UNIVERSITY OF SUSSEX

LUANAR

AI AND DATALOGGING COURSE

G U I D E

This course is designed to develop hardware and machine learning skills for those with basic Python knowledge. We will develop data collection methods, gather datasets, and apply machine learning on these datasets.

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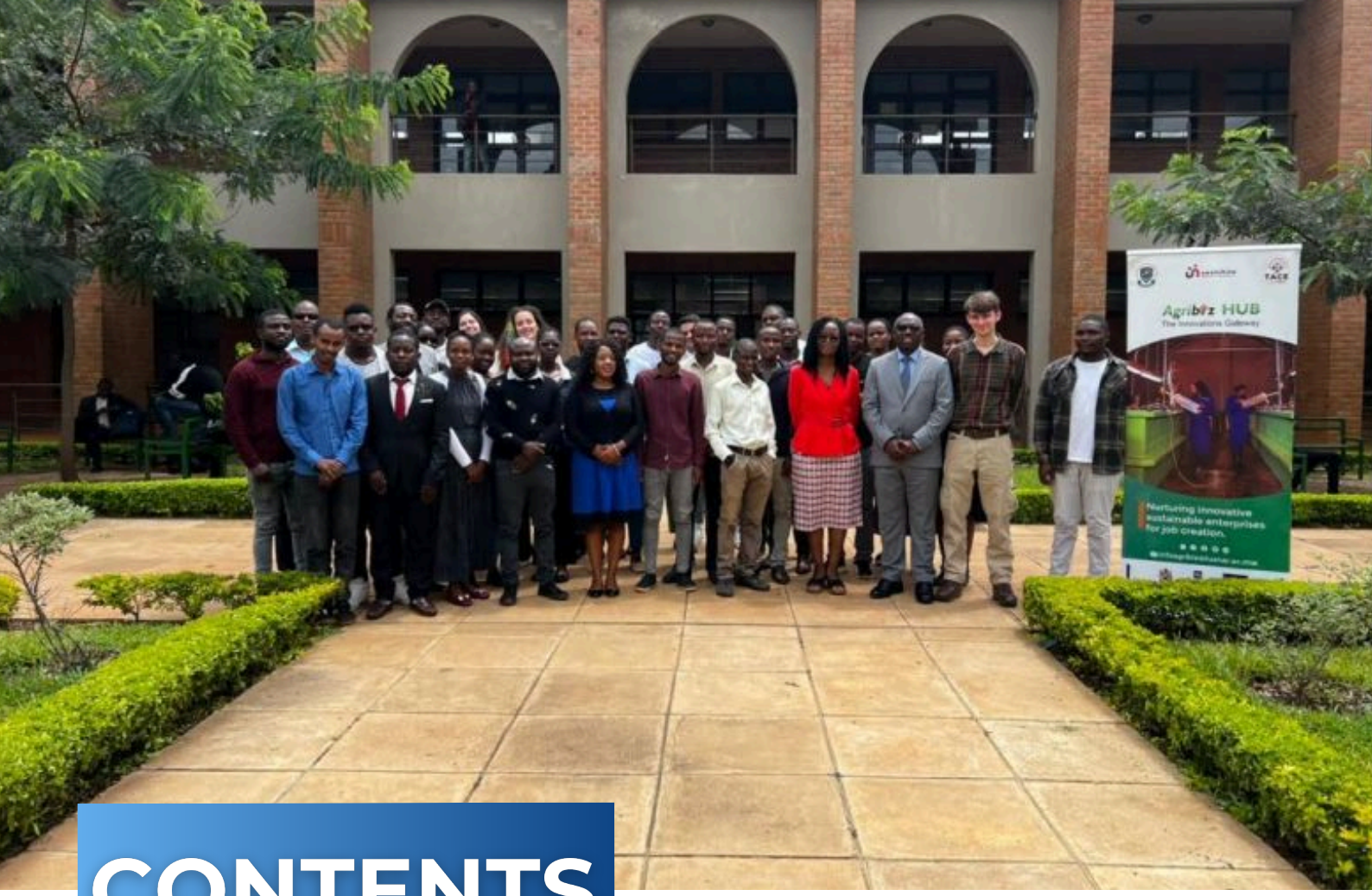

