NASA Artemis Student Challenge Opportunities

LEAPFROG

Software Challenge Informational Session #4 for Competition Teams

FINAL WEBINAR: COMPETITION STARTS MAY 24th!

Student Team

UC San Diego

USC University of Southern California

Berkeley
UNIVERSITY OF CALIFORNIA

Faculty Team

John Kosmatka (PI)
University of California, San Diego

David Barnhart (Co-PI)
University of Southern California

Dan Zevin
University of California Berkeley

May 21st, 2021

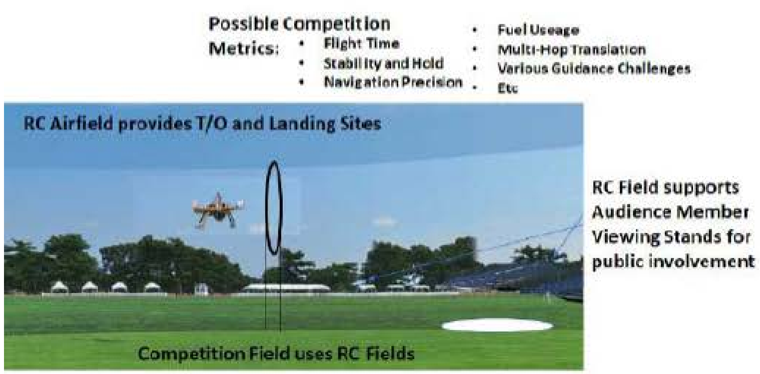
Reminder:

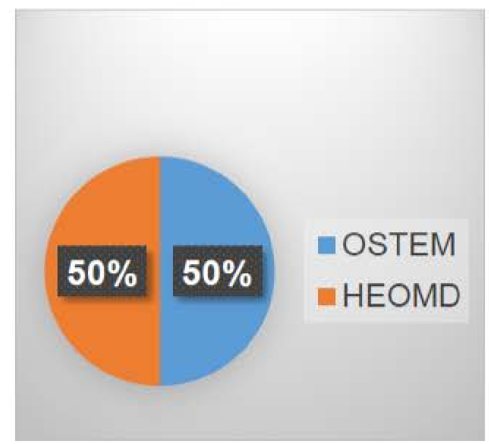
LEAPFROG is 1 of 3 Theme-3 2020 Awards

THEME 3 AWARDS – PILOT ARTEMIS STUDENT CHALLENGES

- Lunar/Martian Lander skills competition using existing technology to execute the competition in Earth's gravity and atmosphere
- Develops Artemis-relevant systems engineering and integration skills, and requires innovations to perform well against the other teams
- Requires the development and evolution of critical thinking and hands-on skill sets to enable humankind's next great steps off of Earth

CALIFORNIA





Artemis LEAPFROG Project Goals

National Aeronautics and Space Administration

- Update existing USC LEAPFROG lander prototype
- Develop competitions around the Lunar Lander prototype
- Run Competitions in Summer of 2021!

LEAPFROG Operations Center: Up to 500 meter range

Possible Competition Metrics:
- Flight Time
- Stability and Hold
- Navigation Precision
- Fuel Useage
- Multi-Hop Translation
- Various Guidance Challenges
- Etc

Wireless signal booster

Laptop Control

RC Field supports Audience Member Viewing Stands for public involvement

RC Airplane Pits: LEAPFROG Fueling and Pre-Flight C/O

LEAPFROG Sets up PostFlight Assessment and Scoring

Run a national competition in 2021!

Updated Timeline

Activities	Start Date	End Date
Announce S/W Competition	3/4/21	3/5/21
Run Signups for all potential Teams	3/5/21	5/7/21
Run PX4 and Simulation Webinars	3/28/21	5/12/21
Finalize Teams, Notify Acceptance	**5/12/21**	**5/17/21**
Seminar #1	***S/W Tools***	***4/7/2021***
Seminar #2	***Running the Sim***	***4/30/2021***
Seminar #3	***Modifying Sim***	***5/12/2021***
Seminar #4	***Competition Metrics***	***5/21/2021***
Run Software Challenge (4 Weeks)	**5/24/21**	**6/18/21**
Finalize and Contact Winners	**6/21/21**	6/30/21
Ship out LEAPFROG Vehicle Kits	7/1/21	7/15/21
Run Vehicle Building Bootcamps & Run Exhibition Flights	**7/28/21**	**8/11/21**
Submit Final Report to NASA	8/5/21	8/31/21

Update on Initial Team’s (as of 4/30/2021)

Current Teams identified in our Registration Site:

Idaho State University
Purdue University
New Mexico Tech
City College of San Francisco
New Mexico Highlands University
California State Polytechnic University, Pomona
University of Illinois Urbana-Champaign
UC Berkeley
University of West Florida
Arizona State University
University of Texas at Austin
Texas A&M University
New Mexico State University

Notes:

- **Only US universities or institutions can sign up for possible Lander Kits**
- **International participation is possible as part of a USC team**
- **Every Team MUST have a Faculty Mentor signed up**

