PROGRAMMING WORKSHOP

04 Nov 2023

By Goldman Sachs APAC Women in Engineering x YWLC

PLEASE DOWNLOAD MATERIAL FROM

https://tinyurl.com/apwe-ywlc-2023

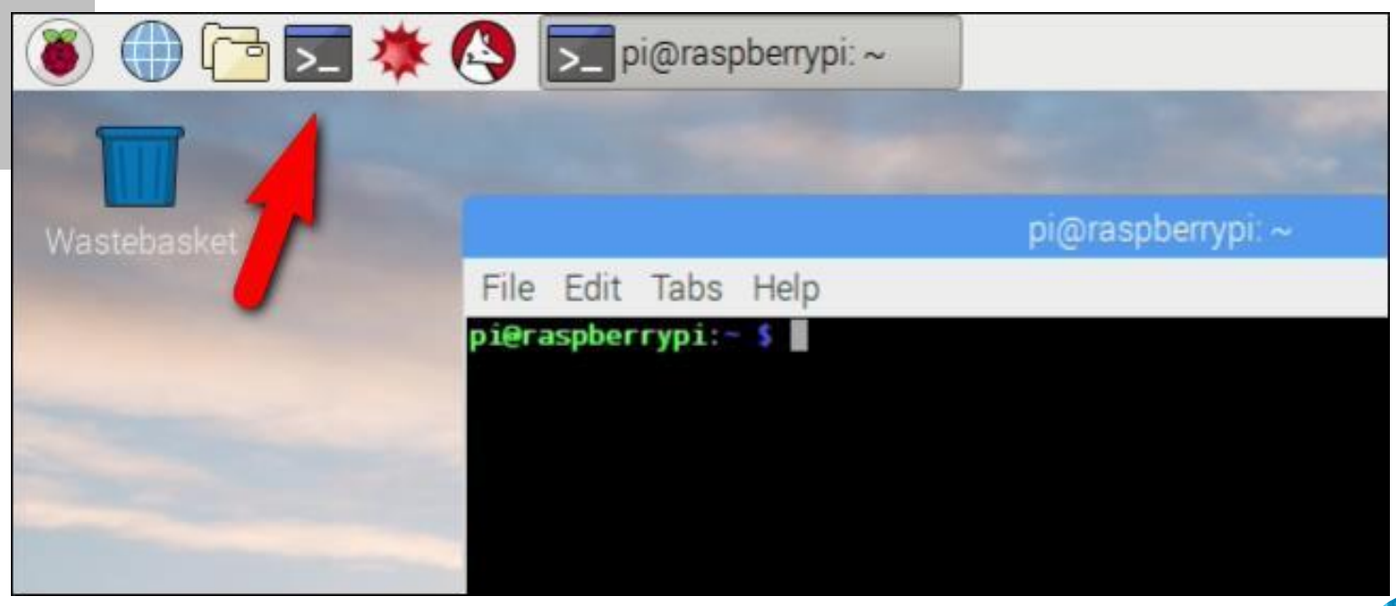
AGENDA

- Icebreaker activity
- Python basics and how to run Python on Raspberry Pi
- Hardware basics
- Smart Lighting System

PYTHON BASICS

PYTHON PROGRAMMING ON RPI


```
cd Desktop
cd CodingWorkshop
python helloworld.py
```



PYTHON BASICS

- Print statement

```
print("Hello, World!")
```

- Comment

```
#This is a comment
```

- Variables

```
x = 5
y = "John"
print(x)
print(y)
```

https://www.w3schools.com/python/trypython.asp?filename=demo_variables1

PYTHON BASICS

- If…Else block

```
a = 200
b = 33
if b > a:
  print("b is greater than a")
elif a == b:
  print("a and b are equal")
else:
  print("a is greater than b")
```

==	Equal	x == y
!=	Not equal	x != y
>	Greater than	x > y
<	Less than	x < y
>=	Greater than or equal to	x >= y
<=	Less than or equal to	x <= y

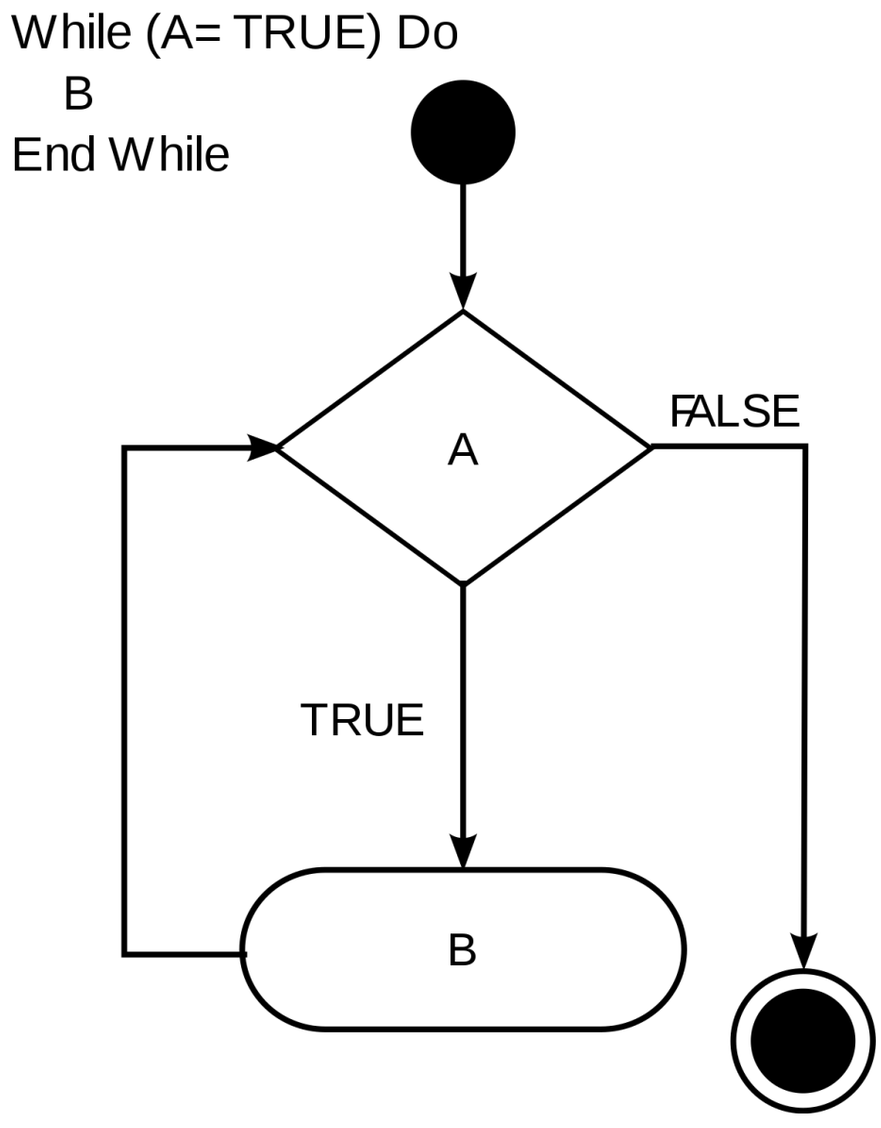
https://www.w3schools.com/python/trypython.asp?filename=demo_if_else

PYTHON BASICS

- While loop

```
i = 1
while i < 6:
  print(i)
  if i == 3:
    break
  i += 1
```

https://www.w3schools.com/python/trypython.asp?filename=demo_while_break



PYTHON BASICS

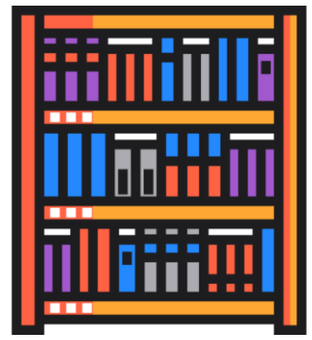
- Library imports

```
from gpiozero import LED
from time import sleep

led = LED(17)

while True:
    led.on()
    sleep(1)
    led.off()
    sleep(1)
```

https://gpiozero.readthedocs.io/en/stable/api_input.html



Library/Module

Imports

Your code program

BREAK TIME!

