AI ILLUMINATORS WORKSHOP

30 / 31 May 2024
By Goldman Sachs Engineering x IMDA

PLEASE DOWNLOAD MATERIAL FROM

https://tinyurl.com/gs-imda-2024

AGENDA

Day 1

- Icebreaker
- Basics of Python using Rpi and Google Colab
- Smart Lighting with Rpi + LED + LDR
- Introduction to Telegram Bot

Day 2

- Introduction to Artificial Intelligence
- Bring it All Together – Telegram Bot + AI
- Sustain-a-bot

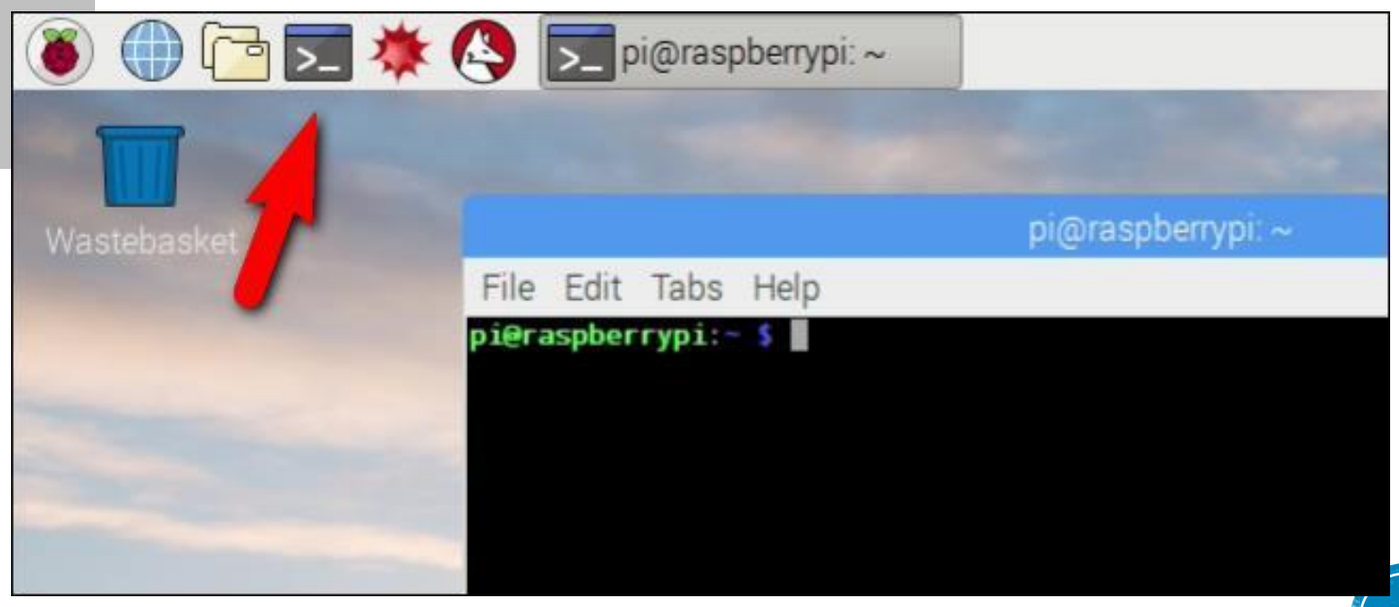
ICE-BREAKING!

- Please go to www.menti.com
- Enter participant code: 75007718

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

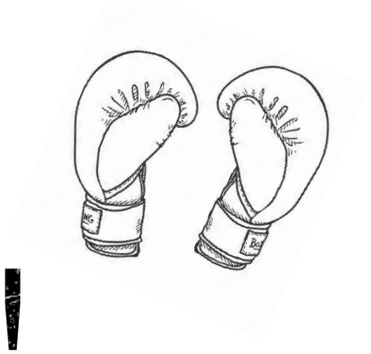
- If…Else block

```
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

TRY IT OUT!



- Write code to **print** the corresponding weight class of boxers given an integer weight.
- Apply what you just learnt about **variables** and **if/else**.
- Run test cases!

Weight Class	**Weight (kg)**
Featherweight	Below 57
Lightweight	Between 57 and 66
Middleweight	Between 66 and 81
Heavyweight	Above 81

PYTHON BASICS

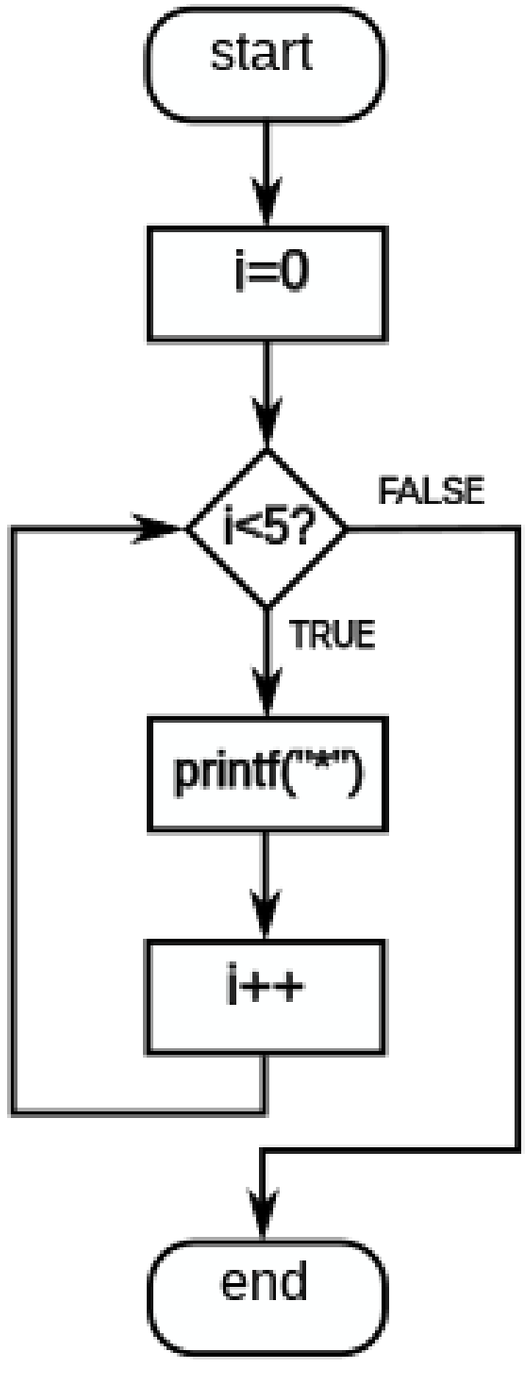
- For loop

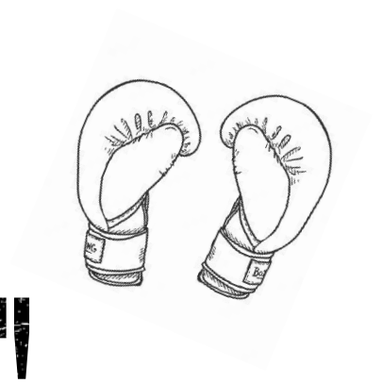
```
for x in range(6):
  print(x)
```

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