Software Competition Challenge and Exhibition Flights

~ *March to June 2021*

~ *June to August 2021*

Virtual Software Challenge

Crater Landing

Goal: Locate & land in center of designated crater

Obstacle Avoidance

Goal: Identify & maneuver past potential hazards

- Virtual S/W Challenge run remotely
- Skills enable transfer between Simulation and Flight
    - Waypoint navigation, control methodology, obstacle avoidance
- Two Challenges earn Points, highest point earner wins
- Top 6 teams will advance to Hardware Kit Build and Top 3 for Flight Exhibition
- Possible that more kits may be available to competition teams (US only)

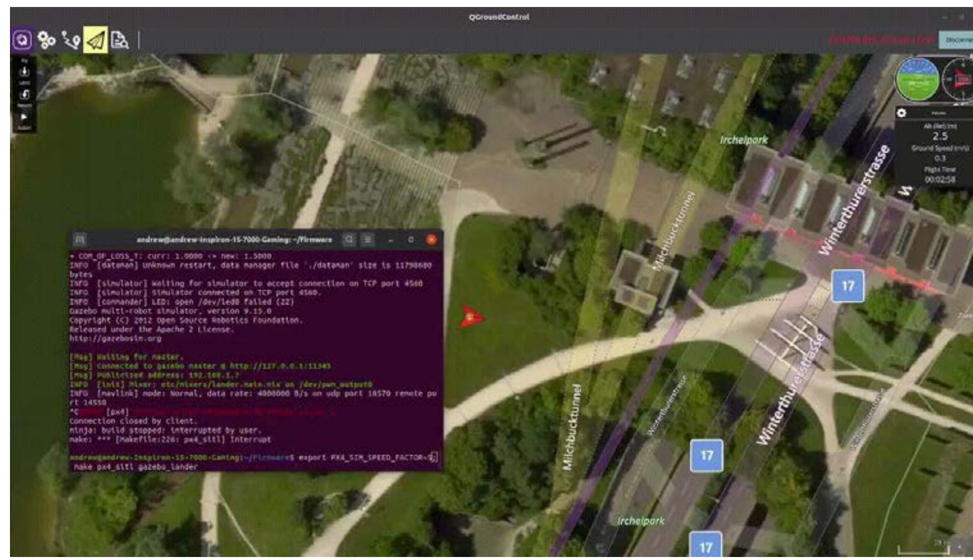
Kit Boot Camp and Flight Exhibition

Goal: Enable teams from S/W challenge to build full kit (without Engine), and run Exhibition Flights with Winning S/W

- Teams from S/W Challenge (first 6 at minimum) will receive full hardware "Kit"
- Boot Camp will be run during summer to help all teams "Build" their Lunar Lander Vehicle
- Exhibition Flights will be run in CA for the Top three Teams in the S/W challenge

Software Challenge uses PixHawk Simulation Software

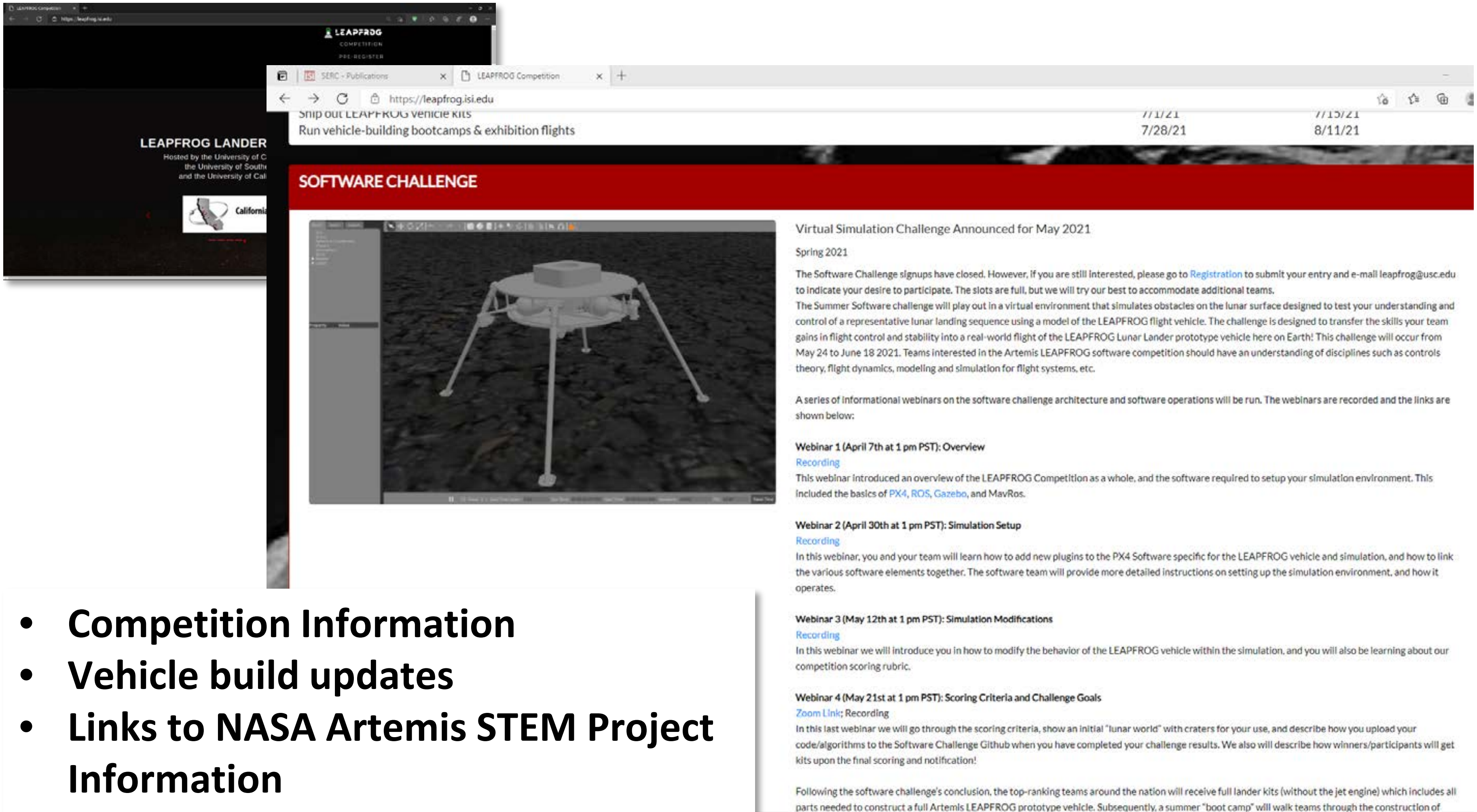
- Basic simulation with plant model of LEAPFROG components created
- Generic Earth centric physics model applied, uses Gazebo for visualization
- PixHawk controller algorithms integrated with open source tools into simulation
- Scenario provided to mimic dimensions and geography of competition RC Field