- Please come back at 10:15 am

HARDWARE BASICS

- Raspberry Pi (RPi)

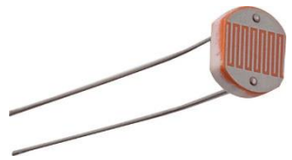
- Breadboard

- Jumper Wires

- Light-Emitting Diode (LED)

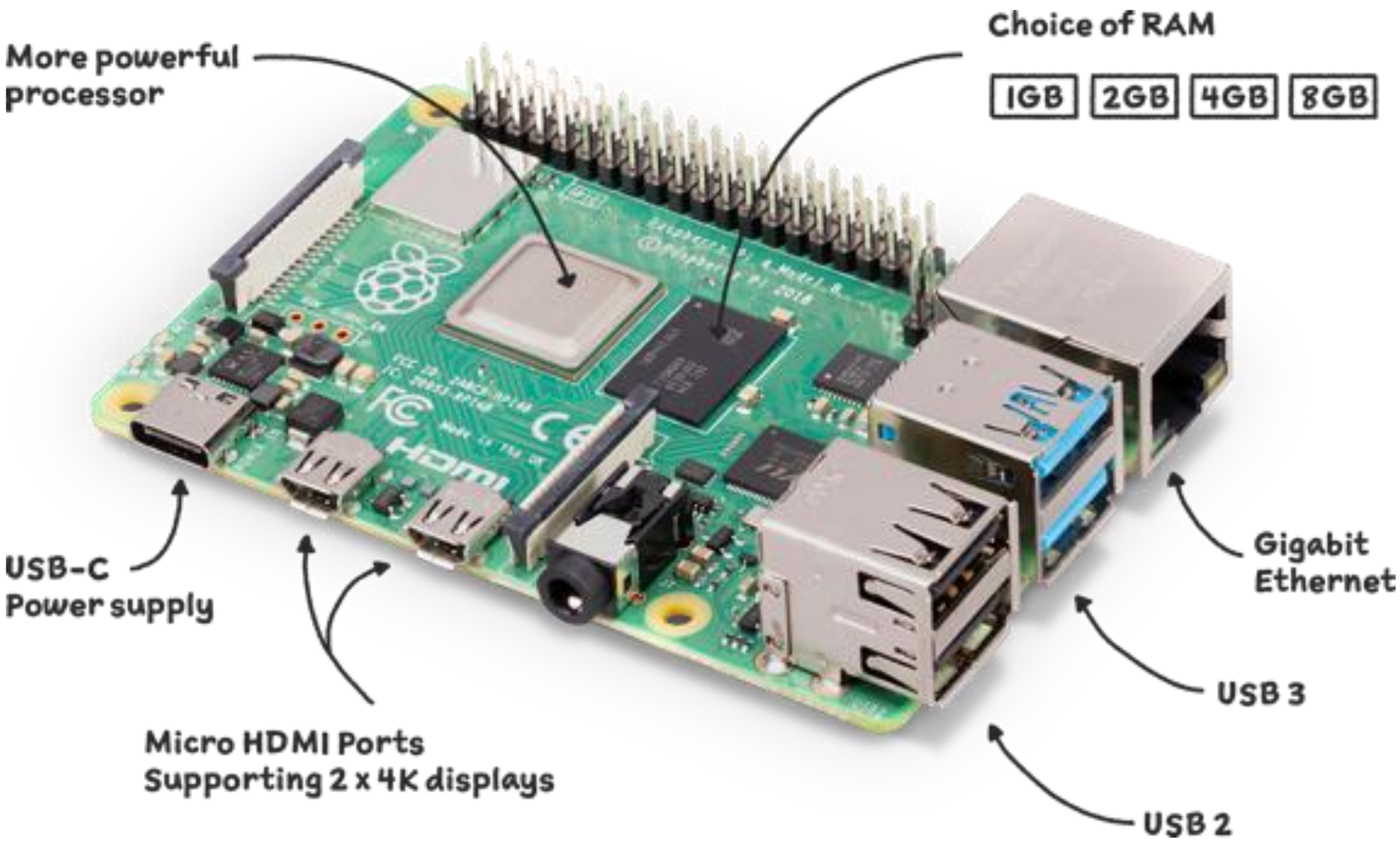
- Resistor

- Light Dependent Resistor (LDR)

