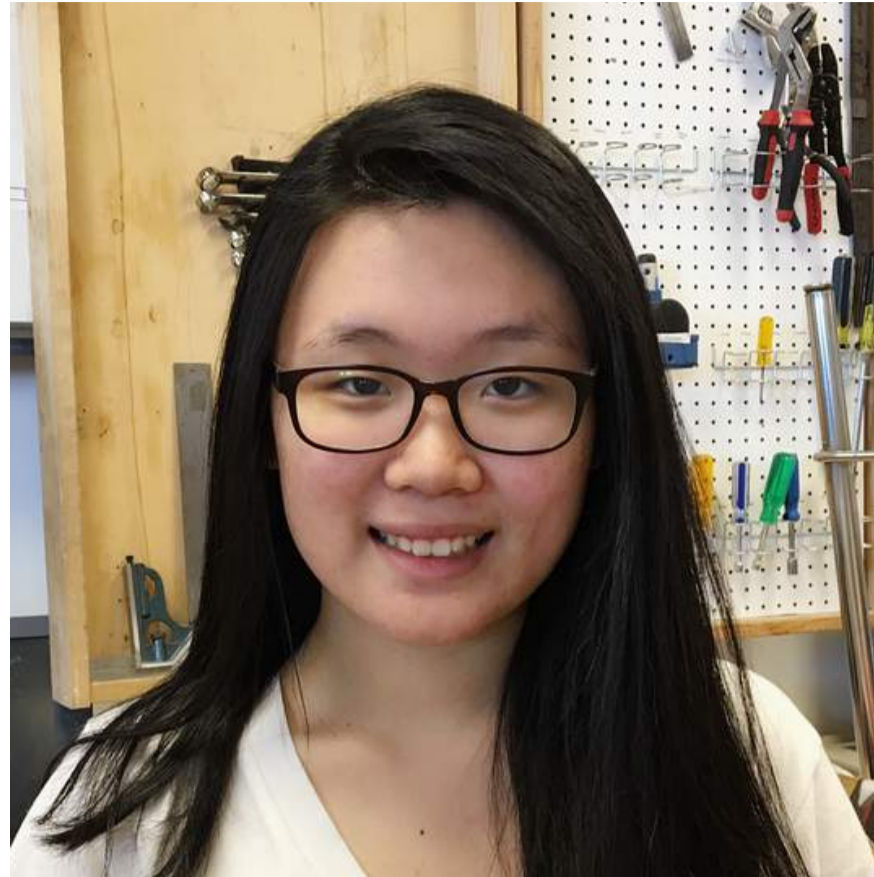




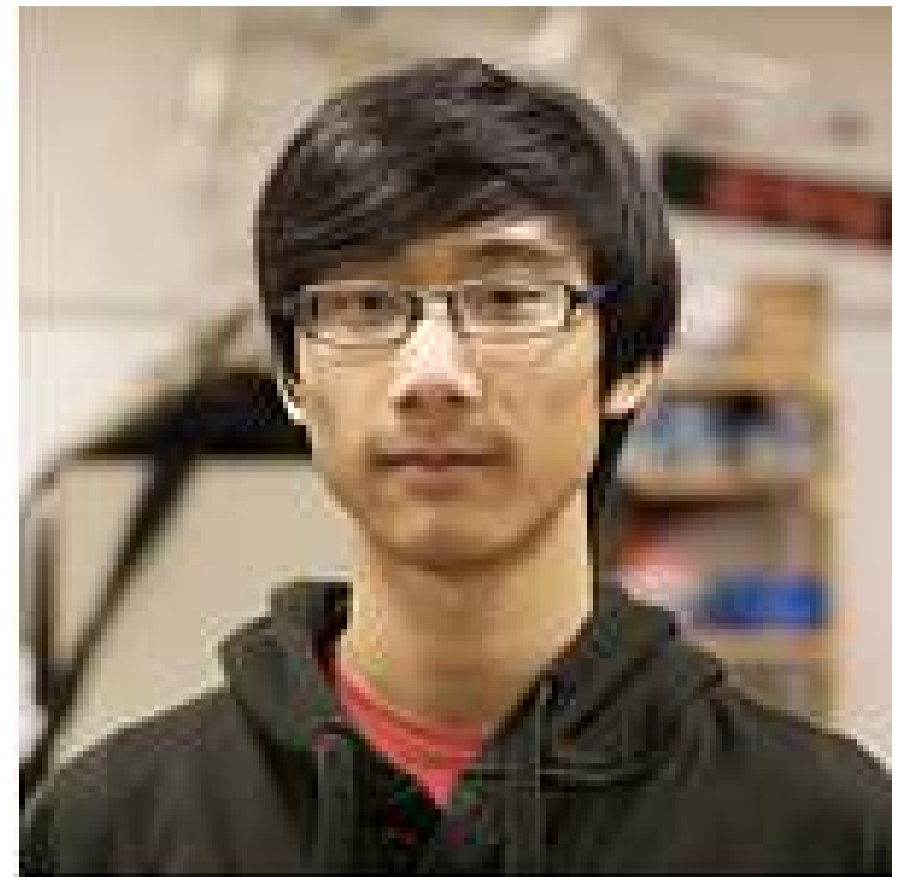
# MEET OUR BOARD!



Jion Fairchild  
*President of Engineering*



Yubin Kim  
*Preisdent of Marketing*



Ethan Cheng  
*President of Software Engineering*



Jonah Sachs-Wetstone  
*Vice President of Engineering*



Courtney Chiu  
*Vice President of Marketing*



Nicole Shin  
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Anthony Zeng  
*Director of Electronics*



Dana Yang  
*Director of Lab Operations and Safety*



Daniel Chain  
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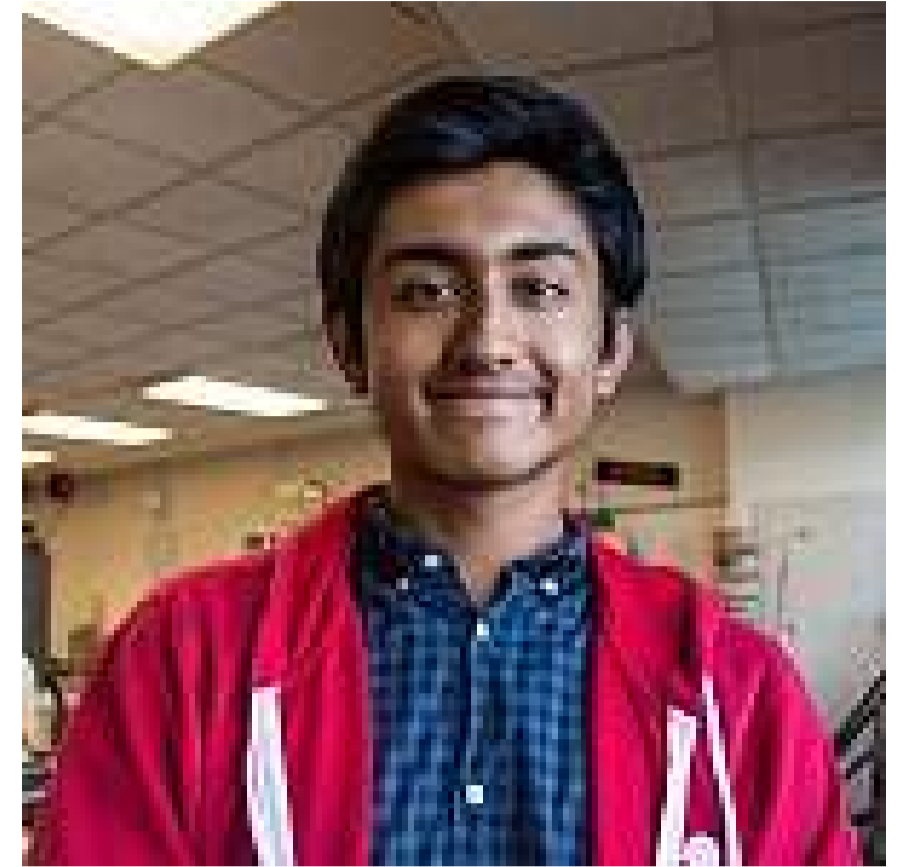




Christopher Sherling  
*Director of Strategy*



Leith Conybeare  
*Assistant Director of Strategy*



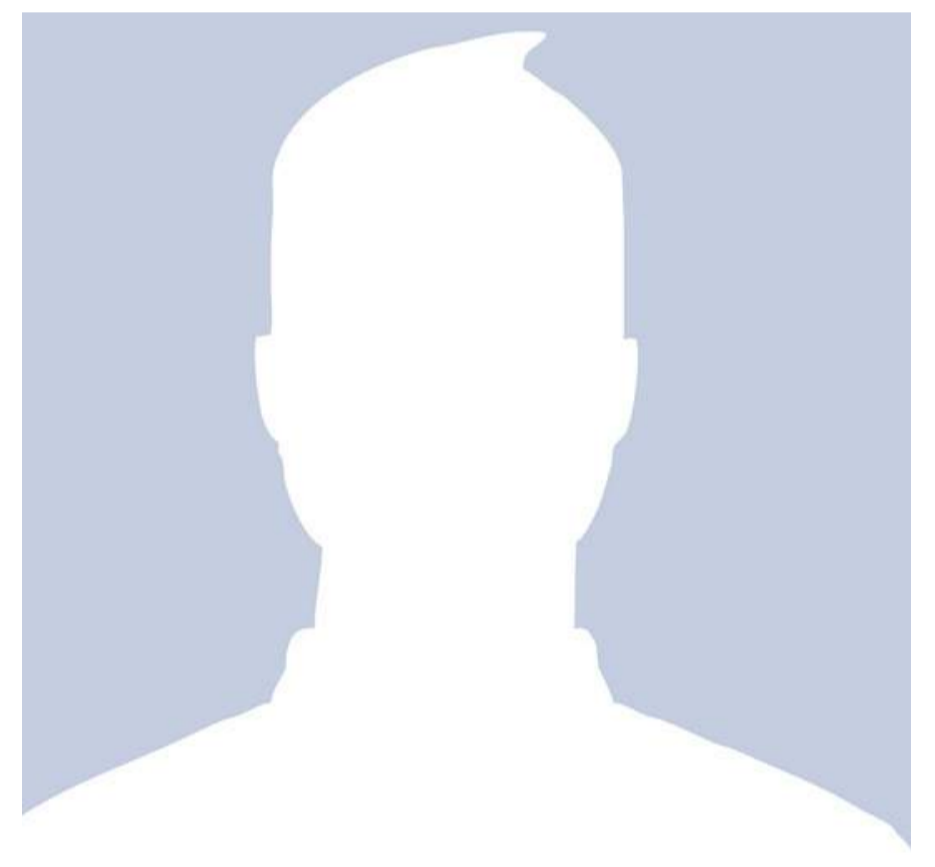
Shantanu Jha  
*Director of Design*



Anya Keller  
*Primary Machinist*



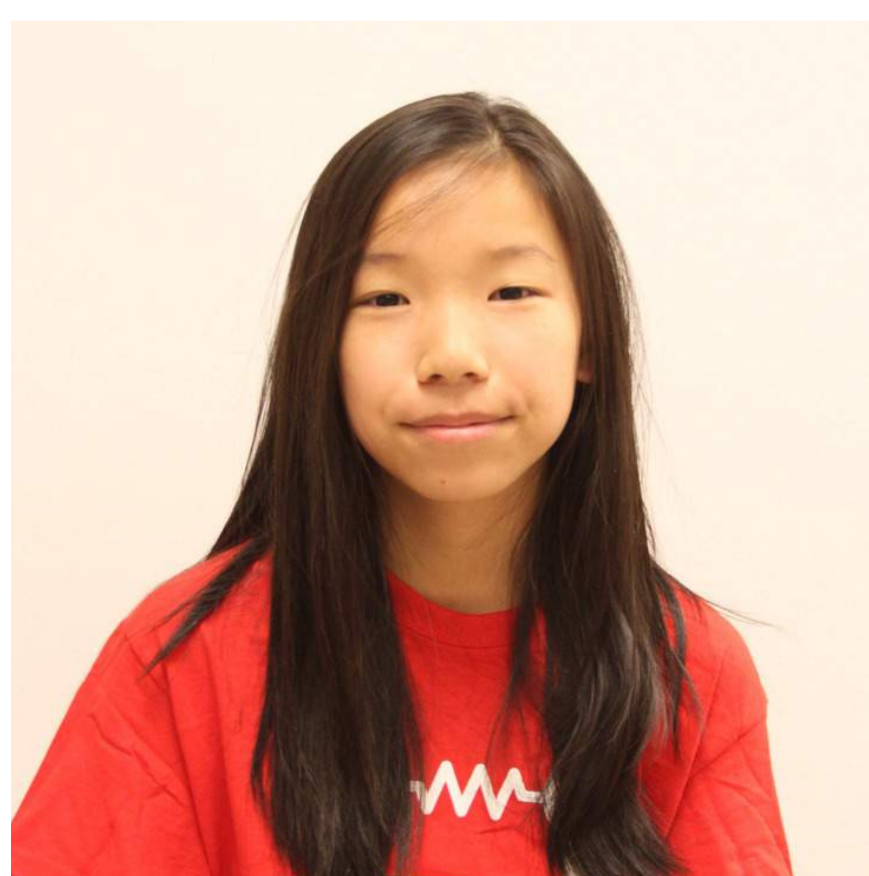
Arpita Abrol  
*Director of Field Construction*



