SEASON SUMMARY

FTC Team #3839 Mechanical Geniuses

2019-2020 | Skystone

Team Summary

This year, team 3839 is a **first year team** at Palm Harbor University High School, with 5 teams. Our team **consists of 12 active members**, 8 of which are new members, and 4 who are returning members to the club.

From the beginning of the season, our team had been focused on **creating an efficient robot** to score the most amount of points during both the Tele-op and Autonomous periods. Through multiple design iterations to multiple parts of the robot, and advancing our programming algorithms, we were able to create an efficient robot **leading us to the Florida State Championship.**

Although we were focused on creating an efficient robot for the game, we realized the importance of mentorship and outreach, by **organizing and hosting multiple outreach events** throughout the year. From fostering the creation of a robotics club at Largo High School, to doing weekly **mentoring to a local FLL team**, we were deeply involved in fostering the FIRST & STEM Community .

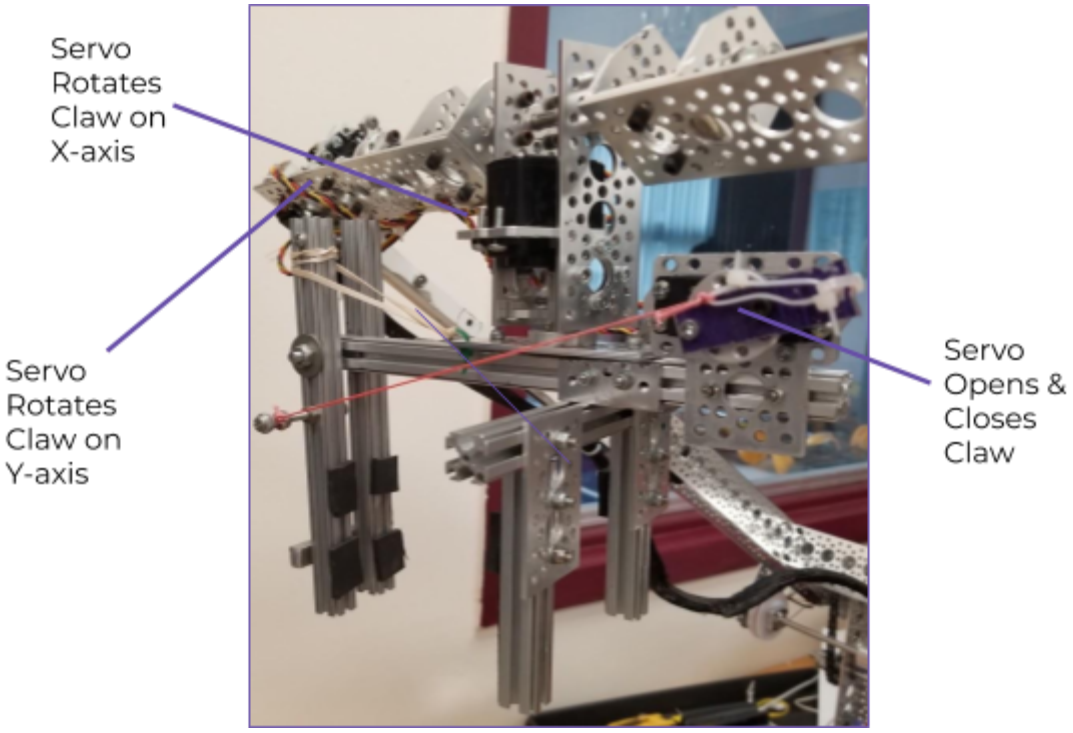
As a rookie team, with great mentorship and leadership, we were able to win **Finalist Alliance Captain and the Control Award**, maintaining a record of 21-4-0, and advancing to the Florida State Championship in Jacksonville.

Mechanical Design

With one of the most unique designs in the Gulf Coast League and the State, we were able to **stack 7 blocks** with a capstone, generating us a ton of points. We had 3 main components to our scoring design: Lift, Extension, Claw.

