# Raspberry Pi - Introduction

**Eli the Computer Guy - December 12, 2024**
Version1

## Goal

This class will teach the basics of what Raspberry Pi computers are and why they are useful for IoT and other projects.

## What is a Raspberry Pi?

Raspberry Pi's are ARM based full fledged computers.  They run an operating system and are configured to run services, or be "desktop" computers.

Their largest selling point is the GPIO pins. These are pins you can connect to standard electronic sensors, and outputs.  You can add a motion sensor, and control LED's lighting up.

Originally the primary selling point of Pi's was the price point.  The prices have gone up, and competitors have become cheaper. Now the ability to run a system off of a battery, and be able to connect everything from LED's to GPS is the value proposition.

When looking at competitors a major advantage of Pi is the whole ecosystem. The hardware is solid, the OS is designed for it, and accessories are easy to find.  Most other primary competitors are "quirky"...

## What are the Pi Versions?

**Pi 4B**
https://www.raspberrypi.com/products/raspberry-pi-4-model-b/

**Pi 5**
https://www.raspberrypi.com/products/raspberry-pi-5/
Real Time Clock
Need specific power supply for full functionality. 27W vs. 15W

**Pi Zero**
https://www.raspberrypi.com/products/raspberry-pi-zero-2-w/
Need a special adapter for Mouse and Keyboard
One is USB
One is Power
Buy with Pre Soldered Headers
https://www.adafruit.com/product/6008

**Compute Module**
https://www.raspberrypi.com/products/compute-module-4/?variant=raspberry-pi-cm4001000
Compute modules are plugged into expansion boards to create a complete system. The idea is that the module acts as upgradeable compute subsystem for a device.

**Pico**
https://www.raspberrypi.com/products/raspberry-pi-pico/
Not a computer... This is a microcontroller competitor to Arduino

**Other Versions**
There are numerous versions of Raspberry Pi's. Make sure to fully spec the hardware.

# Pi Accessories

When buying a Pi you only get the board. At a minimum you'll need to buy a power supply, and SD card.

**Form Factor**
At first glance Pi 4B and Pi 5 look to be the same form factor. This is not the case. Make sure to buy appropriate accessories for the Pi you own.

**First Party vs. Third Party Components**
Other than the Pi itself the question of first party or third party hardware is up to you. Third party components are generally good, just read the reviews. The main question will be stock of items if you will be deploying your finished devices and need to support them for a period of time.

**Cases**
Standard cases can be problematic from a heat perspective. Oddly stock standard cases can cause Pi's to overheat and throttle their CPU's for any kind of demanding task.

For lab work, and "real" geeks you don't need a case. I rarely run any of mine in them.

**Cooling**
**https://www.raspberrypi.com/products/active-cooler/**
Cooling is especially important for the Pi 5. There are passive coolers without a fan, and active coolers with a fan. For labs I recommend the active coolers. For real world situations you may want to use passive so that they do not fail due to dirt and dust.

**Displays**
You can connect displays to Pi's using HDMI, or the built in display connector. There are numerous touchscreen options that just connect to the USB port.

**Cameras**
You can connect cameras directly to Pi's. I prefer Arducam cameras. My experience is that they seem to be as good as first party, but are a fraction if the cost. Arducam also has a number of camera modules for different purposes.

https://www.arducam.com/raspberry-pi-camera-solution/

Pi Zero's require a specific ribbon cable to connect to cameras.  Their connector is smaller than the standard Pi's.

### Hats

Like Arduino Shields.  These are add-ons that connect to the full GPIO Pin connector.

## What is PiOS

PiOS is the OS supported for the Pi.  It includes the drives for displays, cameras, and includes GPIOZero module to be able to easily use GPIO pins with Python.

It is a fork of Debian so if you know Ubuntu it's easy to use.

You can install other OS's on Pi's, but they may lack the ability to easily connect Pi accessories or use GPIO pins.  You can configure them to do so, but it's extra work.

## Installing PiOS

Install the Installer onto your main computer.  Then use it to image a Pi OS to an SD card.

## PiOS Tour

Standard type of GUI environment.

## PiOS Connectivity

To connect with SSH, VNC, I2C and more you have to enable the interface.

