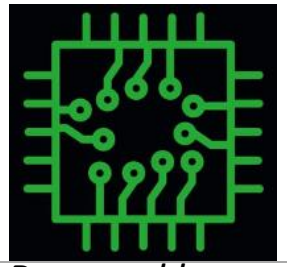
Al Hussein
Technical University
جامعة الحسين التقنية

Internet Of Things

Getting Started with Hardware



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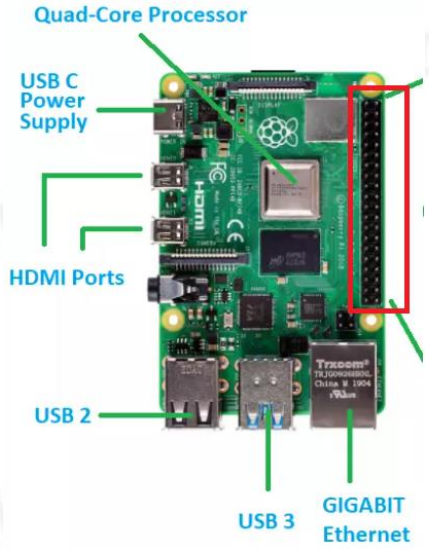
Introduction

- The Raspberry Pi 4 has a GPIO header with 40 pins



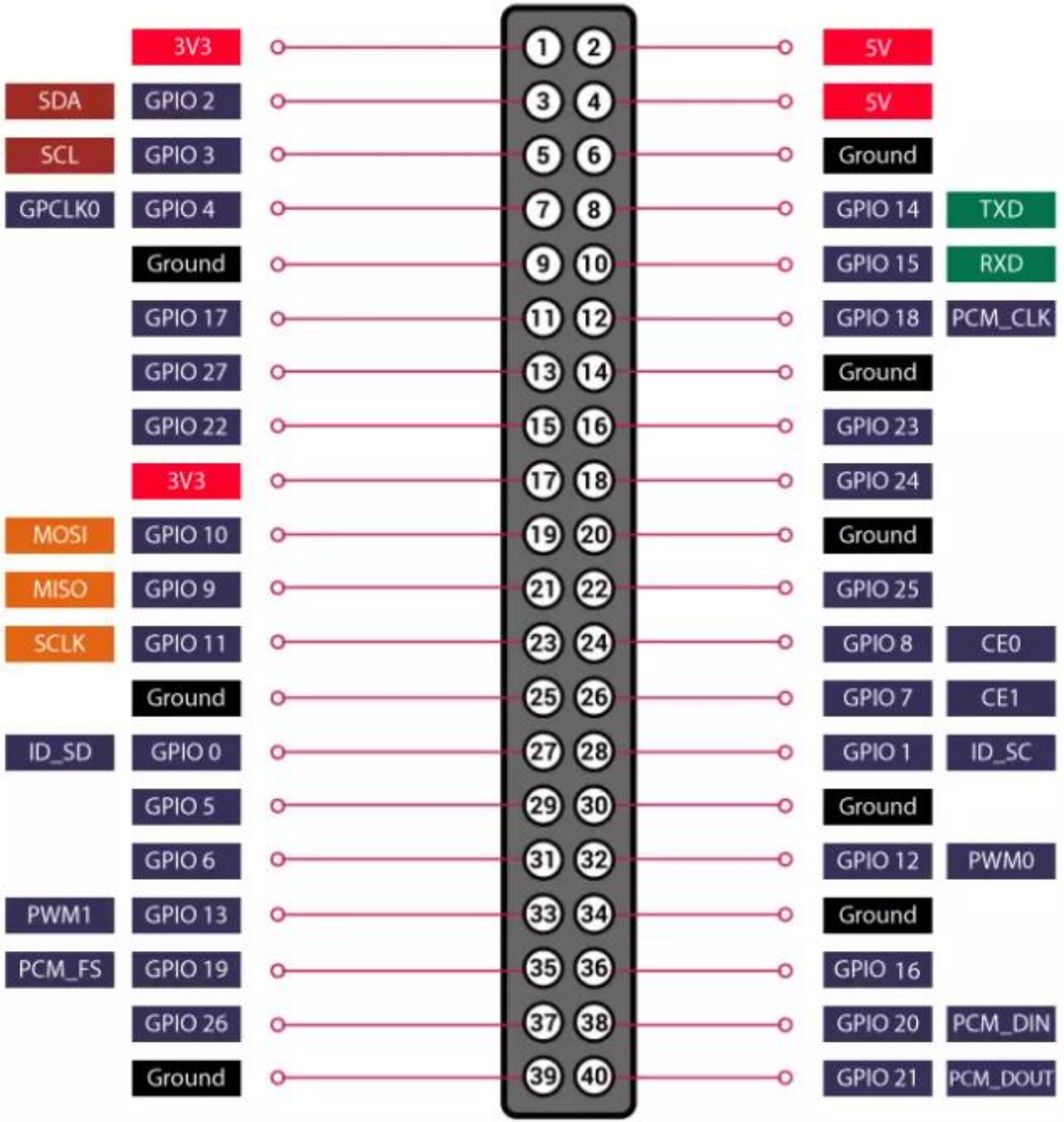
- GPIOs allow you to easily control hardware components and communicate with other devices
- It brings the Raspberry Pi much closer to hardware applications making it perfect for robotics, IOT , …etc

