UNITED INTERNATIONAL UNIVERSITY (UIU)
Dept. of Computer Science & Engineering
Course No: CSE 4326
Course Title: Microprocessors and Microcontrollers Laboratory

Experiment No. 03: Introduction to Raspberry Pi (Gen 4 Model B/B+).

Objective:

Raspberry Pi is defined as a minicomputer the size of a credit card that is interoperable with any input and output hardware device like a monitor, a television, a mouse, or a keyboard – effectively converting the set-up into a full-fledged PC at a low cost.
Raspberry Pi is a programmable device. It comes with all the critical features of the motherboard in an average computer but without peripherals or internal storage. To set up the Raspberry computer, you will need an SD card inserted into the provided space. The SD card should have the operating system installed and is required for the computer to boot. Raspberry computers are compatible with Linux OS. This reduces the amount of memory needed and creates an environment for diversity.

Raspberry Pi Launch History:

The Raspberry Pi is a microprocessor rather than a microcontroller. It is larger than the ordinary microcontroller, consumes more power, operates at 700MHz-1.5GHz, and has 1-8GB of RAM. In addition, unlike microcontrollers, the Raspberry Pi can run both 32-bit and 64-bit programs. There are many versions of Raspberry-pi released to date.

- In February 2012, the first iteration (the Raspberry Pi Model B) was introduced, followed by the Model A, which was simpler and less expensive.

Figure:1 Raspberry Pi Model B Board

- The Raspberry Pi Model B+, a board with an enhanced design, was introduced by the Foundation in 2014. These first-generation boards include ARM11 processors and are about the size of a credit card. They are the typical mainline form factor. A year later, improved A+ and B+ models were launched. In April 2014, a "Compute Module" for embedded applications was launched.

Figure:2 Raspberry Pi Model B+ Board

- In February 2015, the Raspberry Pi 2 was introduced, having a 900 MHz 32-bit quad-core ARM Cortex-A7 CPU and 1 GB RAM. A 900 MHz 64-bit quad-core ARM Cortex-A53 CPU was included in Revision 1.2. (The same as that in the Raspberry Pi 3 Model B, but underclocked to 900 MHz).

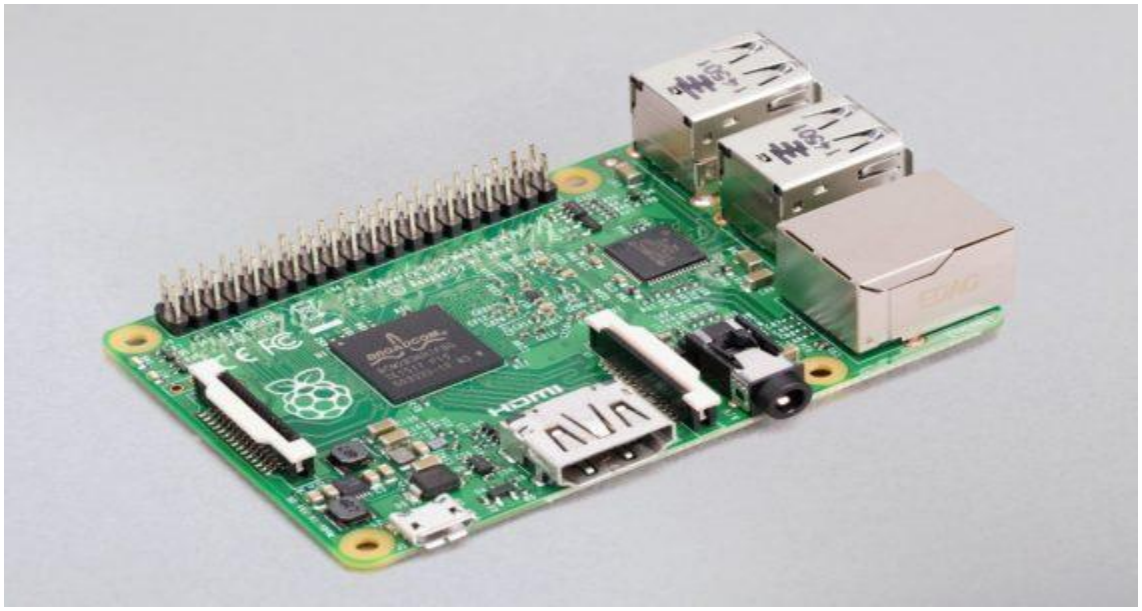


Figure:3 Raspberry Pi 2 Board

- In February 2016, the Raspberry Pi 3 Model B was announced, with a 1.2 GHz quad-core ARM Cortex-A53 CPU, onboard 802.11n Wi-Fi, Bluetooth, and USB boot capabilities.

- The Raspberry Pi 3 Model B+ has a faster 1.4 GHz CPU, three-times faster gigabit Ethernet (throughput restricted to approx. 300 Mbit/s by the internal USB 2.0 connection), and dual-band 802.11ac Wi-Fi (100 Mbit/s). Power over Ethernet (PoE) (with the PoE HAT add-on), USB boot, and network boot are among the other features (an SD card is no longer required).

Figure:4 Raspberry Pi 3 B+ Board

- In June 2019, the Raspberry Pi 4 Model B was released, featuring a 1.5 GHz quad-core ARM Cortex-A72 processor, onboard 802.11ac Wi-Fi, Bluetooth 5, full gigabit Ethernet (throughput not limited), two USB 2.0 ports, two USB 3.0 ports, 1–8 GB of RAM, and dual-monitor support via a pair of micro-HDMI (HDMI Type D) ports for up to 4K resolution. The 1 GB RAM version has been discontinued, and the prices for the 2 GB version have been cut. A new circuit board has been added to the 8 GB version. When paired with a suitable power supply, the Pi 4 may also be powered through a USB-C connector, allowing additional power to be delivered to downstream devices. But the Pi can only be operated with 5 volts and not 9 or 12 volts like other minicomputers of this class. The initial Raspberry Pi 4 board has a design flaw where third-party e-marked USB cables, such as those used on Apple MacBooks, incorrectly identify it and refuse to provide power. People tested 14 different cables and found that 11 of them turned on and powered the Pi without issue.[29] The design flaw was fixed in revision 1.2 of the board, released in late 2019. In mid-2021, Pi 4 B models appeared with the improved Broadcom BCM2711C0. The manufacturer is now using this chip for the Pi 4 B and Pi 400. However, the tack frequency of the Pi 4 B was not increased in the factory.

Figure:5 Raspberry Pi 4B Board

Raspberry Pi Model Comparison:

Model	RPi 2 B	RPi 3 B	RPi 3 B+	RPi 4 B
SOC Type	Broadcom BCM2836	Broadcom BCM2837	Broadcom BCM2837B0	Broadcom BCM2711
CPU Clock	4 × Arm Cortex-A7, 900 MHz	4 × Arm Cortex-A53, 1.2 GHz	4 × Arm Cortex-A53, 1.4 GHz	4 × Arm Cortex-A72, 1.5 GHz
RAM	1 GB	1 GB	1 GB	1 GB/2 GB/4 GB
GPU	Broadcom VideoCore IV	Broadcom VideoCore IV	Broadcom VideoCore IV	Broadcom VideoCore VI
USB Ports	4	4	4	4 (2 × USB 3.0 + 2 × USB 2.0)
Ethernet	100 Mbit/s base Ethernet	100 Mbit/s base Ethernet	Gigabit Ethernet (max. 300 Mbps)	Gigabit Ethernet (no limit)
Power over Ethernet	No	No	Yes (requires separate PoE HAT)	Yes (requires separate PoE HAT)
WiFi	No	WiFi 802.11n	WiFi 802.11ac Dual Band	WiFi 802.11ac Dual Band
Bluetooth	No	4.1	4.2 BLE	5.0 BLE
Video Output	HDMI/3.5 mm Comp./DSI	HDMI/3.5 mm Comp./DSI	HDMI/3.5 mm Comp./DSI	micro-HDMI/3.5 mm Comp./DSI
Audio Output	I^2S/HDMI/3.5 mm Composite	I^2S/HDMI/3.5 mm Composite	I^2S/HDMI/3.5 mm Composite	I^2S/HDMI/3.5 mm Composite
Camera Input	15 Pin CSI	15 Pin CSI	15 Pin CSI	15 Pin CSI
GPIO Pins	40	40	40	40
Memory	MicroSD	MicroSD	MicroSD	MicroSD

Raspberry Pi Model 4B:

Today we are going to specifically talk about Raspberry-Pi 4 model B.

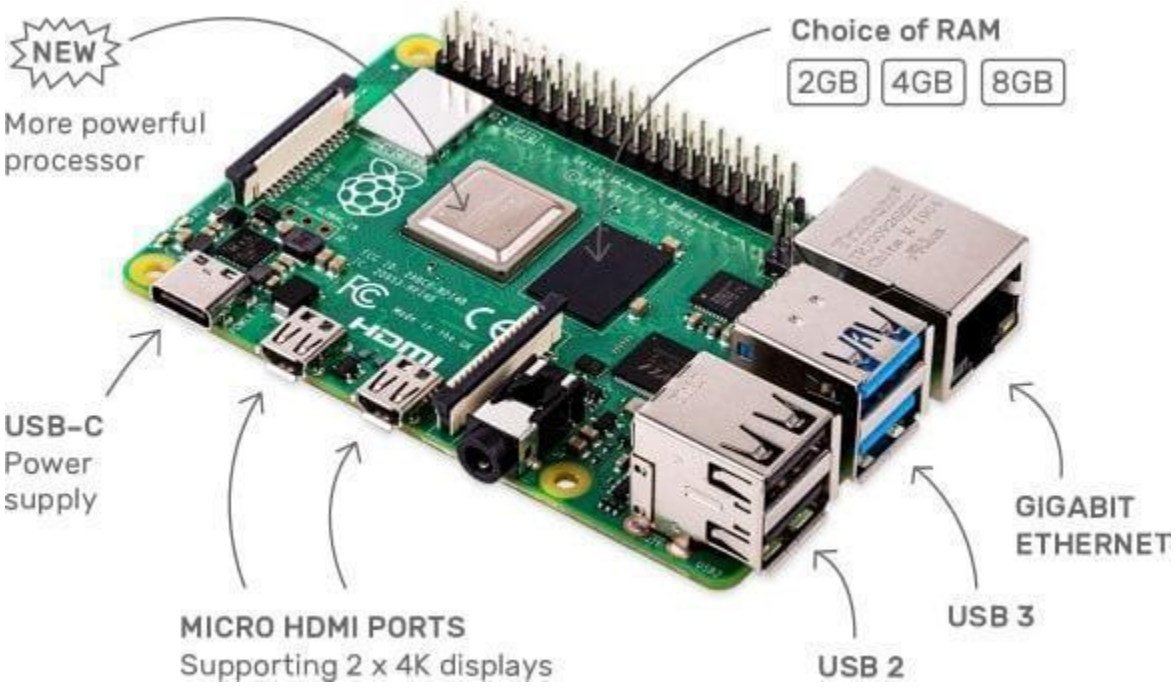


Figure:6 Raspberry Pi 4B Board Overview

The Raspberry Pi 4 Model B is the most recent addition to the popular Raspberry Pi computer line. When compared to the previous-generation Raspberry Pi 3 Model B+, it provides ground-breaking improvements in processing speed, multimedia performance, memory, and

connection while maintaining backward compatibility and similar power consumption. In terms of desktop performance, the Raspberry Pi 4 Model B is equivalent to entry-level x86 PCs.