```
fruits = ["apple", "banana", "cherry"]
for x in fruits:
  print(x)
  if x == "banana":
    break
```

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





TRY IT OUT!

- Write code to print all even numbers from 1 to 100.
- Hint: The mod operator (%) gives the remainder of a division.
- Think:
  - 5 % 2 evaluates to 1
  - 6 % 2 evaluates to 0
  - …

Even Numbers
1 to 100

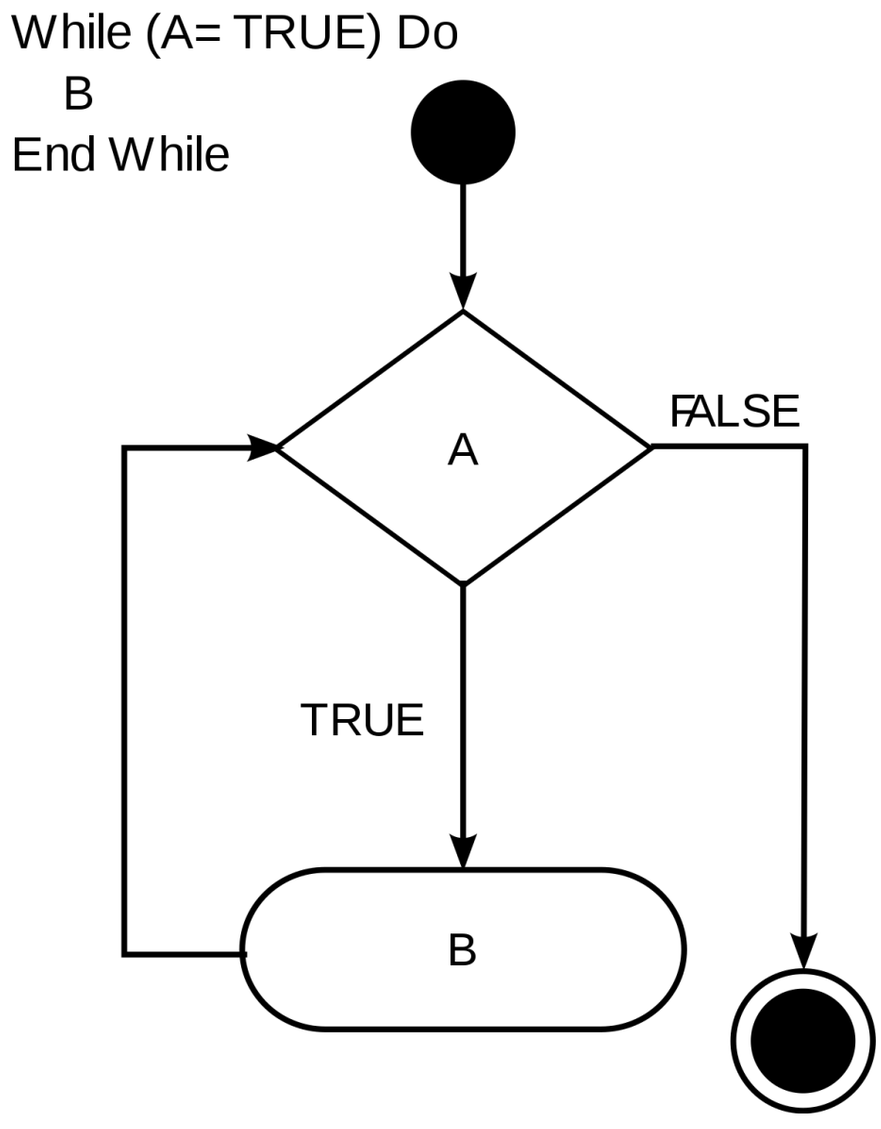
2	12	22	32	42	52	62	72	82	92
4	14	24	34	44	54	64	74	84	94
6	16	26	36	46	56	66	76	86	96
8	18	28	38	48	58	68	78	88	98
10	20	30	40	50	60	70	80	90	100

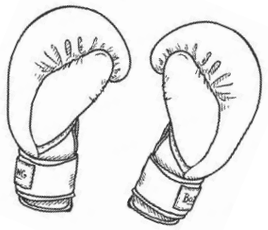
PYTHON BASICS

- While loop

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

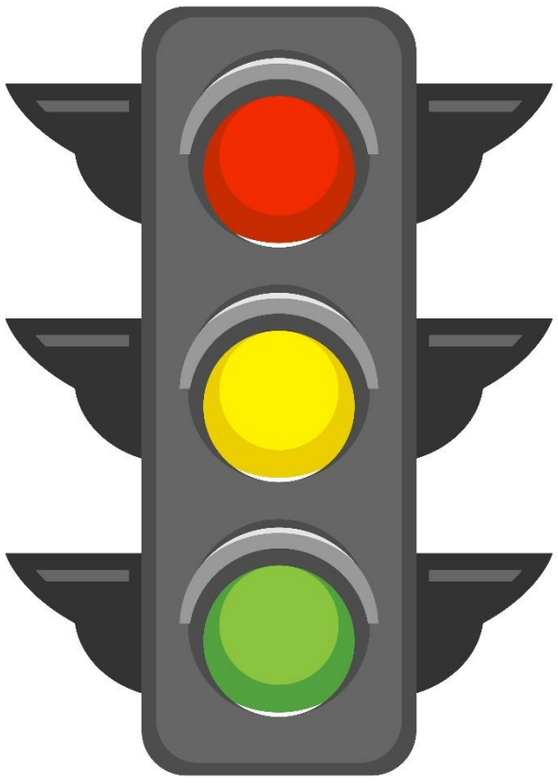
https://www.w3schools.com/python/trypython.asp?filename=demo_while_break





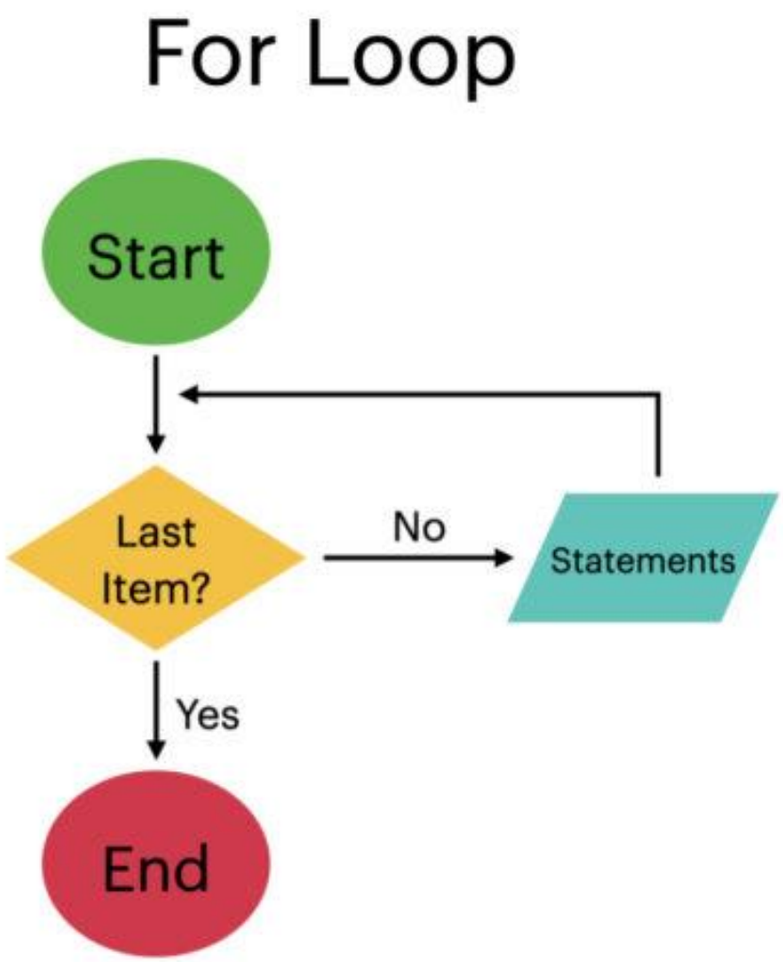
TRY IT OUT!

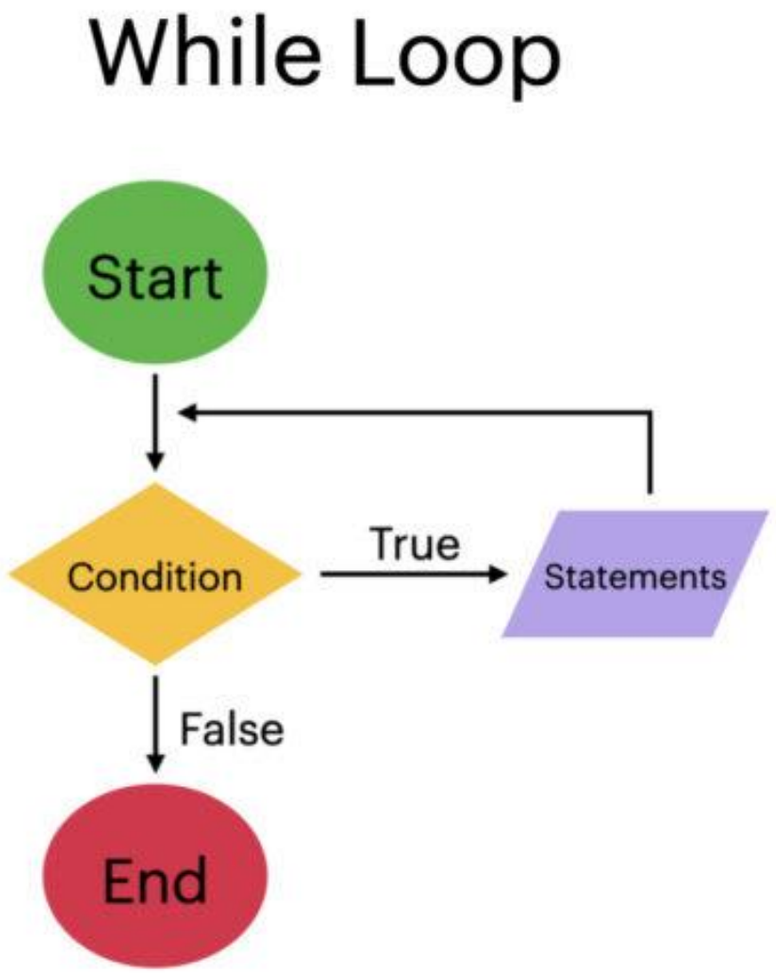
- Write code that prints the corresponding action for a traffic light colour
  - Green -> go
  - Amber -> slow down
  - Red -> stop
- …and keeps doing so until you say “exit”!
- Combine what you’ve learnt!
- Hint: color = str(input(“…”))



PYTHON BASICS

- For vs While loop





PYTHON BASICS

- Functions

```
def my_function(fname):
  print(fname + " Refsnes")

my_function("Emil")
my_function("Tobias")
my_function("Linus")
```

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

```
def greet():
    print('Hello World!')

# call the function
greet()

print('Outside function')
```

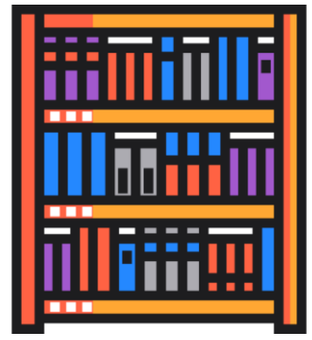
PYTHON BASICS

- Library imports

```
from math import sqrt

print(sqrt(4))   # => 2
print(sqrt(526)) # => 22.93468988235943
```

https://docs.python.org/3/library/math.html



Library/Module

Imports

Your code program

PYTHON BASICS

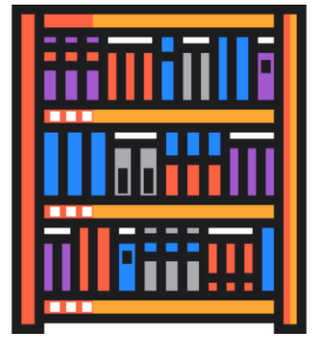
- Library imports

```
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

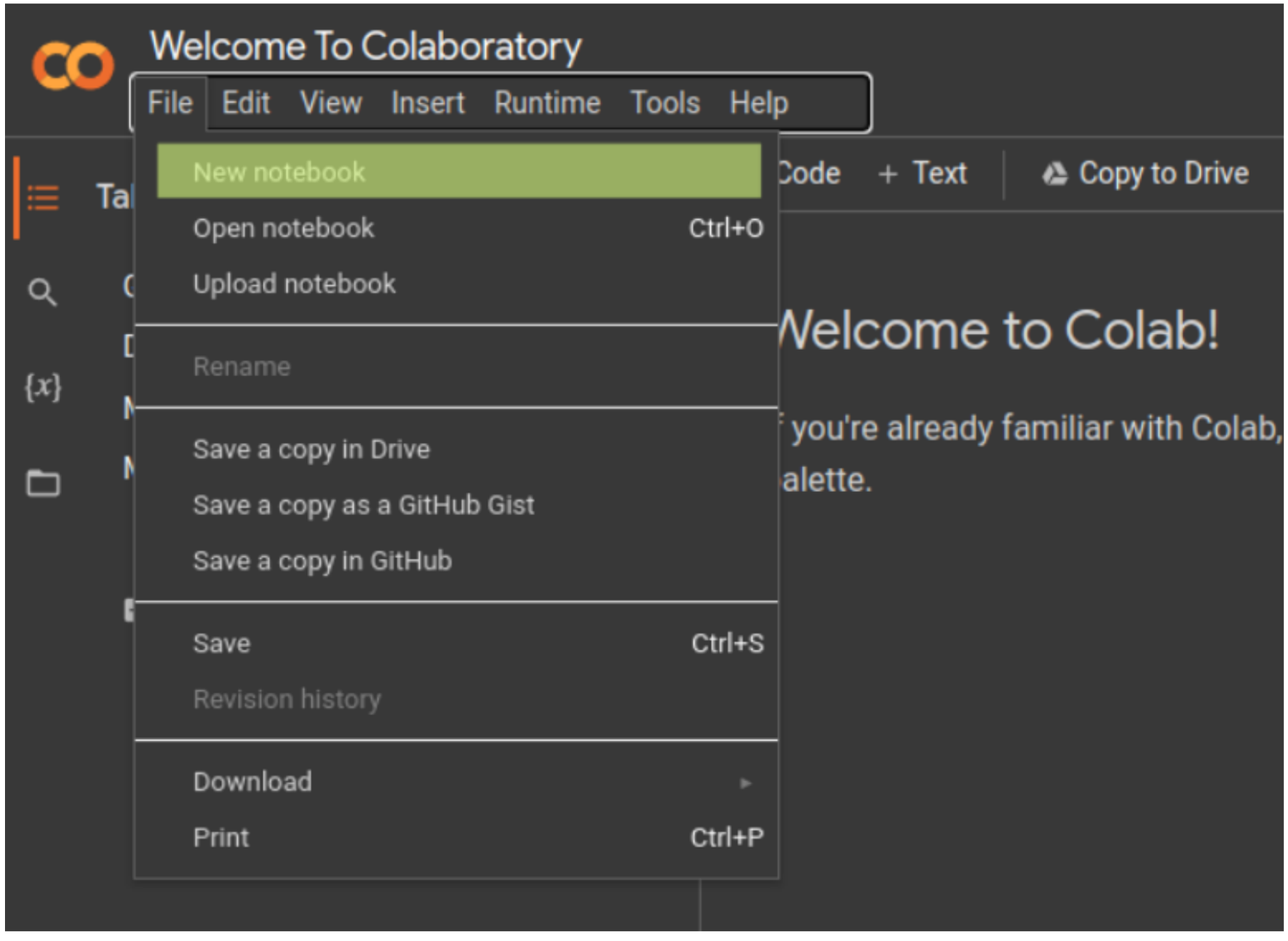
Imports

Your code program

PYTHON PROGRAMMING ON COLAB

Make sure you have your Google account username and password.

