digital skills programme

Introduction to

Part 2

Recap

- Variables
- Types
- Arithmetic operators
- Boolean logic
- Strings
- Printing
- Exercises

Agenda

- Lists
- Dictionaries
- Sets
- If Else
- Loops
- Functions
- Classes
- Exercises

Lists

- One of the most useful concepts
- Group multiple variables together (a kind of **container**!)

```
fruits = ["apple", "orange", "tomato", "banana"]  # a list of strings
print(type(fruits))
print(fruits)
```

```
<class 'list'>
['apple', 'orange', 'tomato', 'banana']
```

Indexing a list

- Indexing – accessing items within a data structure

```
fruits[2]
```

```
'tomato'
```

- Indexing a list is not very intuitive...
- The first element of a list has an **index 0**

Index:	0	1	2	3
List:	apple	orange	tomato	banana

Quick quiz

What will **fruits[3]** return?

```
fruits = ["apple", "orange", "tomato", "banana"]  # a list of strings
print(type(fruits))
print(fruits)
```

```
<class 'list'>
['apple', 'orange', 'tomato', 'banana']
```

Quick quiz

What will this return?

```
fruits[4]
```

```
---------------------------------------------------------------------------
IndexError                                Traceback (most recent call last)
<ipython-input-14-b8c91da6ba3a> in <module>()
----> 1 fruits[4]

IndexError: list index out of range
```

Data structure sizes

Make sure you are always aware of the sizes of each variable!

This can easily be done using the **len()** function.

It returns the length/size of any data structure

```
len(fruits)
```

```
4
```

Is a tomato really a fruit?

```
fruits[2] = "apricot"
print(fruits)
```

```
['apple', 'orange', 'apricot', 'banana']
```

Furthermore, we can modify lists in various ways

```
fruits.append("lime")    # add new item to list
print(fruits)
fruits.remove("orange")  # remove orange from list
print(fruits)
```

```
['apple', 'orange', 'apricot', 'banana', 'lime']
['apple', 'apricot', 'banana', 'lime']
```

Lists with integers

range() - a function that generates a sequence of numbers as a list

```
nums = list(range(10))
print(nums)
```

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

```
nums = list(range(0, 100, 5))
print(nums)
```

```
[0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85,
90, 95]
```

Slicing lists

- Slicing – obtain a particular set of sub-elements from a data structure.
- Very useful and flexible.

```
print(nums)
print(nums[1:5:2]) # Get from item 1(starting point) through item 5(end point, not included) with step size 2
print(nums[0:3]) # Get items 0 through 3(not included)
print(nums[4:]) # Get items 4 onwards
print(nums[-1]) # Get the last item
print(nums[::-1]) # Get the whole list backwards
```

```
[0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95]
[5, 15]
[0, 5, 10]
[20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95]
95
[95, 90, 85, 80, 75, 70, 65, 60, 55, 50, 45, 40, 35, 30, 25, 20, 15, 10, 5, 0]
```

Lists – helpful functions

- Makes them extremely useful and versatile

```
print(len(nums))   # number of items within the list
print(max(nums))   # the maximum value within the list
print(min(nums))   # the minimum value within the list
```

```
20
95
0
```

Lists can be of different types

- Not very useful, but possible

```
mixed = [3, "Two", True, None]
print(mixed)
```

```
[3, 'Two', True, None]
```

Mutability

Mutable object – can be changed after creation.

Immutable object - can **NOT** be changed after creation.

Quick quiz

- Are lists mutable?

