ECE 4560: Introduction to Robotics and Automation

Prof. Maegan Tucker

Tuesday Aug. 25, 2026

Today’s Class

Objective 1: Who am I?

Objective 2: Review Syllabus

- Course Topics
- Homework Policies
- Lab Projects
- Overall Schedule

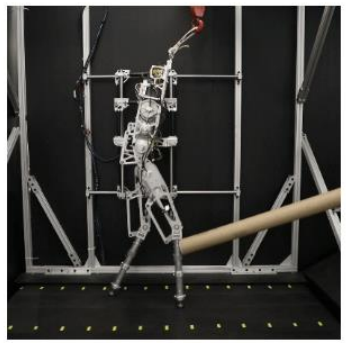
Objective 3: Motivation for Robotics

Who am I?

- BS in ME from Georgia Tech, 2017
- PhD from Caltech, May of 2023
- Consultant for Disney Research during 2023
- Began at GT as an Assistant Professor in January 2024
- Joint appointment in ECE (66%) and ME (34%)
- Half of my time is spent directing the Dynamic Mobility Lab

Dynamic Mobility

The Georgia Tech Dynamic Mobility (Dynamo) Lab aims to drive forward the field of bipedal locomotion and robotic-assisted mobility by developing novel techniques in the fields of control theory, human-robot interaction, and biomechanics. Overall, our group is focused on: 1) developing control techniques for achieving dynamic, natural, and robust bipedal locomotion inspired by tools and techniques from nonlinear control theory, optimization, and hybrid systems, 2) developing learning algorithms to practically adapt robotic behaviors based on human feedback, and 3) conducting clinical investigations to study the effects of robotic interventions for human rehabilitation and biomechanics.

