ZERO ROBOTICS
Summer 2022 ISS Finals

What is Zero Robotics?

- A robotics competition for middle school students to learn how to code.
- Began December 9th, 2009
- An experience that serves to motivate students to pursue careers in STEM.

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Zero is for **Zero Gravity**

- The finals occur aboard the ISS!

Zero is for **Zero Cost**

- No entry fees

Zero is for **Zero Configuration**

- Everything is programmed online

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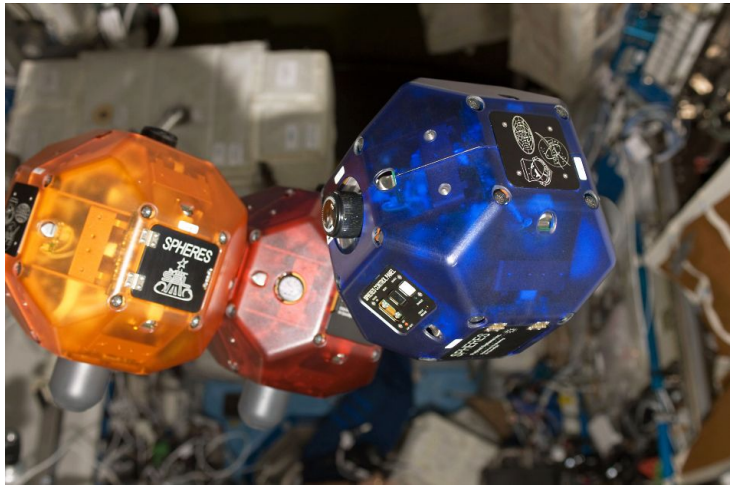
Meet the Robots

Astrobees

- The Astrobees are NASA's newer autonomous robots set to replace the SPHERES
- NASA currently has three autonomous robots: Honey, Queen, and Bumble.
- These robots are equipped with multiple powerful sensors that allow them to operate autonomously.



SPHERES

- The SPHERES, or Synchronized Position Hold Engage and Reorient Experimental Satellite, are NASA's older robots
- These Robots have been used aboard the ISS for over a decade and incorporated into ZR since the beginning.
- These robots operate semi-autonomously and are able to complete simple tasks and experiments.

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More about the Astrobees!

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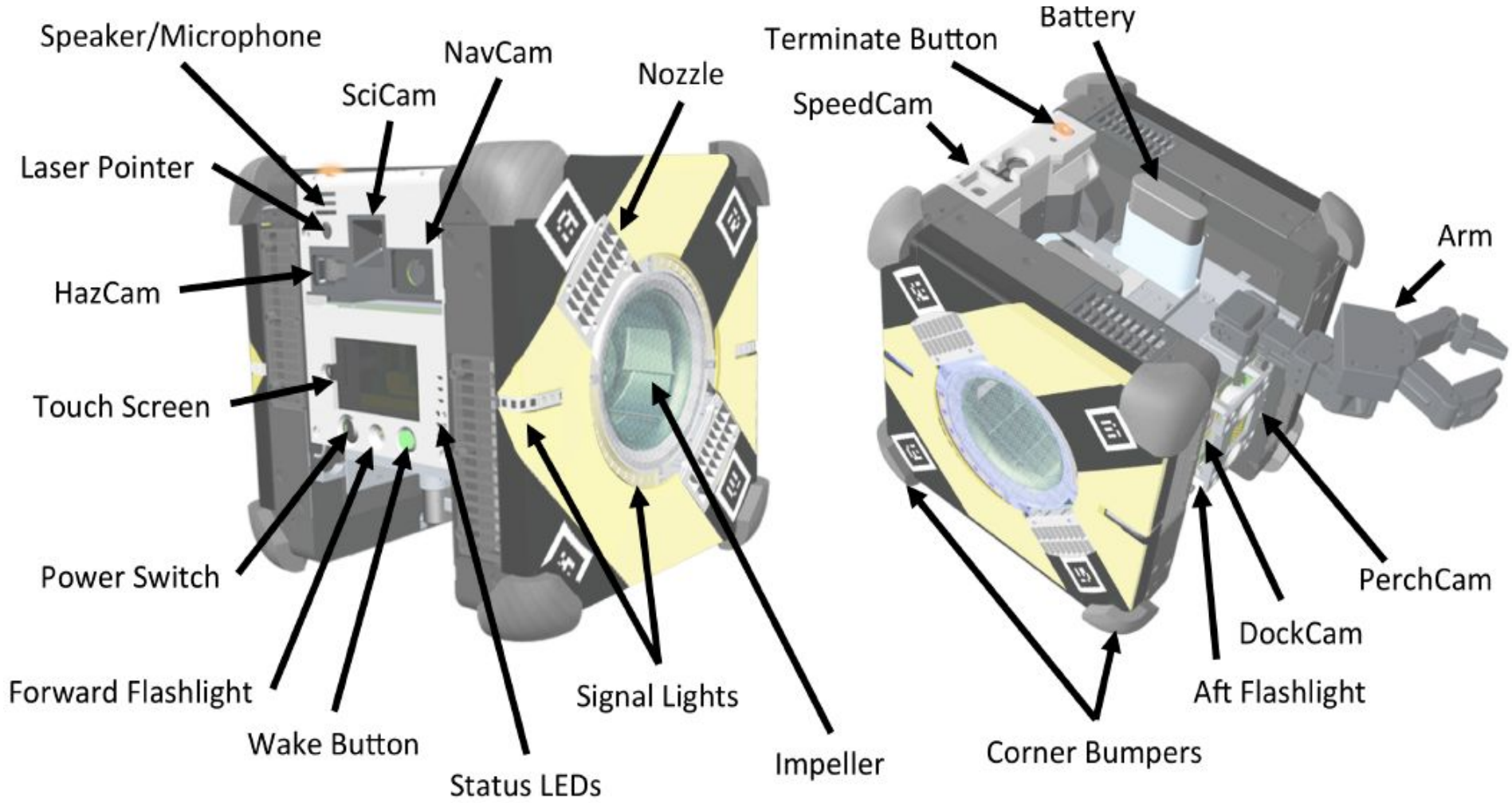
Astrobee (cont.)