If you don't have an account, **a parent may be able to create one for you** or, if you're old enough to do so under your country's laws, you can **create your own account**.



CODING IN COLAB

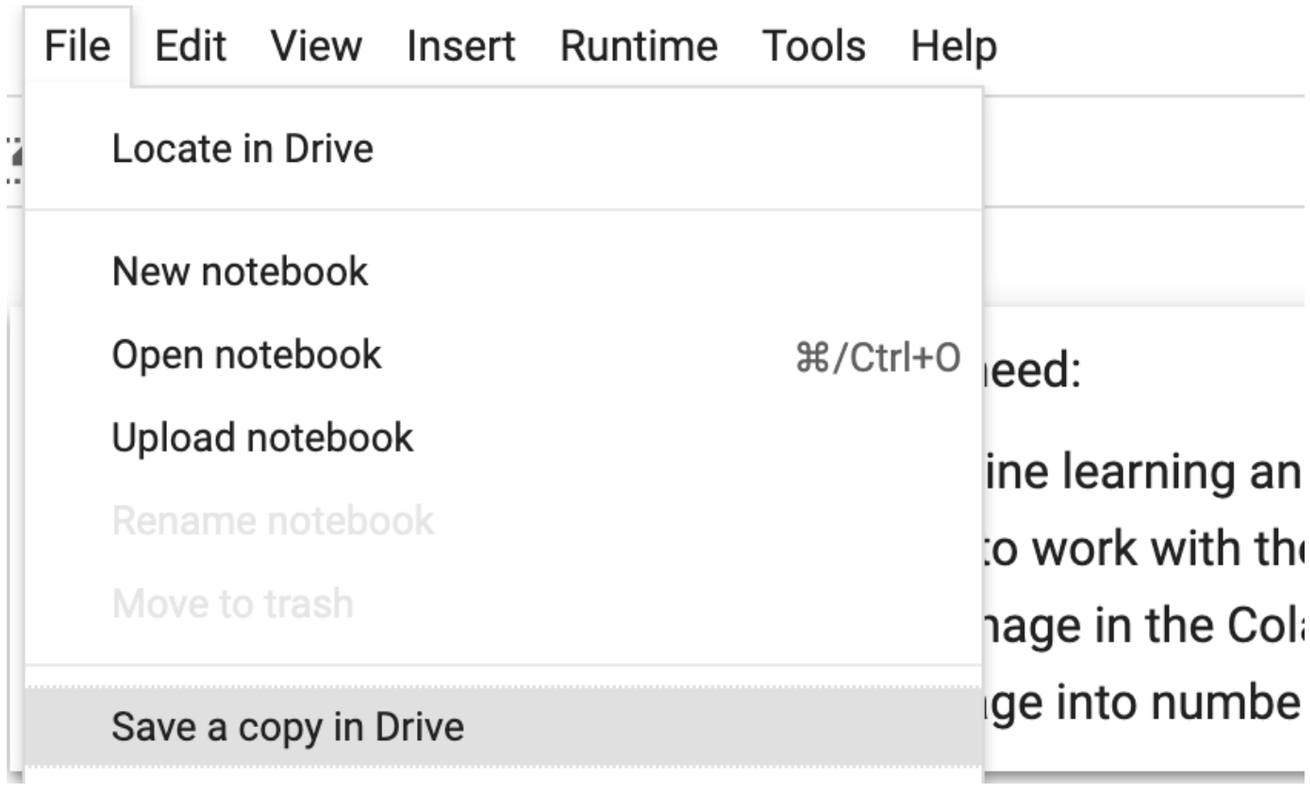
- Getting started in the code cells

```
seconds_in_a_day = 24 * 60 * 60
seconds_in_a_day
```

```
86400
```

Check that you can run all the code in the notebook by going to the `Runtime` menu and choosing `Run all`.

- Don’t forget to save your work!



15 MIN BREAK ☺

SMART LIGHTING

HARDWARE BASICS

- Raspberry Pi (RPi)

- Breadboard

- Jumper Wires

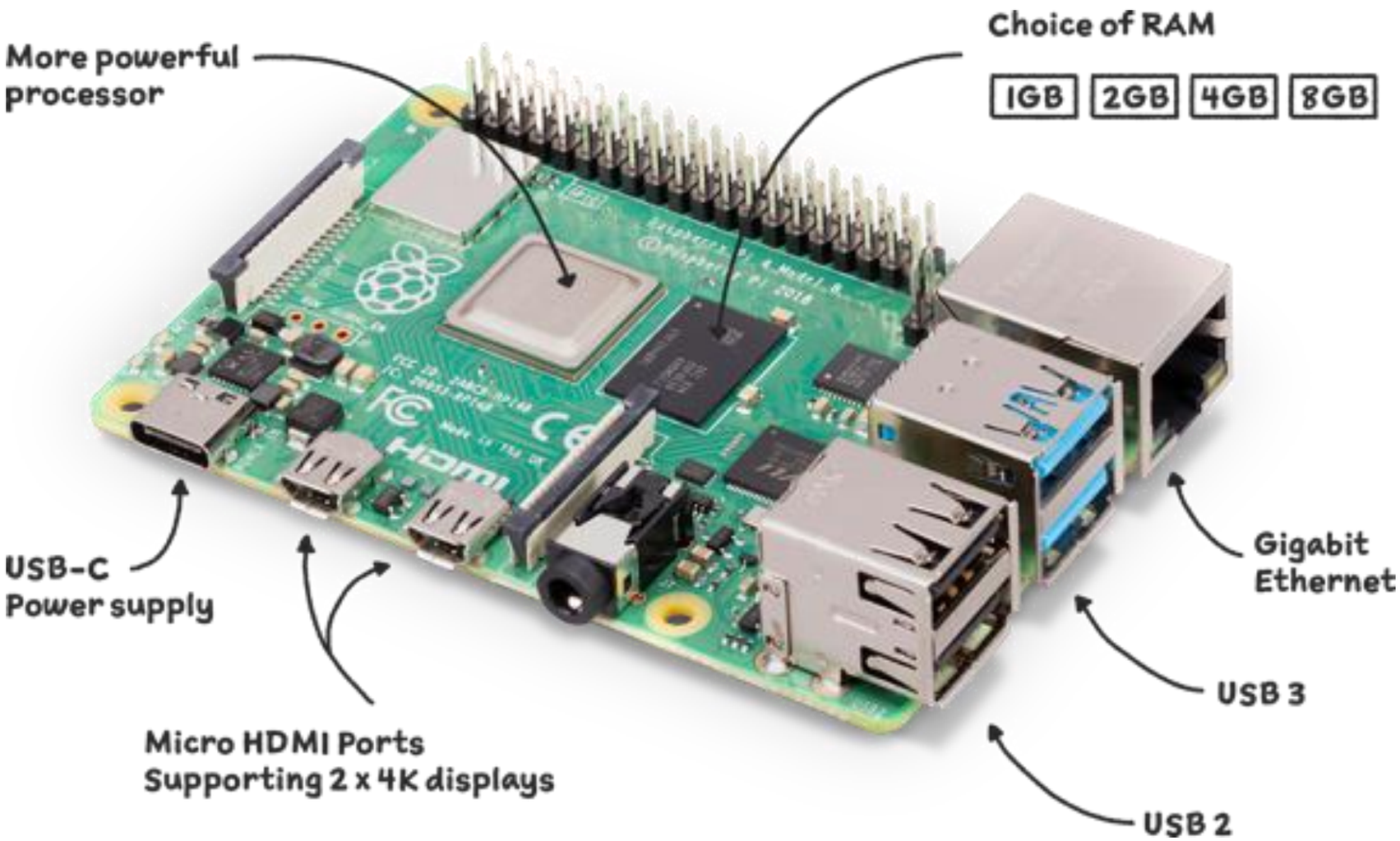
- Light-Emitting Diode (LED)

- Resistor

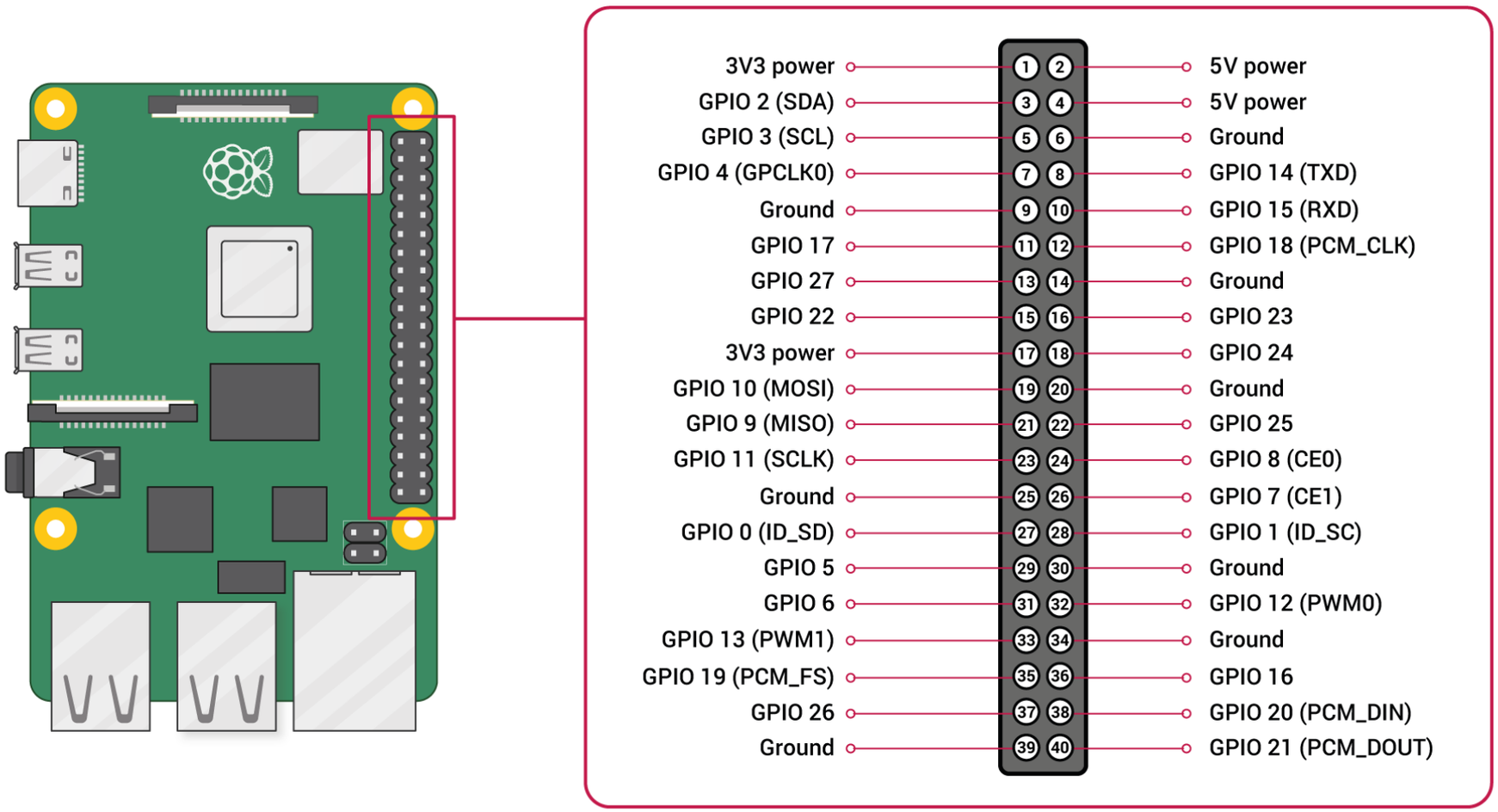
- Light Dependent Resistor (LDR)