CONTENTS

FACILITATORS

- Alejandra Carriero

- Paula Seidler

- Elizabeth Bandason

- Dexter Shepherd

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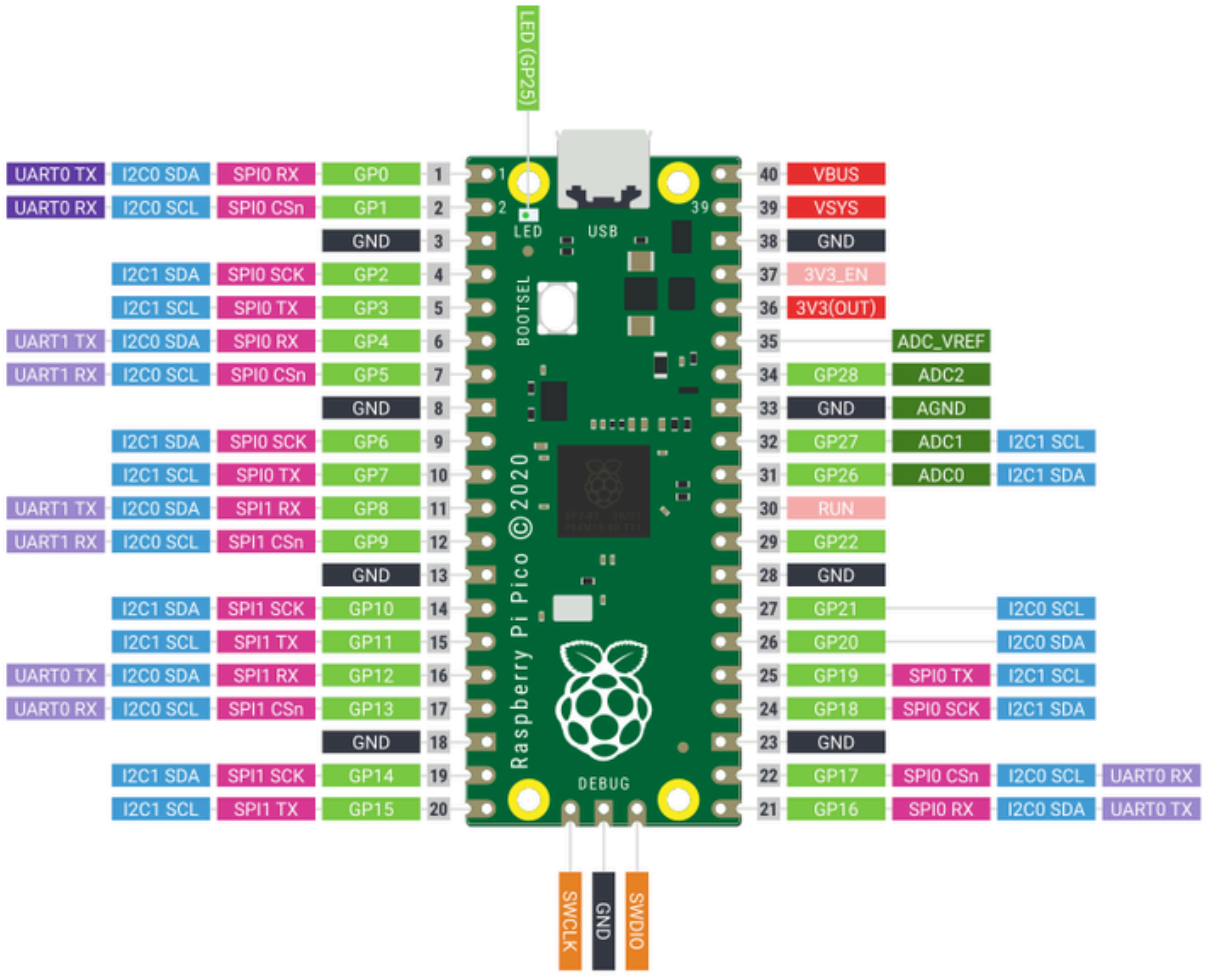
RASPBERRY PI

