Pre-lab Assignment-1

A Raspberry Pi is a small, affordable, credit card-sized single-board computer developed by the Raspberry Pi Foundation. It can be used in a wide range of IoT-driven applications, including home automation, weather stations, smart surveillance systems, etc. Raspberry Pi runs on its own operating system called Raspberry Pi OS (formerly Raspbian). This is a Debian-based 32-bit Linux distribution developed by the Raspberry Pi Foundation. *It is more than just a microcontroller, it is a "microcomputer", which makes it a very powerful computing edge device for Internet of Things (IoT).* To get started with the Raspberry Pi, you will need to prepare the small, affordable microcomputer for use. We start with setting up the Raspbian OS as follows:

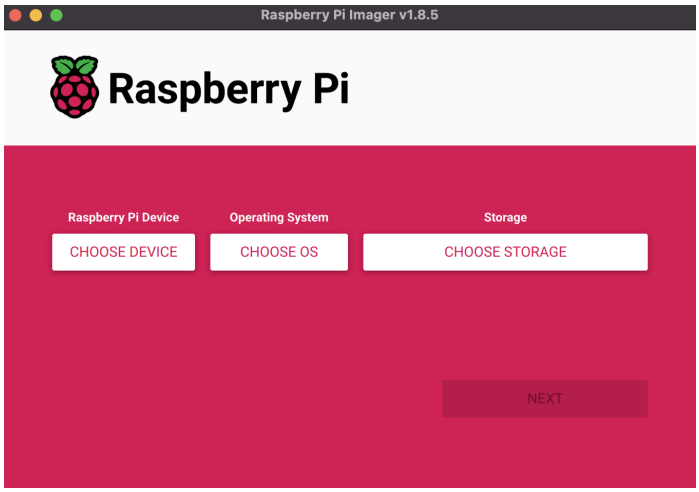
Components Required:

1. Raspberry Pi
2. HDMI Cable
3. Raspberry Pi Camera
4. Raspberry Pi Power Supply
5. SD Card
6. SD Card Reader
7. Monitor, Keyboard Mouse.

***Note**: You can use the computers in the IoT lab CS 1109 for setting up your PI and use your NetID credentials to login.*

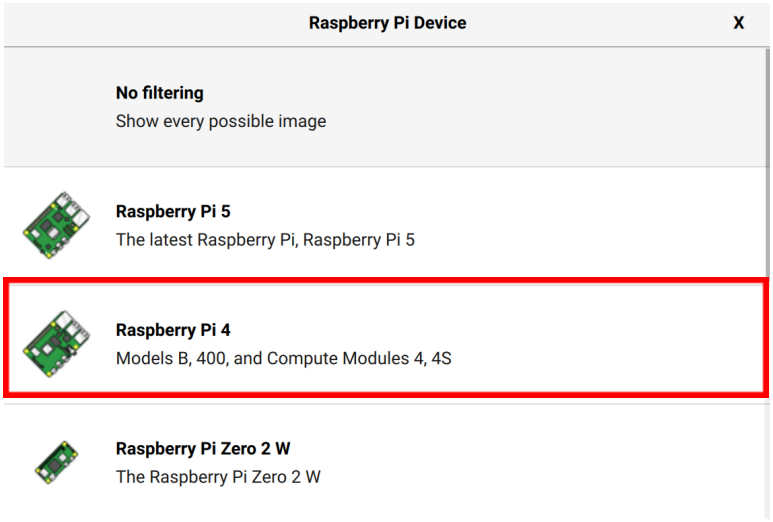
1- RPI Setup:

1. Insert the SD card into the SD Card reader and plug it into your machine (preferably your personal laptop for now).
2. Install the Raspi SD card Imager from here:

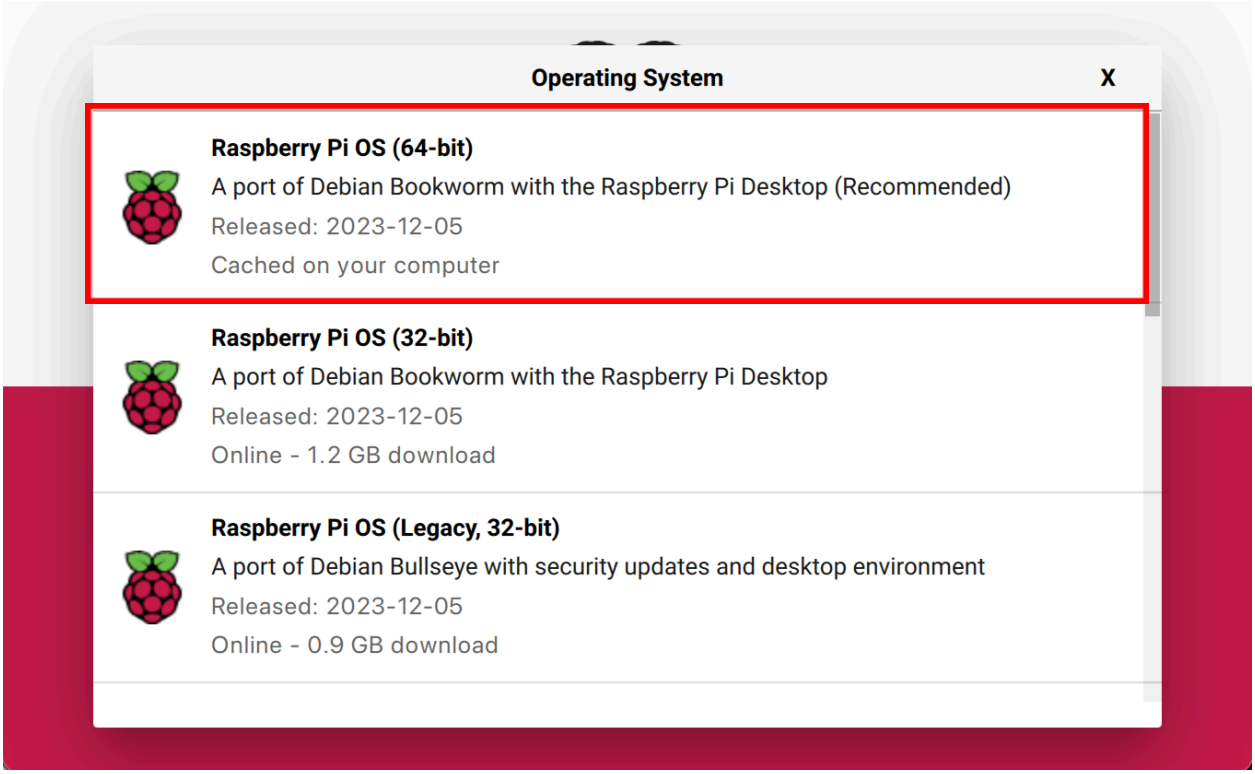


Source: https://www.raspberrypi.com/software/

3. Select Choose Device
4. Select Raspberry Pi 4



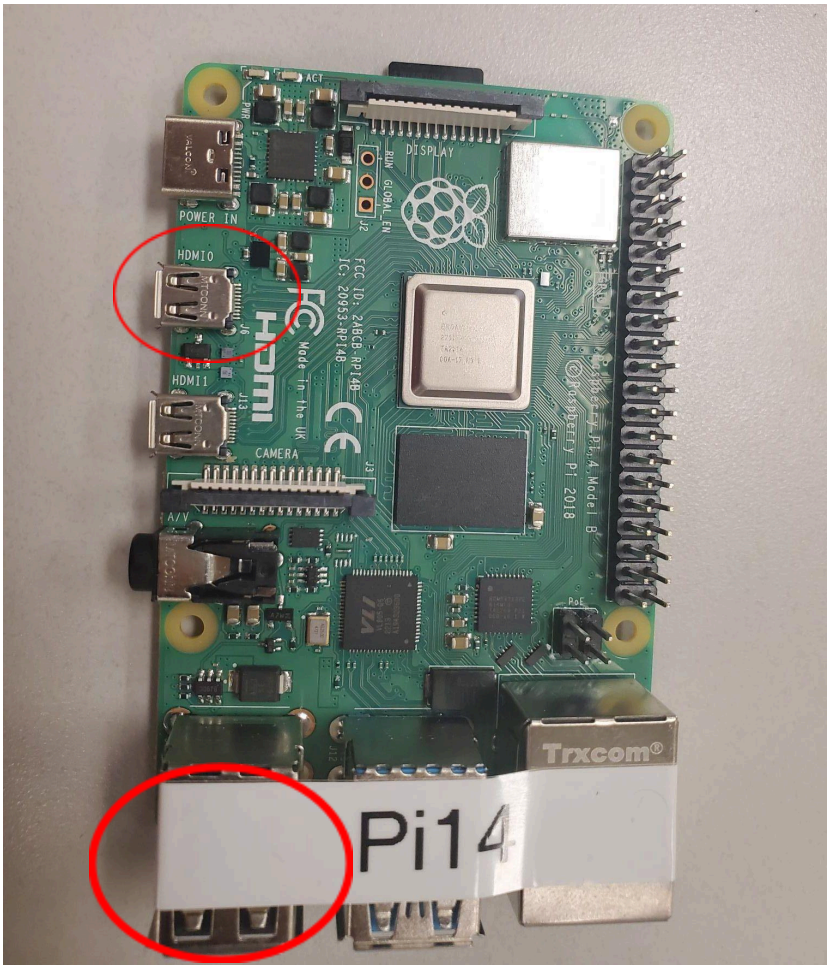
5. Select Choose OS
6. Select Raspberry Pi OS (64-bit)



