INTRODUCTION TO PROGRAMMING WITH PYTHON

THE UNIVERSITY of EDINBURGH
Centre for Data, Culture & Society

DATA CULTURE SOCIETY

WELCOME!

- Introductions
- Can everyone access Noteable?

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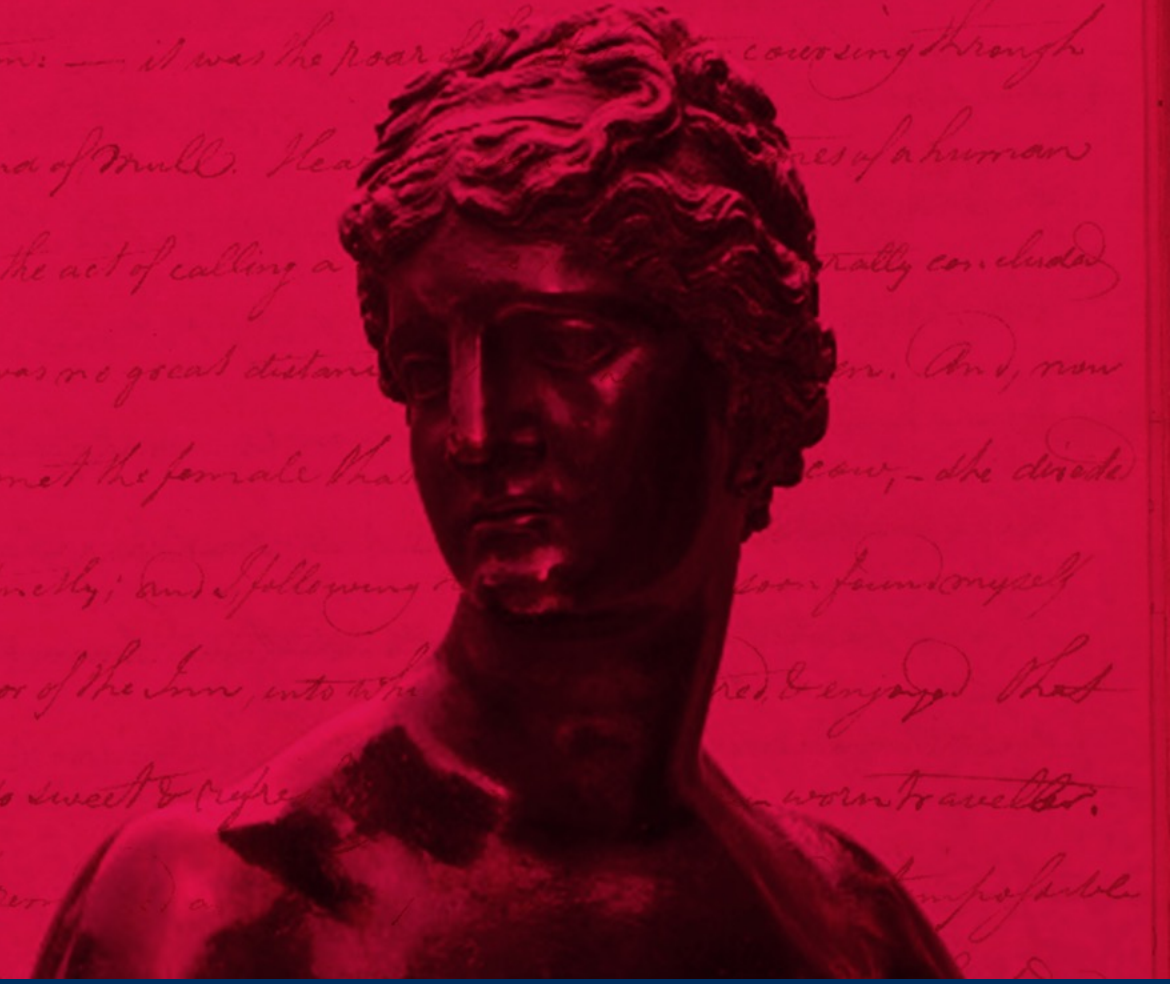
WEEK 1:
WRITING AND RUNNING CODE, CONDITIONS & LOGIC