Features of Raspberry Pi 4 Model B:

The features of Raspberry-pi 4 model B are:

- Broadcom BCM2711, Quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- 2GB, 4GB or 8GB LPDDR4-3200 SDRAM (depending on model)
- 4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
- Gigabit Ethernet
- 2 USB 3.0 ports; 2 USB 2.0 ports.
- Raspberry Pi standard 40-pin GPIO header (fully backward compatible with previous boards)
- 2 × micro-HDMI ports (up to 4kp60 supported)
- 2-lane MIPI DSI display port
- 2-lane MIPI CSI camera port
- 4-pole stereo audio and composite video port
- 265 (4kp60 decode), H264 (1080p60 decode, 1080p30 encode)
- OpenGL ES 3.1, Vulkan 1.0
- Micro-SD card slot for loading operating system and data storage
- 5V DC via USB-C connector (minimum 3A*)
- 5V DC via GPIO header (minimum 3A*)
- Power over Ethernet (PoE) enabled (requires separate PoE HAT)
- Operating temperature: 0 – 50 degrees C ambient

Although, just to highlight the features people primarily use are:

- **GPIO Pins** for connecting the Raspberry Pi to electrical components are known as general-purpose input-output pins.
- **The Ethernet connector** of the Raspberry Pi connects it to a wired network. For wireless communications, the Raspberry Pi features Wi-Fi and Bluetooth built-in.
- **Two USB 3.0 ports** and two USB 2.0 ports are utilized to connect devices such as a keyboard and mouse. The two USB 2.0 ports are black, whereas the two USB 3.0 ports are blue.
- **AV connection:** This AV port allows you to connect your Raspberry Pi to speakers or headphones.
- **The Camera Module port** is used to connect the official Raspberry Pi Camera Module, which allows the Raspberry Pi to take pictures.
- **HDMI ports:** The Raspberry Pi is connected to external displays using these HDMI connectors. The Raspberry Pi 4 has two micro-HDMI connectors, allowing it to simultaneously drive two displays.

- This **USB port** provides electricity to the Raspberry Pi. The Raspberry Pi 4 features a USB Type-C connector, whereas prior Raspberry Pi models had a micro-USB port.
- **External display port:** This connection is used to connect the Raspberry Pi to the official seven-inch touch panel for touch-based input.
- **MicroSD card slot (underside of the board):** This card slot holds the Raspberry Pi operating system and data on a microSD card.

Setting Up Raspberry Pi:

What You Will Need?

Which Raspberry Pi?

There are several models of Raspberry Pi, and for most people, Raspberry Pi 4 Model B is the one to choose. Raspberry Pi 4 Model B is the newest, fastest, and easiest to use.

A Power Supply

To connect to a power socket, all Raspberry Pi models have a USB port (the same found on many mobile phones): either USB-C for Raspberry Pi 4, or micro-USB for Raspberry Pi 3, 2, and 1.
You need a power supply that provides at least 3.0 amps for Raspberry Pi 4.

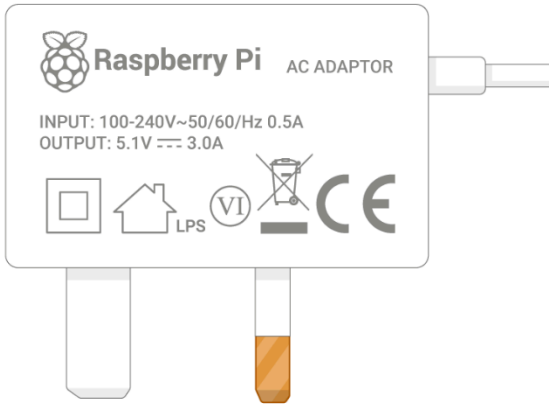


Figure:7 Raspberry Pi 4B Power Adaptor

It's recommended to use our official USB-C Power Supply for Raspberry Pi 4.

A microSD Card

Your Raspberry Pi needs an SD card to store all its files and the Raspberry Pi OS operating system.

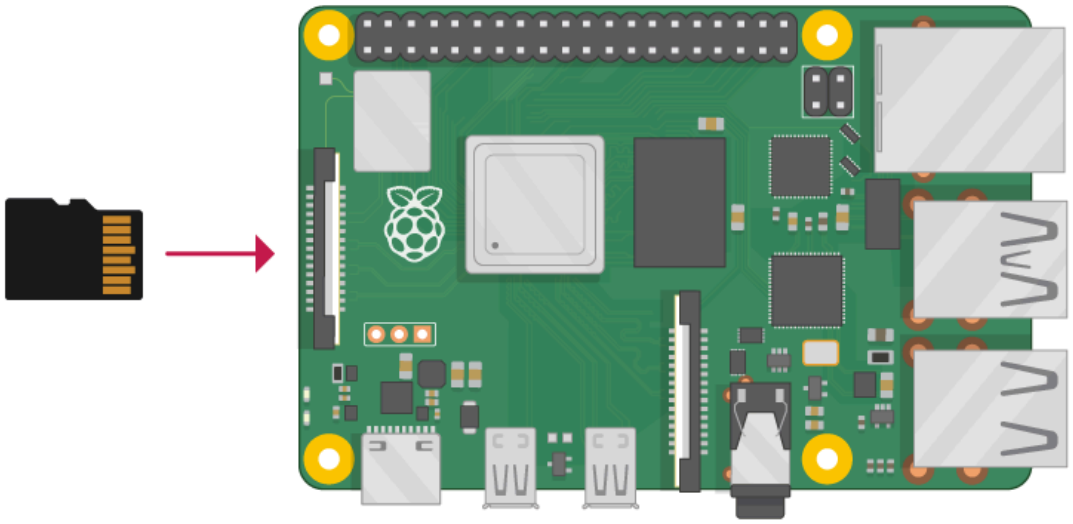


Figure:8 Inserting MicroSD card in Raspberry Pi 4B Board

You need a microSD card with a capacity of at least 8GB.

A keyboard & a mouse

To start using your Raspberry Pi, you need a USB keyboard and a USB mouse.
Once you've set up your Raspberry Pi, you can use a Bluetooth keyboard and mouse, but you'll need a USB keyboard and mouse for the first setup.

A TV or computer screen

To view the Raspberry Pi OS desktop environment, you need a screen, and a cable to link the screen and your Raspberry Pi. The screen can be a TV or a computer monitor. If the screen has built-in speakers, Raspberry Pi can use these to play sound.

HDMI

Your Raspberry Pi has an HDMI output port that is compatible with the HDMI port of most modern TVs and computer monitors. Many computer monitors may also have DVI or VGA ports.
Raspberry Pi 4 has two micro-HDMI ports, allowing you to connect two separate monitors.

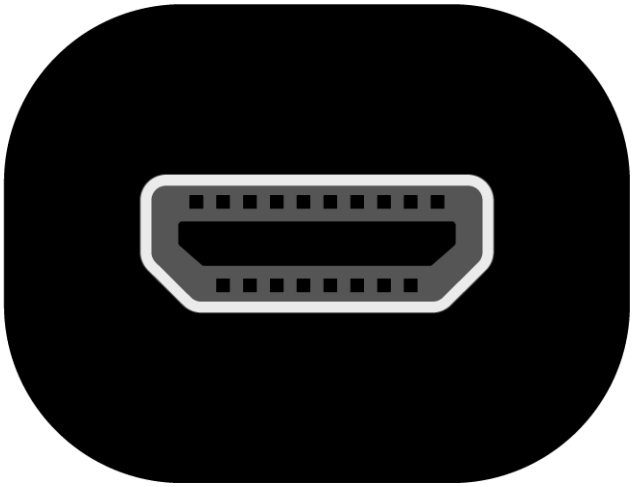


Figure:9 Micro-HDMI pin

You need either a micro-HDMI to HDMI cable or a standard HDMI to HDMI cable plus a micro-HDMI to HDMI adapter, to connect Raspberry Pi 4 to a screen.

Figure:10 Micro-HDMI to HDMI cable

DVI

If your screen has a DVI port, you can connect your Raspberry Pi to it using an HDMI to DVI cable.

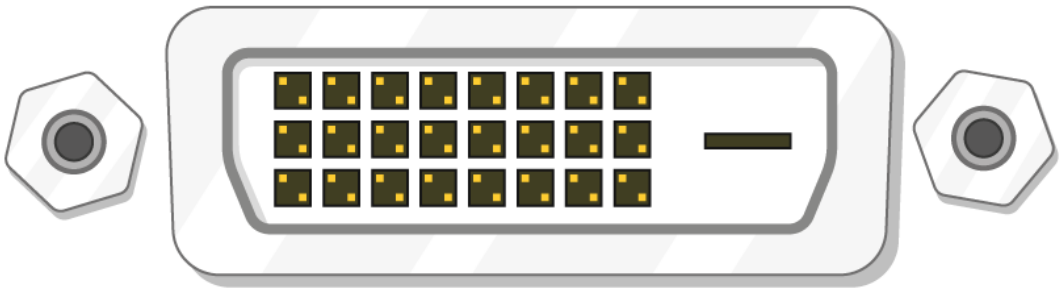


Figure:11 DVI pin

VGA

Some screens only have a VGA port.

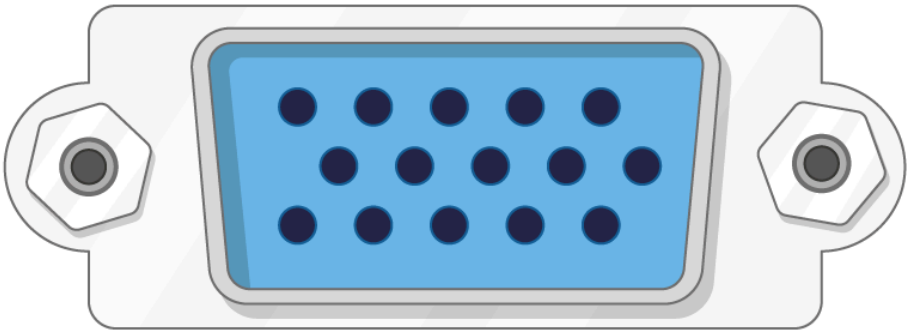


Figure:12 VGA pin

To connect your Raspberry Pi to such a screen, you can use an HDMI to VGA adapter.

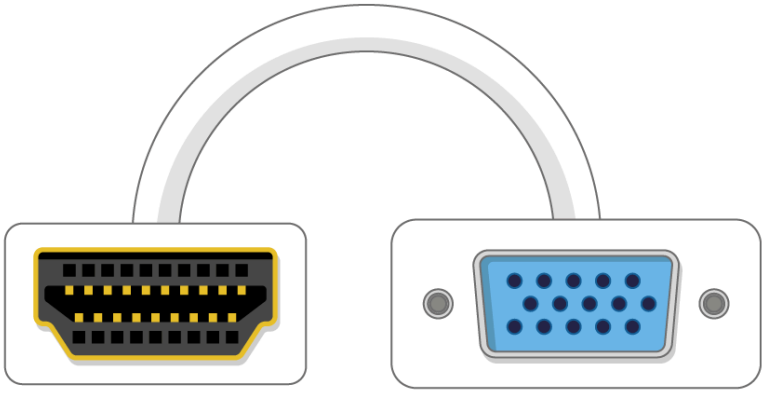


Figure:13 HDMI to VGA cable

Optional Extras

A Case

You may want to put your Raspberry Pi in a case. This is not essential, but it will protect your Raspberry Pi. If you'd like, you can use the official case for Raspberry Pi 4 or Raspberry Pi Zero or Raspberry Pi Zero W.

Headphones or speakers

The large Raspberry Pi models (but not Raspberry Pi Zero or Raspberry Pi Zero W) have a standard audio port like the one on a smartphone or MP3 player. If you want to, you can connect your headphones or speakers so that your Raspberry Pi can play sound. If the screen you're connecting your Raspberry Pi to has built-in speakers, Raspberry Pi can play sound through these.

An Ethernet Cable

The large Raspberry Pi models (but not Raspberry Pi Zero or Raspberry Pi Zero W) have a standard Ethernet port to connect them to the internet; to connect Raspberry Pi Zero to the internet, you need a USB to Ethernet adapter.

Raspberry Pi 4, Raspberry Pi 3, and Raspberry Pi Zero W can also be wirelessly connected to the internet.

Setup the SD Card:

If you have an SD card that doesn't have the Raspberry Pi OS operating system on it yet, or if you want to reset your Raspberry Pi, you can easily install Raspberry Pi OS yourself. To do so, you need a computer that has an SD card port — most laptop and desktop computers have one.

The Raspberry Pi OS operating system via the Raspberry Pi Imager
Using the Raspberry Pi Imager is the easiest way to install Raspberry Pi OS on your SD card.

[Note: More advanced users looking to install a particular operating system should use this guide to install operating system images.]