Introduction

BE CAREFUL

- Before you plug anything to a Raspberry Pi pin, you have to know that you can easily damage the board if you do something wrong
- If you pay attention and double check everything there is no reason you will burn the board

PINOUT

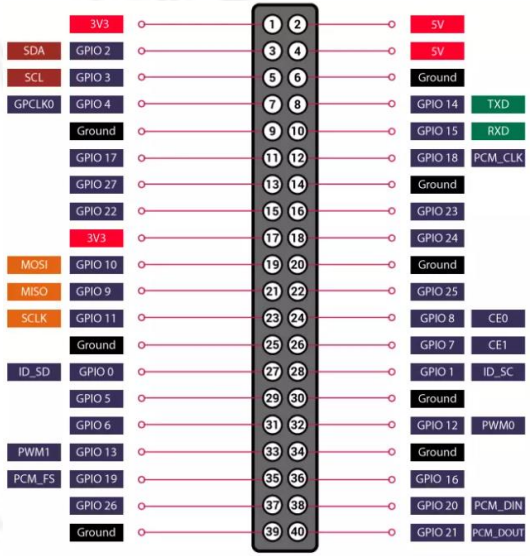

3V3 1 2 5V
SDA GPIO 2 3 4 5V
SCL GPIO 3 5 6 Ground
GPCLK0 GPIO 4 7 8 GPIO 14 TXD
Ground 9 10 GPIO 15 RXD
GPIO 17 11 12 GPIO 18 PCM_CLK
GPIO 27 13 14 Ground
GPIO 22 15 16 GPIO 23
3V3 17 18 GPIO 24
MOSI GPIO 10 19 20 Ground
MISO GPIO 9 21 22 GPIO 25
SCLK GPIO 11 23 24 GPIO 8 CE0
Ground 25 26 GPIO 7 CE1
ID_SD GPIO 0 27 28 GPIO 1 ID_SC
GPIO 5 29 30 Ground
GPIO 6 31 32 GPIO 12 PWM0
PWM1 GPIO 13 33 34 Ground
PCM_FS GPIO 19 35 36 GPIO 16
GPIO 26 37 38 GPIO 20 PCM_DIN
Ground 39 40 GPIO 21 PCM_DOUT

Power Pins

- The power pins are used as a source to power external components not to power the Raspberry Pi itself from external source
- You can find 2 pins bringing 3.3 Volts and 2 pins bringing 5 Volts
- Those pins can be used to give power to components such as sensors and small motors

Ground Pins (GND)

- The ground is very useful for making a common reference between all components
- Always remember to connect all components to the ground
- 8 of the 40 GPIOs are ground, you can find them with the three letters GND