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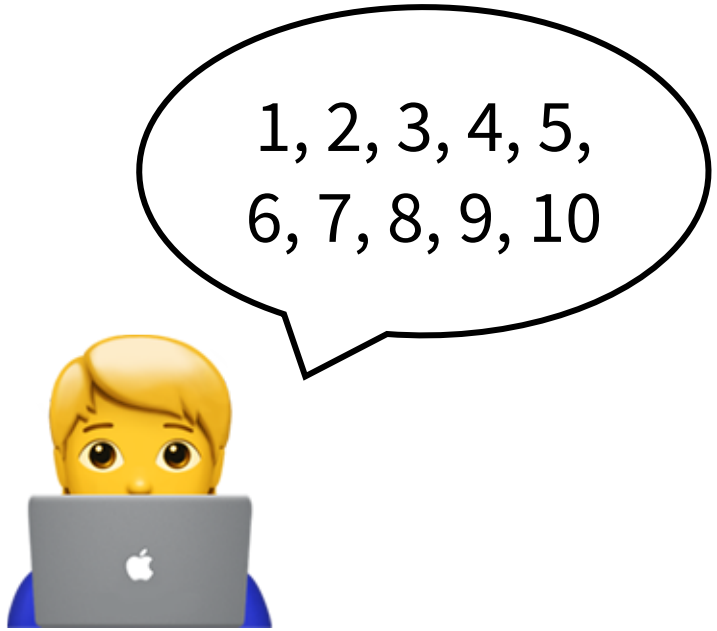
Programming = Telling the computer what to do

You need to speak a language the computer will understand, e.g., Python

Syntax

Count from 1 to 10.




```
for number in range(1,11):
    print(number)
```

```
1
2
3
4
5
6
7
8
9
10
```

2. There are **TEXT CELLS** like this one with explanations of concepts.
3. And **CODE CELLS** with Python code (see below). Code cells have a `In []` written to the left.
4. You can **RUN CODE CELLS** by clicking on them and pressing **Shirt + Enter**. When you run a cell code in it is run (it "happens", computer will do what
   appear underneath the cell.
   nd RUN code cells.

Jupyter Notebooks

✅ Remember to RUN ALL THE CELLS IN ORDER AS YOU GO THROUGH THIS NOTEBOOK (if you skip some, you might see some unexpected errors).

🎯 Learning objectives:

At the end of this badge you will know:

- How is code executed by Python.
- What are variables.
- That are variables types (string, int, float, bool), and how they impact on how code behaves e.g. 20 + 20 is different than "20"+"20".
- How to change variable types with Casting.
- How to ask user for some input.

➡ SOON SPOILER ALERT:

You will also understand these lines of code:

In [ ]:
```
# Remember - run all code cells from top to bottom as you go through notebook. (Shift + Enter)
# Lines starting with '#' are just comments, they output nothing when run.
```

In [ ]:
```
# Running code and printing things.
# Prints appear immediately under the cell.

print(3 + 1)
print(3 + 2)
print(3 + 3)
```

In [ ]:
```
# but Output/return of ONLY THE LAST LINE of code appears in the Out[ ]: section below your print.
# That's why printing is a nice way to know what's going on

2 + 1
2 + 2
2 + 3
```

Markdown cells

Code cells

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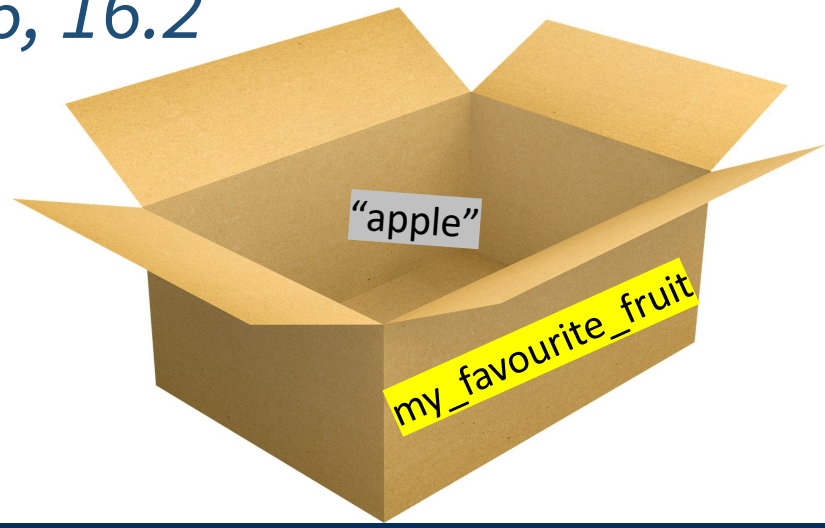
Code is written in **lines**. Each line does something, and they are **executed** from top to bottom.

```
count = 43
print(count)
count = 44
print(count)
```

