

COEN 5830, Fall 2024

Introduction to Robotics

Lecture 1

Introduction and Overview

Leopold Beuken (leopold.Beuken@Colorado.edu)

Tuesday, 8/27/2024

About the Lecturer

- Dr. Leopold (Leo) Beuken
- Completed PhD at CU Boulder
- Research on **bio-inspired sensing** and sensory processing
- Originally from **South Africa**
- Can find me trying to **catch trout** in a stream or on a **golf course** when I'm not prepping your lectures.
- **Super excited about the new robotics program!**



About Me:

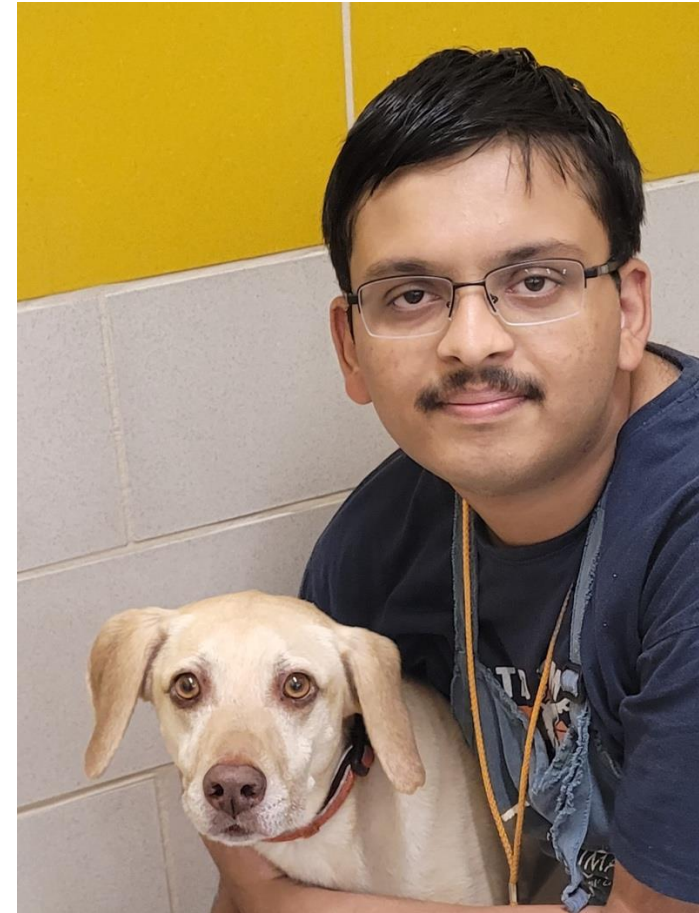


Srikrishna Bangalore Raghu

2nd year PhD student in Computer Science

**Research Interests: Motion Planning,
Expressive Robotics, Non-Prehensile
Manipulation**

**Hobbies: Dancing, Volunteering, Video
Games**



Talk to your neighbor!



Where do you come from?

What do you like to do for fun?

What other courses are you taking?

- One of my **missions** in the first year is to create a **strong robotics student community**.
- **Community** and **belonging** is **essential** in a small, new program!
- Shameless plug for Robotics Seminar course. 1 unit can be repeated up to three times.

Contact Information



Leo Beuken

Leopold.Beuken@colorado.edu

Office: ECNT 212

Office hours:

Tue 12:00 – 2:30 ECNT 212*

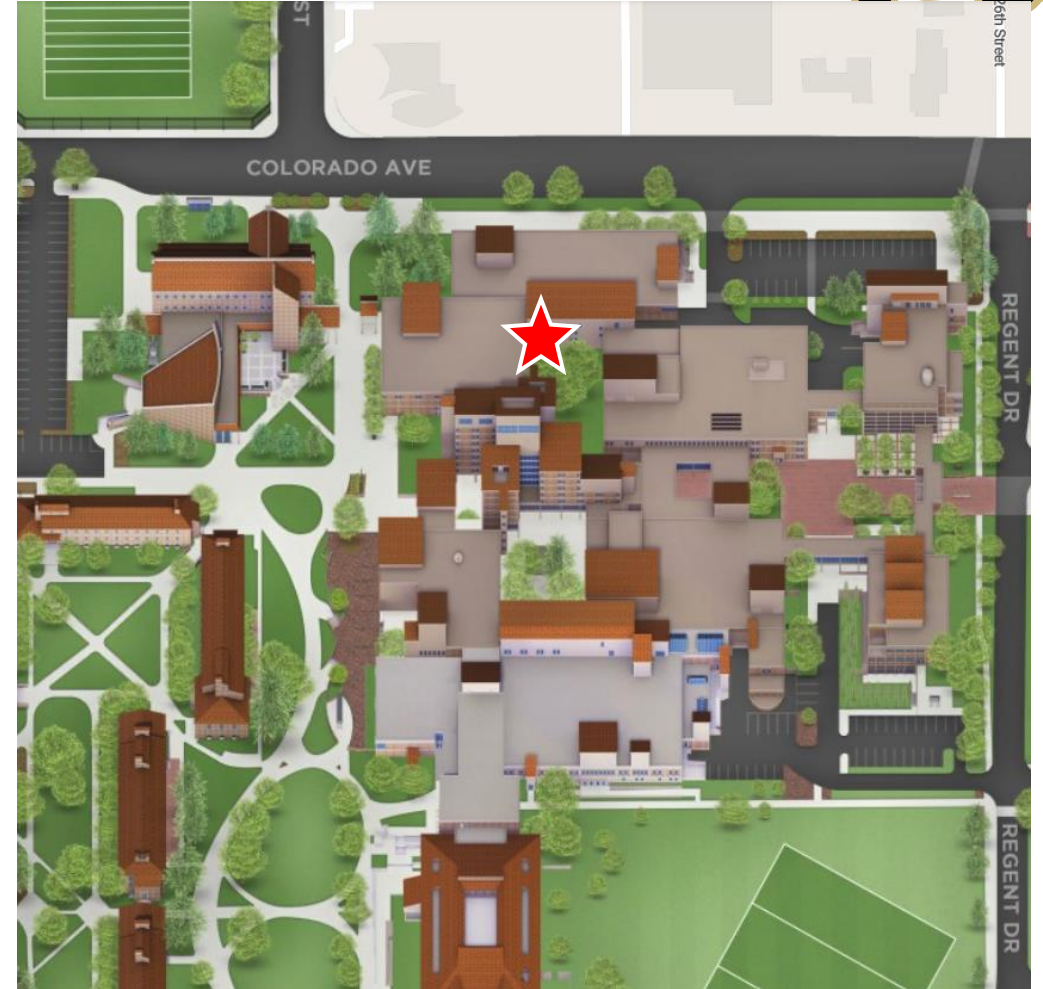
TA: Shrikrishna Raghu

Srikrishna.Bangaloreraghu@colorado.edu

Office hours:

Mon 2:30 – 4:30 ECOT 832*

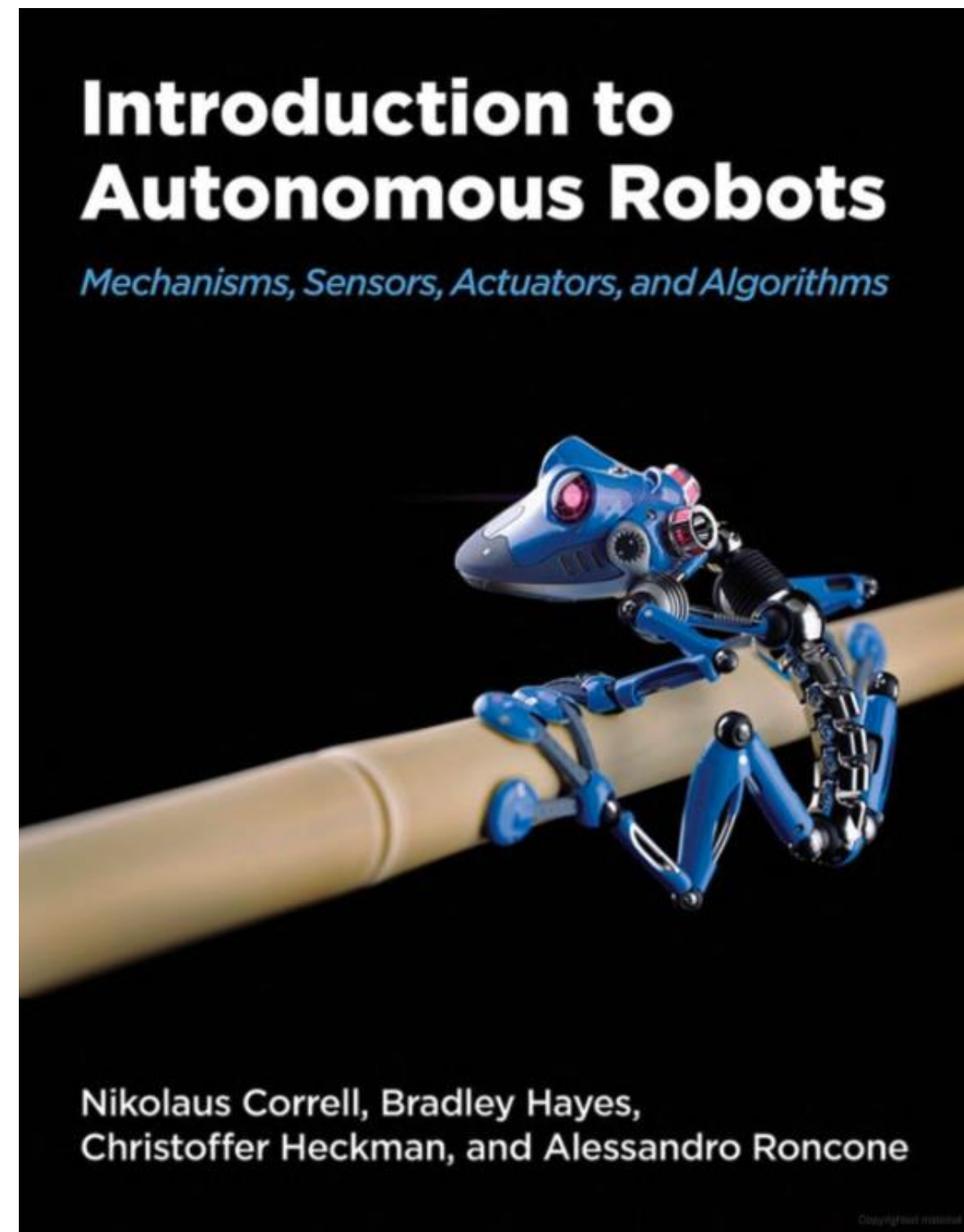
Fri 2:30 – 3:30 ECCS 114E*



*There is a signup sheet for office hours: https://o365coloradoedu-my.sharepoint.com/:x/g/personal/lebe3608_colorado_edu/EcsUhEN_TZRNqG19qIN7nH0BNO4pVNO-d9779UlhV-v0Q?e=tJAlet

Resources and Website

- **Textbook** is on Github (you need to compile a latex file). **Not required**, but will serve as an excellent resource. **Complete lecture notes will be made available.**
<https://github.com/Introduction-to-Autonomous-Robots/Introduction-to-Autonomous-Robots>
- All course materials (notes, homeworks, midterms, etc.) will be on the course **Canvas** page:
<https://canvas.colorado.edu/courses/110700>
- **Piazza** will serve as the primary platform for course-related questions. This is an online forum style website that allows students to ask questions that are visible to everyone in the course. This way everyone learns from each others' questions. You are encouraged to answer each others' questions! <https://piazza.com/colorado/fall2024/coen5830>
Access code: **grohl**
- **Grading inquiries** are to be directed to Srikrishna.
- Please only email me with **personal questions/comments**, otherwise post on Piazza.



Classroom Atmosphere



- Laptops in the back please
- I will ask you many questions
- Please stop me with questions!
- Lecture style is discussion-based
- Please be on time

Assessments and Lectures



- **No exam**
- **1 at-home midterm (20%)**
 - **2 hours** to complete midterm **individually** in 48 hour period*
- **1 Final Project (30%)**
- **Homework Assignments (50%)**
 - Every 2-3 weeks (6-8 total)
 - Solutions will be posted
 - **Collaboration encouraged**, but you need to submit your own work
 - **No late submissions** will be accepted