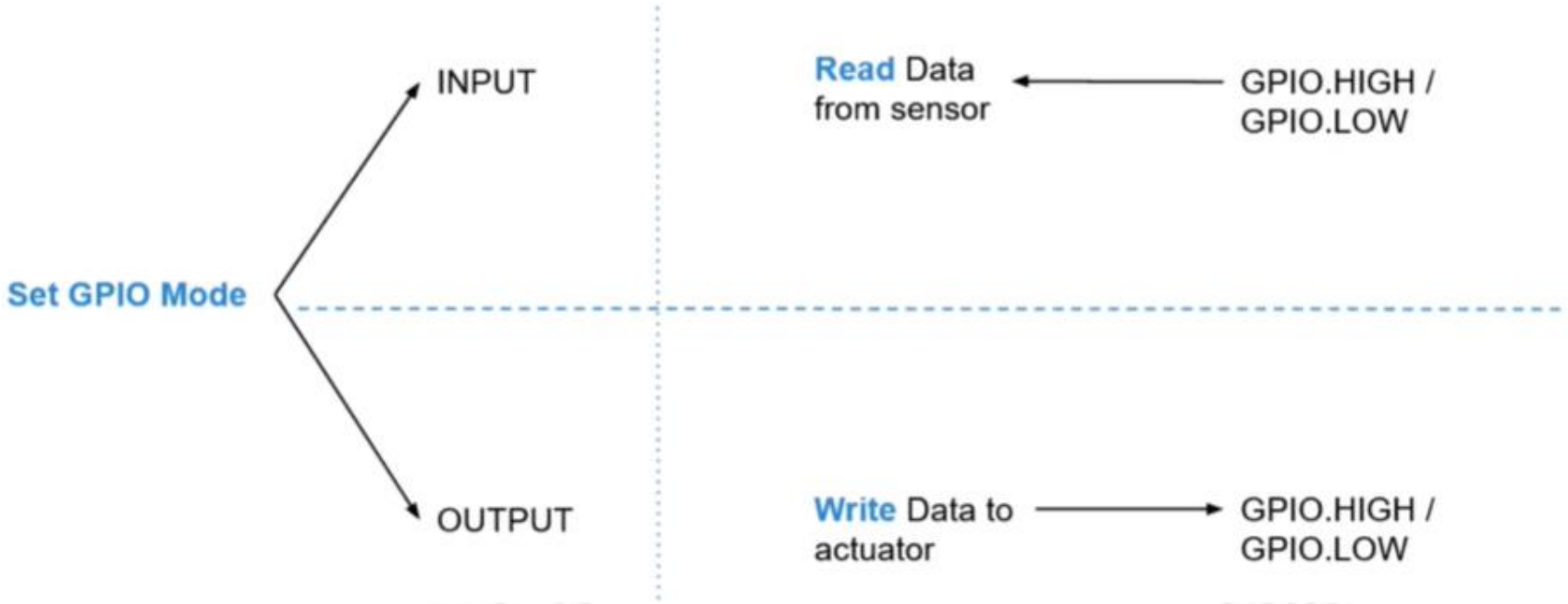


GPIOs

- With the ground pins and power pins we already have 12 pins taken and 28 left as GPIO
- GPIO means General Purpose Input Output
- Basically, a GPIO is a pin can use to write some data to external component as output or read data from external component as input
- GPIOs will allow you to:
  - Read some basic sensors for example infrared or push button
  - Control Led and motors

GPIOs

- The Raspberry Pi GPIOs are similar to digital pins on Arduino board



GPIOs

- First you need to choose whether you want to use them as input or output
- If you configure a GPIO as input, you will be able to read the value from it (HIGH or LOW), which also means the max voltage or zero Volt
- If you configure a GPIO as output, you will be able to write value to it (HIGH or LOW).
- So digital pin or GPIO has only two states:
  - LOW: means zero Volt
  - HIGH: means 3.3 Volt

GPIOs

- Its like a switch that you turn ON and OFF
- You can control GPIOs using code
- For the code to actually read or write a state to a GPIO, you can use the GPIO api Python module which will make things very simple for you

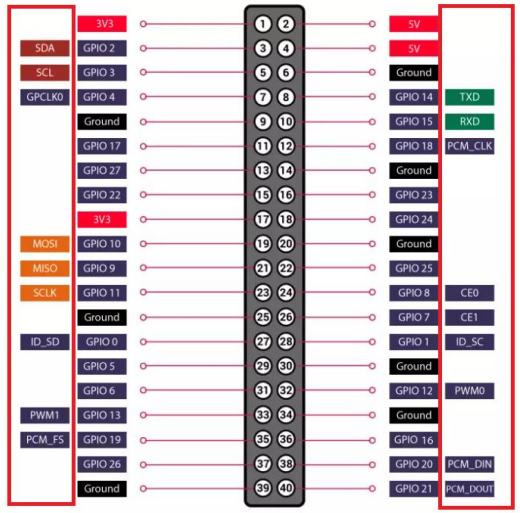
RPi.GPIO Python module

GPIOs – Voltage

- All GPIOs work with 3.3 Volt
- Its important to know that if you want to plug a component with a different voltage

Communication Protocols

- You can use a few communication protocols directly with the Raspberry Pi GPIOs
- With these protocols you will be able to transfer far more information than digital pins
- On pinout, you can see two columns for alternate functions