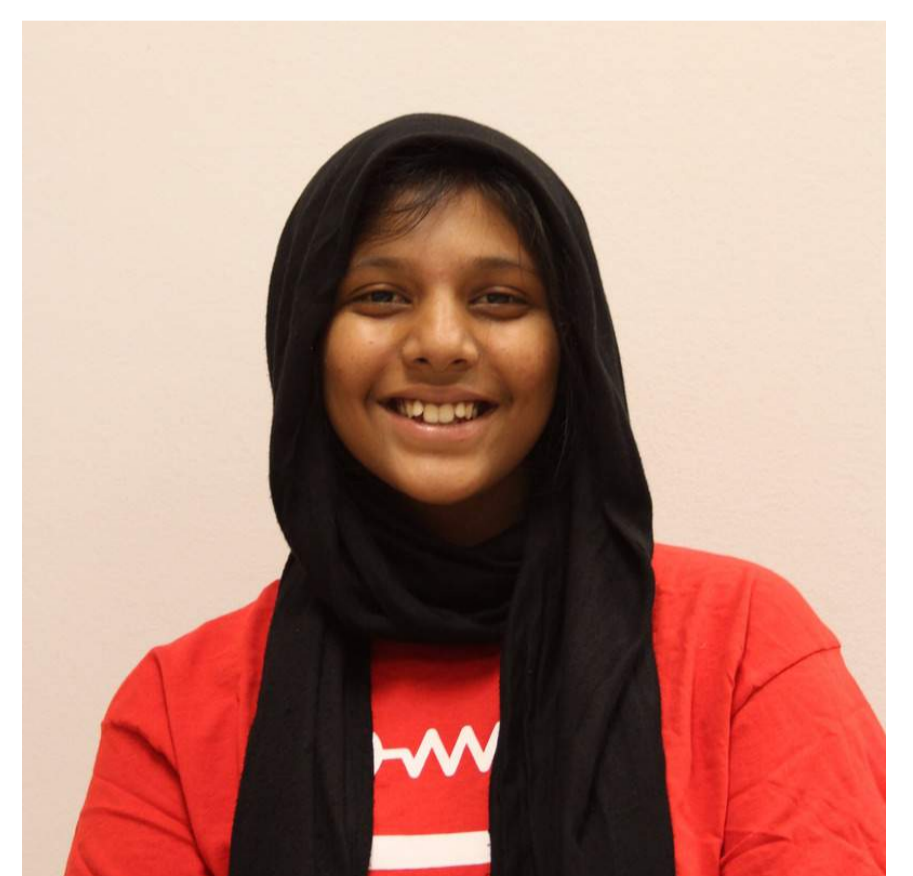
Franklin Wang  
*Director of Animations*



Sally Ko  
*Director of Finance*



Winne Lin  
*Co-Director of Public Relations*

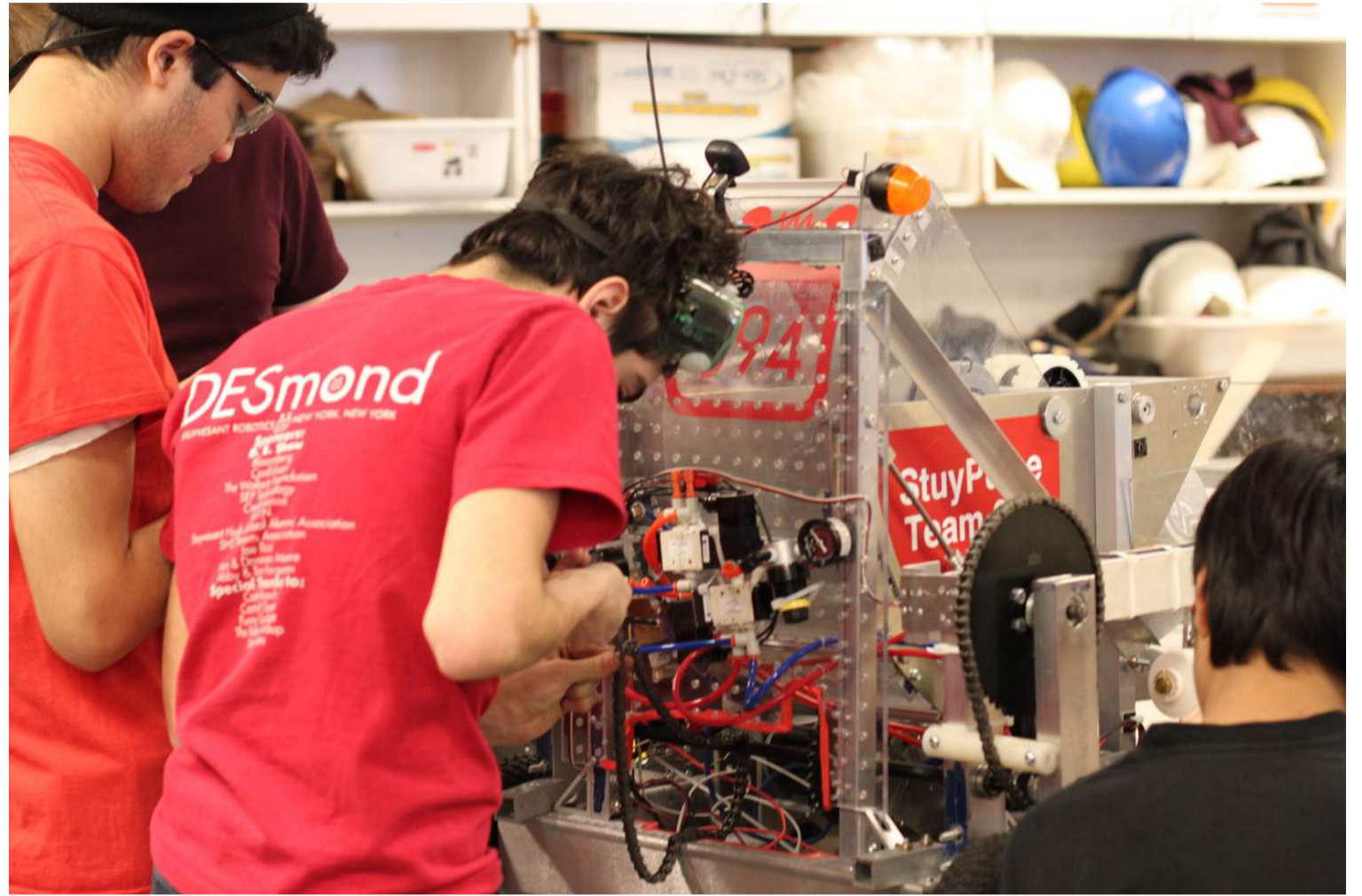


Lamia Bushra  
*Co-Director of Public Relations*



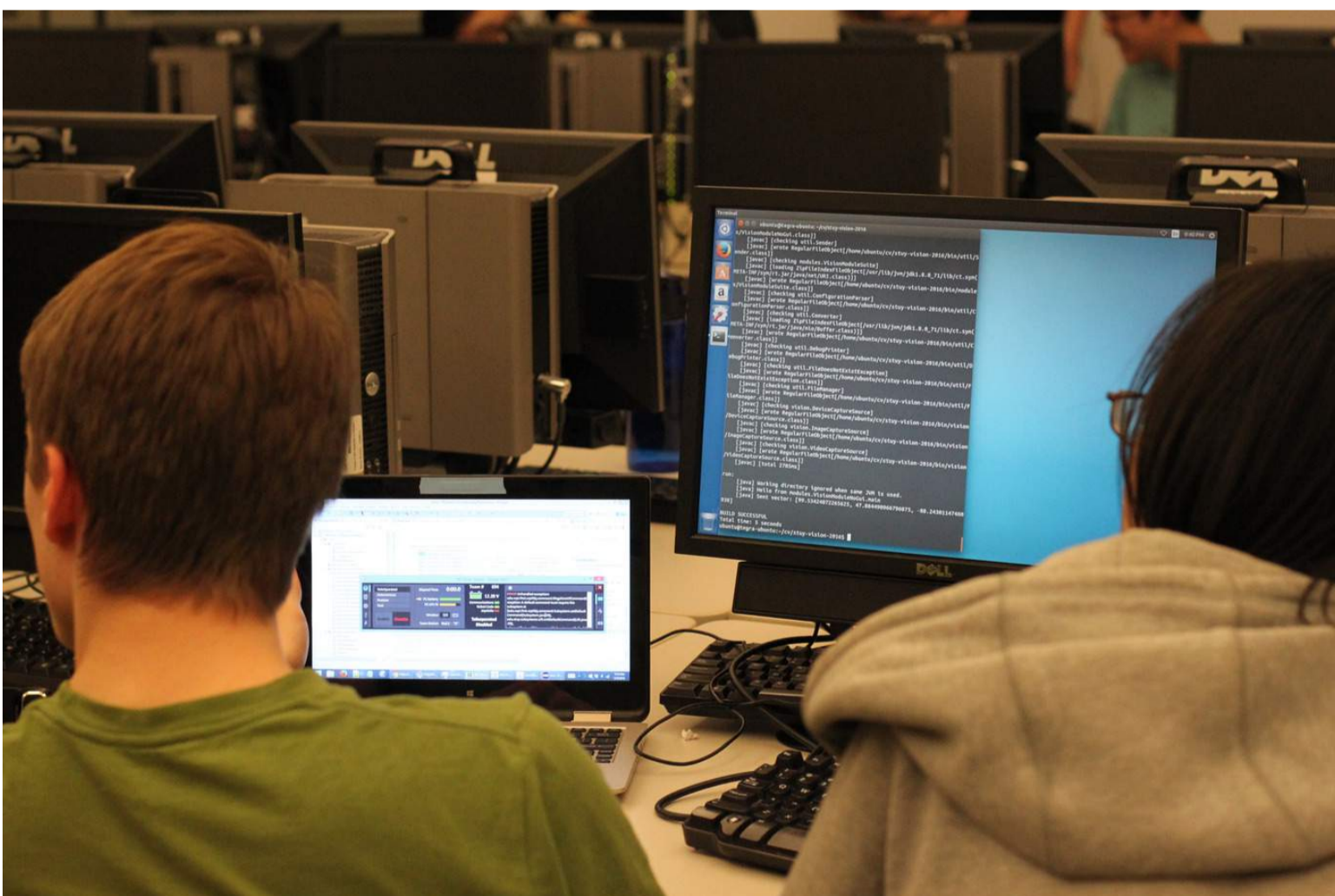
## ENGINEERING

Our Engineering division is our largest division. They are responsible for building the robot and designing it based on the challenge for that year. Every year during build season, Engineering divides up into several groups, each



led by a veteran member, to be in charge of one aspect of the robot such as the drivetrain, electronics, or mechanisms. The president and vice president of Engineering is familiar with every part of the robot, and is able to explain all the parts of it.

## SOFTWARE ENGINEERING



Software Engineering writes the software that controls the robot's movement on the playing field, as well as ensures that the electronic aspect of the robot is functioning smoothly. The programming team is also

responsible for making sure all of the old robots have working code so that they are prepared to perform for demonstrations. Veteran members take it upon themselves about software and programming from scratch.