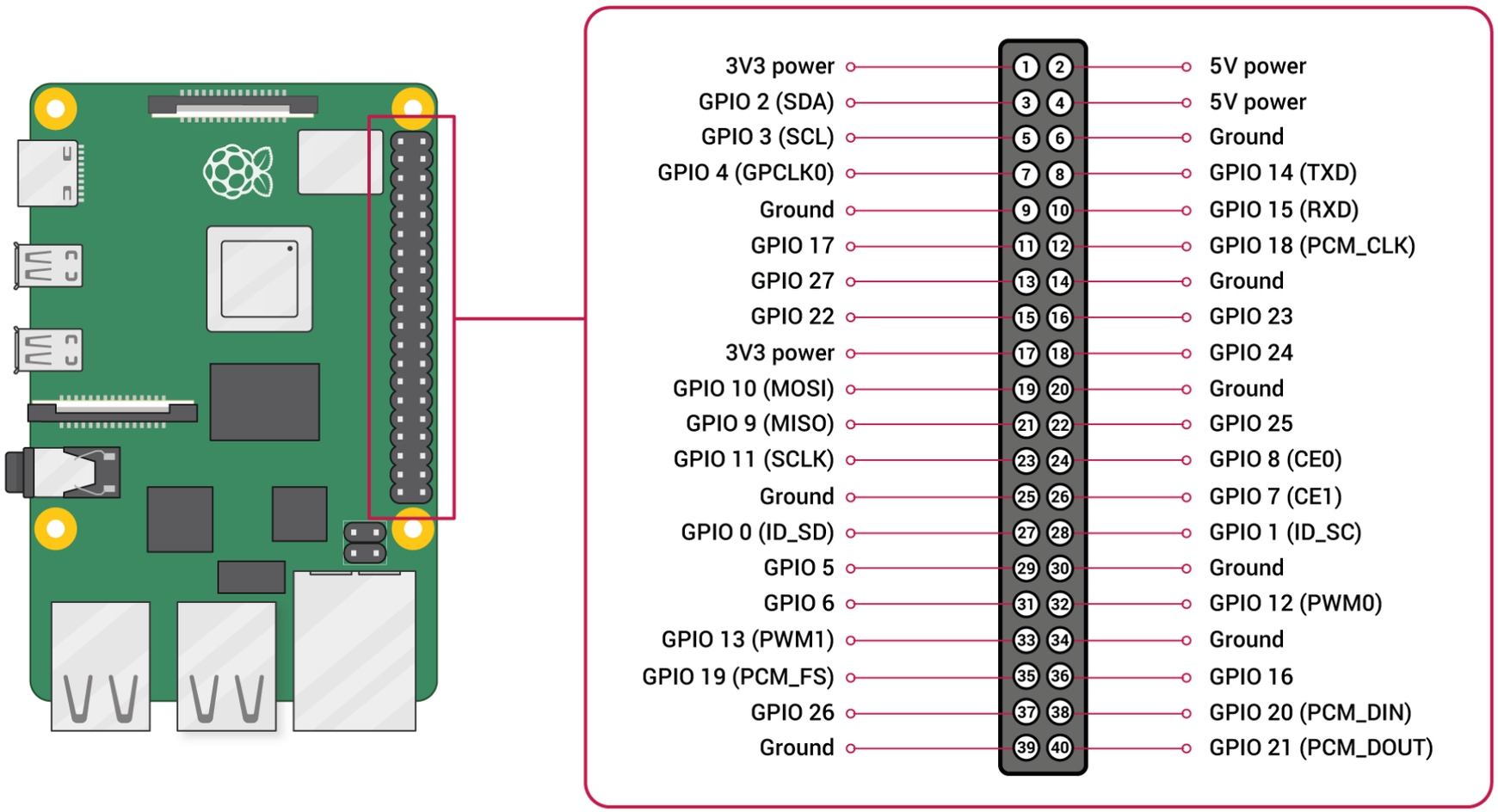


- Capacitor

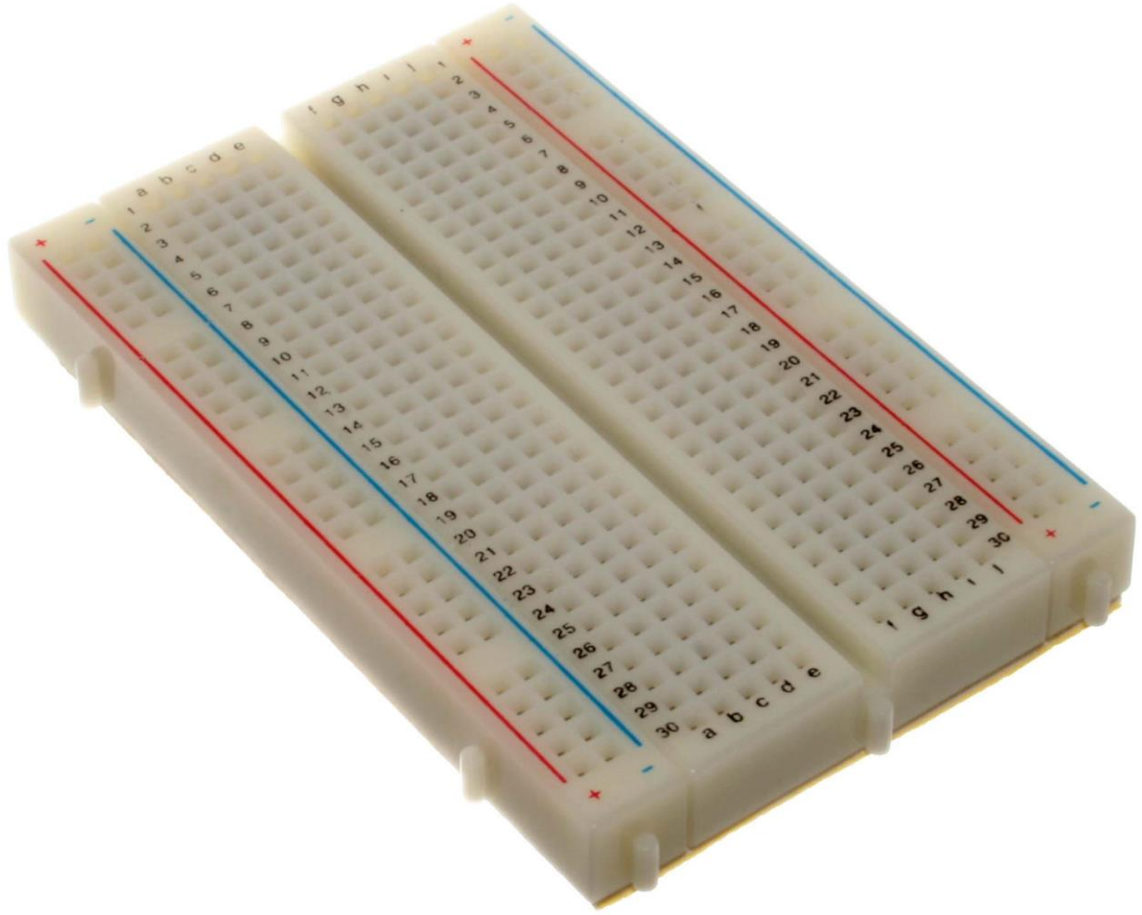
WHAT IS RASPBERRY PI?