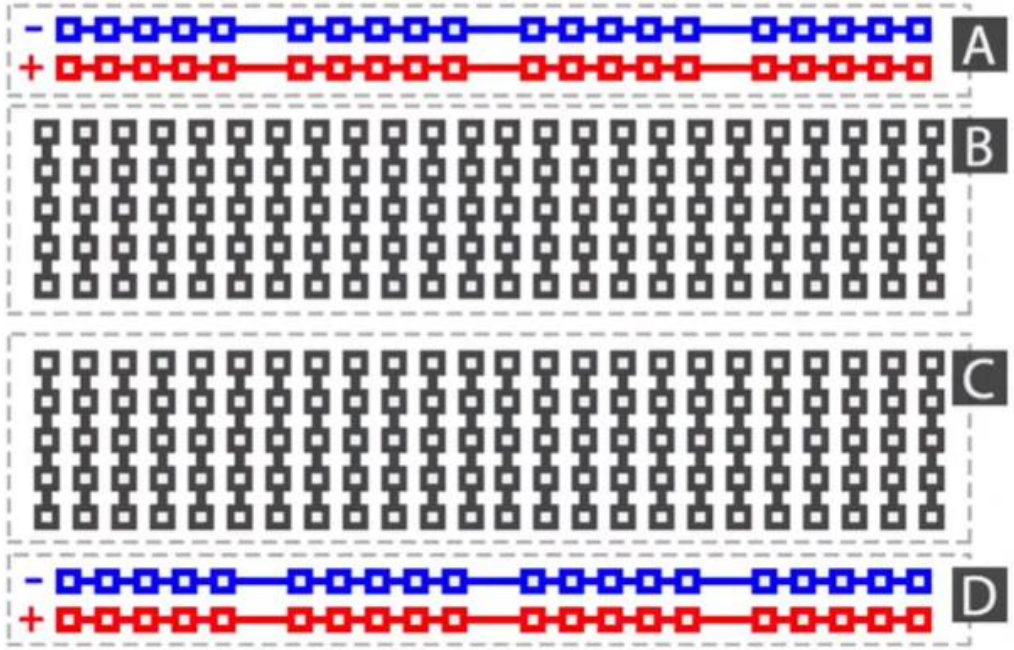


Communication Protocols

- Some GPIOs have alternate functions
- You don’t need to know all alternate functions to get started
- Some communication protocols:
  - UART
  - SPI
  - I2C

Breadboard

- To be able to create a Hardware circuits with Raspberry Pi you have to know just a little bit about breadboard and resistors
- Breadboard is used to connect multiple components together with GPIOs



Breadboard

- What you need to know that underneath the surface, there are metal lines that make connections between components
- A component that you plug on a line is electrically connected to all of other components on that line

Resistors

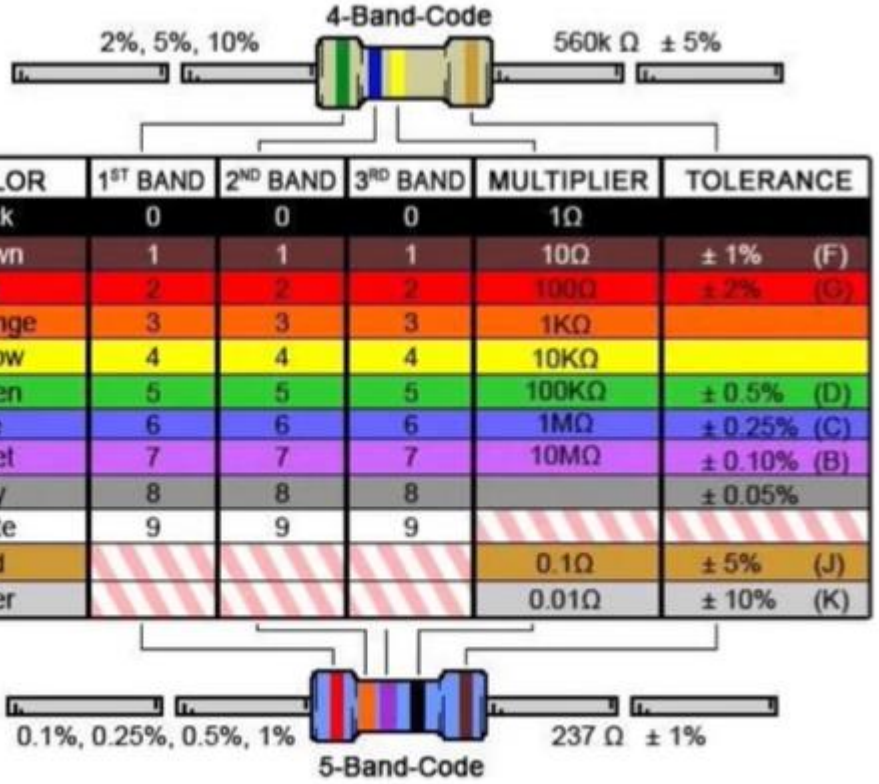
- To connect an LED, we will need LED, some wires, and one resistor
- The resistor is used to lower the amount of current that goes through the LED
- Also help to protect GPIOs so they don't burned with too much current