- Capacitor

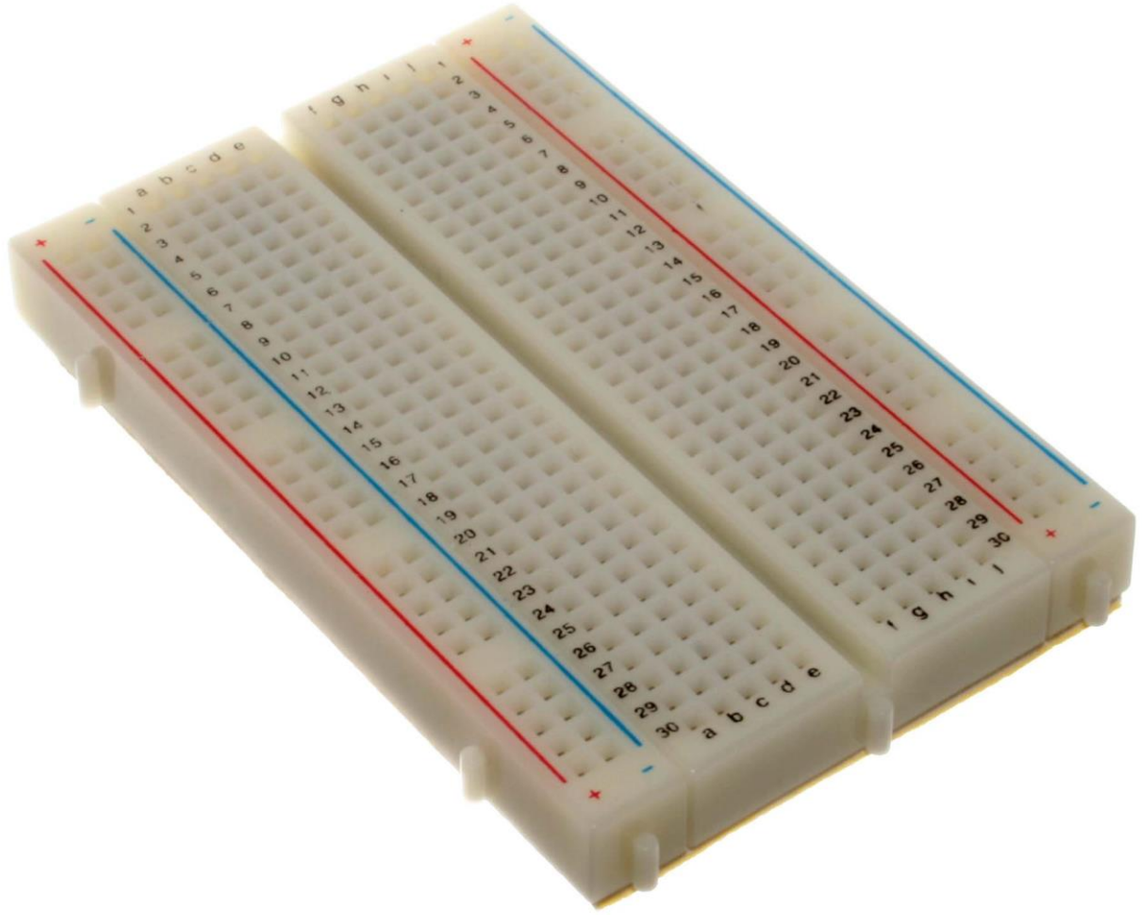
WHAT IS RASPBERRY PI?

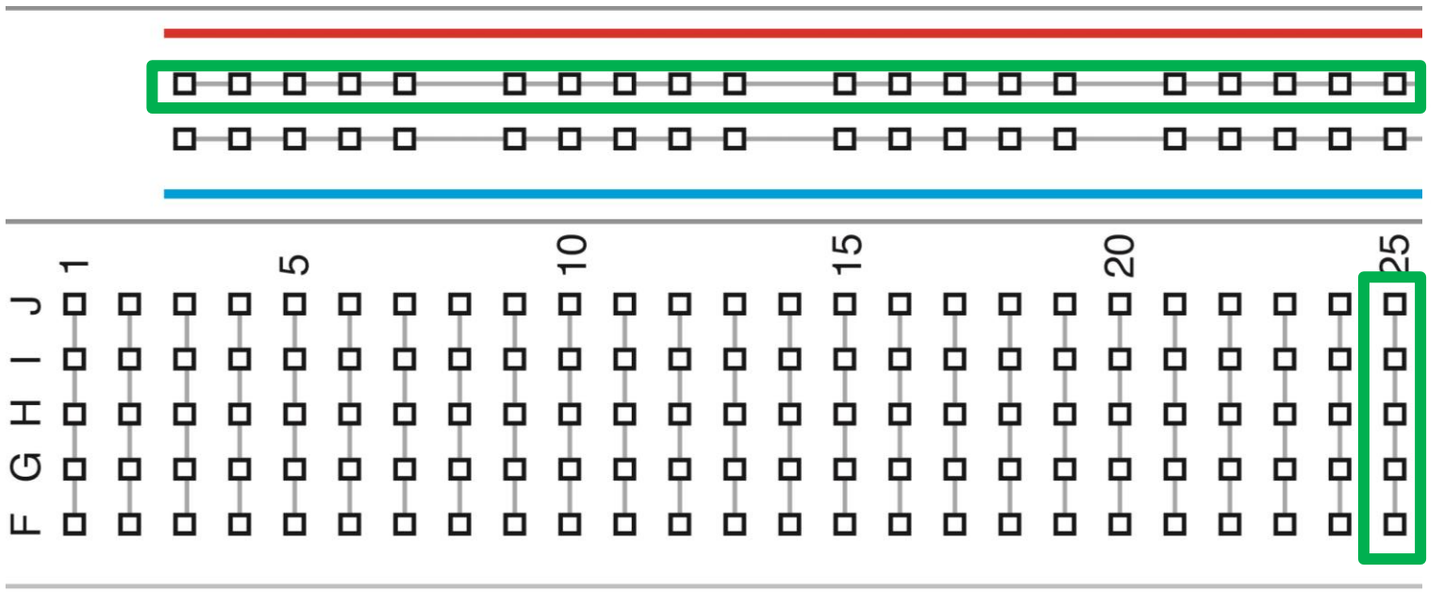


GPIO PIN CONVENTIONS



SOLDERLESS BREAD BOARD

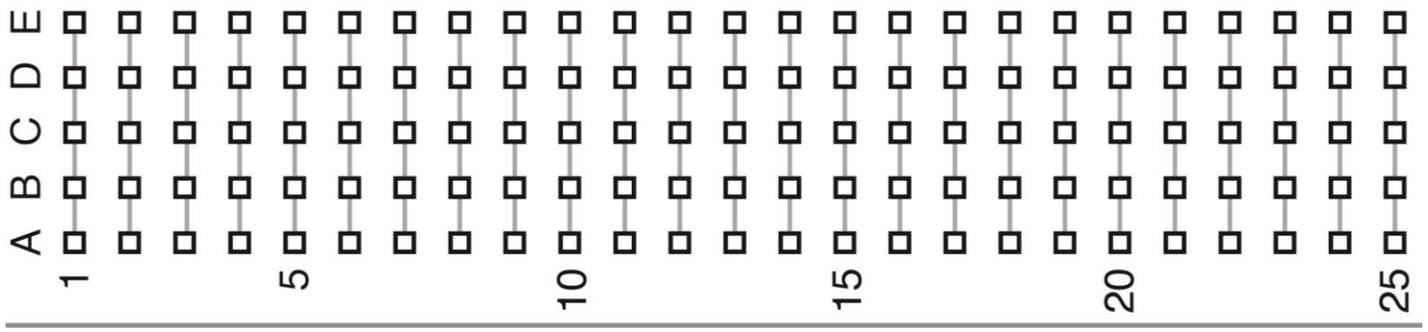




↙All the holes in this row are connected

↖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



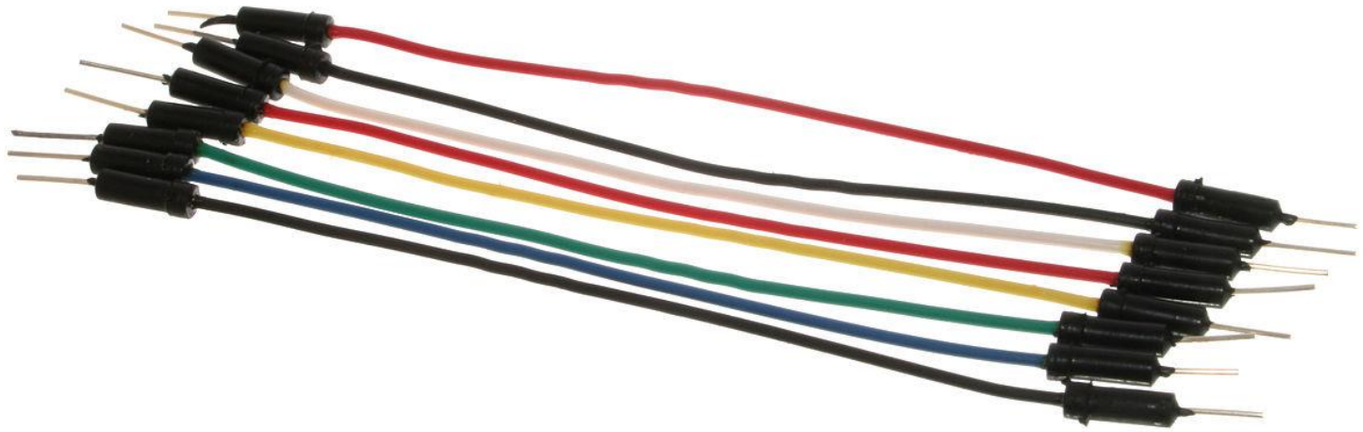
↙All the holes in this row are connected

↖All the holes in this row are connected

LIGHT-EMITTING DIODE (LED)