Variables are places to store values for later. There are different types of variables:

- **string** for text, e.g., *"banana" or "I like Python"*
- **int** (integer) for whole numbers, e.g., *1, 5, 2014*
- **float** for decimal numbers, e.g., *2.25, 6.1246, 16.2*
- **bool** (Boolean) for logic values: *True, False*

```
my_favourite_fruit = "apple"
```



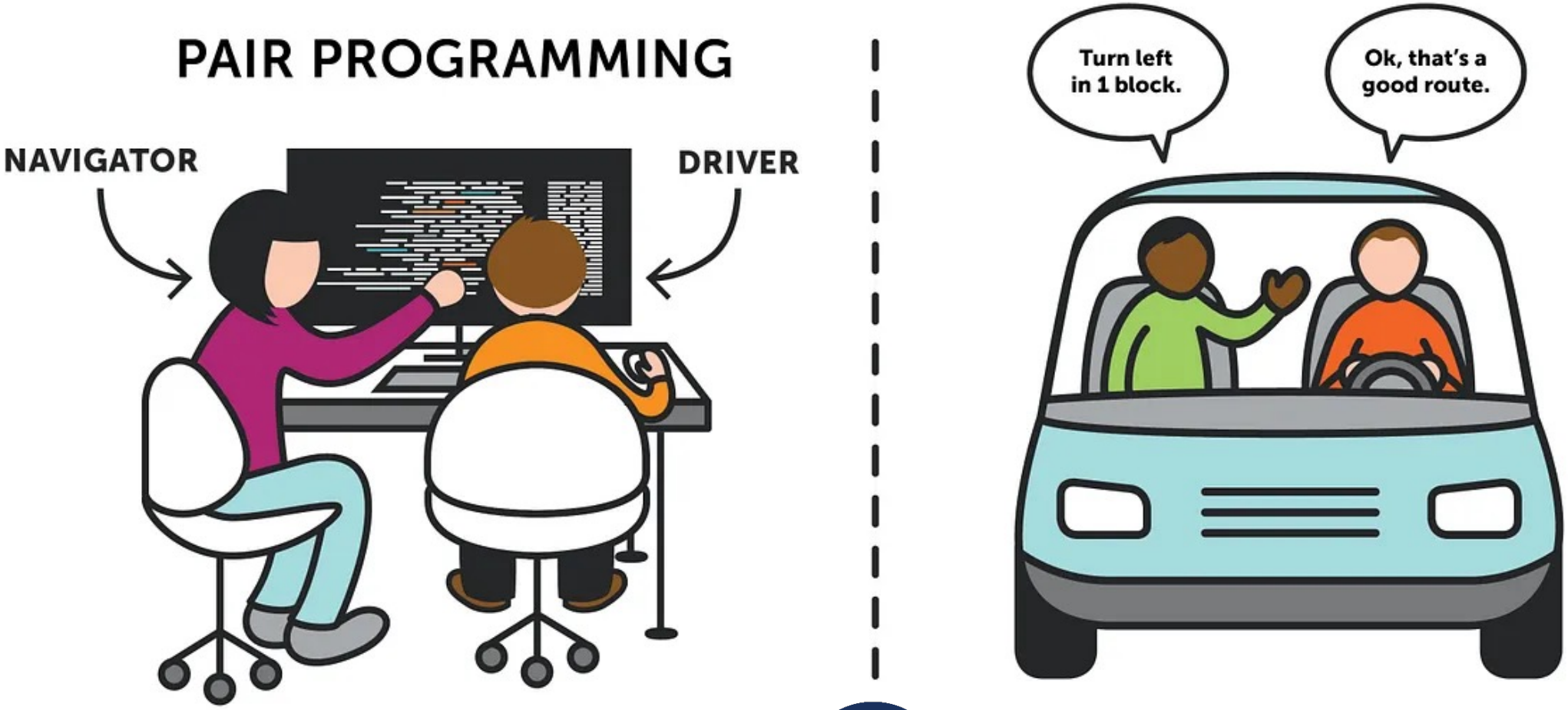


Image from https://medium.com/@tomspencer_uk/pair-programming-and-problem-solving-4531ef3bf171