# MARKETING

Marketing has a varied list of responsibilities that range from fundraising, branding, and logistical work such as meals during build season, trip planning, award submissions, outreach as well as any other task that does not fall



under the other sub teams. This division keeps our projects running smoothly and being the primary contact for our sponsors. They are

responsible for coordinating all of our outreach efforts, which include mentoring FLL, FTC, and FRC teams as well as reaching out to communities' centers.



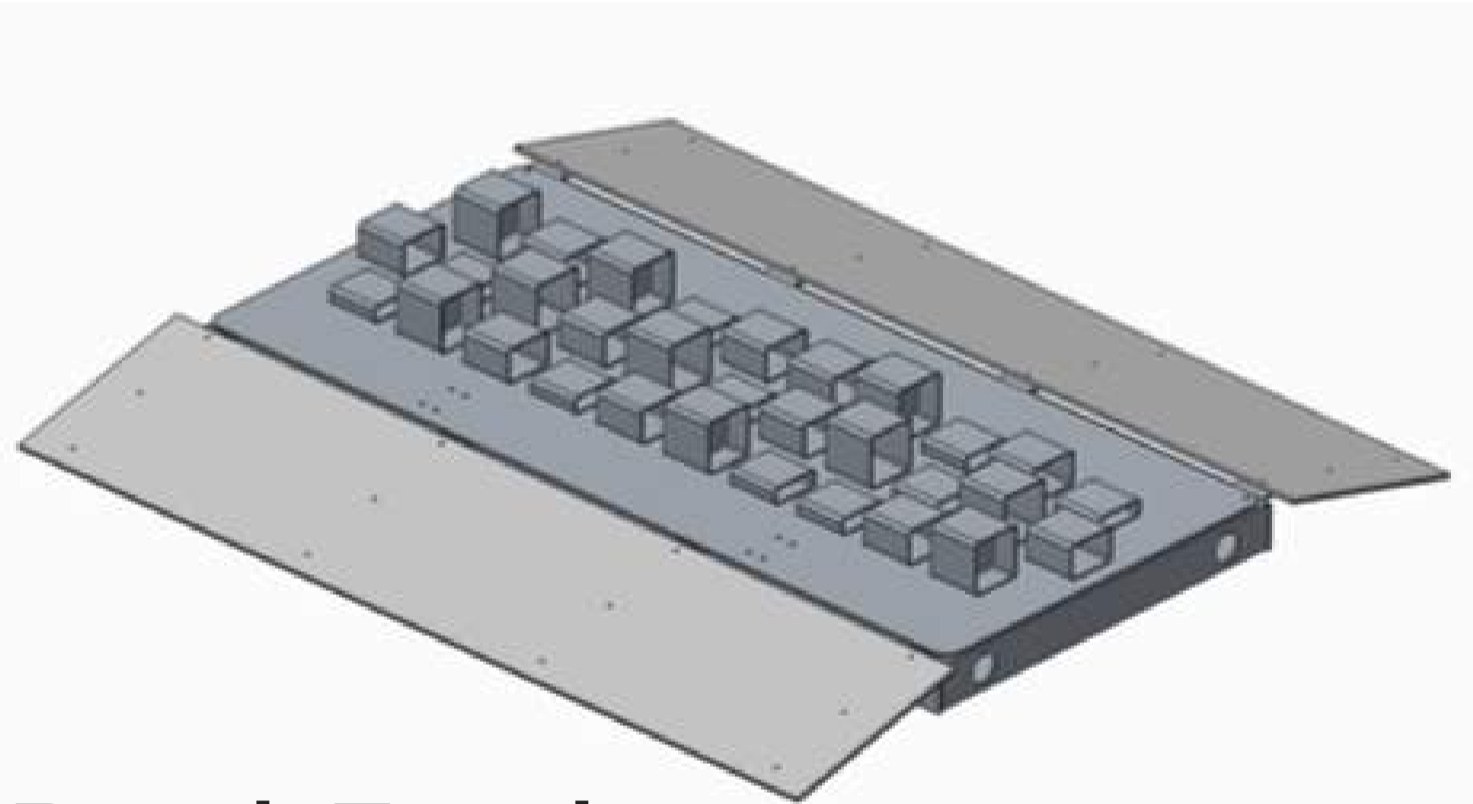
# ANIMATION

Our animation division specializes in creating 3-D models and manipulating them to create videos which showcase technology or advocate safety. Using the professional Autodesk software, 3ds Max and Combustion, animators are responsible for creating a safety animation and a technology video for the Autodesk Visualization Award.

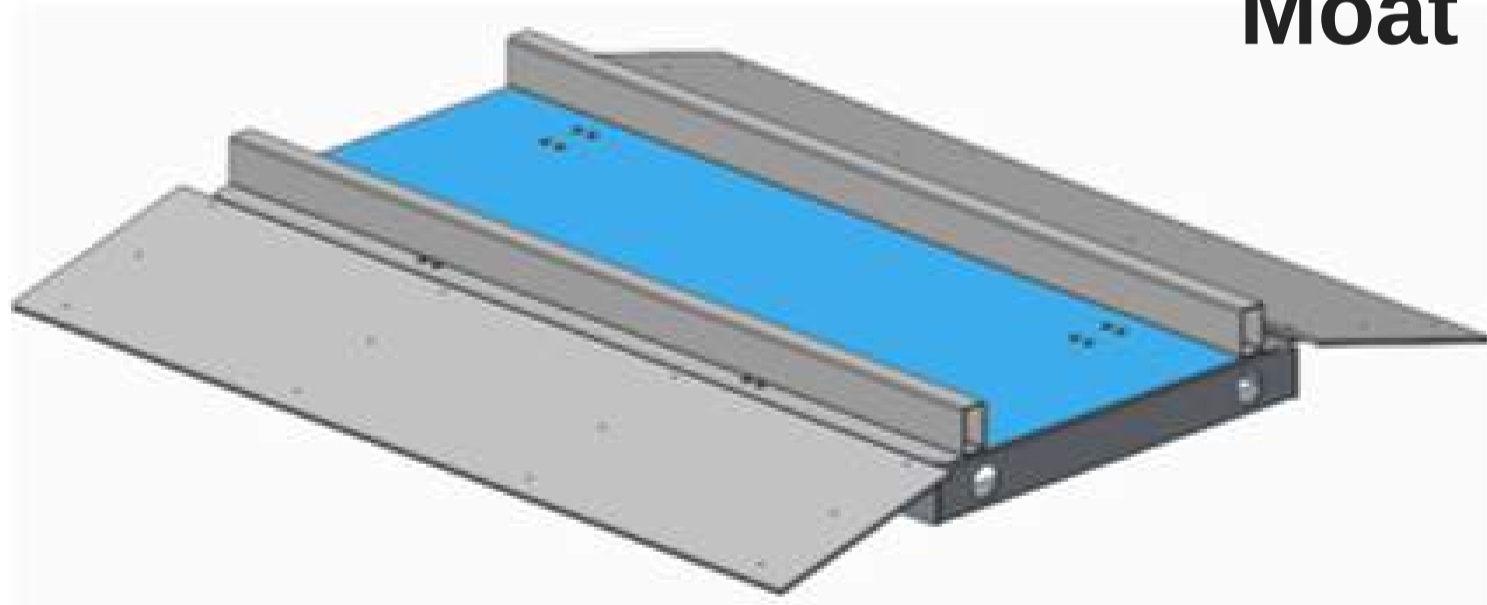


This year's game, Stronghold, is based on a medieval theme. Stronghold requires robots to cross defenses (field obstacles) and shoot boulders (large foam balls) into the opponent's castle (tall goal with a window sized opening at the top) in an attempt to capture it. Teams of three robots, each representing a high school, form an alliance to compete against an opposing alliance. Teams can take either an offensive or defensive stance as part of their strategy. Matches run for two minutes and 45 seconds and teams each play eight matches per event.