RESISTOR

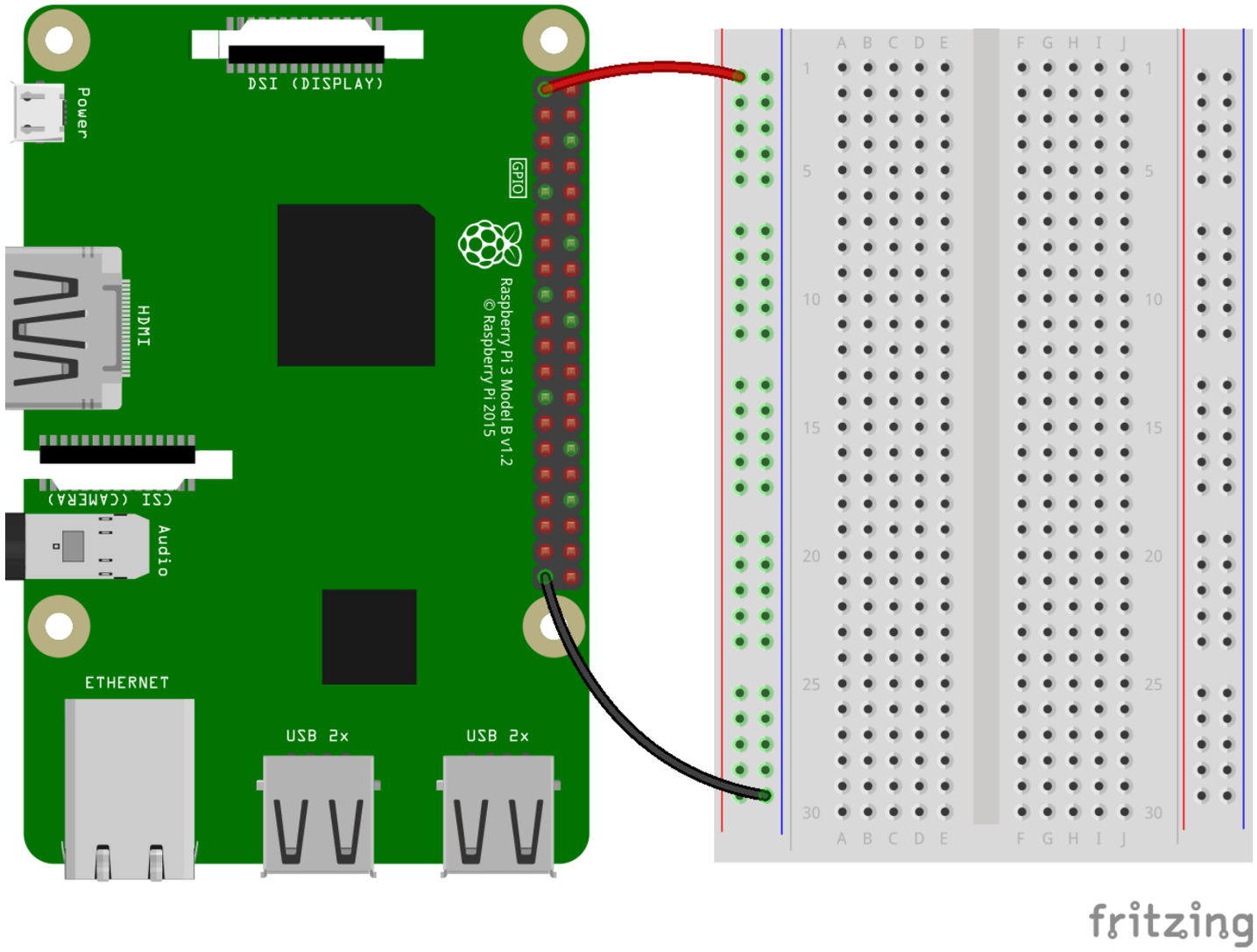
JUMPER WIRE



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

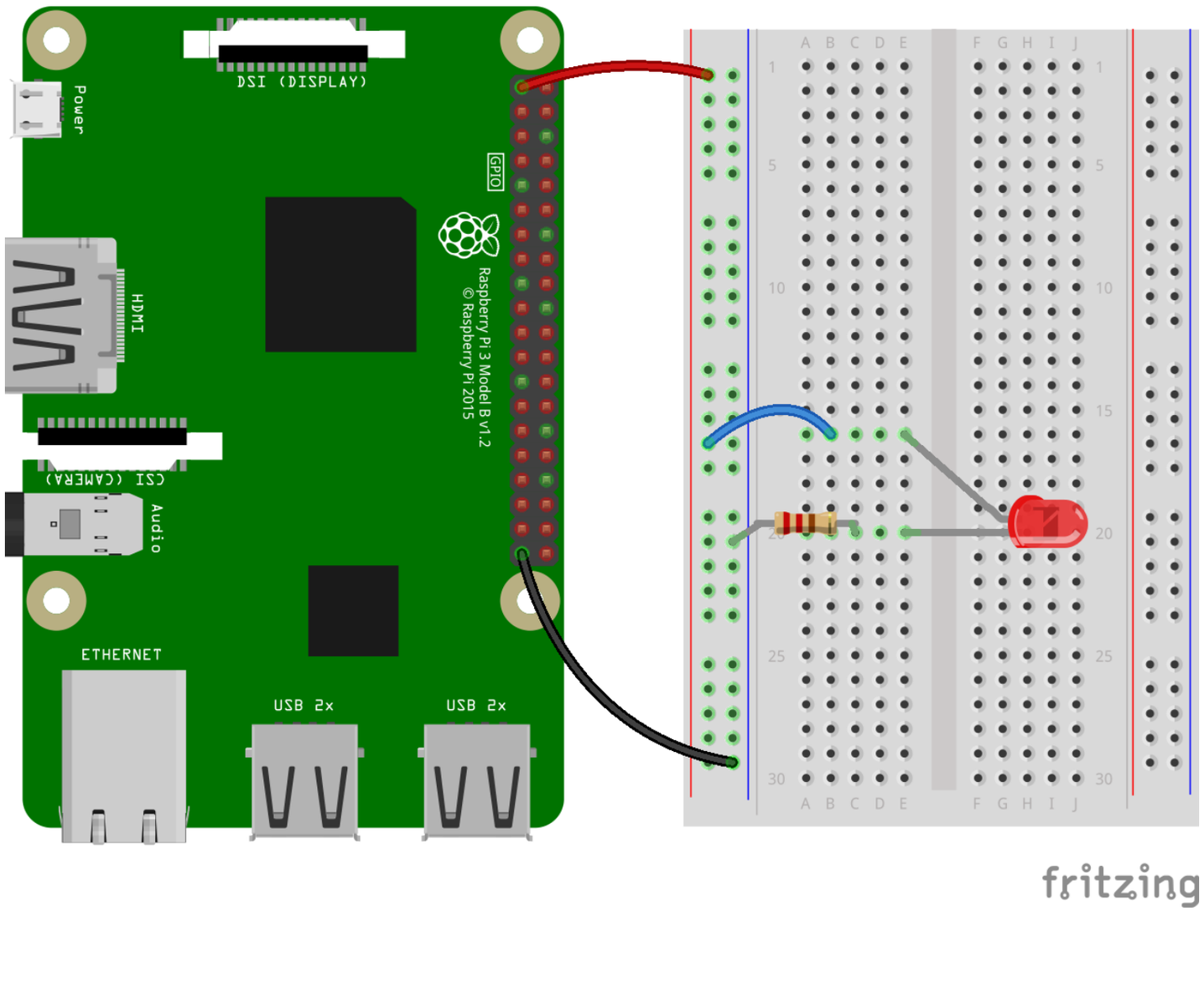
How to turn LED on?

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!

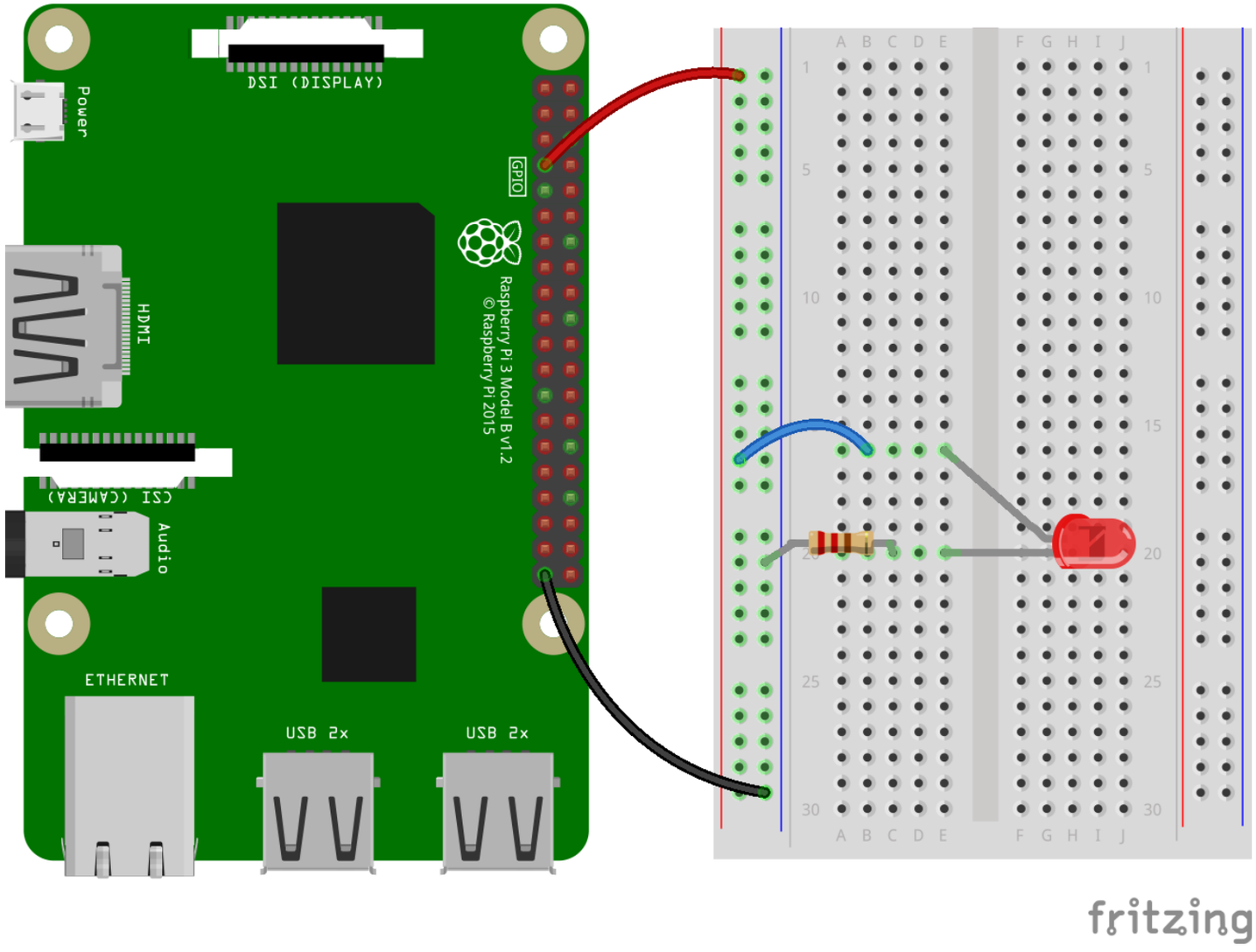


HANDS ON: LED

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)