Pair Programming

- find a partner
- switch driver & navigator roles regularly, e.g., after every task in the notebook
- you can work with the same partner throughout the course, or switch between sessions
- ask us for help! (yes, even for small things)

Let's get programming – Notebook 1a

https://noteable.edina.ac.uk/login

→ log in with your student/staff account

→ select Python 3 and start the server

→ click "+GitRepo" (top right) add the GitHub link below, and click "clone".

https://github.com/DCS-training/IntroToPython_2023

Comparing Variables

```
2 == 2                    True
2 == 3                    False

"apple" == "apple"        True
"apple" == "orange"       False
"apple" == "Apple"        False

”2023" == 2023            False
```

```
2 < 2       False
2 < 3       True
3 > 2       True
2 <= 2      True

3 != 2      True
3 != 3      False
```

Conditionals

- Controlling what part of your code gets executed based on conditions
- E.g., “If the traffic light is green, go, otherwise, wait.”

```
traffic_light = "green"

if traffic_light == "green":
    print('go')
else:
    print('wait')
```

```
go
```

```
traffic_light = "red"

if traffic_light == "green":
    print('go')
else:
    print('wait')
```

```
wait
```

Let's get programming:

Notebook 1b –

Conditions & Logic

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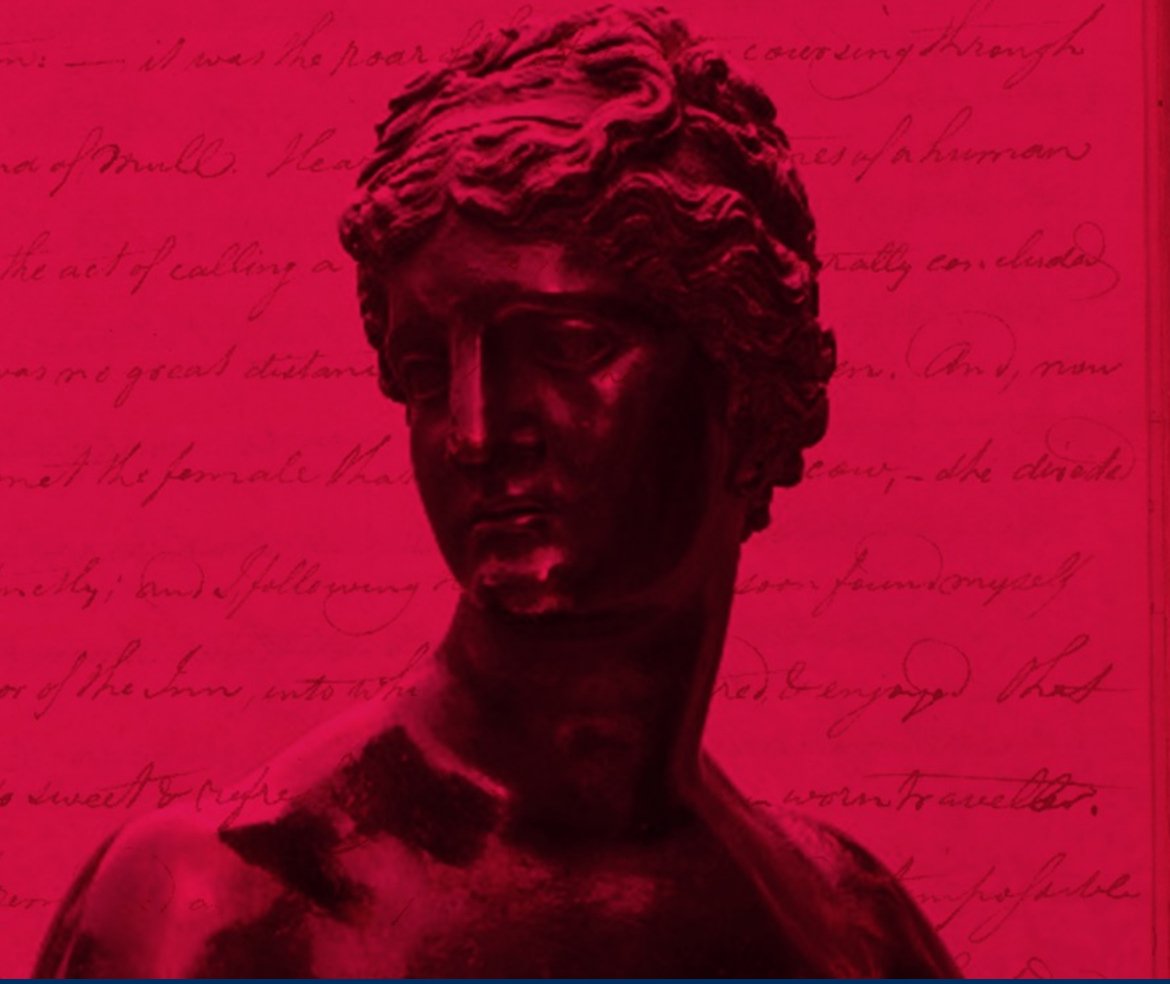
WEEK 2:
USING AND WRITING FUNCTIONS