PICO

Raspberry Pi Pico is a low cost, high-performance microcontroller board built around Raspberry Pi's very own chip - the RP2040. SImilar to Arduino, we can upload code directly onto the board to run. What is also great is it runs Python! So no need to learn more complex languages such as C/C++.
These boards cost around $4 and are capable of running machine learning algorihtms.



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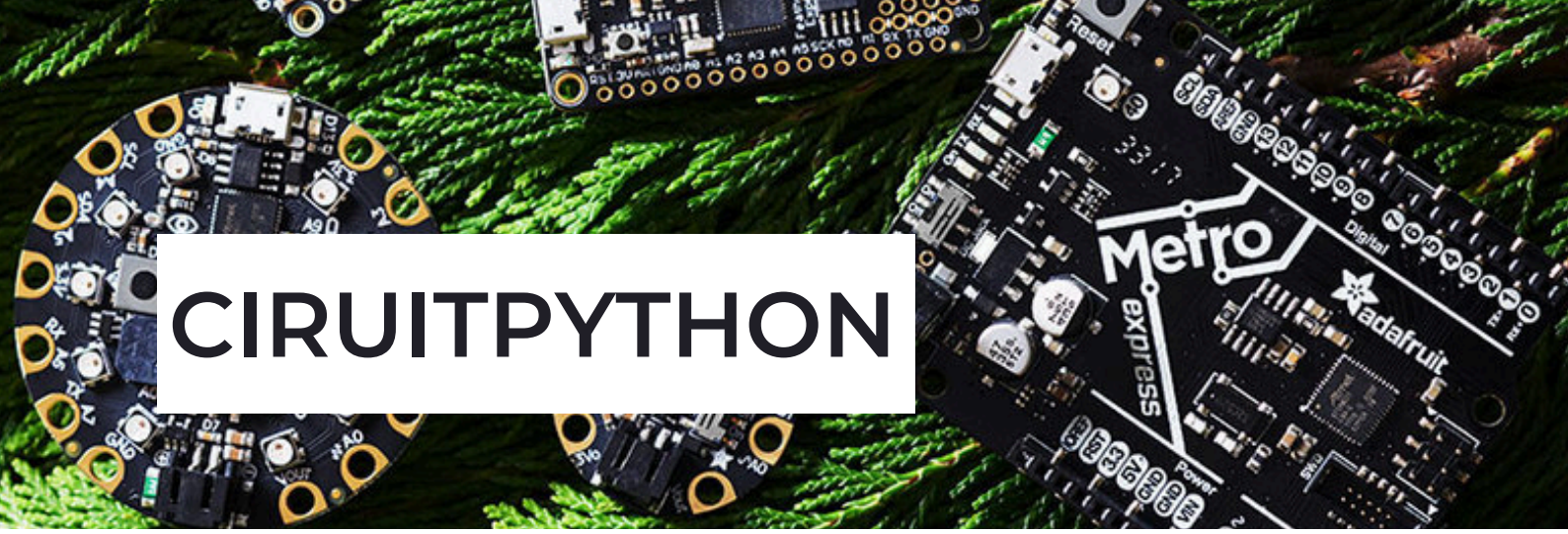


