Raspberry Pi

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Outline

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- Raspberry pi hardware
- Raspberry pi vs. Arduino
- Raspberry pi OS
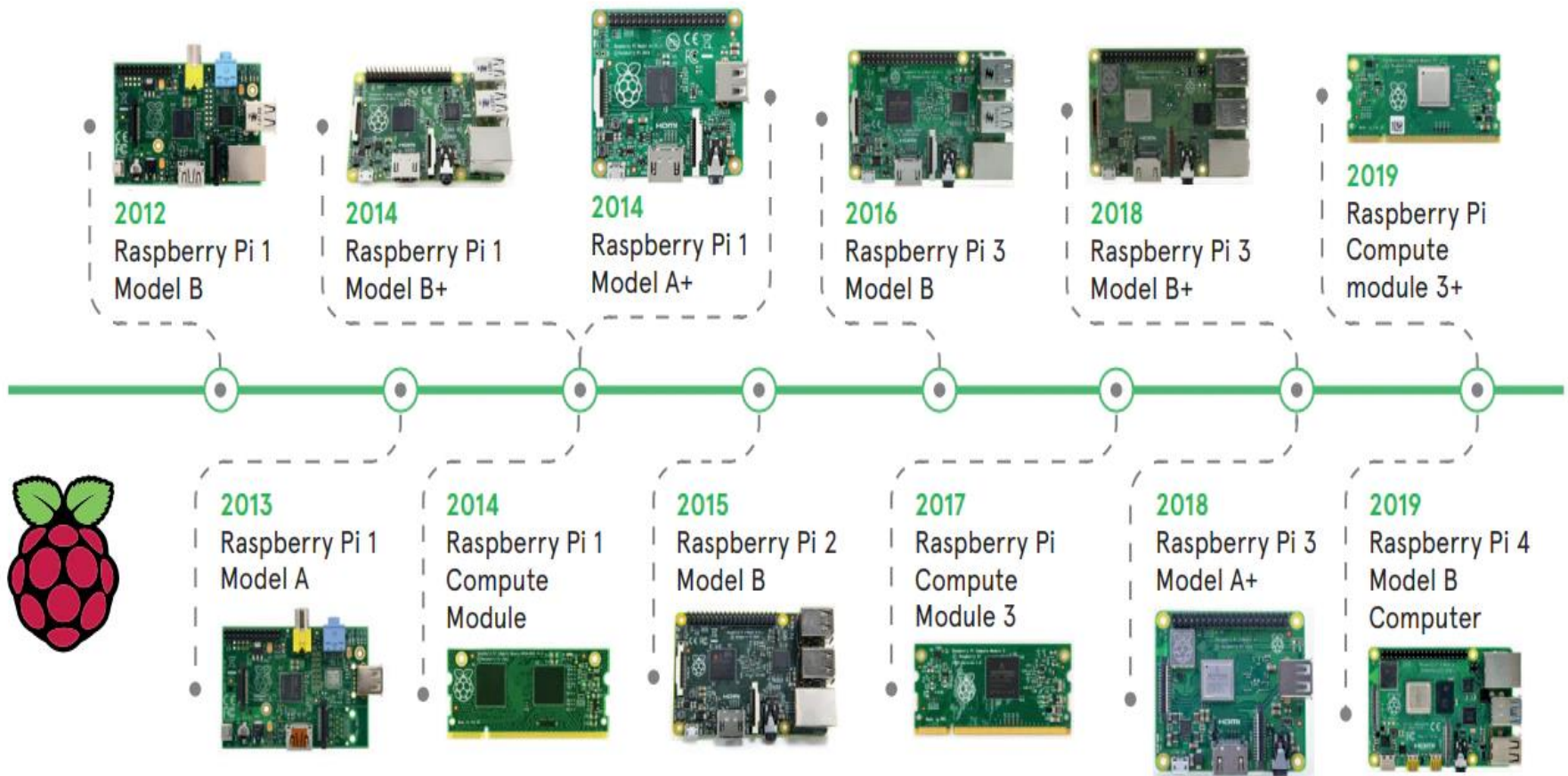- Python with Raspberry pi
- LED example

What is Raspberry Pi?

- Raspberry pi is a credit- card sized computer that plugs into the TV and a keyboard .It functions almost as a computer .

- Its is a fully featured micro-computer squashed onto a circuit board.

- It was developed in United Kingdom (UK) by the Raspberry Pi foundation with the intension of promoting the teaching of basic computer science in schools.

- The recommended Operating System is called Raspberry Pi OS (Linux based)

Raspberry Pi

- The Raspberry Pi has a small footprint (about 9x6cm) and it is cheap. Their models are priced between US$5–35.

- You plug it into a monitor and attach a keyboard and mouse.

- Raspberry Pi also allows interfacing sensors and actuators through the general purpose I/O pins. It has so-called GPIO pins (General Purpose Input/Output) for connection sensors and other electronic components like LEDs, etc.

- It can be used to learn programming, IT and other technical skills, etc.

