

MiS

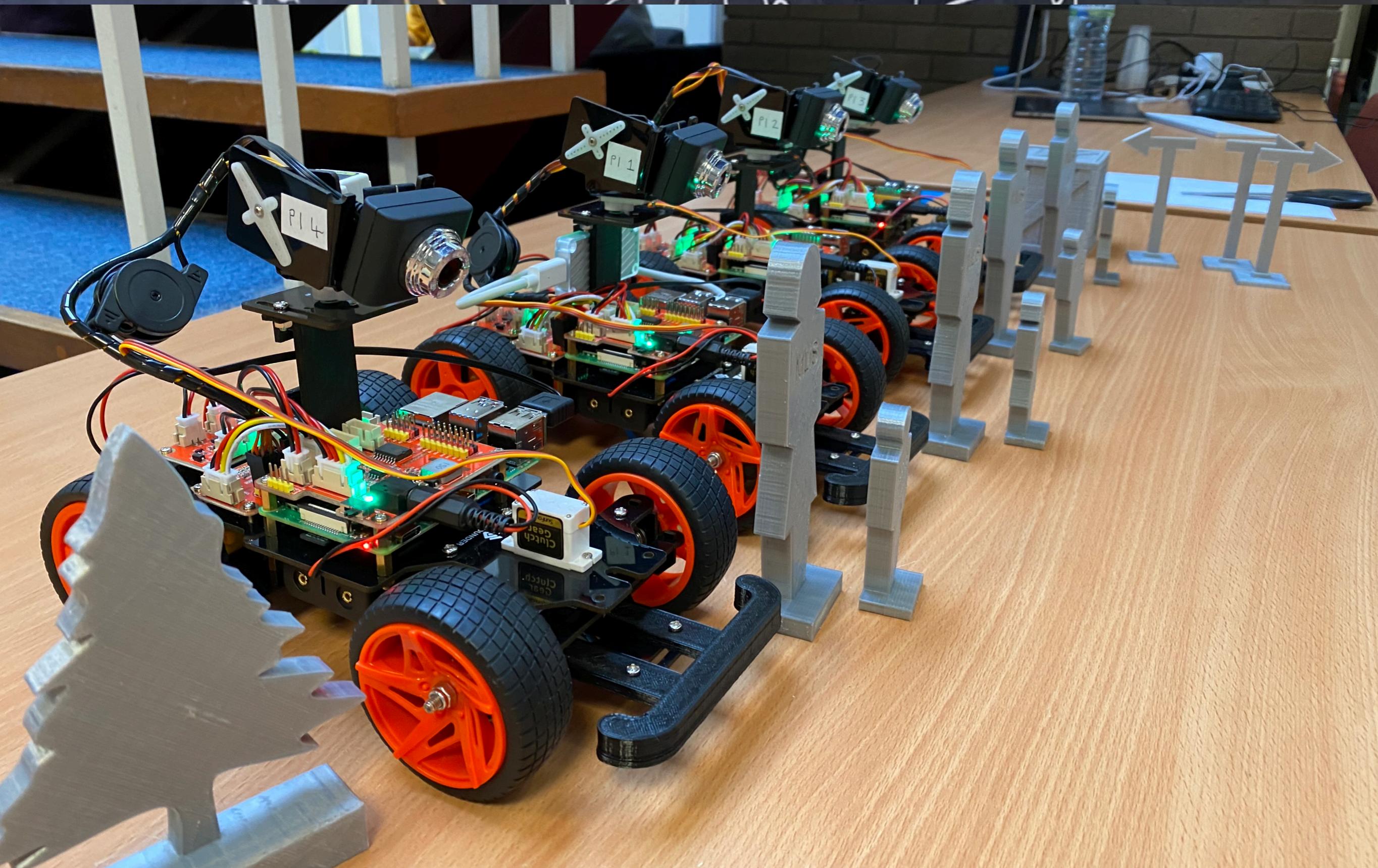
Pi Car Project

School of Physics & Astronomy
and
Faculty of Science



MLiS Machine Learning in Science

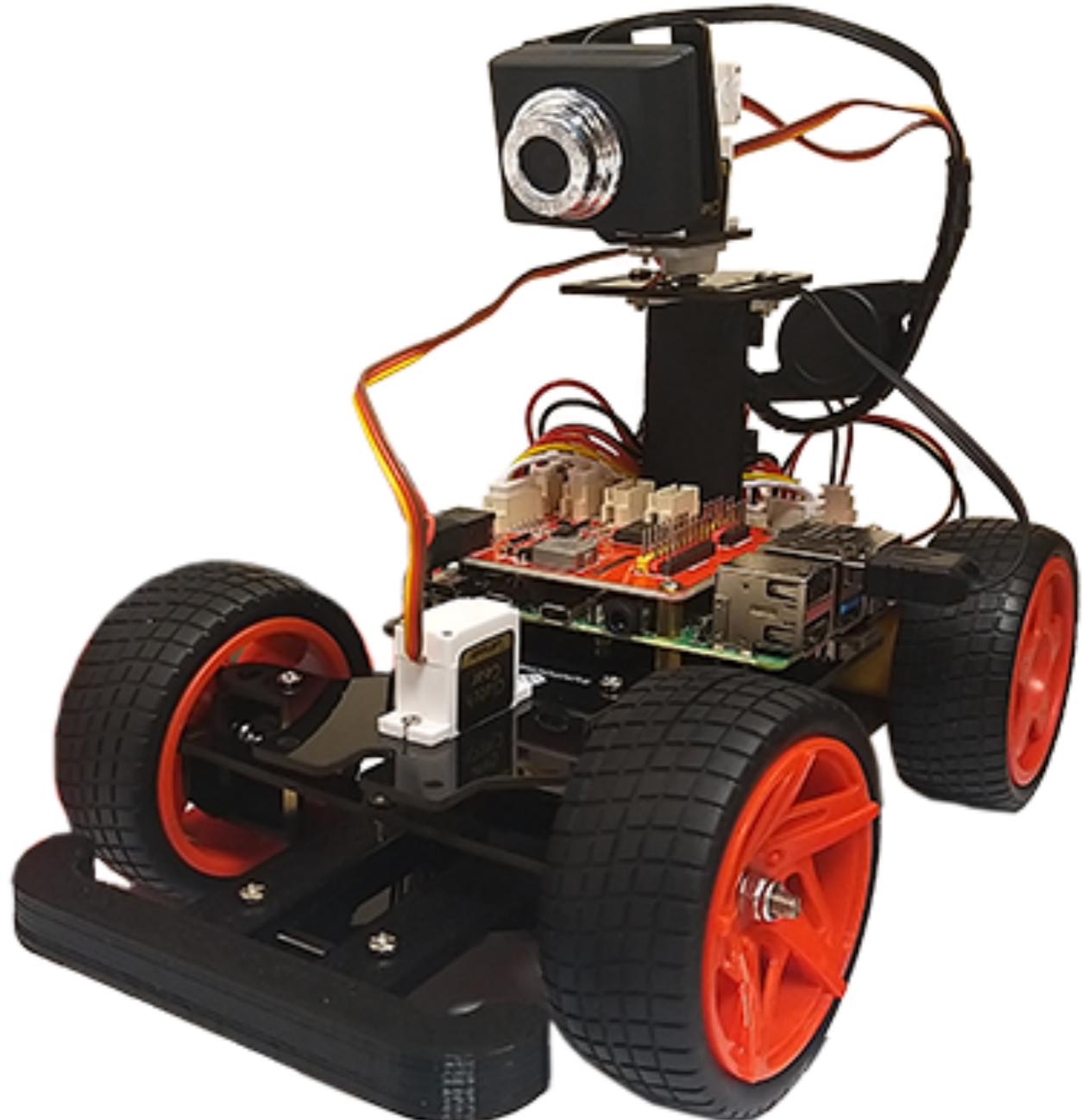
School of Physics & Astronomy and Faculty of Science