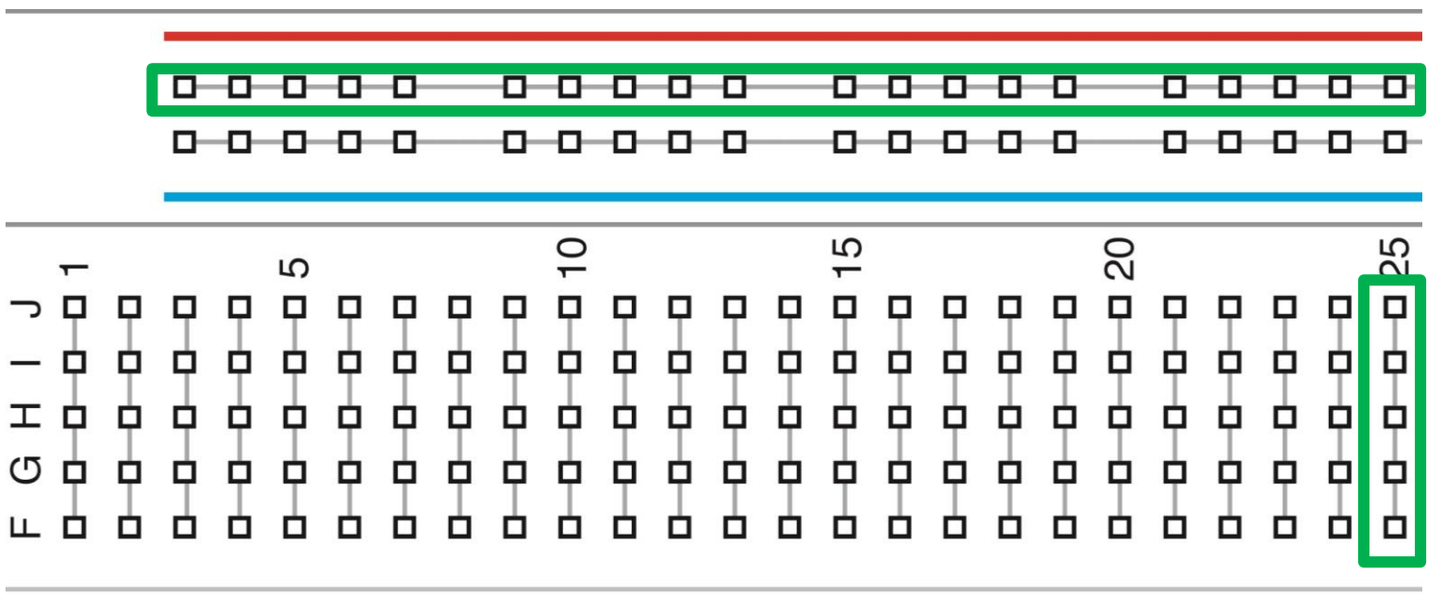


GPIO PIN CONVENTIONS



SOLDERLESS BREAD BOARD

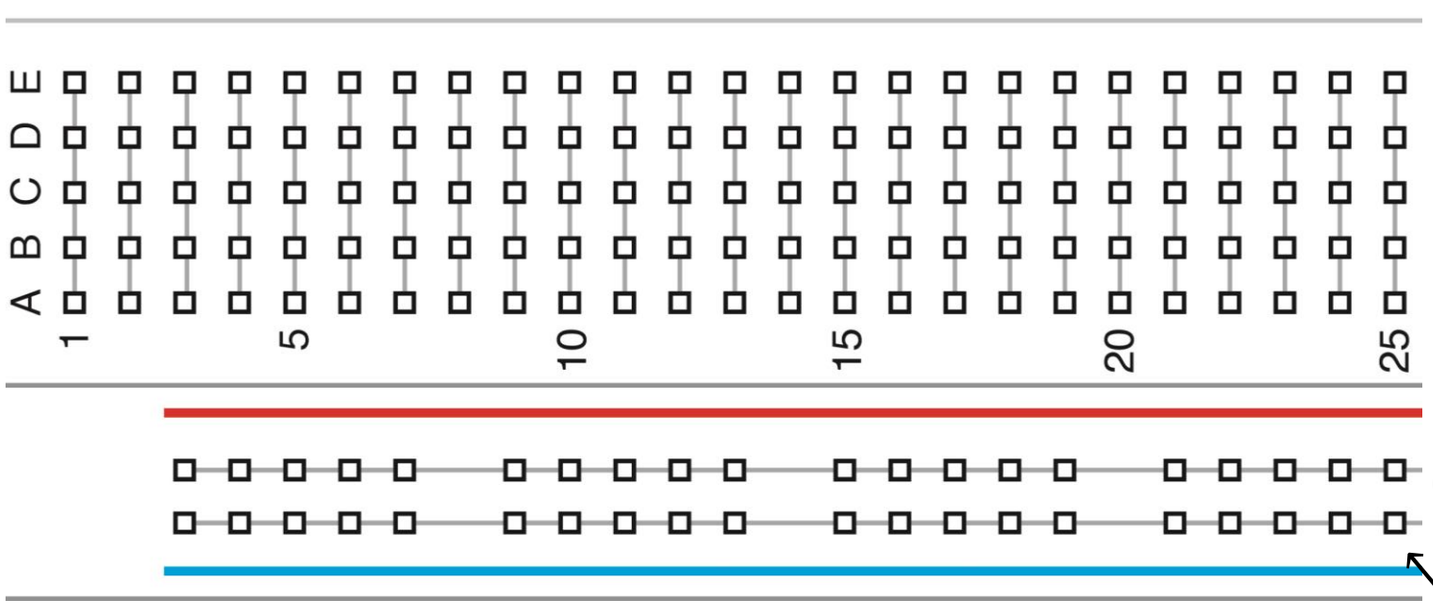




↙All the holes in this row are connected

↖All the holes in this row are connected

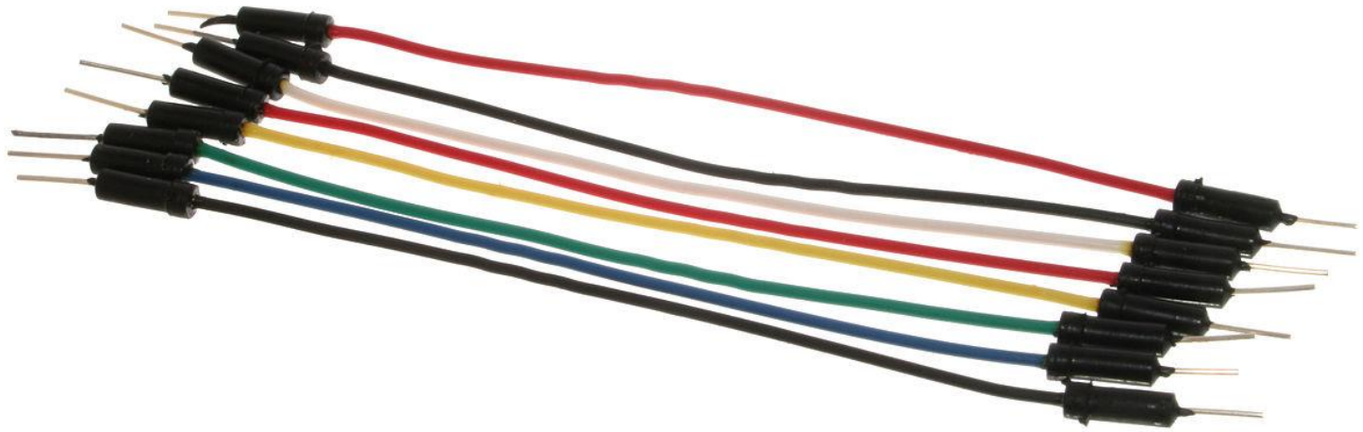
5 holes on the same row and same side are connected, because underneath they're all sitting on one single metal clip