- The "Hardrive" is a Micro SD card

Raspberry pi History

Raspberry Pi - The Historical Journey

2012 Raspberry Pi 1 Model B

2014 Raspberry Pi 1 Model B+

2014 Raspberry Pi 1 Model A+

2016 Raspberry Pi 3 Model B

2018 Raspberry Pi 3 Model B+

2019 Raspberry Pi Compute module 3+

2013 Raspberry Pi 1 Model A

2014 Raspberry Pi 1 Compute Module

2015 Raspberry Pi 2 Model B

2017 Raspberry Pi Compute Module 3

2018 Raspberry Pi 3 Model A+

2019 Raspberry Pi 4 Model B Computer

Raspberry pi Models

	Raspberry Pi 1 Model A	Raspberry Pi 1 Model A+	Raspberry Pi 1 Model B	Raspberry Pi 1 Model B+	Raspberry Pi 2 Model B	Raspberry Pi 3 Model B	Raspberry Pi Zero
Release Date	2013	2014	2012	2014	2015	2016	2015
SoC	Broadcom BCM2835	Broadcom BCM2835	Broadcom BCM2835	Broadcom BCM2835	Broadcom BCM2836	Broadcom BCM2837	Broadcom BCM2835
CPU Speed	700 Mhz ARM-1176JZF-S	700 Mhz ARM-1176JZF-S	700 MHz ARM-1176JZF-S	700 Mhz ARM-1176JZF-S	900 Mhz ARM-Cortex-A7	1.2 Ghz ARM-Cortex-A53	1 Ghz ARM1176JZF-S
Cores	1	1	1	1	4	4	1
SDRAM	256 MB	256 MB	512 MB	512 MB	1 GB	1 Gb	512 MB

Raspberry Pi Features

- All models feature a Broadcom System on a Chip (SoC), which includes an ARM compatible central processing unit (CPU) and an on-chip graphics processing unit (GPU, a VideoCore IV).

- CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM.

- Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or MicroSDHC sizes.

- Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phonon jack for audio.

- Lower level output is provided by a number of GPIO pins

- The B-models have an 8P8C Ethernet port and the Pi 3 and Pi Zero have on board Wi-Fi 802.11n and Bluetooth.

Raspberry Pi 3

- Raspberry Pi 3 is the third generation of Raspberry Pi and it packs quite a formidable punch in its credit card-sized package. Most notably, in addition to the standard features of the Raspberry Pi (such as four USB 2.0 ports and built-in Ethernet), it has:

- A 1.2GHz 64-bit quad-core ARMv8 CPU

- 802.11n Wireless LAN

- Bluetooth 4.1 Low Energy (BLE)

- The powerful CPU coupled with Wireless LAN and Bluetooth 4.1 radio makes it an ideal candidate for IoT projects, because multiple sensors can be connected to it simultaneously.

- In addition, the Raspberry Pi has a 40-pin GPIO (General Purpose I/O) connector for interfacing with external sensors.

Raspberry Pi Zero

- The Raspberry Pi Zero is the smallest Raspberry Pi ever made.

- Although it doesn't have a processor that's as powerful as the Pi 3, its small size is especially suited for embedded projects (such as wearables, etc.), where space is a premium

Raspberry Pi Hardware

GPIO Pins

microSD Card
(the Back)