- *The bridge between the Software and Flight Challenge is the PIXHAWK CONTROLLER*

Where to get more Information?

- **"LEAPFROG.ISI.EDU"**



- **Competition Information**
- **Vehicle build updates**
- **Links to NASA Artemis STEM Project Information**
- **Information about the LEAPFROG Team members**

Whom to Contact

- **Fill out registration on Website (leapfrog.isi.edu)**

- **Information E-mail: leapfrog@usc.edu**

- Technical and Competition Contact:
  - Prof David Barnhart, Barnhart@isi.edu

- Programmatic Contact:
  - Prof John Kosmatka, jkosmatka@ucsd.edu

CHALLENGE START, SCORING CRITERIA, HOW TO TRANSFER YOUR CODE, HOW TO GET QUESTIONS ANSWERED

CHALLENGE BEGINS 0800 PST MAY 24th!

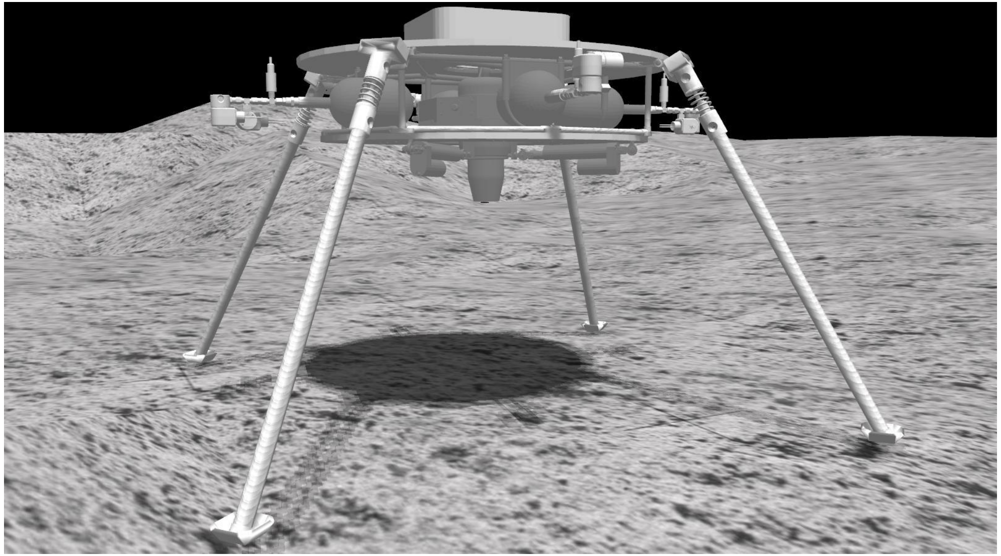
- Challenge Start: Email sent from LEAPFROG@USC.EDU to all Team Leads and Mentors
- YOU MUST ACKNOWLEDGE AND ACCEPT YOU ARE IN THE CHALLENGE by Responding to the Email!!!
  - A response back to you will then confirm you have started and are on your way!
- YOU MUST HAVE A FACULTY/STAFF MENTOR LISTED TO COMPETE! Please add in your initial e-mail!
  - This is required to secure a kit upon completion of the Challenge, as a University or academic representative will have to sign off on its receipt

- Questions during the challenge should be sent to the Discussion Section on the Gitlab (shown below). *ALL ANSWERS WILL BE ABLE TO BE SEEN BY EVERYONE DURING THE CHALLENGE.*

- When you have uploaded your final submission by June 18th, E-MAIL your Confirmation to LEAPFROG@USC.EDU , and a response will indicate to you we have received and will start scoring.
  - *All teams will receive confirmation NLT 30 June 2021*.