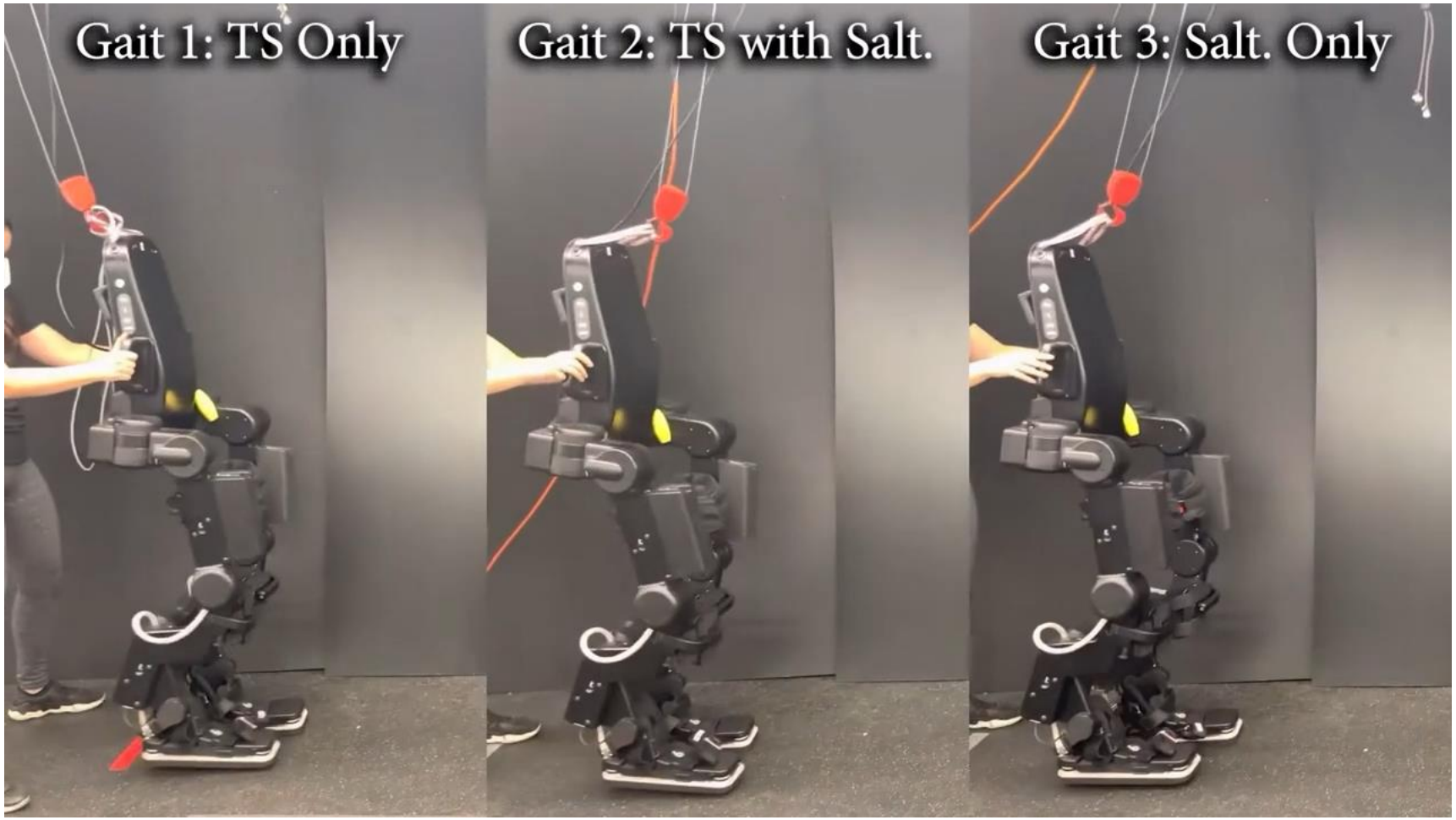


Bipedal Locomotion

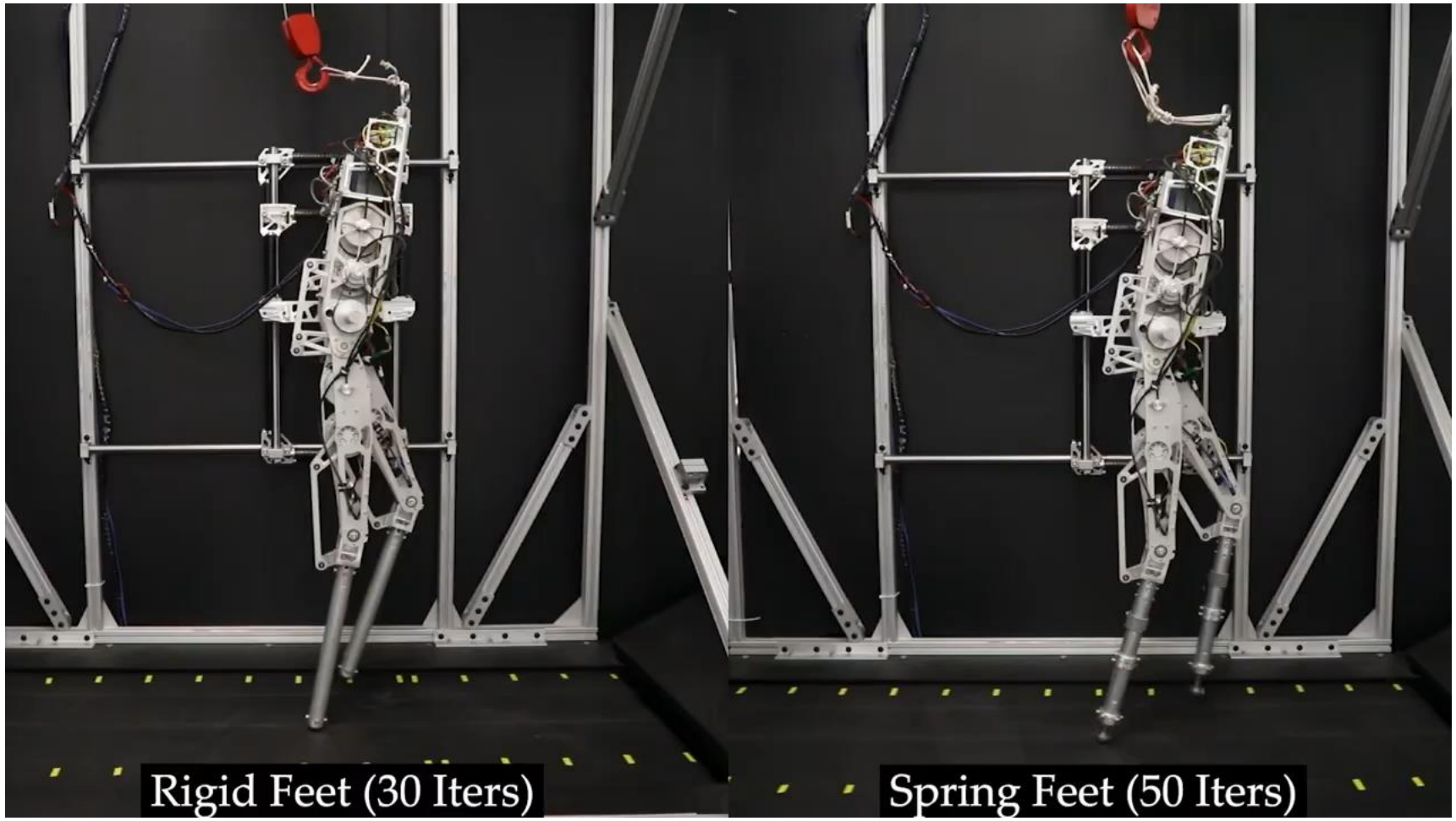
Learning from Human Feedback

Biomechanics of Robot-Assisted Locomotion

Background on my research



Background on my research



What to Expect in ECE 4560

ECE 4560 is about **engineering principles**; robotic manipulator **kinematics, dynamics, and control**; applications of robots in industry, medicine, and other areas; team projects and hands-on laboratory experience.

The course will consist of:

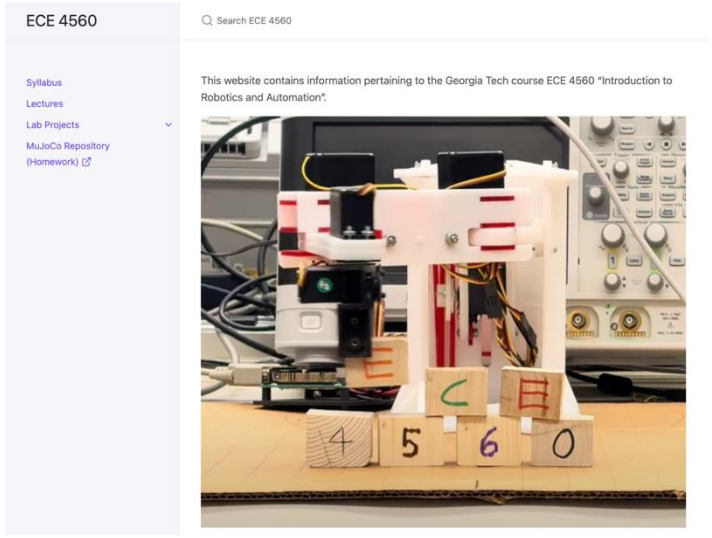
- Exams: 2 midterms, and 1 final exam
- Homework*: Nearly* weekly sets due on Friday
- Lab: Each homework set will have a lab-based checkpoint
- Presentations: End-of-the-semester group project presentations
- Simulation: Simulation problems in some homework sets

Grade breakdown

- Homework: 10%
- Lab: 20%
  - (10% semester-long submissions, 10% end-of-semester project presentation)
- Midterm: 20% each
  - Tuesday, September 29th, 5-6:15pm
  - Thursday, October 29th, 5-6:15pm
- Final: 30%
  - Thursday, December 10th, 6-9pm

What to Expect in ECE 4560

Course and lab materials available via course website



I will be updating course notes and resources on course website and Canvas as the course progresses

Logistics

Class time and venue: Tuesday/Thursday 5-6:15pm

- In-person course. Attendance/participation will be used when deciding end-of-year grade “rounding”
- I will post the updated lecture notes before class, old lecture notes are available online

Lab time and venue: open hours, Van Leer E265

- TA hours: Thursday, 2-4pm or 4-6pm

Websites

- Canvas: for handouts and assignments
- Discussion: Ed Discussion on on canvas
- Gradescope: for assignment submission (link on canvas)