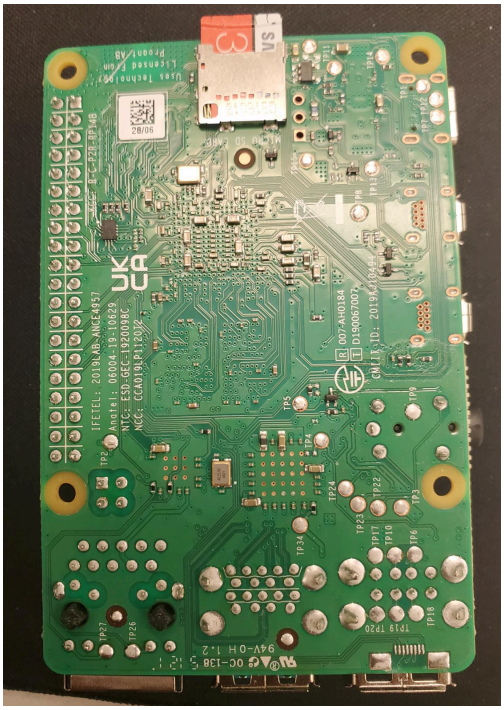
7. Once selected, go back to the original window and Select Choose Storage.

If your SD card reader is inserted properly, it will detect and show a MASS storage option. Select that.

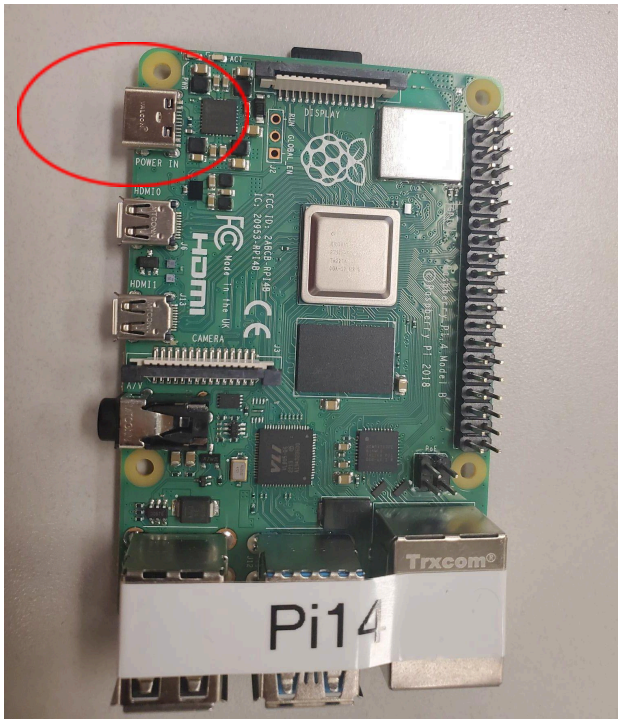
8. Select the Write Option
9. This will start flashing your SD card with the Raspberry Pi image.
10. Once completed, make sure you have the requisite components to power up your Pi. In order to get a desktop view of the Raspberry Pi, you need to connect your Raspberry Pi to the monitor using the HDMI cable (HDMI to micro HDMI cable is provided to you in the kit). Connect the Keyboard and Mouse to the USB ports of the Raspberry Pi.



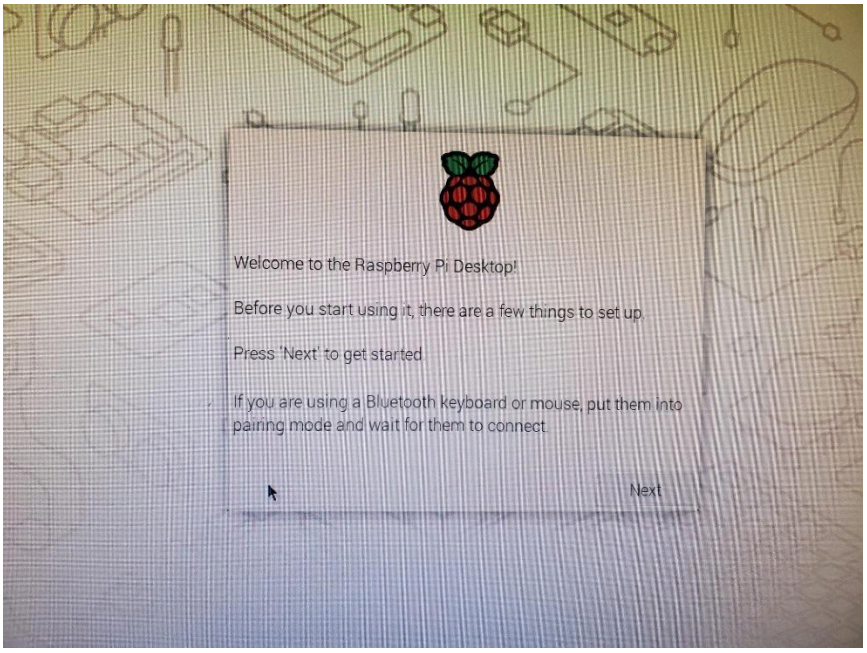
11. Insert the SD card into the SD Card port of Raspberry Pi.



