

URLS

- Students' materials: <https://tinyurl.com/apwe-2022>
- Full materials: <https://tinyurl.com/apwe-full-ans>



CODING WORKSHOP

Welcome!





WELCOME!



WARM UP TIME

Blow wind blow!





To your new neighbors and our volunteers!

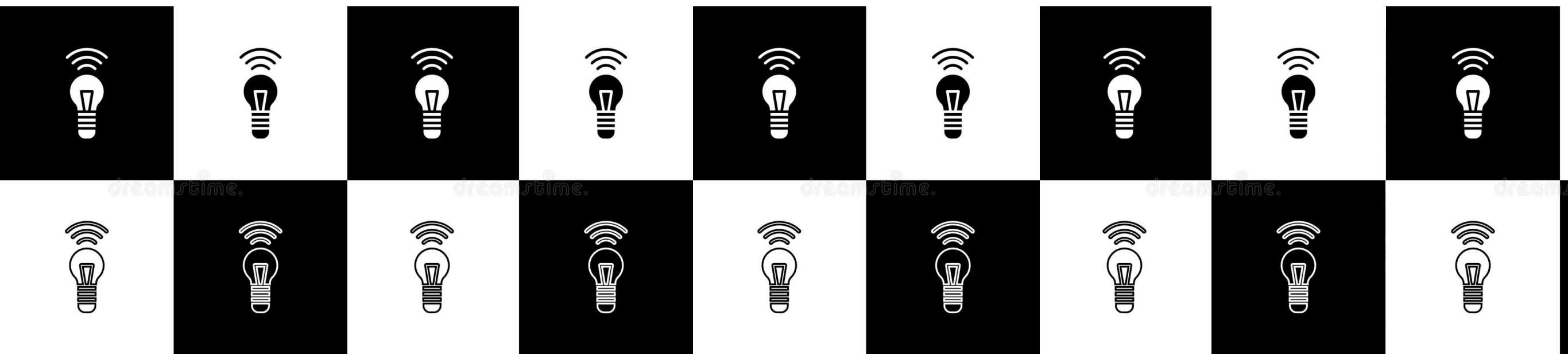
KAHOOT GAME

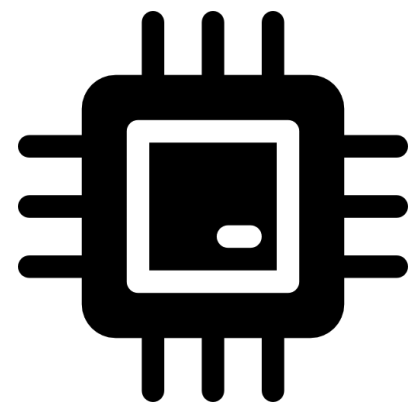
Let's have fun!





DIY SMART LIGHTING SYSTEM

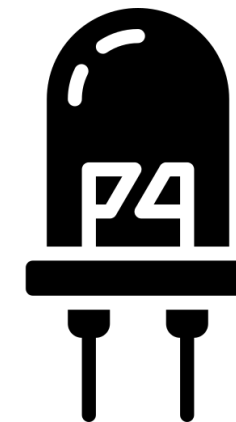




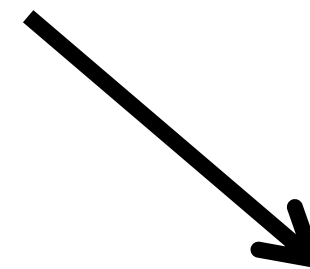
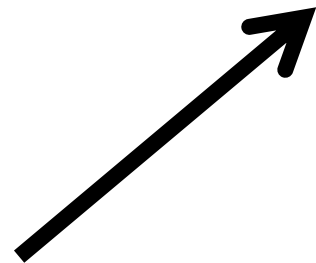
RPi

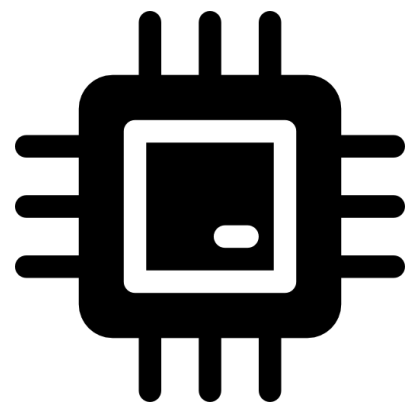


Sensor



Light





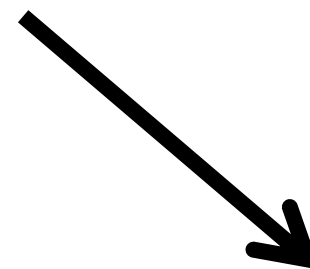
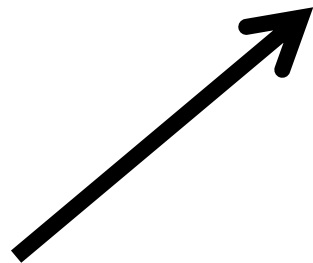
RPi



Sensor



Light



PROGRAM FOR TODAY

- Raspberry Pi & Circuit design
- Run Python on Pi
- Program the Smart Lighting System



HARDWARE BASICS

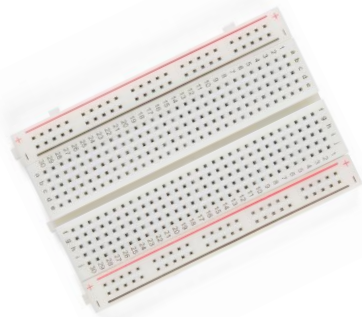


THE HARDWARE

- Raspberry Pi (RPi)



- Breadboard



- Jumper Wires



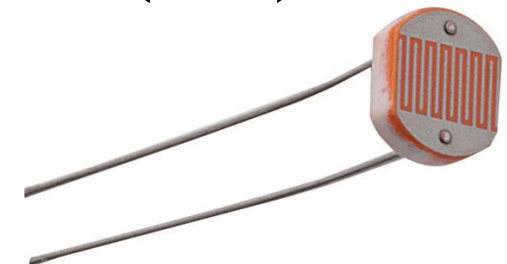
- Light-Emitting Diode (LED)



- Resistor



- Light Dependent Resistor (LDR)



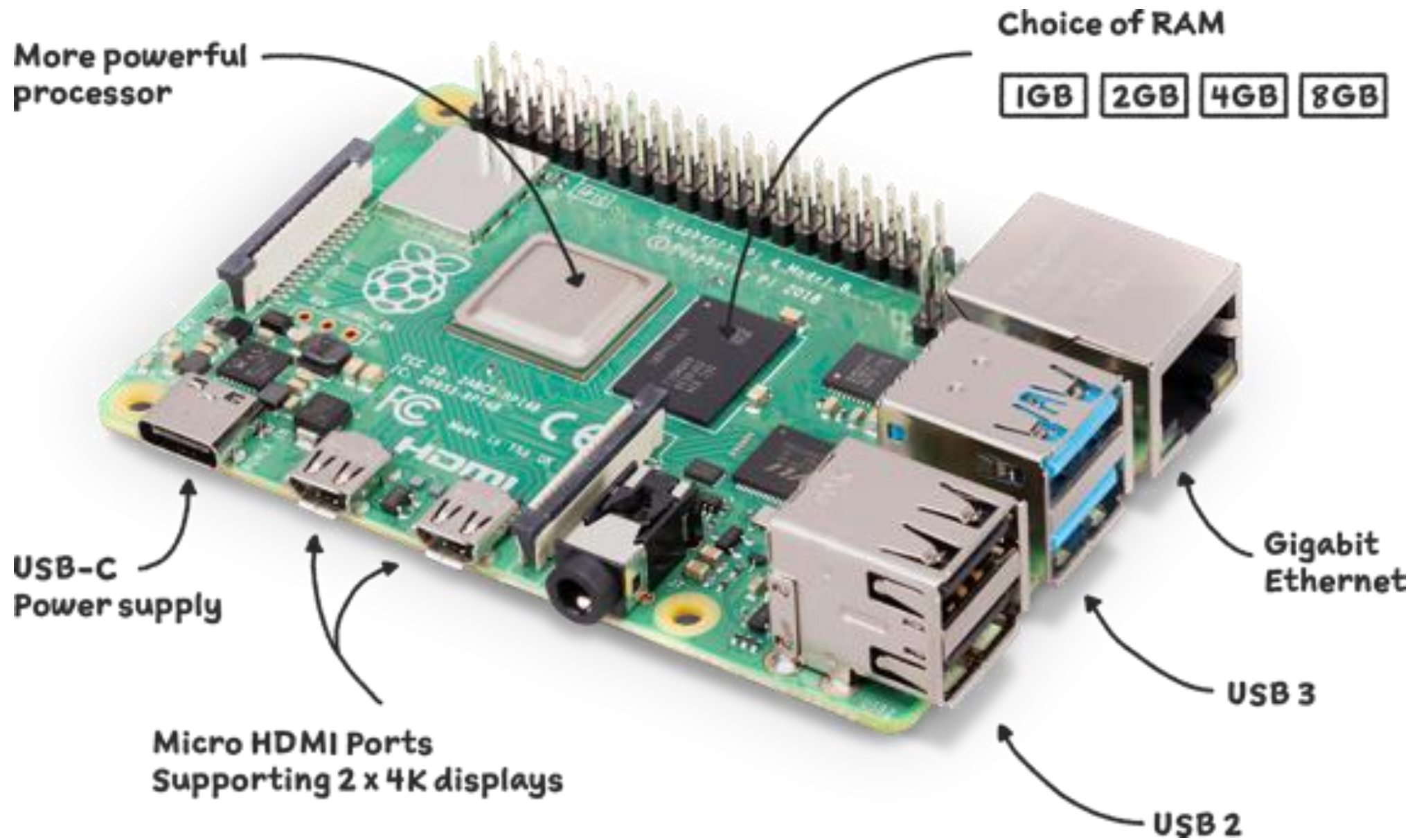
- Capacitor



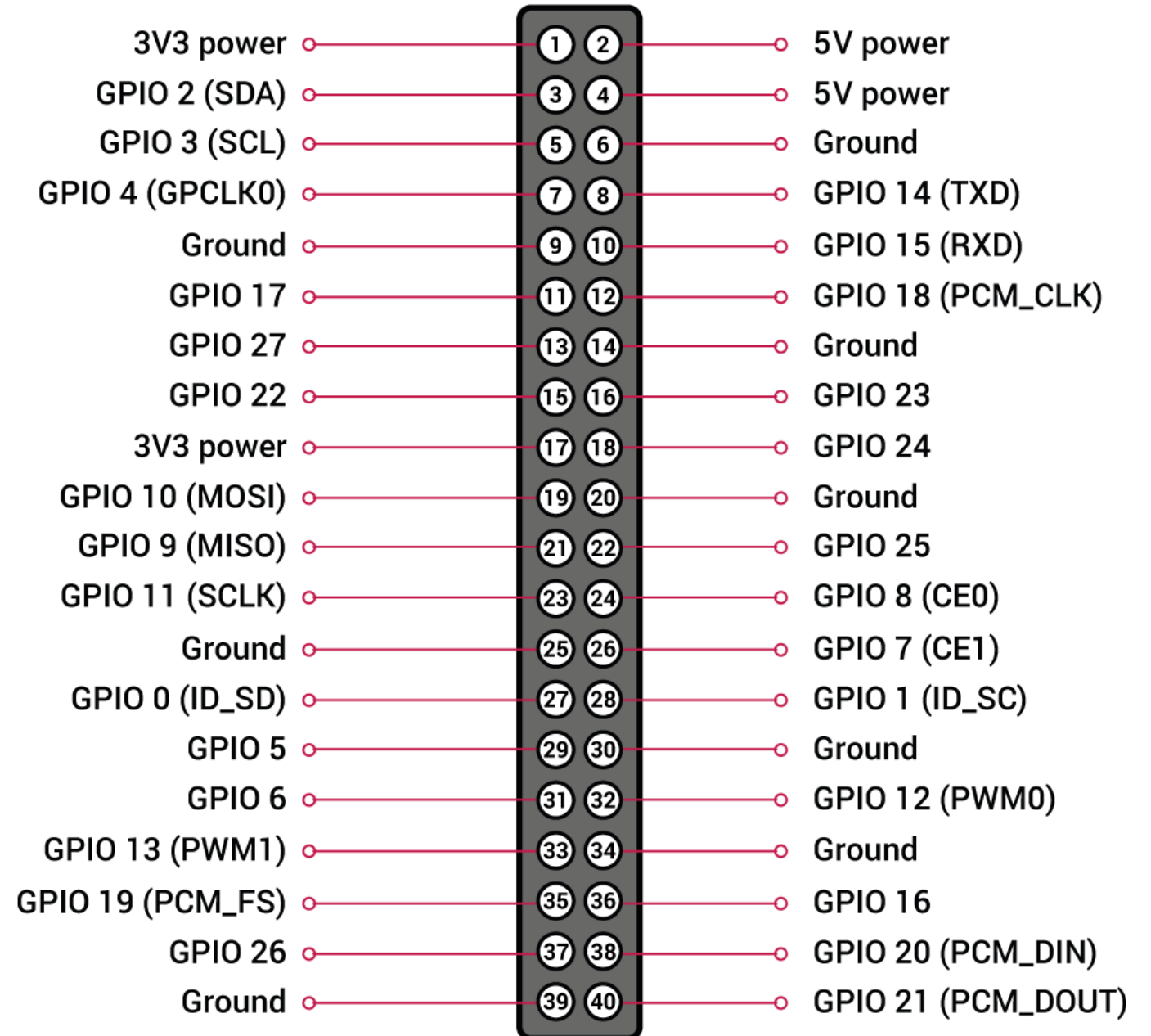
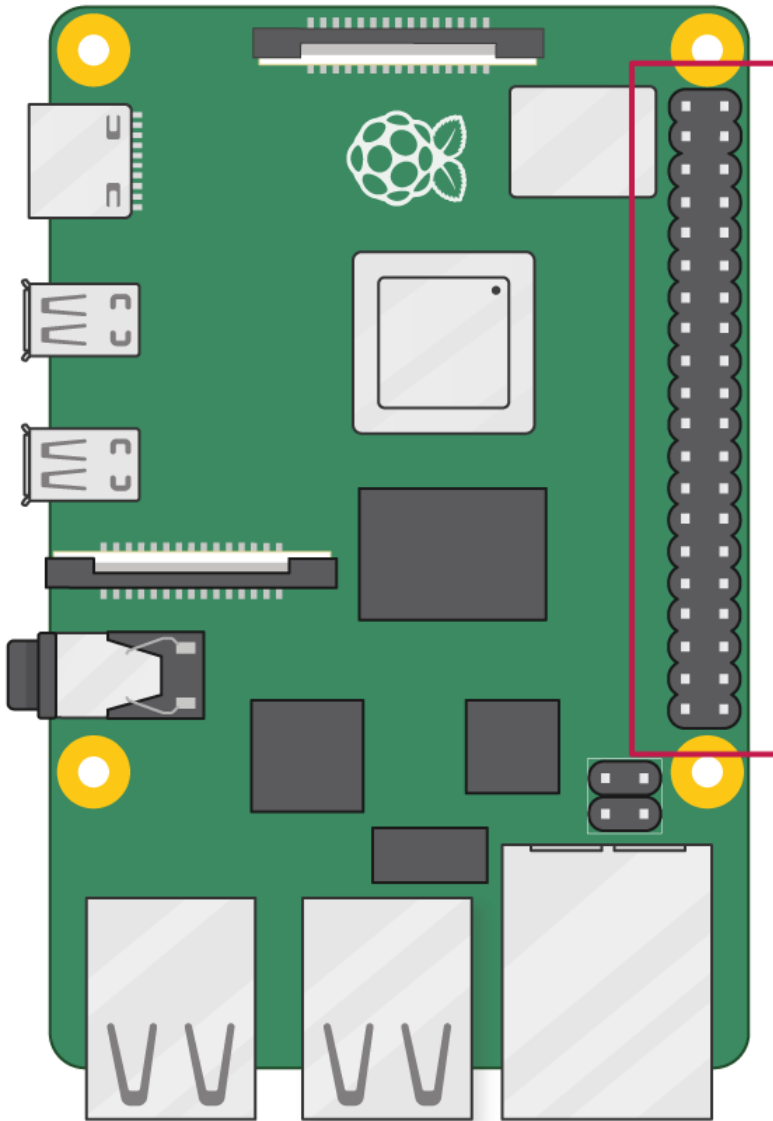
- Motion sensor (for bonus part)

