BENDER AUTONOMOUS ROBOTIC SYSTEMS

PREPARING STUDENTS FOR INDUSTRY THROUGH PRACTICAL APPLICATION

ABOUT THE TEAM

The Bender Autonomous Robotics Systems (ARS) Team is a cross-disciplinary VIP (Vertically Integrated Project) class & team at Boise State University competing in the annual NASA Lunabotics Challenge.

Our mission is to teach students how to design, build, and operate an autonomous robot capable of mining and transporting simulated lunar regolith.

2019

Year Class/Team Started

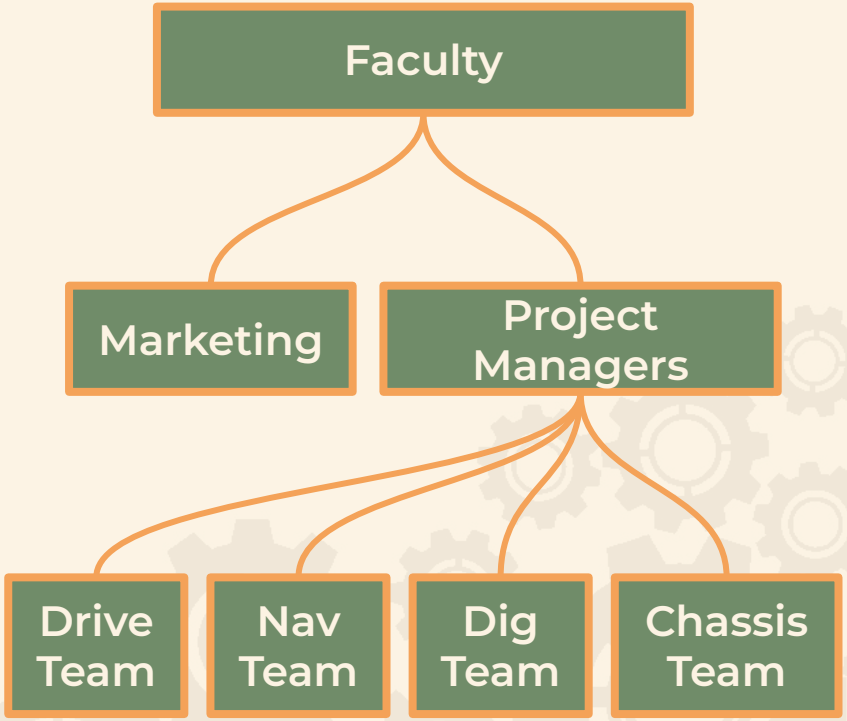
30

Number of Students (2024-2025)

15

Number of New Students (2024-2025)

TEAM STRUCTURE

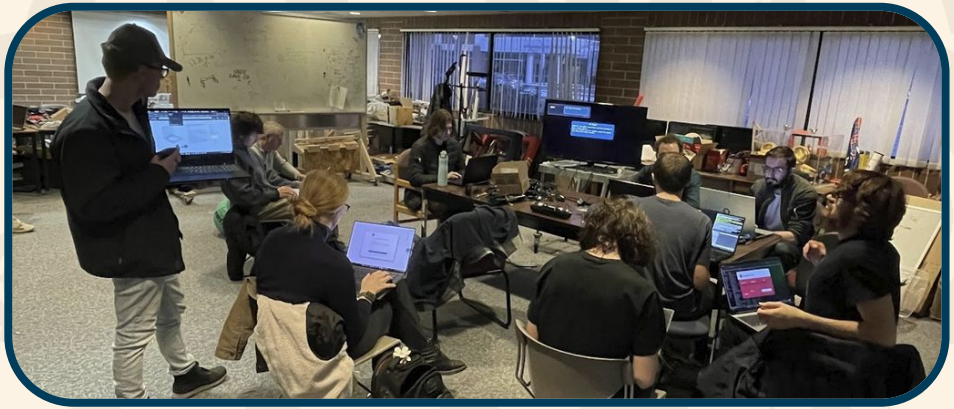


The Team is structured like a real engineering company, with:

- Students leading as project managers
- Subsystem leads
- Marketing coordinators

Faculty act as advisors, while students drive all design, testing, and coordination efforts.