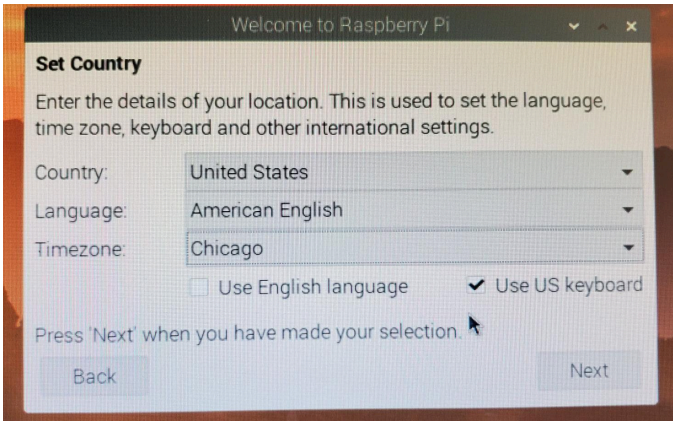
12. Turn ON your Raspi by connecting it to the power supply.



13. On booting, it will display the following screen (use the monitors in Lab 1109):

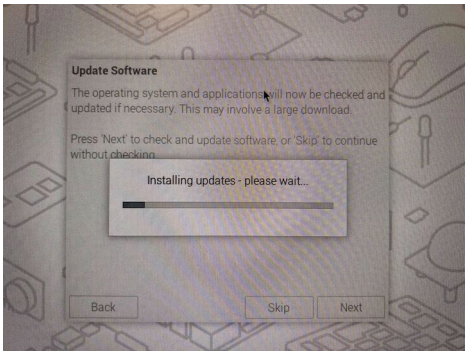


14. Click Next
15. Select the Country, Language, and Time Zone

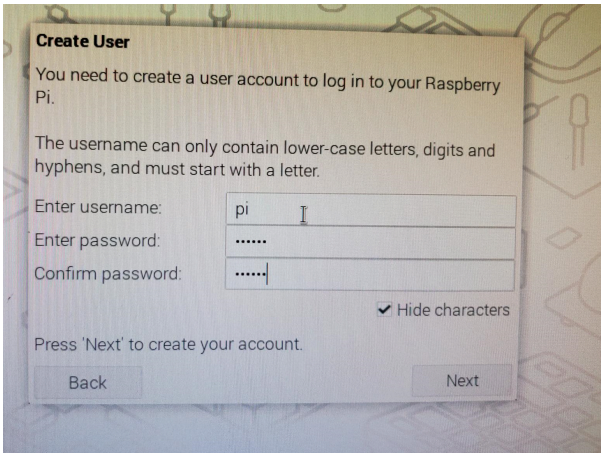


Check the box for Use English Language and Use US Keyboard.

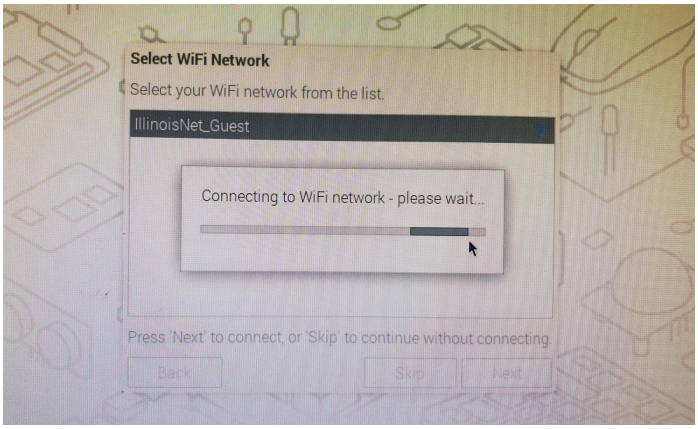
NOTE: At any point, if it asks to install updates, choose Skip – 'continue without checking'