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The Great AstroSpelling Bee!

This year's challenge is: **The Great AstroSpelling Bee**

- Teams are to strategize and choose a password consisting of 3 - 6 unique letters for the Astrobee to spell out.

- Each team has 5 minutes to complete their selected password.

- Scores are based on the password complexity, accuracy, and time it takes to complete the password.

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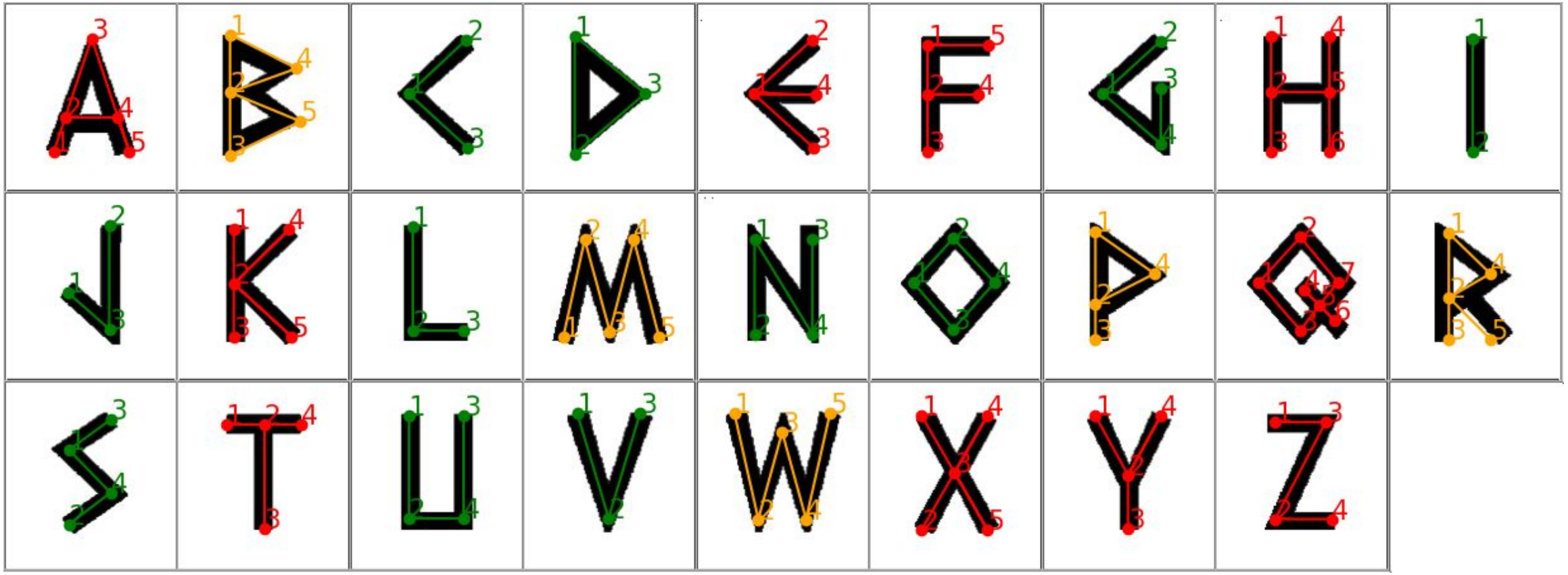
Letter Waypoints