Download and launch the Raspberry Pi Imager

- **Visit the Raspberry Pi downloads page**

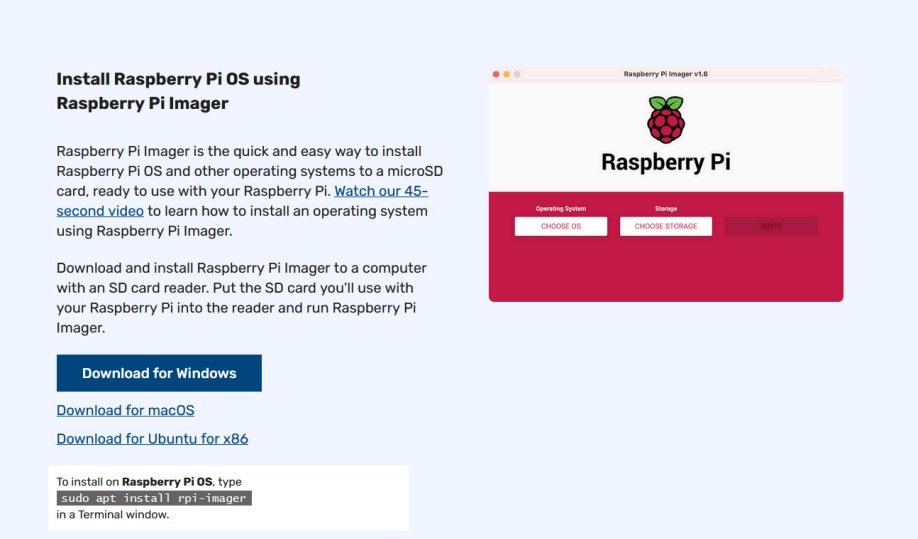


Figure:14 Raspberry Pi Imager

- Click on the link for the Raspberry Pi Imager that matches your operating system

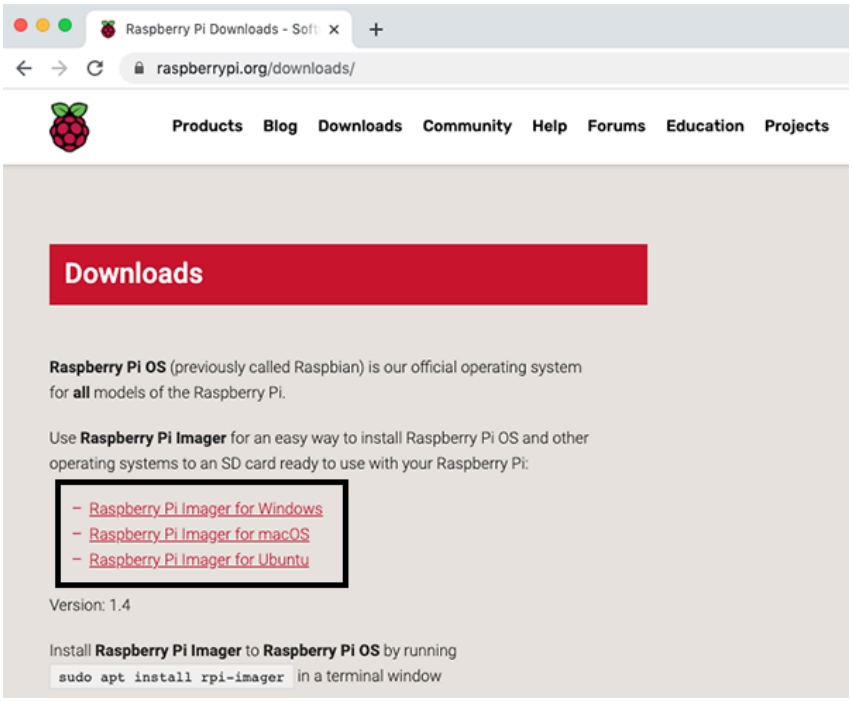


Figure:15 Raspberry Pi Imager download

- When the download finishes, click it to launch the installer

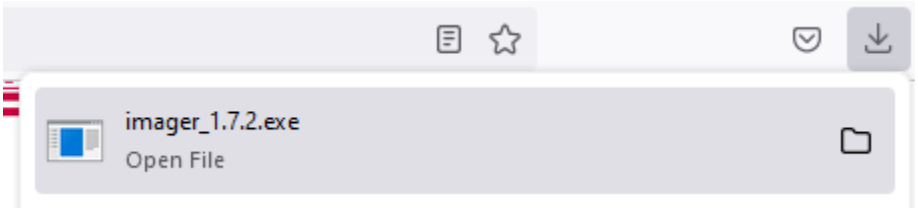


Figure:16 Downloads

Using the Raspberry Pi Imager

Anything that's stored on the SD card will be overwritten during formatting. If your SD card currently has any files on it, e.g. from an older version of Raspberry Pi OS, you may wish to back up these files first to prevent you from permanently losing them.

When you launch the installer, your operating system may try to block you from running it. For example, on Windows, you may receive the following message:

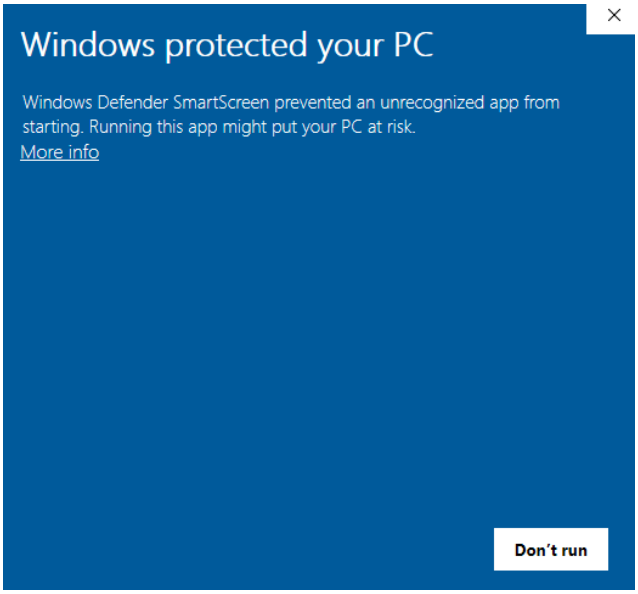


Figure:17 Windows Defender Warning

- If this pops up, click on **More info** and then **Run anyway**
- Follow the instructions to install and run the Raspberry Pi Imager
- Insert your SD card into the computer or laptop SD card slot
- In the Raspberry Pi Imager, select the OS that you want to install and the SD card you would like to install it on.

***[Note:** You will need to be connected to the internet the first time for the Raspberry Pi Imager to download the OS that you choose. That OS will then be stored for future offline use. Being online for later uses means that the Raspberry Pi imager will always give you the latest version.]*

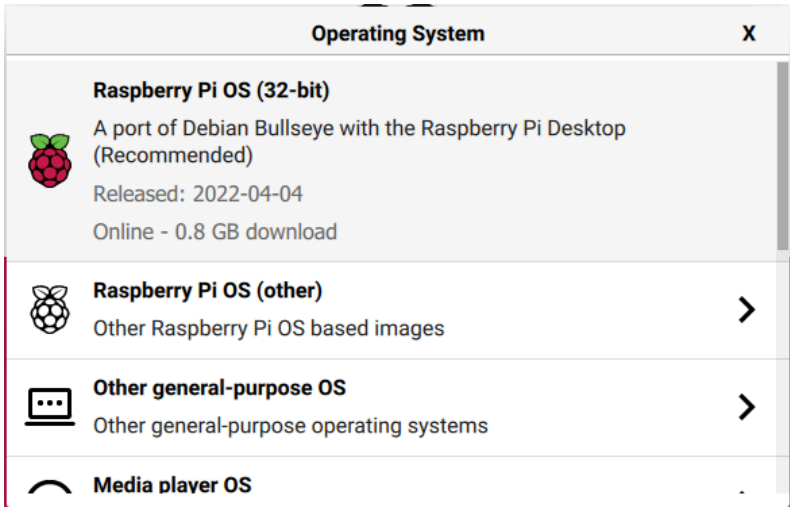


Figure:18 Selecting Raspberry Pi OS

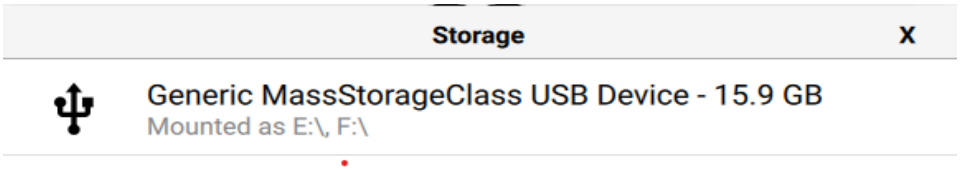


Figure:19 Selecting SD card for Raspberry Pi OS

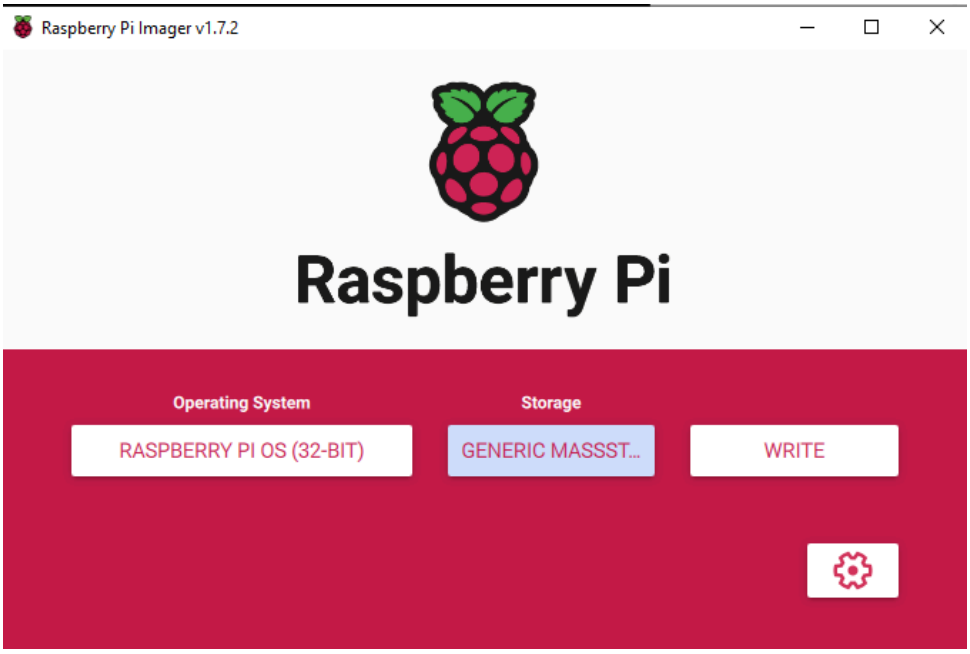


Figure:20 Writing Raspberry Pi OS to SD card

- Then simply click the **WRITE button**
- Wait for the Raspberry Pi Imager to finish writing
- Once you get the following message, you can eject your SD card.

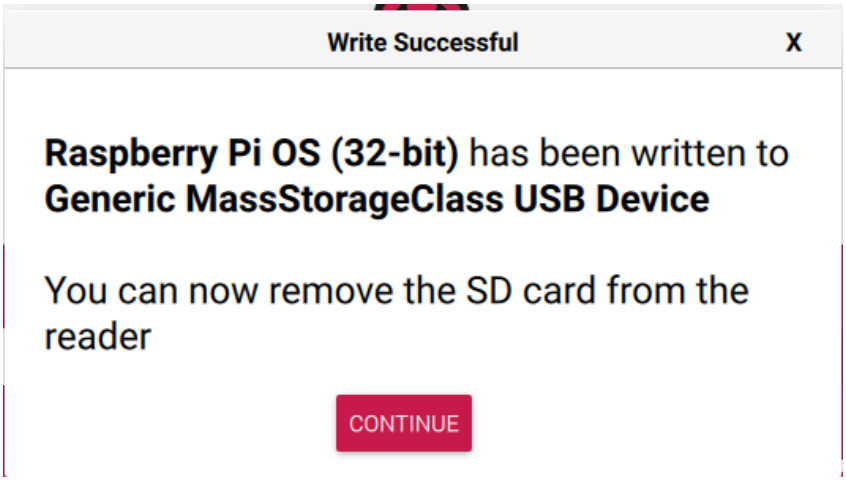


Figure:21 Successfully Written

Connect the Raspberry Pi:

Now get everything connected to your Raspberry Pi. It's important to do this in the right order so that all your components are safe.