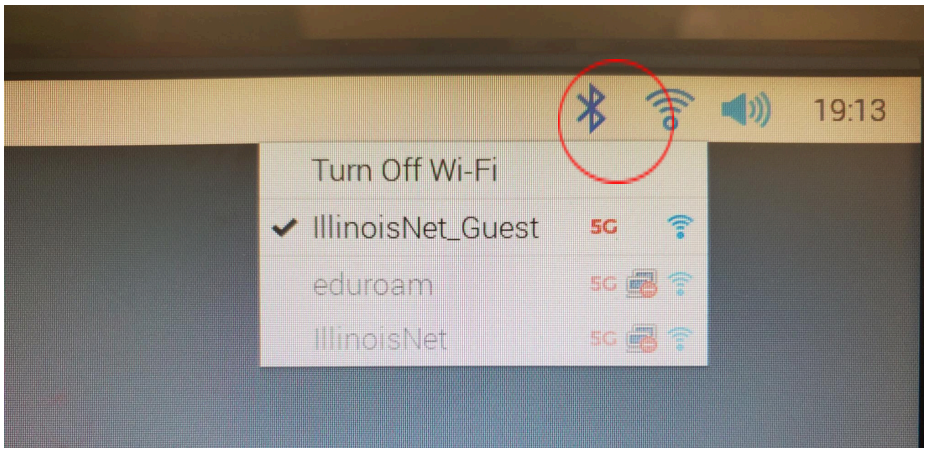
16. Set up a name and password for your Raspberry Pi. **User Name: pi, Password: 123456**



17. If you are in the Illinois network, connect to the IllinoisNet_Guest network in the next window prompt.



18. Once the installation is complete, select the Wi-Fi icon from the Desktop and Connect to IllinoisNet_Guest



19. Open the browser and set your credentials to connect to the **IllinoisNet_Guest.**

20. Check your System Date:

If your Raspberry Pi shows an incorrect Date and time, use the following command to set the date and time (open the terminal window and enter the following command, replacing the date and time with the current one):

>> sudo date --set '2023-11-31 20:45:00'

21. Get your Raspberry Pi's MAC address using the following command from a terminal:

>> ifconfig

MAC address is the one with wlan0 ether *aa:bb:cc:dd:ee:ff*

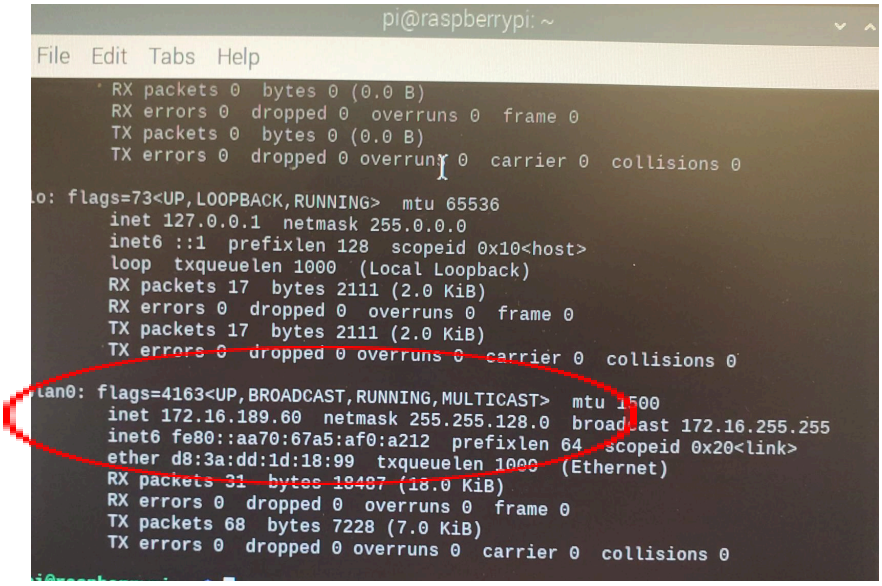
22. Register the MAC address of your Raspi in the following link:

https://clearpasspub.techservices.illinois.edu/guest/auth_login.php?target=%2Fguest%2Fmac_list.php

(Note: If this fails with a message such as the "MAC Address is already registered," you do not need to do anything else, the Pi has already been connected to the internet, and this step is complete)

23. Check your IP address using the following:
>> ifconfig

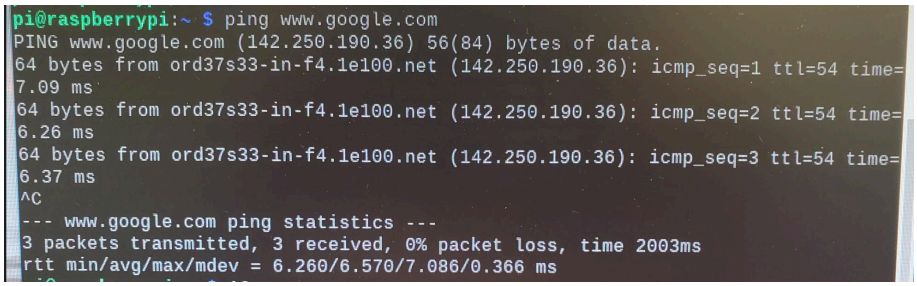
The IP address should be displayed with wlan0 interface as shown below:



If connected to IllinoisNet_Guest, the IP address will start with 172.16.xx.xx. To make sure you are connected, try pinging www.apple.com on the terminal window.