Tuples

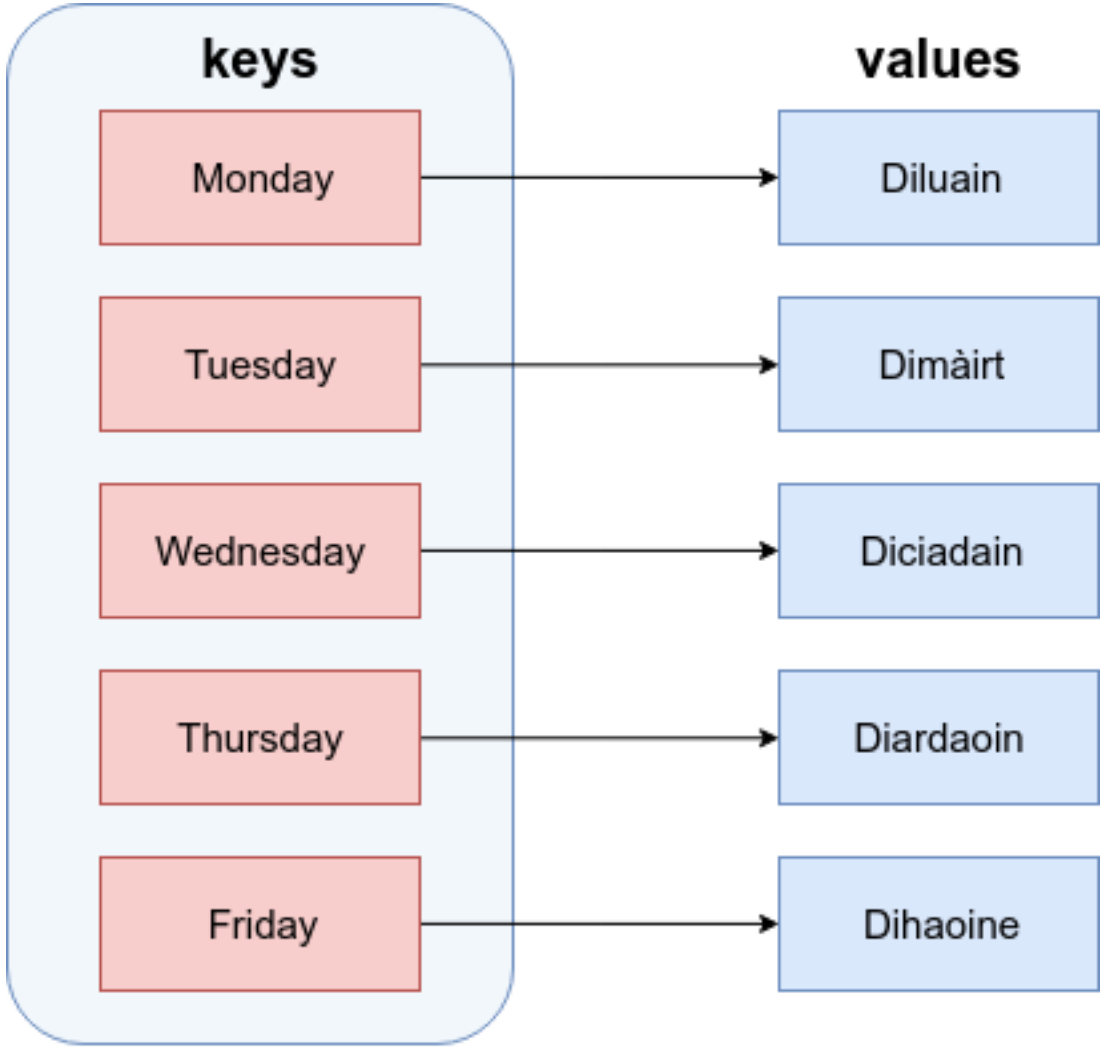
- Effectively lists that are immutable (I.e. can't be changed)

```
fruits = ("apple", "orange", "tomato", "banana")  # now the tomato is a fruit forever
print(type(fruits))
print(fruits)
```

```
<class 'tuple'>
('apple', 'orange', 'tomato', 'banana')
```