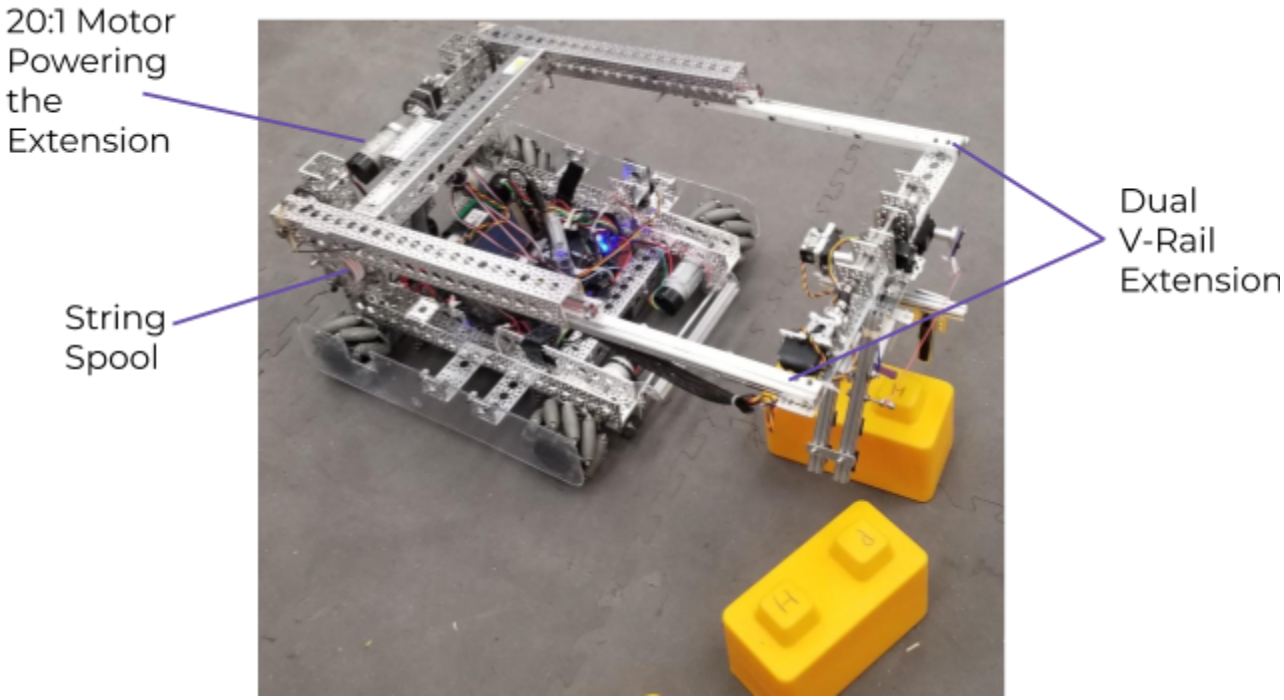
Multi-Axis Claw

Our claw was one of the most unique intakes in the FTC season. With **3 axis of rotation**, it could pick up a stone in any orientation, and through advanced software implementation, the process of **stabilizing the claw to the position of the stone was quick and automated**. The claw also implemented a custom integrated capstone, that dropped the capstone with a click of a button on the final stone.