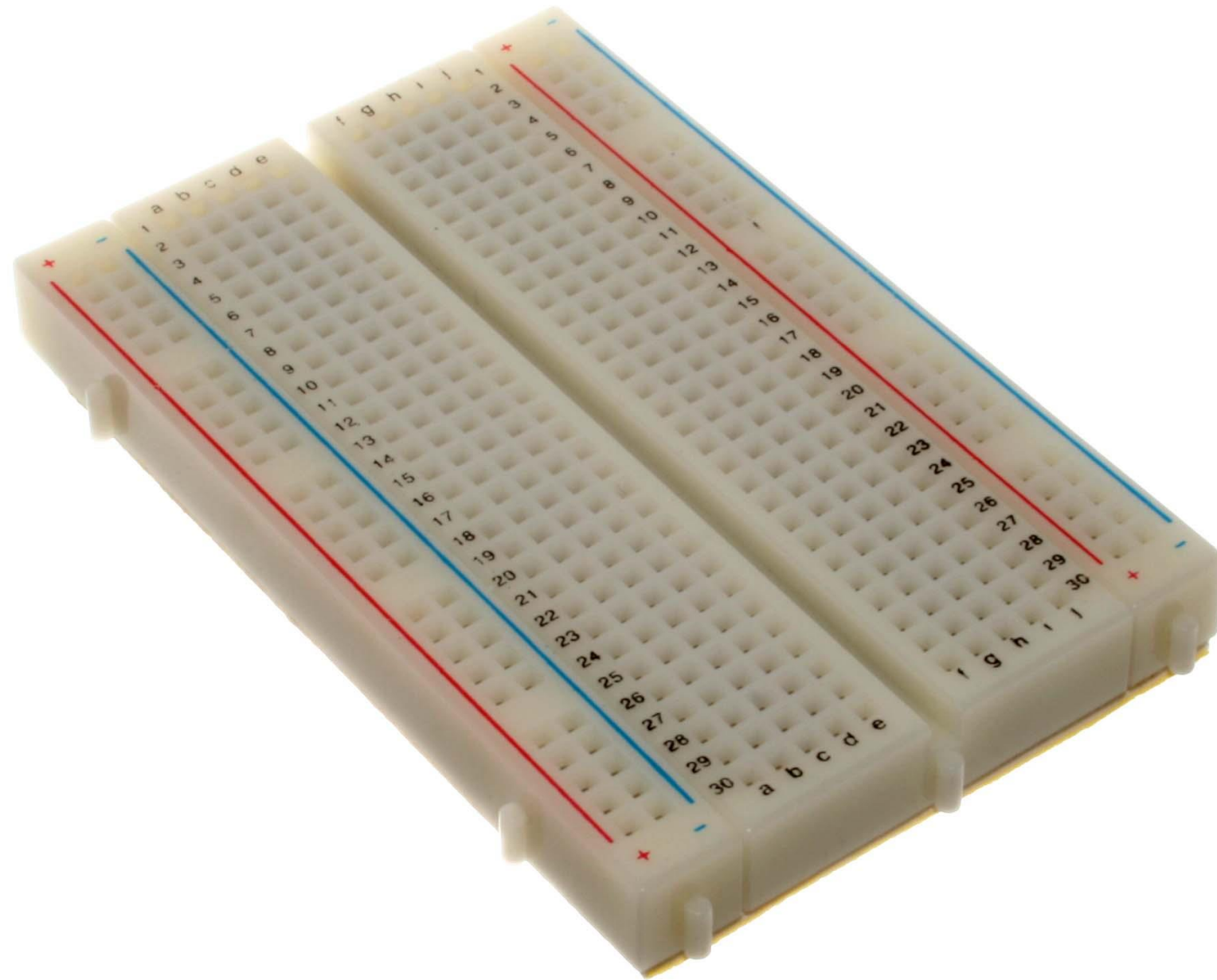


WHAT IS RASPBERRY PI?

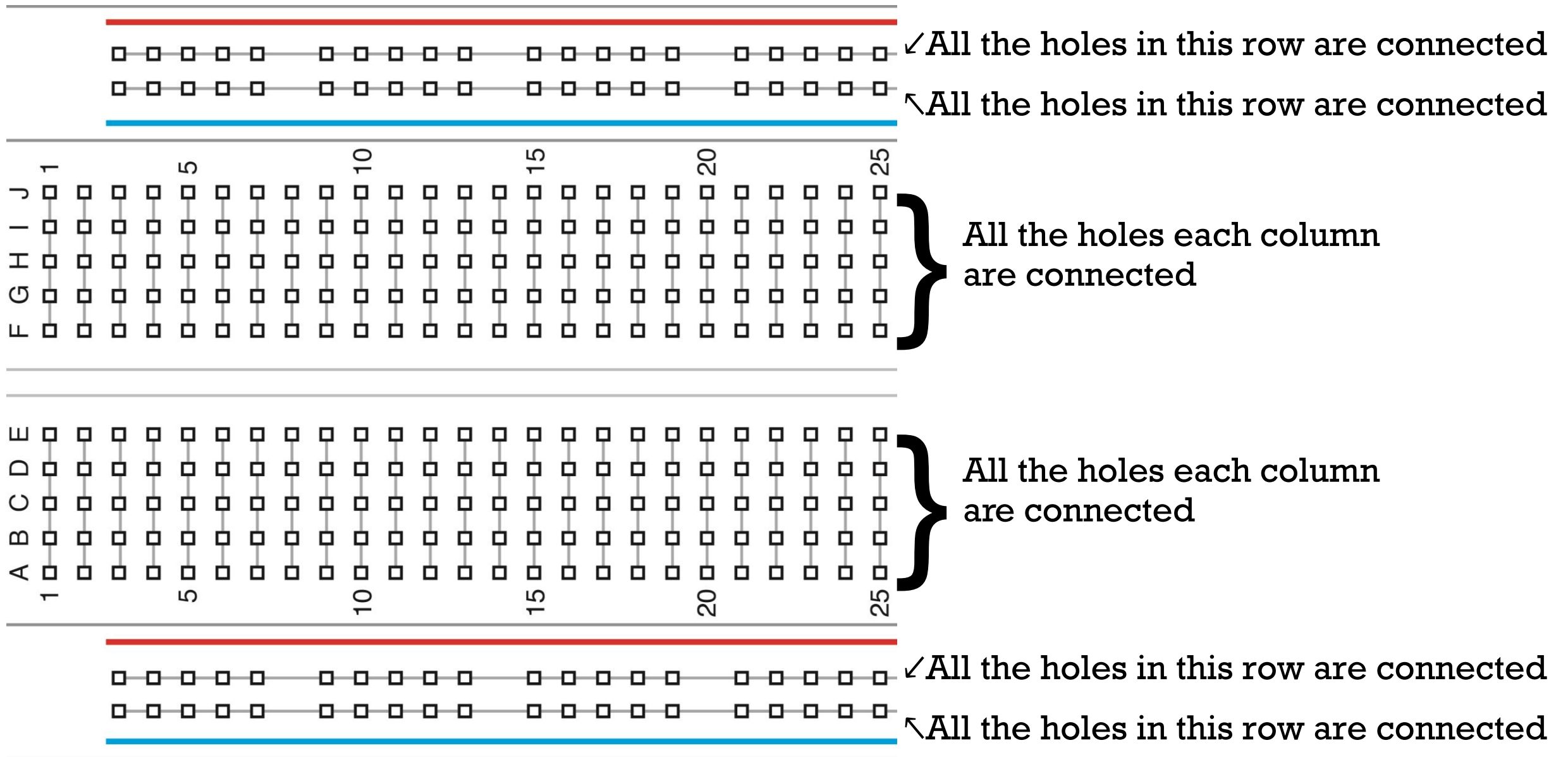


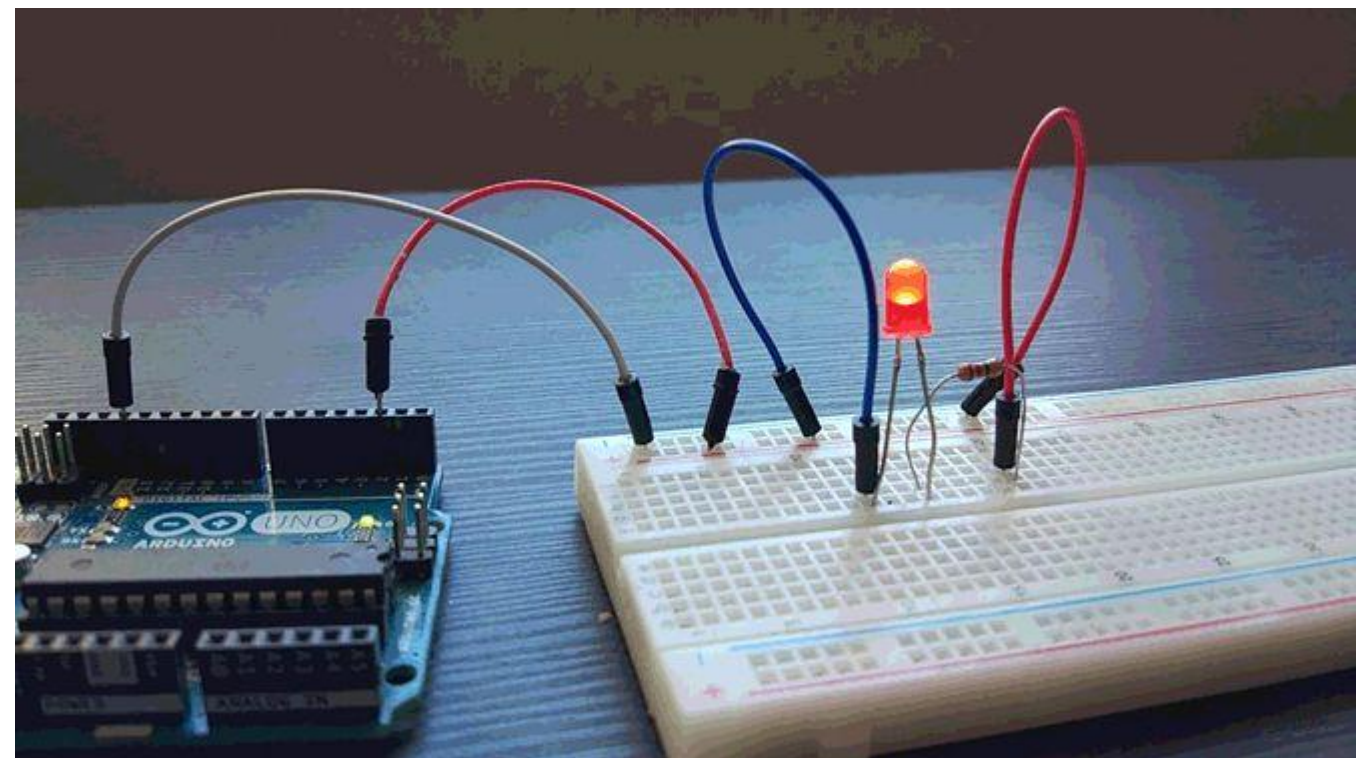
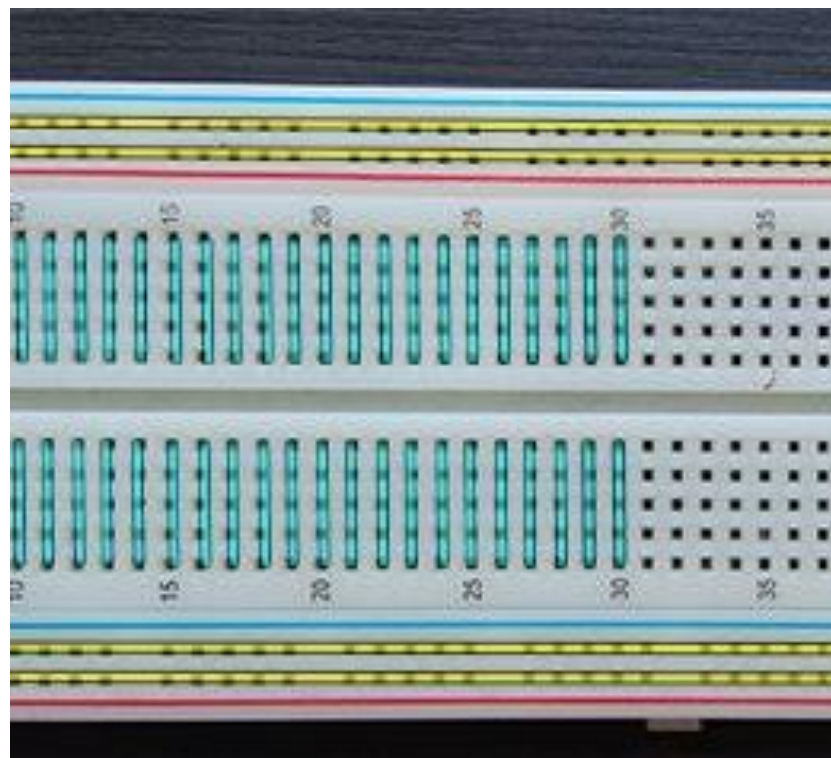
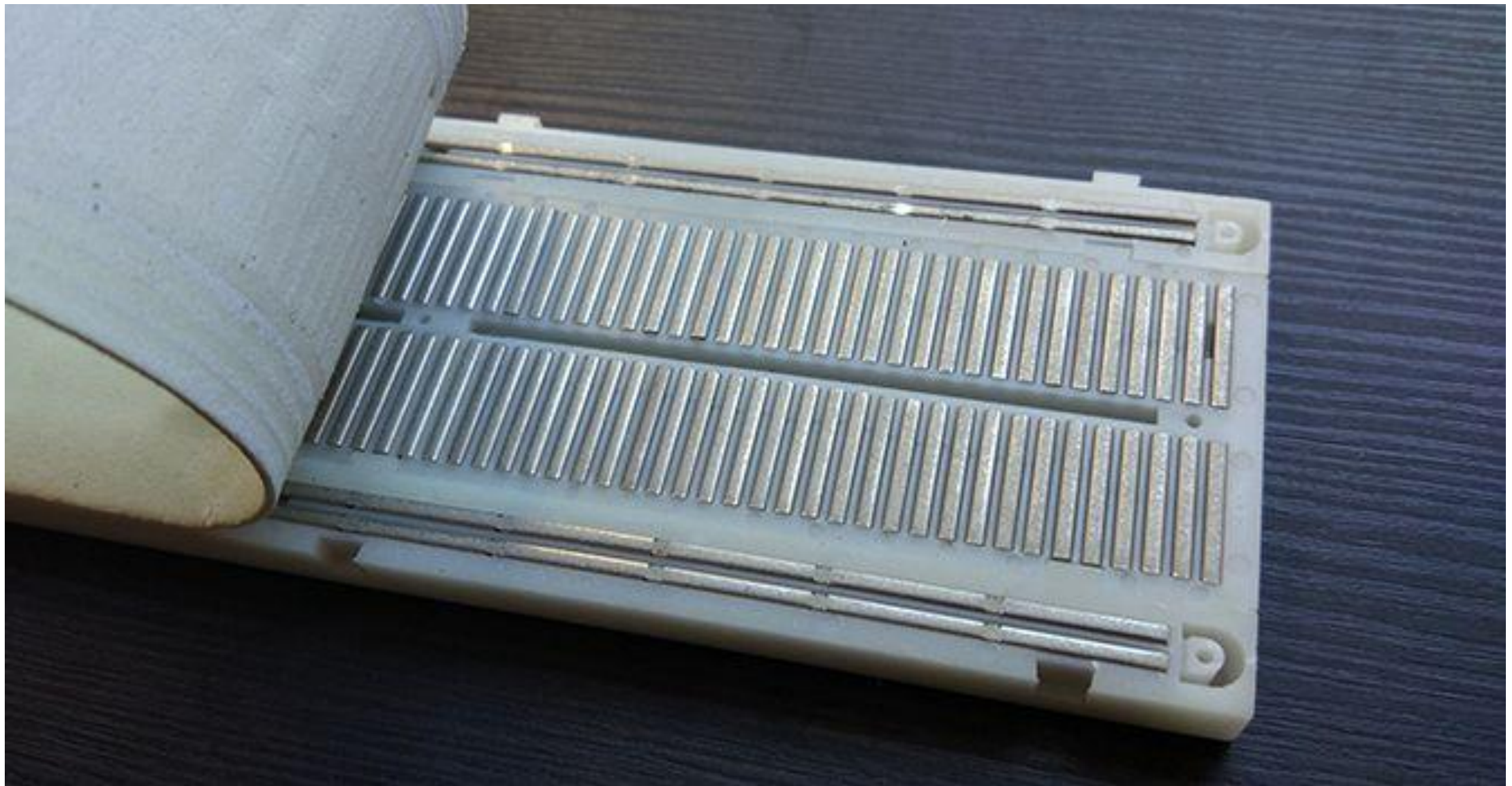
GPIO PIN CONVENTIONS