Ethernet

Camera
Connector

USB A x 4

Power Supply (USB C)   microHDMI x 2

https://www.raspberrypi.org
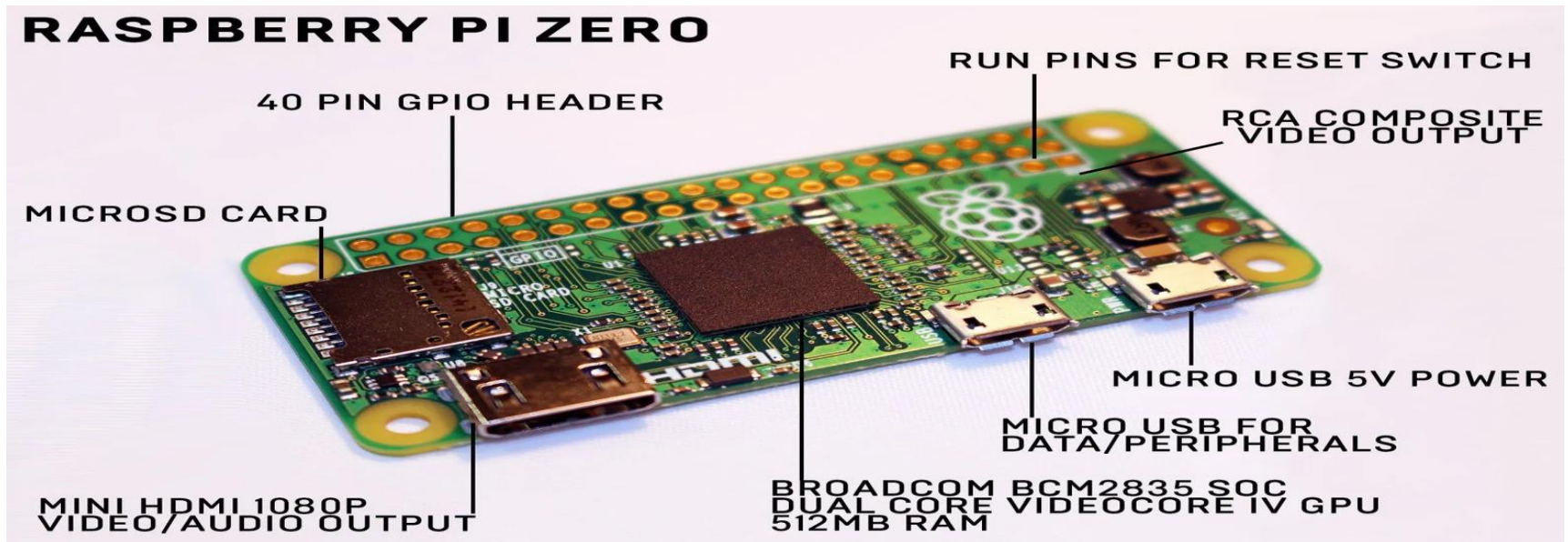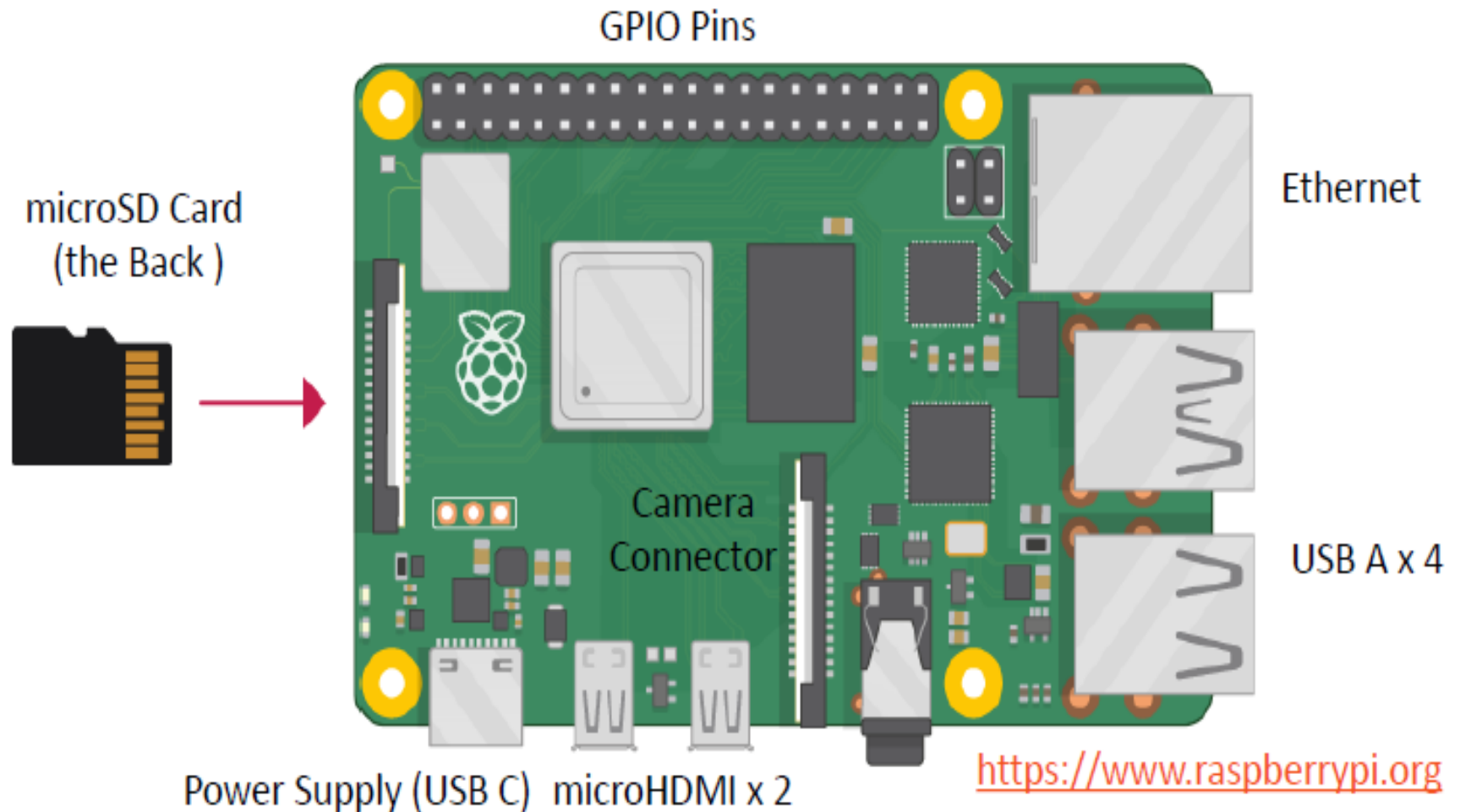
Raspberry Pi vs. Arduino

- Raspberry Pi (RP) is a Microcomputer
- It has an ordinary Operating System (OS)
- You can connect USB devices, Keyboard, Mouse, Monitors, etc.
- It has a "hard-drive" in form of a microSD card
- RP has Bluetooth, Wi-Fi, and Ethernet connection
- RP has basically all the features an ordinary computer has but in a much smaller package
- 2, 4 or 8 Gb RAM
- RP runs Linux applications