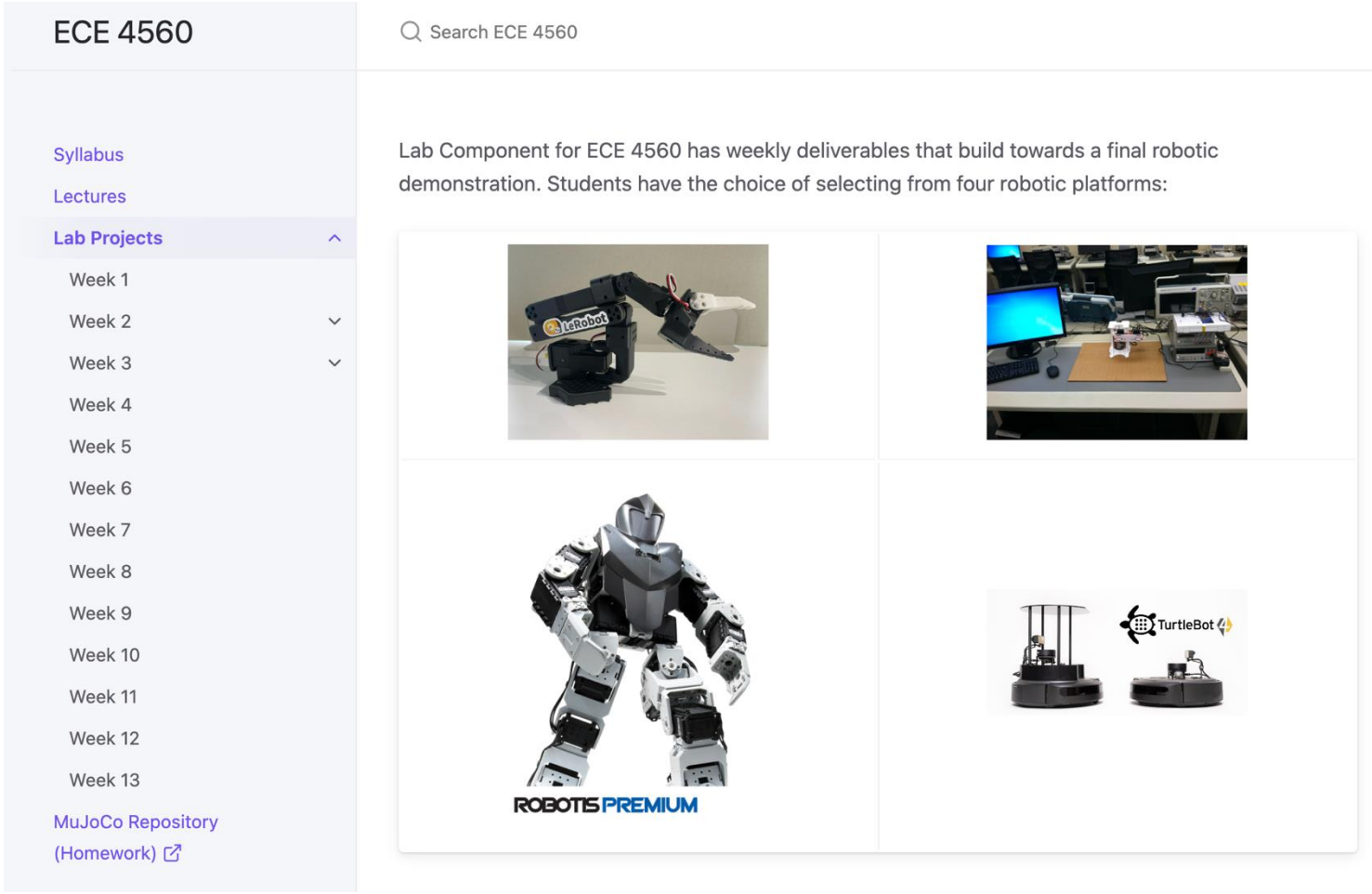
Grading

Homework Sets

- Due every week on Friday at midnight
- Submit homework on Canvas
- Every student is given 3 days for automatic extensions
  - Each assignments can be handed in one day late each. For extensions above one day, please contact me ahead of time.
  - After these 3 days, you may submit up to 24 hours late for a 20% penalty. After 24 hours, the solutions will be posted.
- If you have an unusual circumstance, please contact me *before* solutions are posted. No submissions will be accepted after solutions are posted.