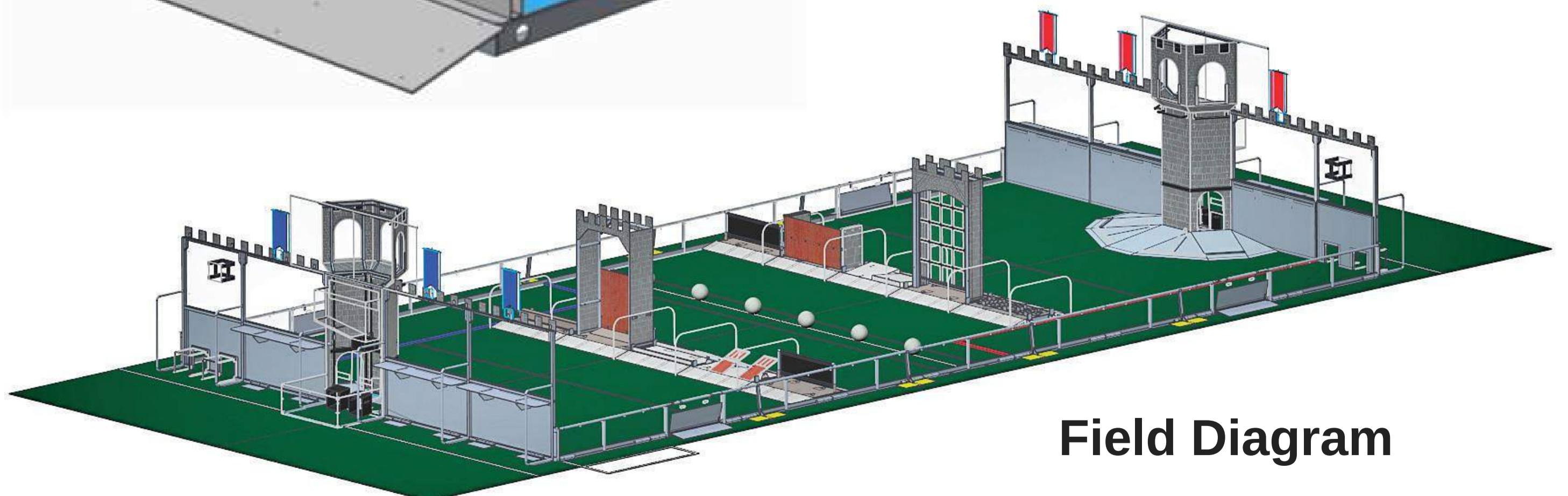
## DEFENSES



Rough Terrain



Moat

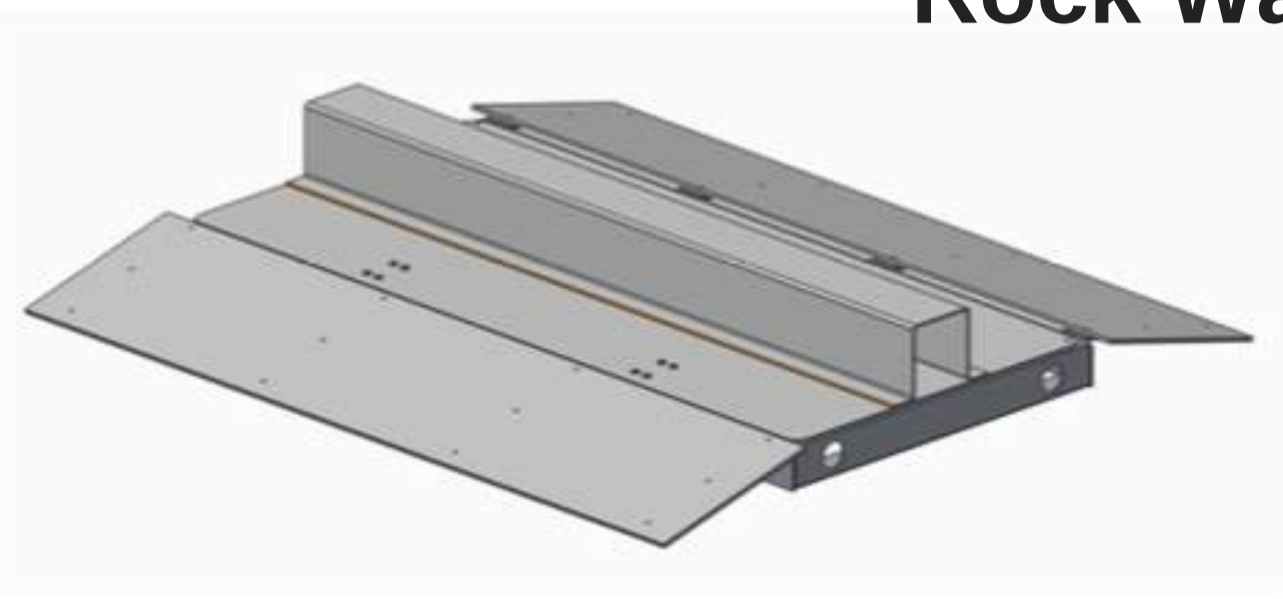


Field Diagram

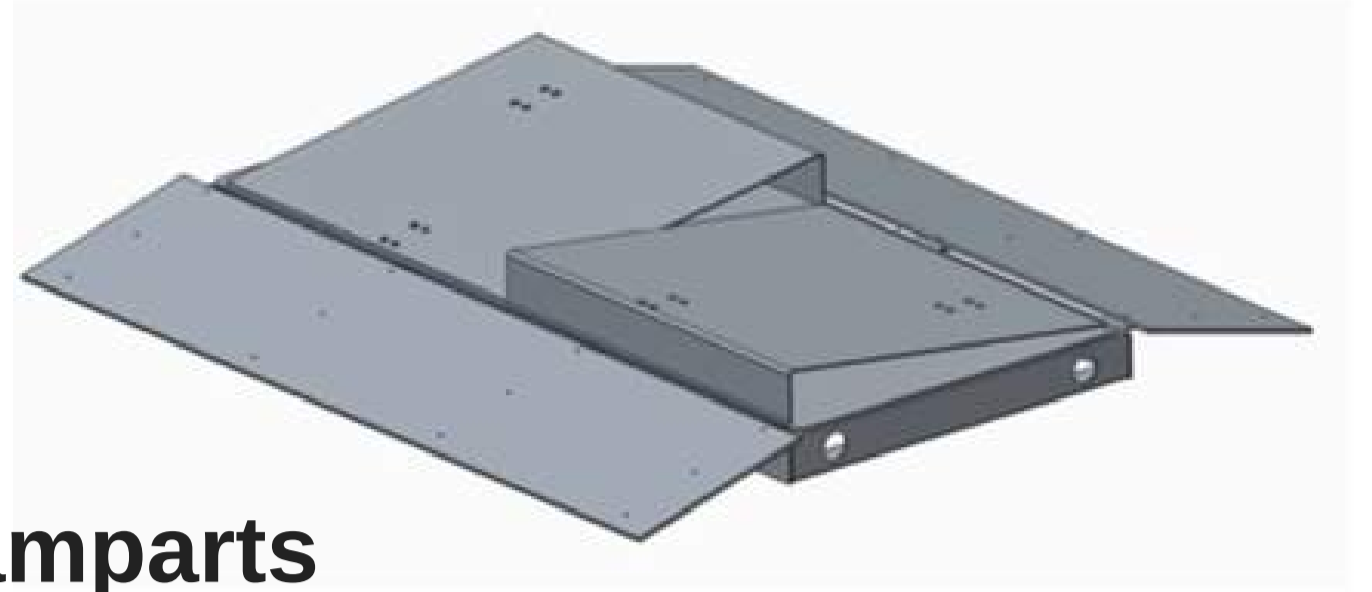




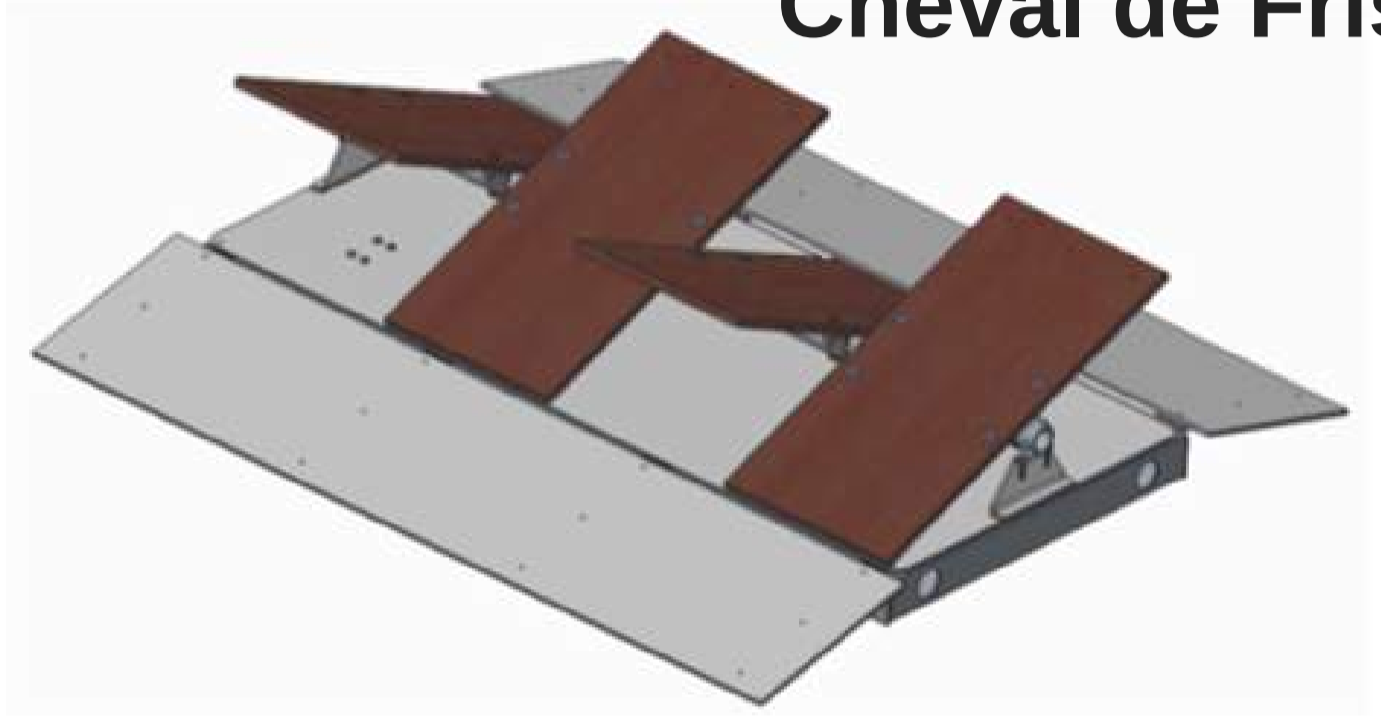
Low Bar



Rock Wall



Ramparts



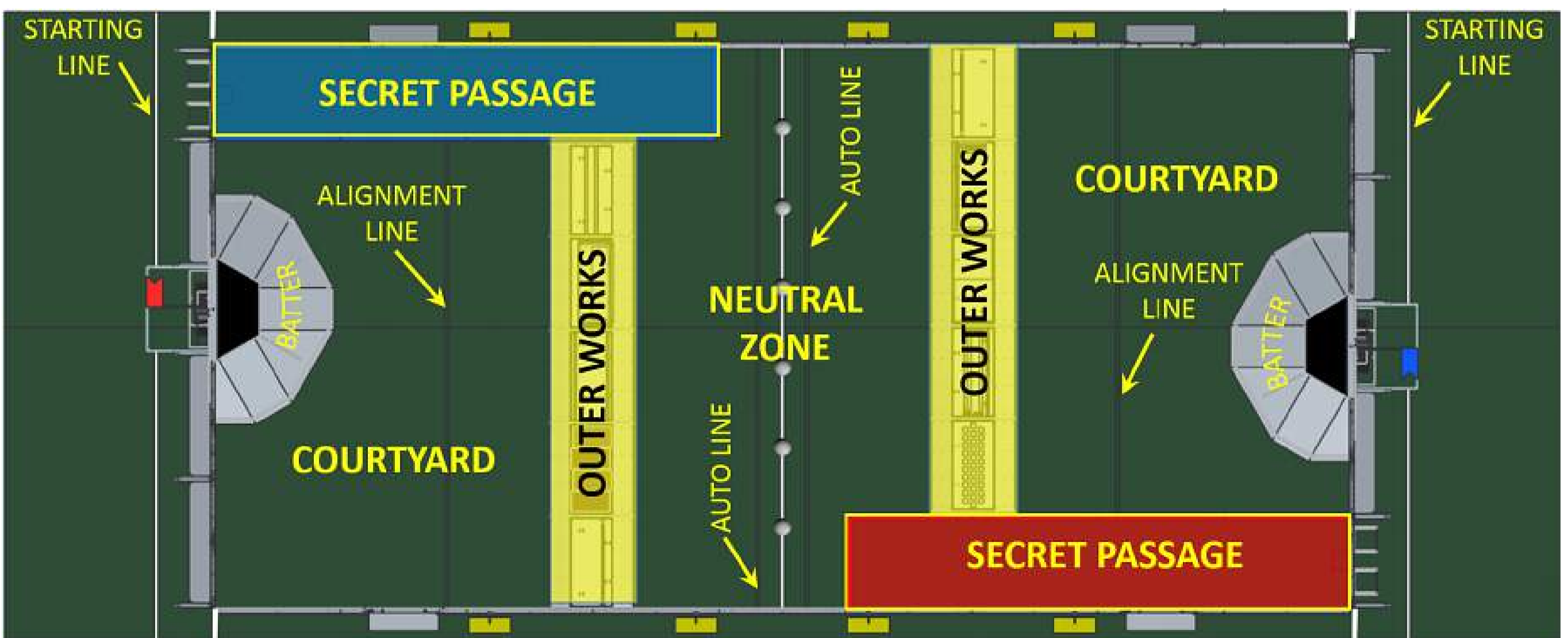