>> ping www.apple.com

If successful, you will observe ping(icmp) response messages as shown below, implying that you are connected to the network.



Once connected to Wi-Fi, run the following commands to update applications and packages from the terminal window:

>> sudo apt update

>> sudo apt upgrade

24. Install the sense-hat module using the following command:

    >> sudo apt install sense-hat

25. Make sure the I2C is enabled on your Raspi. To do that, run the following command on the terminal:

>> sudo raspi-config

>> Select Interface Options

>> Select I2C

>> Select <YES> when prompted with “Would you like the ARM I2C interface to be enabled?”

>> Hit OK, and Select <<Finish>>

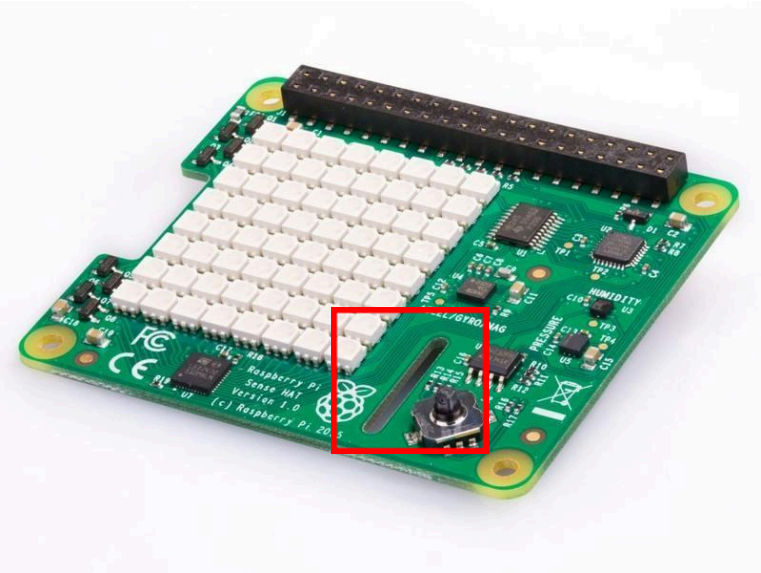
26. Reboot your Pi to apply the changes.

Installing Sense Hat with Camera:

To install the Sense Hat, first make sure all peripherals are disconnected, especially the camera.

Next run the camera through this hole on the Sense Hat. DO NOT CONNECT THE SENSE HAT YET. Make sure that the blue tab is facing the right way. You can check this by lining the Sense Hat with the Pi and matching the black pin connectors with the large array of pins on the

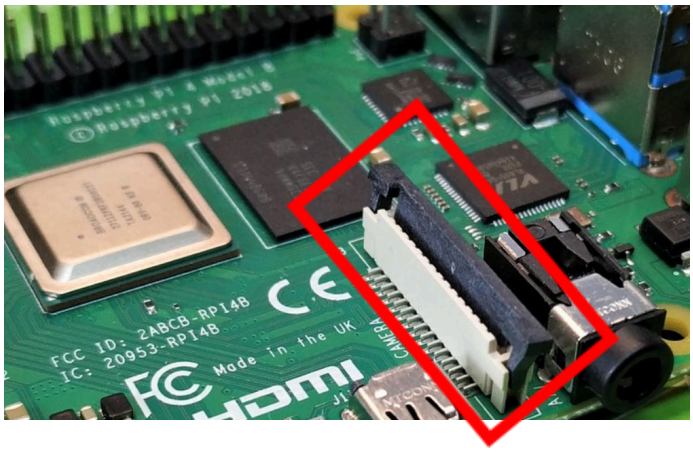
Raspberry Pi. Once the camera is through the Sense Hat, install the camera (instructions are below). Then connect the sense hat to the pi.