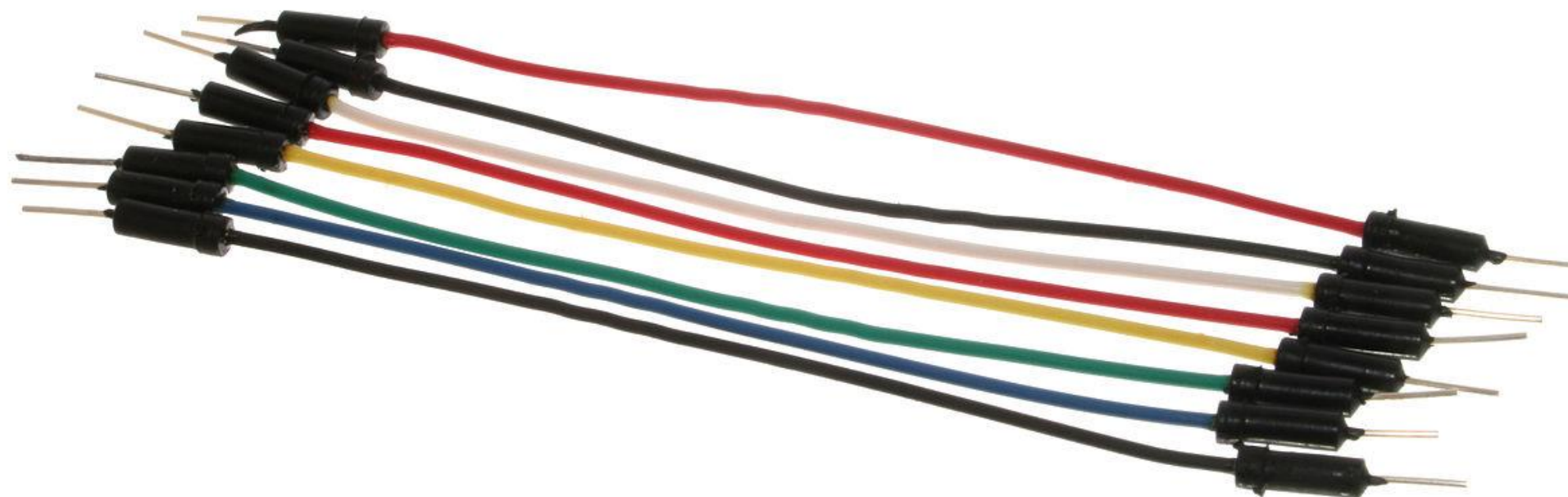




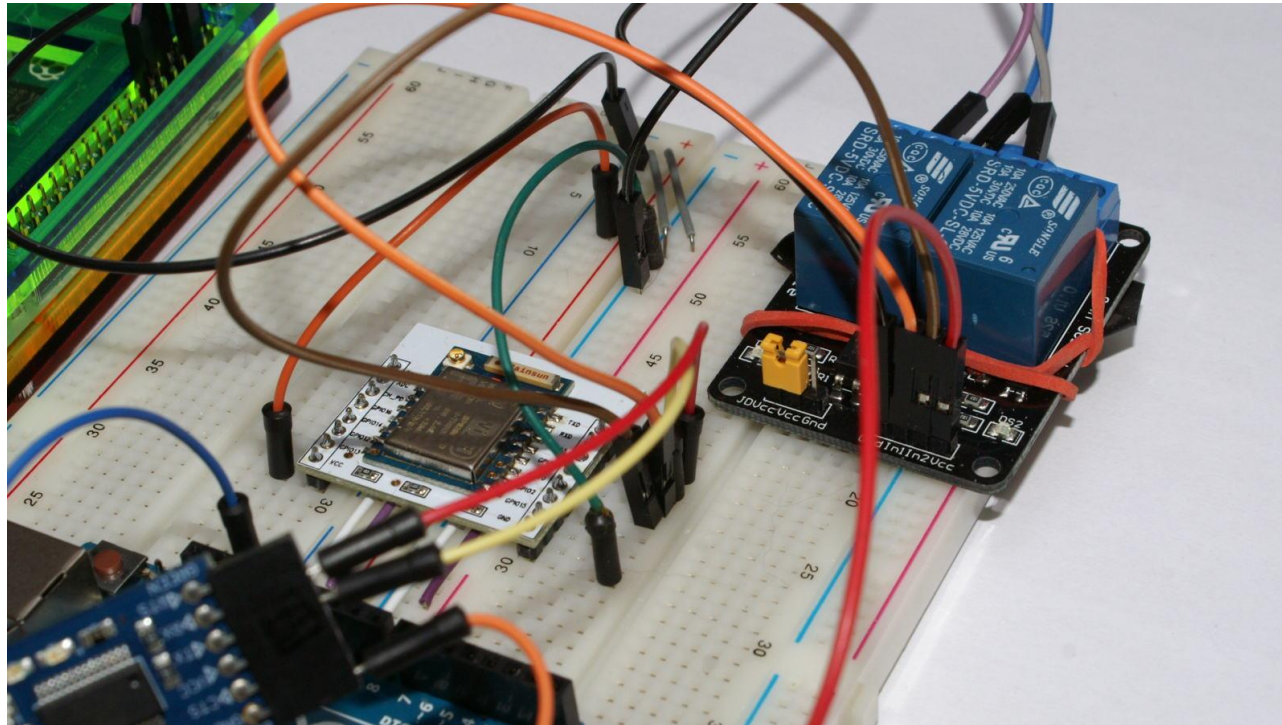
SOLDER-LESS BREAD BOARD



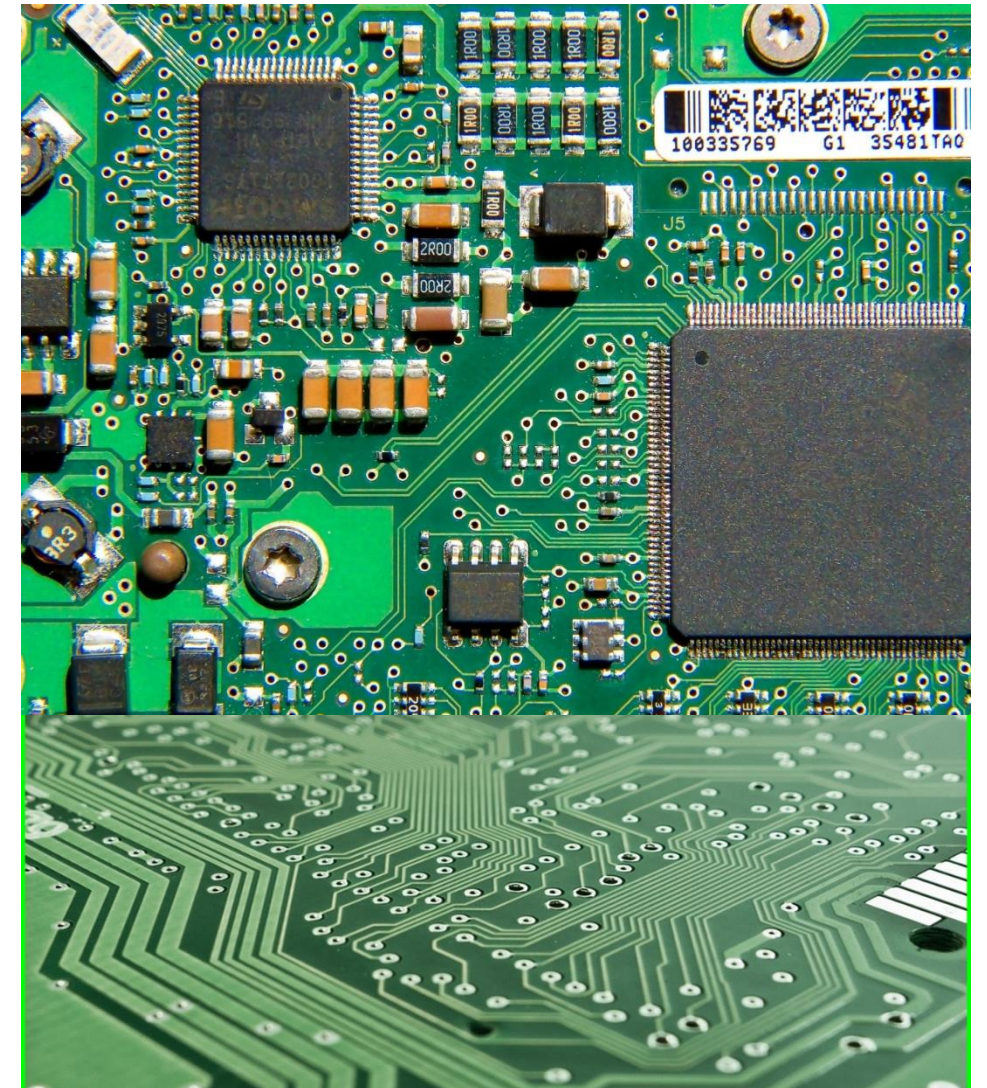




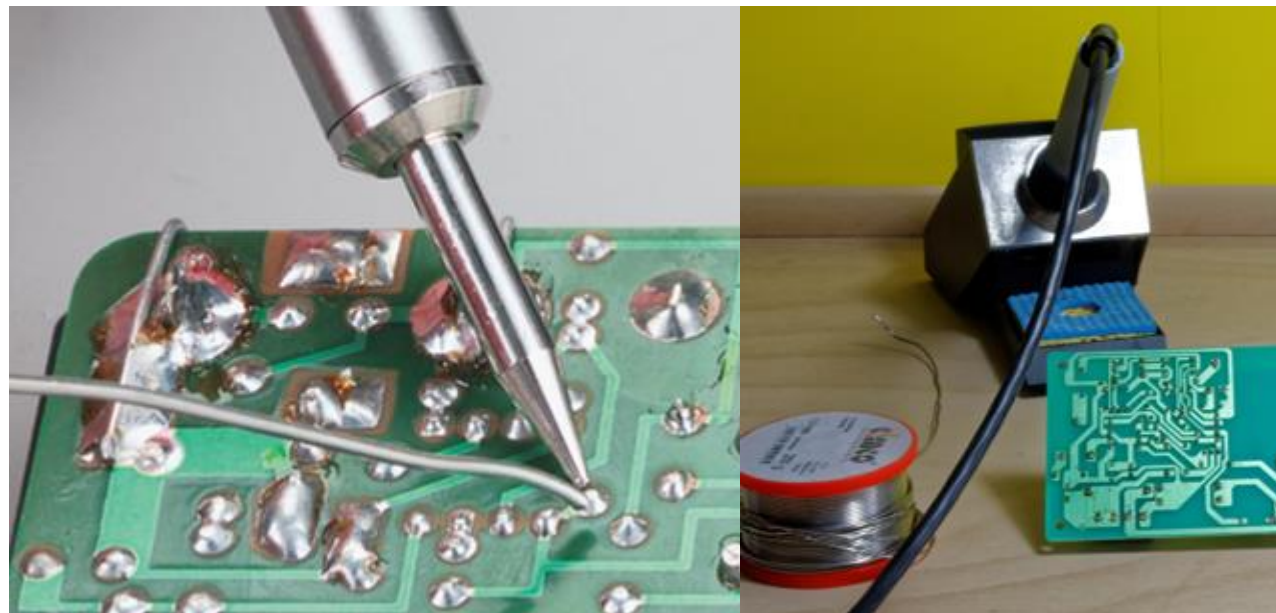
JUMPER WIRE



Breadboard Prototype



Printed Circuit Board

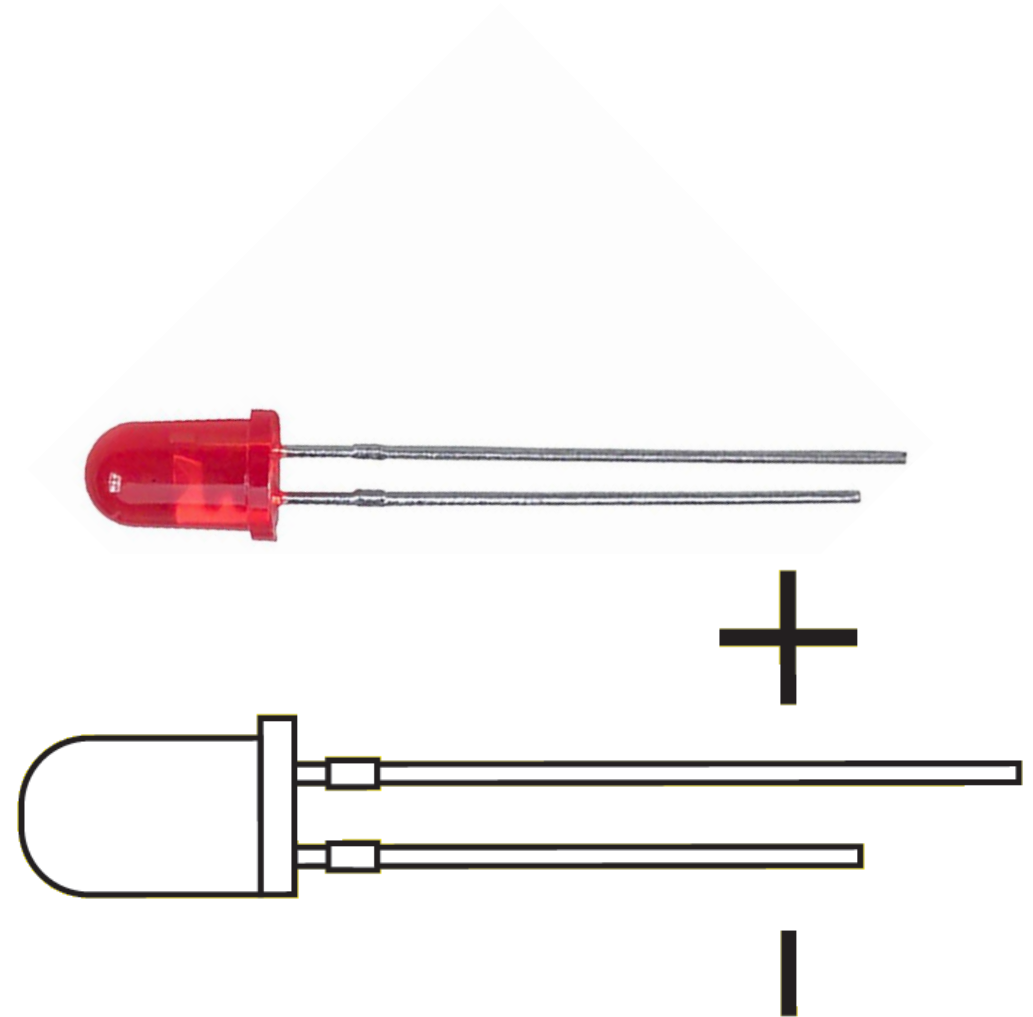