Cheval de Frise



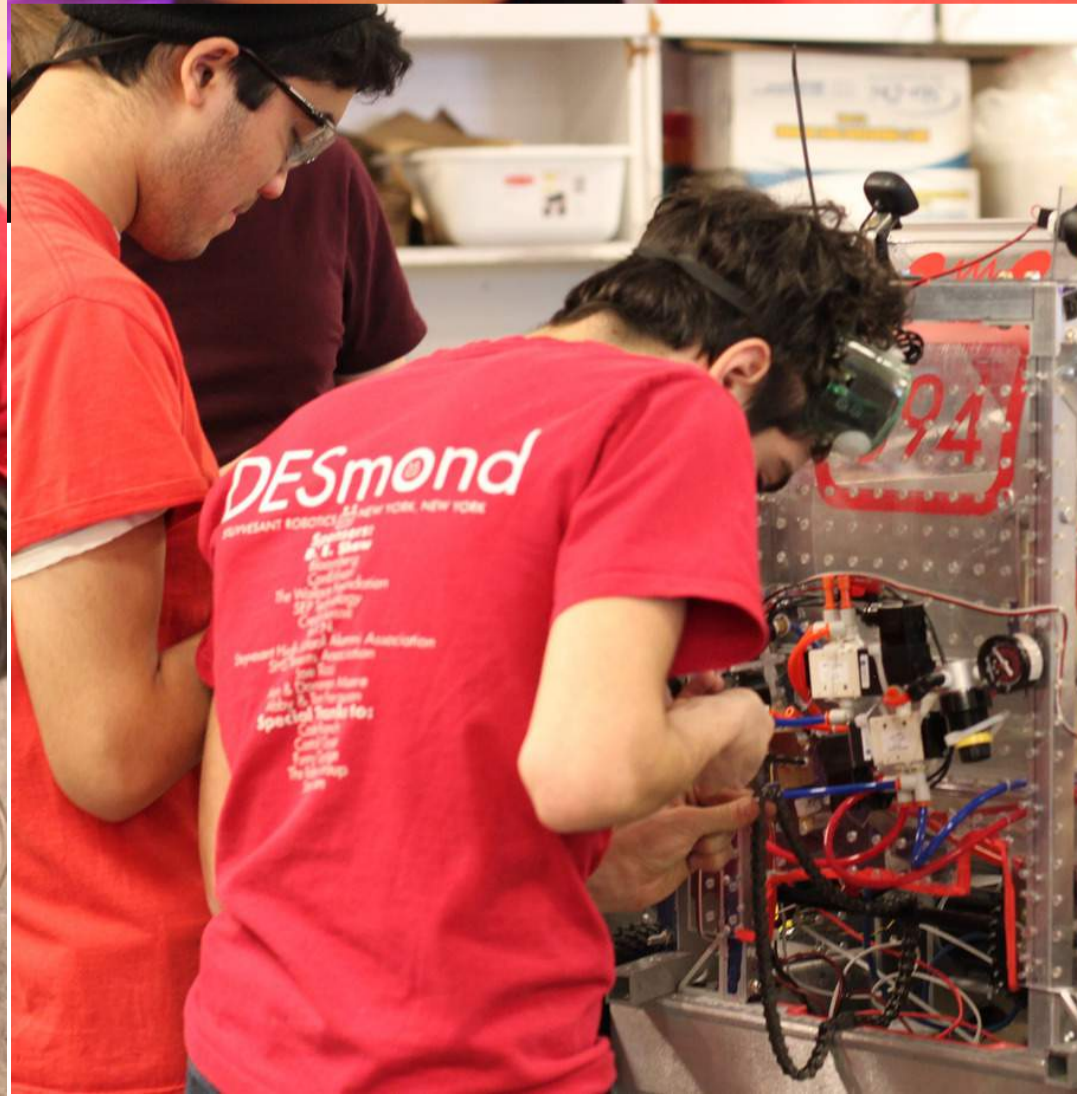
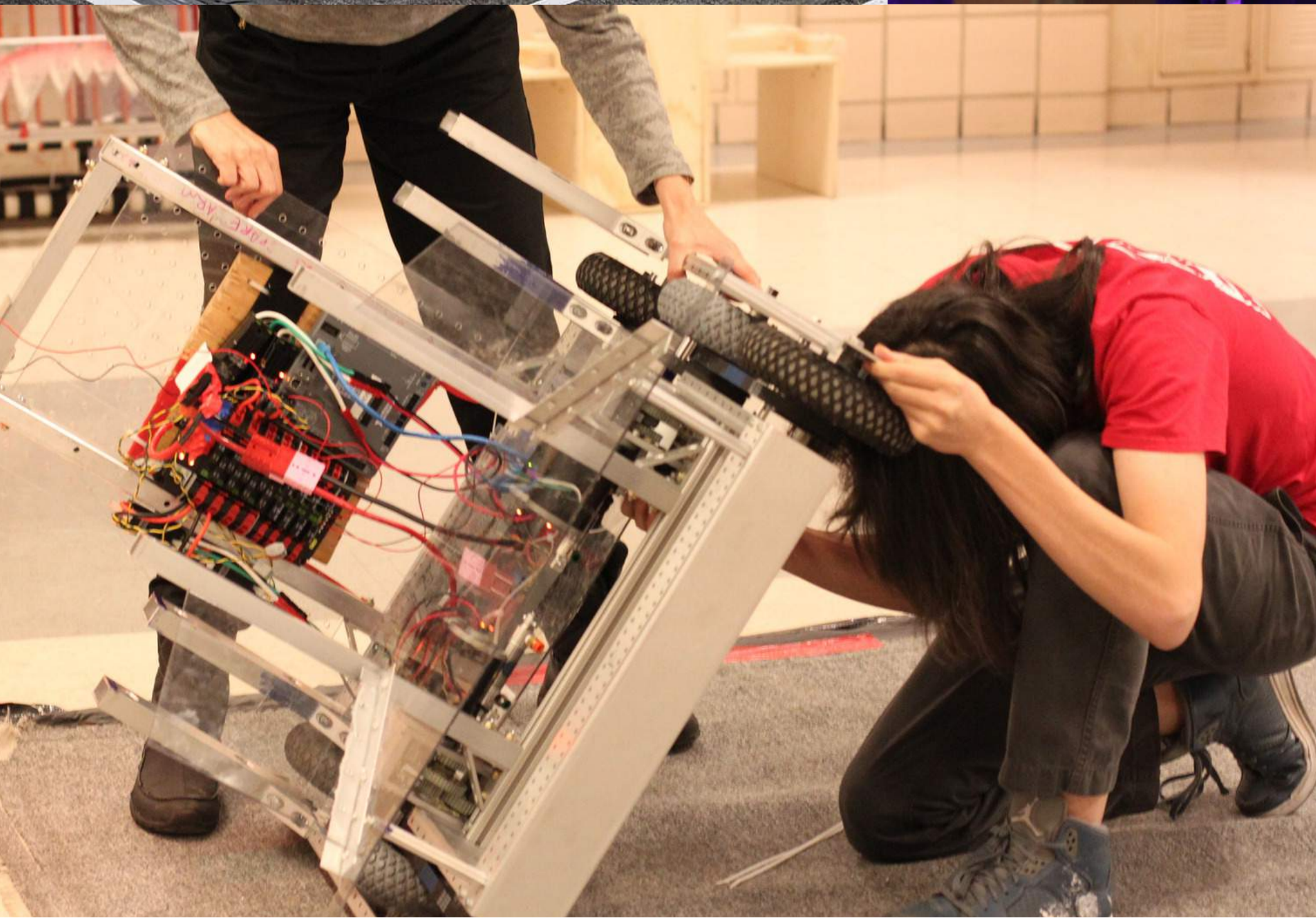
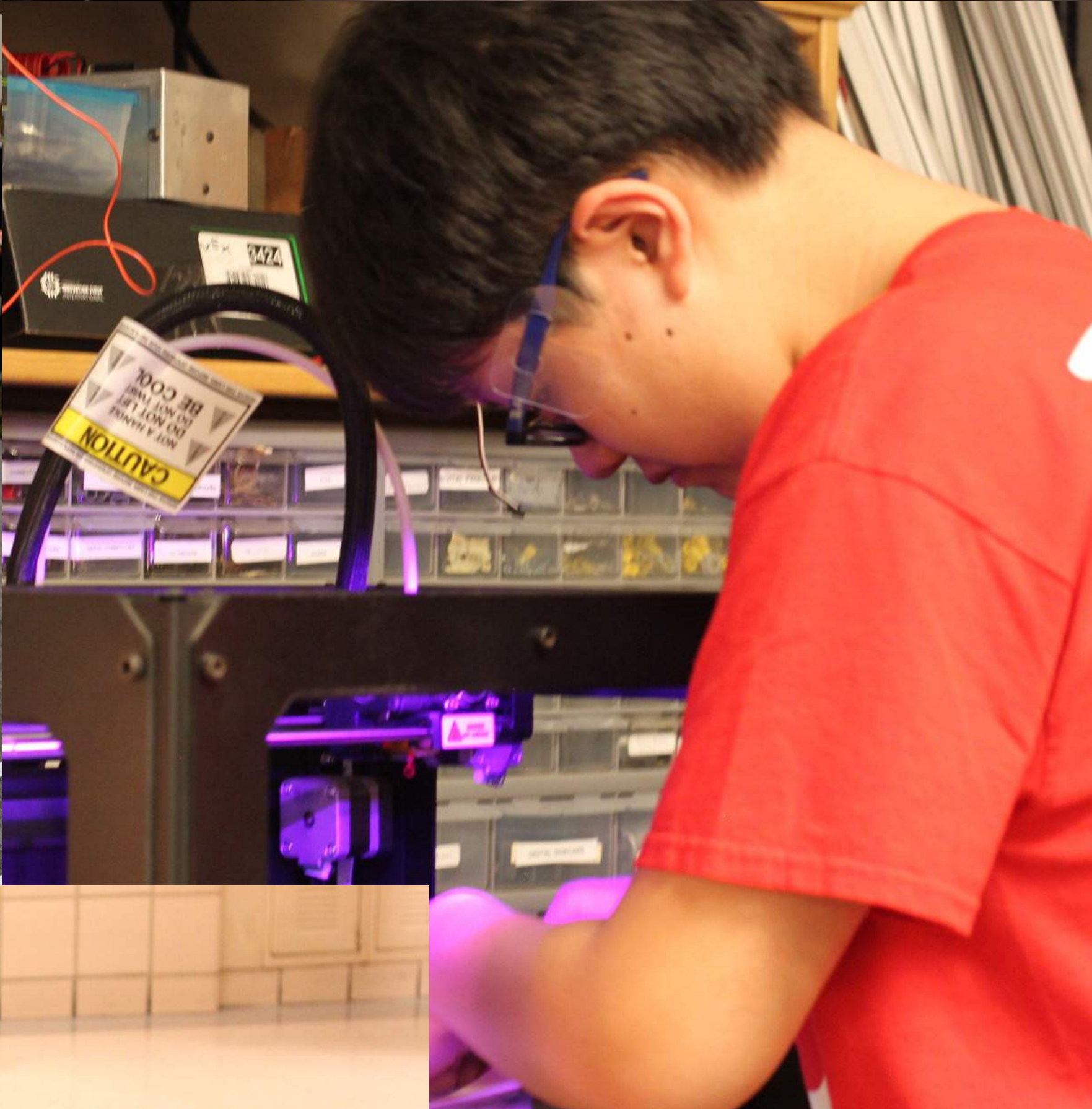
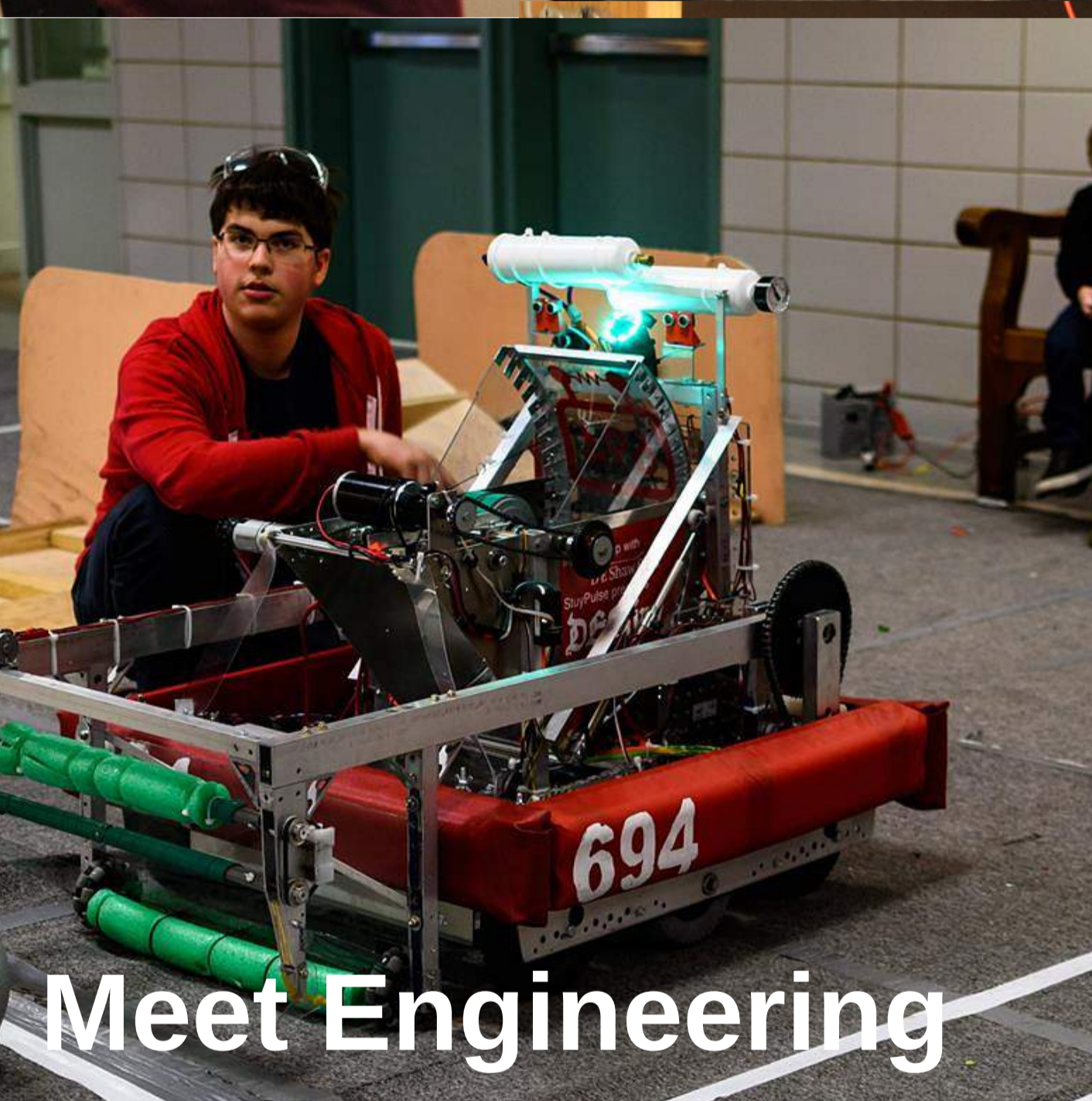
Portcullis



Drawbridge







Meet Engineering





Meet the brains behind the money!