- Arduino is a Microcontroller
- Arduino has a Bootloader and not an ordinary operating system
- Arduino is NOT a computer, only a small controller, whose purpose is to control things
- No Bluetooth, Wi-Fi (some models have), and Ethernet (but can be provided as so-called Shields)
- Very little RAM (a few Kb)
- Inexpensive
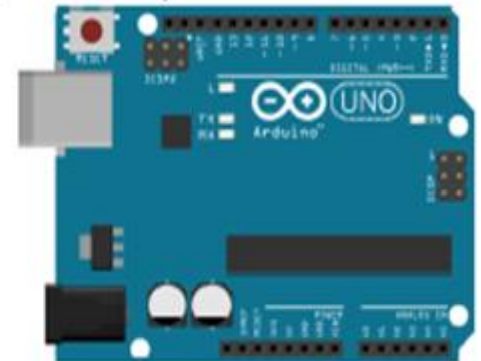
Arduino Strength

Arduino Strengths

- Analog input
- Native hardware PWM
- Control motors
- Real time control

- ...
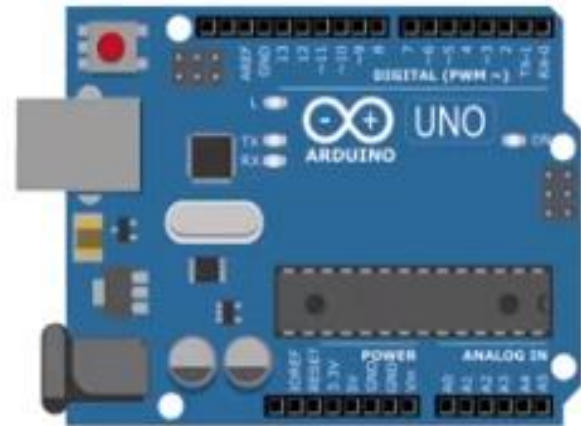
⇨ **Hardware Control**

Raspberry Pi Strength

Raspberry Pi Strengths

- Complete OS (Linux, …)
- Write with C++/Python/Etc
- Control a camera
- Computer vision, AI, machine learning
- Create web apps
- Many applications, multi-threading
- …

⇒ **Software Applications**
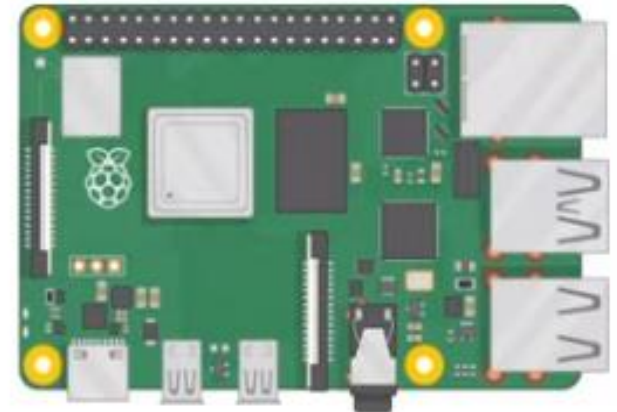
Raspberry Pi or Arduino
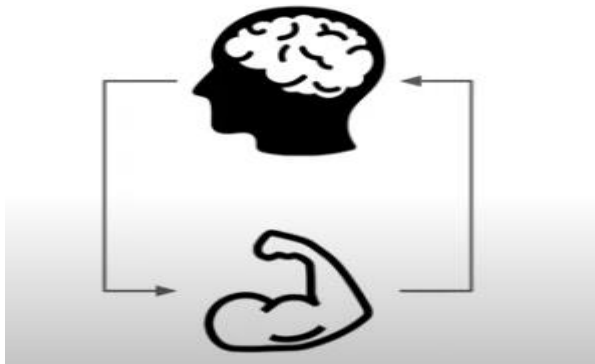
High Level (software)

Low Level (hardware)

Arduino finds application in systems that perform simple repetitive tasks that need only one action at a time such opening and closing doors, turning on and off lights and so on

Raspberry Pi microcomputers are the faster of the two. This makes them an ideal partner for any data-intensive application.

Raspberry Pi IoT applications are best suited for tasks that need multiple functions at the same time. This could include gathering location data from a mobile asset, sending it to the cloud, and sending an email if it leaves the designated boundaries.

Raspberry pi is ideally suited for complex activities such as controlling complex robots, weather monitoring, and internet publishing, among others

Getting Started with Raspberry Pi

Hardware Requirements

- **Essential:**

    - ❖ Raspberry Pi board
    - ❖ Micro SD Card (+ Adapter)
    - ❖ USB keyboard
    - ❖ Display (with HDMI, DVI, or Composite input)
    - ❖ Power Supply

- **Highly suggested extras include:**

    - ❖ USB mouse
    - ❖ Internet connectivity - LAN cable
    - ❖ Heat sink for Processor
    - ❖ Case

USB C **Power Supply** 15W (5V, 3A)

Monitor (with HDMI)

microHDMI to HDMI Cable

Mouse

Raspberry Pi

Keyboard

Micro SD Card (+ Adapter)