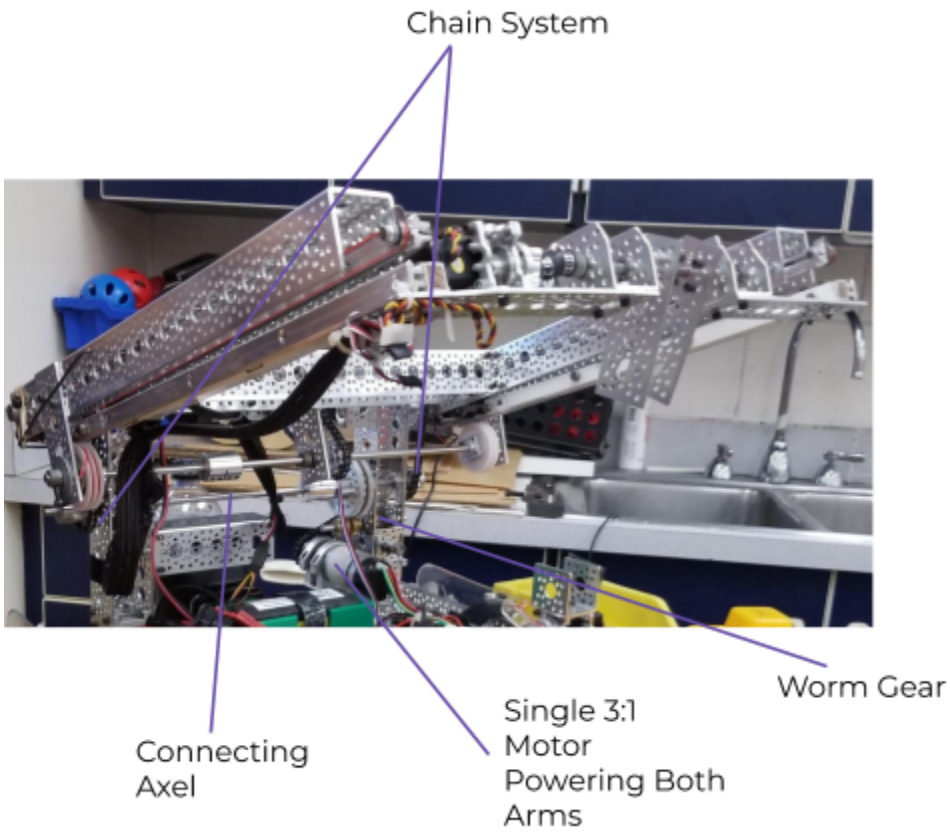
Dual Extension System

When discussing ideas for stacking, the team decided on a complex string system through multiple brainstorming sessions. Though different ideas were discussed, eventually we chose to design a single arm that could go in-and-out, our extension, and up-and-down, the arm, because of its speed when compared to a two-step process. Our **extension primarily involved two v-rails per arm**, sliding by each other with a **series of gridplates and bearings**, and a **system of strings around a spool** with two sections, with the string wrapped in opposite directions in each section. These strings, when rotated with the chain, would **pull the extension either in or out depending on the direction they were spun**. Though we faced some issues with strings snapping, we were able to fix this by implementing a stronger string. Throughout our competitions, we were able to stack up to seven stones and one capstone during the Tele-Op period.