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Welcome Back!

Whilst you are coming in, open up your web browser and load up Noteable:

https://noteable.edina.ac.uk/login
→ log in with your student/staff account
→ select Python 3 and start the server
→ from last week you should have all the files, if you do not then...

click "+GitRepo" (top right) add the GitHub link below, and click "clone".
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Welcome Back!

Chris Oldnall

Sarah Schöttler

Last week...

- Write and run,
- logic and conditionals.

...this week...

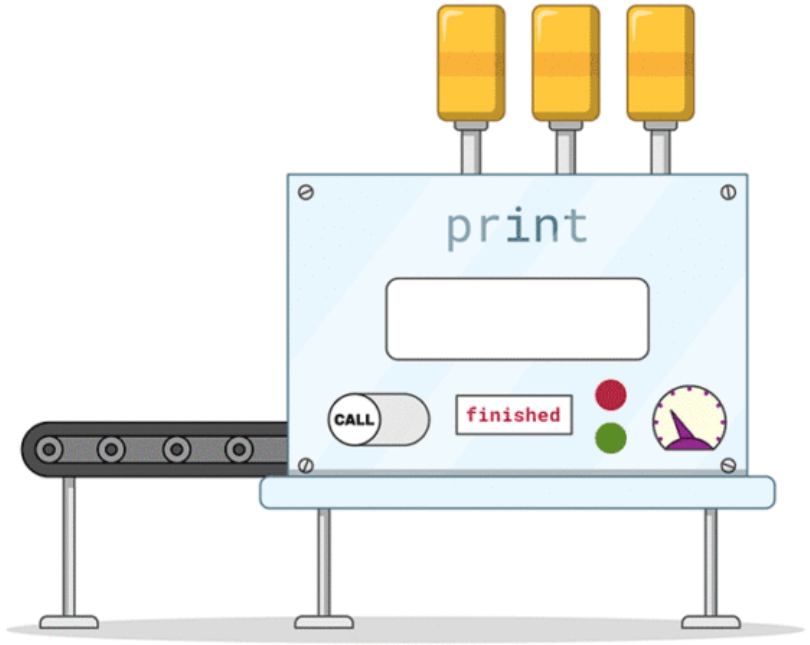
- Functions,
- and more functions!

1. What is a function?

2. Why do we use functions?

3. How do I make a function in Python?

1. What is a function?



1. What is a function?

A way to generalise a process that will need to be done over and over again.

2. Why do we use functions?

- Reduce lines of code,
- Enhance computing performance,
- Make life easier!