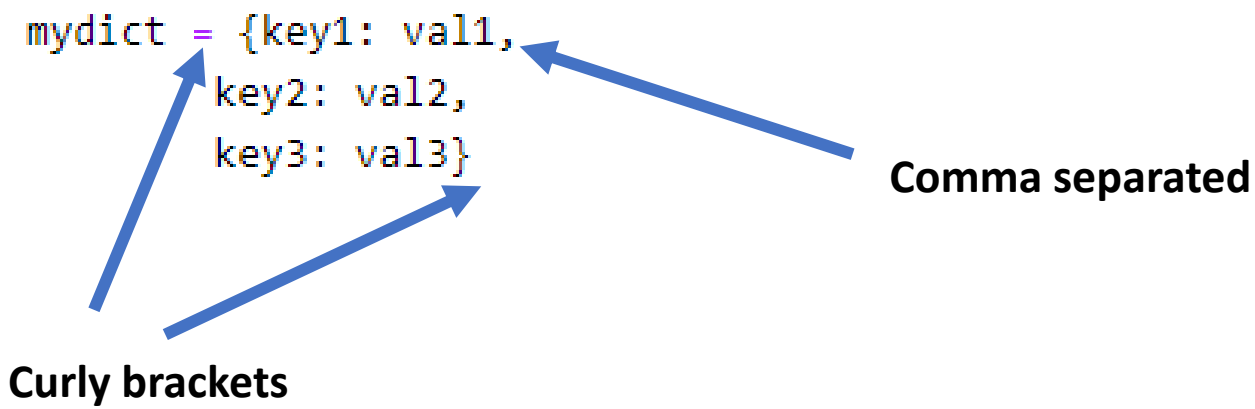
Dictionaries

- Similar to actual dictionaries
- They are effectively 2 lists combined – keys and values
- We use the keys to access the values instead of indexing them like a list
- Each value is mapped to a unique key



Dictionary definition

Defined as comma separated **key : value** pairs:



Dictionary properties

- Values are mapped to a key
- Values are accessed by their key
- Key are unique and are immutable
- Values cannot exist without a key

Dictionaries

Let us define the one from the previous image

```
days = {"Monday": "Diluain", "Tuesday": "Dimàirt",
        "Wednesday": "Diciadain", "Thursday": "Diardaoin",
        "Friday": "Dihaoine"}
print(type(days))
print(days)
```

```
<class 'dict'>
{'Monday': 'Diluain', 'Tuesday': 'Dimàirt', 'Wednesday': 'Diciadain',
'Thursday': 'Diardaoin', 'Friday': 'Dihaoine'}
```

Accessing a dictionary

Values are accessed by their keys (just like a dictionary)

```
days["Friday"]
```

```
'Dihaoine'
```

Note that they can't be indexed like a list

Altering a dictionary

Can be done via the dictionary methods

```
days.update({"Saturday": "Disathairne"})
print(days)
days.pop("Monday")  # Remove Monday because nobody likes it
print(days)
```

```
{'Monday': 'Diluain', 'Tuesday': 'Dimàirt', 'Wednesday': 'Diciadain',
'Thursday': 'Diardaoin', 'Friday': 'Dihaoine', 'Saturday': 'Disathairn
e'}
{'Tuesday': 'Dimàirt', 'Wednesday': 'Diciadain', 'Thursday': 'Diardaoi
n', 'Friday': 'Dihaoine', 'Saturday': 'Disathairne'}
```

Keys and Values

It is possible to obtain only the keys or values of a dictionary.

```
print(days.keys())   # get only the keys of the dictionary
print(days.values()) # get only the values of the dictionary
```

```
dict_keys(['Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday'])
dict_values(['Dimàirt', 'Diciadain', 'Diardaoin', 'Dihaoine', 'Disathai
rne'])
```

This is useful for iteration.

Sets

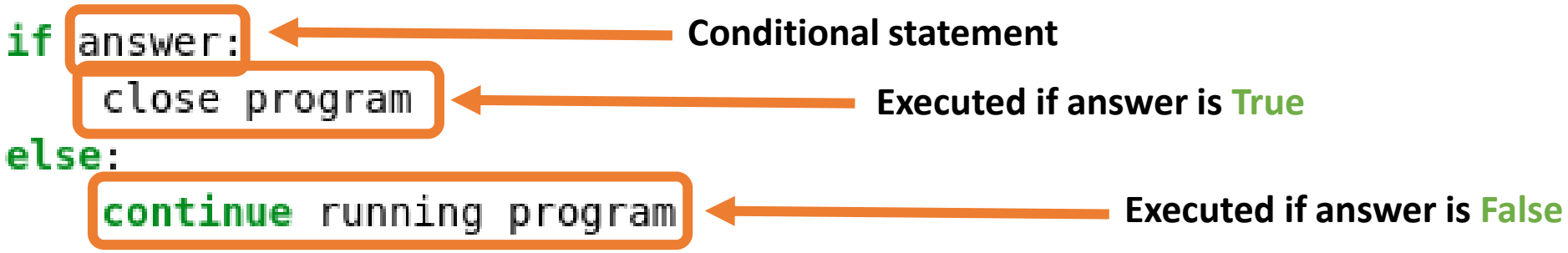
- Effectively lists that can't contain duplicate items
- Similar functionality to lists
- Can't be indexed or sliced
- Can be created with **{}** or you can convert a list to a set

```
x = set([1, 2, 3])  # a set created from a list
print(type(x))
print(x)
y = {1, 2, 3}       # a set created directly

x == y              # x and y are the same object
```

```
<class 'set'>
{1, 2, 3}

True
```

If Else

- Fundamental building block of software



If Else example

Try running the example below.
What do you get?

```
x = True
if x:
    print("Executing if")
else:
    print("Executing else")
print("Prints regardless of the outcome of the if-else block")
```

```
Executing if
Prints regardless of the outcome of the if-else block
```

Indentation matters!