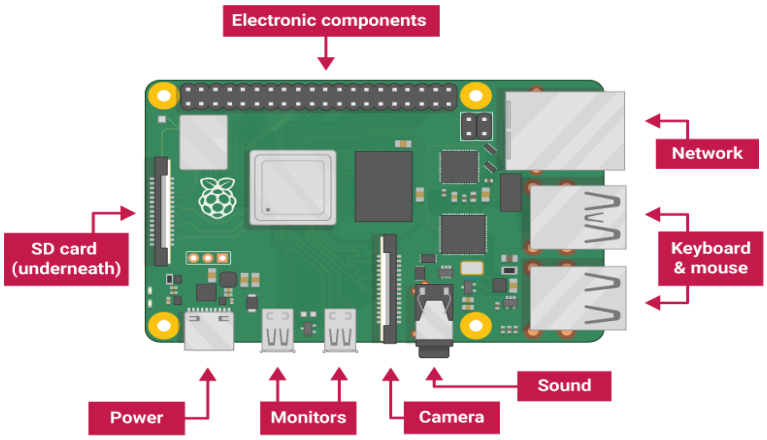


Figure:22 Raspberry Pi 4 Connection Ports and GPIO Pins

- Insert the SD card you've set up with Raspberry Pi OS into the microSD card slot on the underside of your Raspberry Pi.

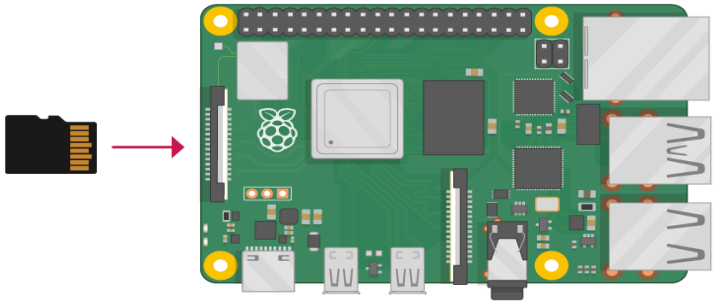


Figure:23 Inserting MicroSD card in Raspberry Pi 4B Board

Note: Many microSD cards come inside a larger adapter — you can slide the smaller card out using the lip at the bottom.

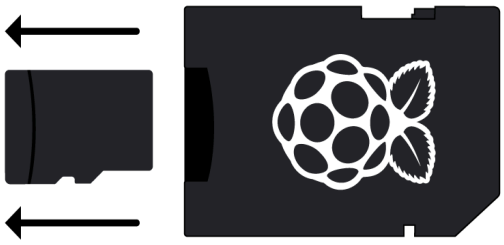


Figure:24 Extracting MicroSD card from Adapter

- Find the USB connector end of your mouse's cable, and connect the mouse to a USB port on Raspberry Pi (it doesn't matter which port you use).

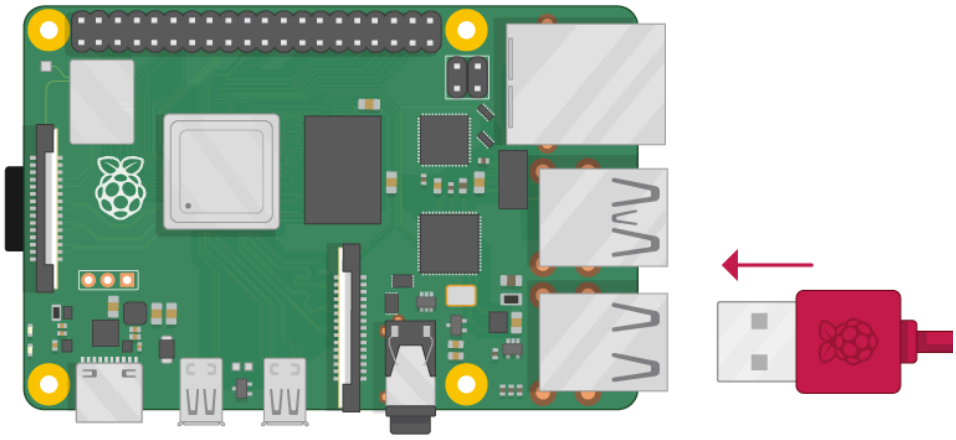


Figure:25 Connecting Mouse via USB port

- Connect the keyboard in the same way.

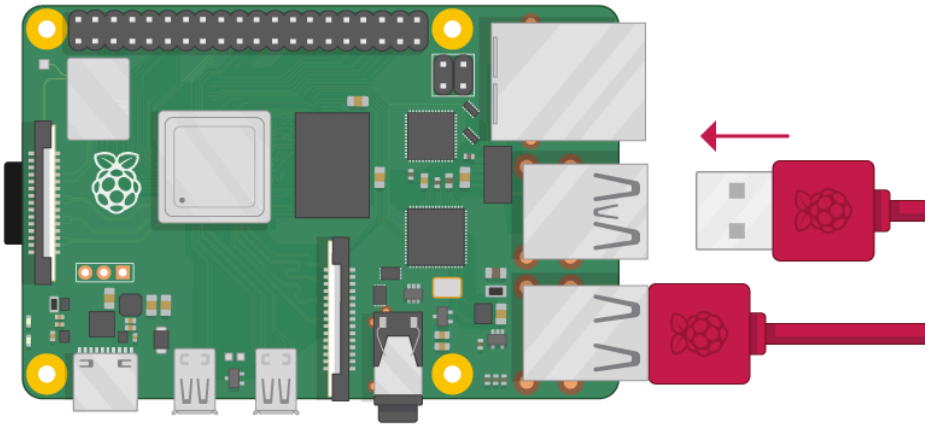


Figure:26 Connecting Keyboard via USB port

- Make sure your screen is plugged into a wall socket and switched on.
- Look at the HDMI port(s) on your Raspberry Pi — notice that they have a flat side on top.
- Use a cable to connect the screen to Raspberry Pi's HDMI port — use an adapter if necessary.

Raspberry Pi 4

Connect your screen to the first of Raspberry Pi 4's HDMI ports, labeled HDMI0.

Note: Make sure you have used HDMI0 (nearest the power in port) rather than HDMI1.

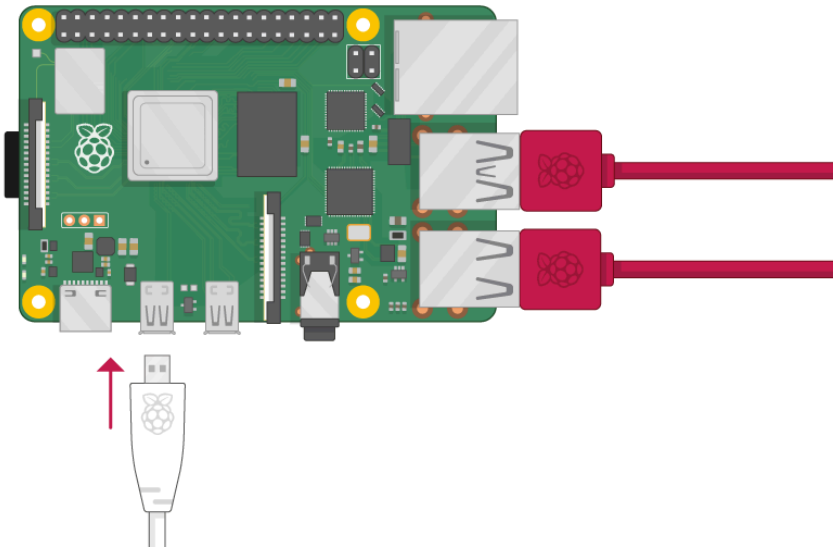


Figure:27 Connecting Screen via Micro-HDMI port

You can connect an optional second screen in the same way.

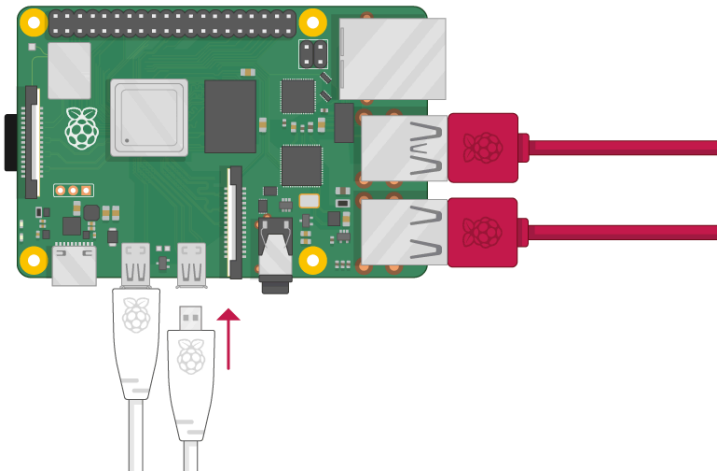


Figure:28 Connecting Secondary Screen via Micro-HDMI port

Note: Nothing will display on the screen, because your Raspberry Pi is not running yet.

- If you want to connect your Raspberry Pi to the internet via Ethernet, use an Ethernet cable to connect the Ethernet port on Raspberry Pi to an Ethernet socket on the wall or on your internet router. You don't need to do this if you want to use wireless connectivity, or if you don't want to connect to the internet.

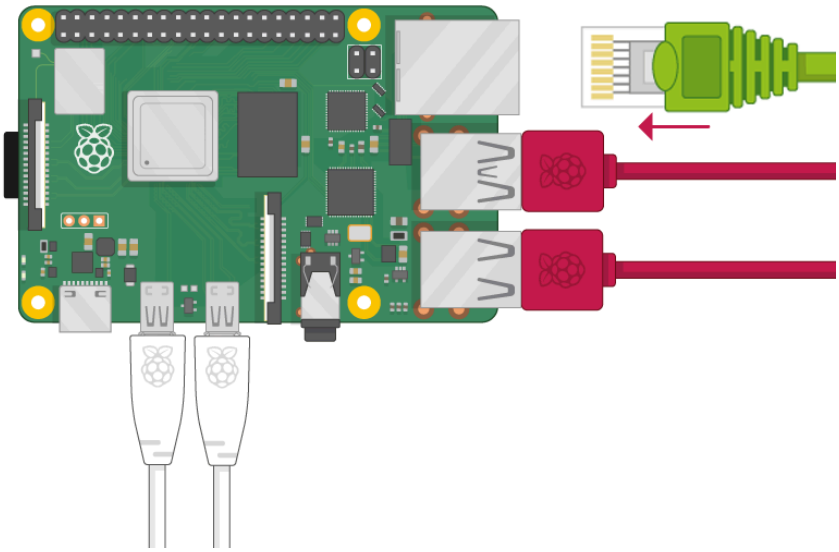


Figure:29 Connecting Ethernet cable in Ethernet port

- If the screen you are using has speakers, sound will play through those. Alternatively, connect headphones or speakers to the audio port if you prefer.

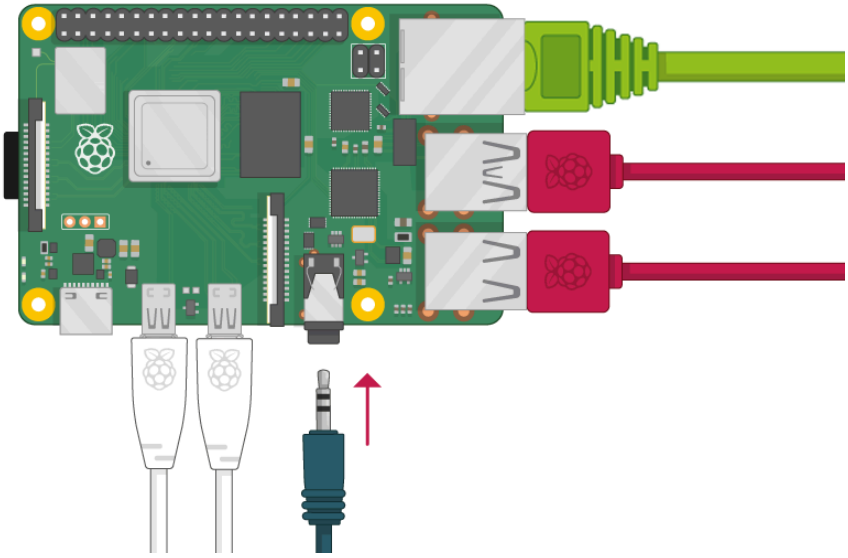


Figure:30 Connecting Audio Jack for Sound

Start-Up The Raspberry Pi:

Your Raspberry Pi doesn't have a power switch. As soon as you connect it to a power outlet, it will turn on.