This simulates real-world experience in technical development, team collaboration, and project leadership.

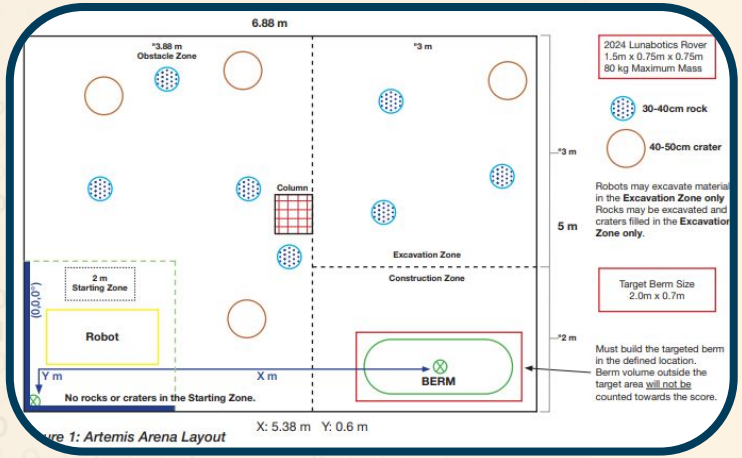


NASA LUNABOTICS

- Annual NASA-hosted robotics competition simulating lunar excavation. 2024-2025 was the first year that the Bender team competed.

- The goal is to design, build, and operate a robot to autonomously mine and transport regolith

- The competition is held at the Kennedy Space Center in Florida after the Spring Semester



ure 1: Artemis Arena Layout

1st	1st	16th
Idaho Team	*NOVA Award*	*Overall Place*

2024-2025 Results

OUTREACH & ACHIEVEMENTS

1st

NOVA Award 2025 Lunabotics Competition

250

Students Reached (K-12 Outreach)

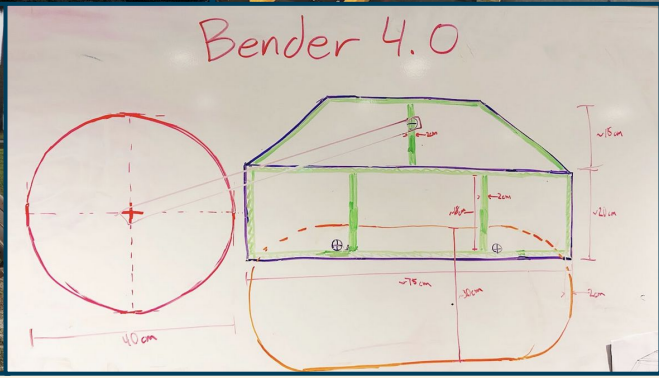
75%

Retention Rate (Fall 2024 - Spring 2025)

33%

Increase in students (2023-2024)

BENDER



The **Bender Robotics Team** exists to give students the **opportunity to experience the full lifecycle of engineering a complex system**, just **like a professional company**. From concept to prototype, testing to delivery, and outreach to impact, we empower students to take ownership of real responsibilities across design, leadership, operations, and innovation.

Our goal is to cultivate the next generation of curious, confident, and capable engineers, project managers, technical marketers, leaders, and visionaries, all while tackling one of the most ambitious challenges in student robotics.

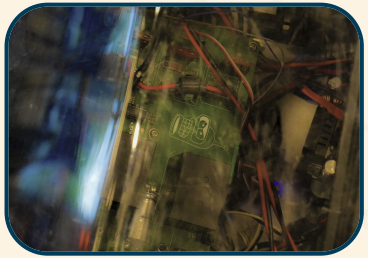
SUB-TEAM BREAKDOWN

The Bender Robotics Team is divided into four core subteams, each focused on a critical aspect of the robot's functionality. These subteams operate semi-independently under project management but collaborate frequently to ensure seamless system integration.