- Code is grouped by its indentation
- Indentation is the number of whitespace or tab characters before the code.
- If you put code in the wrong block then you will get unexpected behaviour

```
x = 10
if x%2 == 0:
    print(x,'is even!')
    if x%5 == 0:
        print(x,'is divisible by 5!')
        print('Output only when x is divisible by both 2 and 5.')
    else:
        print(x,'is not divisible by 5!')
        print('Output only when x is divisible by 2 but not divisible by 5.')
else:
    print(x,'is odd!')
print('No indentation. Output in all cases.')
```

```
10 is even!
10 is divisible by 5!
Output only when x is divisible by both 2 and 5.
No indentation. Output in all cases.
```

Extending if-else blocks

- We can add infinitely more if statements using **elif**

```
if condition1:
    condition 1 was True
elif condition2:
    condition 2 was True
else:
    neither condition 1 or condition 2 were True
```

- elif = else + if which means that the previous statements must be false for the current one to evaluate to true

Bitcoin broker example

```
purchasePrice = float(input("Price at which you have purchased bitcoins: "))
currentPrice = float(input("Current price of the bitcoins: "))

if currentPrice < purchasePrice*0.9:
    print("Not a good idea to sell your bitcoins now.")
    print("You will lose", purchasePrice - currentPrice, "£ per bitcoin.")
elif currentPrice > purchasePrice*1.2:
    print("You will make", currentPrice - purchasePrice, "£ per bitcoin.")
else:
    print("Not worth selling right now.")
```

Quick quiz

- What would happen if both conditions are True?

```
purchasePrice = float(input("Price at which you have purchased bitcoins: "))
currentPrice = float(input("Current price of the bitcoins: "))

if (currentPrice > purchasePrice*0.9):
    print("Not a good idea to sell your bitcoins now.")
    print("You will lose", purchasePrice - currentPrice, "£ per bitcoin.")
elif (currentPrice > purchasePrice*1.2):
    print("You will make", currentPrice - purchasePrice, "£ per bitcoin.")
else:
    print("Not worth selling right now.")
```

For loop

- Allows us to iterate over a set amount of variables within a data structure. During that we can manipulate each item however we want

```
for item in itemList:
    do something to item
```

- Again, indentation is important here!

Example

- Say we want to go over a list and print each item along with its index

```
fruits = ["apple", "orange", "tomato", "banana"]
print("The fruit", fruits[0], "has index", fruits.index(fruits[0]))
print("The fruit", fruits[1], "has index", fruits.index(fruits[1]))
print("The fruit", fruits[2], "has index", fruits.index(fruits[2]))
print("The fruit", fruits[3], "has index", fruits.index(fruits[3]))
```

```
The fruit apple has index 0
The fruit orange has index 1
The fruit tomato has index 2
The fruit banana has index 3
```

- What if we have much more than 4 items in the list, say, 1000?

For example

- Now with a for loop

```
fruitList = ["apple", "orange", "tomato", "banana"]
for fruit in fruitList:
    print("The fruit", fruit, "has index", fruitList.index(fruit))
```

```
The fruit apple has index 0
The fruit orange has index 1
The fruit tomato has index 2
The fruit banana has index 3
```

- Saves us writing more lines
- Doesn't limit us in term of size

Numerical for loop

```
numbers = list(range(10))
for num in numbers:
    squared = num ** 2
    print(num, "squared is", squared)
```

```
0 squared is 0
1 squared is 1
2 squared is 4
3 squared is 9
4 squared is 16
5 squared is 25
6 squared is 36
7 squared is 49
8 squared is 64
9 squared is 81
```

While loop

- Another useful loop. Similar to the for loop.
- A while loop doesn't run for a predefined number of iterations, like a for loop. Instead, it stops as soon as a given condition becomes true/false.

```
n = 0
while n < 5:
    print("Executing while loop")
    n = n + 1

print("Finished while loop")
```

```
Executing while loop
Executing while loop
Executing while loop
Executing while loop
Executing while loop
Finished while loop
```

Break statement

- Allows us to go(break) out of a loop preliminary.
- Adds a bit of controllability to a while loop.
- Usually used with an if.
- Can also be used in a for loop.