Soldered Breadboard





LIGHT-EMITTING DIODE (LED)

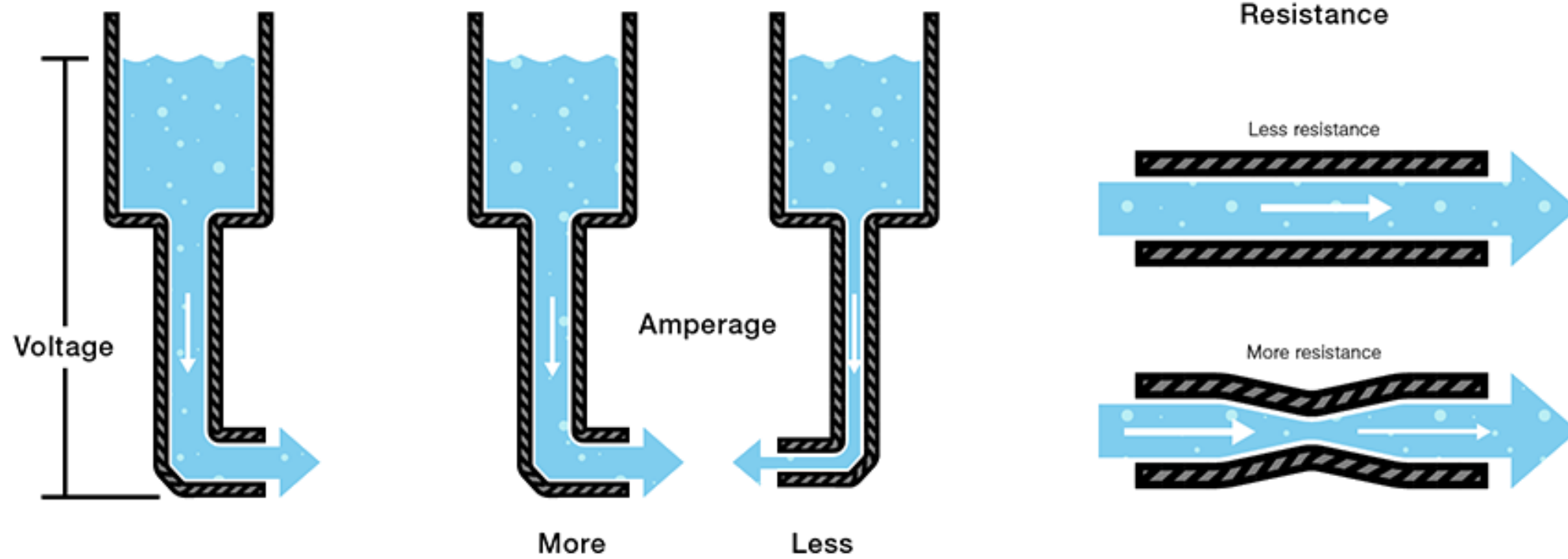


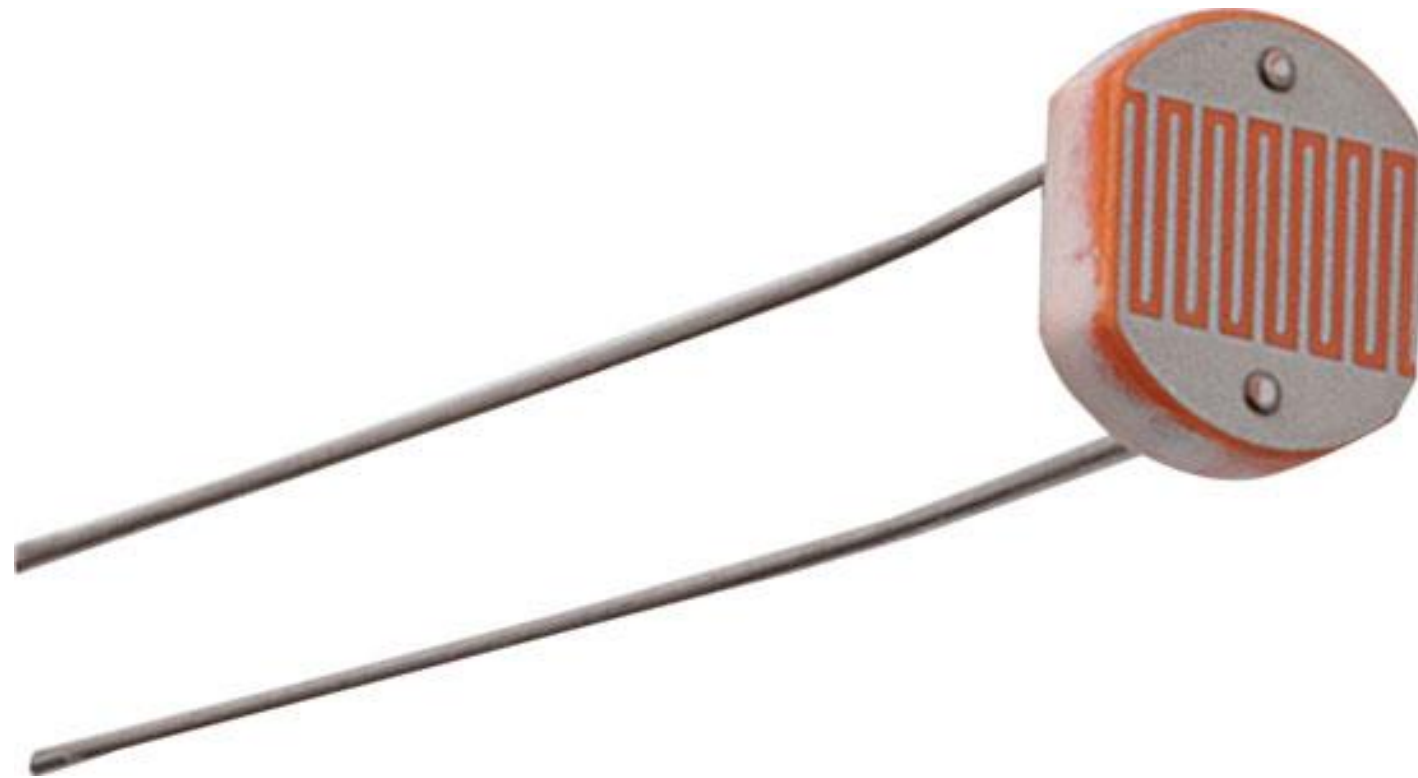


RESISTOR

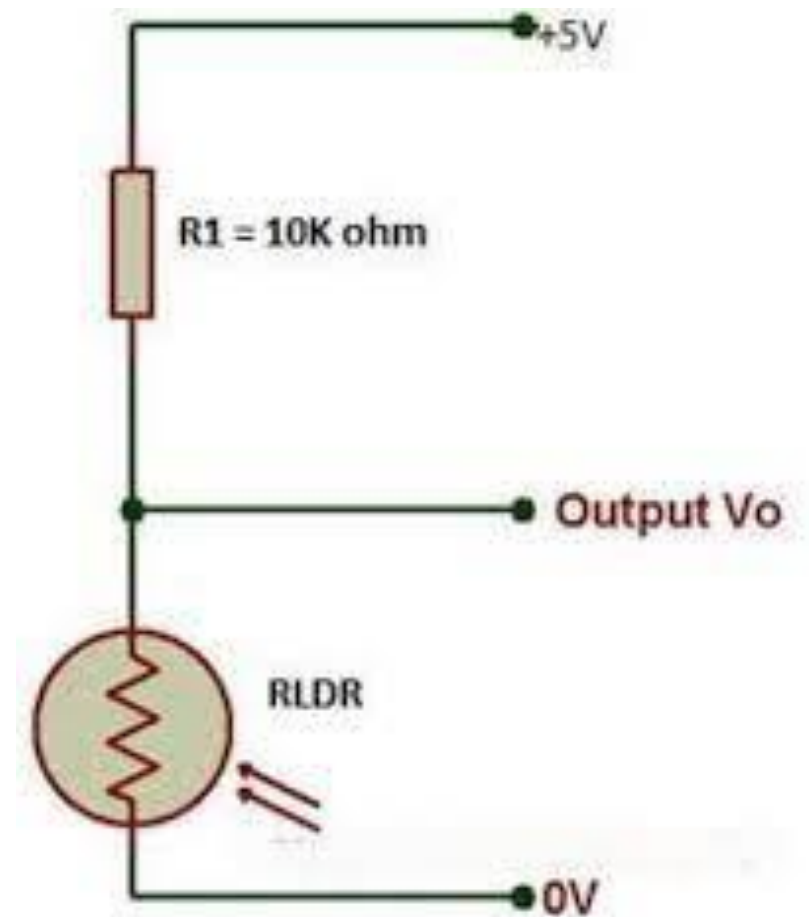
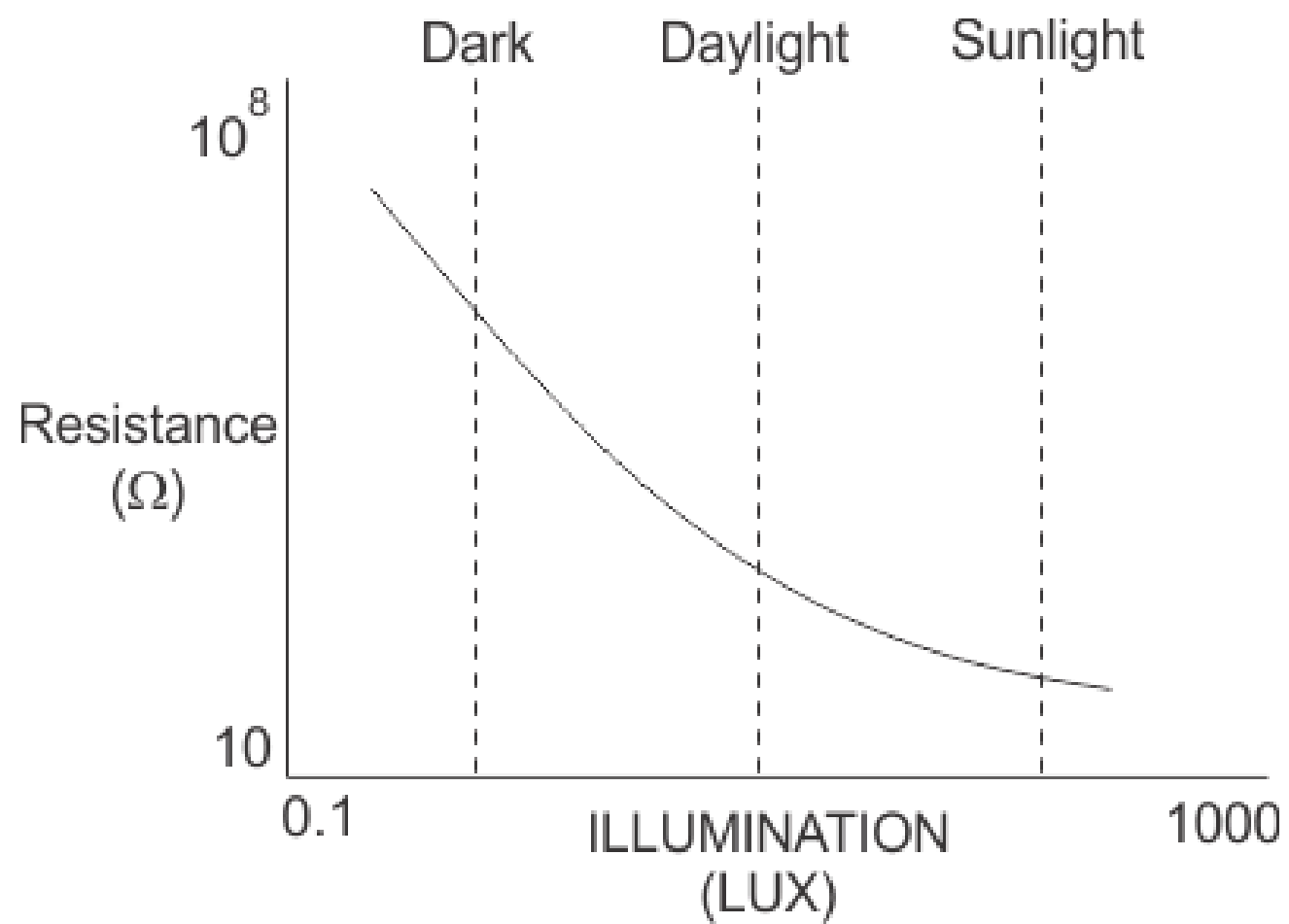
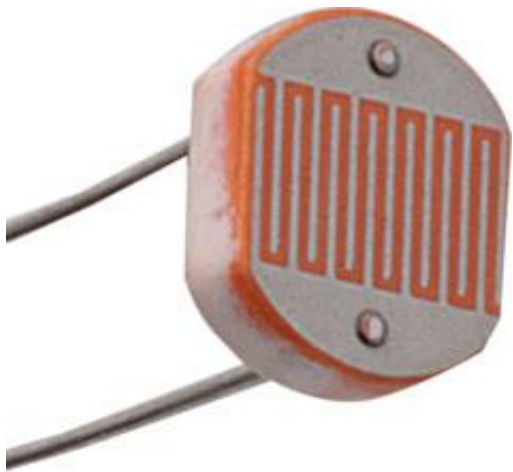