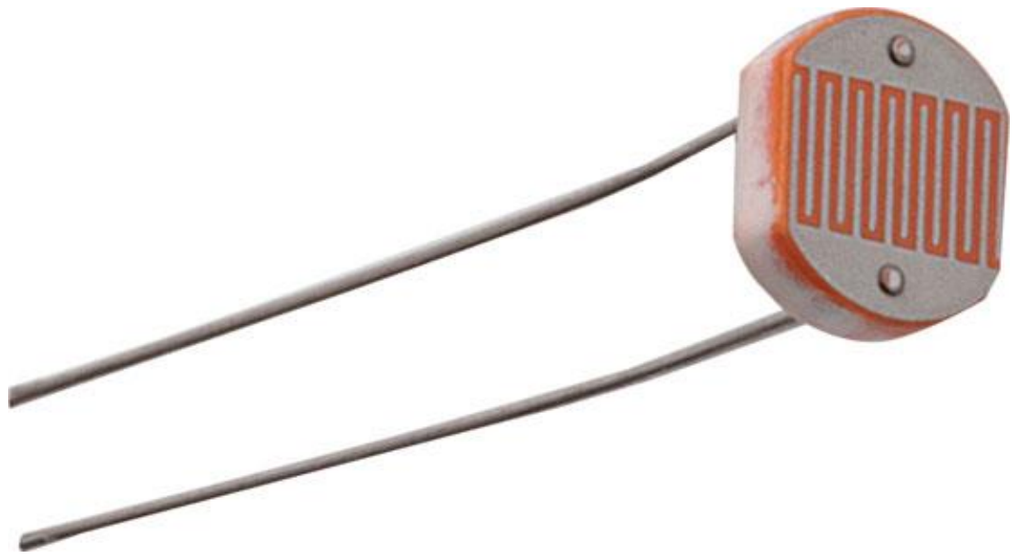
1. How to make LED blink continuously?
   (Hint: use a combination of sleep() and a while loop)

HANDS ON: LED

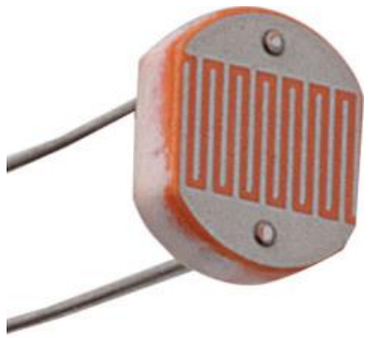
1. How to make LED blink 10 times?

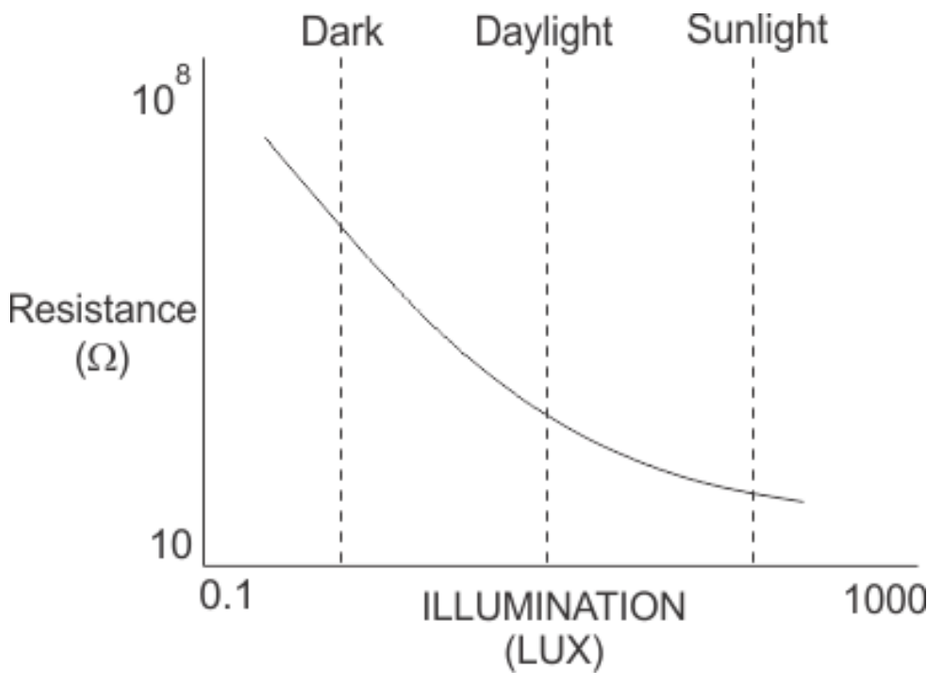
HANDS ON: LED

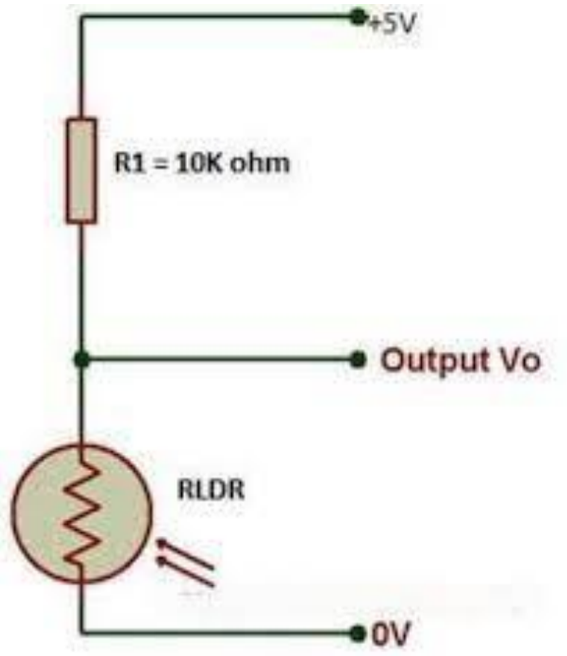
2. How to make LED blink continuously?



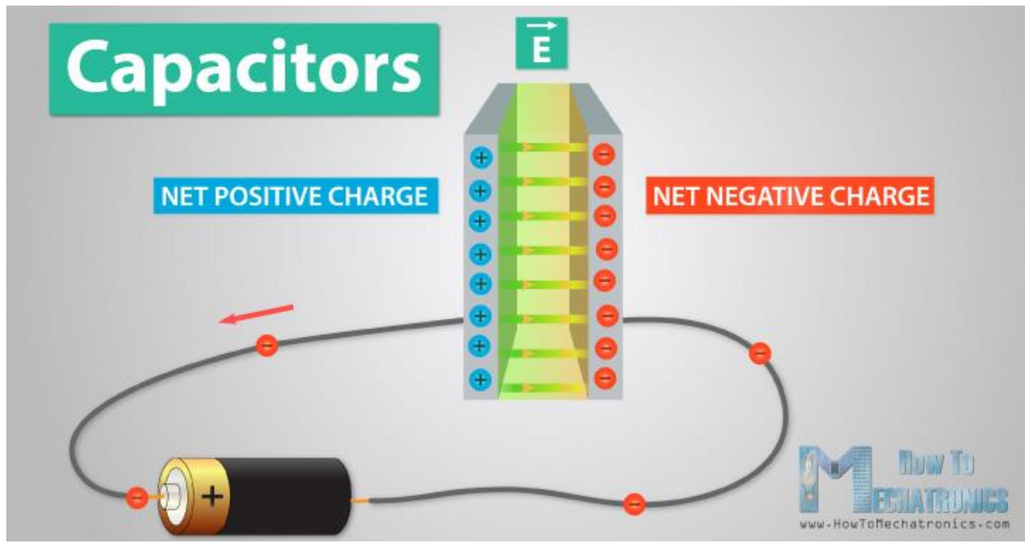
LIGHT DEPENDENT RESISTOR (LDR)