(8GB or more)

https://www.raspberrypi.org
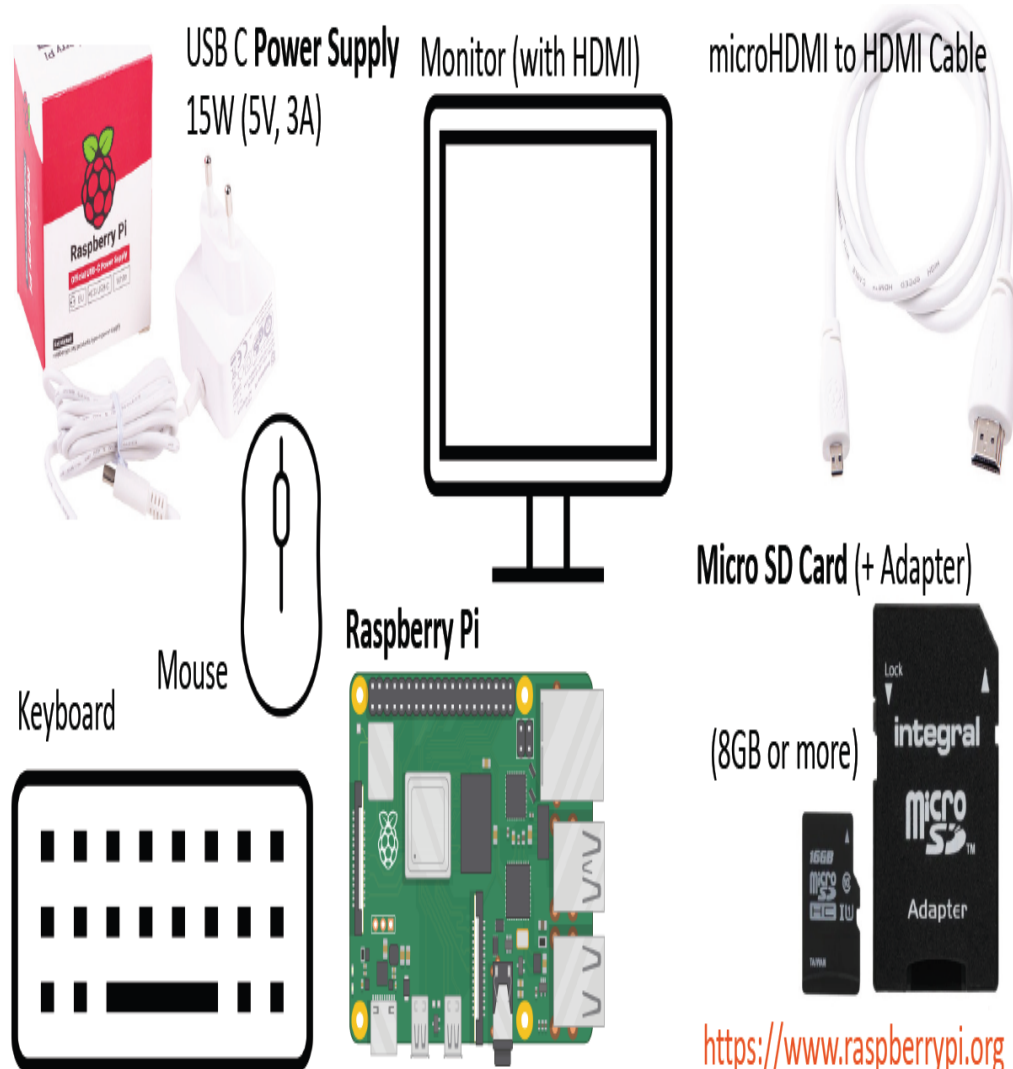
Raspberry Pi OS

- In order make your Raspberry Pi up and running you need to install an Operating System (OS)

- The OS for Raspberry Pi is called Raspberry Pi OS (previously known as *Raspbian*)

- The Raspberry Pi Foundation recommends the use of Raspbian, a Debian-based Linux operating system.

- Other third party operating systems available via the official website include Ubuntu MATE, Snappy Ubuntu Core, Windows 10 IoT Core, RISC OS.

- To install the necessary OS, you need a microSD card

- Then you use the Raspberry Pi Imager in order to download the OS to the microSD card