Quick quiz

How many times are we going to execute the while loop?

```
n = 0
while True:  # execute indefinitely
    print("Executing while loop")

    if n == 5:  # stop loop if n is 5
        break

    n = n + 1

print("Finished while loop")
```

```
Executing while loop
Executing while loop
Executing while loop
Executing while loop
Executing while loop
Executing while loop
Executing while loop
Finished while loop
```

Functions

- Allow us to package functionality in a nice and readable way
- reuse it without writing it again
- Make code modular and readable
- Rule of thumb - if you are planning on using very similar code more than once, it may be worthwhile writing it as a reusable function.

Function declaration

keyword

Any number of arguments

```
def functionName(argument1, argument2, argument3, ... argumentN):
    statments..
    ..
    ..

    return returnValue
```

[Optional] Exits the function and returns some value

- Functions accept arguments and execute a piece of code
- Often they also return values (the result of their code)

Function example

```
def printNum(num):
    print("My favourite number is", num)

printNum(7)
printNum(14)
printNum(2)
```

```
My favourite number is 7
My favourite number is 14
My favourite number is 2
```

Function example 2

We want to make a program that rounds numbers up or down.

Try to pack the following into a function.

```
x = 3.4
remainder = x % 1
if remainder < 0.5:
    print("Number rounded down")
    x = x - remainder
else:
    print("Number rounded up")
    x = x + (1 - remainder)

print("Final answer is", x)
```

```
Number rounded down
Final answer is 3.0
```

Function example 2

```
def roundNum(num):
    remainder = num % 1
    if remainder < 0.5:
        return num - remainder
    else:
        return num + (1 - remainder)

# Will it work?
x = roundNum(3.4)
print (x)

y = roundNum(7.7)
print(y)

z = roundNum(9.2)
print(z)
```

```
3.0
8.0
9.0
```

Function example 3

$$(val - src[0]) \times \frac{dst[1] - dst[0]}{src[1] - src[0]} - dst[0]$$

```
# Generic scale function
# Scales from src range to dst range
def scale(val, src, dst=(-1,1)):
    return (int(val - src[0]) / (src[1] - src[0])) * (dst[1] - dst[0]) + dst[0]

print(scale(49, (-100,100), (-50,50)))
print(scale(49, (-100,100)))
```

```
24.5
0.49
```

Python built-in functions

		Built-in Functions		
abs()	dict()	help()	min()	setattr()
all()	dir()	hex()	next()	slice()
any()	divmod()	id()	object()	sorted()
ascii()	enumerate()	input()	oct()	staticmethod()
bin()	eval()	int()	open()	str()
bool()	exec()	isinstance()	ord()	sum()
bytearray()	filter()	issubclass()	pow()	super()
bytes()	float()	iter()	print()	tuple()
callable()	format()	len()	property()	type()
chr()	frozenset()	list()	range()	vars()
classmethod()	getattr()	locals()	repr()	zip()
compile()	globals()	map()	reversed()	__import__()
complex()	hasattr()	max()	round()	
delattr()	hash()	memoryview()	set()	

To find out how they work: https://docs.python.org/3.3/library/functions.html

Classes

- Important for programming
- Useful, but more advanced
- Will not be taught here due to time limitations .. but there are explanations and examples in the notebooks

Further reading

- LinkedIn Learning:
- Python Essentials Training – more detailed; good if you want to use your own environment – https://www.linkedin.com/learning/python-essential-training-2/welcome?u=50251009&auth=true
- Python for Data Science – continues this course; taught with Jupyter Notebooks as well – https://www.linkedin.com/learning/python-for-data-science-essential-training-part-1/data-science-life-hacks?u=50251009&auth=true
- Python Crash Course book – more detailed; more exercises
- Python Data Analysis – O'Reilly press
- PEP 8 style: https://www.python.org/dev/peps/pep-0008/

Exercise time

- Cool exercises that can test your knowledge (notebooks 2 and 3)
- There is checking code which checks if you have completed your task. Please don't modify it.
- You can also do your exercises at home (Noteable is accessible from everywhere)
- Google is your best friend when coding
- Extra notebook available with advanced exercises