- Plug the power supply into a socket and connect it to your Raspberry Pi's power port.

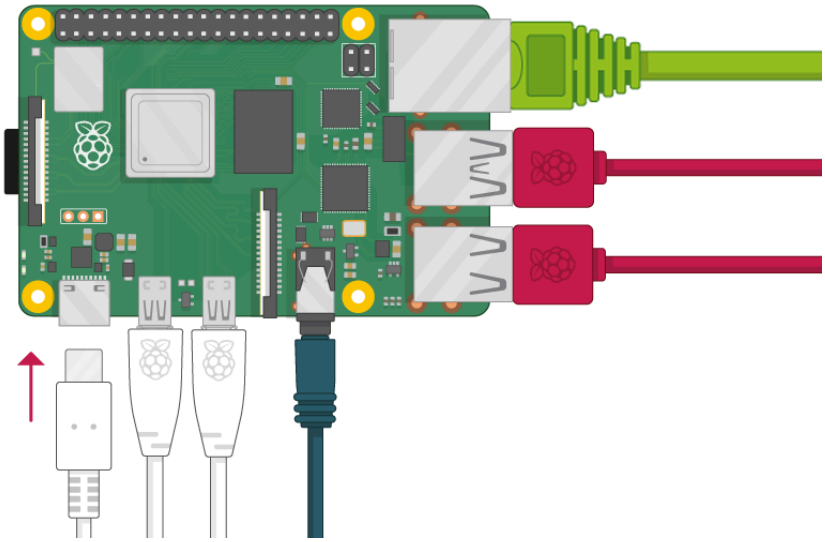


Figure:31 Powering Raspberry Pi with Power Adapter via Type-C Port

You should see a red LED light up on the Raspberry Pi, which indicates that Raspberry Pi is connected to power. As it starts up (this is also called booting), you will see raspberries appear in the top left-hand corner of your screen.

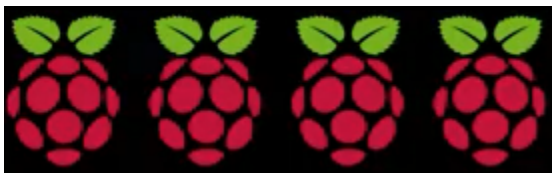


Figure:32 Booting Raspberry Pi OS

After a few seconds, the Raspberry Pi OS desktop will appear.

Figure:33 Home Screen of Raspberry Pi OS

Finishing The Setup:

When you start your Raspberry Pi for the first time, the Welcome to Raspberry Pi application will pop up and guide you through the initial setup.

Figure:34 Setup Menu

- Click on Next to start the setup.
- Set your Country, Language, and Timezone, then click on Next again.

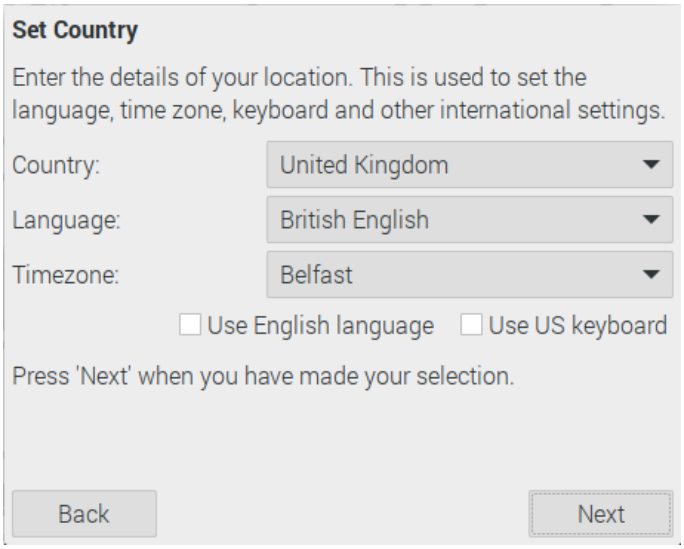


Figure:34 Setup Country

- Enter a new username and password for your Raspberry Pi and click on Next.

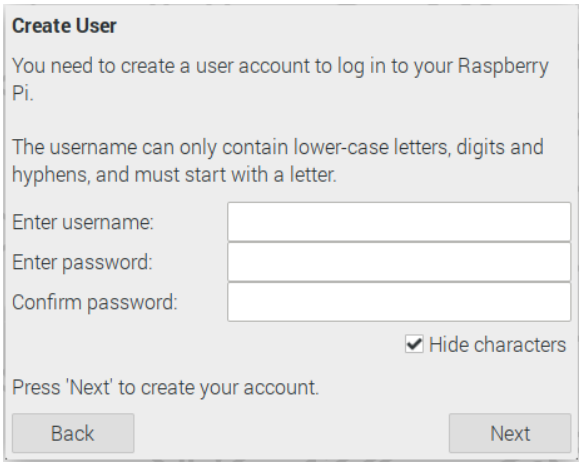


Figure:35 Creating User

- Set up your screen so that the Desktop fills your monitor.

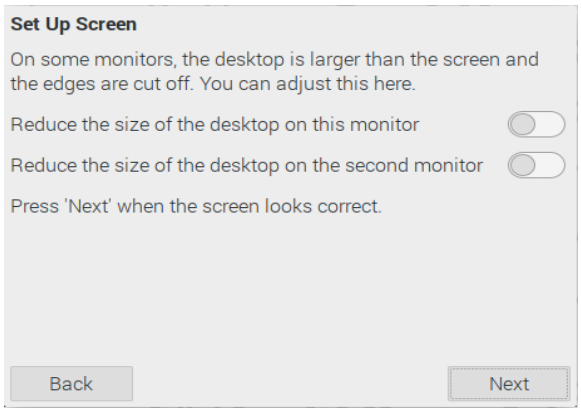


Figure:36 Setting-up Screen

- Connect to your wireless network by selecting its name, entering the password, and clicking on Next.

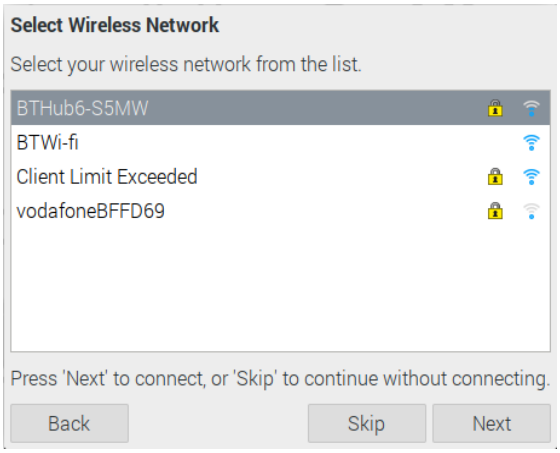


Figure:37 Connecting to Wifi

Note: If your model of Raspberry Pi doesn't have wireless connectivity, you won't see this screen.
Note: Wait until the wireless connection icon appears and the correct time is shown before trying to update the software.

- Click on Next, and let the wizard check for updates to Raspberry Pi OS and install them (this might take a little while).

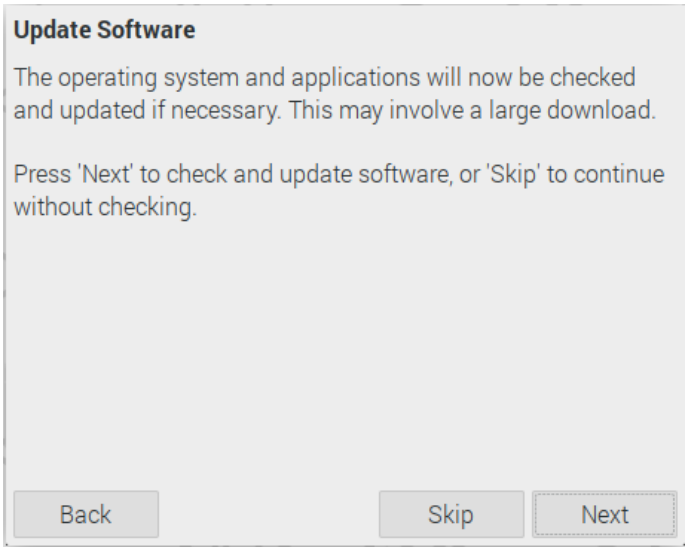


Figure:38 Update Software

- Click on Restart to finish the setup.

Where to find help?

[If you're having problems with your Raspberry Pi, there are lots of places you can get help and advice:

- *Check out the help section and the documentation on the Raspberry Pi website*
- *The Raspberry Pi forum, including the Beginners section, is a great place to ask questions and get support from the Raspberry Pi community*
- *Call out on Twitter using the hashtag #rpilearn, or submit a question on the Raspberry Pi Stack Exchange*
- *You could also attend a free Raspberry Jam community event to talk to people about their experiences and get some first-hand help from fellow Raspberry Pi users.]*

Raspberry Pi Desktop

Your Raspberry Pi runs Raspberry Pi OS, a version of an operating system (OS) called Linux. (Windows and macOS are other common operating systems.)
After Raspberry Pi OS starts up, you will see the Desktop appear.

Figure:39 Home Screen of Raspberry Pi OS

The Raspberry Pi icon in the top left-hand corner is where you access the menu.

- Click on it to find lots of applications, including Programming applications.
- To open a text editor, click on Accessories and choose Text Editor.