- Since Raspberry Pi runs Linux operating system, it supports Python "out of the box".
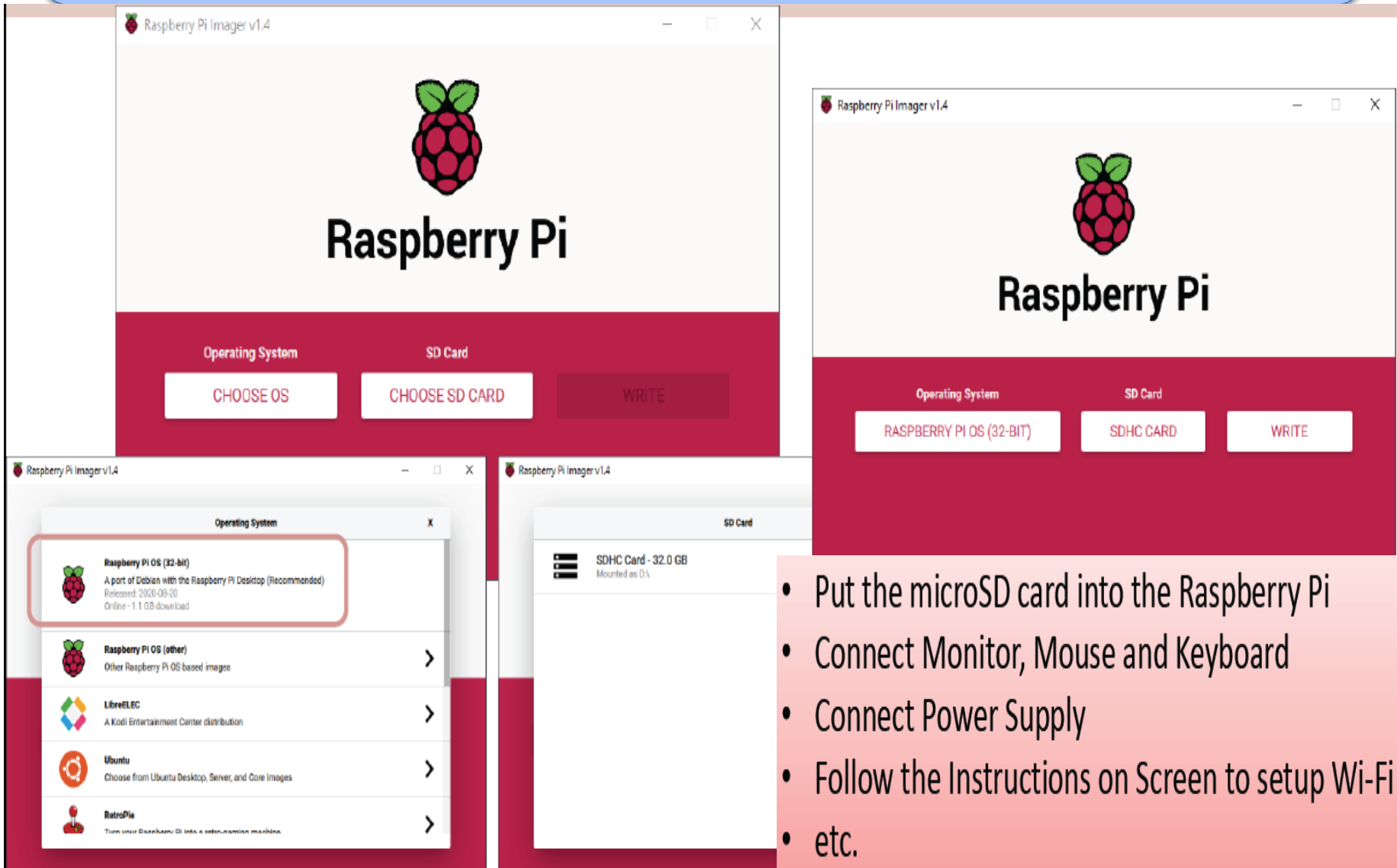
Linux Based OS

- Android Things
- Arch Linux
- OpenSuse
- Raspberry Pi Fedora Remix
- Pidora
- Gentoo Linux
- CentOS Raspberry Pi
- Kali Linux
- Slackware ARM
- Puppy Linux

Other Operating Systems

- RISC OS Pi
- FreeBSD
- NetBSD
- Windows 10 IOT Core
- Haiku
- HelenOS

Raspberry Pi Imager


- Put the microSD card into the Raspberry Pi
- Connect Monitor, Mouse and Keyboard
- Connect Power Supply
- Follow the Instructions on Screen to setup Wi-Fi
- etc.

Connect to Wi-Fi Network

- The first thing you typically need to do is to connect your Raspberry Pi to a Wi-Fi network.
- Your home network normally works fine. If you are in a company or a university, you may get some trouble.
- In these situations, you can configure a Mobile hotspot using your Windows 10/11 PC
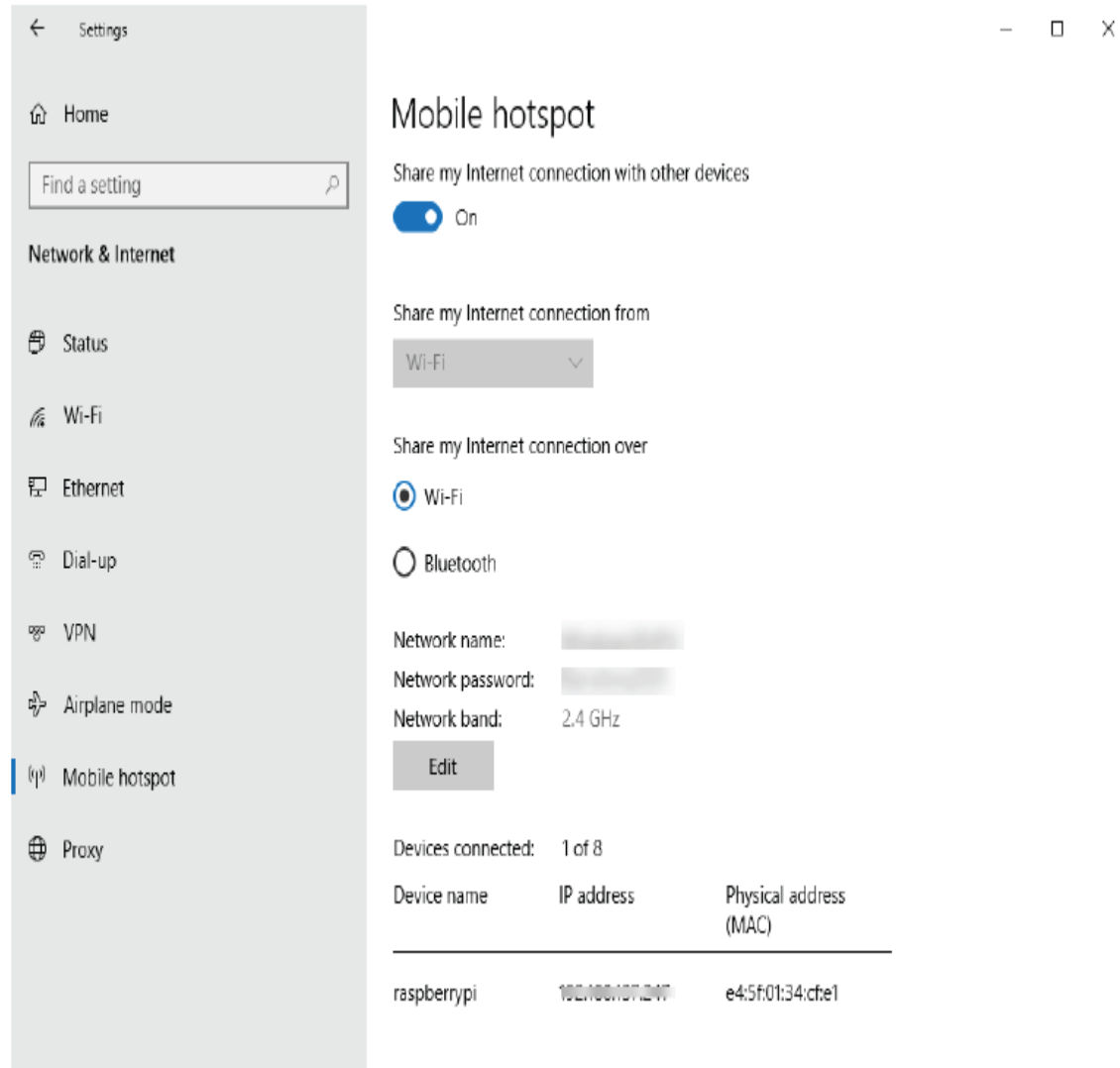
The Linux Terminal