Nav

Ensure obstacle detection and real-time route adjustments

Integrate LiDAR, stereo cameras, IMUs, and beacon tracking



Dig

Engineer the excavation and material handling system

Ensure reliable actuation and mechanical

Drivetrain

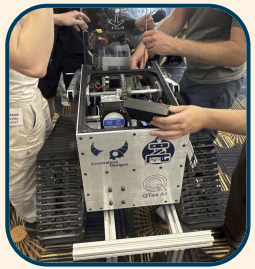
Design and build the vehicle's mobility system

Integrate motor controllers and power systems

Chassis

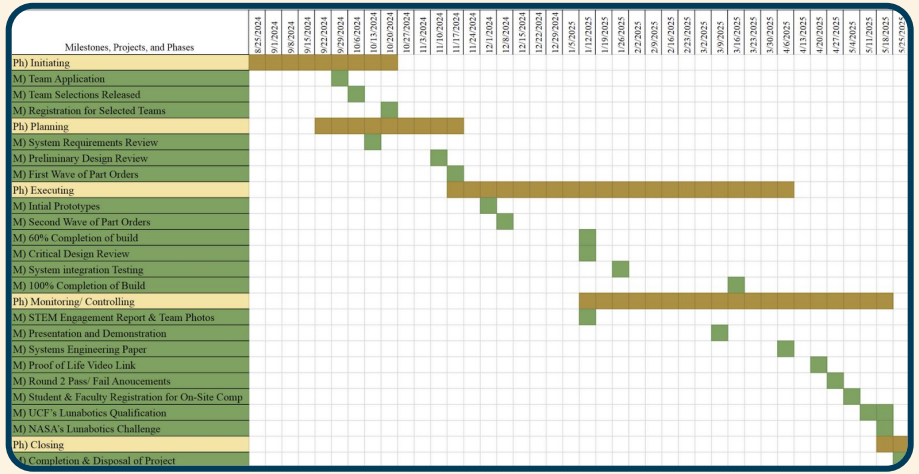
Design the structural frame to support all subsystems

Ensure ease of assembly and maintenance



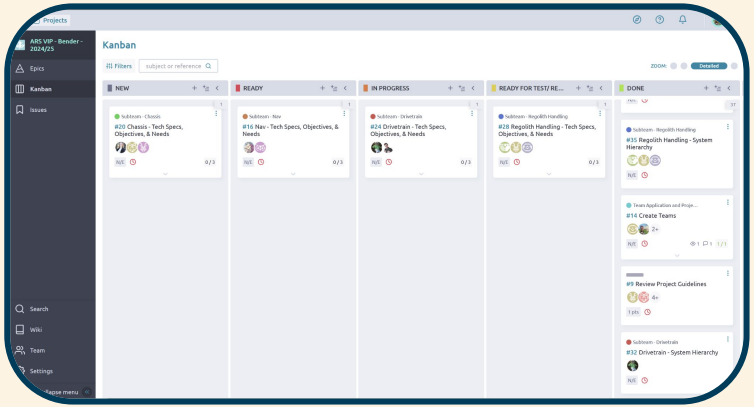
PROJECT MANAGEMENT

Our project managers coordinate all technical and non-technical aspects of the team, ensuring that deadlines are met, subsystems stay aligned, and every team member has the support they need to succeed. They bridge communication between faculty, advisors, sponsors, and student teams.



Key Responsibilities:

- Oversee timelines, goals, and deliverables across all subteams
- Run weekly milestone reviews
- Coordinate design reviews (SRR, PDR, CDR, Demo)
- Manage risks, testing schedules, and internal documentation
- Maintain communication with faculty advisors and NASA competition officials



TECHNICAL MARKETING

The Technical Marketing team ensures that the innovation happening within Bender Robotics is clearly communicated to the public, sponsors, and BSU community. This subteam blends engineering understanding with storytelling, design, and outreach, offering a unique opportunity for students interested in technical communication, media, or branding.

Key Responsibilities:

- Maintain brand identity across shirts, robot decals, and online presence
- Produce photos, videos, and graphics to showcase progress and team culture
- Manage social media, website updates, and newsletters
- Lead community outreach events

Technical Marketing bridges the gap between engineering and the outside world. It gives students a chance to develop portfolios in communication, design, and campaign strategy, while helping the team secure funding, grow visibility, and celebrate its work.