Pi Car

- ▶ Raspberry Pi 4
- ▶ Onboard Camera
- ▶ Coral Edge TPU
- ▶ Access to 2080 Ti GPU





Tasks

- ▶ Collect data
- ▶ Train Machine Learning algorithm
- ▶ Navigate test circuits
- ▶ Make manoeuvres

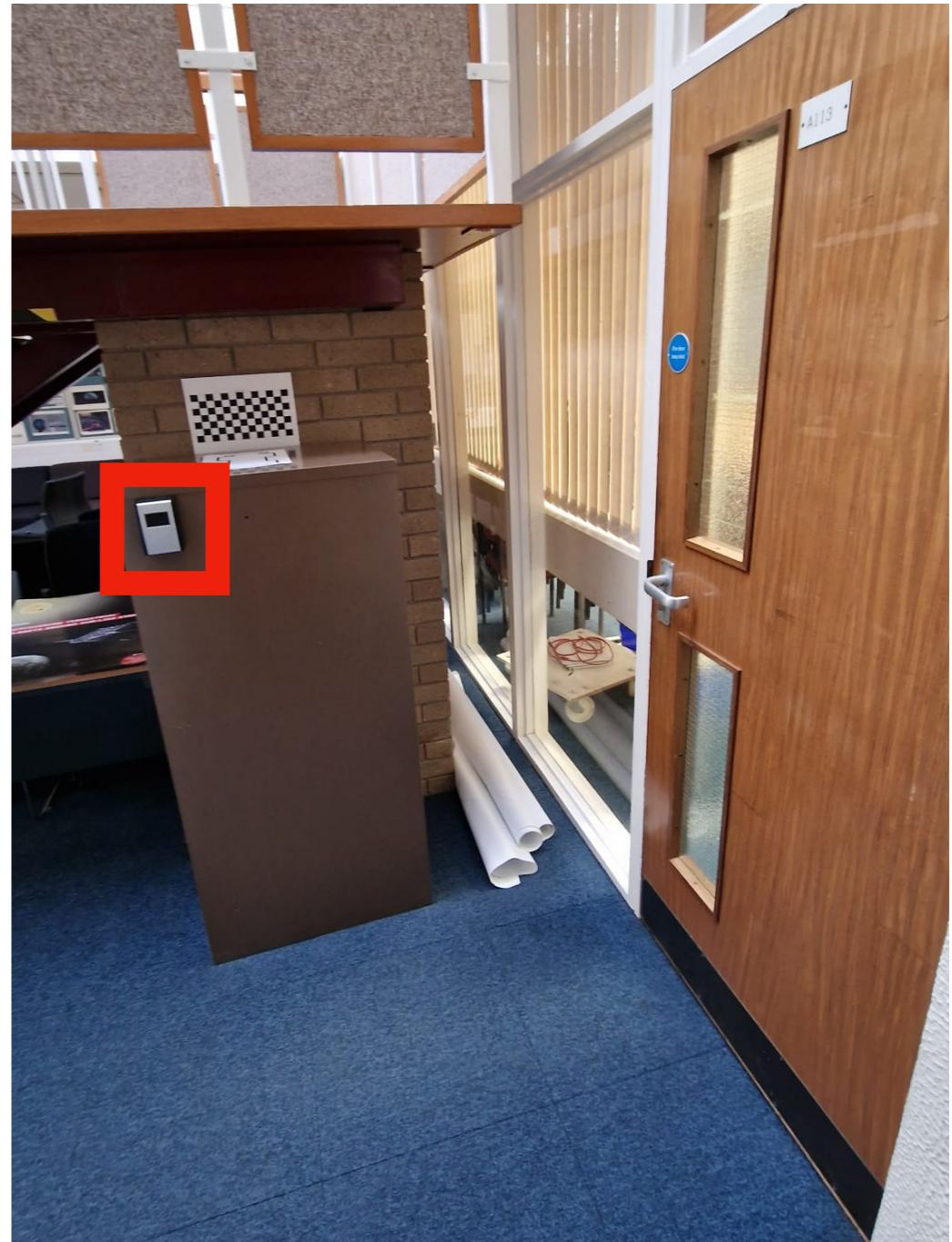
MLiS

Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Location → Room A113 CAPT





- ▶ Passcode: year neural network invented

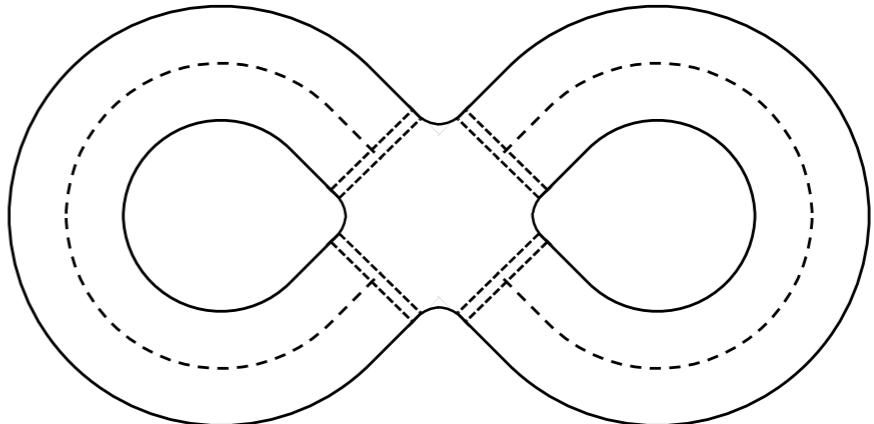
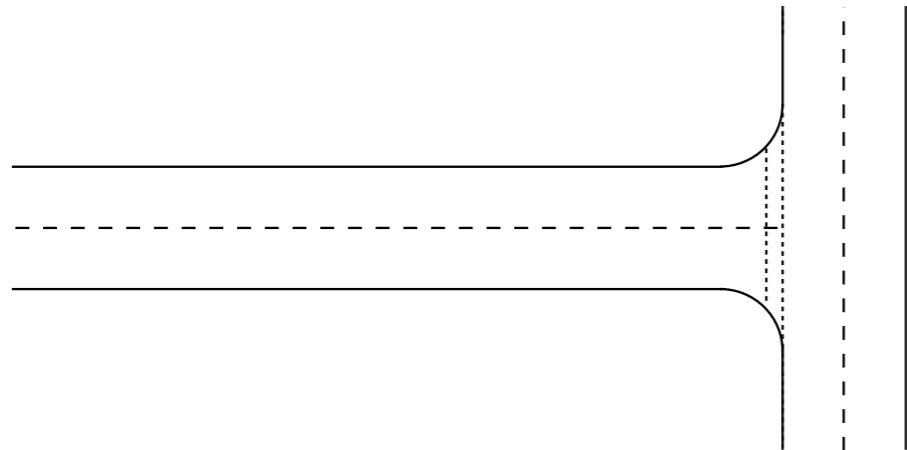
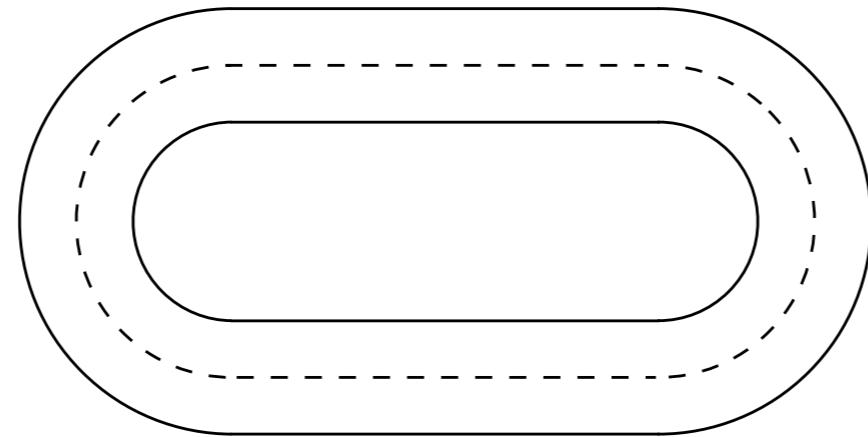
MLiS

Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Tracks



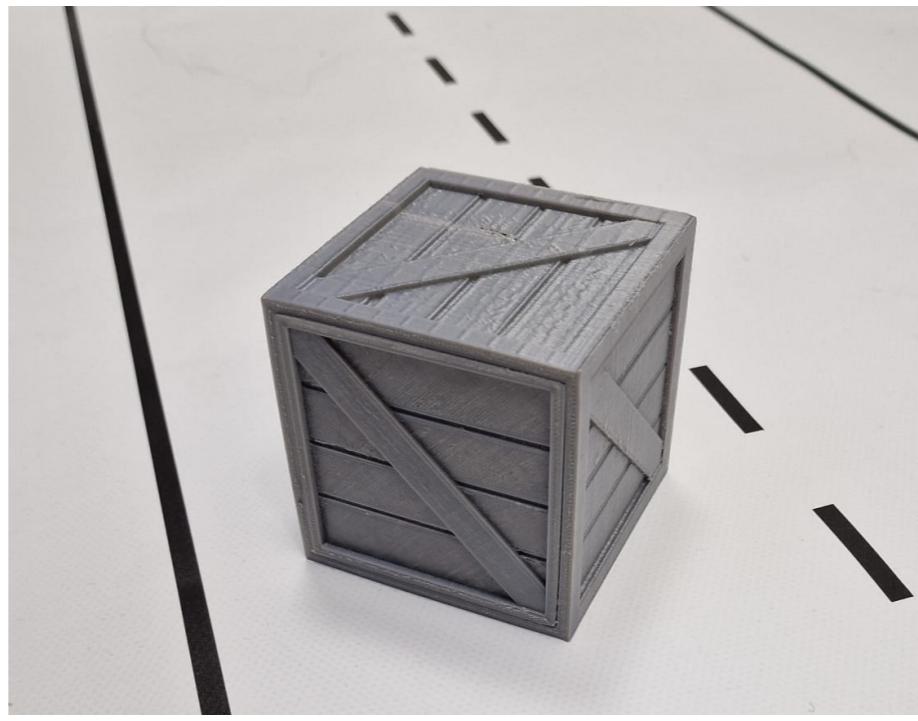
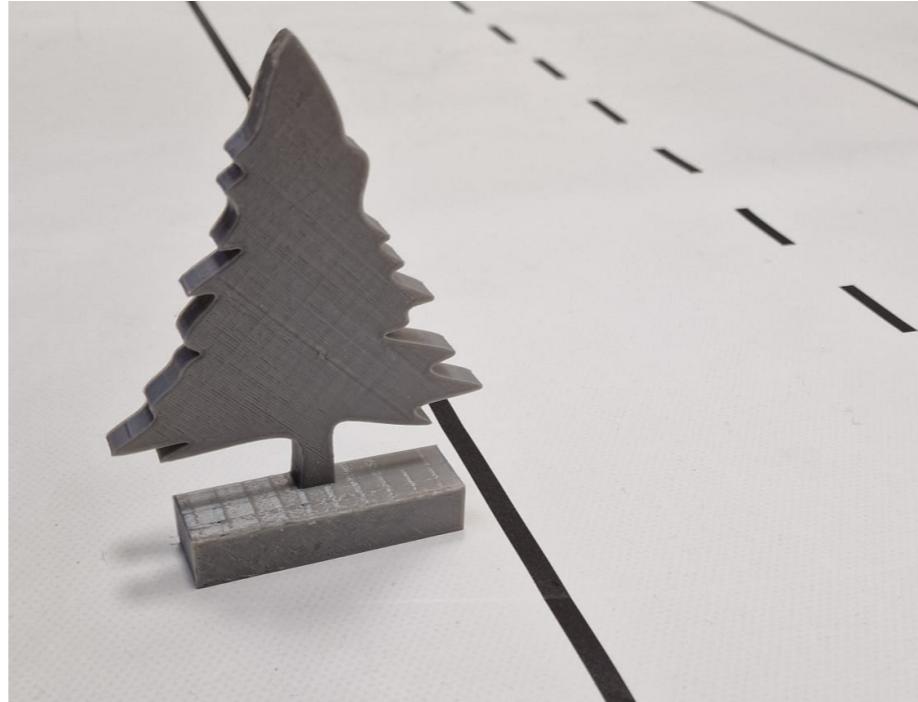
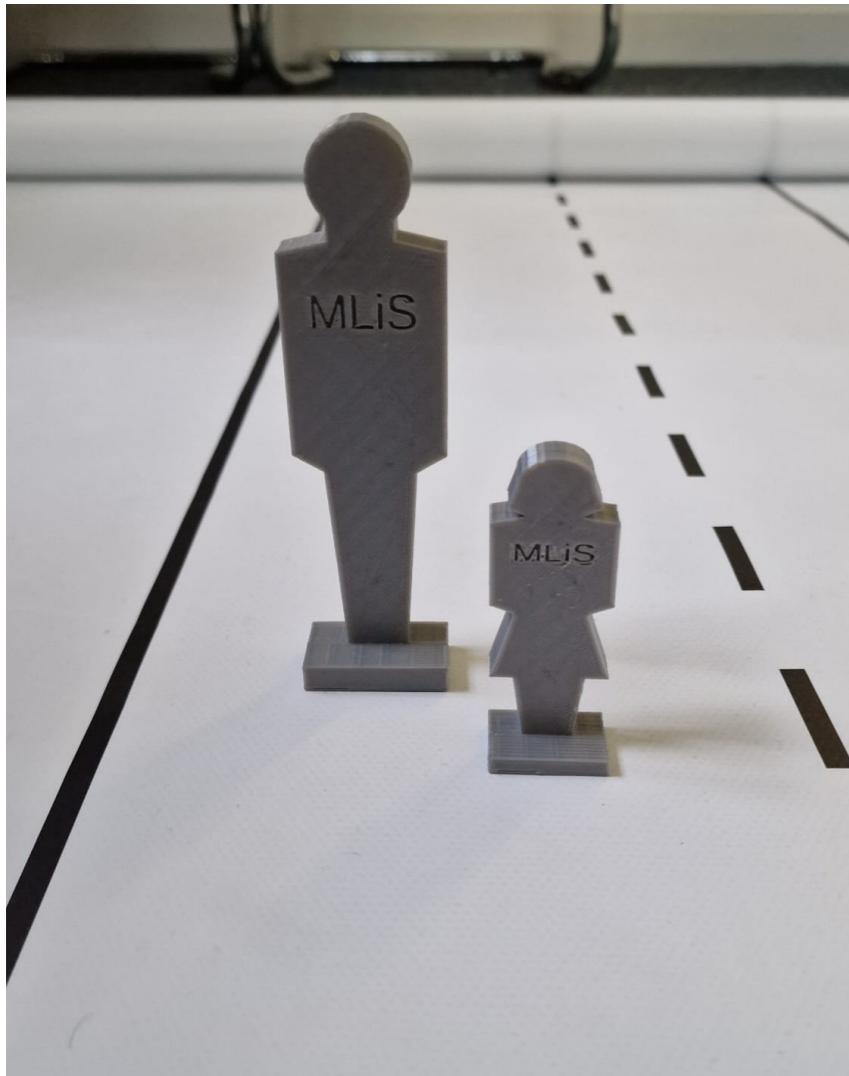
MLiS

Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



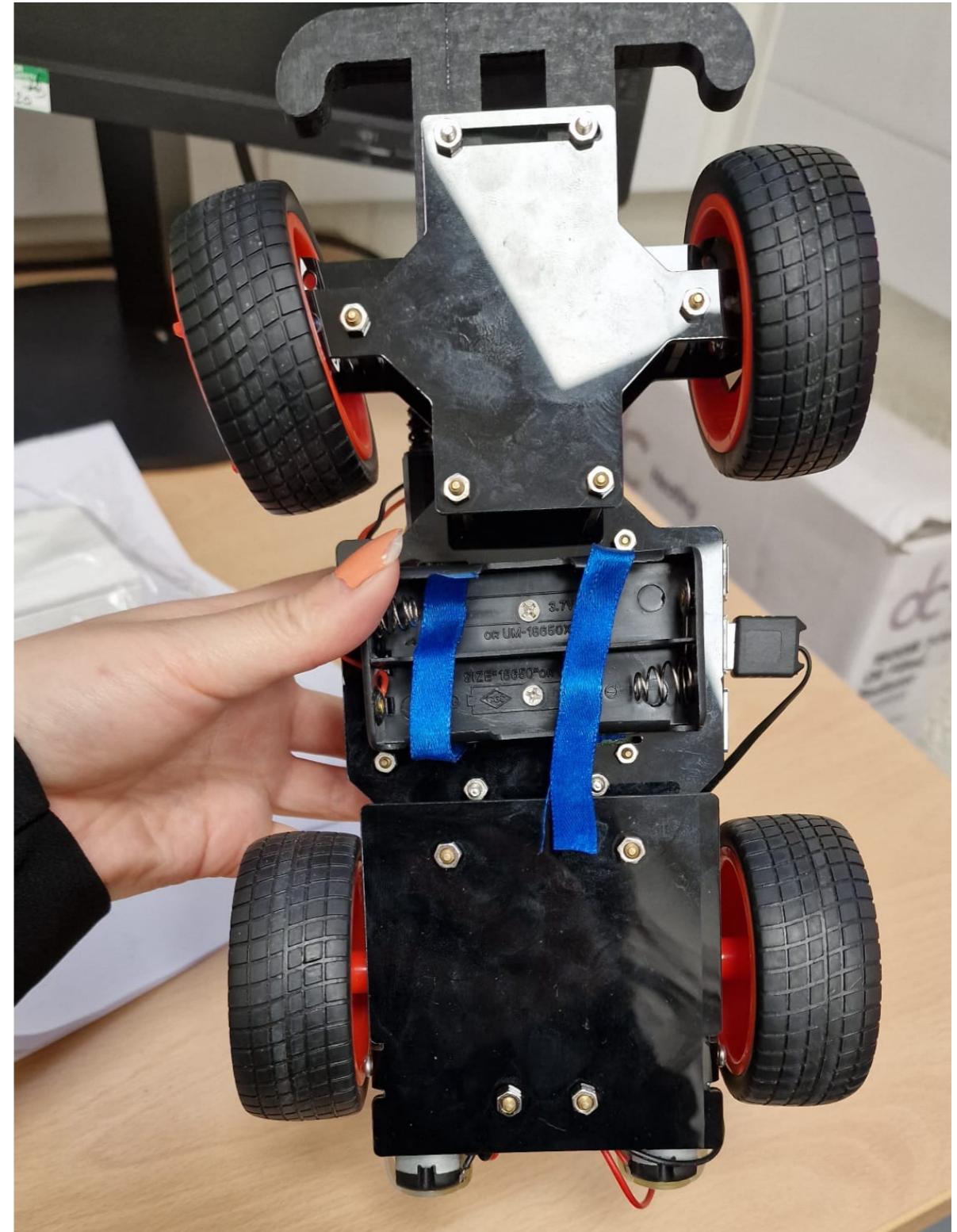
Obstacles





Set up:

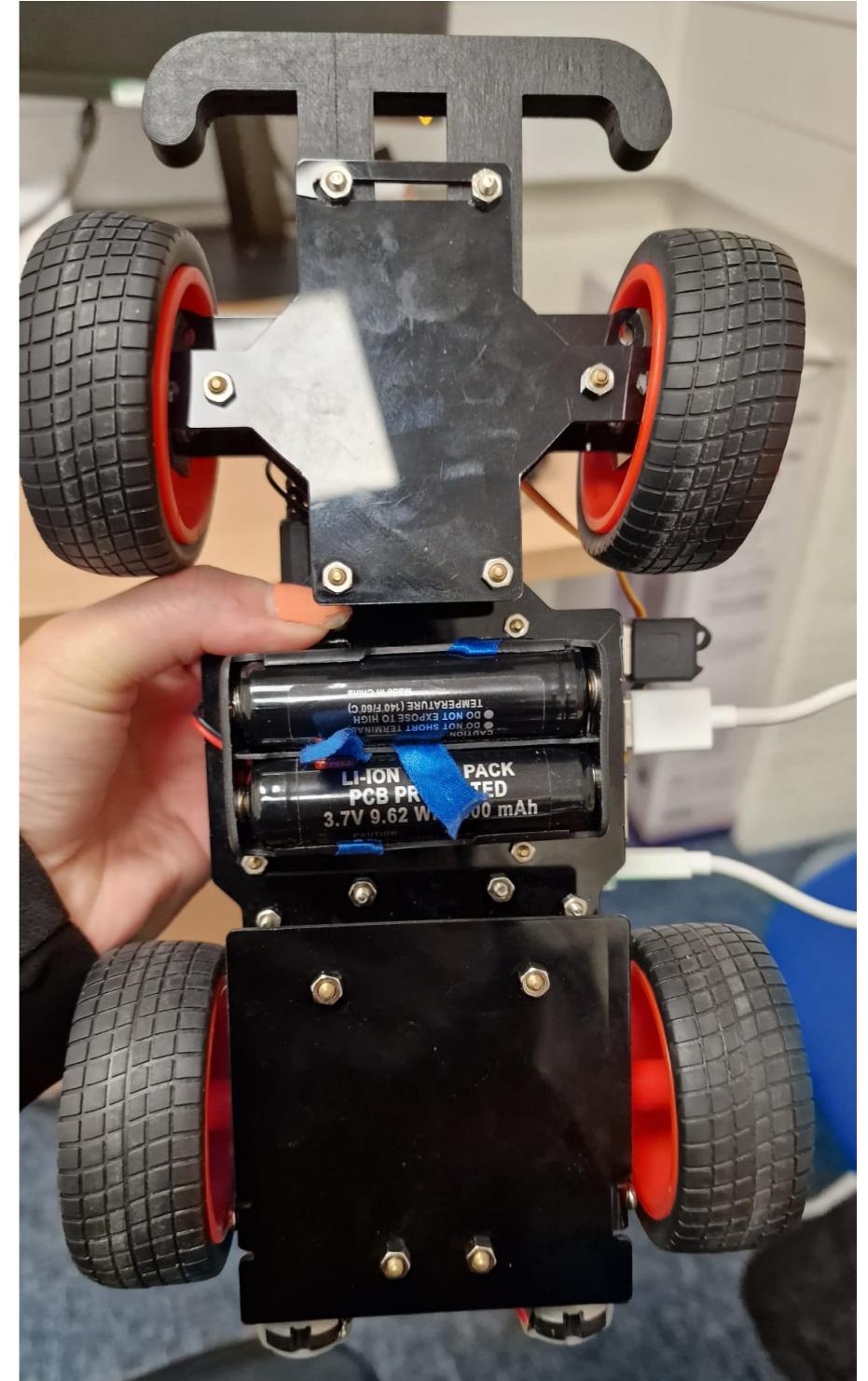
- ▶ Use ribbons beneath battery





Set up:

- ▶ Use ribbons beneath battery
- ▶ Helps to remove them easier
- ▶ Make sure to charge batteries for next person!