Symbol

Resistor

Resistors

- How to recognize resistor?
- Sometimes you will have to read resistor value from the color bands on the resistors



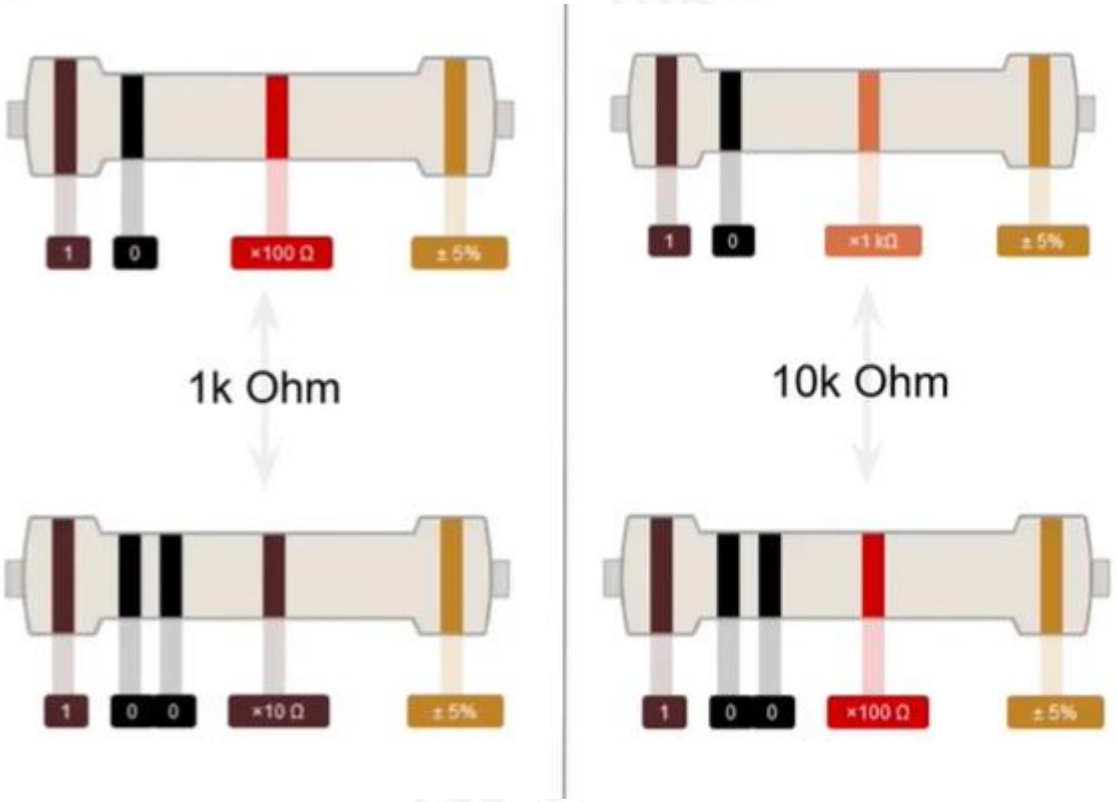
COLOR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	± 0.5% (D)
Blue	6	6	6	1MΩ	± 0.25% (C)
Violet	7	7	7	10MΩ	± 0.10% (B)
Grey	8	8	8		± 0.05%
White	9	9	9		
Gold				0.1Ω	± 5% (J)
Silver				0.01Ω	± 10% (K)

Resistors

- Usually, you will see 4 bands or 5 bands resistor
- The first 2 or 3 bands correspond to a number, the next band corresponds to multiplier (x1, x10, x100) ohm
- The last band is for tolerance, you will not need to worry about it in this class, any value will be fine

Resistors – Example

- 1K ohm = 1000 ohm



Any Questions???