Course Overview and Schedule

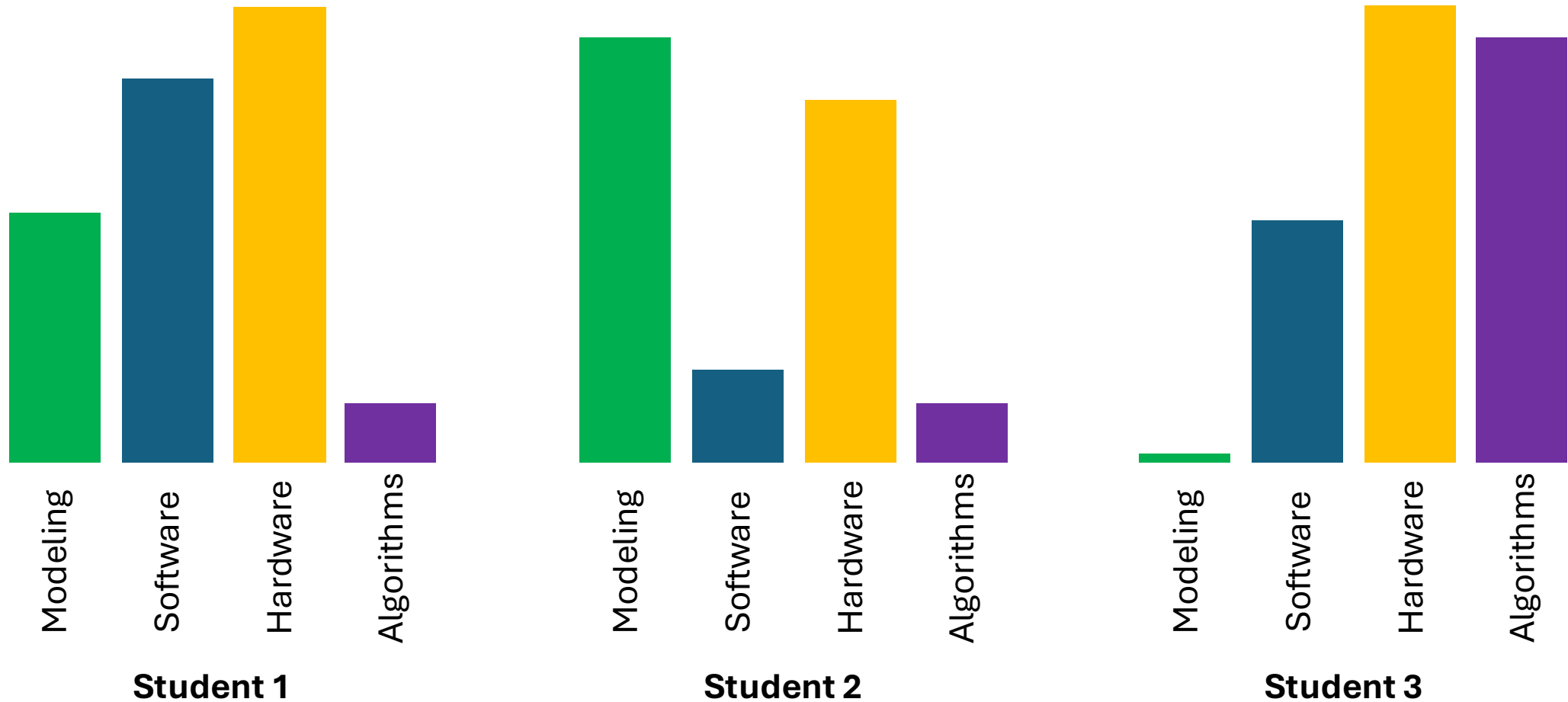


Week	Topic	Description
1-3	Programming	Python Basics, NumPy, SciPy, Matplotlib, Object-Oriented Programming, Debugging, Visual-Studio Code, Git.
4-5	Path Planning	Discretization, Random Trees, Dijkstra, A*, Probabilistic Road Maps, RRT, RRT*
6-8	Kinematics	Linear Algebra, Forward Kinematics, Denavit-Hartenberg (DH) Parameters, Inverse Kinematics, Differential Kinematics.
9-10	Dynamics	Ordinary Differential Equations (ODEs), Modeling physical systems, Laplace Transforms
11-12	Control	Transfer Functions, Stability, Proportional-Integral-Derivative (PID) Control
13	Perception	Encoders, Computer Vision
14	Thanksgiving Break	Take a break!
15	Perception	Inertial, Lidar
16	Actuation	DC Motors, Stepper Motors, Servos, Linear Actuators, Soft actuators