Batteries

- Make sure positive end of battery goes into positive end of battery case and charger

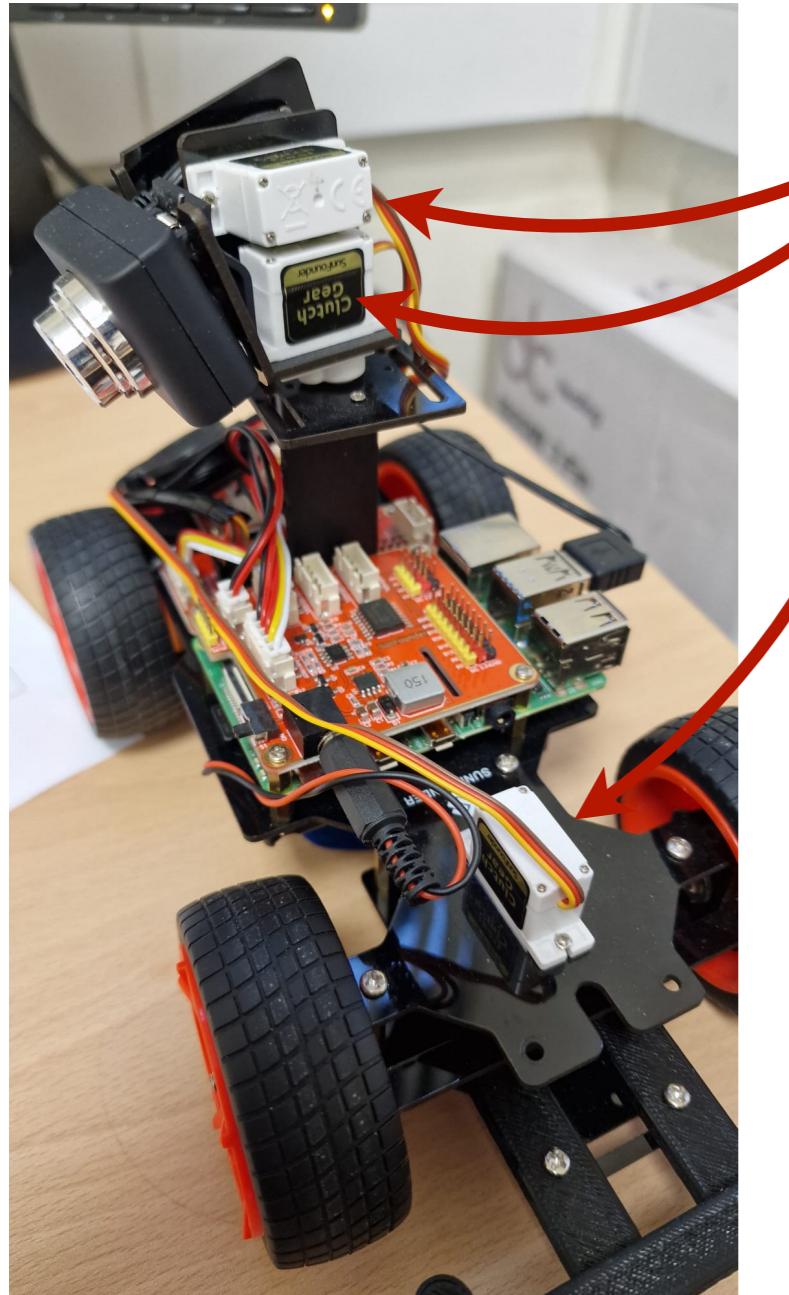


Positive



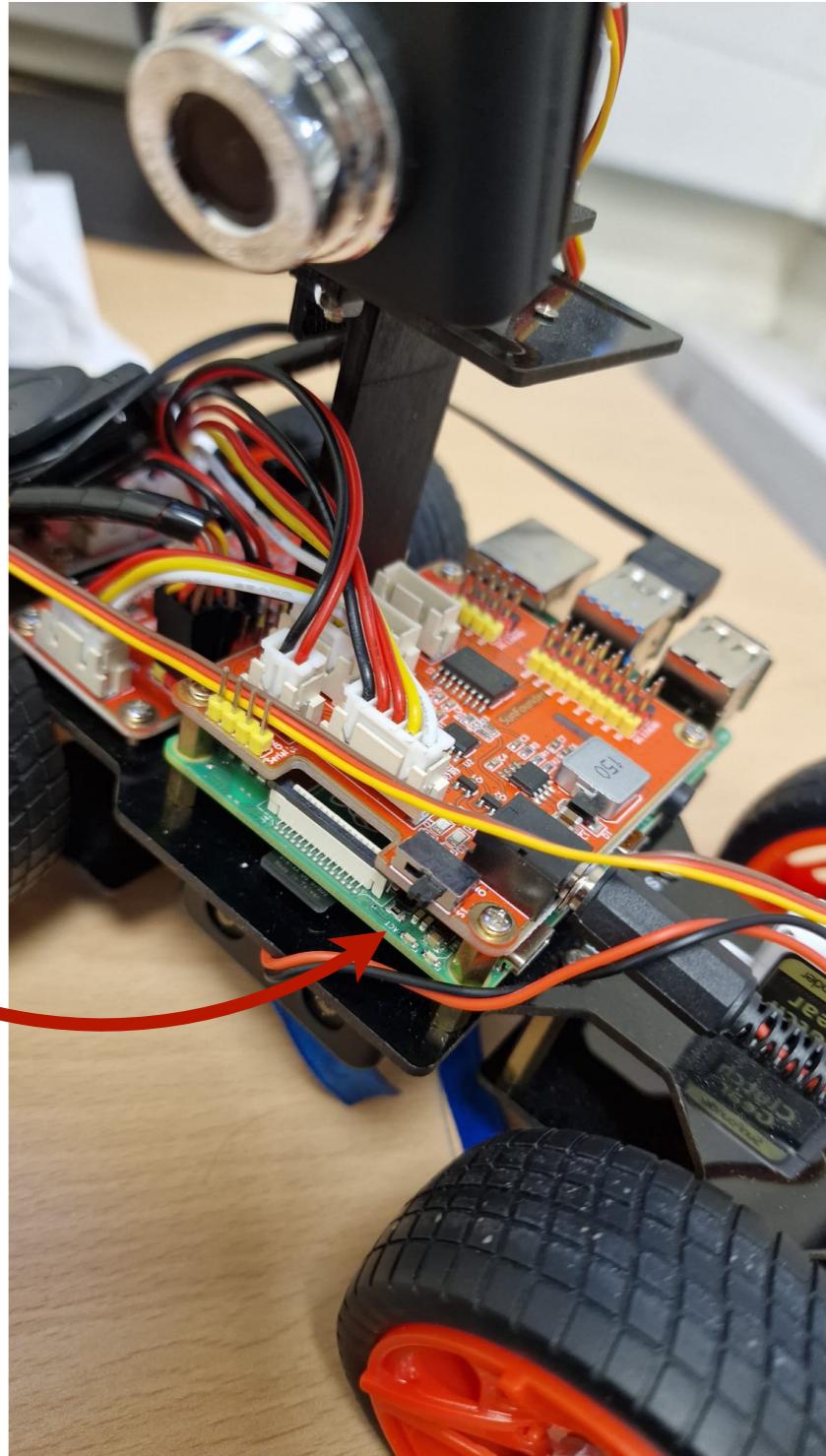


Set up:



Servos

On/off



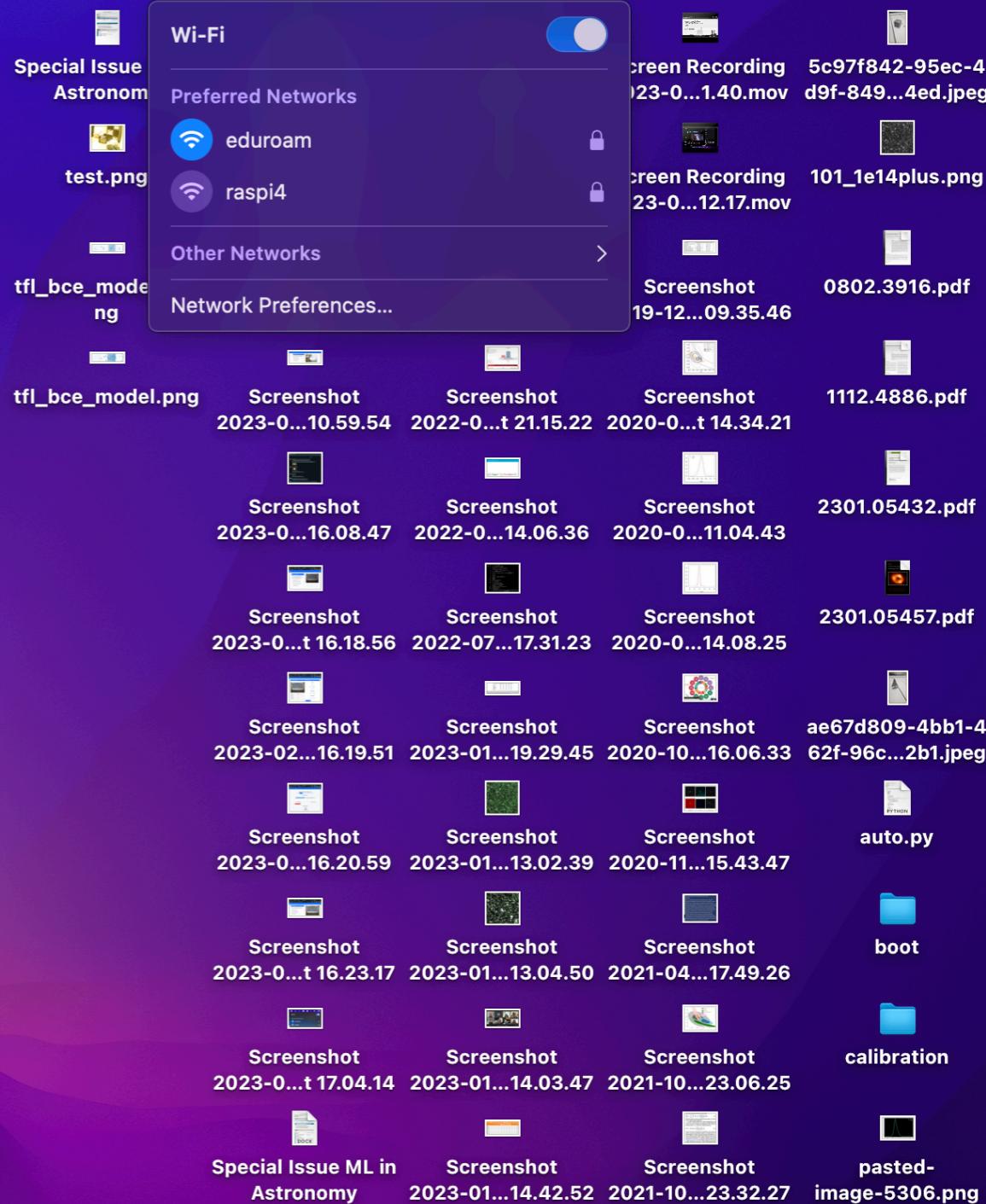


Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



 Keynote File Edit Insert Slide Format Arrange View Play Window Help



MLiS

Machine Learning in Science
School of Physics & Astronomy and Faculty of Science



Wifi: backprop



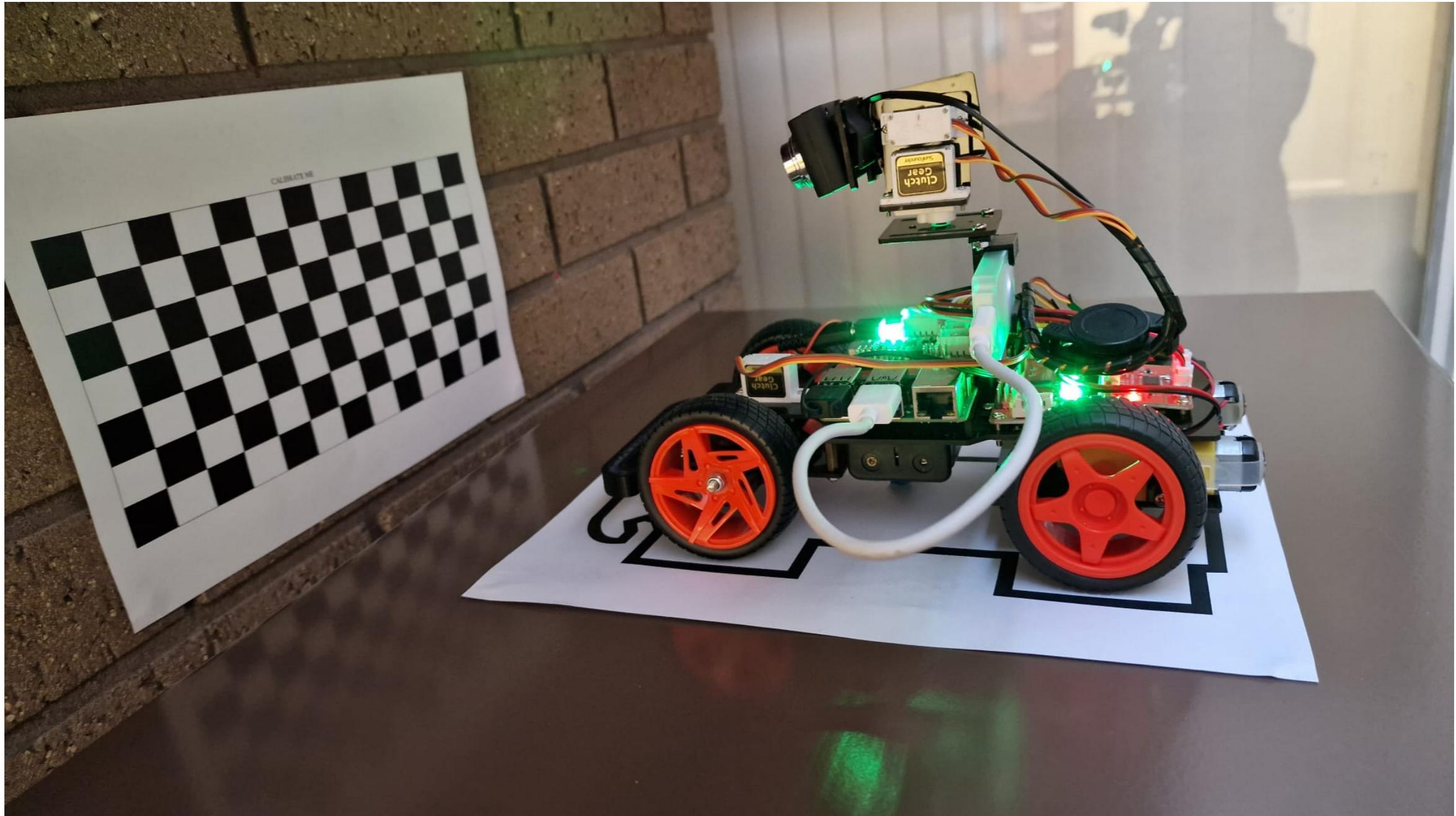
Calibrate:

The screenshot shows a web browser window with the following details:

- Address Bar:** The URL `192.168.50.1:8000` is highlighted with a red box.
- Navigation Bar:** Buttons for Back, Forward, Stop, and Refresh are visible. A warning icon indicates "Not Secure".
- Toolbar:** Includes icons for search, refresh, and various extensions.
- Header:** The page title is "MLiS" and the active tab is "Home", both highlighted with red boxes.
- Content Area:**
 - Welcome:** "Welcome to MLiS2!"
 - Text:** "If you can see the image your camera is working correctly. Using this browser interface you can:"
 - List:**
 - Manually drive your car
 - Start and stop recordings
 - Start and stop self-driving
 - Calibrate your car
- Image:** To the right of the content area, there is a live video feed from a camera. The feed shows an office environment with a desk, a chair, and a small robot car. A blue dotted grid is overlaid on the image, used for camera calibration.



Calibrate:





Calibrate:

value limits:
-30 - 30

Not Secure | 192.168.50.1:8000/calibration/ Error

MLiS Home Calibration About

Current Vehicle Configuration

Adjust Configuration

Camera

Up

Left Right

Down

Front Wheels

Left Right

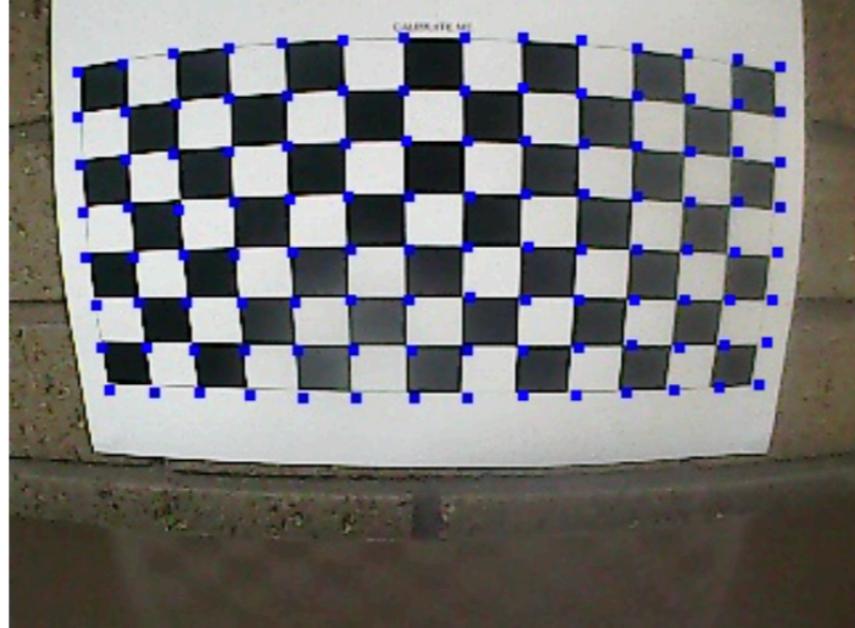
Back Wheels

Left Right

Save Settings

Variable Value

forward_A	1
forward_B	1
turning_offset	8
pan_offset	0
tilt_offset	0



**Drive:**

MLiS Home Control Calibration About

Speed (use spotters for ludicrous and plaid)

Back Stop Forward Ludicrous Plaid

Steering Angle: 0

-40 -30 -20 -10 0 10 20 30 40

Record Driving Full Self Driving

Select FSD Model

base
 maggie
 maggie_tpu
 maggie_tflite



Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Terminal

Shell

Edit

View

Window

Help



ppzml1 — -bash — 74x20

```
> ssh pi@192.168.50.1 #remote connect
```



Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Terminal

Shell

Edit

View

Window

Help



ppzml1 — -bash — 74x20

```
> ssh pi@192.168.50.1 #remote connect  
pi@192.168.50.1 password:  
> rasp
```



Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Terminal

Shell

Edit

View

Window

Help



ppzml1 — -bash — 74x20

```
> ssh pi@192.168.50.1 #remote connect  
pi@192.168.50.1 password:  
> rasp  
> cd SunFounder_PiCar-V/remote_control/capture/ #move to folder
```



Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Terminal

Shell

Edit

View

Window

Help



ppzml1 — -bash — 74x20

```
> ssh pi@192.168.50.1 #remote connect  
pi@192.168.50.1 password:  
> rasp  
> cd SunFounder_PiCar-V/remote_control/capture/ #move to folder  
> ls #list files
```



Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Terminal

Shell

Edit

View

Window

Help



ppzml1 – -bash – 74x20

```
> scp -r pi@192.168.50.1:SunFounder_PiCar-V/remote_control/capture/* .
```



Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Terminal

Shell

Edit

View

Window

Help



ppzml1 – -bash – 74x20

```
> scp -r pi@192.168.50.1:SunFounder_PiCar-V/remote_control/capture/* .  
> ls
```