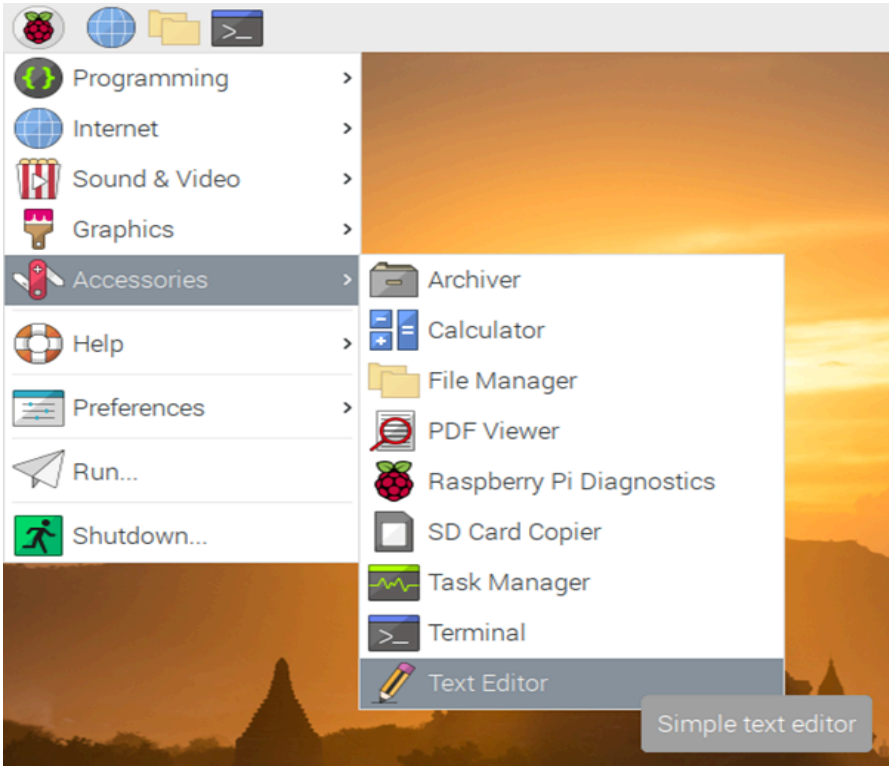


Figure:40 Opening Text Editor

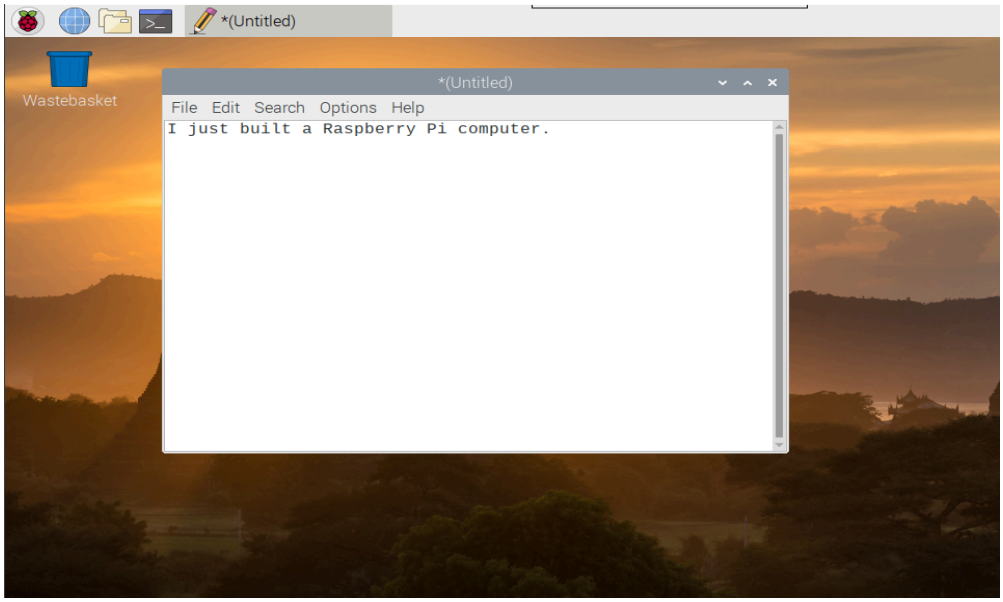


Figure:41 Writing on Text Editor

- Close the text editor by clicking the x in the top right-hand corner of the window.
- Explore what other applications are currently available in the menu.

Note: The Raspberry Pi Imager gives the option to install Raspberry Pi OS Full, which comes with all recommended software already loaded, including office applications and some games.

Keyboard & Mouse Settings

To set up your mouse and keyboard, select Preferences and then Mouse and Keyboard Settings from the menu.

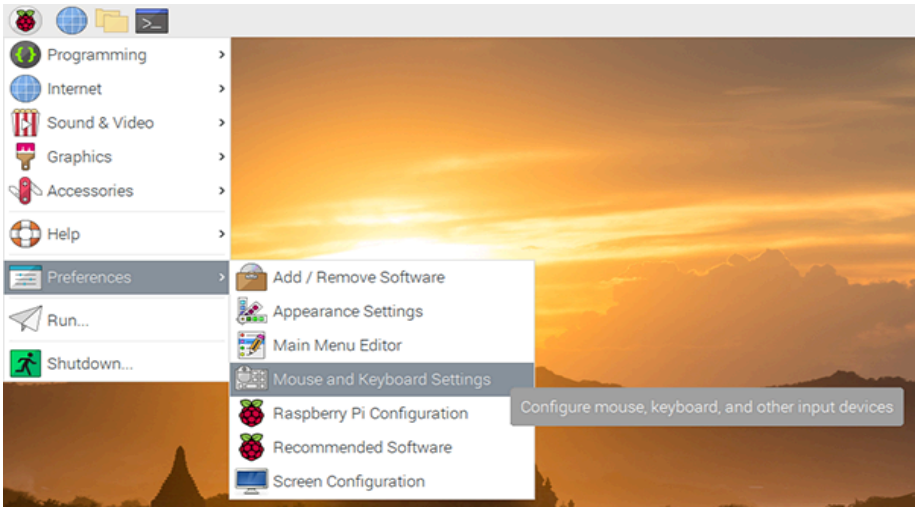


Figure:42 Configure Mouse & Keyboard

Mouse

You can change the mouse speed and double-click time here, and swap the buttons if you are left-handed.

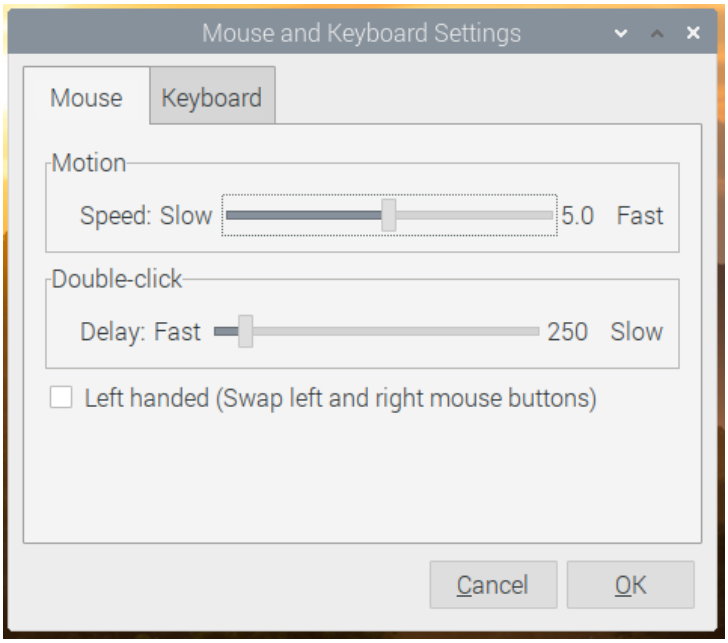


Figure:43 Configure Mouse

Keyboard

You can adjust the key repeat delay and interval values here.

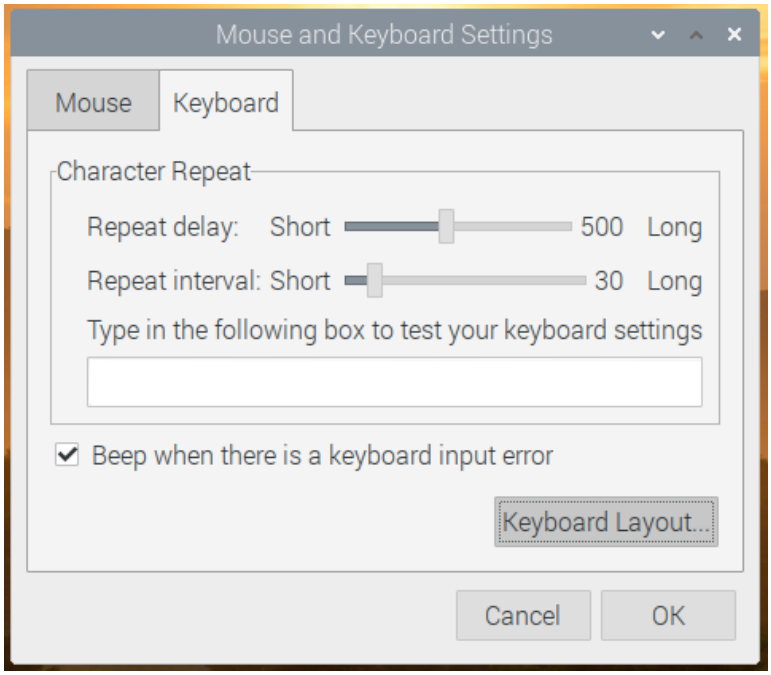


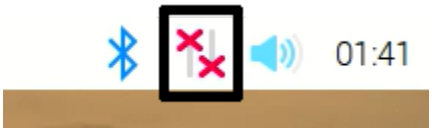
Figure:44 Configure Mouse Keyboard

Connecting to the Internet

If you want to connect your Raspberry Pi to the internet, you can plug an Ethernet cable into it (if you have a Raspberry Pi Zero, you'll need a USB-to-Ethernet adapter as well).
If your model is a Raspberry Pi 4, Raspberry Pi 3, or Raspberry Pi Zero W, you can also connect to a wireless network.

Connecting to a Wireless Network

- Click on the wireless network icon in the top right-hand corner of the screen, and select your network from the drop-down menu.



- Type in the password for your wireless network, then click on OK.

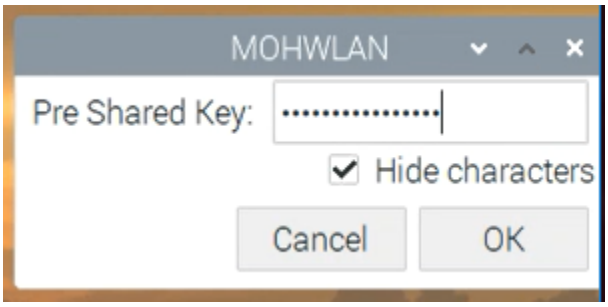


Figure:45 Connecting to Network

- Once your Raspberry Pi is connected to the internet, you will see a wireless LAN symbol instead of the red crosses.

- Test your connection by clicking on the web browser icon and searching the web for Raspberry pi.

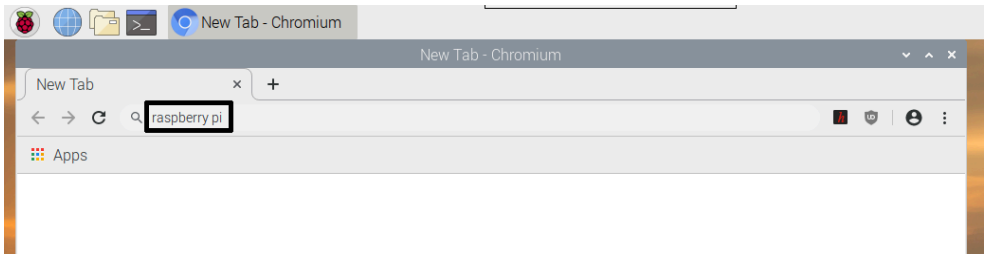
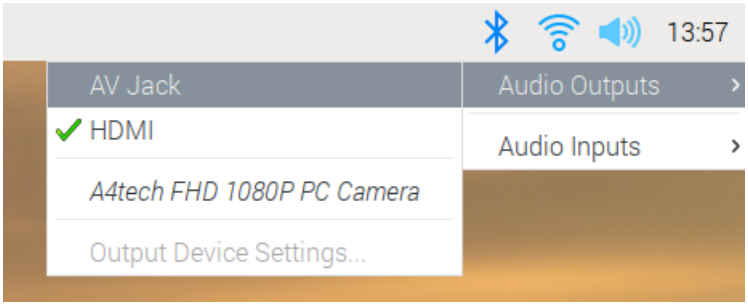


Figure:46 Checking Network

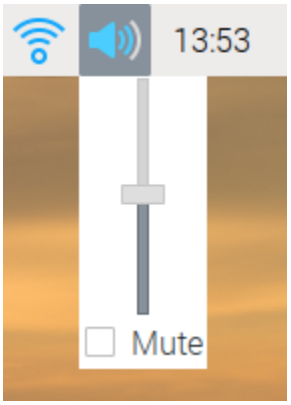
Setting Up the Sound

Your Raspberry Pi can either send sound to the screen's built-in speakers through the HDMI connection (if your screen has speakers) or to the analog headphone jack.

- Right-click on the speaker icon in the top right-hand corner, and select Audio Outputs, to choose whether your Raspberry Pi should use the HDMI or the AV Jack connection for sound.



- Click on the speaker icon to adjust the volume by moving the slider up or down.



Installing Software

There are many, many software programs and applications you can download and install on Raspberry Pi.

Note: Your Raspberry Pi has to be connected to the internet before you can install software.

- In the menu, click on Preferences and then on Recommended Software.

