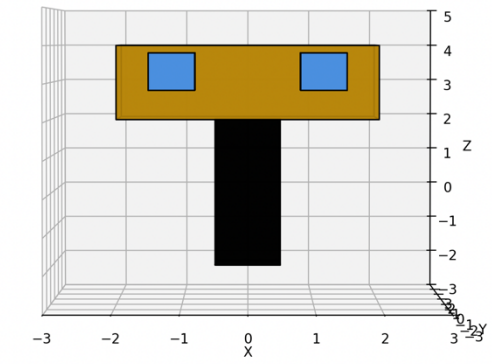
Homework 1 – Implementing Gaze Behavior

In this homework, you will implement gaze behavior on the following simulated robot. We have implemented basic functionality for the robot. The robot has a control loop running at 10Hz (`Robot.start`). This control loop redraws the robot at every cycle according to its joint state (`Robot.joint_states`). It also runs the text-to-speech engine in the background. The interaction is defined in `interaction_logic_seperate_thread.`



Rules & Policy

1. This homework should be completed independently. You can talk to your friends about high-level logics, but you should not share your code with your friends, nor look at their code.
2. You are not allowed to use any AI tools beyond single-line auto-completion.
3. The instructor may select students to conduct a code audit, where you will have to explain how your code works.

Disclosure: The initial robot drawing code was created by Claude. The idea, robot implementation, and questions were developed by Humans ☺.

Installation & Setup:

We will be using Python for this homework, and it has a few major dependencies (`matplotlib, pyttsx3`). We recommend using conda and you can install the dependencies using the following steps:

1. `conda create –n hri–2025 python=3.10`
2. `conda activate hri–2025`
3. `pip install –r requirements.txt`

Questions:

[4 points] Implement Mutual Gaze

For this question, you will implement mutual gaze on the simulated robot through the `mutual_gaze_loop` function. The function is called every 0.1 second (10Hz) and receives the latest image captured by your webcam. You will process the image, find the face, and have the robot face the person by changing its pan and tilt.

To process and find the face, we recommend using Google's mediapipe package. However, other methods for Face detection are allowed.

[2 points] Implement Deictic Gaze

For this question, you will implement Deictic gaze that coincides with language. The robot will talk about a picture in the environment, *"Look at that picture"*. When the robot reaches the word "picture", the robot should look at the "picture". The location of the picture is given in `self.objects_in_env["picture"].`

[4 points] Implement Gaze Aversion

For this question, you will implement cognitive gaze aversion. The gaze aversion should happen before the robot says "I think it is very pretty". The implementation should not be hard-coded, and the timing for the gaze should be drawn from the distribution described below (from Andrist et al. 2013).

Length (sec)	Mean = 3.54, SD = 1.26
Start time (sec)	Mean = -1.32, SD = 0.47
End time (sec)	Mean = 2.23, SD = 0.63