- The Raspberry Pi OS is a Linux based OS and comes with a GUI with limited features, so very often you need to type "low-level" commands using the Terminal
- The Linux terminal is a powerful tool for "low-level" operations on the OS

Update Raspberry Pi OS

Run the following commands in the Terminal window:

• First run the following:

sudo apt update

• Then:

sudo apt full-upgrade
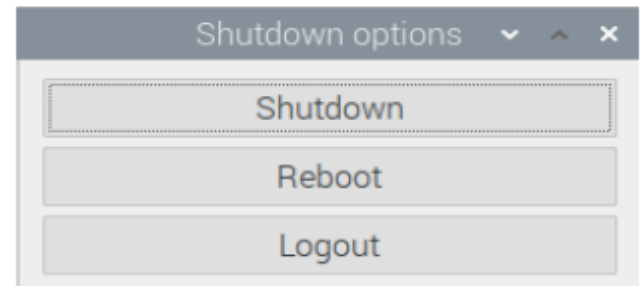
How to Power off your Raspberry Pi?

Unlike your other electronic devices, Raspberry Pi doesn't come with an "off" switch.
• You should not just "pull out the plug"

Or use the Graphical Interface:

• Enter the following in the Terminal:

sudo poweroff

Shutdown options

Shutdown

Reboot

Logout

• This will give you a clean shutdown. After that, you can unplug the computer.
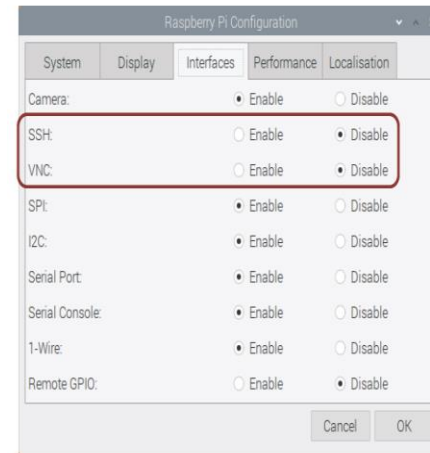• How to turn on Raspberry Pi after shutdown? It's simple. Just plug it in.

Remote Access

Typically, you want to have Remote Access to you Raspberry Pi from your ordinary Desktop Computer. Different options:
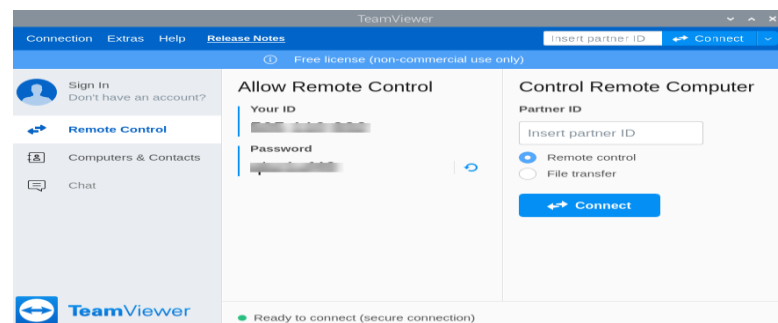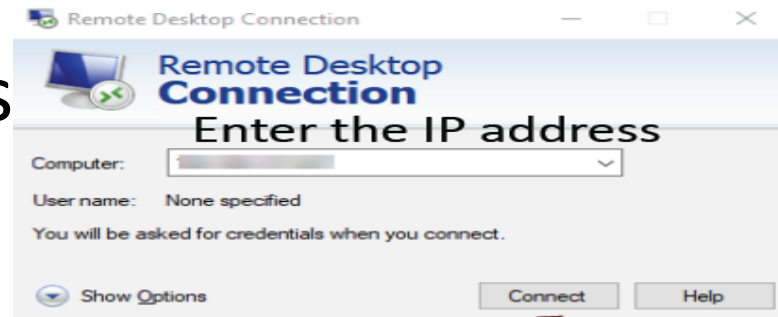
- SSH – Command Line Access