LEAPFROG Webinar 4: Competition Scoring and Code Delivery

May 21, 2021



Today's Overview

1. Getting access to code and setting up teams.

2. Scoring criteria for simulation competition.

Create a GitHub Account

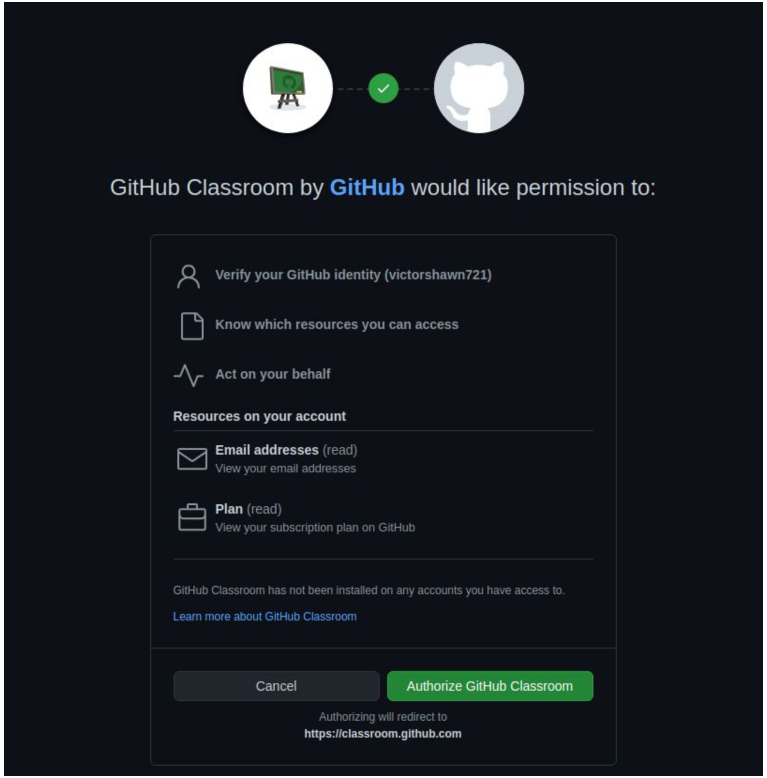
- Goto the following link: https://github.com/join
- Fill the form and create an account.
- For step by step instructions, refer the link below: https://www.wikihow.com/Create-an-Account-on-GitHub

If you already have an account, you can skip this.

Join the classroom

- Join the classroom using the following link: https://classroom.github.com/g/CJGQgGdU

- Authorize GitHub Classroom



Create a new team

SERC-LEAPFROG-Artemis-Challenge

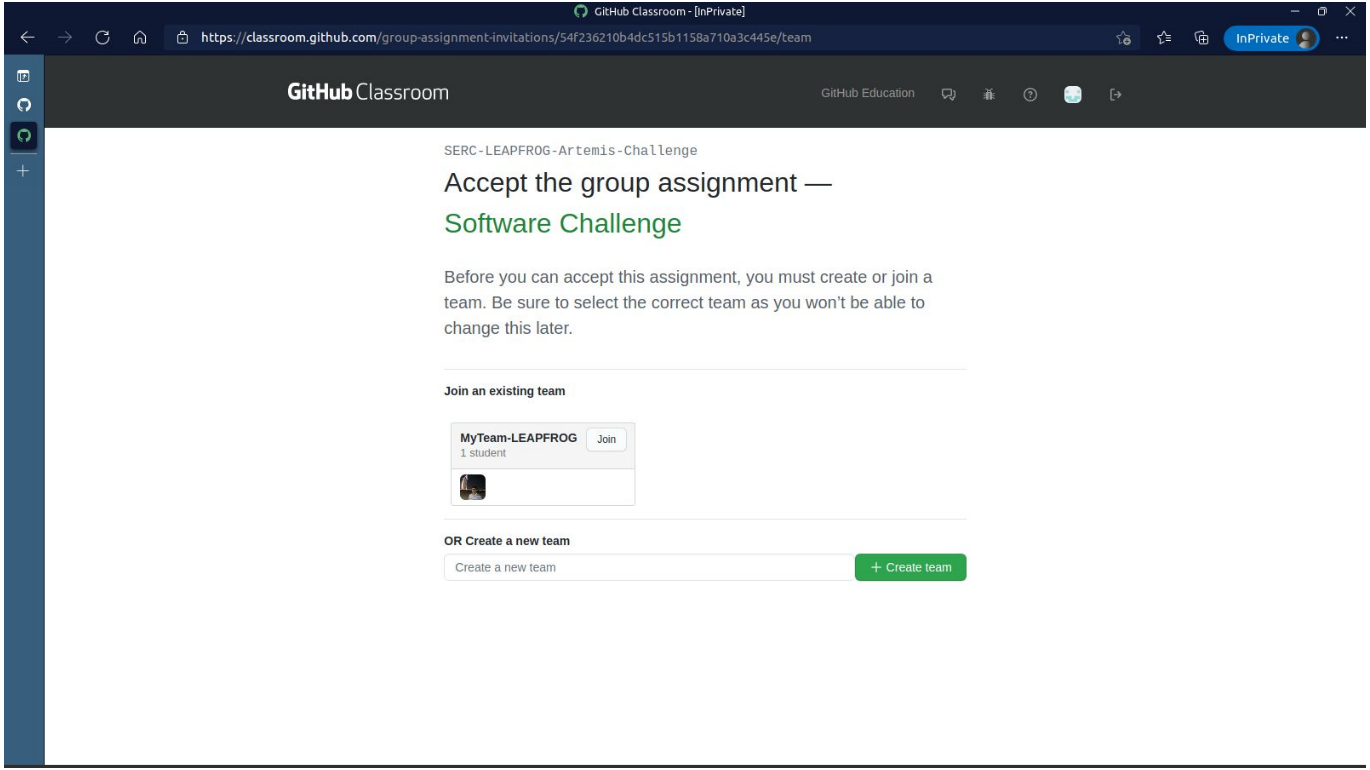
Accept the group assignment — Software Challenge