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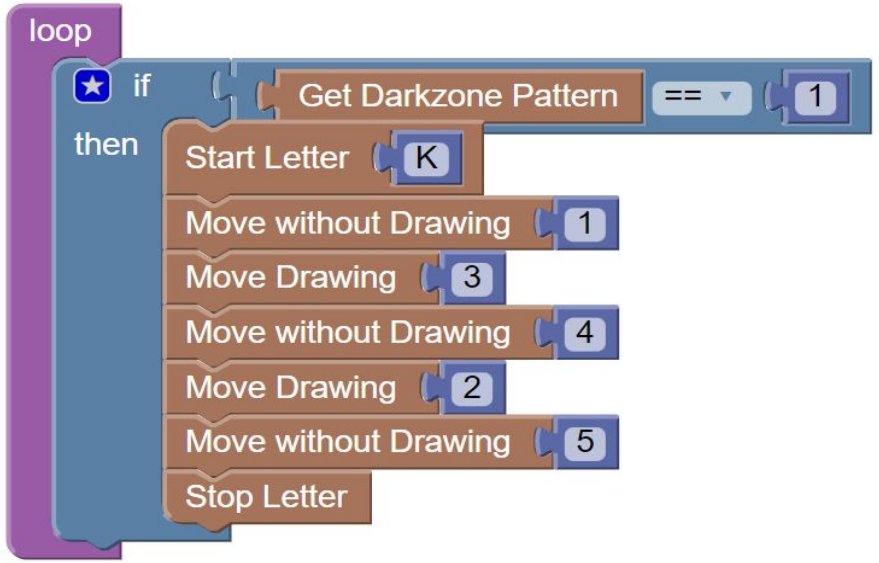
IDE

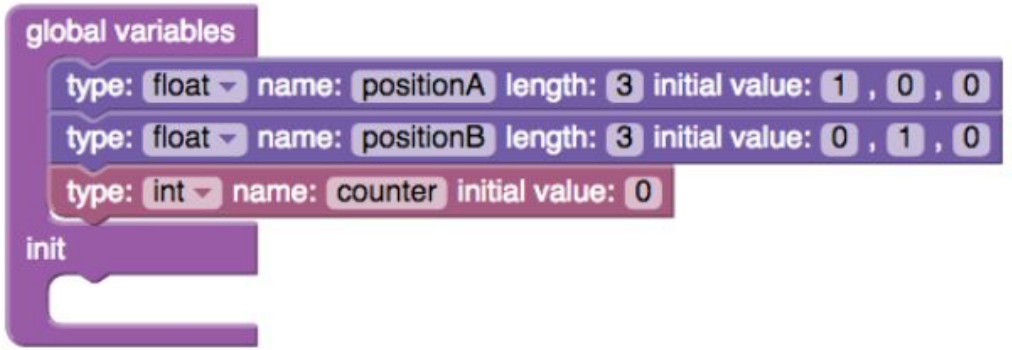



```
1  void loop() {
2    if (game.get_darkzone_pattern() == 1) {
3      game.start_letter(75);
4      game.move_no_draw(1);
5      game.move_draw(3);
6      game.move_no_draw(4);
7      game.move_draw(2);
8      game.move_no_draw(5);
9      game.stop_letter();
10   }
11 }
```

- The IDE or Integrated Development Environment is where the students write their code.
- The students use a graphical interface to code and command the Astrobee.
- As students drag different blocks together on the graphical interface, this code is translated to C++

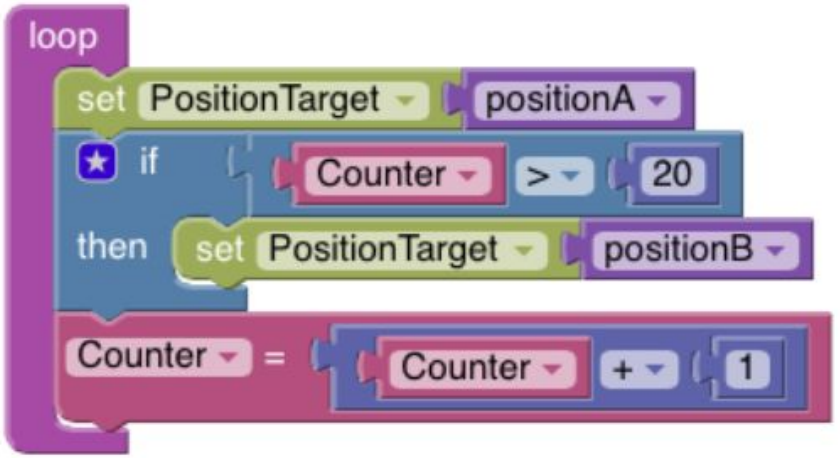
Block Coding Example

Init page:



EASY WAY!