Lab Projects

1. SO-101 Robotic Arm Track (required for weekly lab checkpoints)
2. Old Robotic Arm Track
3. Mobile Robot Track
4. Bipedal Robot



SO-101 Robotic Arm Track

Project Track:

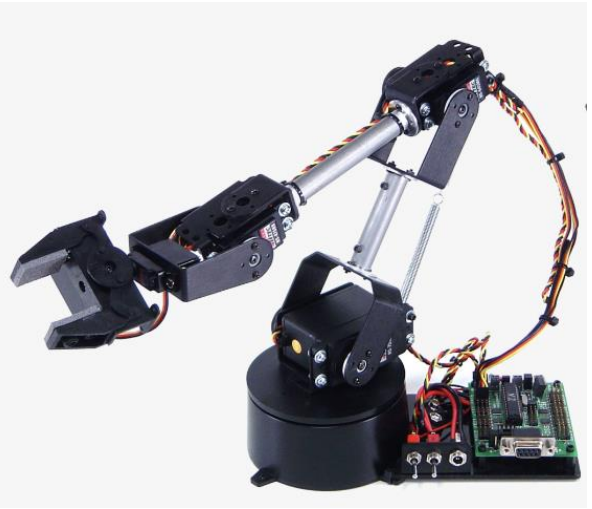
https://maegantucker.com/ECE4560/projects/
https://huggingface.co/docs/lerobot/en/so101

1. SO-101 Manipulator
   "Leader" Arm + "Follower" Arm
   - Calibration
   - Teleoperation
   - Forward Kinematics
   - Inverse Kinematics and Trajectory Design

Robotic Arm Track

Project Track:
https://pvela.gatech.edu/classes/doku.php?id=manipulator:adventures

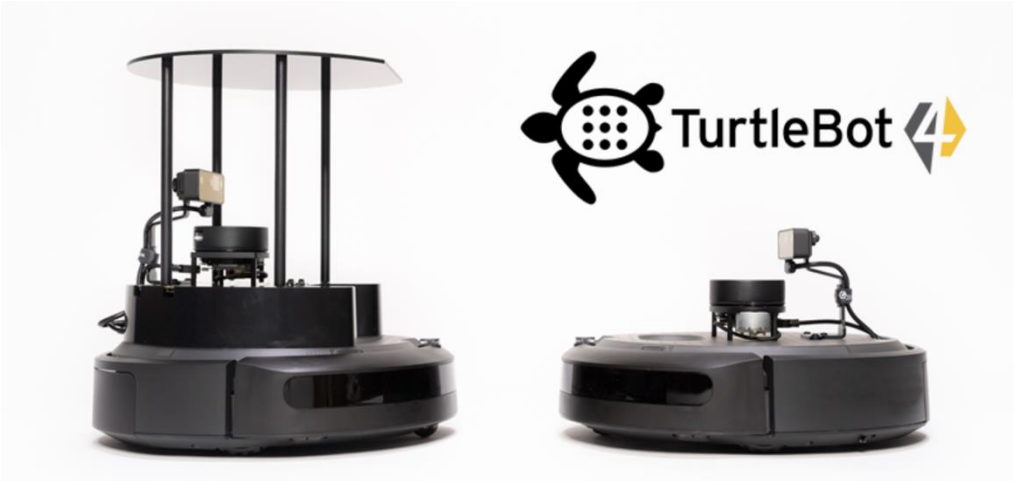
1. Piktul Planar Manipulator Arm
   - Calibration
   - Inverse Kinematics and Trajectory Design
2. Lynx6 Manipulator Arm
   - Calibration
   - Inverse Kinematics and Trajectory Design