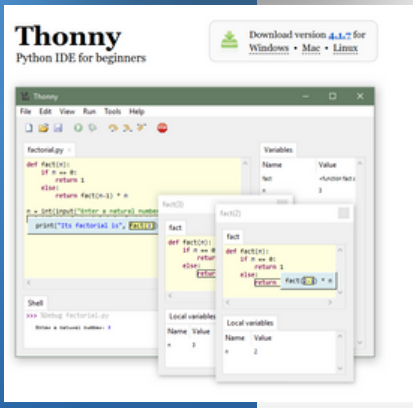
CIRUITPYTHON

CircuitPython is an open-source derivative of the MicroPython programming language targeted toward students and beginners. Development of CircuitPython is supported by Adafruit Industries. It is a software implementation of the Python 3 programming language, written in C. It has been ported to run on several modern microcontrollers.

```
import board
import digitalio
import time
import analogio
```

USEFUL LIBRARIES

board - allows interaction with the pins
digitalio - allows interaction with the GPIO pins for digital input and output
time - allows delays in the python code
analogio - allows interaction with analogue pins



USEFUL WEBSITES

https://docs.circuitpython.org/en/latest/docs/index.html - docs
https://www.raspberrypi.com/documentation/microcontrollers/pico-series.html - pico docs
https://stackoverflow.com/questions - finding support
https://thonny.org/ - Thonny IDE needs to be installed

```
analog_pin = analogio.AnalogIn(board.A0)
digital_pin = digitalio.DigitalInOut(board.D2)
digital_pin.switch_to_input(pull=digitalio.Pull.UP)
led_pin = digitalio.DigitalInOut(board.D13)
led_pin.switch_to_output()

while True:
    # Print analog and digital values
    print(f"Analog: {analog_pin.value}, Digital: {digital_pin.value}")

    # Control LED based on digital input
    led_pin.value = digital_pin.value

    time.sleep(0.5)
```

we can call in digital and analogue pins as input or output devices. To read an input device we can look at the .value, in the same way we can change the .value to be a 1 or 0 for outputting voltage to hardware.

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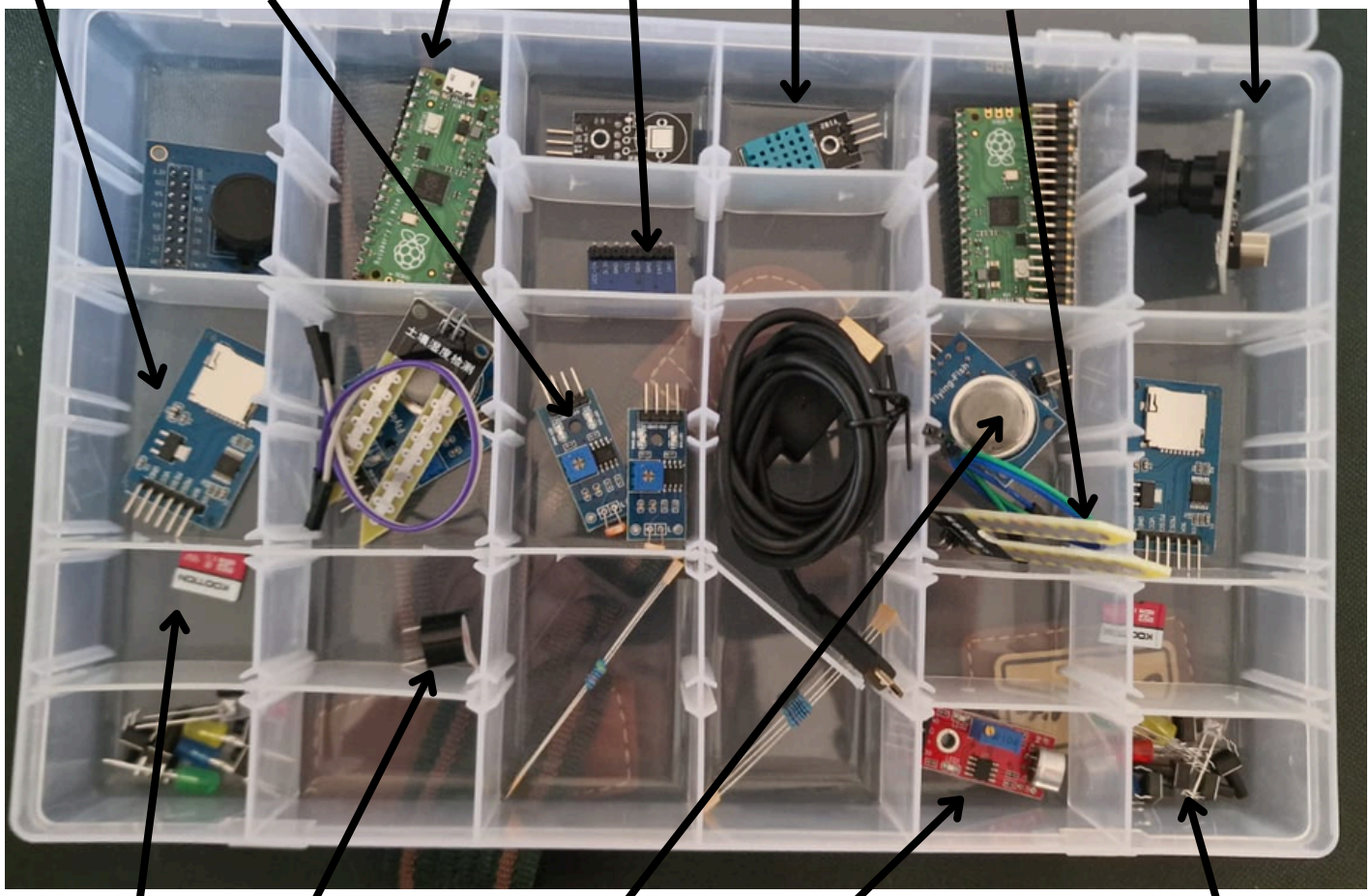
THE KITS