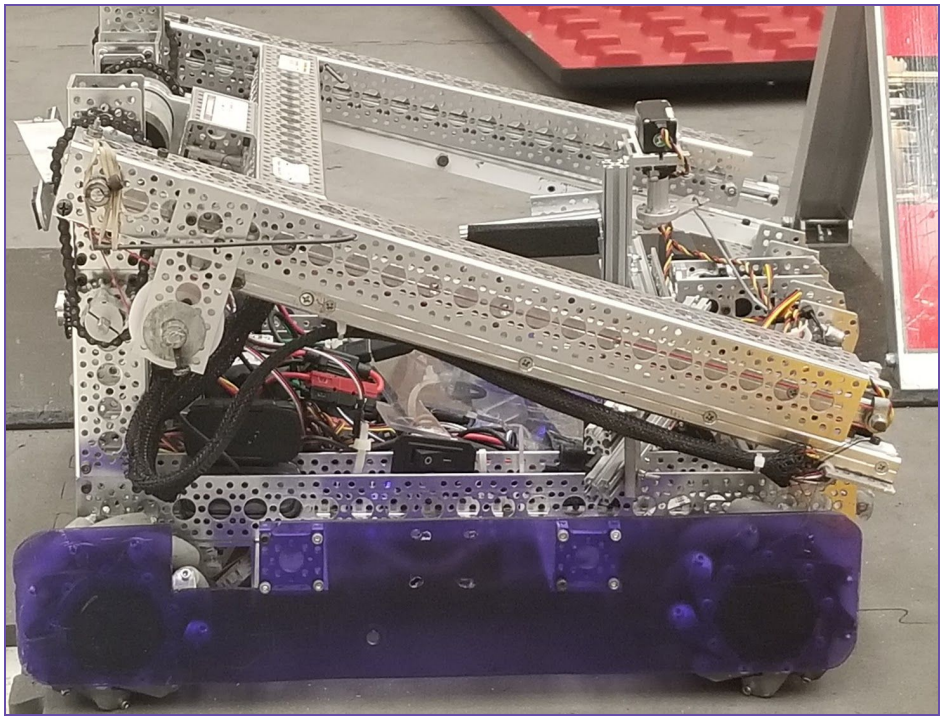


3:1 Dual Arm Lift

When discussing how we wanted our robot to be built and work, one thing that we could all agree on was having a tall arm to stack on the foundation. Eventually, we decided on **worm gears as our method of lifting the arm due to their strength and versatility**. The team wanted our arm to go up and over the robot to stack behind us, allowing us to stack higher since the point of rotation would then be closer to the foundation. The arm system involves a **3:1 gear ratio** on the **worm gear** and a strong motor. We retained speed by including a **short chain system** that turned our worm gear mechanism. When lifted in front of our robot, we could stack five stones perpendicular to the robot or six parallel, however these numbers could be increased when lifting the arm over the back of the robot.



Retracted View



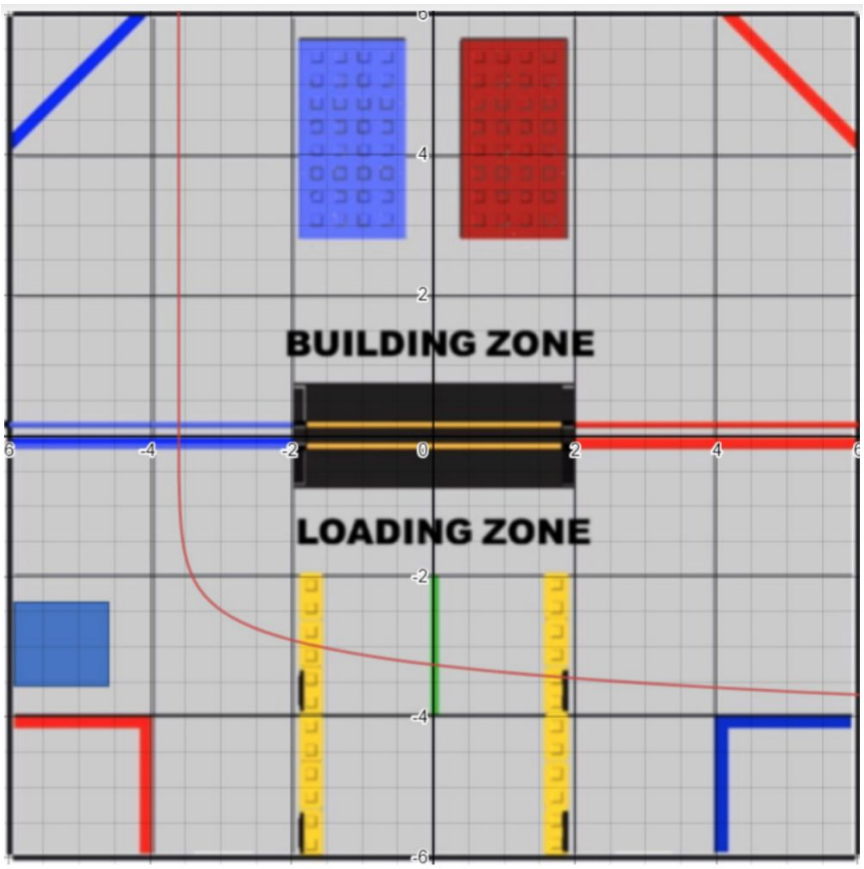
Extended View

Programming

Autonomous

Our goal in autonomous was to create the most efficient paths to score the **most amount of points possible** in the least amount of time consistently. We went through many iterations of autonomous programming from getting the encoder values from one location to another, to **custom logarithmic/exponential path following curves** which increased the efficiency and reliability of the autonomous.