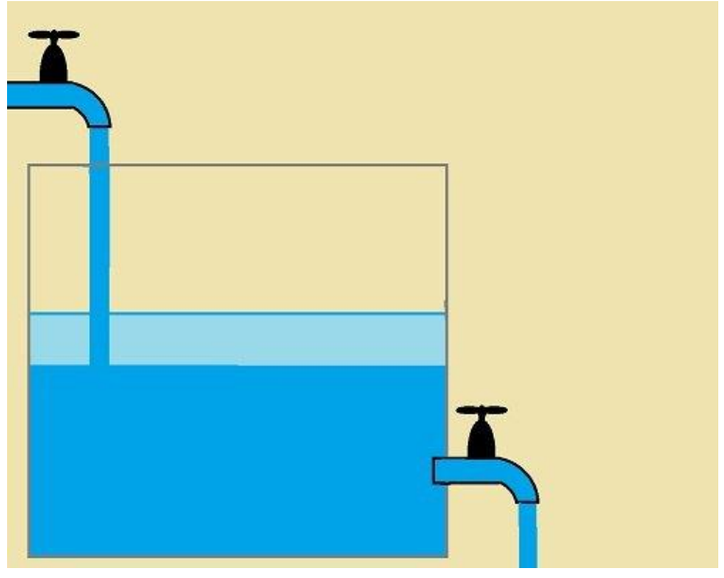


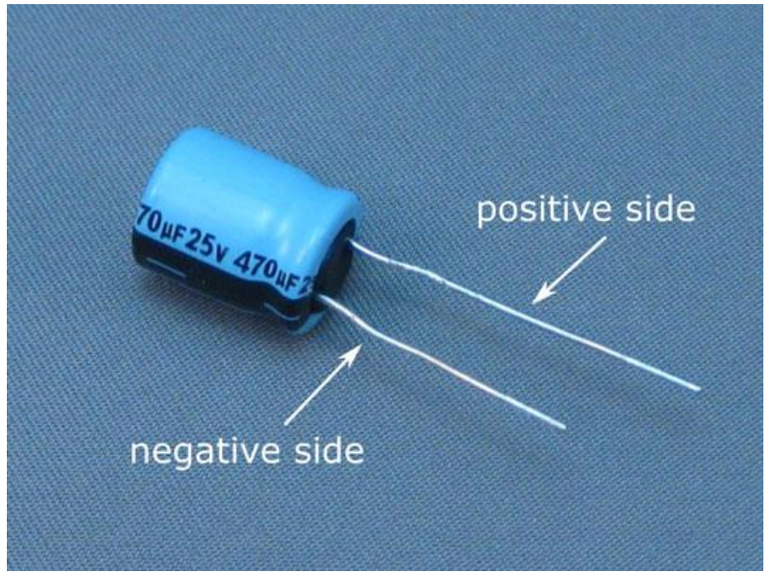

Dark
Daylight
Sunlight
10^8
Resistance
(Ω)
10
0.1
ILLUMINATION
(LUX)
1000


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

CAPACITOR


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

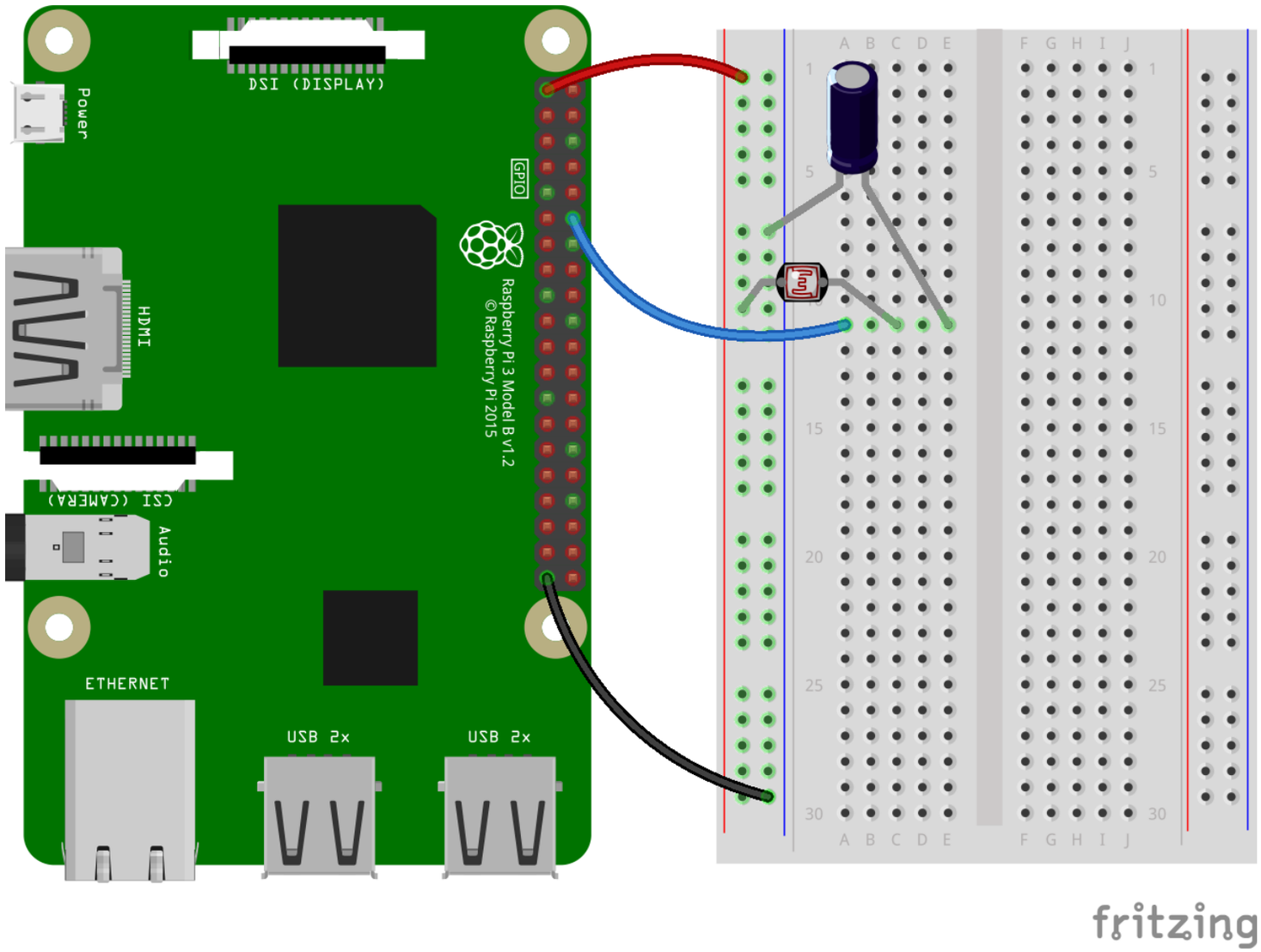



70uF 25v 470uF
positive side
negative side

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)

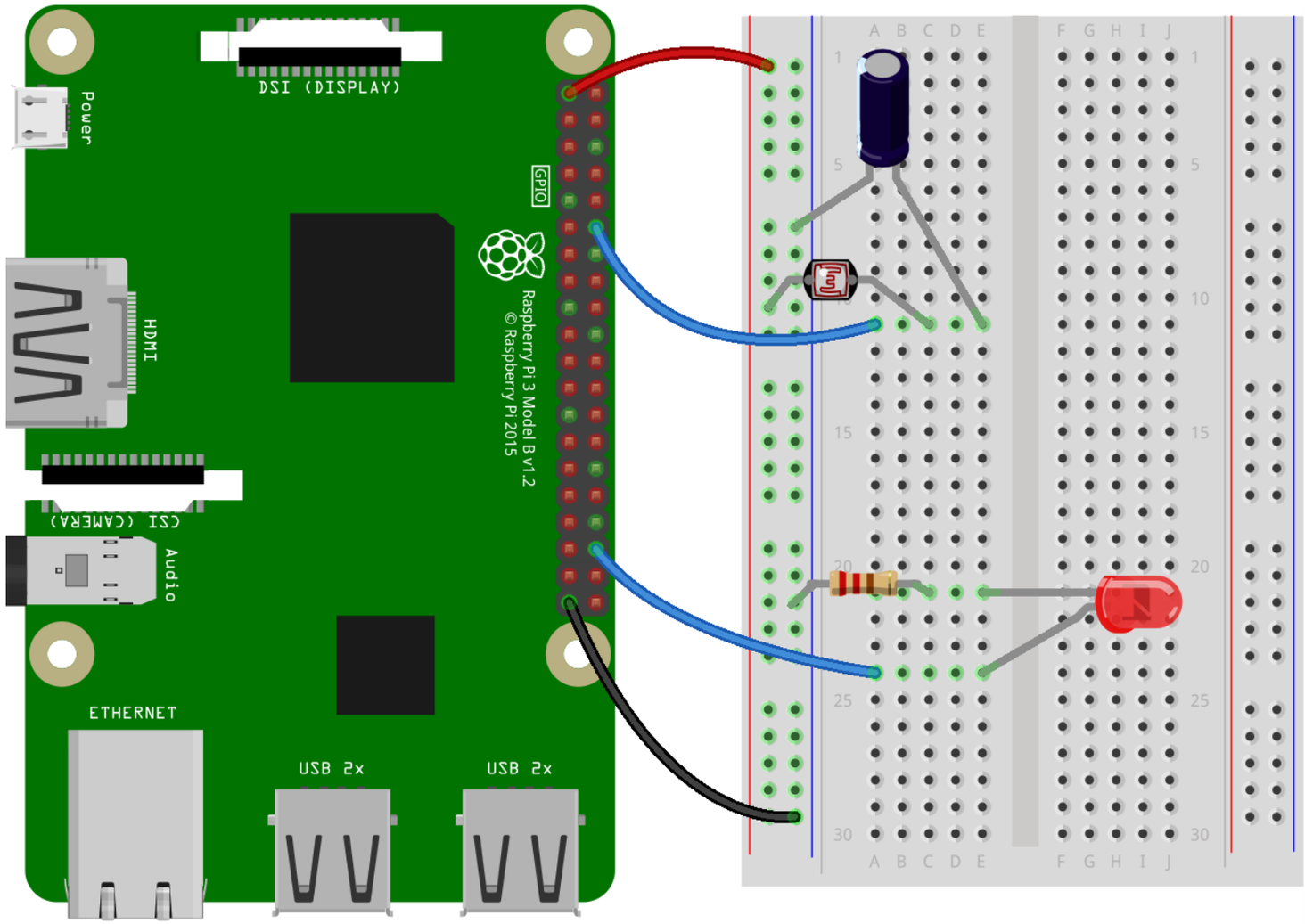
HANDS ON: LDR

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)

LUNCH BREAK

TELEGRAM BOT

TELEGRAM BOT

- Please refer to Create Telegram Bot Token.pdf on how to create a bot token
- Please refer to AI Chatbot Workshop.pdf

- For Advanced Students
  - Please refer to Telegram Bot Google App script google sheets.pdf

PANEL DISCUSSION

REFRESHER QUIZ

REFRESHER QUIZ

- Please go to www.menti.com
- Enter participant code: 46975104

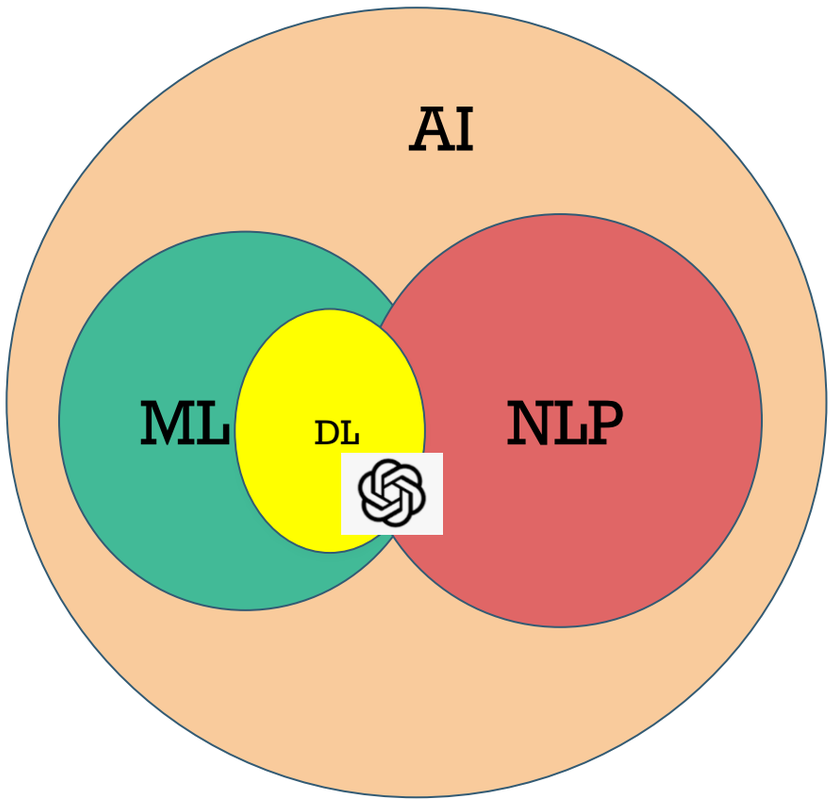
AI & SUSTAIN-A-BOT PRELUDE

AI & SUSTAIN-A-BOT

- We are going to introduce Artificial Intelligence tomorrow.
- By the end of tomorrow, you are going to craft a telegram bot that champions sustainability in Singapore. Your code has the power to make a real difference in shaping a greener, more resilient future for our city-state
- You can use all the concepts that have been covered during the workshop, i.e. Python, AI, Telegram Bot.
- What do you have in mind?