Course Goals



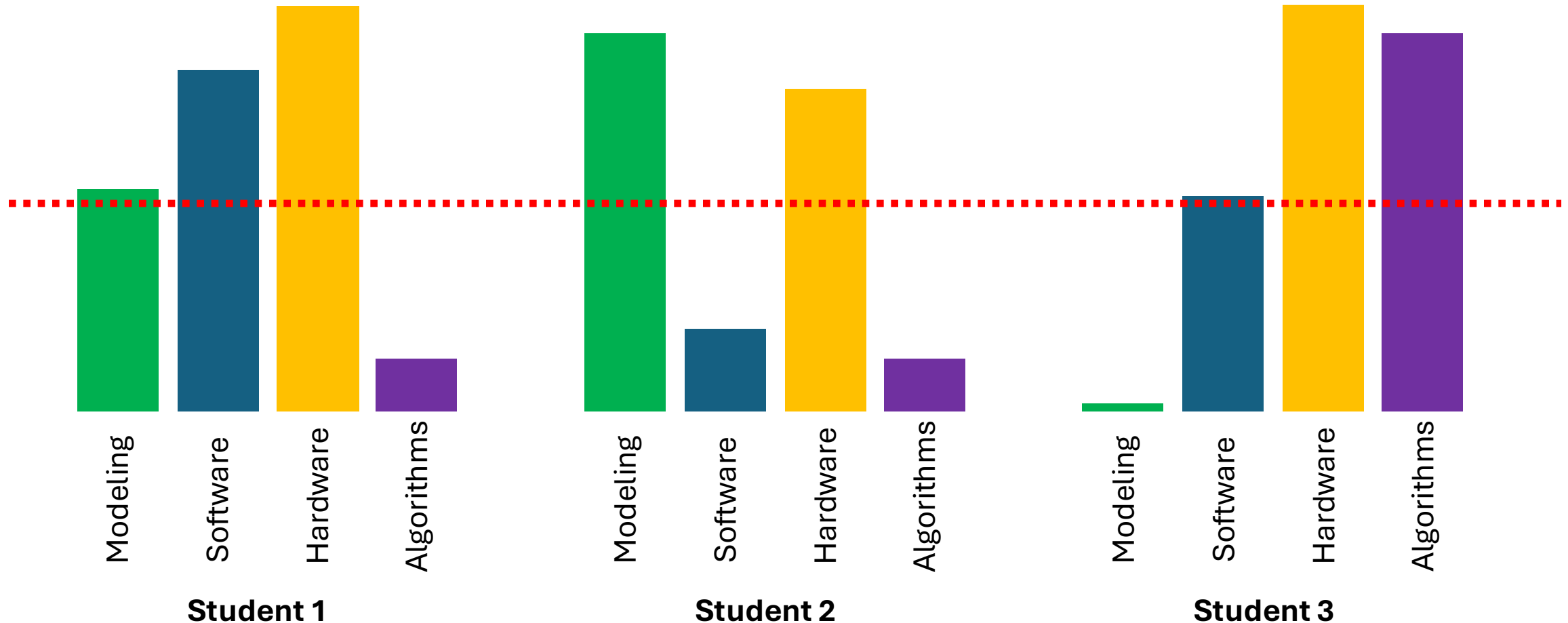
- There are students from diverse technical backgrounds (that's the point of having the robotics program!)