Build Season is a six week time period that is used by all FRC teams to build the robot based on the FIRST challenge for this year, FIRST Stronghold. During our Kickoff, we immediately begin to discuss new strategies and robot designs. This year, with fresh new faces and the expertise of our older members, along with mentors and alumni, we dive headfirst to build a robot that will win us the first place prize. Each week of build season is spent planning, making prototypes, and building the robot.

## Week 1

Week one of build season was spent building the field and all the parts that needed to be part of it. Software engineers worked out new codes and downloaded new software in order to ensure that the code that would be used on the new robot would be the perfect one.

## Week 2

Our Engineering division this week almost finished the field construction. They also began to build their defenses for the field. There were also patches made to the installer that would be used for the robot. The robot was named DEStiny by our top sponsor, D.E. Shaw.

## Week 3

In our third week of build season, the CAD for this year's robot was completely finished. They took apart portions of the old prototypes and almost completed the construction of the defenses. The chassis and wheels were also worked on.

## Week 4

For week four, we finished the the essentials of field construction. We also finished the shooter sideplate and assembled the back wheels to attach to the chassis. The code for both the potentiometer for the acquirer and the encoders on the shooter were completed as well.

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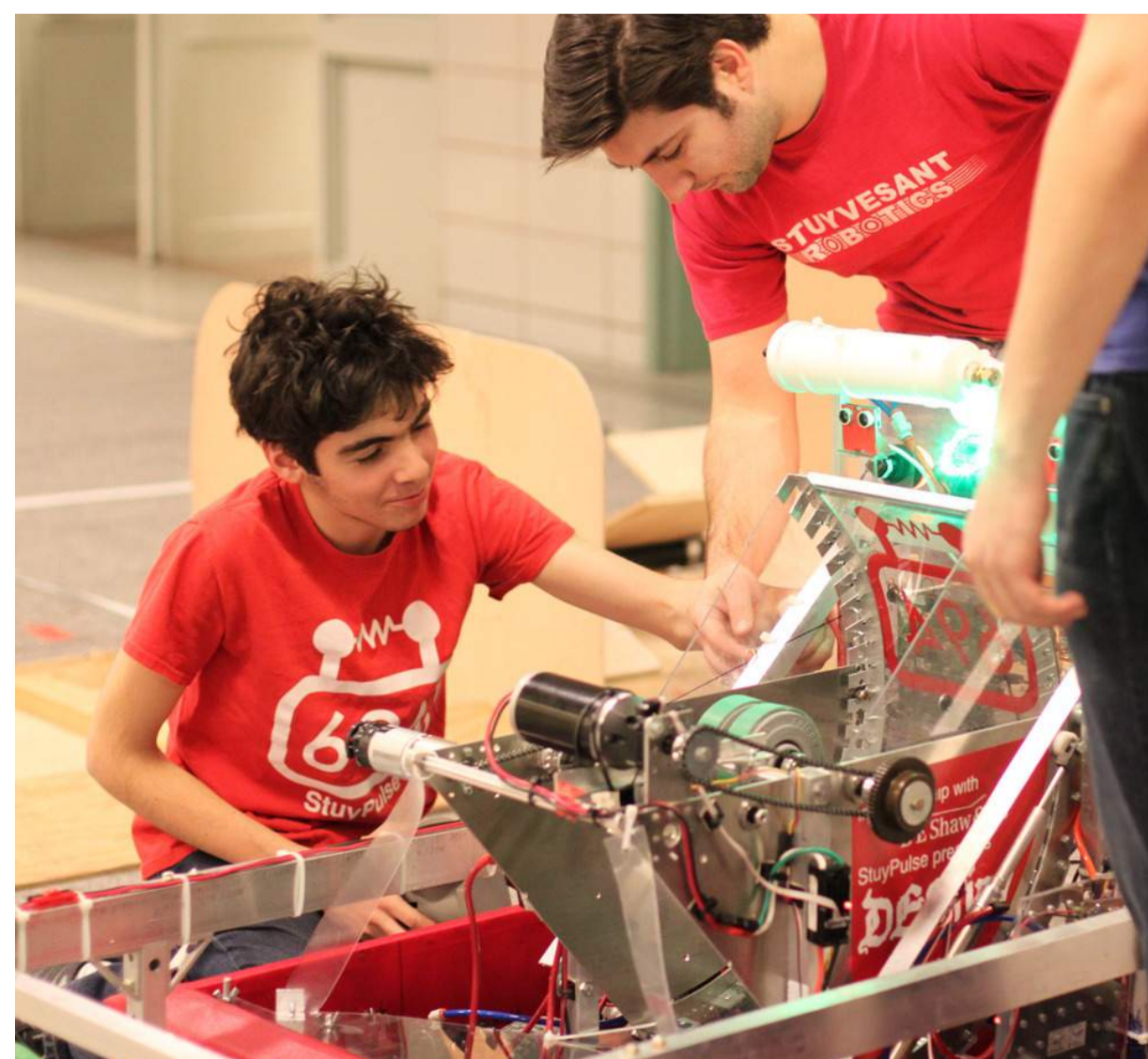
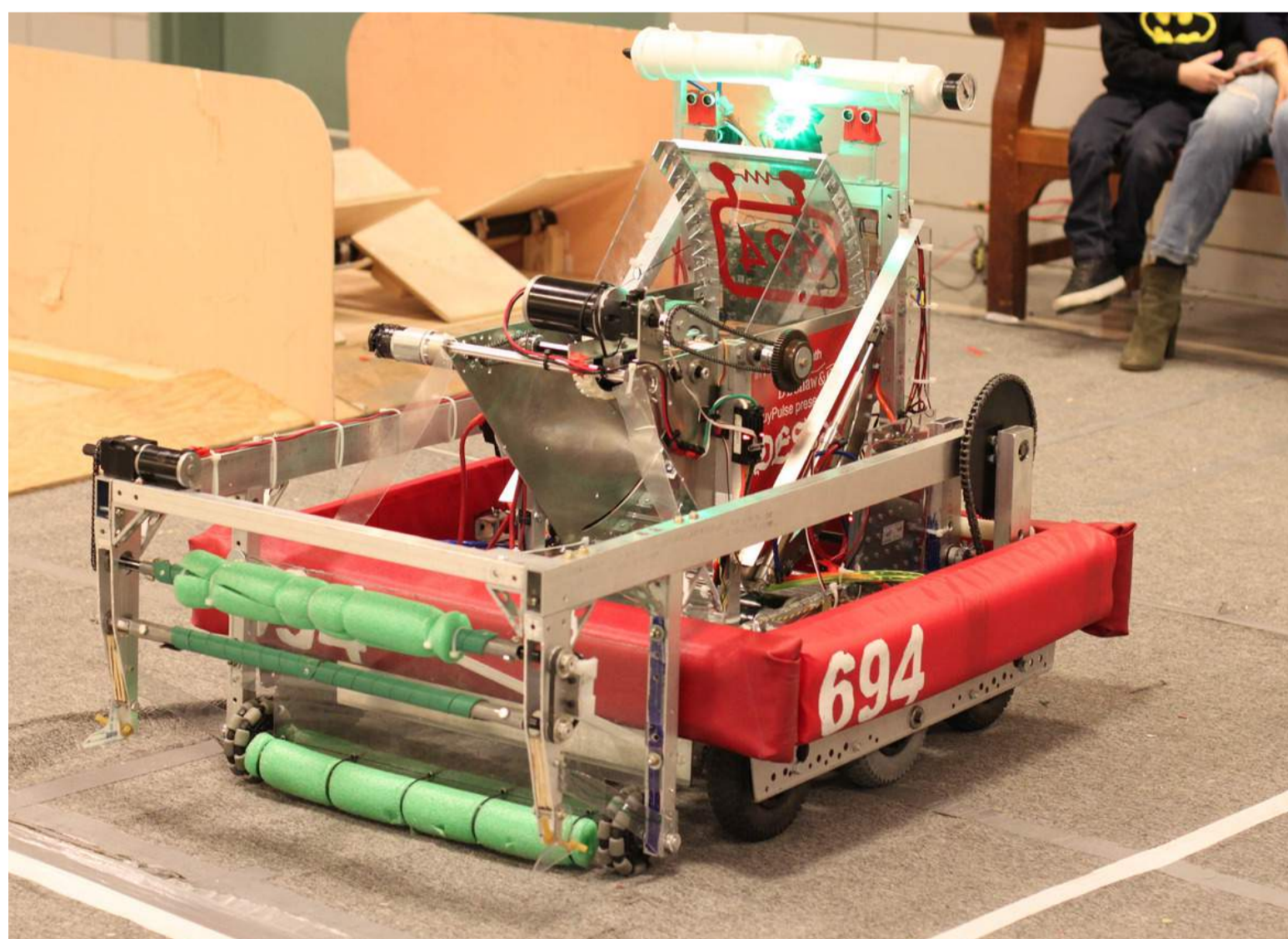


## Week 5

During Week five of build season, the team mounted the electronic plates on the robot, and locked the shooter into place. As a result, DEStiny will not be able to shoot layups. We also worked on our operator controls and our shooter algorithm.

## Week 6

During the last week of build season, we put all of our energy into finalizing our robot before we shipped it off.





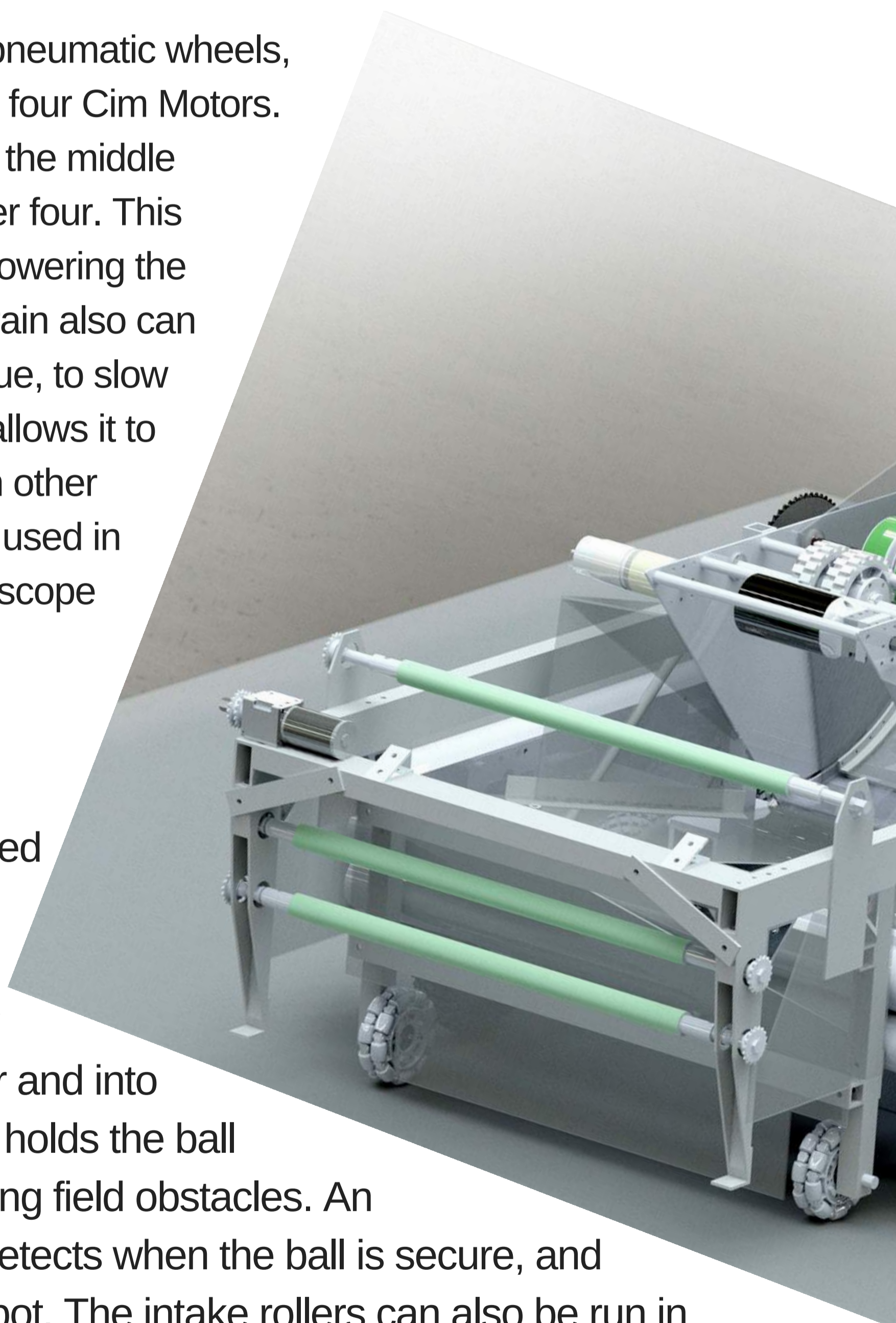
This year's robot is one of the most ambitious and complex that this team has ever constructed. The design can be divided into five main subsystems: The drivetrain, the ball intake, the shooter, the drop-down arm, and the sensor rig/computer vision.