Before you can accept this assignment, you must create or join a team. Be sure to select the correct team as you won't be able to change this later.

Create a new team

MyTeam-LEAPFROG | + Create team

Join existing team



Accept Assignment

You have successfully created team: MyTeam-LEAPFROG ×

SERC-LEAPFROG-Artemis-Challenge

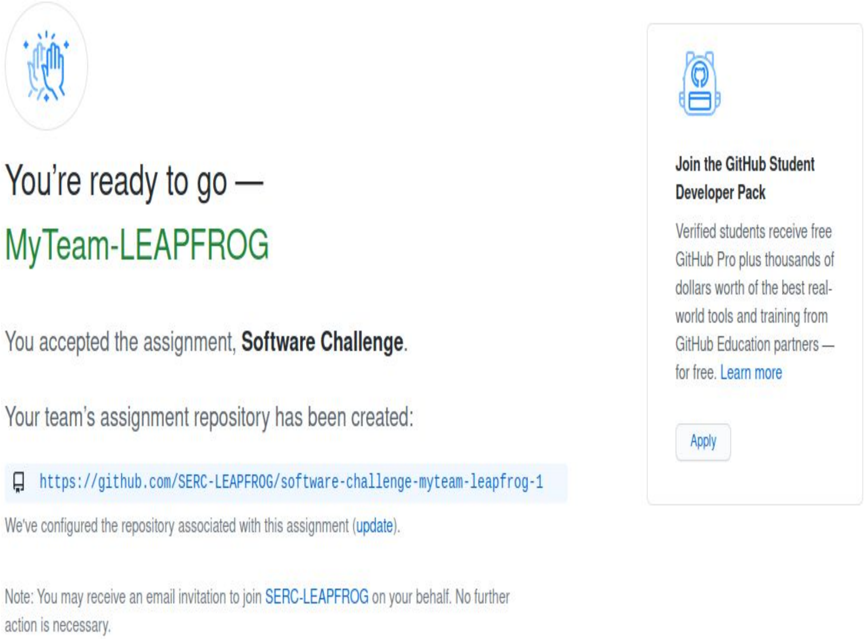
Accept the group assignment — Software Challenge

Accepting this assignment will give your team, **MyTeam-LEAPFROG**, access to the `software-challenge-myteam-leapfrog` repository in the SERC-LEAPFROG organization on GitHub.