©Elprocus.com



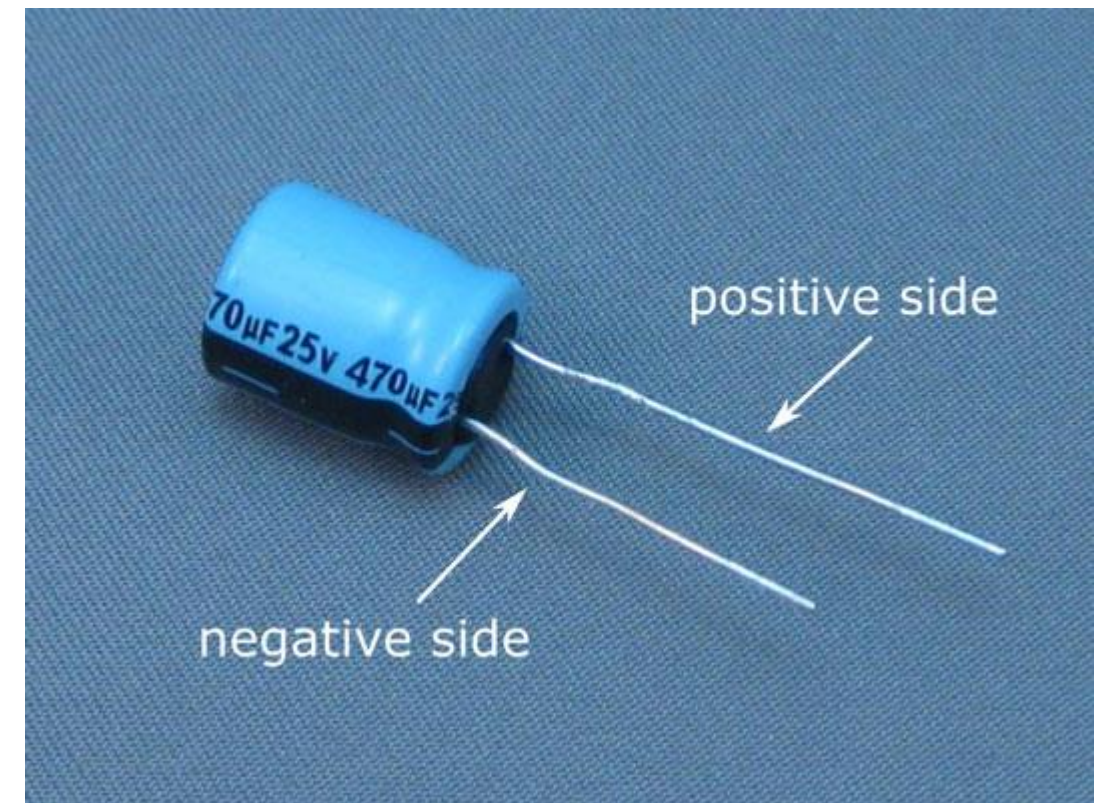
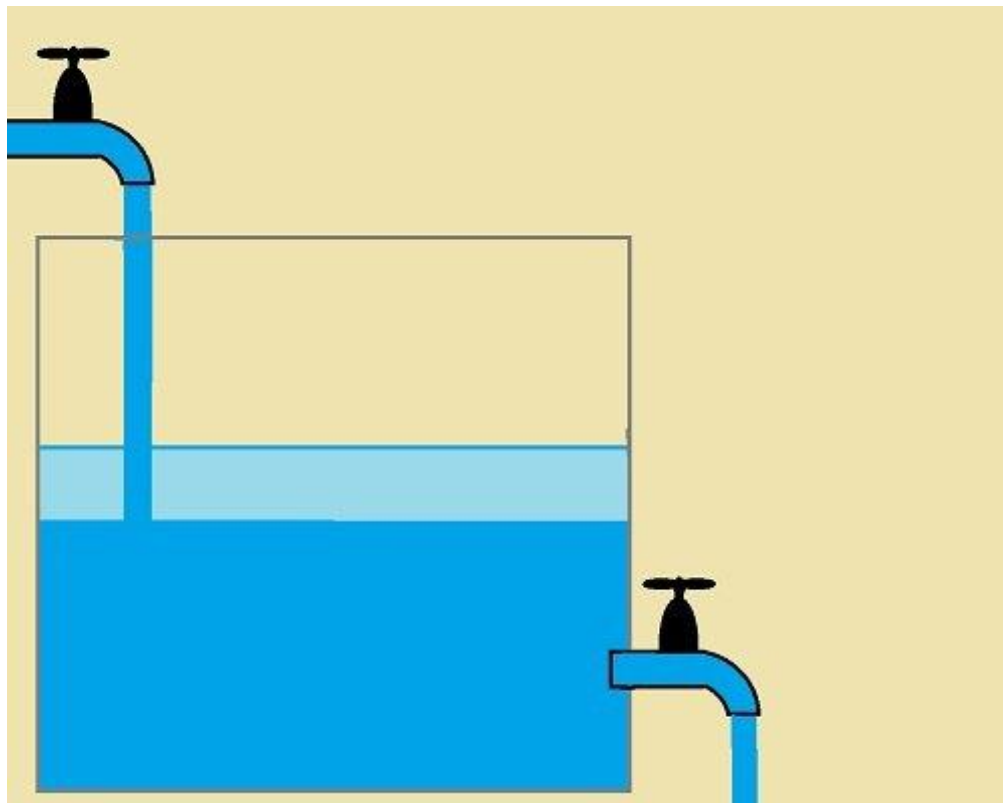
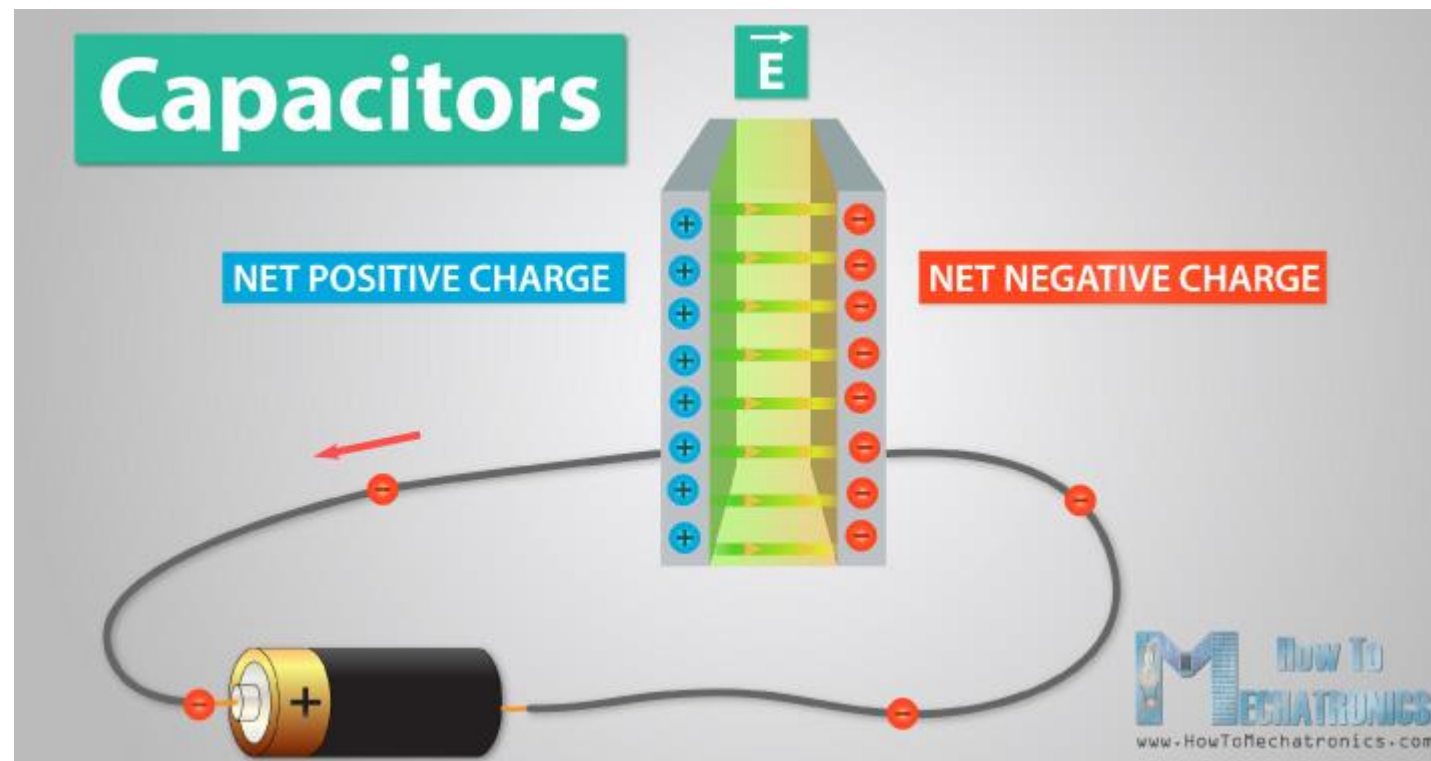


LIGHT DEPENDENT RESISTOR (LDR)





CAPACITOR

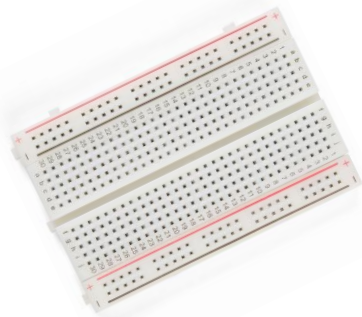


THE HARDWARE

- Raspberry Pi (RPi)



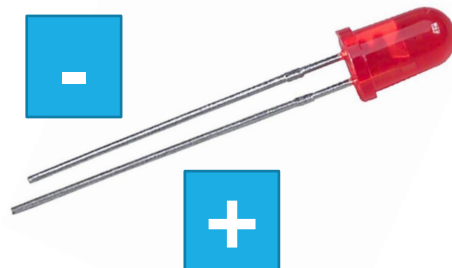
- Breadboard



- Jumper Wires



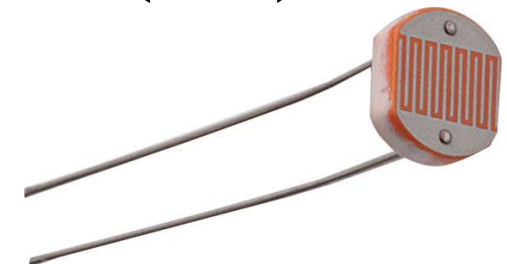
- Light-Emitting Diode (LED)



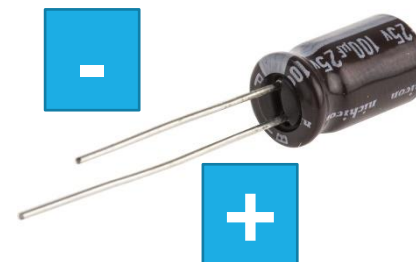
- Resistor



- Light Dependent Resistor (LDR)



- Capacitor



- Motion sensor (for bonus part)