## Drivetrain

DEStiny's drivetrain consists of six pneumatic wheels, three on each side, and is powered by four Cim Motors. The drivetrain is drop center, meaning the middle wheels lie below the plane of the other four. This allows the robot to turn on a dime by lowering the scrub forces when it turns. The drivetrain also can shift gears, from speedy, with low torque, to slow but powerful, with a high torque. This allows it to rapidly traverse the field, but also push other robots out of its way. The drive train is used in conjunction with a camera, and a gyroscope to automatically target the goal.

## Ball Intake

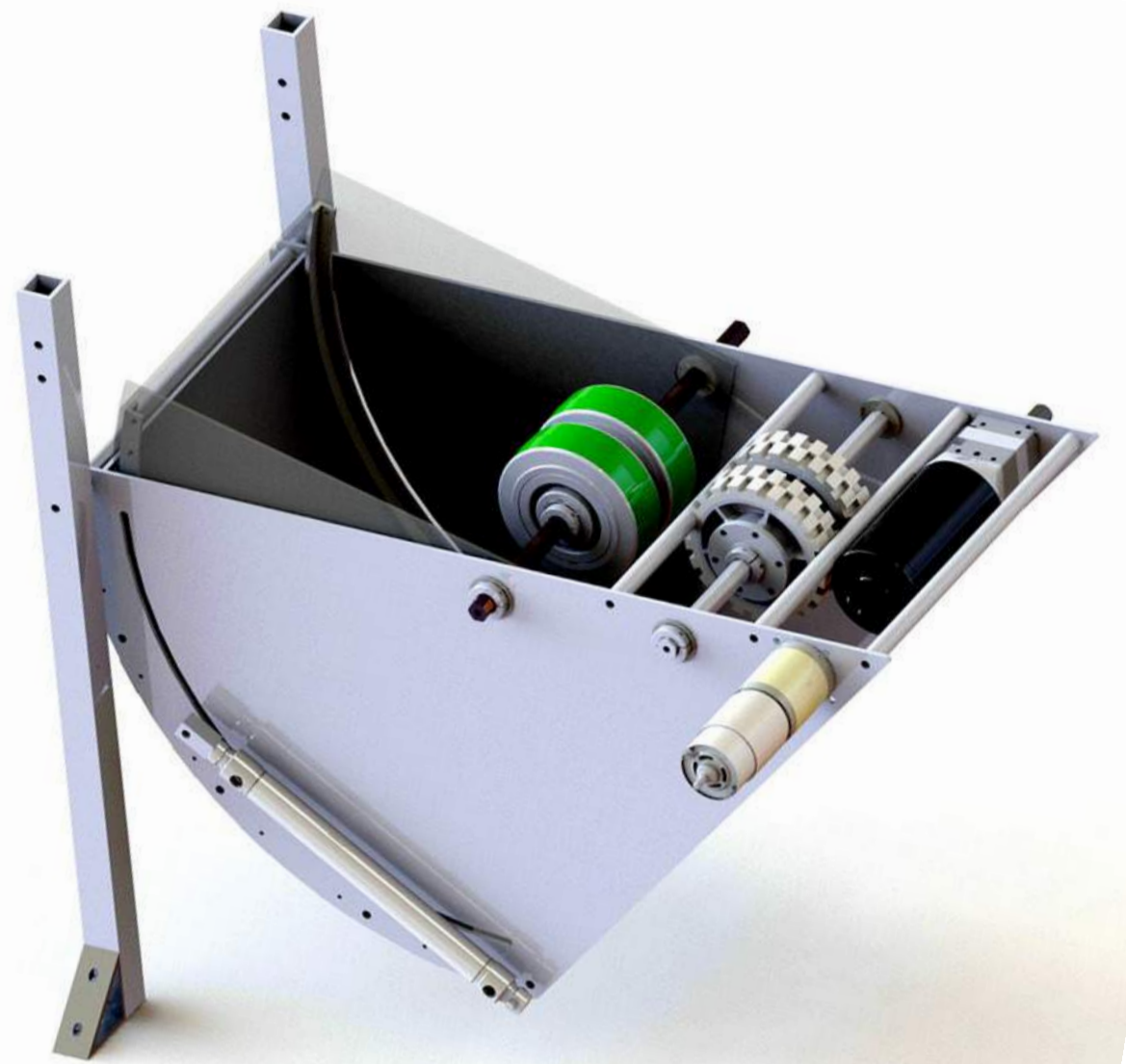
The ball intake of DEStiny is designed to quickly pick balls up off the field. The intake rollers are located on the drop-down arm, and will roll any ball that they touch over the bumper and into the hopper. The hopper wheel then holds the ball securely in place, even when crossing field obstacles. An infrared sensor in the hopper also detects when the ball is secure, and lights up LEDs in the back of the robot. The intake rollers can also be run in reverse, allowing the robot to roll the ball out of the acquirer into the low goal.





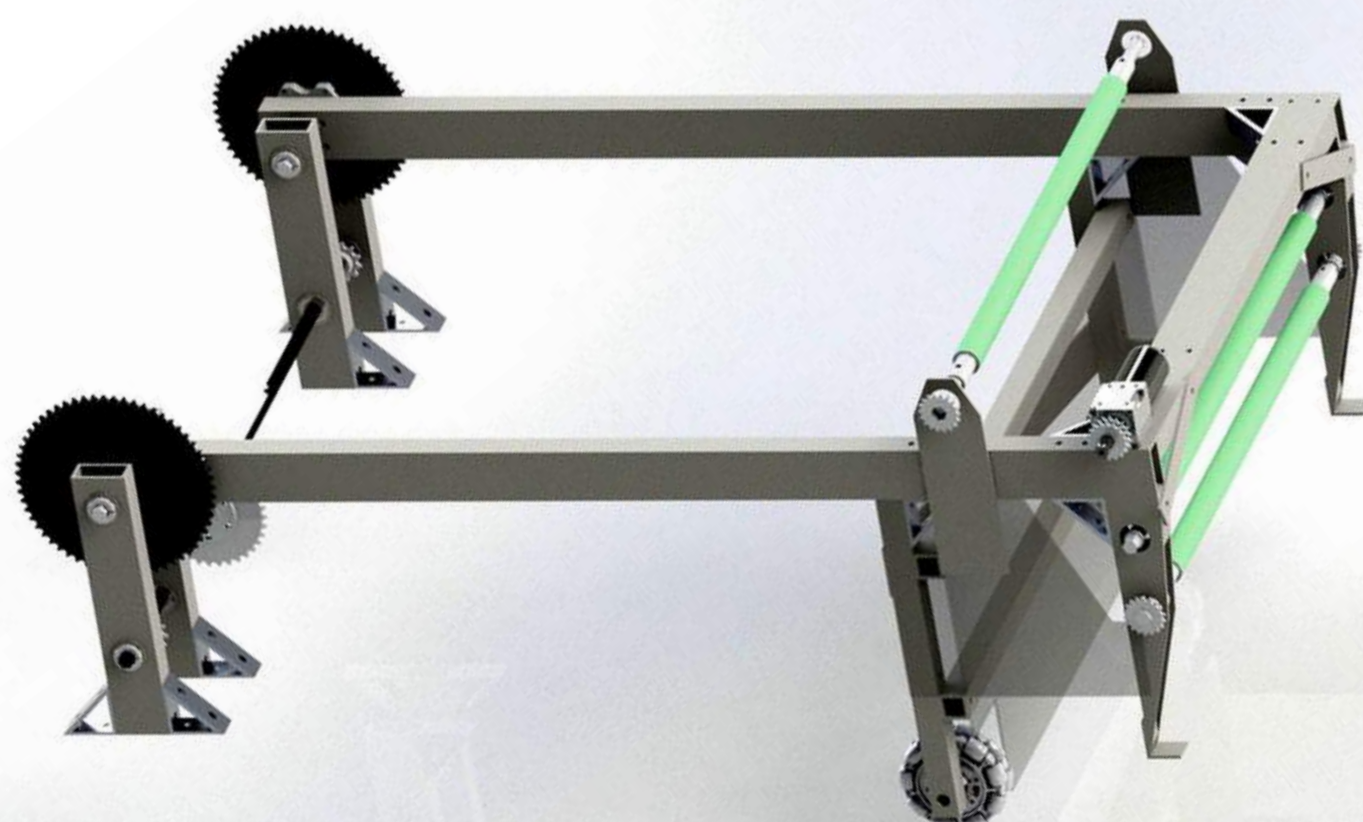
## Shooter

DEStiny's shooter is a consistent, powerful, variable mechanism. The shooter is powered by a flywheel that spins at 3600 rpm to store energy. When the flywheel has spun up, hopper wheel feeds the ball into the shooter wheels, which spin the ball through the hood. The speed of the flywheel can be adjusted in real time, changing the, and distance of the shot. The shot can be manually aimed with a flashlight beam for alignment, which helps the driver line up for a shot.



## Drop-Down Shooter

DEStiny is equipped with a multifunctional drop-down arm, to help navigate the field. A potentiometer is fitted onto the pivot point of the arm, allowing the robot to know where the arm is at all times, and automatically move the arm to certain angles. There are two hooks on the end of the arm that can grab onto the portcullis, and two fangs that can grab the drawbridge and sally port, and lower the cheval de frise. The arm is also geared at a ratio of 225 to 1, allowing it to lift the robot off the ground, allowing it to unjam itself if it ever gets stuck on a defense.





Software Engineering started this year, as always, with teaching their new members Java, git, eclipse and the tools for writing robot code. They attracted great dedicated new members who have learned a lot and been a great help. The process of writing robot code is similar every year, but what really stood out was their advances in computer vision (CV).

The CV on their robot got further this year than ever has before, though not without trouble. They kicked off the build season really well, writing visual processing code that correctly found goals on test images within Week 1. Going forward, we had to make sure code was able to find the goal in more diverse, realistic conditions and ensuring an efficient way to run the CV code. Soon they reached the ambitious part of their plan: running the CV code on a Jetson TK1. Jetsons are fast with graphics, but running the CV on one required a way to send that data to the roboRIO. Their first version communicated over a Serial port connection, which ran into problems on the bot. They tried again using an ethernet connection, and it worked on the final testing day. However, this method found problems in the quirky FMS environment. It worked in the pit, but not on the actual field. During SoFlo Regional, they decided to run the CV on the roboRIO. At Champs, they worked in wedges of time to get in tests, and on the last day of qualifications got the bot on the practice field for the first complete CV test. The ball went through the goal all ten times they wanted it to.



For the following years, they plan to continue building upon their successes in CV to ensure that it works for the first competition and hope to better utilize other sensors on the robot, such as PID tuning the gyro.