Here is an example of how we planned these curves:



$$y = -\log_{10}(x + 3.6) - 2.7$$

In our autonomous program, we also implemented **deceleration and acceleration**, in order to account for the different amounts of slippage of varying fields. This made our autonomous a lot more reliable.

```
try {
    //Acceleration
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF1)){
        robot.setDrivePower( leftBackDrivePower: speed*0.27,  leftFrontDrivePower: speed *0.27,  rightBackDrivePower: speed *0.27,  rightFrontDrivePower: speed *0.27);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF2)){
        robot.setDrivePower( leftBackDrivePower: speed*0.4,  leftFrontDrivePower: speed *0.4,  rightBackDrivePower: speed * 0.4,  rightFrontDrivePower: speed *0.4);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF3)){
        robot.setDrivePower( leftBackDrivePower: speed*0.6,  leftFrontDrivePower: speed *0.6,  rightBackDrivePower: speed * 0.6,  rightFrontDrivePower: speed *0.6);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF4)){
        robot.setDrivePower( leftBackDrivePower: speed*0.8,  leftFrontDrivePower: speed *0.8,  rightBackDrivePower: speed * 0.8,  rightFrontDrivePower: speed *0.8);
    }
    //Normal Speed
    while (Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lFhalf)){
        robot.setDrivePower(speed, speed, speed, speed);
    }
    //Deceleration
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF5)){
        robot.setDrivePower( leftBackDrivePower: speed*0.5,  leftFrontDrivePower: speed *0.5,  rightBackDrivePower: speed * 0.5,  rightFrontDrivePower: speed *0.5);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF6)){
        robot.setDrivePower( leftBackDrivePower: speed*0.4,  leftFrontDrivePower: speed *0.4,  rightBackDrivePower: speed * 0.4,  rightFrontDrivePower: speed *0.4);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF7)){
        robot.setDrivePower( leftBackDrivePower: speed*0.2,  leftFrontDrivePower: speed *0.2,  rightBackDrivePower: speed * 0.2,  rightFrontDrivePower: speed *0.2);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF8)){
        robot.setDrivePower( leftBackDrivePower: speed*0.17,  leftFrontDrivePower: speed *0.17,  rightBackDrivePower: speed *0.17,  rightFrontDrivePower: speed *0.17);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF9)){
        robot.setDrivePower( leftBackDrivePower: speed*0.12,  leftFrontDrivePower: speed *0.12,  rightBackDrivePower: speed *0.12,  rightFrontDrivePower: speed *0.12);
    }
    while(Math.abs(robot.lF.getCurrentPosition()) < Math.abs(lF10)){
        robot.setDrivePower( leftBackDrivePower: speed*0.1,  leftFrontDrivePower: speed *0.1,  rightBackDrivePower: speed *0.1,  rightFrontDrivePower: speed *0.1);
    }


}
catch(Exception p_exception) {
```

Tele-op

In addition, we also had driver enhancements and automations to make the driver controlled period even more efficient. Our claw has a servo which determines what angle the claw is at in the y-axis, and using a **REV 270 degree potentiometer** on our arm, we were able to create a ratio between the arm's angle and the claw's angle, and **automatically adjust the claw's angle** to be completely straight, no matter the height of the arm.

Outreach/Community

As a first year team, we learned a lot about the value of mentorship. Through our outreach efforts in the community we were able to help others in the STEM field as well. We have highlighted some of our major events below.

FLL Team Mentoring

We spread FIRST by giving the elementary school students on a FLL team an understanding of what the future of FIRST was. We **showed them our robot in action** and explained to them how it worked and showed them the ways in which FLL was similar to FTC; design, build, program, test. As a result of mentoring this FLL team we got to **help kids who are just starting robotics** and give a local team a boost by giving them fresh ideas. We got to learn about the community. Also they will mention Ayush and 3839 Mechanical Geniuses as one of their mentors at the state competition for FLL.

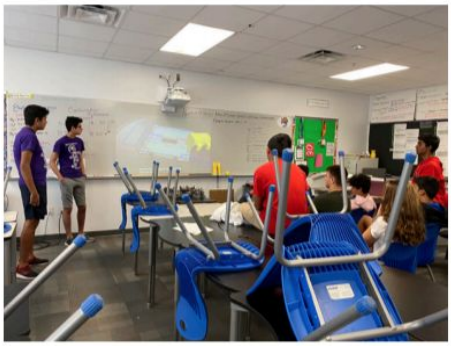
Ayush helps with brain-storming a lifting mecha-nism for the robot

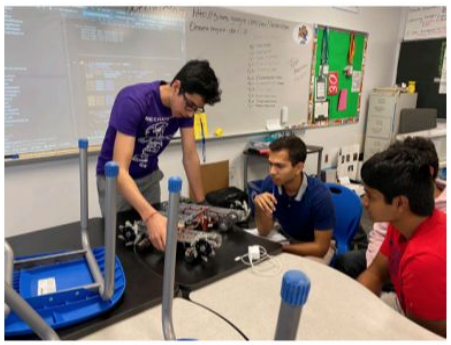
Group photo of Team R.I.S.E Robotics.