Course Goals



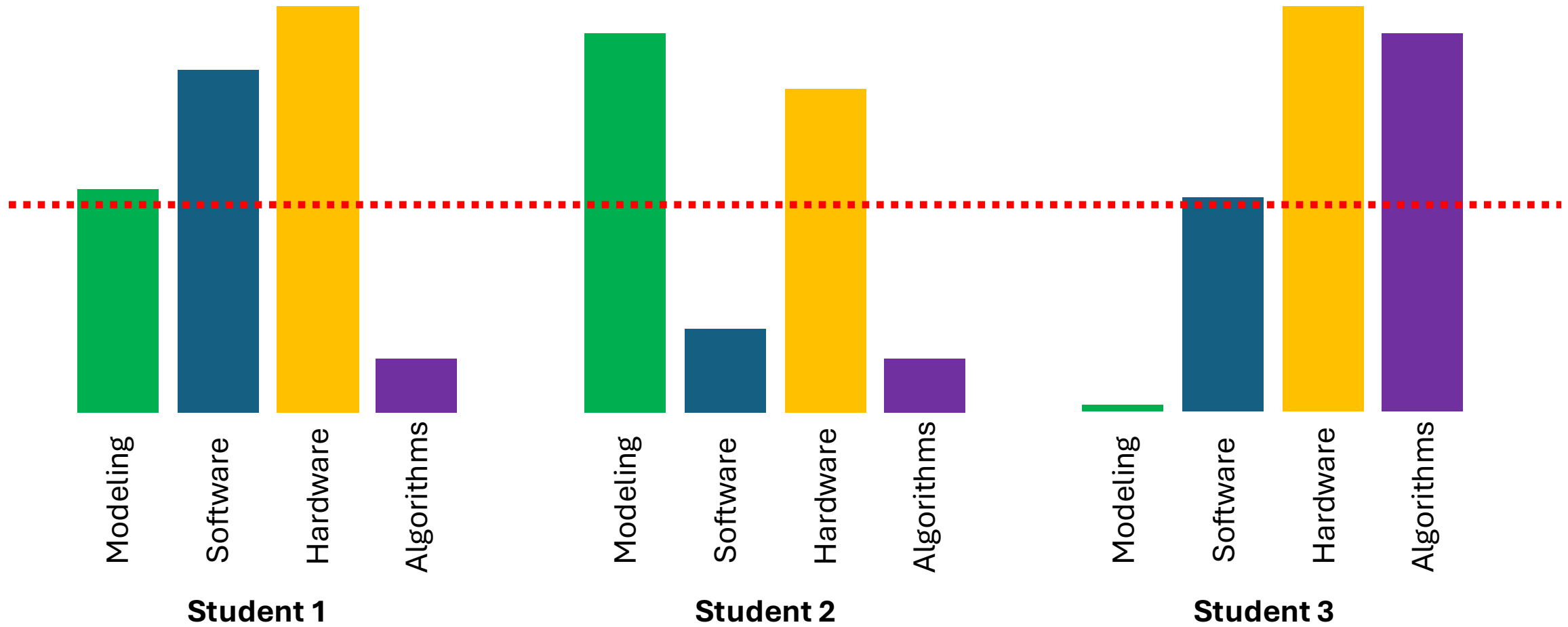
- Get everyone up to an appropriate level of **core competency** in **all aspects** of robotics



Course Goals



- Get everyone up to an appropriate level of **core competency** in **all aspects** of robotics
- What does this mean for you? Parts of the course may be **challenging**, other parts may seem **trivial**.



A Note on Graduate School



- What does this mean for you? Parts of the course may be **challenging**, other parts may seem **trivial**.
- **Embrace** the challenge of hard topics! During grad school you have incredible freedom (and time!) to learn new topics and skills – take advantage of this. “I can’t do that because that’s not my background” is never an excuse, **make it your background!**
- **Don’t neglect** the things you are already well-versed in. There is always more to learn and different perspectives to understand. These topics can often catch you out if you become complacent.
- **Each of us** has a unique opportunity to help **shape** the **Robotics Program** in its early stages.

Accommodations



- Remember to let Disability Services know if you need accommodations!
<https://www.colorado.edu/disabilityservices/>
- Accommodations can't be provided without an official letter from Disability Services
- Handle this ASAP if you haven't already.
- If you require religious accommodations, you are required to let me know by the end of the week.

Academic Dishonesty



- **Collaboration is strongly encouraged** – help shouldn't only come from the instructor/TA, you can help one another! You must indicate collaborators with every homework submission.
- You must **complete individual assignments** by yourself
- For this introductory course, **use of AI or LLMs is strictly prohibited**. This defies the point of forming basic understanding of robotics principles.
- Incidents of academic dishonesty is taken very seriously in the Robotics Program

Topic 1: Programming



- **Self assessment** – am I proficient at programming? Am I proficient at Python? How often do I write code? Do I write code by myself or do I copy and paste?