Meet "Programming"







The F.I.R.S.T. FRC New York City Regional took place on March 11-13, 2016 at Jacob Javits Center. Despite their tough first two days, where they lost comms during two of their qualification matches, StuyPulse had such a great time there and had an incredible experience. They also created a Fix-It Crew that went around and helped teams. One of our members helped a team for over half the regional to try and get their robot up and running. Although StuyPulse were originally eighth seed, they were picked by the fourth seed with 5030 and 5016, which ended up being the winning alliance! StuyPulse is also extremely proud to have received the Engineering Inspiration Award sponsored by NASA, a prestigious award based on their Chairman's Award submission, which made them double qualify for the World Championships in April.

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The SoFlo Regional took place at Palm Beach County Convention Center in West Palm Beach, Florida from March 30th to April 2nd. StuyPulse mainly used this competition as a practice, as going to World Championships was a guarantee. Despite their many drawbacks during the qualification matches, they were the second pick of the 8th seed alliance. For the first time, they played defense as well as crossed over the portcullis in autonomous mode. StuyPulse had one of the only robots at the regional that was able to do this. They made a great leap in their programming computer vision for DEStiny as well. Sadly, they were eliminated during the tiebreaker of the Quarterfinals. Although their robot lost, StuyPulse's Marketing Division saw their work recognized by winning the Entrepreneurship Award, which is awarded to the team with the best business plan for fundraising and organization of budget and team. Overall, their trip to West Palm was a great time for them to relax and get to know each other better, as well as to connect with other teams!

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F.I.R.S.T. World Championships was held at the Edward Jones Dome in St. Louis from April 27th through April 30th, and StuyPulse had such a great time there! Luckily for them, championships fell during their spring break and so they visited the City Museum, the St. Louis Zoo and toured Washington University before and after the four days of competition. It was a great bonding experience for the team, and they had a lot of fun to take a break from the stressed atmosphere of competition. As for the competition, they didn't have high expectations, as their robot was not functioning well at SoFlo, but DESTiny shocked us all and went above and beyond! They played extremely well during the qualification matches, placing first rank after numerous of their matches. Although by the last of the qualification matches they were the eighth seed, they worked their way to first place in the Curie Sub-Division as the alliance captain, with teams 3339, 379, and 1511. This gave them the opportunity to play on Einstein, an even higher field than the Curie Sub-Division. They later lost the tiebreaker match in the Quarterfinals round in Einstein. Being the second ever NYC team that was able to play on this field and given all the hardships they had this season, StuyPulse is extremely proud to have went this far.

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On August 10, StuyPulse, along with eight other international teams (Teams 118, 148, 359, 525, 987, 1538, 1595, 1772, 2468, 4613), flew to Shenzhen, China to attend the second ever China Robotics Challenge (CRC) event. Our first two days in Shenzhen consisted of helping the rookie Chinese teams finish building and programming their robots. After returning from a two day stay at Guilin, China, StuyPulse and the other international teams helped the Chinese teams with the final touches on their robot, preparing them for competition. Members and mentors of our team also aided and mentored the Chinese teams throughout our time together, teaching them from the experience we have after years of being an FRC team.



The scrimmage lasted from August 17 until August 19. After the first day of practice matches, our robot seemed to be performing as expected and did not suffer any damage from shipment. We placed sixth after qualifications, and as the fifth alliance captain, we competed alongside our alliance members, Team 525 and Team 9015. Our alliance made it to semifinals, nearly grasping a seat in the finals. After eliminations with the international teams, the Chinese teams had another elimination round excluding all international teams.



StuyPulse has done many outreach events this past year! A huge thank you to everyone who came and help supported our cause!

## **BAKE SALE**

The many bake sales have been very successful, gathering a lot of attention from the students. This year, they were held once every other month to subsidize travel costs for those going to the SoFlo Regional and the World Championships. Students of all grades devoured homemade goods such as brownies, cookies, cakes, cupcakes, and pie. Their purchases helped greatly, allowing so many more StuyPulse members to be able to afford the expensive travel costs.

## **BOOK SALE**

StuyPulse's annual book sale was a success! They sold a lot of books and related items, and had a great time communicating with people. The demo also went really well, and it turned out to be a fun thing that kept the little children company, especially with throwing the balls into Michael1.

## **MAKER FAIRE**

Maker Faire was an amazing time and a great experience, being amongst many other great people. There, StuyPulse demoed their bot along with other FRC, FTC, and FLL teams, such as team 2601 from Townsend Harris High School. They helped spread the message of FIRST by displaying their robot to all passersby and those interested.

## **MINI MAKER FAIRE**

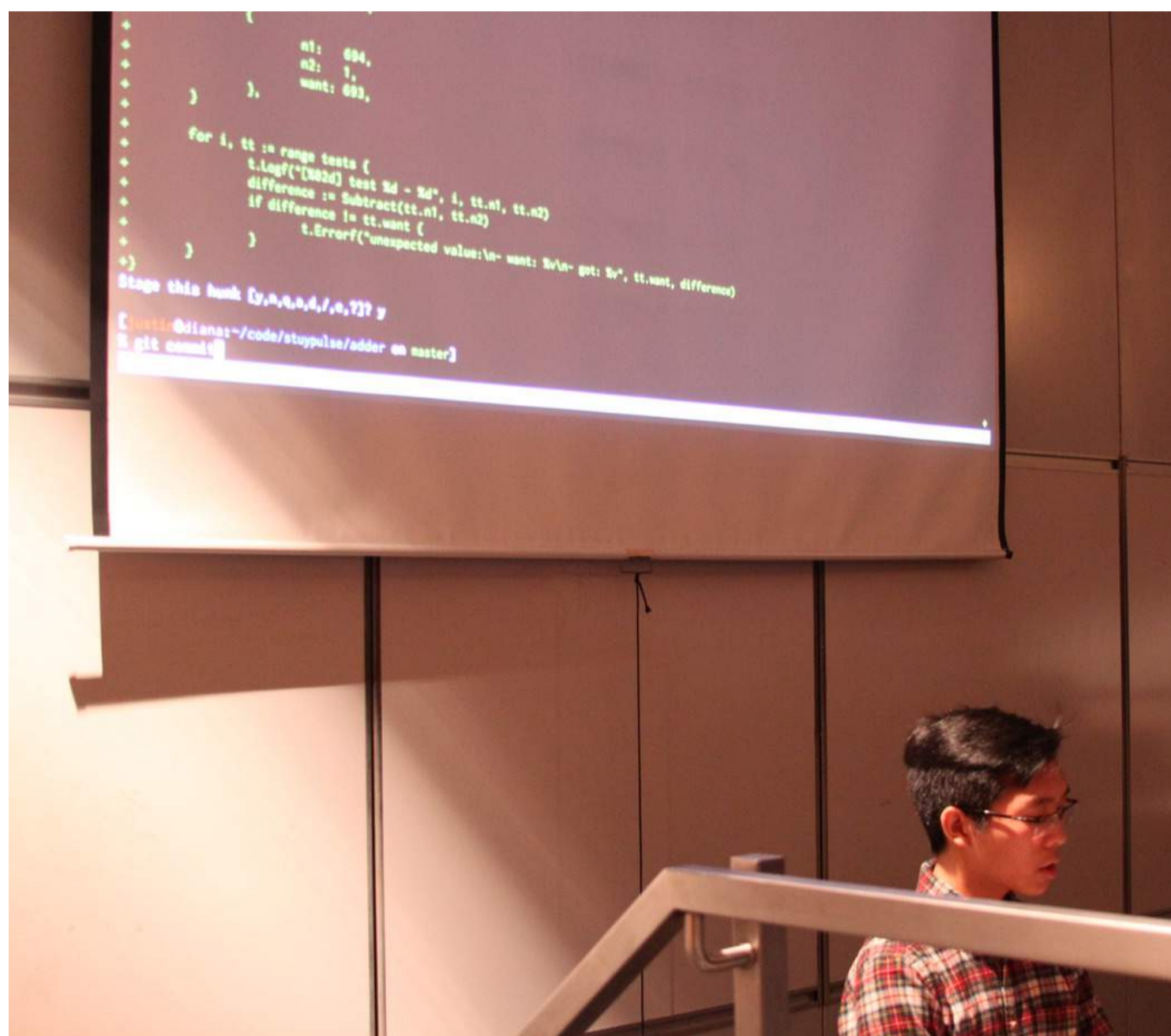
StuyPulse had the opportunity to attend the Mini Maker Faire that was held at the Barnes & Nobles in Tribeca. It was a huge success, allowing StuyPulse to show their love for robots and to spread the ideas of FIRST to all those who attended.

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## StuySplash

StuySplash was an amazing experience and a great event to host! It was an all day event held on Saturday, December 12 in the Stuyvesant High School lecture halls. StuyPulse's Marketing division worked hard to ensure the success of this annual event. Members from more than twenty different teams from all around the city came and listened to the speakers, many of which were StuyPulse



members themselves, who spoke on a huge variety of topics. There were talks on Marketing 101, Pneumatics, Intro to GitHub, and many more. Attendees first listened to an opening speech by Keynote speaker from Microsoft, Stephen Bohlen. Then, as two lectures were set up at the same time, attendees picked which one they wanted to listen to, with a short break in between. The day overall was highly educational for both attending guests and StuyPulse members alike, and they hope to have an equally successful StuySplash next year!

**Stuy Splash  
2015**





StuyPulse's 16th Team Dinner was a huge success! Even though planning was very hectic as they didn't have a lot of time because they went to the World Championship, it still went very smoothly. The potluck was very filling--thanks to those who brought in food, dessert, and drinks! The dinner started out with a welcoming introduction from the President of Marketing (Yubin Kim) and the President of Engineering (Jion Fairchild), which then led to the showing of this year's Chairman's Video. StuyPulse also had a silent auction for those interested in winning items! The demo of DEStiny went very smoothly, although some of the shots missed. Many mentors, alumni and family members attended; mentors and parents were given special thanks for all their help this past year. As well, seniors were thanked for all their hard work! Special guests during their team dinner included their principal, Ms. Zhang, and politician John Liu.





## 310

After the success of the 2014/2015 season in which our team, Stuy Fission 310, made it to super regionals, we were optimistic for this year and ultimately disappointed when we were unable to replicate the success of the past. We began the season with an unusually large number of newbies due to the fact that our sister team 479 only had one, and an inadequate system of training and integrating them into the team. Many newbies spent the build season without anything to do. The ones who were working on our competition robot had trouble doing more advanced things that were needed. The end result was a robot that was not able to make it past the qualifying competition. Though mistakes of this season resulted in a less than optimal competition season, this past year has also taught us a lot. Because our season was cut short, we have had a lot of time to work on training and learning more about robotics and we believe that our current team is more knowledgeable than any of our previous teams.



We also have new leadership due to our president graduating and we are determined to create change. 310 is hopeful that next year we will go farther than we have before.



## 479

Stuy Fusion 479 went into the 2015/2016 season as a dark horse team, not expecting much in terms of competition, but hoping that this would be a breakout season from which our members could learn from. We started out slow, gaining only one newbie and ordering parts much too late into build season, but we eventually picked up pace, using our mistakes from the first qualifier to bounce back during the second qualifier. Although we didn't make it to the finals, we were still able to advance to Regionals on the Inspire Second Place award, which was an inspiring and somewhat surprising accomplishment, considering that we tanked at both qualifiers last season. However, our momentum could no longer overcome the issues with our robot, and we weren't able to make it out of Regionals. Despite this, most of our team was finally able to experience competitions in which we were actually competitive in, and we gained valuable knowledge throughout the season as well. With our current team of experienced juniors, we hope to go farther than we have before next season.





A HUGE thank you to all our sponsors, mentors, alumni, parents, families, faculty advisors, and everyone else that supported us along every step of the way!

## Faculty Advisors

Rafael Colón  
James Lonardo

## Sponsors

D.E. Shaw & Co.  
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Con Edison  
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Abby & Tom Ferguson  
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Yvonne & Roland Conybeare  
Whole Foods Market  
SolidWorks  
The Wallace Foundation  
Evan Layne  
Justin Kim

## Mentors

Dan Lavin  
Ron Kunicki  
James Potter  
Tom Ferguson  
Colin Holgate  
Matt Fairchild  
Jeanne Boyarsky  
Fritz Heckel  
Joe Blay  
Joe Ricci  
Shelly Grant)  
Mel Hauptman

## Parents

Annie Chan-Fairchild  
Lisa Winter  
Richard Leung  
Cindy Sherling  
Igor Olevsky  
Ellen Hartman  
So Nam  
Yvonne and Roland Conybeare



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