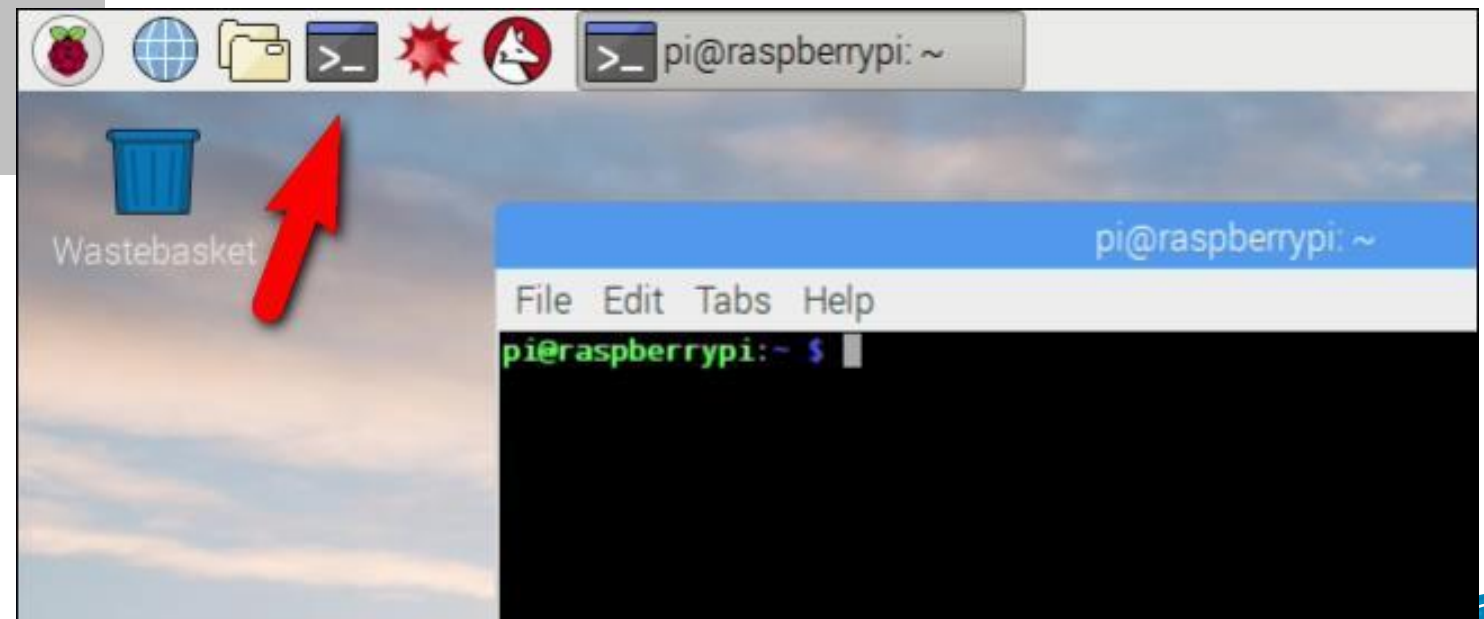
PYTHON BASICS



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")
```

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

==	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



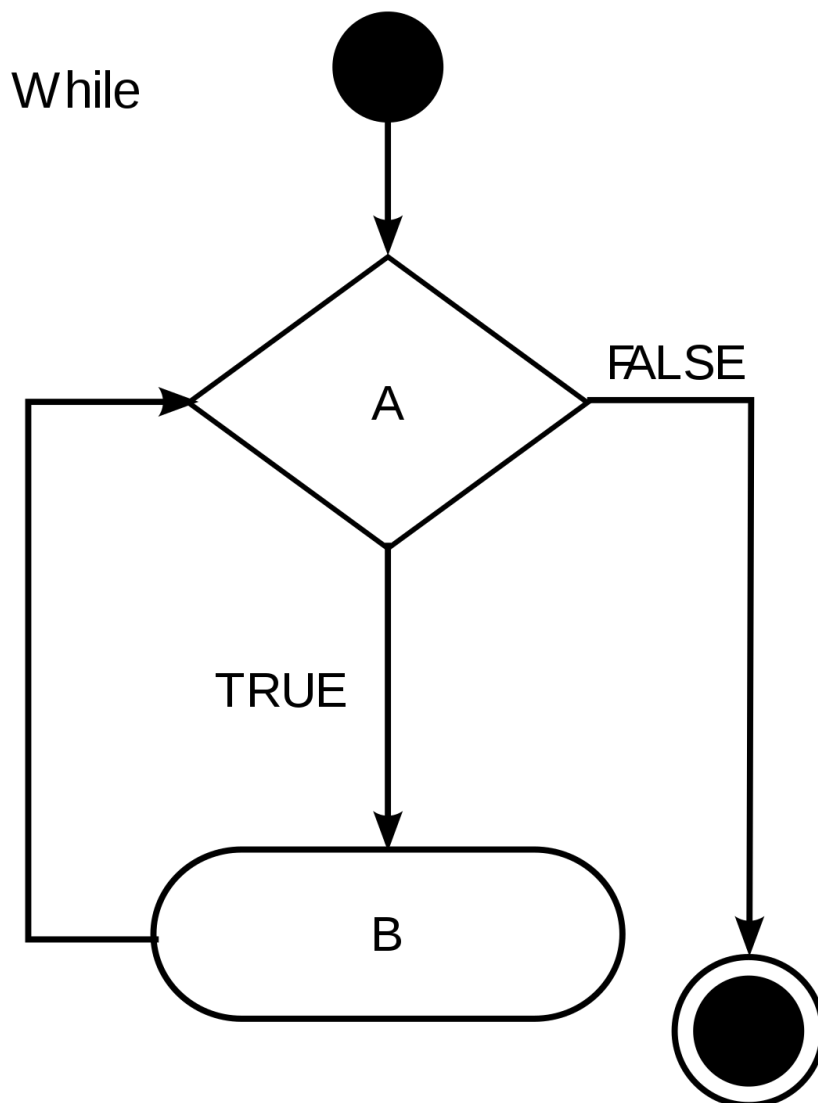
PYTHON BASICS

- 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

While (A= TRUE) Do
B
End While



PYTHON BASICS

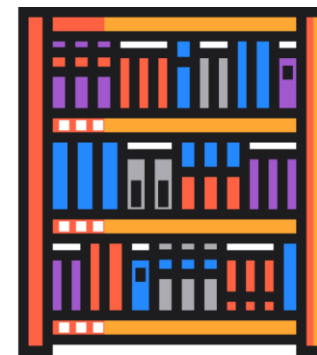
- Library imports

```
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



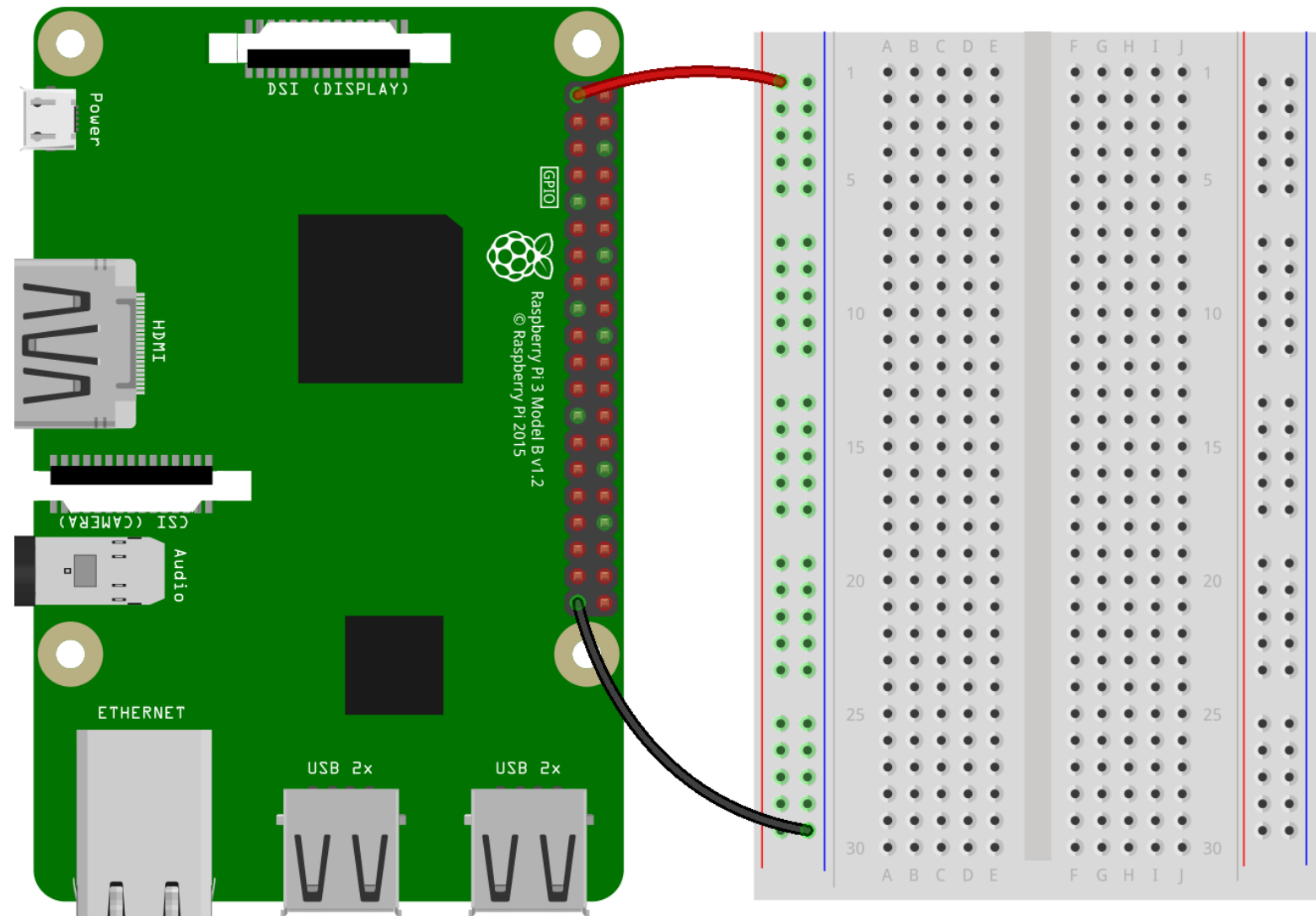
Your code program



HANDS ON: GETTING STARTED

Make a closed circuit:

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



fritzing

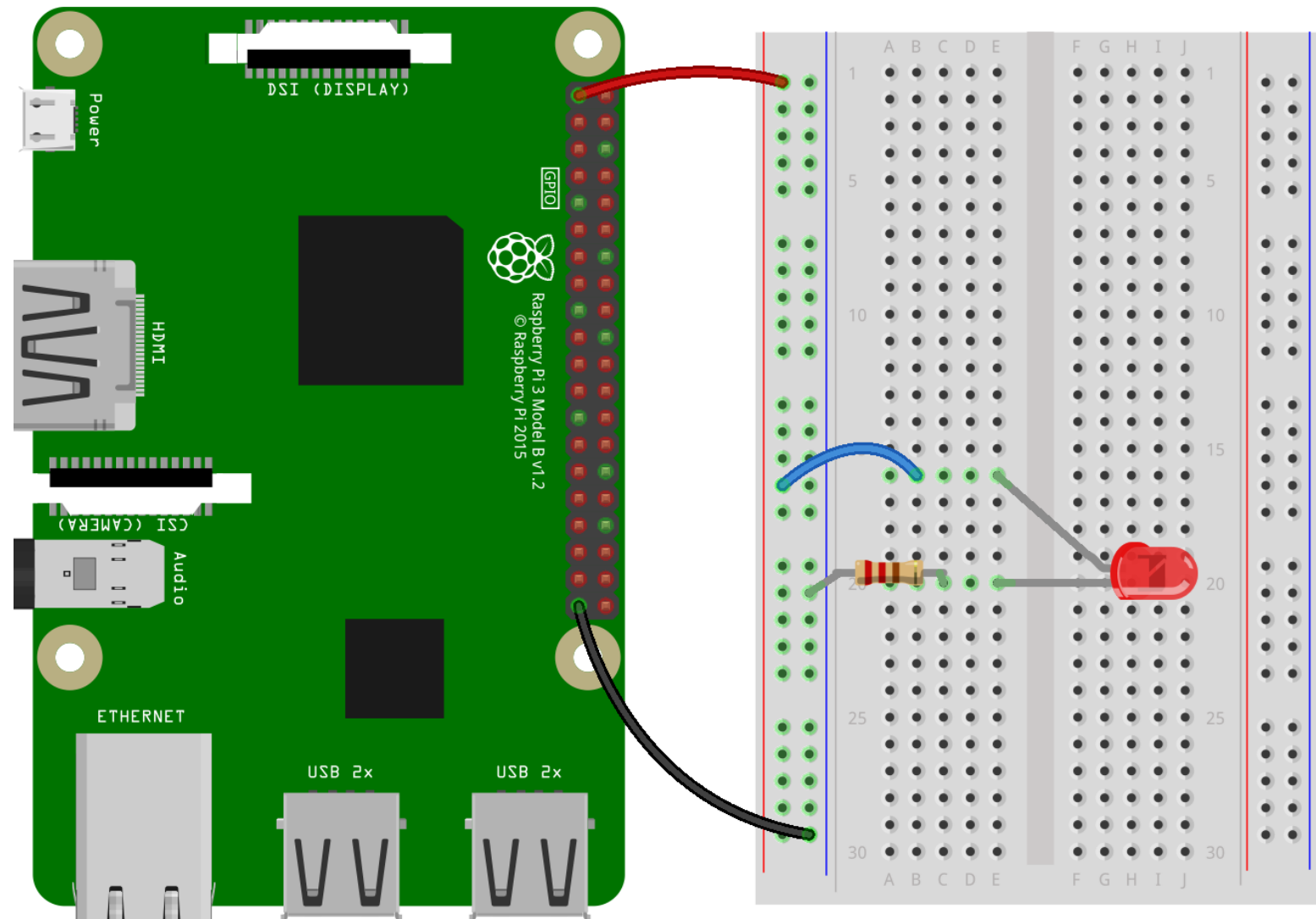


HANDS ON: LED

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!



fritzing

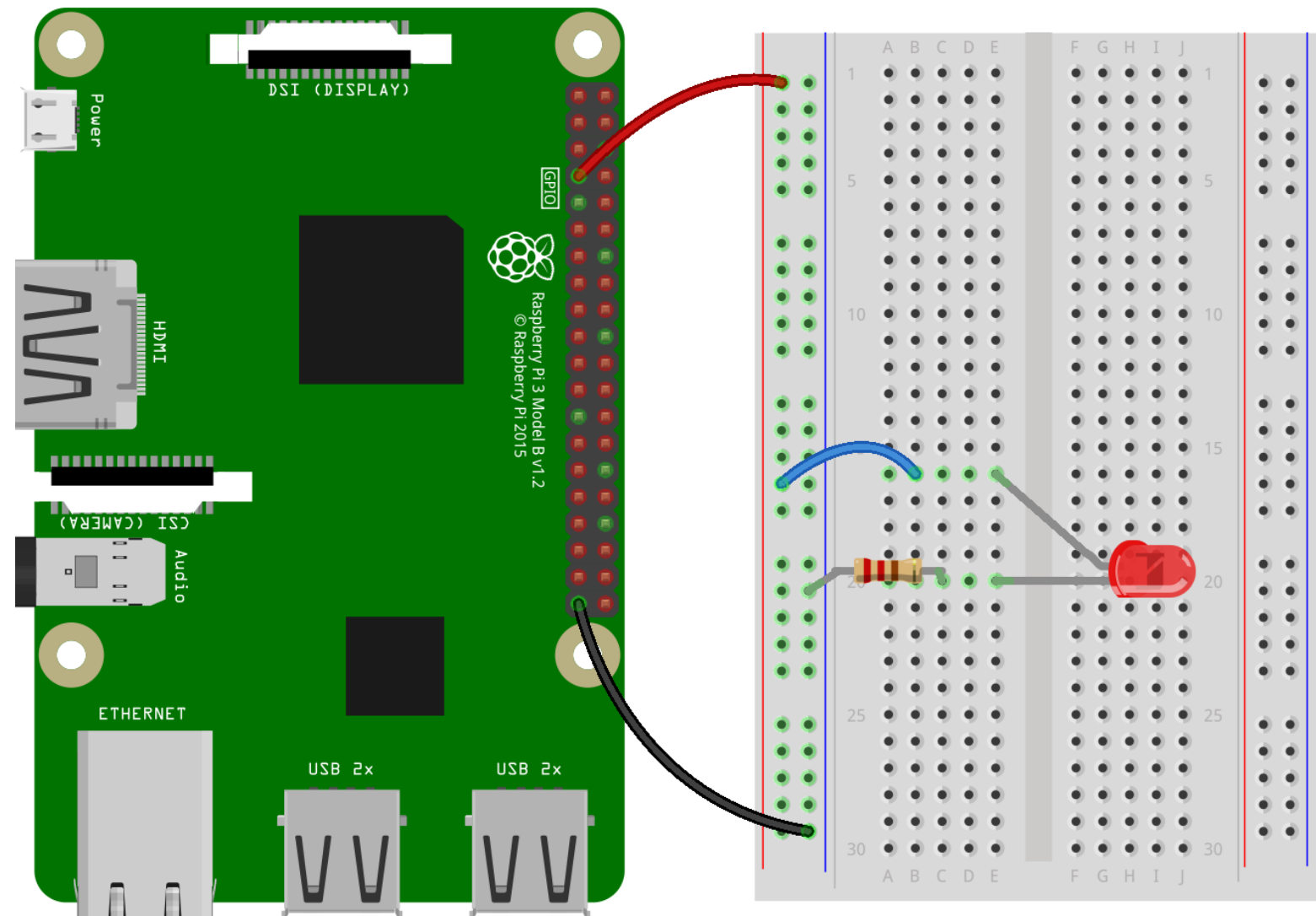


HANDS ON: LED

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!