Main page:



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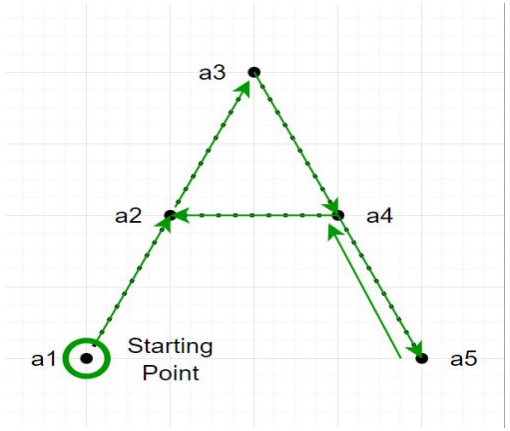
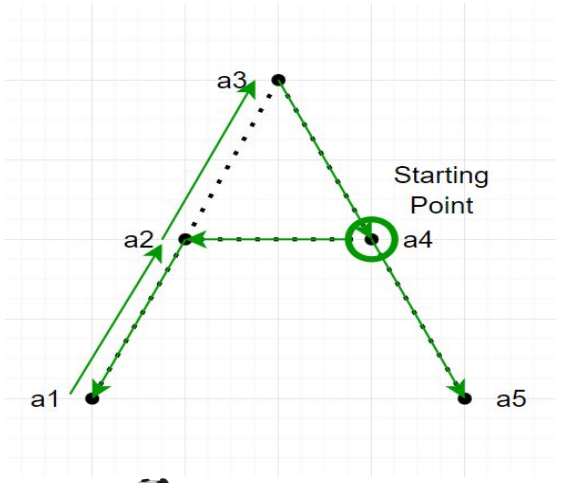
Game Functions





Function	Description
start_letter(char letter);	Indicate the start of a letter drawing sequence.
move_no_draw(point target);	Move to a point while not drawing (lights off)
move_draw(point target);	Move to a point while drawing (lights on)
stop_letter();	Indicate the end of a letter drawing sequence.
get_score();	Compute the total score from the saved telemetry data.

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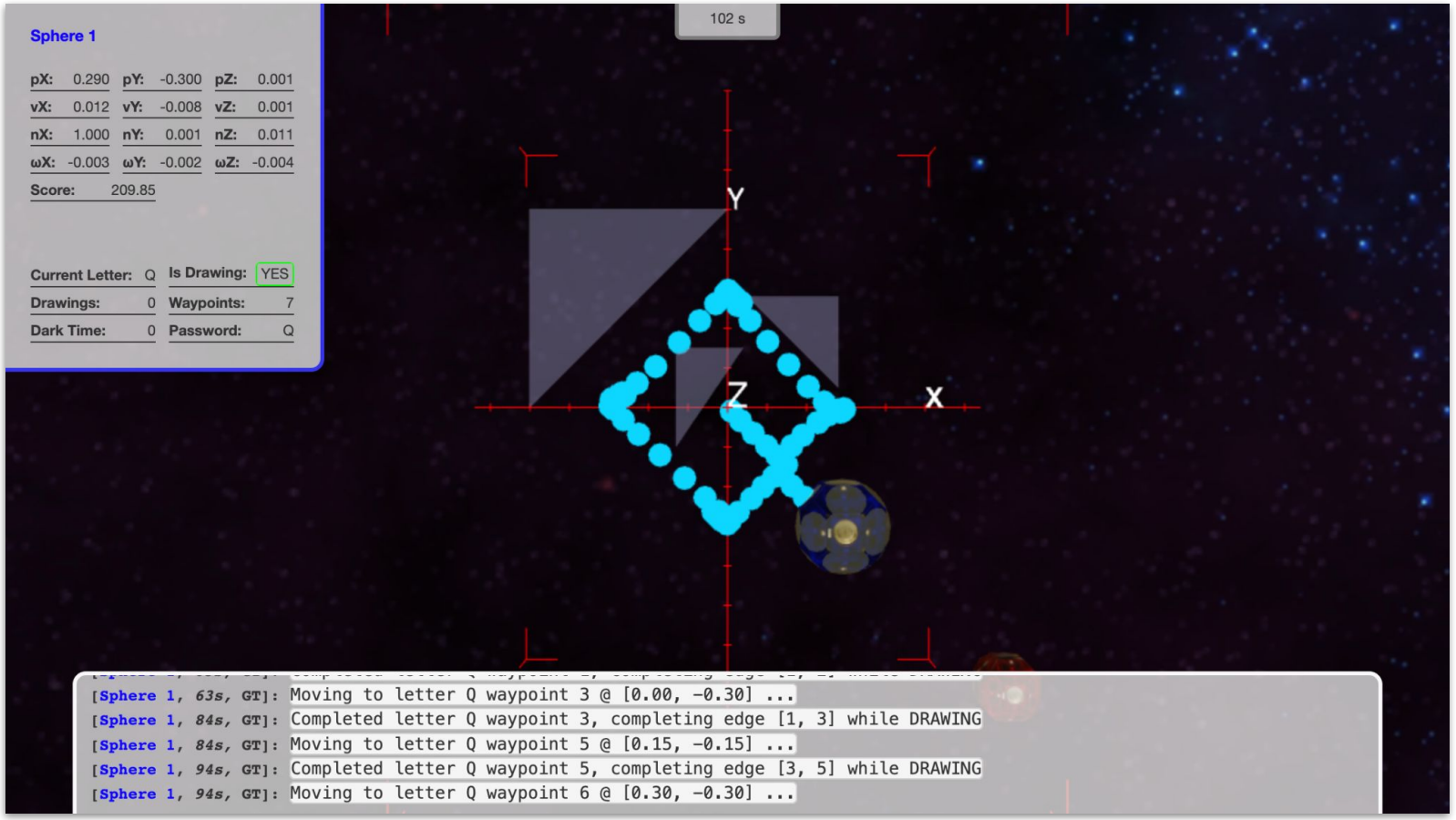
Simulation Software