Mobile Robot Track

Project Track:
https://pvela.gatech.edu/classes/doku.php?id=turtlebot:adventures

1. Turtlebot Basics (Setting up ROS)
2. Moving the Turtlebot
3. Sensing
4. Mapping
5. Navigating the World

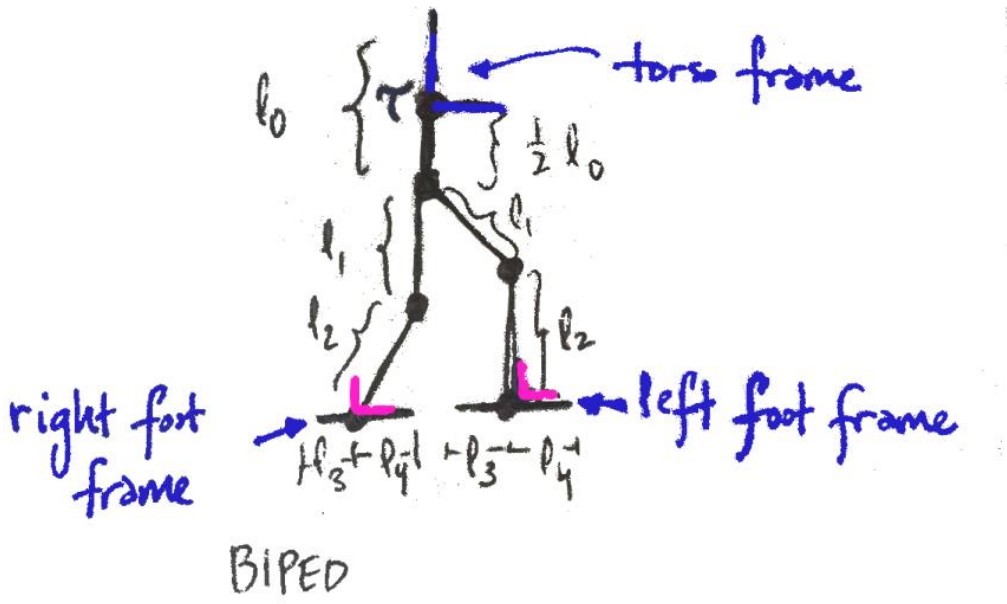


Planar Biped

Project Track:

https://pvela.gatech.edu/classes/doku.php?id=ece4560:biped:adventures

1. Construct biped model
2. Generate Trajectories to Achieve Quasi-Static Bipedal Motion
3. Beyond Quasi-Static Motion



Project Presentations

The final 2 days of the semester will be devoted to final lab. The purpose of these presentations is to show what you've accomplished/learned with your project (10% of your grade)

This includes creative use of your robot (can be in simulation):

- Writing your name with a pencil
- Throwing a ping-pong ball

Other custom projects:

1. Quadrupedal Walking
2. Bi-Manual Manipulation
3. Vision-Based Manipulation

Assignment Policy

All assignments must be handwritten

Abide by the Georgia Tech honor code

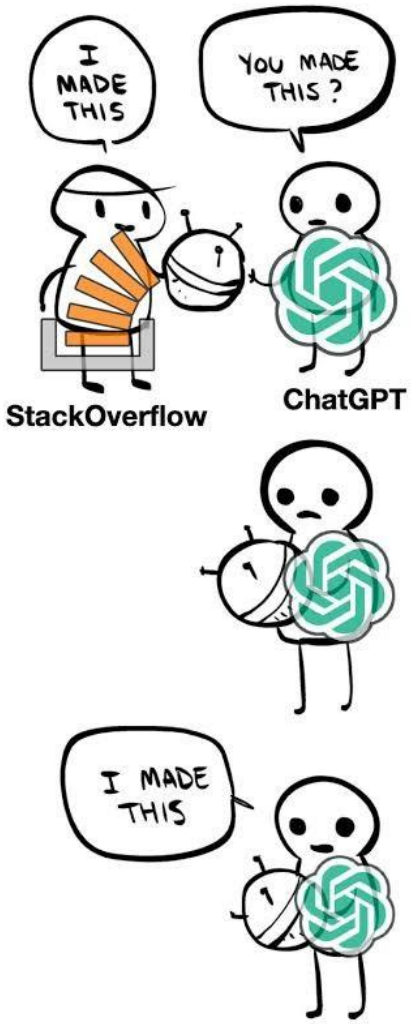
- Reference all your sources
- Do not plagiarize other sources (homework solutions, other students)
- Do not upload course material on other websites

Assignments are individual, but light collaboration is permitted and **encouraged**

Assignment Policy

Generative AI policy

- You are allowed to use AI (GitHub Copilot, ChatGPT) for help with coding
- HOWEVER, you should never directly copy-paste AI-generated text with anything you submit. This counts as plagiarizing. Use your best judgement when it comes to code.
- Please be aware that AI often produces bugs / broken code.



favtutor.com

Who to contact for help with the course

Contact information:

- Email: mtucker@gatech.edu
- Office: TSRB 442
- Office hours: Friday 10am-11am
- TA: Xiaoyu Zhang

Knack Tutoring

- Georgia Tech has partnered with Knack to provide students access to verified peer tutors who have previously aced this course.
- I have not personally used the program (it is a pilot program), but it could be worth checking out at gatech.joinknack.com