2. Why do we use functions?

3. How do I make a function in Python?

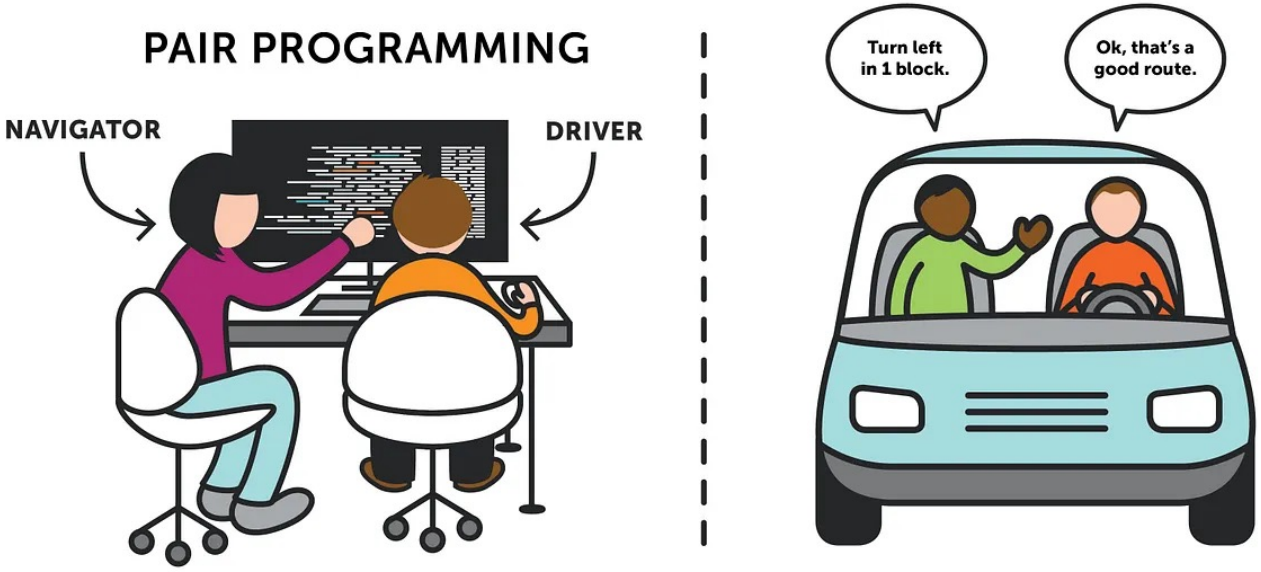
1. *'def'*
2. *Name*
3. *What goes into it (arguments)*
4. *What it does (the steps)*
5. *What it gives back (return value)*

```python
def bake_a_cake(cake_type, cake_size, cake_flavor, cake_filling, cake_frosting):
  """This function bakes a cake of the specified type, size, flavor, filling, and frosting.

  Args:
    cake_type: The type of cake to bake, e.g. "chocolate", "vanilla", "red velvet".
    cake_size: The size of the cake to bake, e.g. "small", "medium", "large".
    cake_flavor: The flavor of the cake to bake, e.g. "chocolate", "vanilla", "strawberry".
    cake_filling: The filling for the cake, e.g. "chocolate ganache", "vanilla buttercream", "strawberry jam".
    cake_frosting: The frosting for the cake, e.g. "chocolate ganache", "vanilla buttercream".

  Returns:
    A cake of the specified type, size, flavor, filling, and frosting.
  """

  print(f"Baking a {cake_type} {cake_size} {cake_flavor} cake...")

  # Prepare the cake batter
  # ...

  # Pour the batter into a cake pan
  # ...

  # Bake the cake
  # ...

  # Let the cake cool
  # ...

  # Fill the cake if specified
  if cake_filling:
    # Fill the cake
    # ...

  # Frost the cake if specified
  if cake_frosting:
    # Frost the cake
    # ...

  print("Cake is ready!")
  return f"{cake_type} {cake_size} {cake_flavor} cake with {cake_filling} and {cake_frosting}"
```

3. How do I make a function in Python?

Pair Programming – Reminder

- work with your partner from last week, or find someone new
- switch driver & navigator roles regularly, e.g., after every task in the notebook
- ask us for help!



Let's do some programming:

Session 2 –

Functions = superpowers.

Let's try imagining the ORDER in which code is executed, in cycles or steps.

In [ ]:
```
# Think about the order in which a computer needs to find answers to some questions.
# In order to then seek answers to other questions

# E.g. you need to know what int("20") is before you can add it to 20.
# And only once you add them you can print the result.

print( int("20") + 20)
```

In [ ]:
```
# Same here. As a human, which parts would you have to solve first?
# try to solve it before you run the code. What's the result you expect?

print( (20 + 50) / 7 == (1+4) * (9-7))
```

What is scope all about?

Local:
Only those close to him (within the same function) who know about what he can do.

Global:
Can be accessed by anyone, anywhere – everyone knows what he can do!

Rule 1: Anything inside a function is mysterious to the outside...
You are not able to peek inside of a function elsewhere in code. Only things returned will become available to the 'global' environment.