Or use some kind of Remote Desktop software:

- **XRDP/RDC (not root user)**
- TeamViewer
- VNC

Make sure to Enable the Feature you want to use

Enter the IP address

Python with Raspberry Pi

- Python is a fairly old Programming Language (1991) compared to many other Programming Languages like C# (2000), Swift (2014), Java (1995), PHP (1995).7
- Today, Python has become one of the most popular Programming Languages.
- The Raspberry Pi OS comes with a basic Python Editor called "Thonny"

LED Example

```
from gpiozero import LED
from time import sleep

pin = 16
led = LED(pin)

while True:
    led.on()
    sleep(1)
    led.off()
    sleep(1)
```
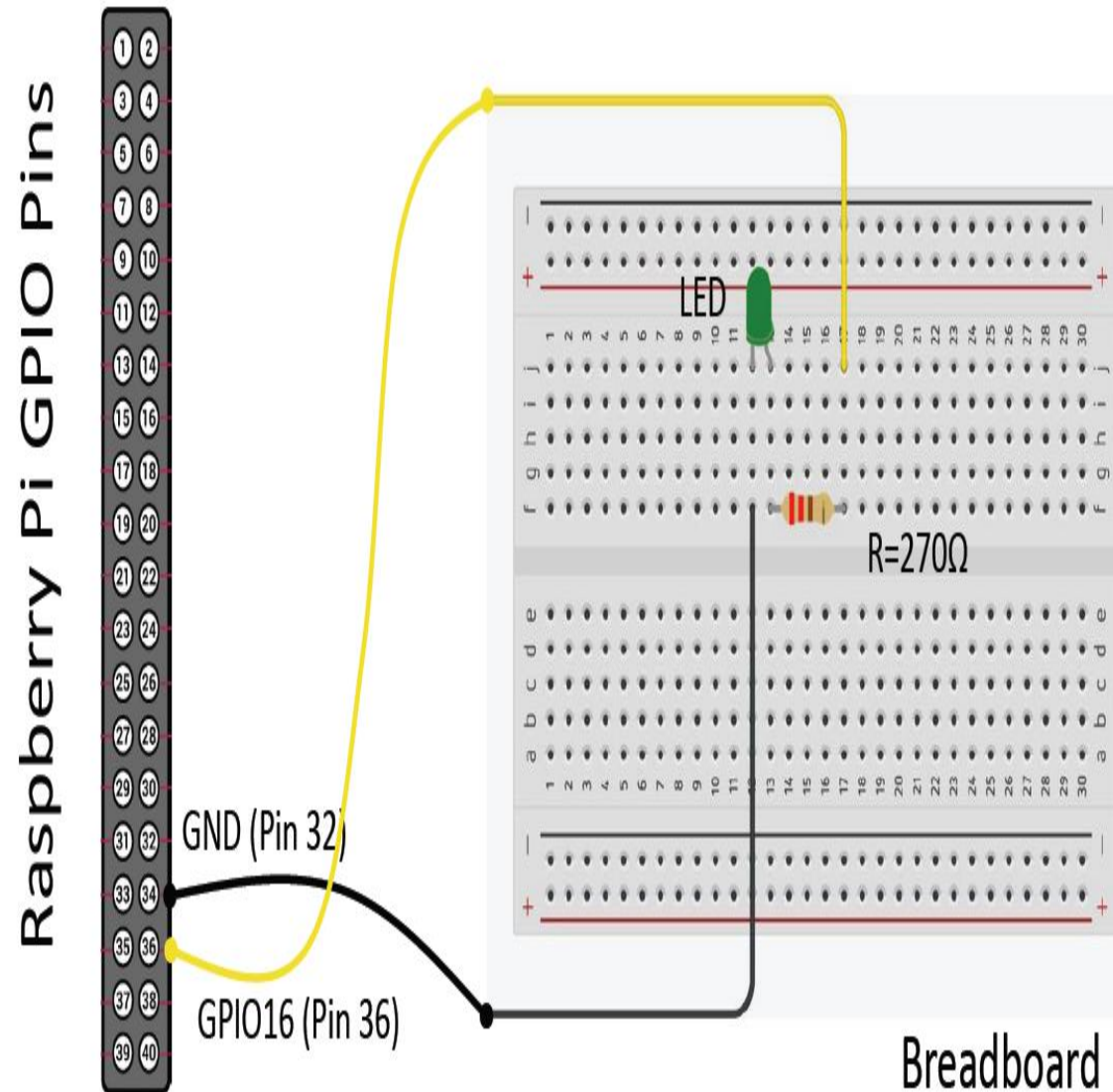
Raspberry Pi GPIO Pins

GND (Pin 32)

GPIO16 (Pin 36)

LED

R=270Ω

Breadboard

Questions