↙All the holes in this row are connected

↖All the holes in this row are connected

JUMPER WIRE



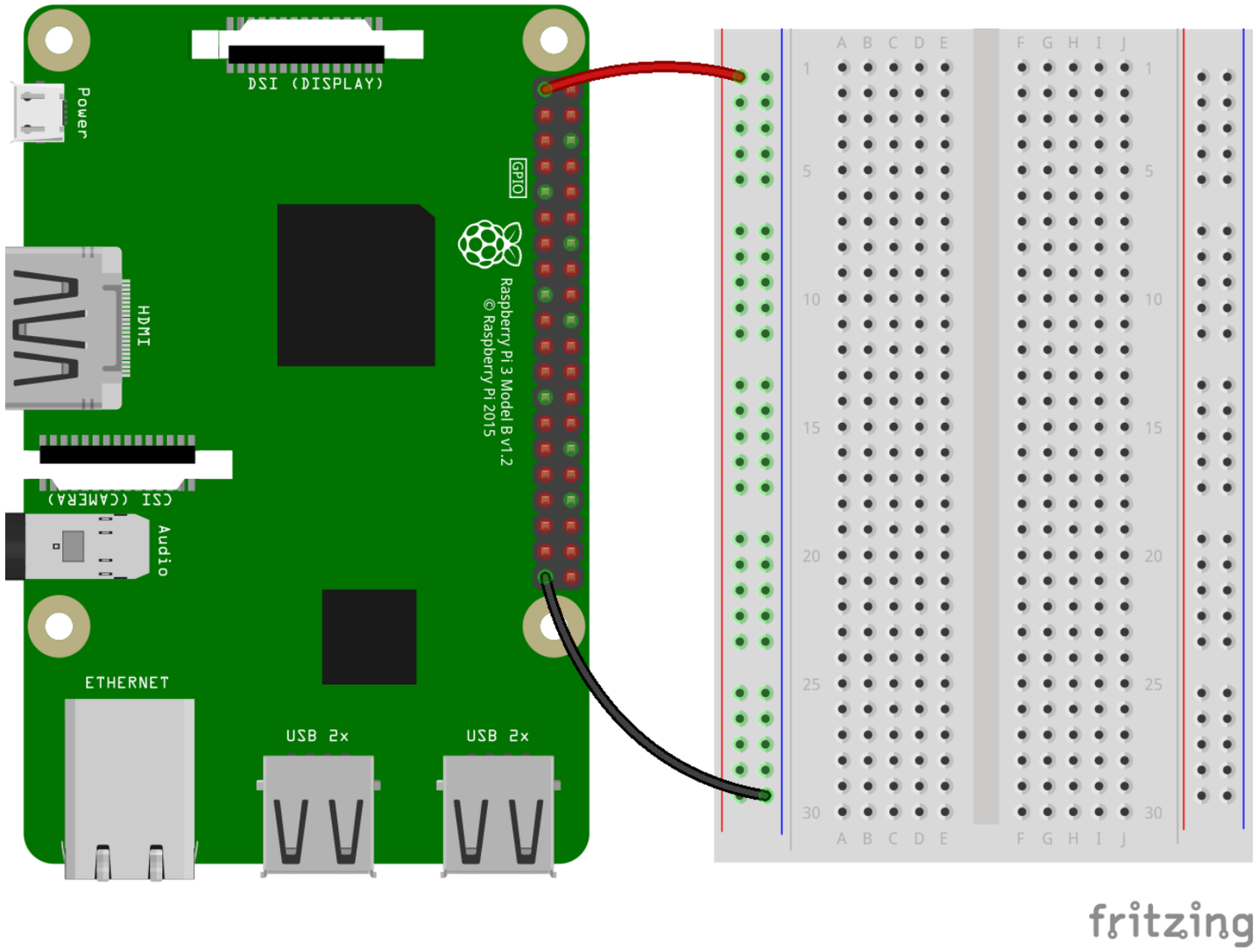
RESISTOR

LIGHT-EMITTING DIODE (LED)

HANDS ON: GETTING STARTED

Make a closed circuit:

1. Connect 3v3 pin with “red” column
2. Connect GND pin with “blue” column



HANDS ON: LED

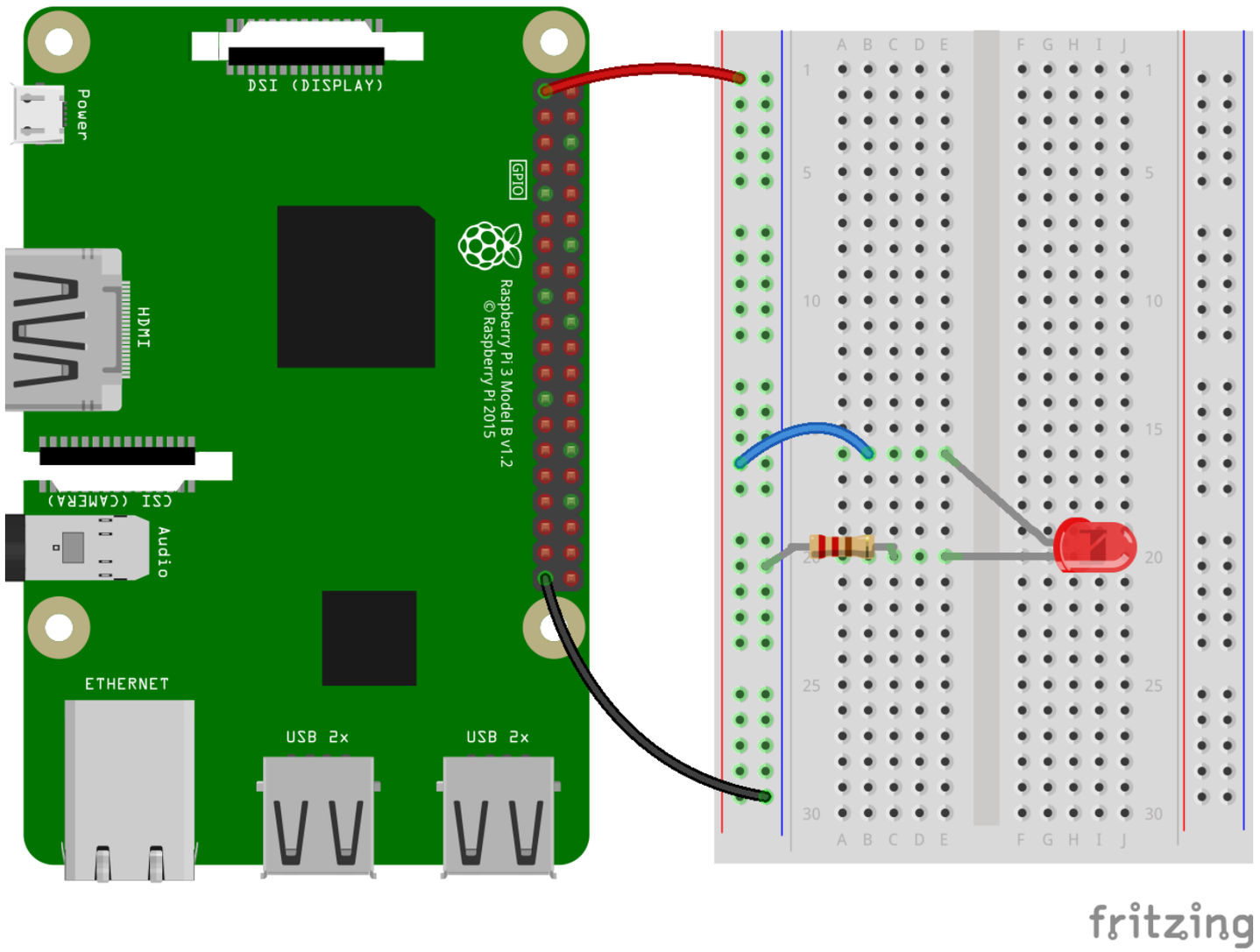
How to turn LED on?

1. Put the long side (kathode/+) of LED on E16, and short side (anode/-) of LED on E20

2. Put one end of the resistor on C20 and the other on any point near the “blue” column

3. Using a jumper wire, connect the “red” column with point B16

LED will now turn on!