fritzing



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?

```
from gpiozero import LED
```

```
import time
```

```
led = LED(4)
```

```
for i in range(10):
```

```
    led.on()
```

```
    time.sleep(1)
```

```
    led.off()
```

```
    time.sleep(1)
```

```
from gpiozero import LED
```

```
led = LED(4)
```

```
led.blink(on_time=1, off_time=1, n=10)
```



HANDS ON: LED

2. How to make LED blink continuously?

```
from gpiozero import LED
```

```
import time
```

```
led = LED(4)
```

```
while True:
```

```
    led.on()
```

```
    time.sleep(1)
```

```
    led.off()
```

```
    time.sleep(1)
```

```
from gpiozero import LED
```

```
led = LED(4)
```

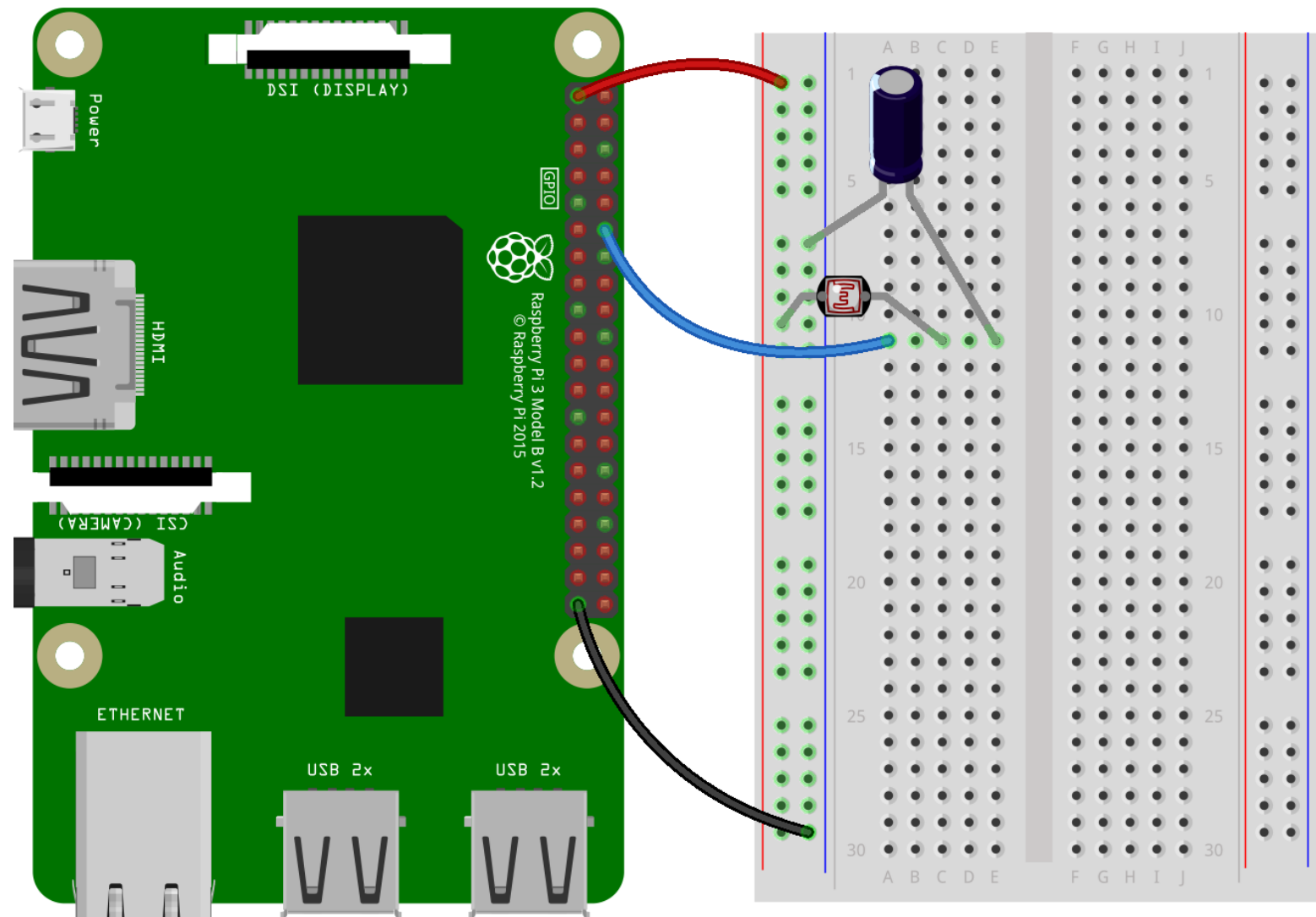
```
led.blink(on_time=1, off_time=1)
```



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



fritzing



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

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

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.

```
from gpiozero import
```

```
LightSensor
```

```
ldr = LightSensor(18)
```

```
while ldr.value < 0.5:
```

```
    continue
```

```
print("It's light!")
```

```
from gpiozero import LightSensor
```

```
ldr = LightSensor(18, threshold=0.5)
```

```
ldr.wait_for_light()
```

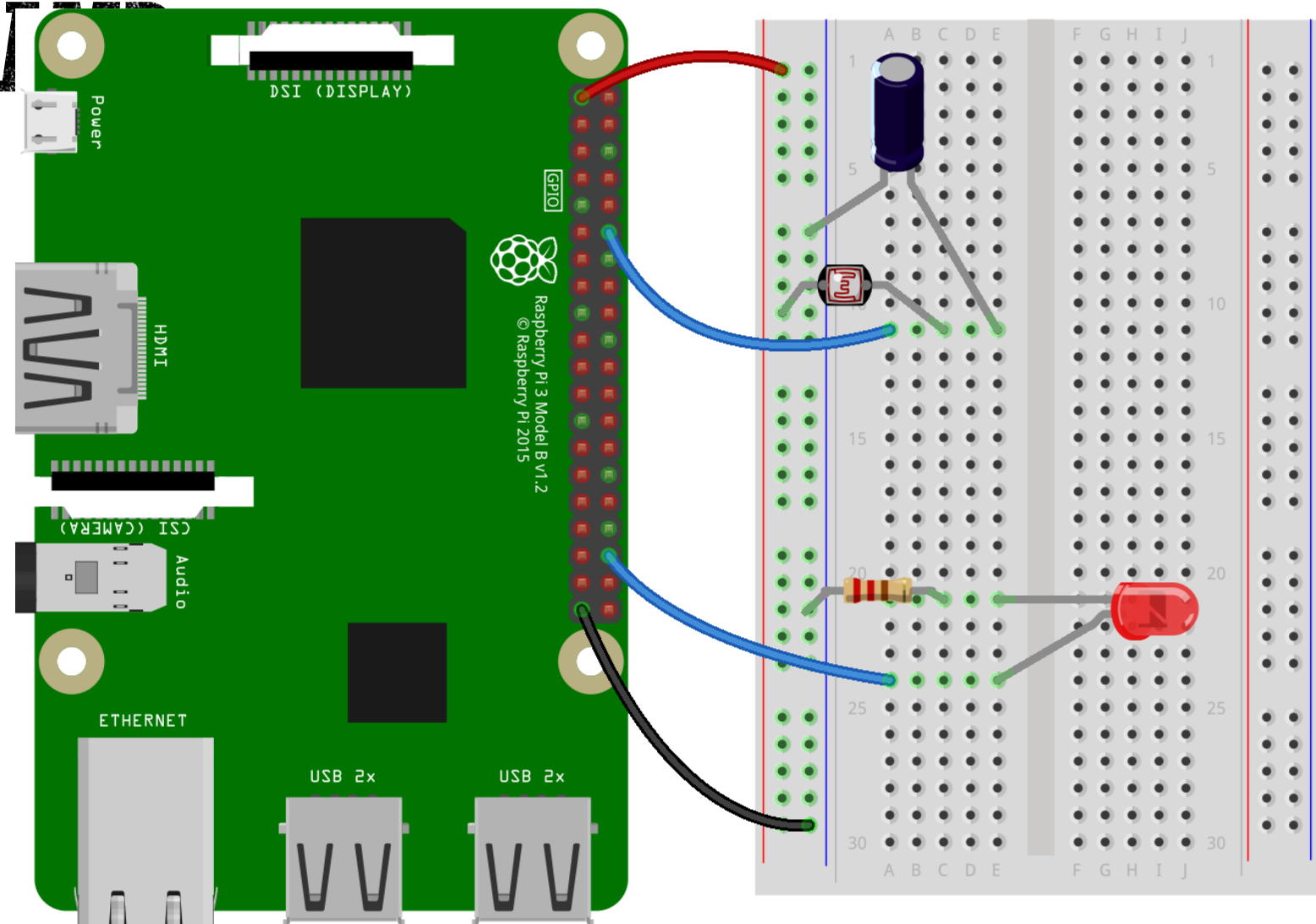
```
print("Light detected!")
```



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



fritzing



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

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

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)

```
from gpiozero import LightSensor, PWMLED
```

```
from signal import pause
```

```
sensor = LightSensor(18)
```

```
led = PWMLED(16)
```

```
led.source = sensor
```

```
pause()
```



HANDS ON: SMART LAMP B)

```
from gpiozero import LightSensor, PWMLED
```

```
from signal import pause
```

```
sensor = LightSensor(18)
```

```
led = PWMLED(16)
```

```
def opposite(sensor_object):  
    for v in sensor_object.values:  
        yield 1 - v
```

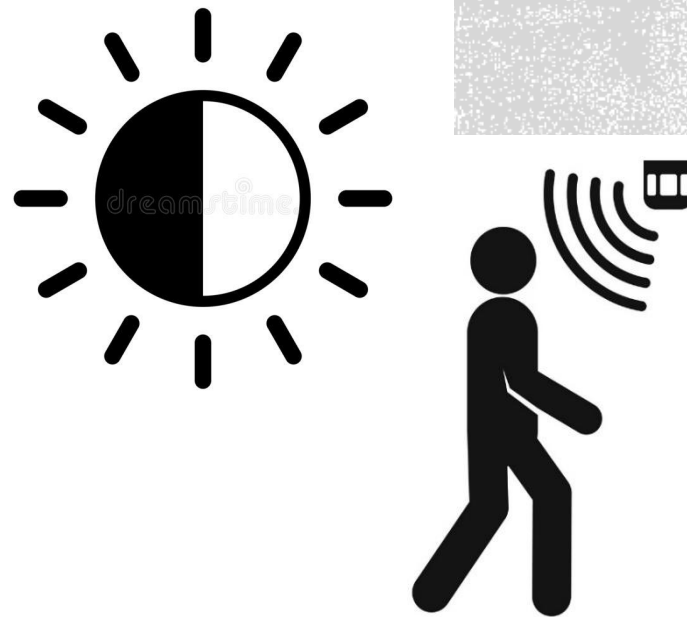
```
led.source = opposite(sensor)
```

```
pause()
```



BONUS CHALLENGE

Integrate Motion Sensor with
your Smart Lamp system



SMART LAMP BONUS CHALLENGE

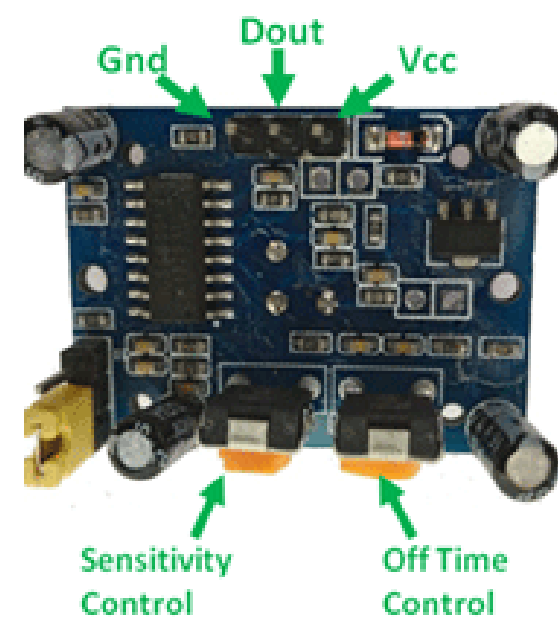
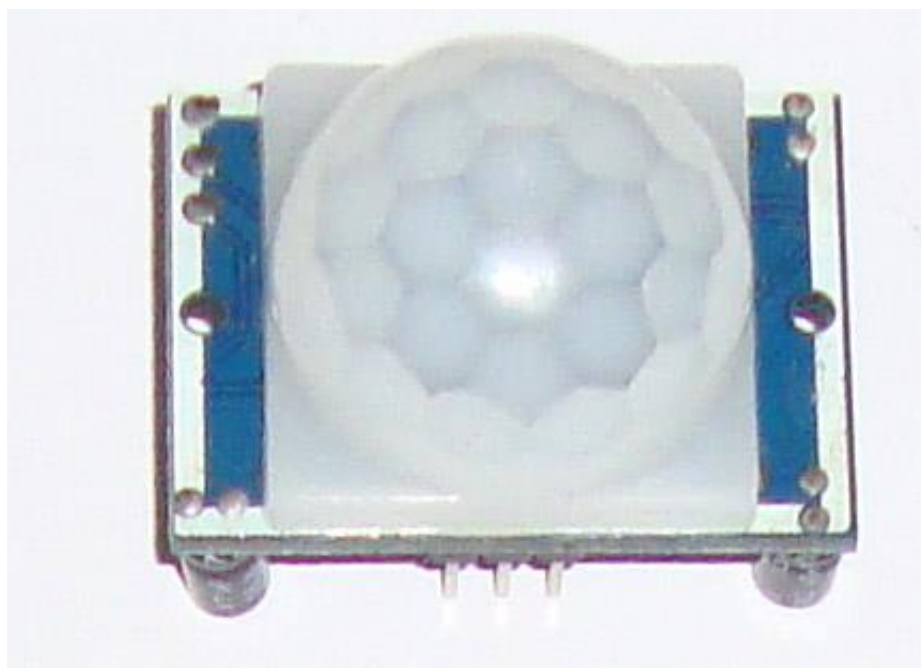
- Integration of Motion Sensor with your existing LDR + LED Smart Lamp circuit
 - Set up Motion Sensor + LED
 - Example idea:
 - When there is motion -> turn on light
 - When there is no motion -> turn off light
 - Set up Motion Sensor + LDR + LED
 - Example idea:
 - Night light turns on/off based on both:
 - The environment's brightness
 - The detected motion