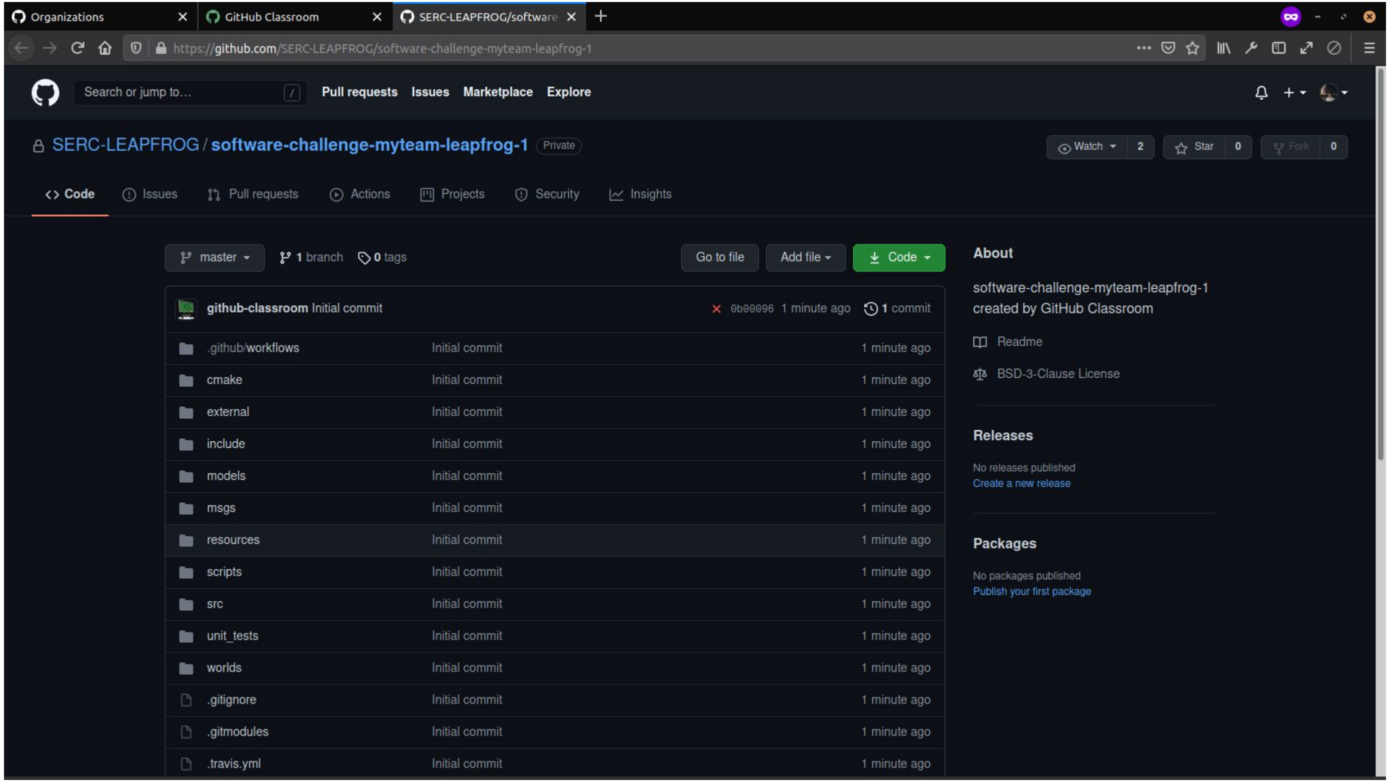
Accept this assignment

Access repository

- If the page on the right does not show up, refresh the page.
- Click on the link, to access the repository.
- GitHub will automatically send a link to join the SERC-LEAPFROG organization. Accept the invitation.