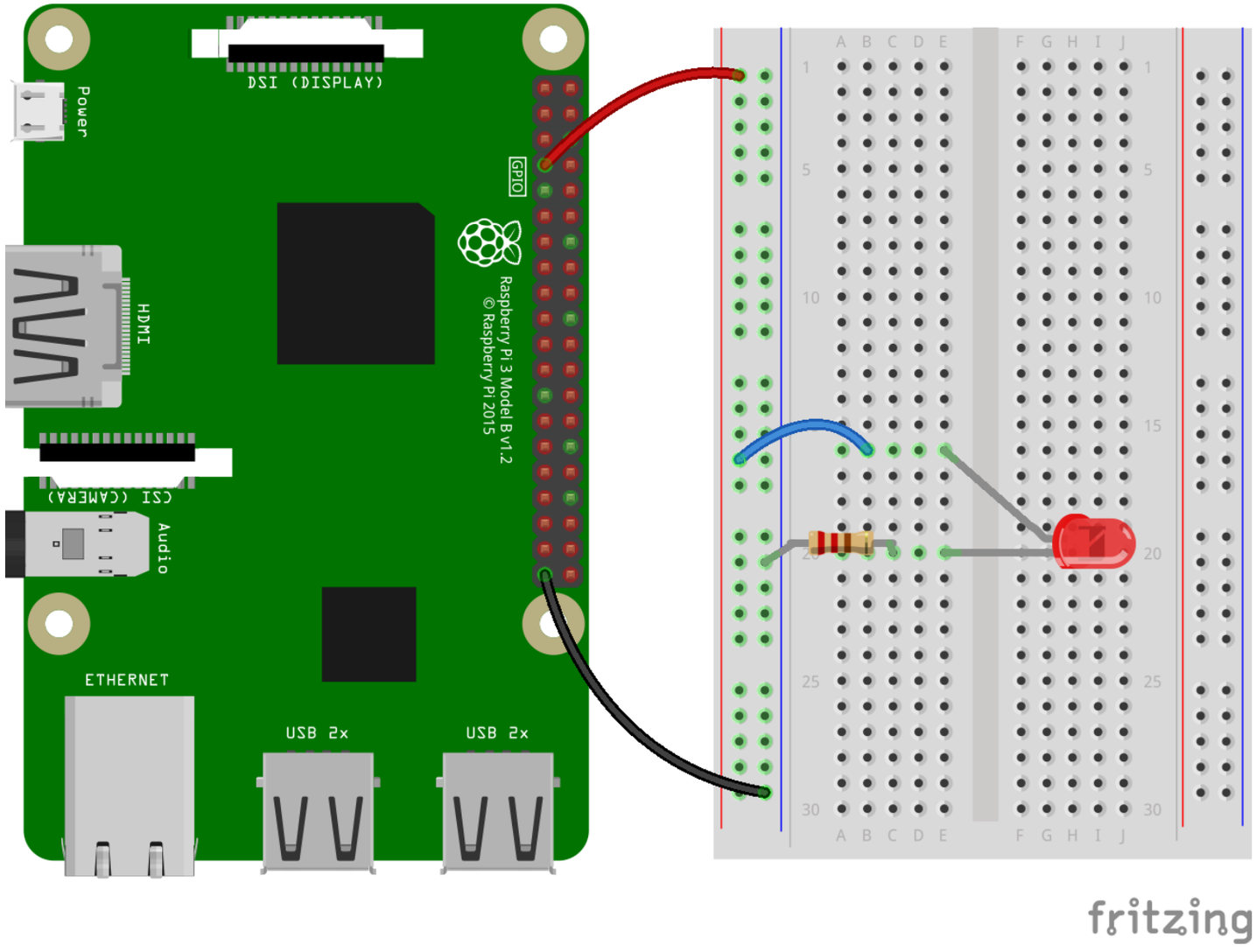


HANDS ON: LED

How to control LED using GPIO pins?

1. Move the jumper wire from 3v3 to GPIO4

LED will now turn off - but we can now control the LED's behavior through code!



HANDS ON: LED

```
from gpiozero import LED
led = LED(4) # the GPIO pin from above
led.on() # turn on
led.off() # turn off
```

For references:
https://gpiozero.readthedocs.io/en/stable/api_output.html#led

HANDS ON: LED

Break down in groups of 2-3 students to replicate the previous demonstration.

Challenges:

1. How to make LED blink 10 times?
   (Hint: use a combination of sleep() and a for loop)

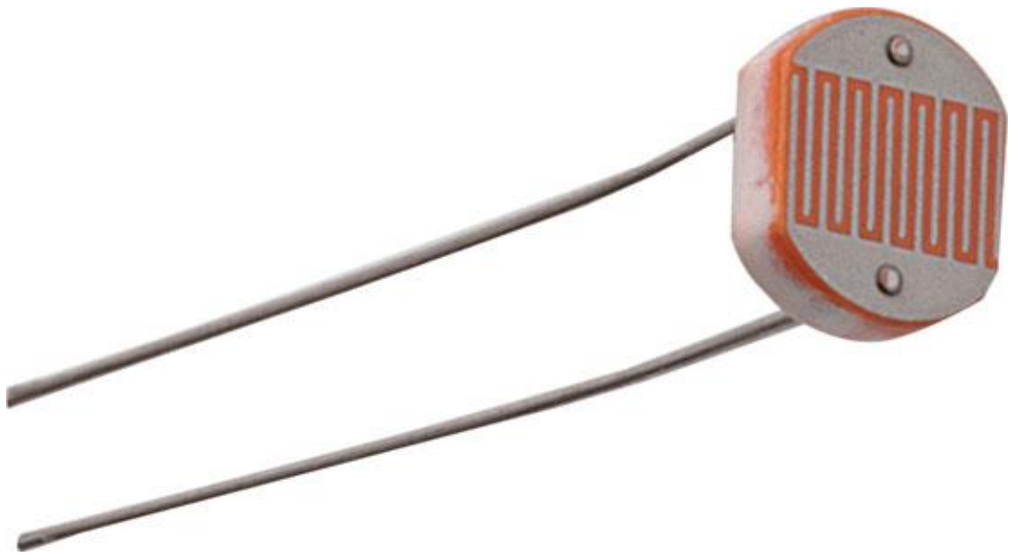
1. How to make LED blink continuously?
   (Hint: use a combination of sleep() and a while loop)

HANDS ON: LED

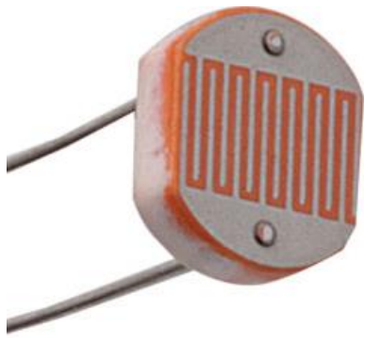
1. How to make LED blink 10 times?

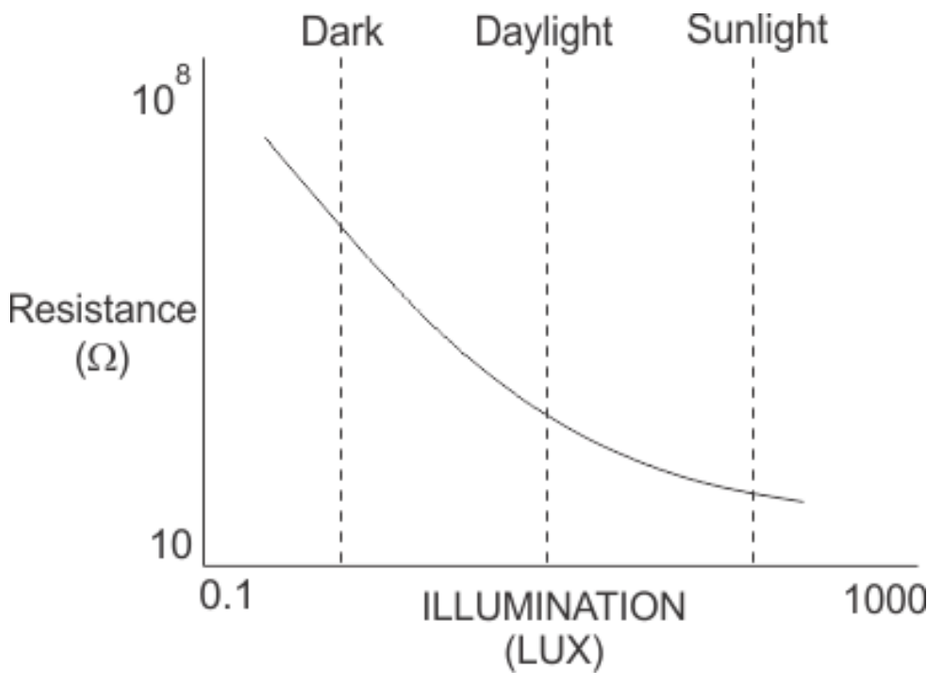
HANDS ON: LED

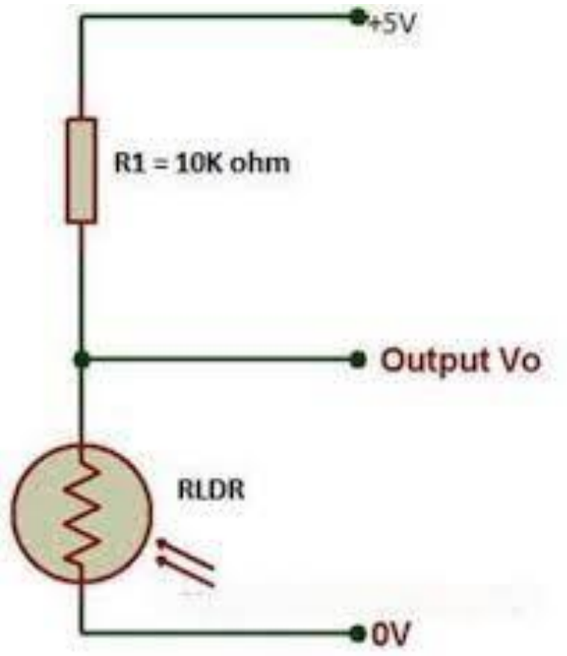
2. How to make LED blink continuously?