Electronic Communication Policy

General guidelines

- Email the Dean of Students if your personal situation requires special academic consideration
- First ask your questions on Ed Discussion in case other students have the same question.
  - Be courteous in these interactions
  - Avoid judgmental language, e.g. “The answer is obvious”, “This is trivial”
  - Try to be constructive
  - Avoid typos and use correct syntax
- If you need something else, please email me
  - Include “[ECE 4560]” in the subject line
  - If you email the TAs, cc me

https://xkcd.com/1873/

Slide borrowed from Matthieu Bloch

Motivation to Robotics

Manufacturing
Wired.com

Agriculture
agfundernews.com

Healthcare
iotworldtoday.com

Motivation to Robotics

Overarching questions:

1. How do we mathematically describe a robot?
2. How can we know what a robot is capable of?
3. How do you translate from joint-angles to the position and orientation of the end-effector? What about the other way around?
4. How do we design motions for a robotic system?

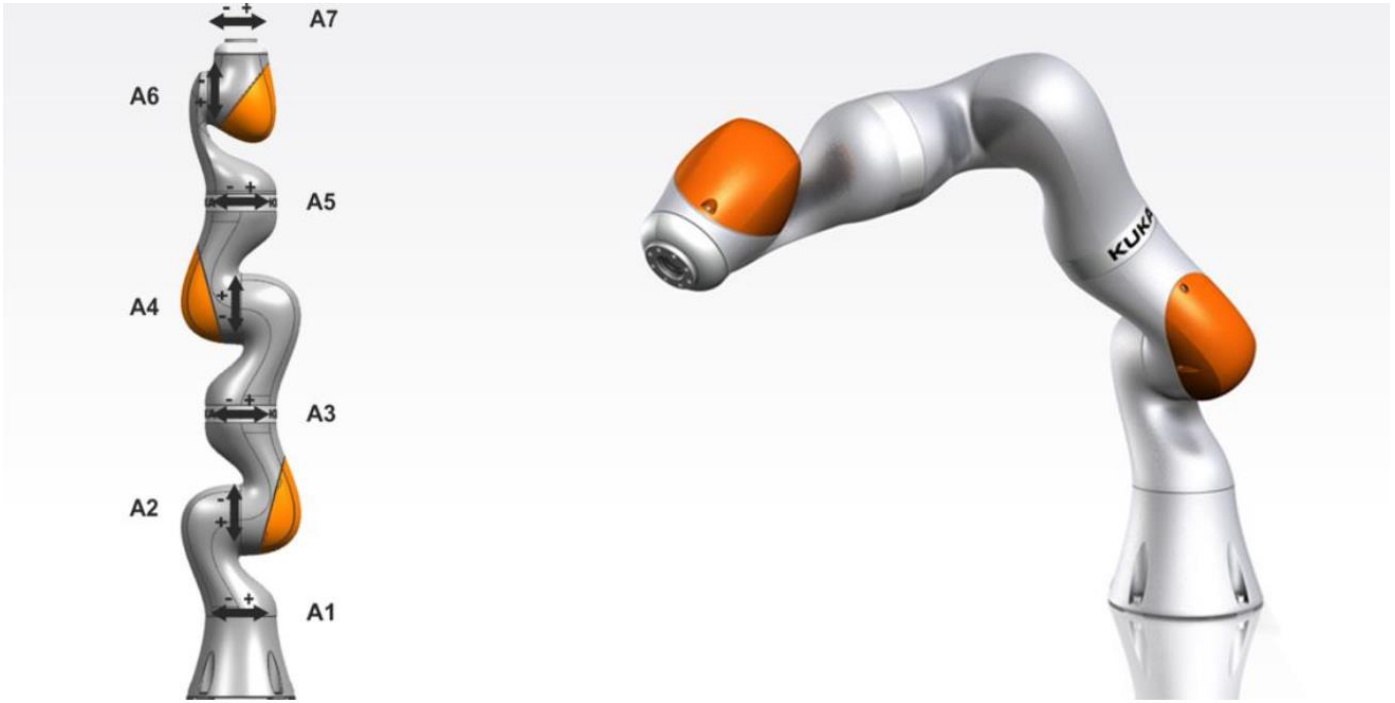


Image borrowed from Jun Ueda

Final Thoughts

I value your feedback - I will use it to make improvements