KEY STATS

66kg

Weight
(145 lbs)

30.3

Power
Consumption
(W/hr)

60/60

Dust Tolerance
Score

71W
155L
63H

Final Robot
Dimensions
(mm)

STUDENT TESTIMONIALS

Brady Ward
Computer Science

Everyone here has been very nice and supportive. Having someone's guidance on how to start learning about the robots nav was immensely helpful

Hunter Gregory
Mechanical Engr.

This team provided an opportunity like no other to work in a semi-professional setting on autonomous robotics at BSU. It encompassed all major aspects, including electrical, mechanical, and software related portions, as well as a large focus on proper team dynamics and systems engineering...

Ethan Varao
EngineeringPlus

It was fun learning experience! I enjoyed expanding my skillset and learning to work with other aspiring professionals!

ALUMNI TESTIMONIALS & IMPACT

Nardos Ashenafi, PhD
Robotics Software Engineer
Bastian Solutions

"The first summer after working on the Bender project, I had the opportunity to get interviewed at a robotics start up company. For most of the technical skills they asked of me, I was able to reference a time when I solved a similar problem in Bender. In the end, I found out that the company actually sponsored the IGVC competition, where Bender was one of the competitors. It's safe to say, Bender tipped the scale in my favor"

Chris Dagher
CEO
QTex AI Inc.

"Being a project manager on the Bender Team was an incredible experience. I loved mentoring students on PCB design and contributing to full system reviews. Programs like this are vital for preparing students to tackle real-world engineering challenges and make them more competitive as they enter the industry or launch their own startups"

Wankun Sirichotiyakul, Phd
Robotics Software Engineer
Bastian Solutions

"The practical knowledge I gained from the Bender project laid a strong foundation for my professional growth and significantly contributed to my development as a robotics engineer. It equipped me with essential hands-on skills for integrating hardware and software components within a robotic system. This experience enabled me to complete one of my internship projects ahead of schedule, leaving a positive impression on my fellow engineers and ultimately leading to a job offer from the team."

BENEFITS TO STUDENTS

Real-World Skills Beyond the Classroom

Teamwork & Communication

Lead meetings, manage people, **make critical decisions** under pressure

Drive a real, high-stakes project from **concept to completion**

Systems Thinking

Gain **resume-building experience** that mirrors engineering companies and **NASA workflows**

Career-Ready Advantages

Practice with **industry tools**

Build a **portfolio** of tangible work

Develop **confidence presenting** in high-stakes environments

Network with faculty, alumni, industry advisors, and NASA professionals

Personal Growth

Learn **time management** and accountability in a high-expectation setting

Contribute to **meaningful outreach** and inspire younger students

Be **part of a community** that encourages curiosity, creativity, and collaboration

HOW TO JOIN

There are two different ways for students to join the Bender Autonomous Robotic Systems VIP Class

1

Register for the Class

The Bender ARS VIP is offered at the 200, 400, and 500 Level to students from all departments (Please check with your advisor to make sure the credits will count towards your degree).

2

Join as a “Club”

While the Bender ARS VIP class is not an official club with the University, you can still be a part of the project in a “club” like capacity if you don’t have the space in your credit load to join the class as a registered student.

THANK YOU

Ready to start learning about robotics? Join the Team, no experience required!