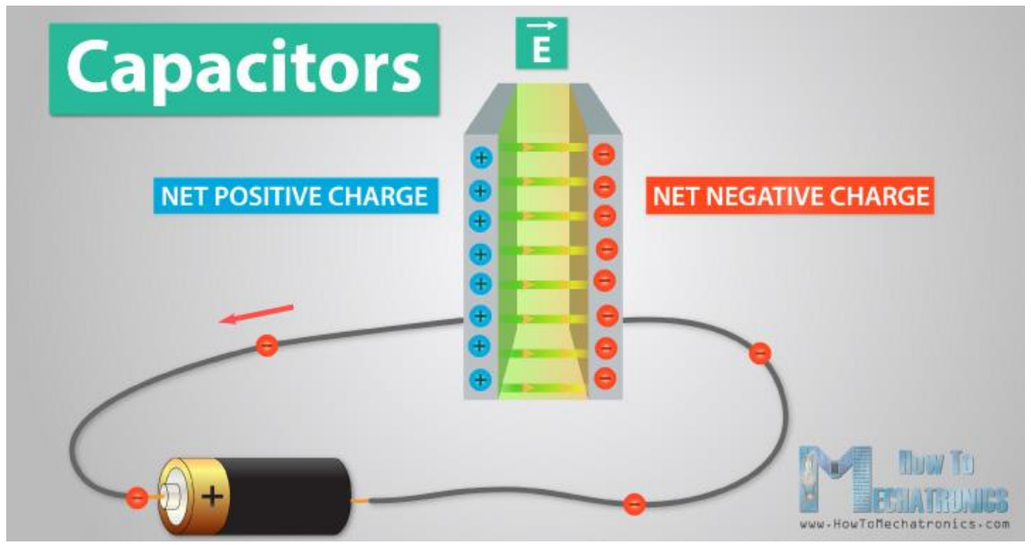
LIGHT DEPENDENT RESISTOR (LDR)

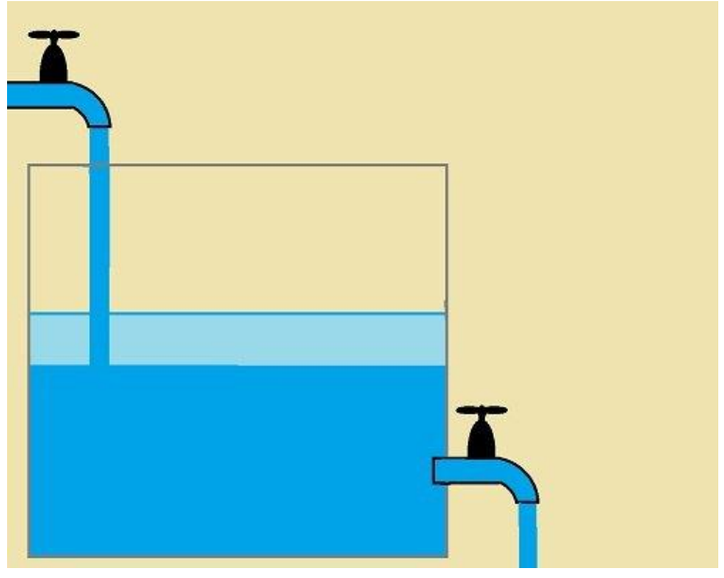


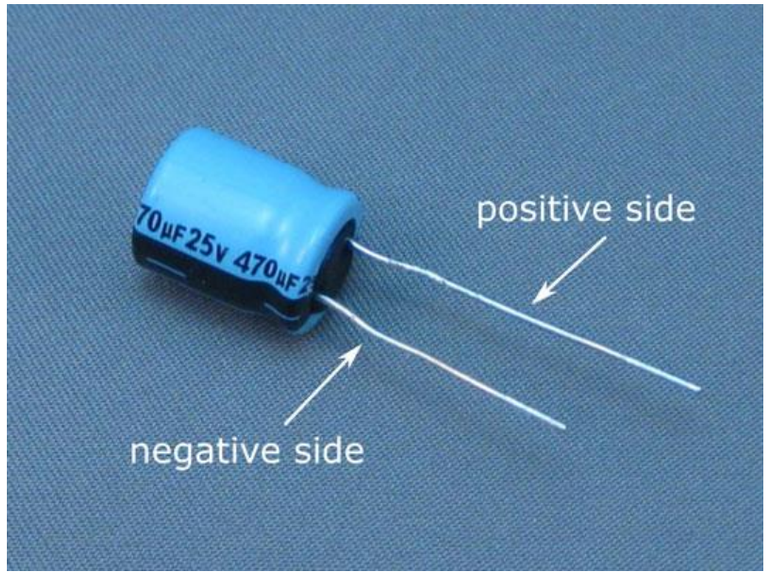

Dark
Daylight
Sunlight
10^8
Resistance
(Ω)
10
0.1
ILLUMINATION
(LUX)
1000


+5V
R1 = 10K ohm
Output Vo
RLDR
0V

CAPACITOR


Capacitors
E
NET POSITIVE CHARGE
NET NEGATIVE CHARGE
How To Mechatronics
www.HowToMechatronics.com