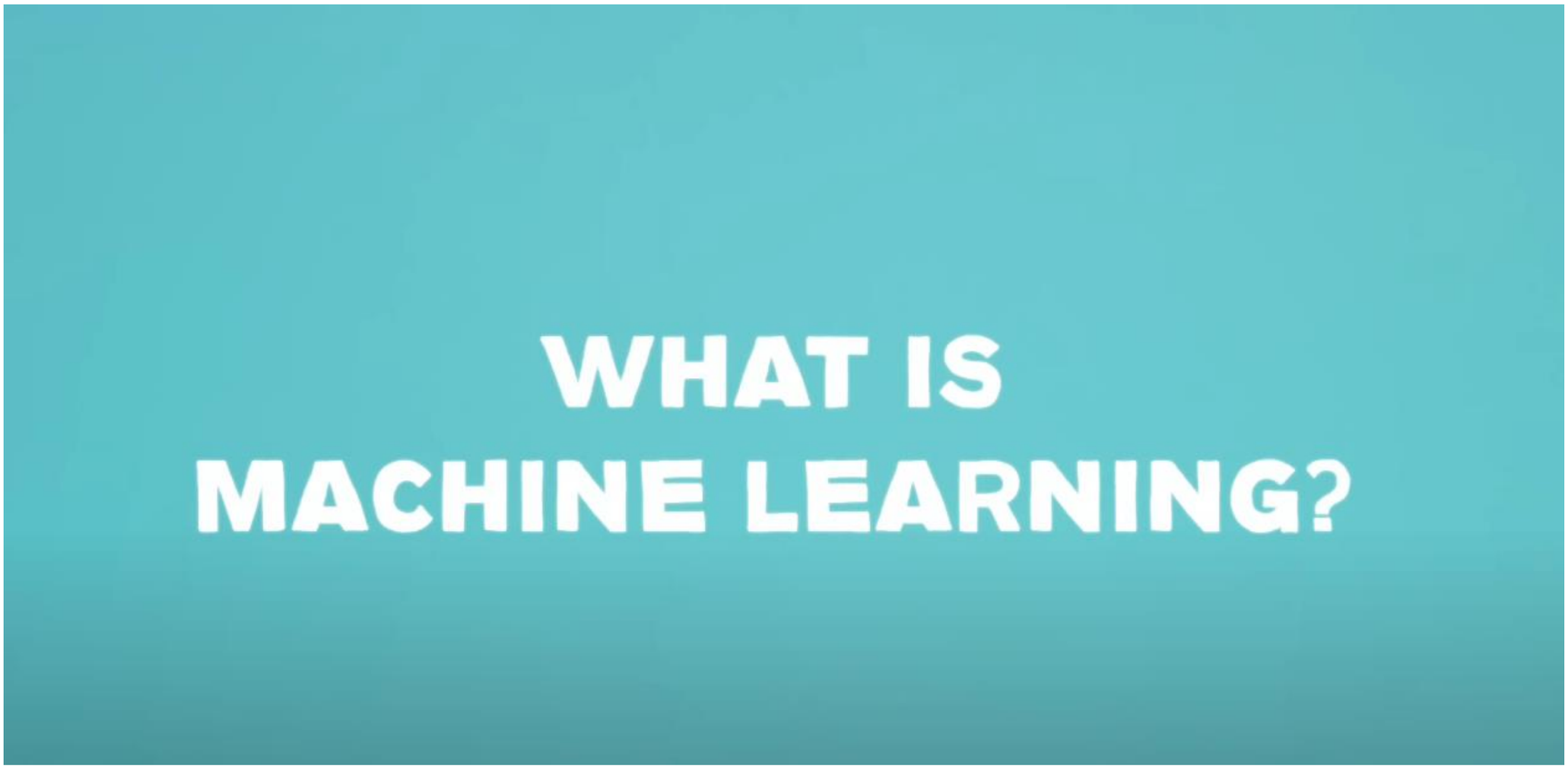
ARTIFICIAL INTELLIGENCE

DEMYSTIFY AI, ML, NLP, DL

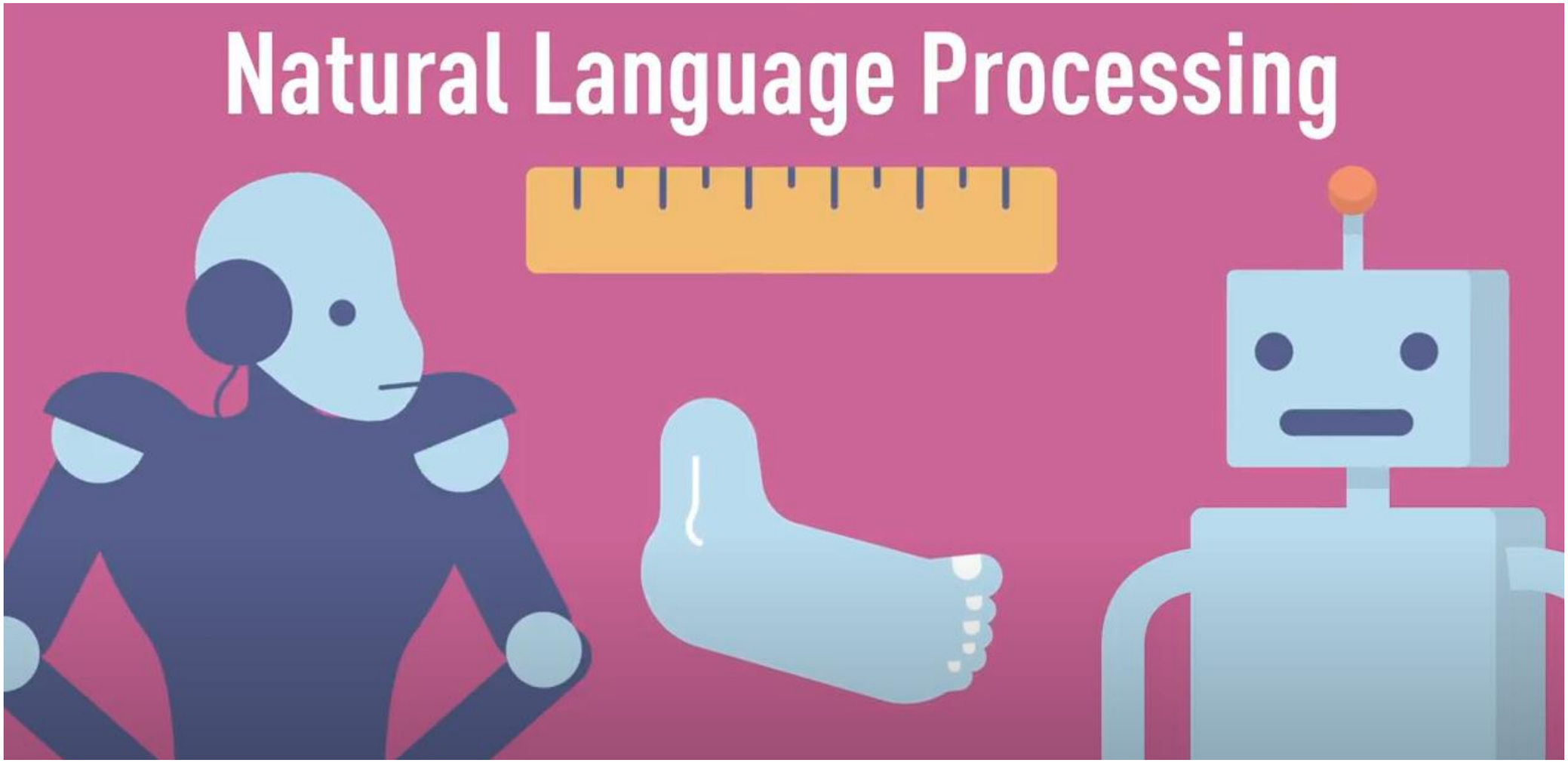


- Artificial Intelligence (AI) - broad discipline of creating *intelligent machines*.
- Machine Learning (ML) - systems that can learn from experience.
- Natural Language Processing (NLP) - systems that can understand human language.
- **Deep Learning (DL)** - systems that learn from experience on large data sets.

MACHINE LEARNING

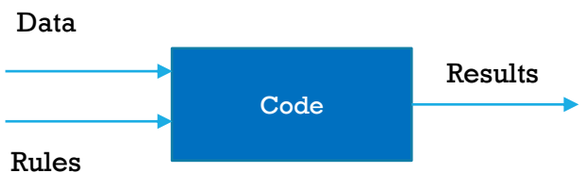


NATURAL LANGUAGE PROCESSING



LEARNING MODEL

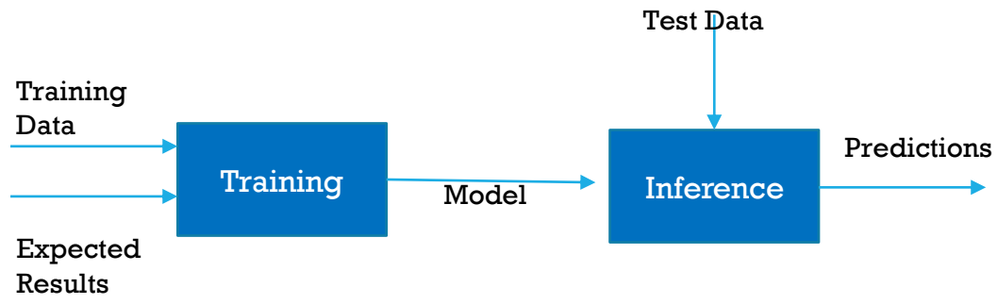
Traditional Programming




```
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")
```

- a and b are Data points
- Conditional logic check is the Rule
- "a is greater than b" is the output

Learning Model



Model is like an equation used to make predictions

For e.g. if our goal is to create an application which sees an image and classifies if it is a cat or a dog,

- We would pass tons of photos (*Training Data*) and its known types (*Expected Results*)
- Our Deep Learning code will create a *Model*
- When the Model sees a new image (*Test Data*) of an unknown type, it will run "*Inference*" to predict.

WHAT DO WE NEED TO BUILD THAT APP?

+

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- Python
- Math (little bit)

- Time
- *Deep Learning Platforms*

- Teamwork
- Imagination

FAMOUS DEEP LEARNING PLATFORMS

1. **TensorFlow** : Python, Javascript, C++, Java
2. Pytorch : Python
3. Keras : Python

What's the pattern?

WHAT WILL WE BUILD TODAY ?

Simple image classifier

Extend to “Save the environment” !

For e.g. On a sea beach, detect plastic bottles, pickup the bottle/mark the spot for future clean-up !

CONCEPTS

Train a model

Convert the model

To be able to run on other devices

Deploy the Pre-trained Model

On Google Collab

Step 1 Today

Inference or Prediction

Classify images

Step 2 Today

HANDS ON

Pre-requisite

- Refer to Google Colab notebook "MobileNet Image Classification"
- Please click File → Save a copy in Drive to enable editing

Test the code

1. Download any image from the internet
2. Put in the test folder
3. See if the model is able to classify the image.

Advanced Exploration

1. If an image's accuracy isn't too high, what can be the reasons ?
2. Try out the image classification on Telegram chatbot

BRING IT ALTOGETHER!

COLLAB NOTEBOOK READ-ONLY LINKS

- BertQnA
- Sentiment Analysis

Please click File → Save a copy in Drive to enable editing

LUNCH BREAK

SUSTAIN-A-BOT

SUSTAIN-A-BOT

- Craft a telegram bot that champions sustainability in Singapore. Your code has the power to make a real difference in shaping a greener, more resilient future for our city-state
- You can use all the concepts that have been covered during the workshop, i.e. Python, AI, Telegram Bot.
- You will have 70 mins to create your bot and 5 mins to present it.
- We will vote for the winners using our own telegram bot :)

CLOSING REMARKS