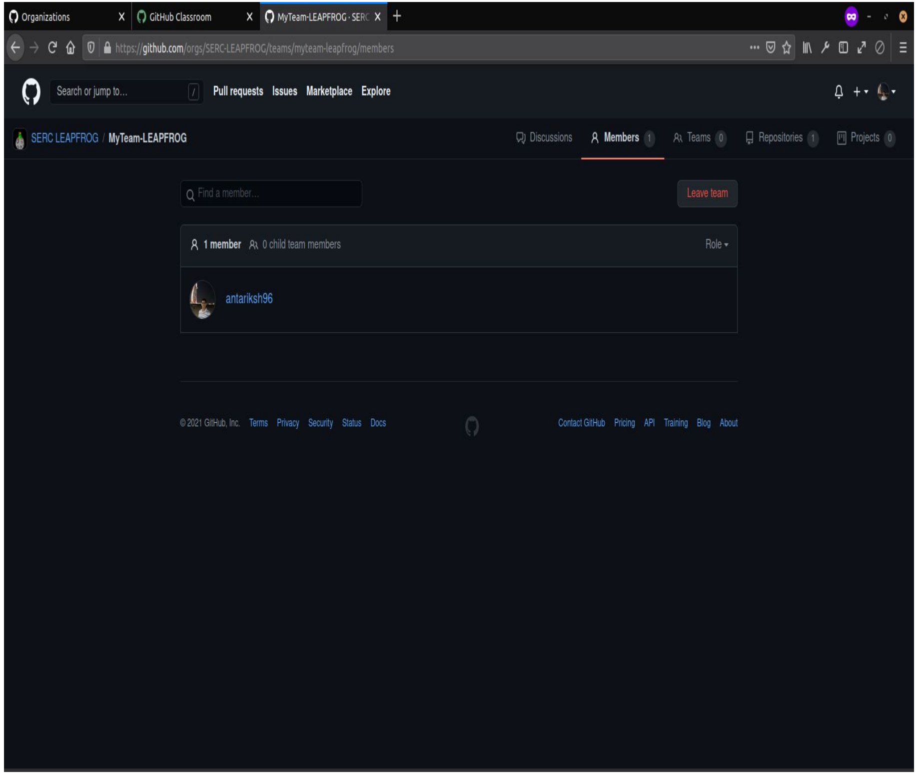
How your repository looks



Manage team members

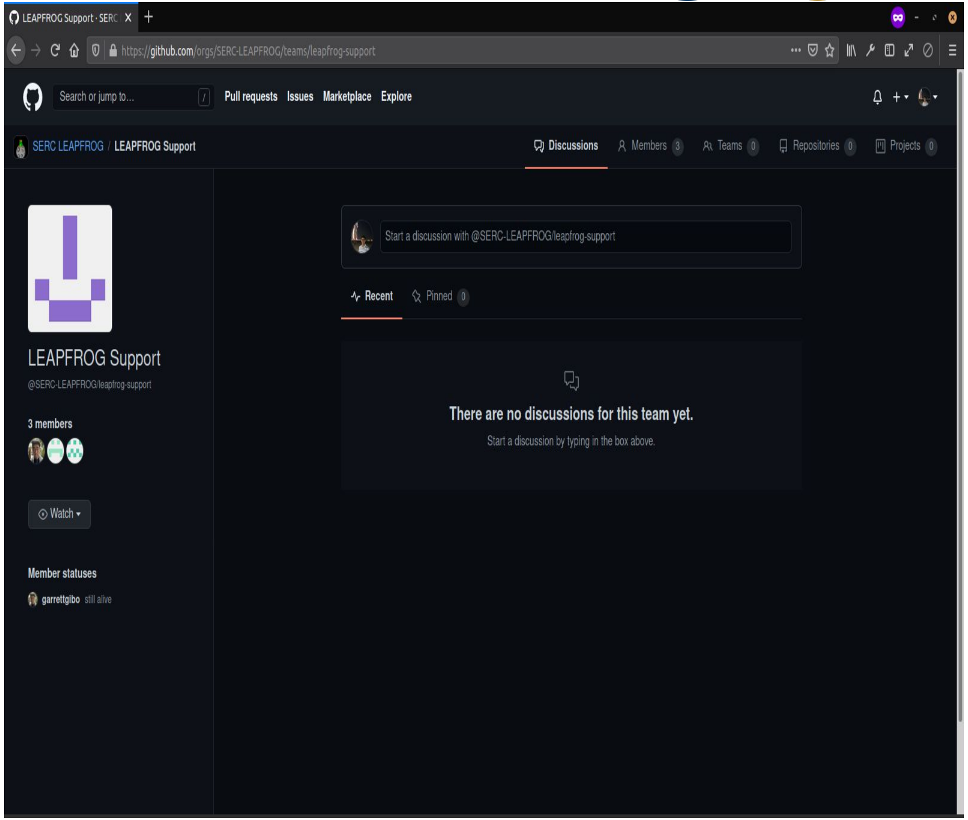
You can manage your members here:

- https://github.com/orgs/SERC-LEAPFROG/teams/
- Then goto **members** tab.



Discussion Forum

- Teams can post their questions and queries on the discussion board.
- https://github.com/orgs/SERC-LEAPFROG/teams/leapfrog-support



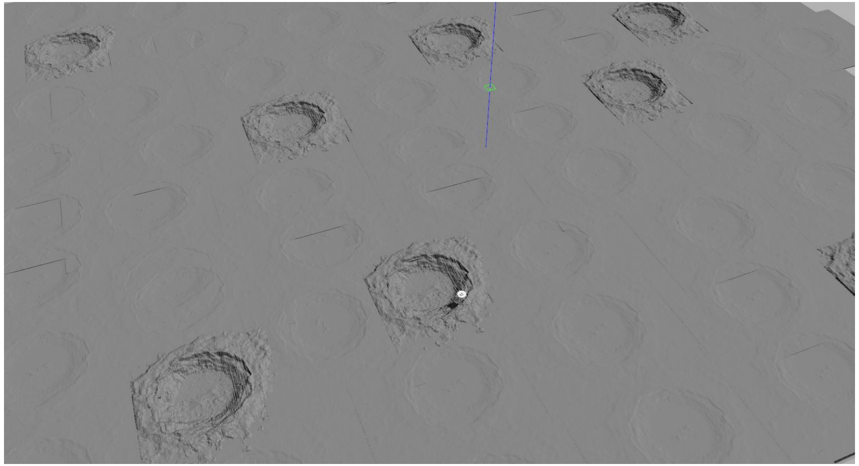
Code of conduct and guidelines

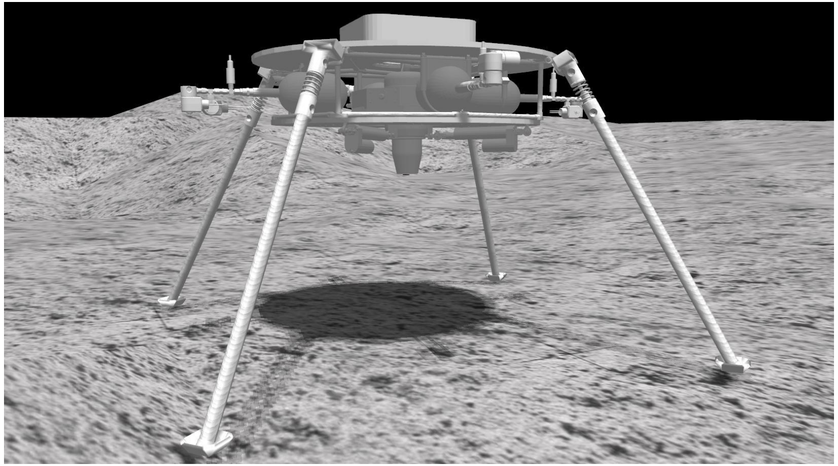
1. Please do not join other teams during the joining process.
2. Once the teams are created, the creator of the team will be made maintainer for the team's repository.
3. The join link will be disabled on May 28th, 2021 11:59 PM PDT.
4. For any queries, please post them in the discussion section. https://github.com/orgs/SERC-LEAPFROG/teams/leapfrog-support

Competition Flow

- Teams will make changes to their code and commit to their repositories.
- Final commit accepted till June 18th, 2021 11:59 PM PDT.
- SCORING:
  a. Scoring will occur from June 21st until June 29th, 2021.
  b. Winners to be announced on June 30th, 2021.
  c. Scoring will be done internal to LEAPFROG team, by downloading the teams final commits, and running the teams code against a new Lunar world.