Machine Learning in Science

School of Physics & Astronomy and Faculty of Science



Kaggle

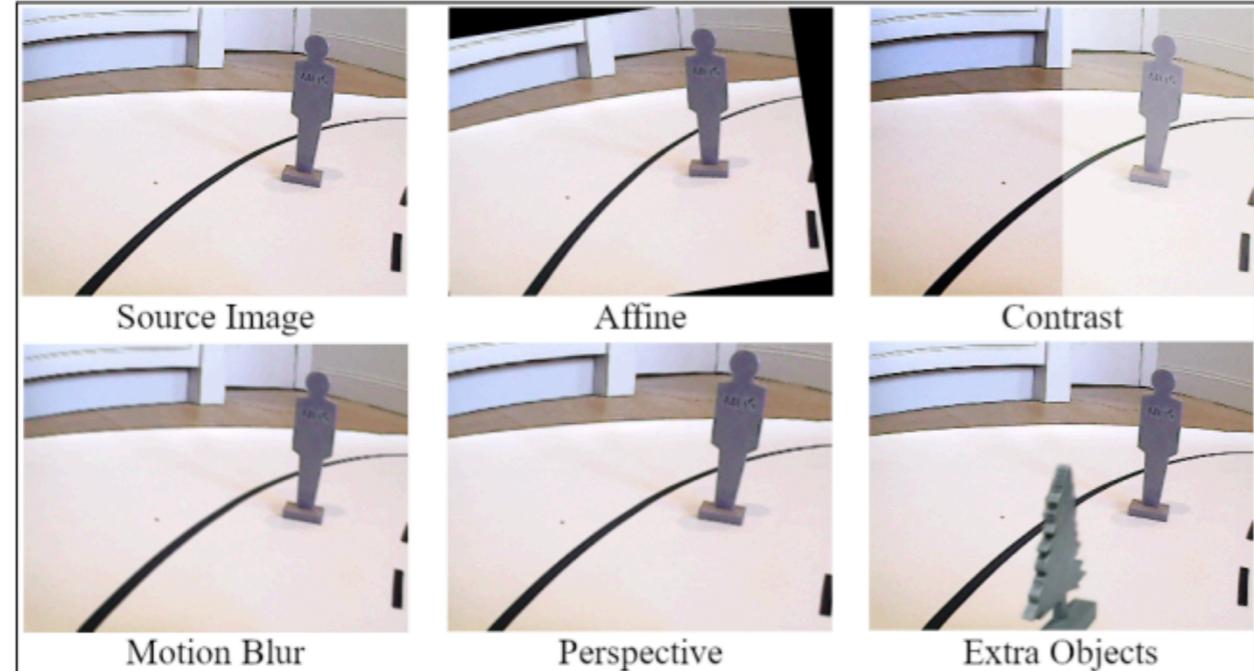
<https://www.kaggle.com/competitions/machine-learning-in-science-ii-2025>

Deadline: 28/03/2024

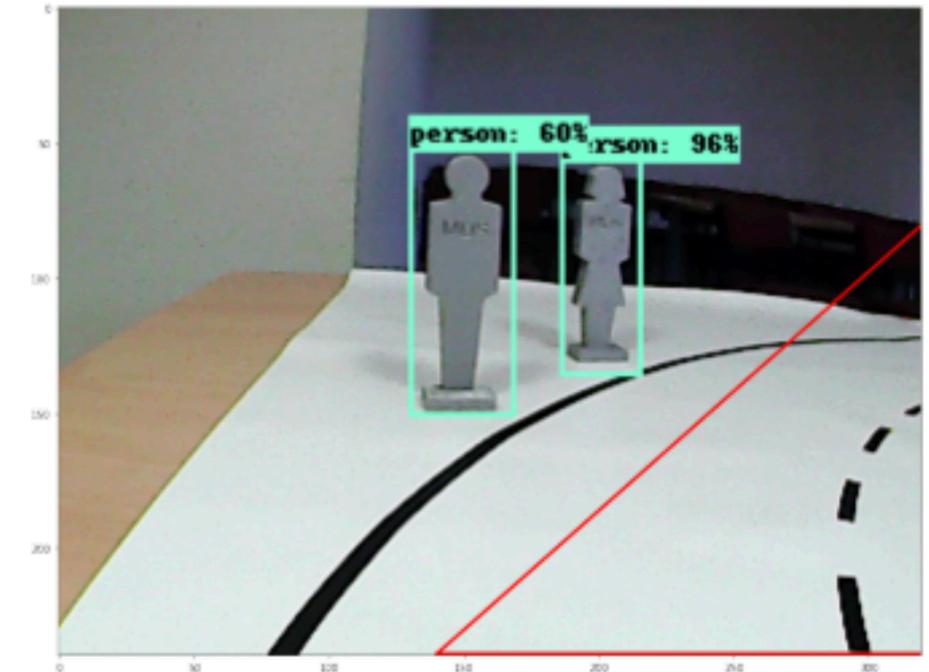
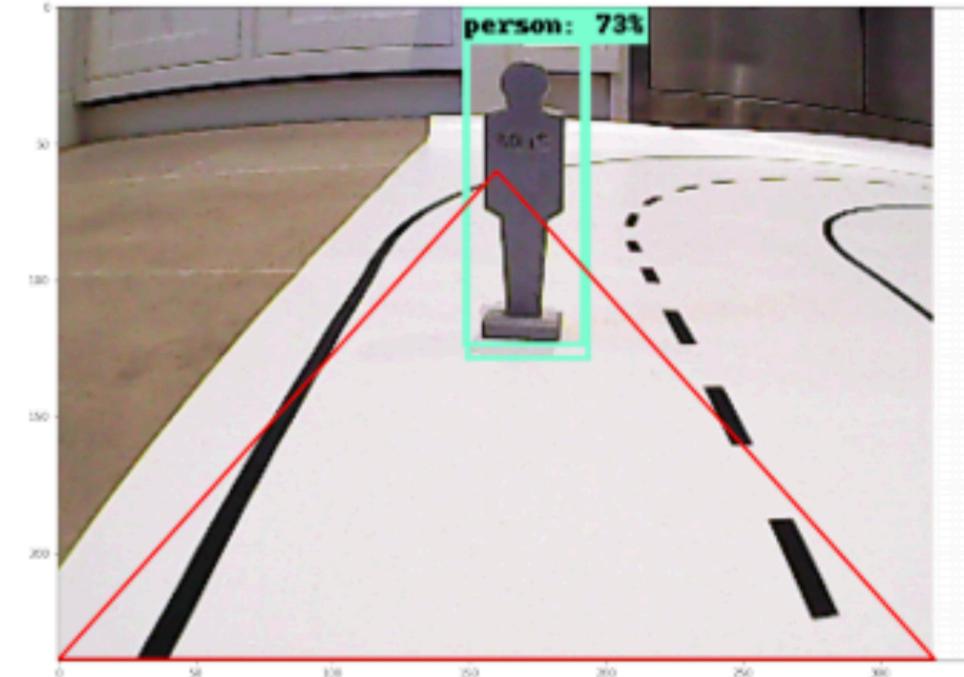


Results

- ▶ Apply knowledge
- ▶ Live test track
- ▶ Presentation & Report



Source: R. Marshall-Hawkes, O. Wiech



Source: A.Mahmood



Getting ready for the live testing

Car models stored in:

> /autopilot/autopilot/models/

Make model directory

> mkdir MyPiCarModel



Example: model.py

A screenshot of a Mac OS X terminal window. The title bar shows "Terminal" and the current directory is "/autopilot/autopilot/models". The command "ssh pi@192.168.50.1" is also visible. The terminal window displays a Python script named "model.py". The script imports TensorFlow Keras, NumPy, imutils, cv2, and os. It defines a class "Model" with methods for initializing the model, preprocessing images, and predicting angles and speeds from images. The code uses cv2.cvtColor to convert images to YUV format, imutils.resize to resize them, and np.clip to normalize the predicted angle and speed values back to car units.

```
from tensorflow import keras
import numpy as np
import imutils
import cv2
import os

class Model:

    saved_model = 'autopilot.h5'

    def __init__(self):
        self.model = keras.models.load_model(os.path.join(os.path.dirname(os.path.abspath(__file__)), self.saved_model))
        self.model.summary()

    def preprocess(self, image):
        image = cv2.cvtColor(image, cv2.COLOR_BGR2YUV) / 255.0
        image = imutils.resize(image, width=80)
        image = image[int(image.shape[0] / 4):, :, :]
        return image

    def predict(self, image):
        image = self.preprocess(image)
        angle, speed = self.model.predict(np.array([image]))[0]
        # Training data was normalised so convert back to car units
        angle = 80 * np.clip(angle, 0, 1) + 50
        speed = 35 * np.clip(speed, 0, 1)
        return angle, speed

(END)
```



Getting ready for the live testing

Run model

```
> python3 run.py --model base  
> python3 run.py --model base --mode drive --duration 60
```



Teams

> Teams of 2-3 emailed to us by end of Friday