- The Simulation allowed the students to visualize and test their code

- The dynamics of the simulation are tuned to match the movement of the actual Astrobees.

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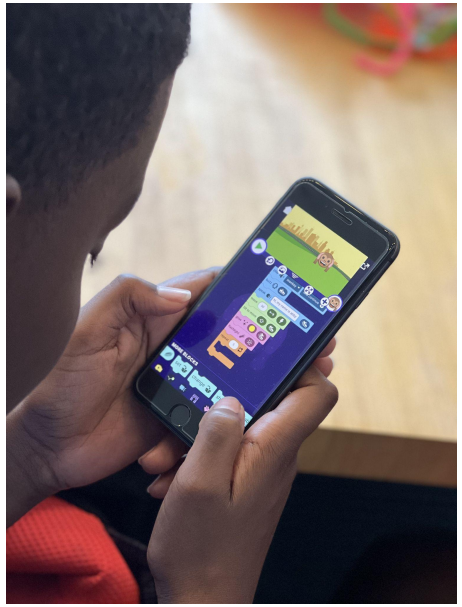
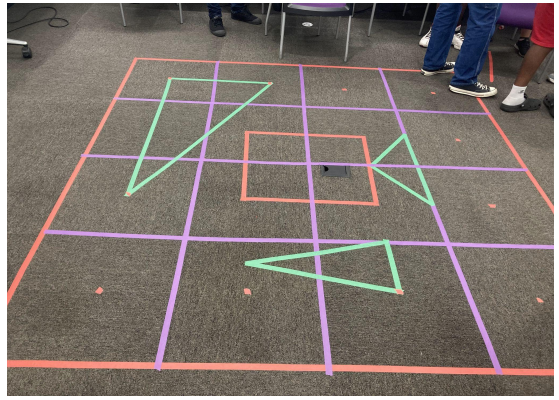
Mentorship (Field Day)





Final Competition

- The Final competition was live streamed from the ISS

- We hosted students from the local area and in various states in the Media Lab

- We were able to successfully run each of the students code aboard the ISS and declare a winner.

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Takeaways

Coding

Troubleshooting

Strategizing

What are some of the big takeaways from the competition?

Acting Out the Game

Working as a team

Refining

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Thanks to the Zero Robotics Team!

- Danielle Wood, MIT, Principal Investigator
- Yiyun Zhang, MIT Grad Students
- Scott Dorrington, MIT Postdoc
- Mauricio Martinez-Elizondo, MSRP
- Darius Nguepi, Vaibhavi James, UROP
- Innovation Learning Center
- Mizanul Chowdury, Technical Expert
- Alvar Saenz-Otero, MIT ZR Co-Founder and Technical Expert
- Many other collaborators, educators and supporters

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THANK YOU