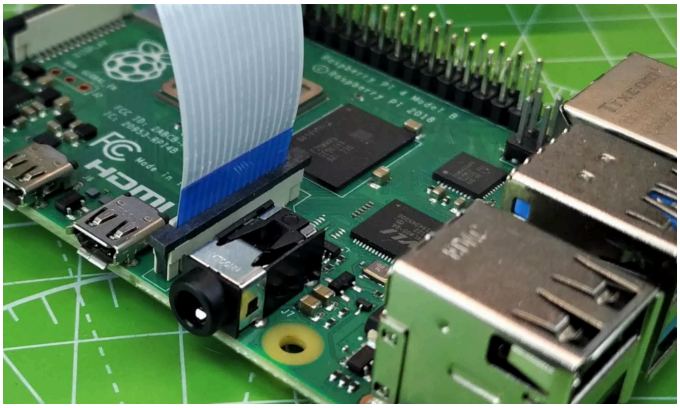
You can keep this configuration of the raspberry pi, sense hat and camera for the rest of semester.

Camera Setup:

1. Power OFF the raspberry pi. Connect the Camera module to the camera port on your raspberry. Lift the tabs of the camera port .



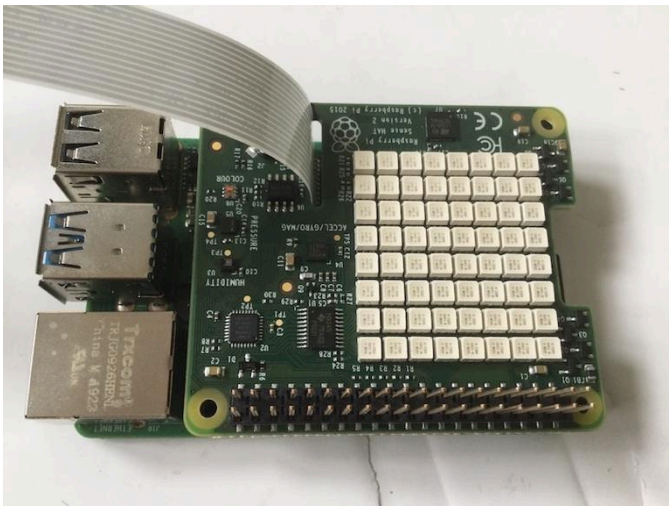
2. Insert the camera cable with the blue tab facing the USB/Ethernet port as shown below.



Source: https://www.tomshardware.com/how-to/use-picamera2-take-photos-with-raspberry-pi

3. Gently slide the tabs down to lock the camera cable in place.

   It should finally look like this:



27. Now power up your Raspberry Pi. Open Thonny** python IDE from the Desktop and write the following code to measure temperature:

```
from sense_hat import SenseHat

sense = SenseHat()
sense.clear()

temp = sense.get_temperature()
print(temp)
```

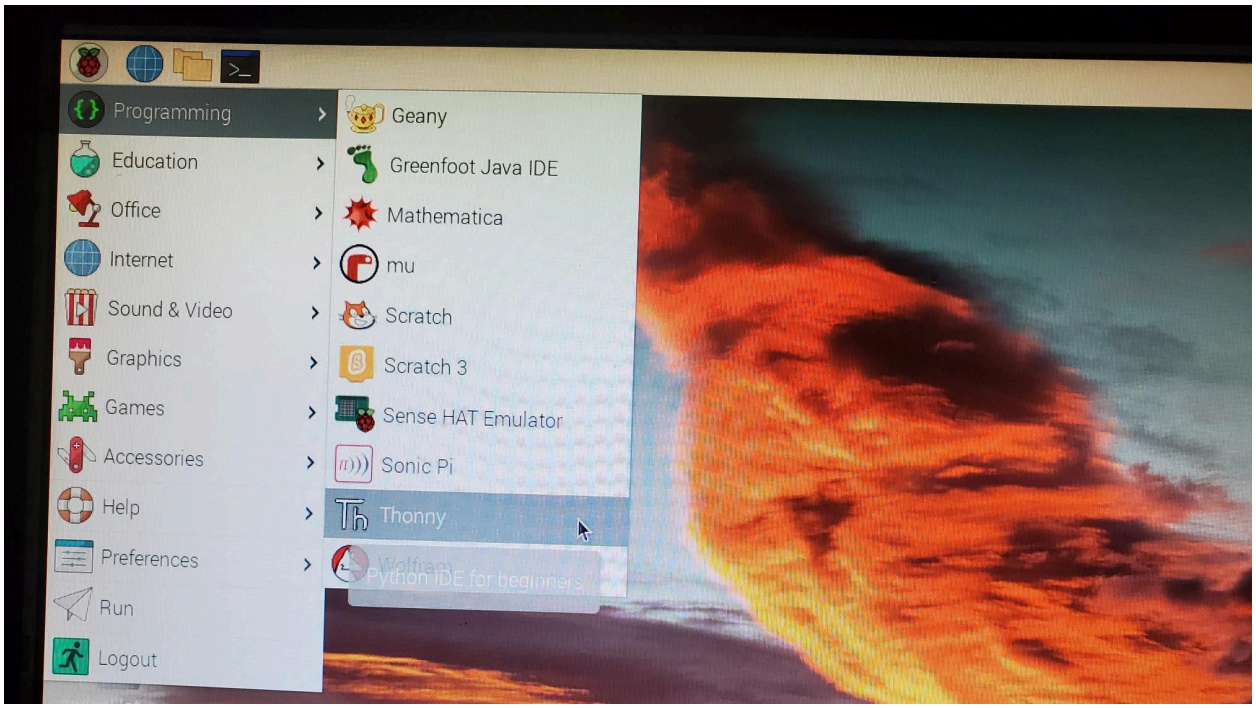
If successful, you should see an output (temperature sensor reading in Celcius) like the following on your console:

35.127749180

If there are any errors, check that your sense-hat library is installed, and verify if the Sense Hat is properly inserted into the Raspi's GPIO pins. For other troubleshooting techniques while using the Sense-Hat module, refer to this and Raspberry Pi Community Forum.

Python IDE on Raspberry Pi:

Python is the main programming language for programming Raspberry Pi as a device. There is also support for other programming languages like Java, but we will be using Python to build applications in this course. Raspberry Pi supports a host of different IDEs that you can use to write your own programs/applications on the Pi, such as Geany, Mu, Thonny, etc. In this course, we will utilize Thonny as the programming environment for creating applications on Raspberry Pi. You can access Thonny from the Desktop GUI of your Raspberry Pi, as shown below:



Alternatively, you can also run your Python scripts on Raspberry Pi via the terminal window using the following command:

```
>> python3 hello_world.py
```

Connecting Raspberry Pi Camera

We will be using the Raspberry Pi Camera V3 module, which is the latest compact camera from Raspberry Pi. It features autofocus and a 12-megapixel sensor and is supported by Raspberry Pi's Picamera2 Python Library. It gives you excellent image quality with precise control.

Now enable I2C.

> >> Select Interface Options
>
> >> Select I2C
>
> >> Select <<YES>> when prompted with "Would you like the ARM I2C interface to be enabled?"
>
> >> Select OK
>
> >> Select <<Finish>>
>
> >> Reboot your Pi

Test if your camera is getting detected by the Raspberry Pi.

We use the built-in libcamera software library to access the camera module. The library is pre-installed in the latest version of Raspbian OS. Run the following commands on a terminal window:

> >> libcamera-hello

This will start the camera and display the preview window. If it is not able to detect any cameras, try fixing the camera's cable to the port (while the Raspberry Pi is turned OFF) or check your OS version.

> >> libcamera-jpeg -o test.jpg

This will capture a full-resolution JPEG image.

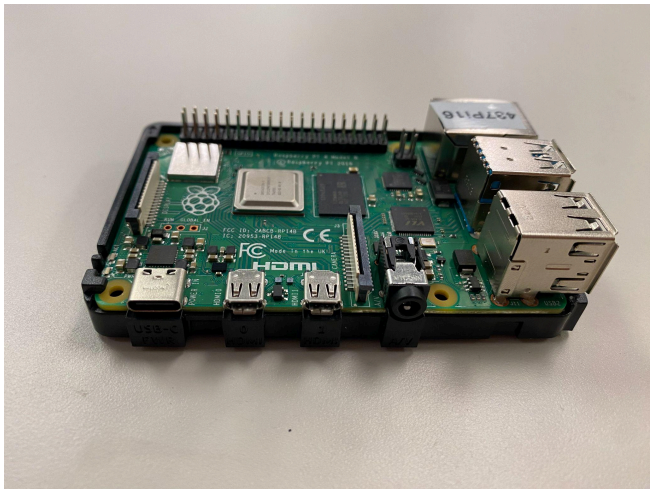
For more options on using libcamera, refer to this

Case Setup

The raspberry pi tends to run very hot after just running for a couple of minutes (enough to burn to the touch). It is a good idea to use the Raspberry Pi case to protect your hands from heat exposure.

1. Take the Case from its package box and take out just the lower tray. It looks like this:

2. Put the Pi into this case. You will have to slide it in. There is no click, but the Pi should be secure in place. It should look like this:



Pre-Lab Deliverable:

Take a short video of your operating raspberry pi and printed temperature. While taking the video, touch the temperature sensor (FYI, temperature is indirectly measured by the Humidity and pressure sensor, both of which are labeled) for a few seconds and print the temperature again to show the change. Additionally, Use the Pi camera to take a photo of you and your partner. Show this in the video as well. Upload the URL of your video to the Canvas Pre-Lab 1 Assignment (one upload per team is enough, make sure you are in a Lab/Project Group in Canvas before submitting)