Steve Swanson

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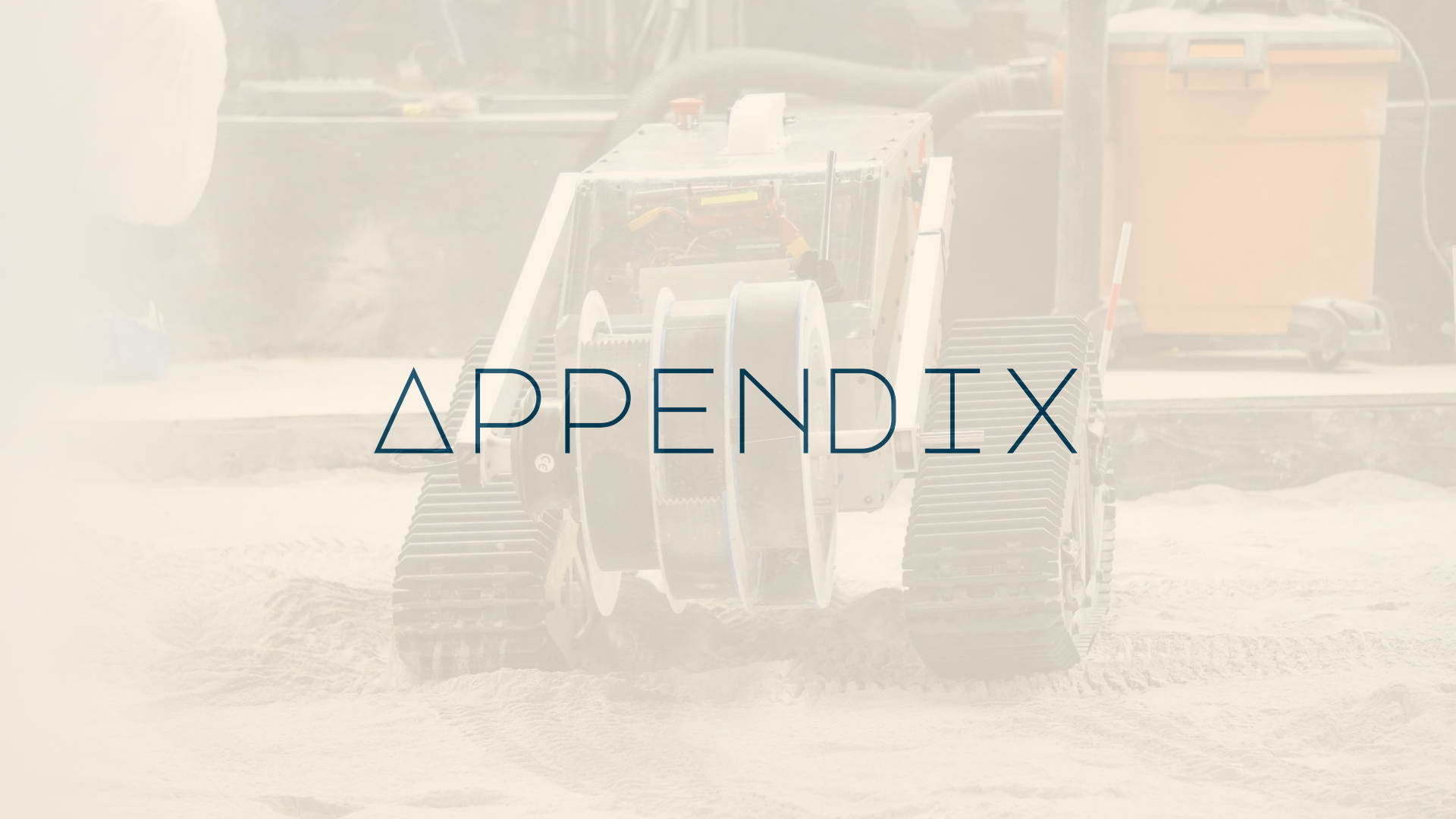

APPENDIX

PROJECT MANAGEMENT & SYSTEMS ENGR.

Hands-On Leadership Experience

Lead real interdisciplinary teams in a fast-paced, evolving environment

Coordinate across mechanical, electrical, software, and marketing subteams

Own deliverables, schedules, **risk management**, and **design review planning**

Systems Thinking in Practice

Manage **integration of subsystems** into one cohesive robotic platform

Practice trade studies, **requirement tracking**, and design iteration cycles

Learn to **balance technical constraints**, team capabilities, and mission goals

Real-World Engineering Lifecycle

Run **full project lifecycle**: SRR → PDR → CDR → Testing → Demo

Use tools like **Gantt charts**, documentation systems, and **review checklists**