Explaining lego parts to team R.I.S.E members

Largo High School

Continuing our efforts to give back to the STEM community, we mentored a non-competitive Robotics club at Largo High School. We guided this club in the matters of what is FTC, FTC vs. Vex, and programming a basic autonomous. We also gave them **contacts and helped them find sponsorships** to **participate in the FTC 2020-2021 season**. We invited the robotics club to s**hadow our team at the Gulf Coast League Championship** to get a feel for what the competition is like, giving them a hands-on experience of FTC. We look forward to going back in the near future to help them with basic building and forming an FTC team by the end of this year.



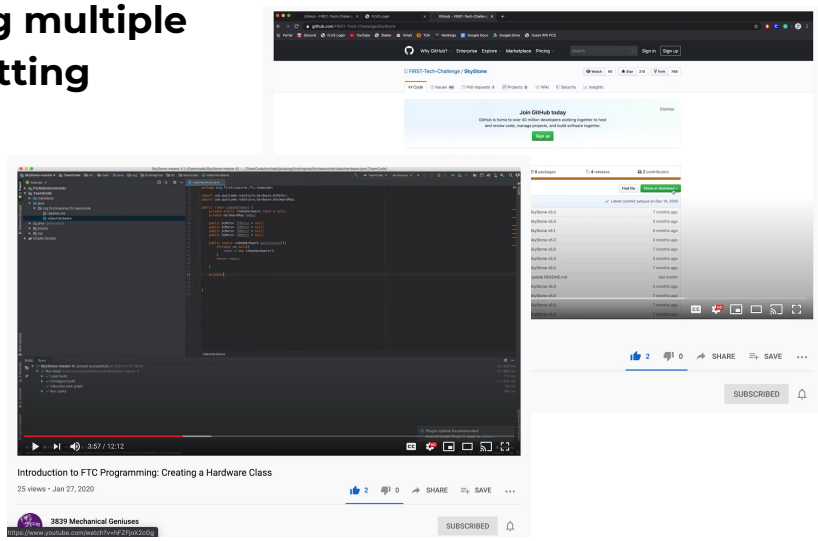


Clearwater Fundamental Middle School

At Clearwater Fundamental Middle School, we were able to **mentor the students on their missions** in the FLL challenge, as well as being able to **show them our robot** and how it functioned. We were able to make an impact on the middle school students, and **inspire them to continue on the FIRST path towards FTC in High School, and continue on with STEM in the future**. We were able to demonstrate our robot, and gave the students an opportunity to drive the robot.

Youtube Tutorials

As a team that greatly benefited and gained from online tutorials on programming and building custom parts, we were happy to give back to the online community of FTC by **creating multiple beginner FTC tutorials on getting started with programming**. These tutorials show how to set up the FTC SDK, download java/android studio, and the basics of creating a Tele-op and Autonomous.



Accolades

The 2019-2020 Skystone Season was an overall success. We learned a lot on how to work together as a team, as well as valuable skills that will be used in FTC seasons to come, as well as in the future careers.

At the Gulf Coast League Championship, we had an overall season record of **21 wins, and 4 losses**, while going **undefeated** at one of the meets. At the league championship, we only lost one match, ranking third overall and becoming the Second Captain. We led a strong alliance, allowing us to win the semifinals undefeated, and becoming the **Finalist Alliance Captain**, advancing us to the State Championship. We were also **nominated for multiple awards**, and **won first place for the control award**.

In Jacksonville, at the Florida State Championship, we were able to compete with the top teams in Florida. In the Scott division, we were able to **win 4 of our matches, and only lose 2**. Although, we were not able to make it to the playoff matches it was a great experience for our team, and will be a useful experience for years to come.