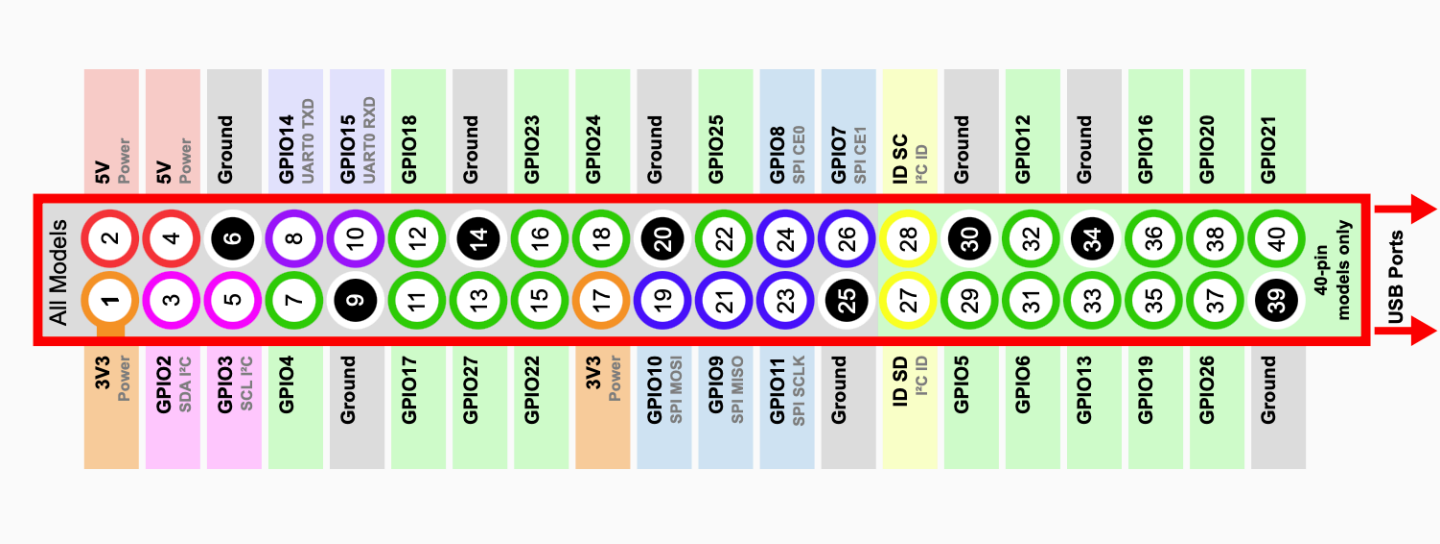
- Start
- Preferences
- Raspberry Pi Configuration
- Interfaces

## GPIO Pins and GPIOZero Module

https://gpiozero.readthedocs.io/en/latest/

```
pinout
```

**GPIO Numbering**
Broadcom numbering is the standard format so that code works across all boards.
Board numbering is the actual number of the pin, and may not work the same on all boards.




## I2C Protocol

I2C Protocol is an electronics communication protocol that allows you to connect up to 128 electronic devices to your Pi.  The is an addressable protocol, but generally addresses are hard set by the manufacturer. So you need to verify your devices are not using the same addresses.  You may also need to find out what address a device is at.

At command prompt run this command to detect I2C devices.

```
i2cdetect –y 1
```

I2C devices are good because you only need to connect 2 communication wires and power instead of up to 16.

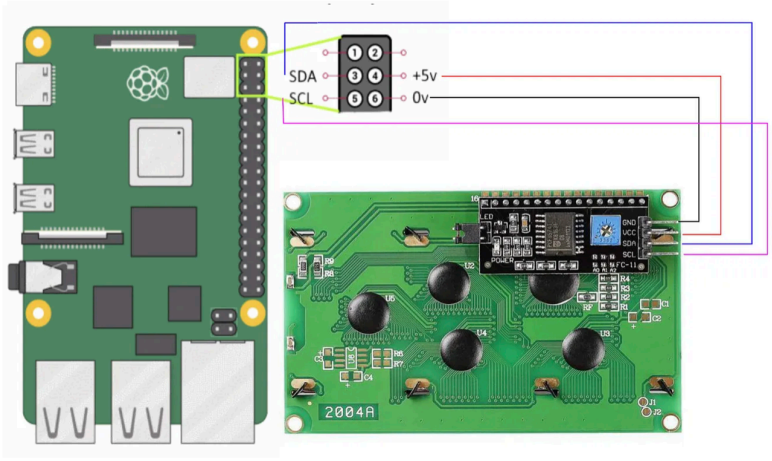
## Sensors and Outputs

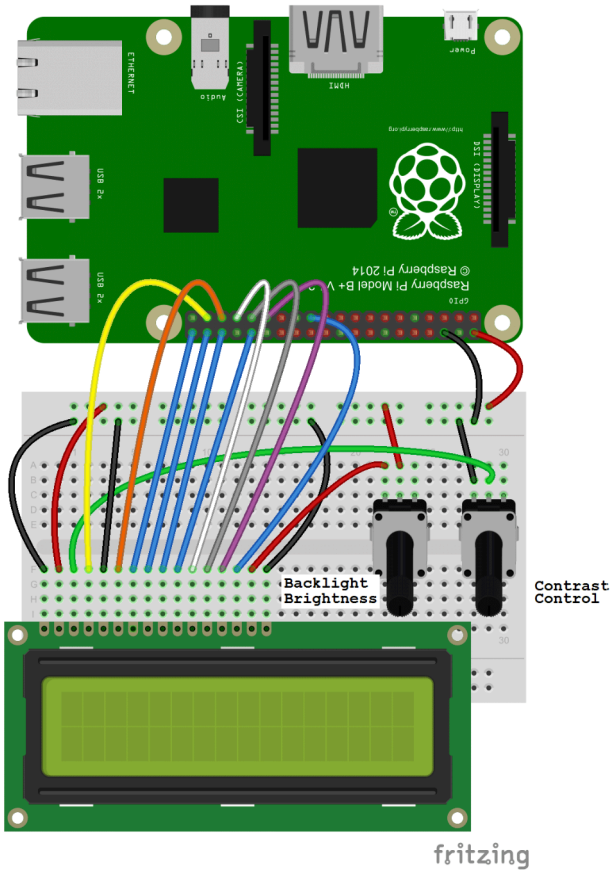
You can connect any type of electronic sensor to the Pi, and control electronic output devices.

## Final Warning

Pi's are real computers, with real computer vulnerabilities!!! Have a plan for patch management and maintenance.

The benefit of Arduino's, Picos and Microcontroller systems is that they do not run operating systems that can be compromised to the same degree.


SDA
SCL
+5v
0v
2004A


Backlight
Brightness
Contrast
Control
fritzing