Competition Overview

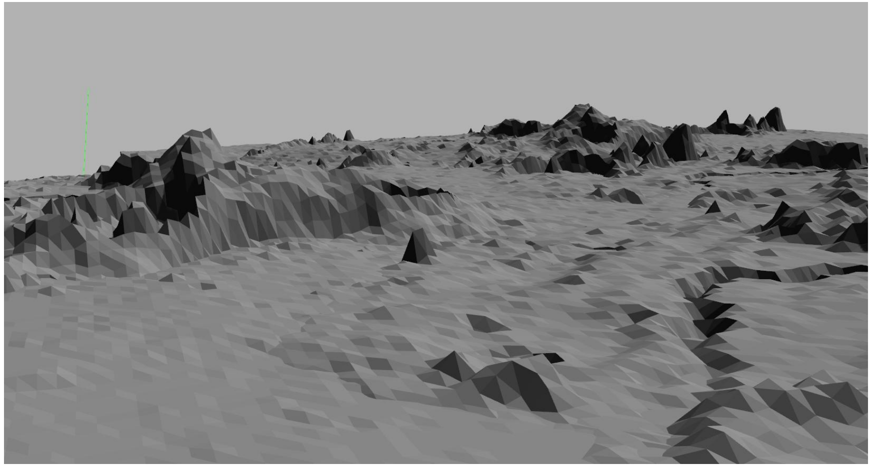




- **Objective:** Navigate and land in a crater while avoiding obstacles and maintaining fuel efficiency

Competition Environment

- Environmental parameters:
  - 4 craters
  - 6 obstacles
    - 0 points for that run if LEAPFROG hits any obstacle



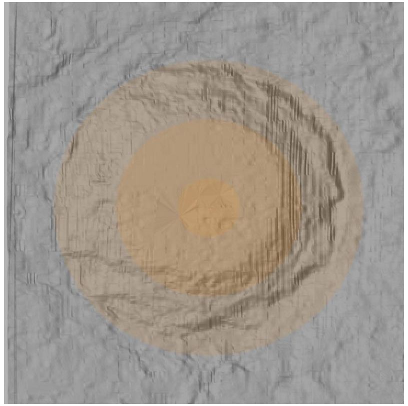
Crater Landing Scoring

Crater Regions:

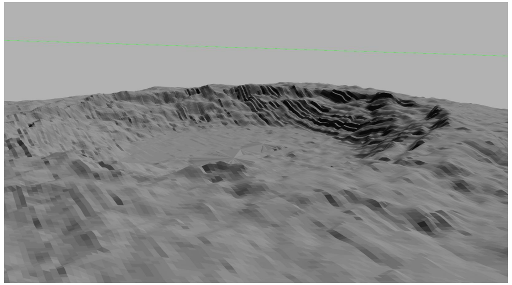
- 3 regions per crater corresponding to their point value
  - Inner (2m) = 20 points
  - Middle (4m) = 10 points
  - Outer (6m) = 5 points

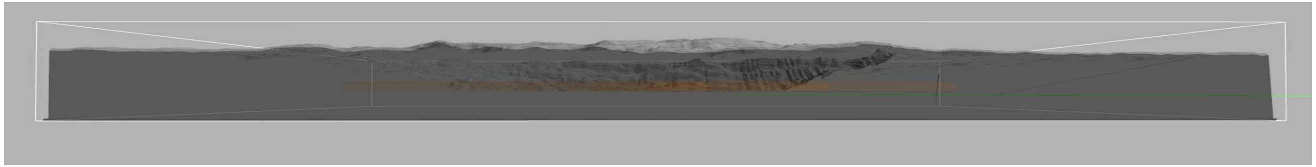
Crater Depths:

- 4 craters with their corresponding point multiplier
  - 1m = 1x
  - 2m = 1.5x
  - 3m = 2x
  - 4m = 2.5x



*Score = crater region * crater depth*





Fuel Consumption Scoring

*score = 50 * (% of fuel left in tank)*

% fuel left is based off the following table:

Consumption rates	Idle (mL/min)	179
	Full Thrust (mL/min)	980
Initial amount of fuel (kg)		4

- Idle occurs when setThrust <= 0.2*maxThrust
- Full Thrust occurs when setThrust > 0.2*maxThrust

Penalties

- Exceeding maximum altitude: -0.5 points / sec
  - Maximum altitude: 10 m
- Exceeding maximum landing speed: -20 points
  - Vertical velocity: 3.9624 m/s
  - Horizontal velocity: 0.9144 m/s
- Colliding with obstacle: 0 points for the entire run