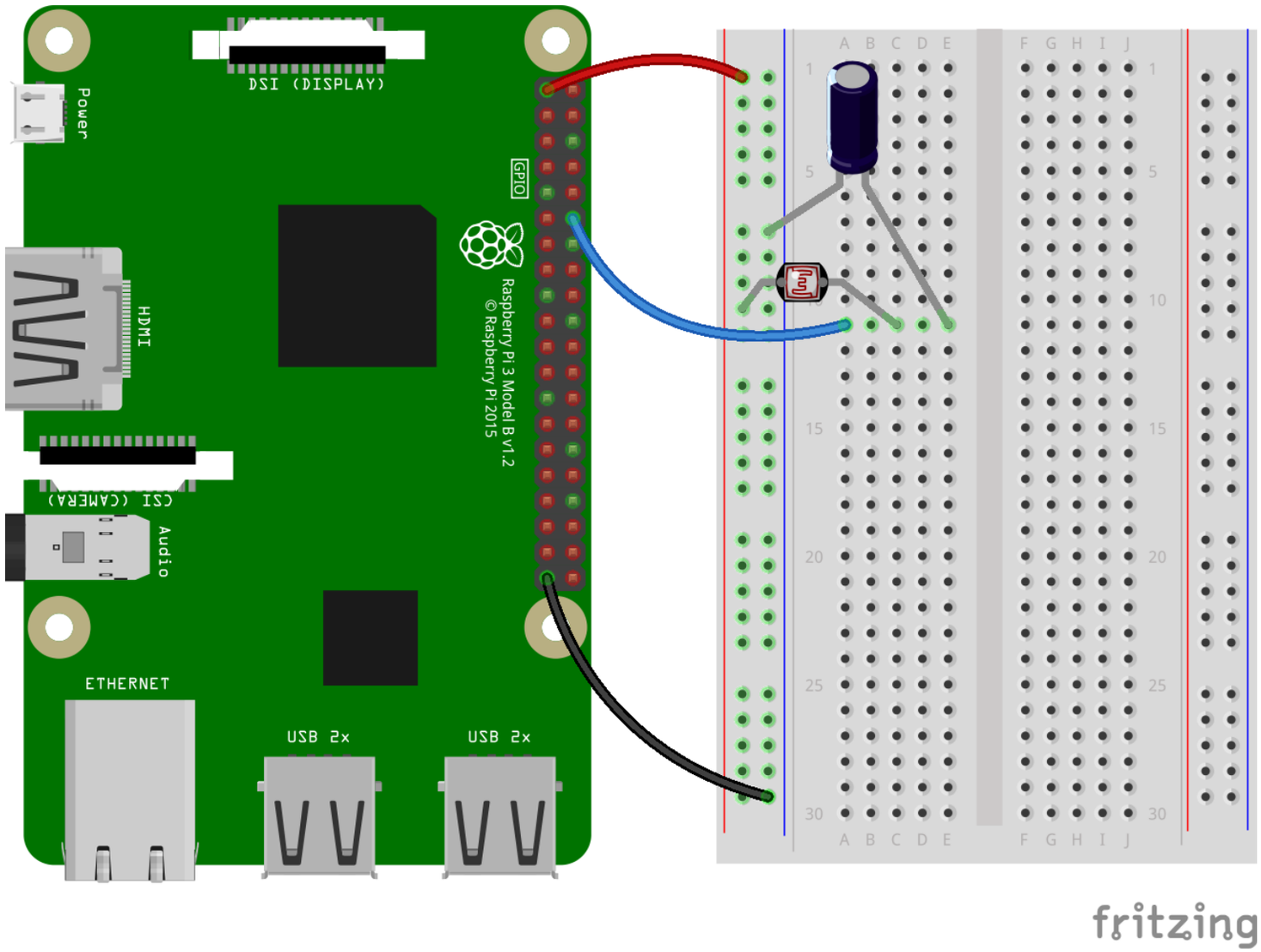



70µF 25v 470µF
positive side
negative side

HANDS ON: LDR

How to use a light sensor?

1. Put long side (kathode/+) of capacitor on E11 and short side of capacitor (anode/-) on “blue” column
2. Connect GPIO18 to A11
3. Put LDR on point C11 and “red” column



HANDS ON: LDR

```
from gpiozero import LightSensor
ldr = LightSensor(18)  # the GPIO pin from above
while True:
    print(ldr.value) # number between 0 (dark) and 1 (light)
```

For references: https://gpiozero.readthedocs.io/en/stable/api_input.html#lightsensor-ldr

HANDS ON: LDR

Replicate the previous demonstration in your group.

Challenges:

1. Make a program output/print something (e.g. “It’s light!”) when the LDR value exceeds a certain threshold.
(Hint: use a combination of while loop and print)

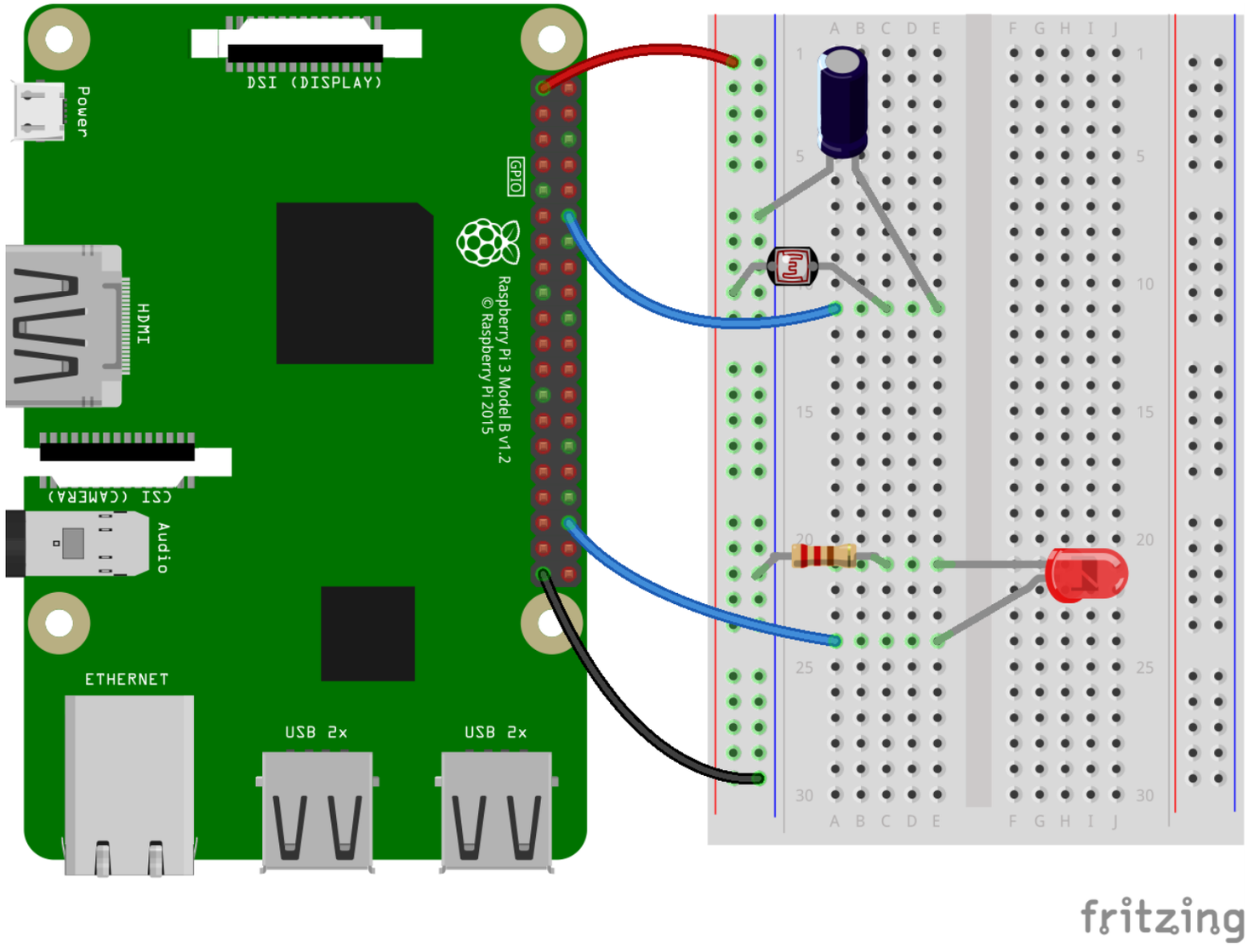
HANDS ON: LDR

1. Make a program output/print something (e.g. “It’s light!”) when the LDR value exceeds a certain threshold.

HANDS ON: SMART LAMP

How to make a smart lamp? (cont. from previous schematics)

1. Put resistor on “blue” column and C21
2. Put LED’s long side (kathode/+) on E24, and the short side (anode/-) on E21
3. Connect GPIO16 to A24



HANDS ON: SMART LAMP

```
from gpiozero import LightSensor, LED

from signal import pause


sensor = LightSensor(18)

led = LED(16)


sensor.when_dark = led.on

sensor.when_light = led.off


pause()
```

HANDS ON: SMART LAMP

Replicate the previous demonstration in your group.

Challenges:

1. Instead of making the LED turn on or off, adjust the brightness of the LED according to the value read by the LDR
   (Hint: use PWMLED here instead of LED)

a) When it's bright, LED is also bright. When it's dark, LED is dim.

b) When it's dark, LED is bright. When it's bright, LED is dim.

HANDS ON: SMART LAMP A)

HANDS ON: SMART LAMP B)