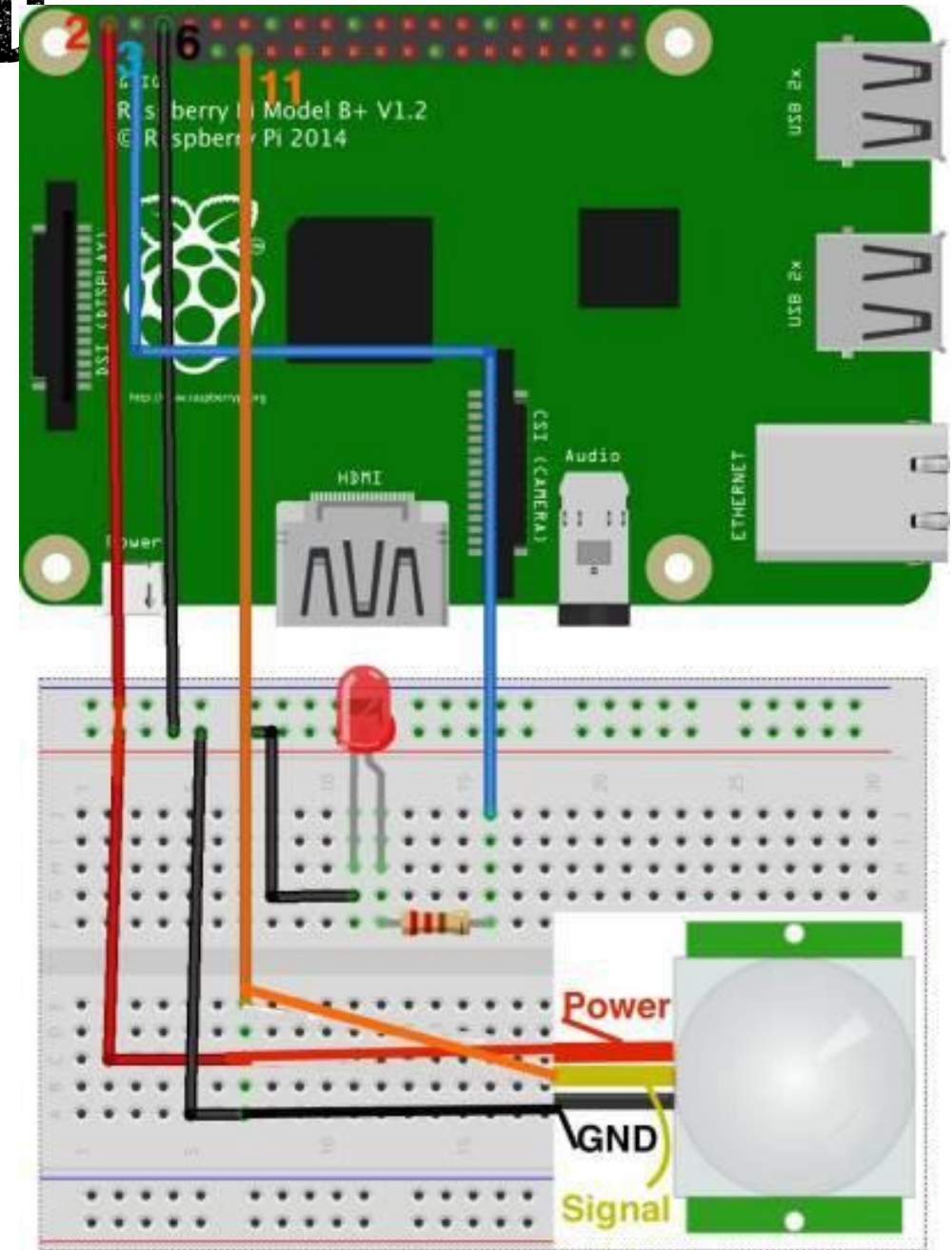
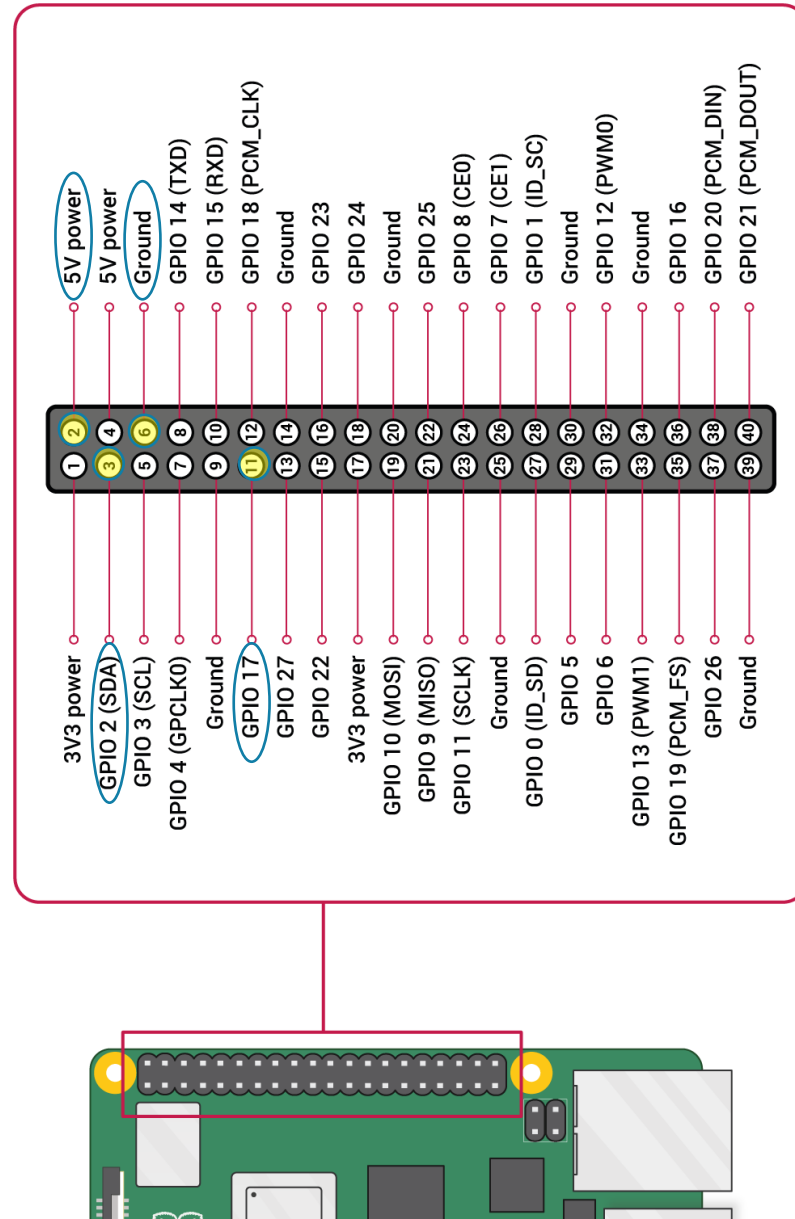
REFER TO THE BONUS SLIDES FOR MORE DETAILS



PIR MOTION SENSOR



MOTION SENSOR + LED



EXAMPLE IDEA:

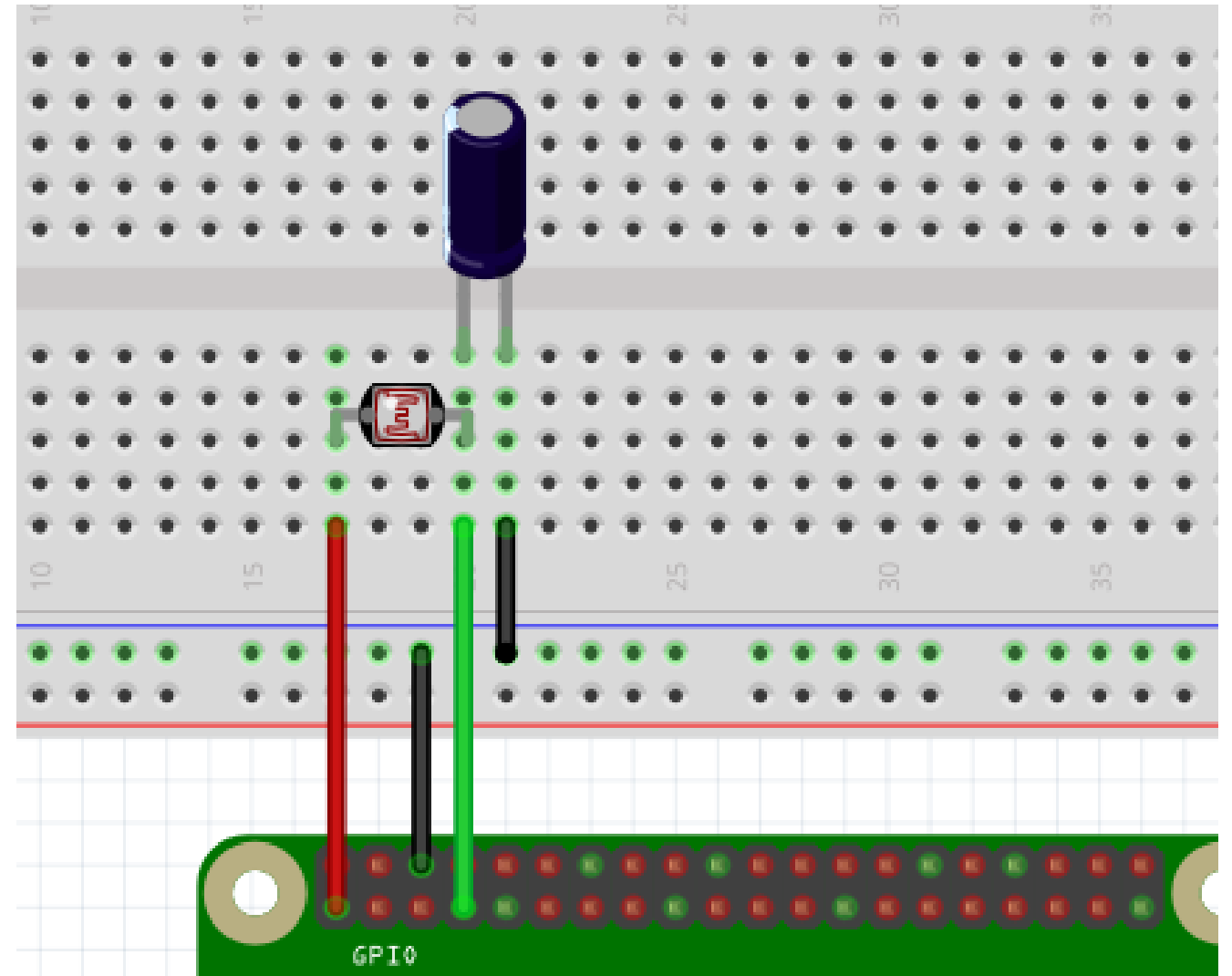
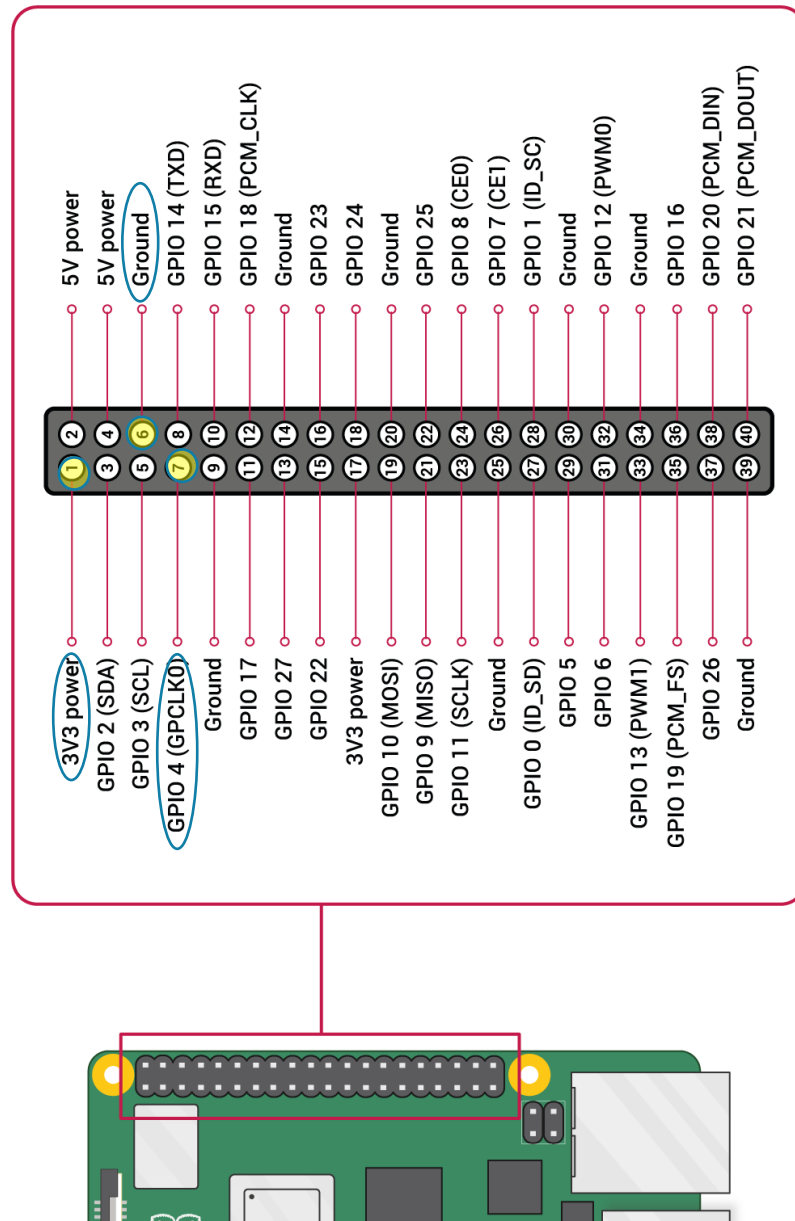
- Smart night light
 - When there is motion → turn on light
 - When there is no motion → turn off light

- Hints:

- `pir = MotionSensor(2)`
- `pir.wait_for_motion()`
- `pir.wait_for_no_motion()`
- https://gpiozero.readthedocs.io/en/stable/api_input.html#motionsensor-d-sun-pir



MOTION SENSOR + LED + LDR



EXAMPLE IDEA:

- Smart'ER' night light
 - Night light turns on/off based on both:
 - The environment's brightness
 - The detected motion

- Hints:

- `pir = MotionSensor(2)`
- `ldr = LightSensor(4)`
- https://gpiozero.readthedocs.io/en/stable/api_input.html#motionsensor-d-sun-pir
- https://gpiozero.readthedocs.io/en/stable/api_input.html#lightsensor-ldr