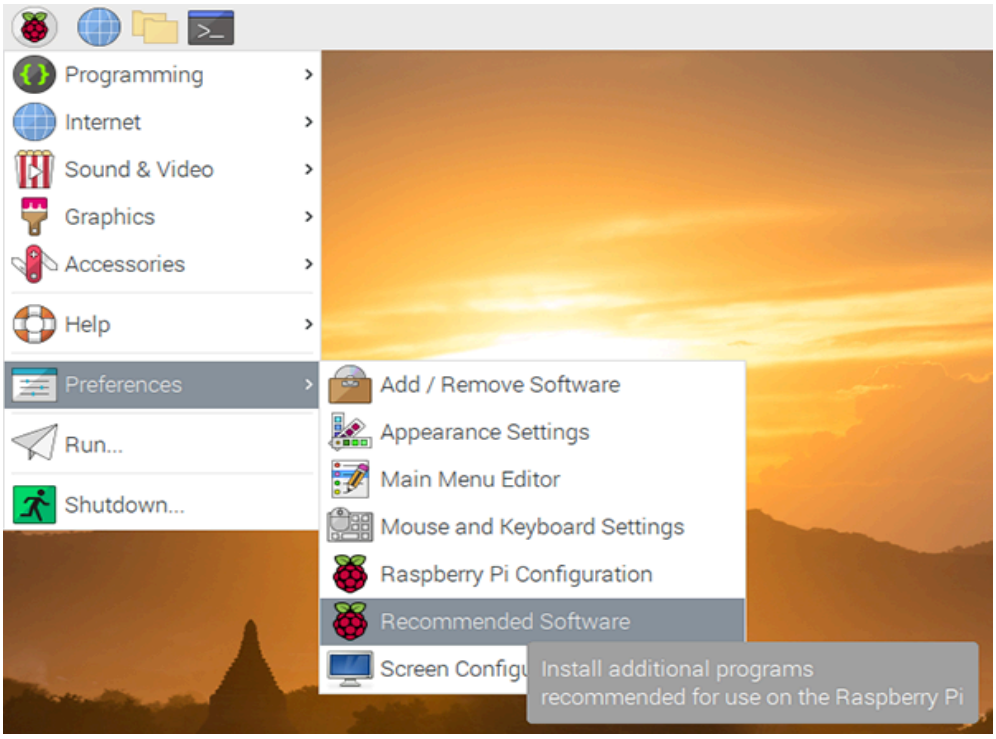


Figure:47 Checking Recommended Softwares

You can browse all the recommended software, or filter it by category.

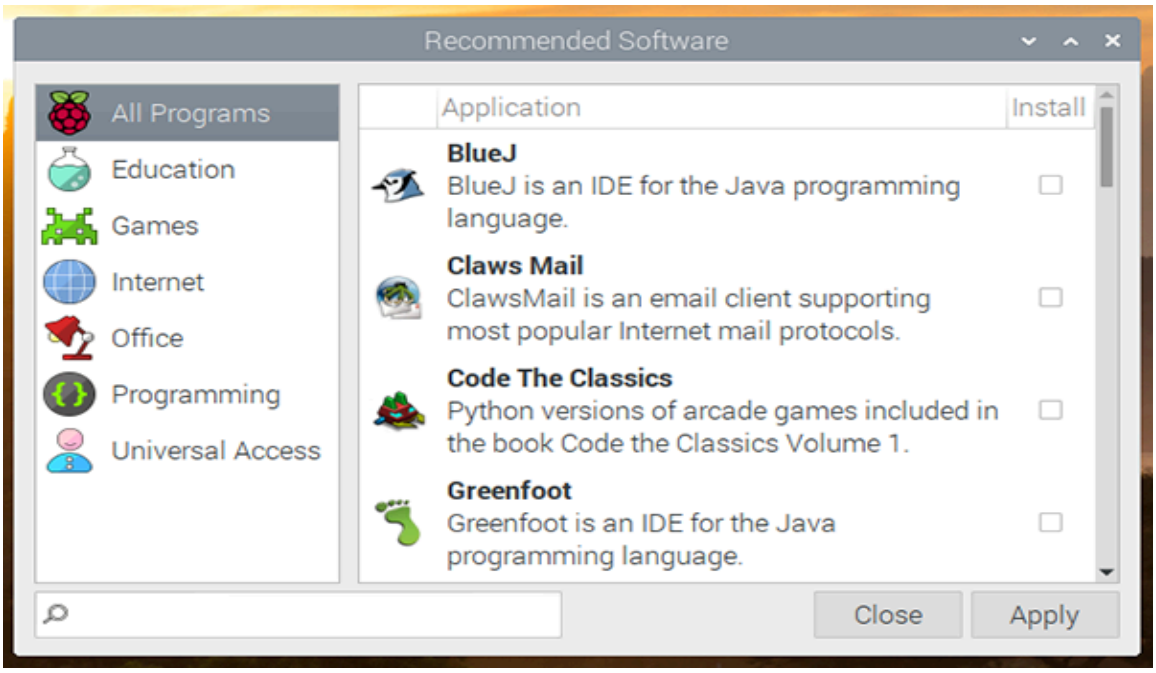


Figure:48 Recommended Softwares

- To install a piece of software, click to mark the checkbox to its right.

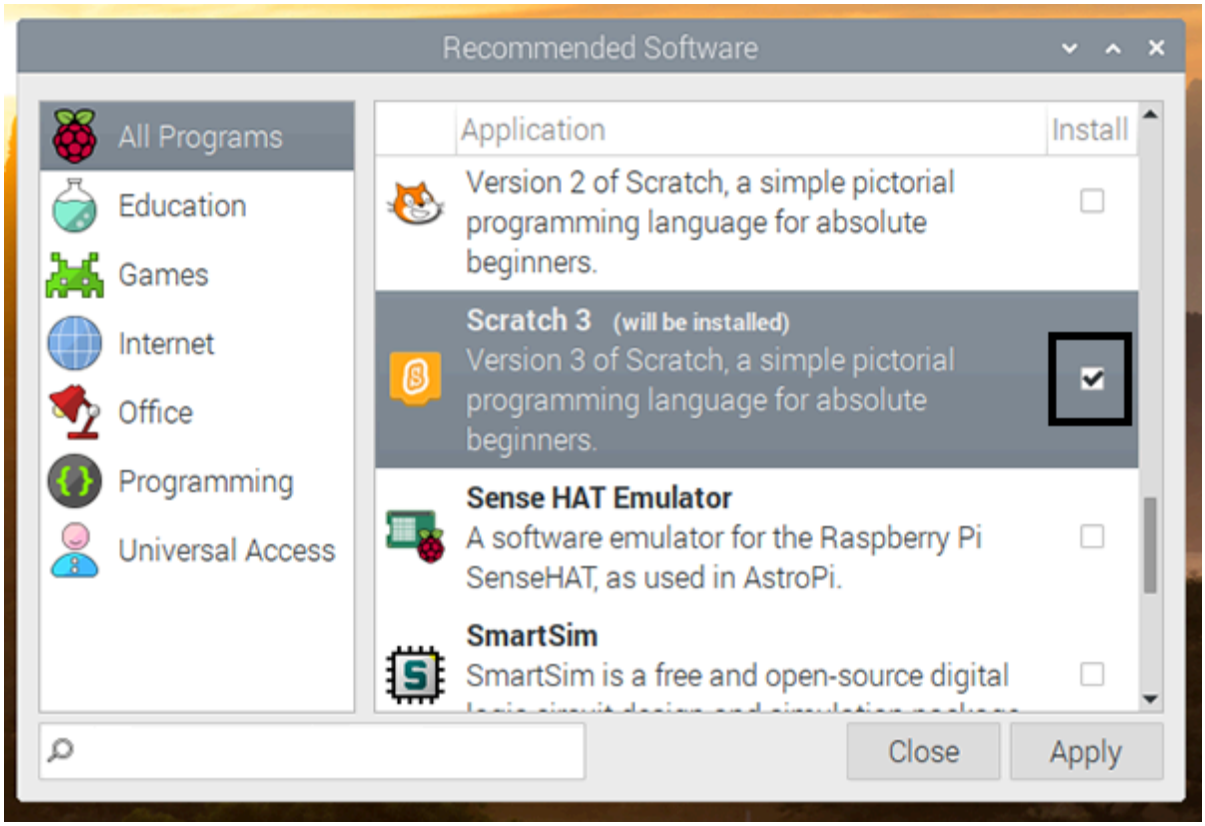
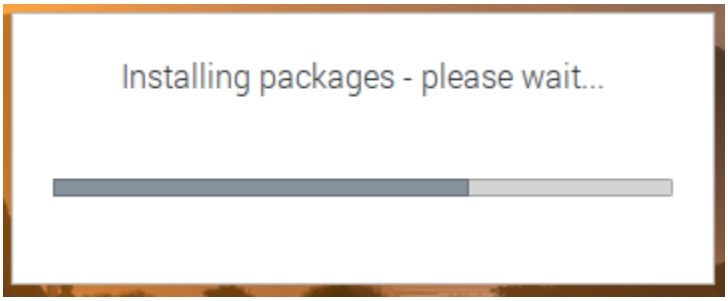


Figure:49 Install Softwares

o Then click on OK to install the selected software.



In addition to the Raspberry Pi's recommended software, there's a huge library of other available programs and applications.

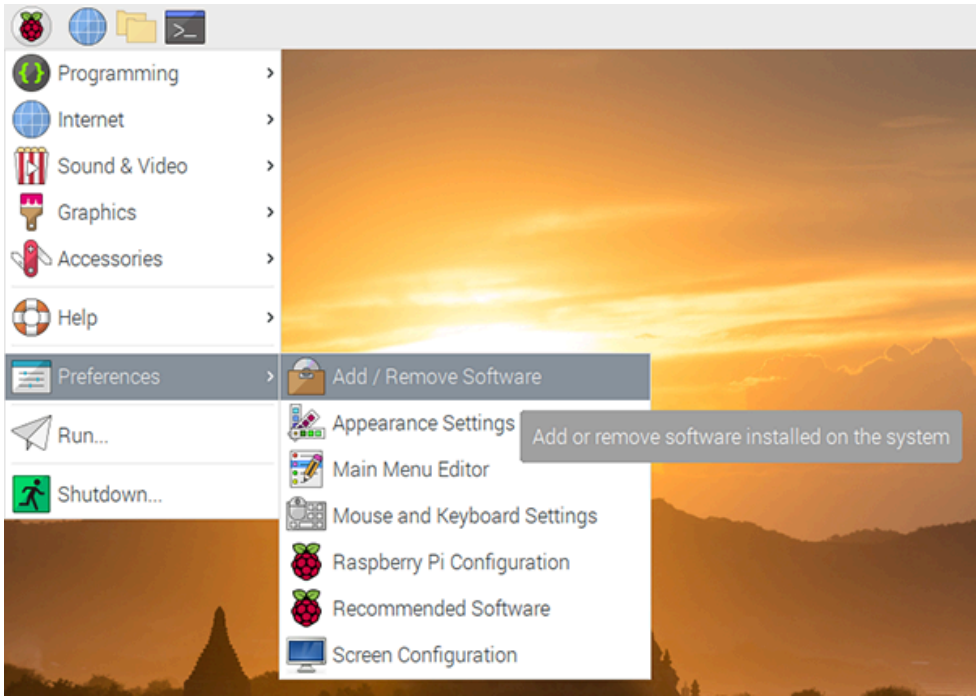


Figure:50 Add or Remove Softwares

You can search for software, or browse by selecting a category from the menu on the left.

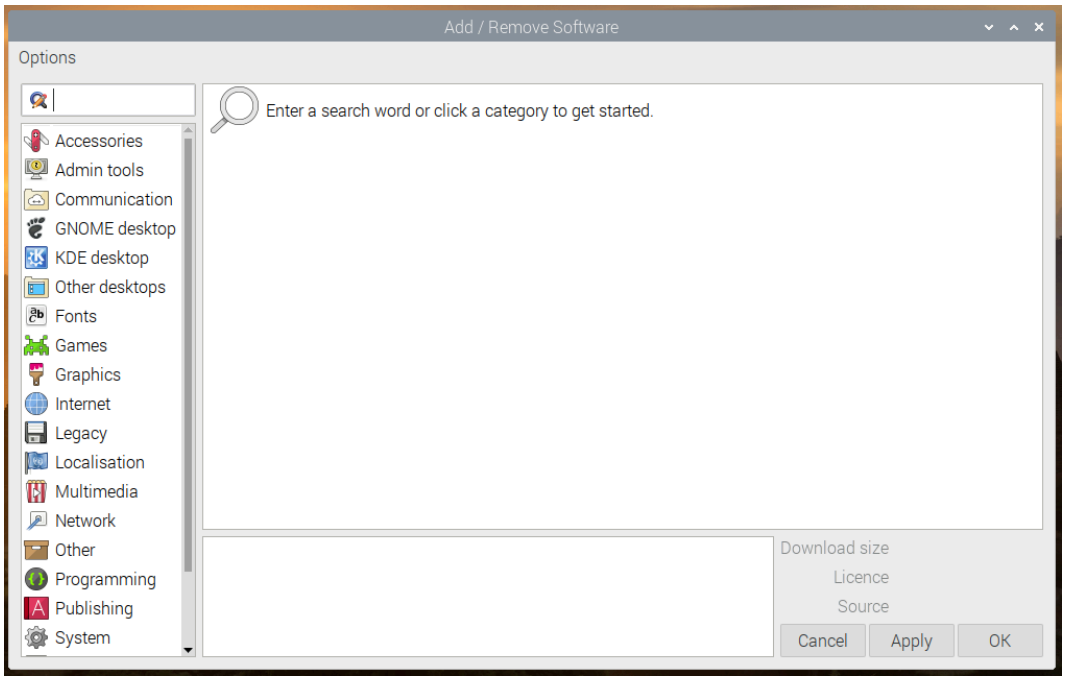


Figure:51 Search Softwares

Introducing the Raspberry Pi GPIOs

GPIO, an abbreviation for General Purpose Input Output pins, serves as versatile interfaces for connecting and managing electronic components such as LEDs, motors, and sensors with your Raspberry Pi. These pins facilitate the two-way exchange of information, enabling your Raspberry Pi to engage with the external world. Most iterations of Raspberry Pi boards feature a dual-row array of 40 GPIO pins. The pin configuration is typically consistent across various Raspberry Pi models.