Rule 2: Functions can look outside, but shouldn't...
Things can get complicated when a function looks outside. We tackle this by carefully specifying arguments with relevant names.

Let's keep programming:

Session 2 –

Functions = superpowers.

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WEEK 3:
LISTS AND COLLECTIONS

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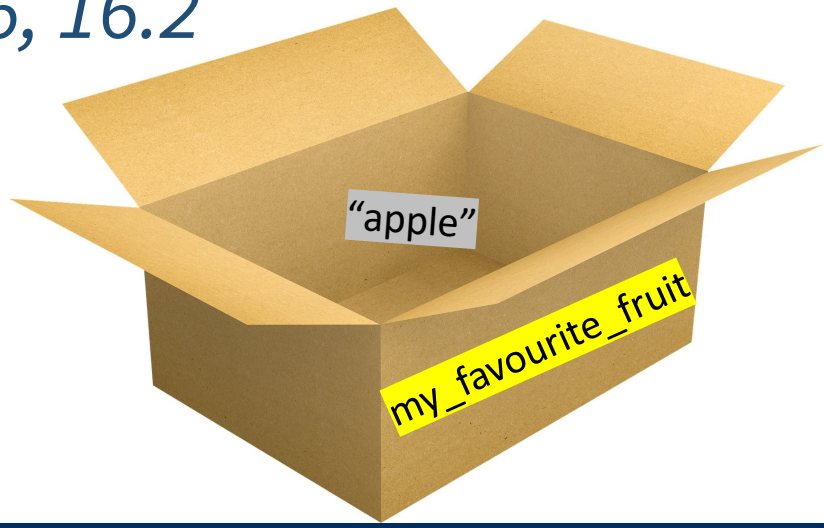
Recap: Variables

Variables are places to store values for later. There are different types of variables:

- **string** for text, e.g., *"banana" or "I like Python"*
- **int** (integer) for whole numbers, e.g., *1, 5, 2014*
- **float** for decimal numbers, e.g., *2.25, 6.1246, 16.2*
- **bool** (Boolean) for logic values: *True, False*

```
my_favourite_fruit = "apple"
```



Lists

```
planet0 = "Mercury"
planet1 = "Venus"
planet2 = "Earth"
planet3 = "Mars"
planet4 = "Jupyter"
planet5 = "Saturn"
planet6 = "Uranus”
```

```
planets = ["Mercury", "Venus", "Earth", "Mars", "Jupyter", "Saturn", "Uranus"]
```

Why use lists?

```
planets = ["Mercury", "Venus", "Earth", "Mars", "Jupyter", "Saturn", "Uranus"]
```

- ✅ Count how many items are in the list
- ✅ Check if a specific item is in the list
- ✅ Find the location of a specific item
- ✅ Add and remove items
- ✅ Sort (alphabetically or otherwise)

Pluto (not a planet)

Alternatives to lists

Tuple

```
planets = ("Mercury", "Venus", "Earth", "Mars", "Jupyter", "Saturn", "Uranus”)
```

- Uses **()** instead of **[]**
- Same as a list, except it **cannot be changed** after creating it

Set

```
planets = {"Mercury", "Venus", "Earth", "Mars", "Jupyter", "Saturn", "Uranus”}
```

- Uses **{}** instead of **[]** (*list*) or **()** (*tuple*)
- Same as a list, except:
  - Every item is unique (items cannot be listed twice)
  - Order does not matter and will change (no indexing)

Dictionaries

- Used to store multiple pieces of information about one thing
- Uses key-value pairs: each piece of data (value) has a label (key)

```
mercury = {“name”: “Mercury”, “day_length”: 59, “hottest_temp”: 430}
```

- Combining lists and dictionaries is useful for real-world data: We often have multiple pieces of information about lots of different things and want to work with all of it at the same time!

```
planets = [   {“name”: “Mercury”, “day_length”: 59, “hottest_temp”: 430},
              {“name”: “Venus”, “day_length”: 243.025, “hottest_temp”: 462},
              {“name”: “Earth”, “day_length”: 1, “hottest_temp”: 56.7},
              …
]
```