Collaborate with advisors, NASA officials, and external reviewers

Career & Academic Advantages

Gain **experience parallel to entry-level** systems engineering or PM roles

Build a **leadership portfolio** that stands out for jobs or grad school

Develop **communication skills** for both technical and non-technical audiences

ELECTRICAL ENGINEERS

Real-World Circuit Design & Integration

Design and test PCBs for motor control, power distribution, and sensing

Work with **high-current systems**, sensor interfaces, and **embedded devices**

Develop **skills in schematics, board layout, and debugging** under real constraints

Embedded Systems & Firmware Development

Program microcontrollers (Teensy, Arduino, STM32) for robot control

Integrate sensors (IMUs, encoders, LiDAR) with **real-time data processing**

Implement **safety systems**, communications protocols (UART, I2C, SPI), and **power management**

Hands-On Hardware Experience

Build and test circuits in real environments, not just simulations

Learn how to **wire, route, and debug systems** on an active vehicle

Collaborate directly with mechanical and software teams for **full system integration**

Career Advantages

Apply classroom theory to **real robotics systems**

Gain experience with tools like **KiCad**, **oscilloscopes**, **logic analyzers**

Build a **portfolio of boards**, firmware, and engineering reports

MECHANICAL ENGINEERS

Full Mechanical Design Experience

Design structural components, drivetrain assemblies, and digging systems

Use CAD software (e.g., SolidWorks, Fusion 360) for **complex part and system modeling**

Perform **stress analysis**, tolerance checks, and mechanical integration

Fabrication & Prototyping

Hands-on experience with **machining, 3D printing, and composite fabrication**

Build and test physical systems under real-world conditions

Learn **rapid iteration** and problem-solving through field testing

System-Level Thinking

Design for **integration with electrical systems, software constraints**, and **user access**

Work on dynamic systems like tracked drivetrains and **moving mechanical linkages**

Contribute to **trade studies** and **mechanical feasibility assessments**

Career Advantages

Apply classroom mechanics, materials, and dynamics to functional robotic systems

Build a portfolio of real, tested designs used in NASA-aligned competition

Gain teamwork, communication, and **project ownership experience**

COMPUTER SCIENCE

Real-World Software Development

Write **code for autonomous navigation**, sensor fusion, and path planning

Develop, test, and **deploy software on embedded systems** (e.g., Teensy, Raspberry Pi, Jetson)

Work with robotics framework (ROS), control algorithms, and **simulation environments**

Technical Tools & Languages

Gain **experience in C++, Python, ROS, Git, and hardware-level programming**

Use tools like **SLAM**, **PID control**, and **state machines** in an applied context

Work with **version control**, **testing frameworks**, and modular codebases

Systems & Integration Skills

Interface with hardware through I/O protocols (UART, I2C, SPI, CAN)

Build and **optimize real-time systems** for performance and reliability

Collaborate with electrical and mechanical teams to ensure seamless robot control

Career Advantages

Build a **robotics portfolio** with **demonstrable system contributions**

Develop **skills in embedded systems**, autonomous vehicles, and real-time software

Gain **experience in collaborative engineering** environments that mirror industry

TECHNICAL MARKETING

Creative Communication in a Technical World

Translate complex engineering work into engaging visuals, videos, and stories

Build public-facing materials: presentations, social media content, sponsor reports

Learn to communicate clearly with engineers, advisors, and public audiences

Real Campaigns, Real Impact

Plan and launch fundraising and outreach **campaigns** (e.g., Bronco Giving Day)

Design branding materials (shirts, logos, banners, robot decals)

Manage and **grow the team's online presence** (Instagram, LinkedIn, YouTube)

AI-Driven Marketing & Automation

Learn to **use AI tools for content creation**, captioning, video editing, and strategy

Set up AI-driven automations for outreach emails, social posting, and design workflows

Gain exposure to platforms like **ChatGPT**, **Zapier**, **N8N**, and more

Professional Skill Building

Build experience in technical writing, brand strategy, and stakeholder outreach

Create a portfolio of real work tied to measurable goals and audience impact

Prepare for **careers in tech marketing**, **product management**, and **creative direction**