In this Lab, we will delve into the process of configuring Raspberry Pi GPIO pins as outputs, allowing you to regulate devices such as LEDs or other actuators by sending high (3V3) and low (0V) signals.

Raspberry Pi GPIO Numbering

There are two different ways to refer to a GPIO pin: its name (which is known as GPIO numbering or Broadcom numbering) or its corresponding pin physical number (which corresponds to the pin's physical location on the header).

For example, GPIO 25 corresponds to pin 22 (see the picture below). Throughout this tutorial, we'll refer to GPIO pins by their GPIO numbering (Broadcom numbering).

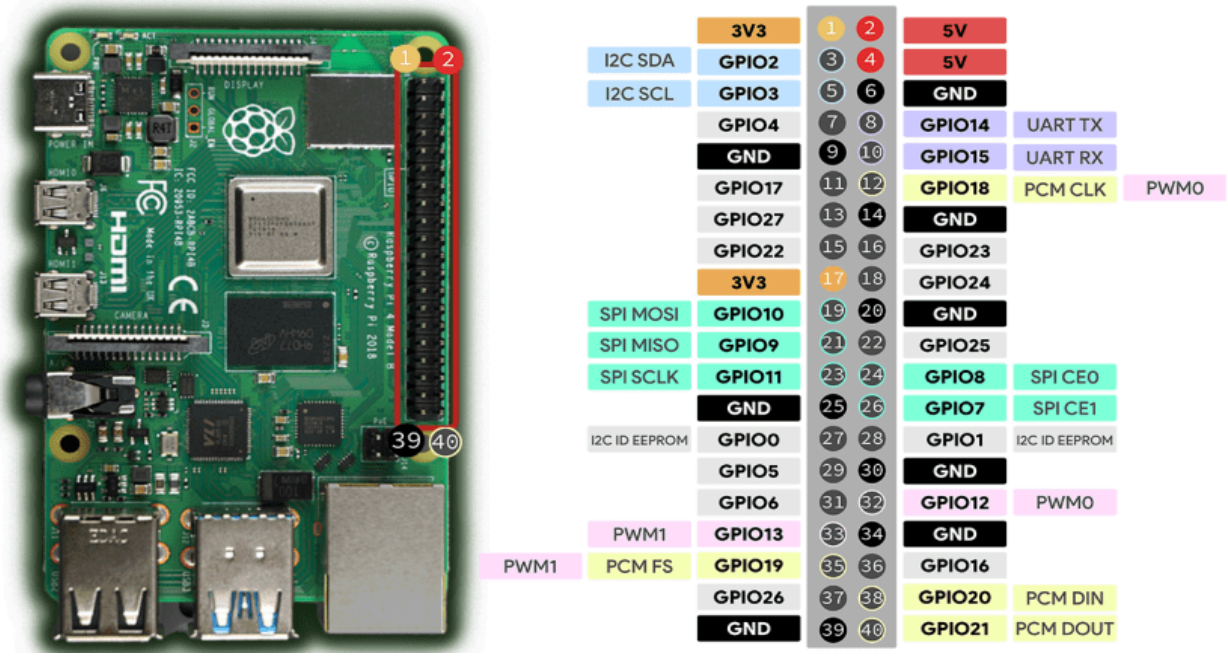


Figure:52 Raspberry Pi 4B GPIO Pinout

GPIO pins can be set to HIGH, which outputs 3.3V and turns a component on, or LOW, which outputs 0V and turns the component off.

Wiring the Circuit

Wire an LED to one of the Raspberry Pi GPIOs. We'll connect one LED to GPIO 14 (pin 8). You can use any other pins, except GPIO 0 and GPIO 1.

Here's a list of components you need:

- Raspberry Pi Board
- LED
- 220 Ohm resistor (or similar)
- Breadboard

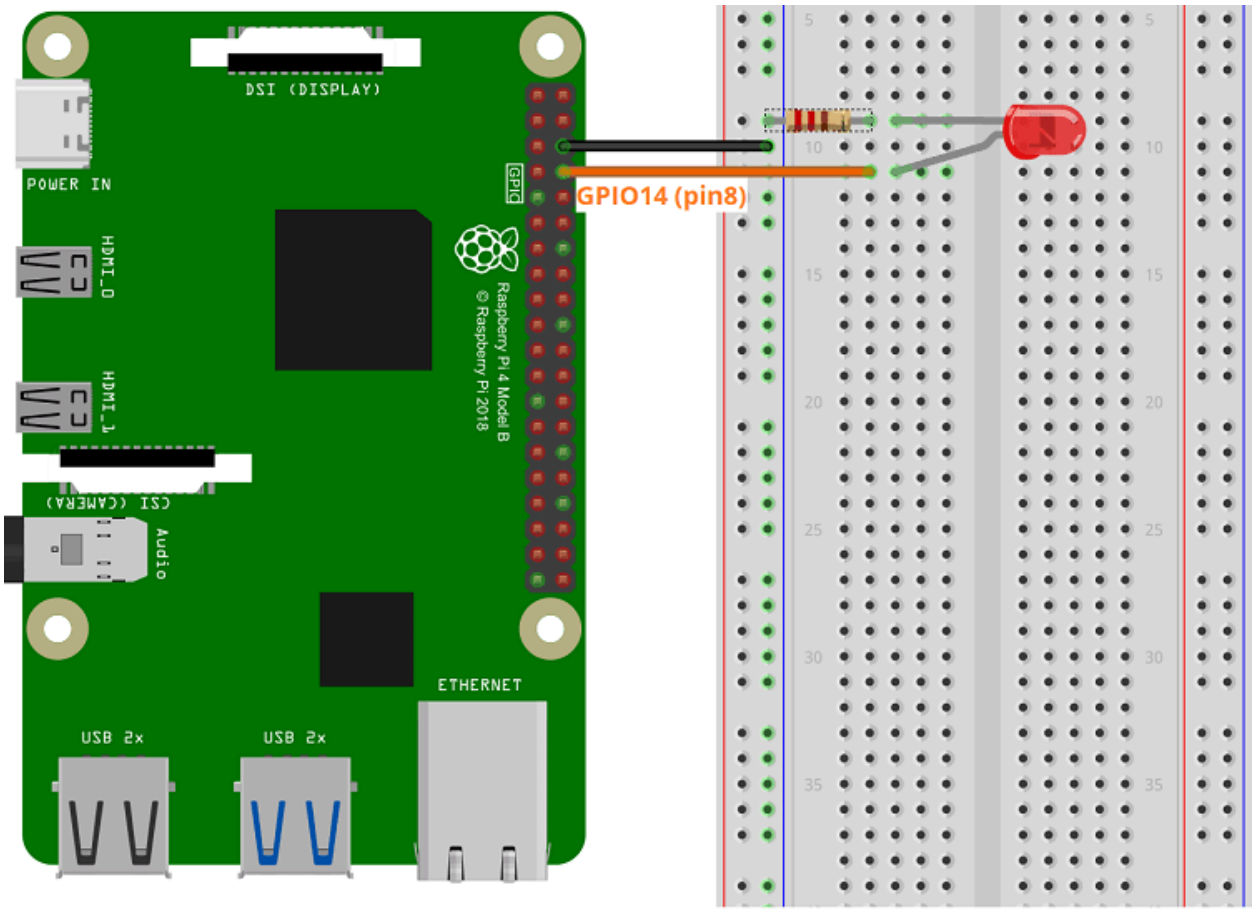


Figure:53 LED Circuit Diagram

Controlling Raspberry Pi Outputs using gpiozero

The gpiozero library offers a comprehensive set of interfaces tailored for common components such as LEDs, buttons, potentiometers, sensors, and more. Rather than manually configuring GPIO properties to manage an LED, gpiozero presents a specialized LED interface equipped with convenient methods for LED control. Additionally, you can opt to utilize the DigitalOutputDevice interface, which is versatile and can be employed for controlling various digital outputs, including LEDs. Let's explore how these interfaces function,

The gpiozero library should already be installed if you're running Raspberry Pi OS — if not, you can run the following command:

python3 -m pip gpiozero

Create a new Python file on your Raspberry Pi called ***blinking_led.py*** and copy the following code.

Here are the required steps to create a new Python file from the terminal:

- Create a new folder for your scripts and go into it. Give a suitable name for the folder, not just any random names like people do!
- Create a new Python file using Thonny IDE (a text editor in pi OS, if not installed you can install from the Preferences—> Recommended Softwares—>Select Thonny IDE—> Install).
- Type the code and save the file.
- Run the Python script.

To create your main folder, you can just create a folder just like you do in windows!

Then you can open Thonny IDE, write the following code and run it! It's that easy:

```
from gpiozero import LED
from time import sleep

led = LED(14)

# blinking an LED forever

while True:

  #set the led ON for one second
```

```
  led.on()

  sleep(1)

  #set the led OFF for one second

  led.off()

  sleep(1)
```

Use of toggle()

The toggle() method reverses the current state of the GPIO. Here's an alternative script to blink an LED using the toggle() method.

```
from gpiozero import LED

from time import sleep

led = LED(14)



# blinking an LED forever

while True:

  led.toggle()

  sleep(1)
```

Lab Reports:

1) Connect a push button and an LED to GPIO pins. Write a program where the LED turns on when the button is pressed and turns off when it's released.
2) Connect a DHT11 or DHT22 sensor to a GPIO pin and read temperature and humidity data. Display this data on the console.

   You can simply install the Adafruit-DHT library for DHT11 or DHT22 sensor by using the command ***pip install Adafruit-DHT*** or follow the instructions from here.

3) Display DHT11 or DHT22 sensor data on an I2C OLED display.

   If you face any difficulties operating an I2C OLED display, click here for necessary library installation.

Conclusion:

In conclusion, the experiment "Introduction to Raspberry Pi" aimed to provide a comprehensive guide for beginners to successfully set up and start using a Raspberry Pi. Through a systematic approach and clear instructions, participants were able to gain the necessary knowledge and skills to navigate the initial stages of the Raspberry Pi setup. During the experiment, participants were introduced to the hardware components of the Raspberry Pi and guided through the process of assembling the device. They learned how to connect peripherals such as a keyboard, mouse, and display, as well as the importance of a stable power supply. Moreover, the experiment covered the installation of the operating system, including the selection and download of the appropriate software. Participants were guided through the steps to format an SD card, write the operating system image, and configure the initial settings. By completing this experiment, participants have acquired the foundational knowledge needed to further explore the vast possibilities offered by Raspberry Pi. They are now equipped to embark on exciting projects, ranging from home automation to robotics, and leverage the Raspberry Pi's versatility in various fields. In conclusion, "Introduction to Raspberry Pi" has provided participants with a solid foundation for their Raspberry Pi journey. It has empowered them to unlock the potential of this remarkable single-board computer, paving the way for endless possibilities and creativity in the world of technology.