Pair Programming – Reminder

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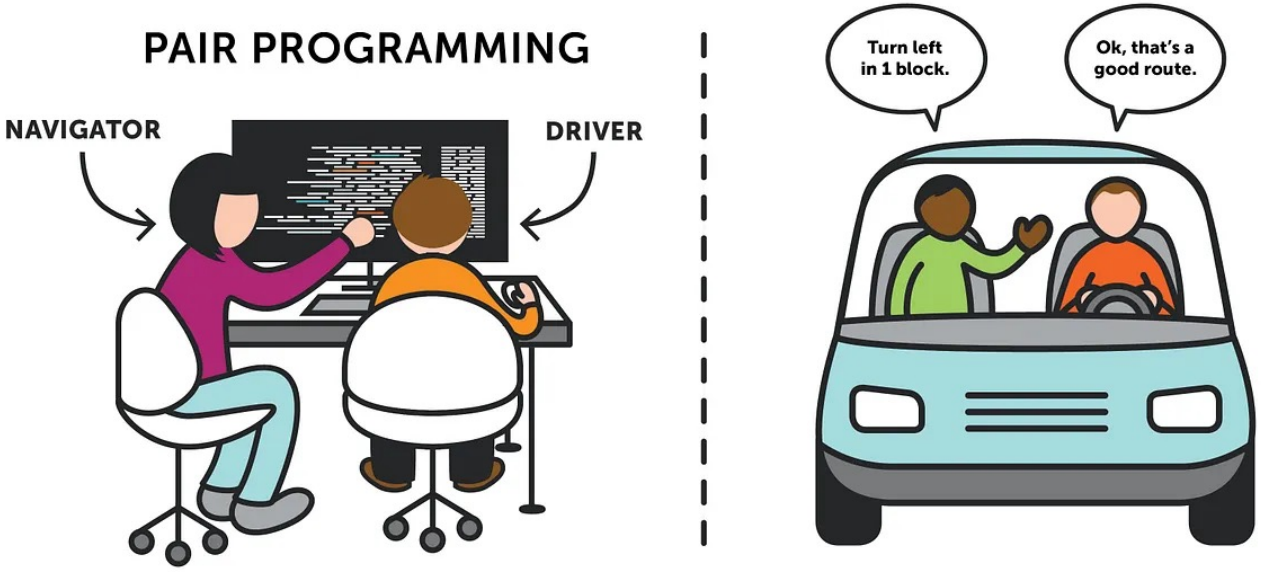

Let's get programming:

Session 3a –

Collections

What are list comprehensions?

How do I get someone to pick the shirts from the wardrobe?

1. Say that it is the shirts you want,
2. For each item of clothing, check if it is a shirt,
3. If it's a shirt, then take it out the wardrobe.

```
shirts = [
        item_of_clothing
        for item in wardrobe:
        if item == shirt
]
```

```
initial_list = [thing1, thing2, …]
variable_name = [
      <thing to get new list of>
      for item in initial_list:
      if item ==/>/< <some condition>
]
```

How do I get someone to pick the shirts from the wardrobe?

1. Say that it is the shirts you want,
2. For each item of clothing, check if it is a shirt,
3. If it's a shirt, then take it out the wardrobe.

Some maths functions that may come in handy...

- **max( ) / min()**
  Get the largest/smallest element in a group. For letters it will mean 'highest/lowest in the alphabet'.
- **len( )**
  Size of the collection, can be used on lists, dicts, but also on strings.
- **sum( )**
  Combine all elements. Just used for numbers.

Let's keep programming:

Session 3b –

List Comprehensions

Finishing up...

- How to import data
- Additional resources
- Feedback for us

How to import data

To import data there is a range of methods, the easiest is using the package 'pandas'

Eg.

```
import pandas as pd
data_frame = pd.read_csv("<Your File Pathway>")
```

Additional Resources

- This course used (slightly modified) notebooks from **Code Storytelling** (http://www.codestorytelling.com). We covered badges 1,2,4,5,7, and 8. Consider working through some more of the notebooks and watching some of the videos.

- **Think Python** is an introductory Python book with many exercises, free to read online: https://greenteapress.com/wp/think-python-2e/

Feedback for us...

- We hope you've enjoyed the course as much as we did.
- It is really useful for us to hear your feedback

https://forms.office.com/r/YYNrqvuNr8
Should be really quick and only take 5 mins (maximum!)

Thank you from us!

- Creating custom data visualizations with Observable notebooks & D3
- Making interactive web maps: Finding the right tool for you
- A Gentle Introduction to Causal Inference