The kits are designed to be one between 4-8 people. Make sure to share sensors if your kit is missing some.



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SCHEDULE

The exact timings are variable to change, depending on the university and transportation. This will be relayed in advance. Lectures will last between 1-2 hours. Some overrun, some will be under. This leaves plenty of time for questions and independent study.

WEEK 1

Timetable	Mon	Tue	Wed	Thu	Fri
Lecture (1.5 hours)	Introduction of course and who we are	Intro to electronics, input and output devices. What boards exist currently and the benefits and trade offs of these. How sensors work. How Python and hardware come together for science.	Data logging - why do we do it and how do we do it? The basis of science requires data. What storage should be used for what? Going through the mechanics of storage and how to add it to a device. What is a useful format to store data in and read on the PC	Visualising data - what makes a good graph, what graphs do you use for what. Making something clear. Making a dataset - on Kaggle what open datasets are and how to make your dataset accessible and useful. Importance of documentation and making others want to use your data, and to trust it	Machine learning on circuitpython devices, and coming up with plan for the day
Practical (2 hours)	Going through Python examples as a group and solving challenges.	Making buttons that give options, based on the button press, different LEDs go off. The tasks will build them up to developing a game to be given a sequence, and have to relay it.	Wiring up SD cards and logging data in a useful format. Looking out for memory overload. Having code that can visualise this on the PC. Start integrating sensors in and storing this.	Designing something compact that they want to use to log data. Options will mainly be camera for image recognition tasks,	In the field gathering datasets based on the devices they have built so far.

WEEK 2

Mon	Tue	Wed	Thu	Fri
What is prediction and the different types of learning. Regression	Classification models (SVM, random forest, clustering)	Classification models and Neural models	Augmentation and scaling data	Interesting AI
No lab - just catch up session	Applying regression and clustering algorithms on data Applying to their own datasets	Classifying existing datasets Applying this to their own dataset	Working with different data types and scaling these	Individual presentations

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