Recapping Python from Year One

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Hello

Hello (1)

Learning Outcomes

1. Understand the basic concepts of the Python programming language
2. Demonstrate knowledge learnt by creating simple Python scripts

Using Python

Using Python (1)

- Python 3.x is the language of choice for this module
  - the simple nature of Python makes it a great programming language for beginners
  - it is cross-platform and works across all major operating systems
- Requires an installation of Python
  - Windows: Download the Executable Here
  - Linux: `sudo apt install python3`
  - macOS: Download the Installer Here

Using Python (2)

macOS and Linux

- Typing `python3` into the terminal window will call the Python interpreter

```
$ python3 filename.py
```

Windows

- Typing `py` or `python3` into the command-line or PowerShell will call the Python interpreter
  - only a single command will work
  - depends on the method of installation

```
$ py filename.py
```

Using Python (3)

Recommended Integrated Development Environment

- Supported IDE: **JetBrains IntelliJ IDEA Community/Ultimate**
  - Apply for an Educational Licence
  - Download JetBrains IntelliJ IDEA
- Features:
  - Debugging
  - Code Refactoring and Profiling
  - Version Control Integration
  - Python, Java, Kotlin, PHP, etc.

Variables and Data Types

Variables and Data Types (1)

Variables

- Variables in Python are a reserved memory location to store values of a particular data type
- They consist of two parts: a *name* and a *value*
    - the names of a variable can be long or short

```
x = 0
module_number = "5032CEM"
roomNumber =  "ECG-01"
```

Naming Convention

- There are a few rules to follow when naming your variables:
    1. Names must start with a letter or an underscore
    2. Names can only contain alphanumeric characters and underscores (`A-z`, `0-9`, and `_`)
- If you need to supply a comment to explain a name, then it does not reveal its true intent
    - if this is the case, then you may want to reconsider renaming your variable

```
et = 0 # Elapsed time
# Could be:
elapsedTime = 0
elapsed_time = 0
```

- Note that variable names are case-sensitive:
    - i.e. `module`, `Module` and `MODULE` are all different variables (and memory locations)

Variables and Data Types (2)

Data Types

- Python has **six** built-in data types:
  1. None: a null object
  2. Boolean: `True` or `False`
  3. Numeric: integer, float, and complex
  4. Sequence: strings, lists, and tuples
  5. Maps: dictionaries
  6. Sets

Variables and Data Types (3)

Determining the Type of Variable

- If you are unsure about the type of variable, you can use the `type()` function
- This will return the class type of the object/variable

```
stringExample1 = "Hello 5062CEM"
type(stringExample1)
type("Hello 5062CEM")
```

```
type(stringExample1) -> <class ‘str’>
type(‘Hello 5062CEM’) -> <class ‘str’>
```

Variables and Data Types (4)

Type Casting

- You can specify a data type to a value by a process known as **type casting**
- As Python is an object-oriented language, classes are used to define its data types
- To cast a value as a particular type, you can use the built-in data types class constructors:
  - i.e. `float()`, `int()` and `str()`

```
castingInteger1 = int(5.6)
castingInteger2 = int("8")
castingInteger3 = int(True)
```

```
castingInteger1 -> 5, <class ‘float’> to <class ‘int’>
castingInteger2 -> 8, <class ‘str’> to <class ‘int’>
castingInteger3 -> 1, <class ‘bool’> to <class ‘int’>
```

Operators

Operators (1)

- An operator is a character that represents an action of some sort
- They are used for performing operations on variables and values (otherwise known as operands)
- Python has a collection of operators built-in:
  - Arithmetic: `addition`, `subtraction`, `division`, `floor division`, `multiplication`, `exponentiation` and `modulus`
  - Comparison: `same as`, `not equal`, `greater than`, `greater than or equal to`, `lower than`, and `lower than or equal to`
  - Logical: `and`, `or` and `not`
  - Identity: `is` and `is not`
  - Membership: `in` and `not in`

Conditional Statements

Conditional Statements (1)

- Comparison and logical operators are used with conditional statements to ensure certain conditions have been met
- Recap on the comparison and logical operators:

Comparison Operators

Operator	Explanation
`==`	The Same
`!=`	*Not* the Same
`>`	Greater Than
`>=`	Greater Than or Equal To
`<`	Less Than
`<=`	Less Than or Equal To !

Logical Operators

Operator	Explanation
`and`	Both comparisons evaluate to `True`
`or`	One comparison evaluates to `True`
`not`	Inverts the evaluated boolean

Conditional Statements (2)

- A basic decision statement which is done using a selection structure
- The decision will be described to the interpreter by a conditional statement
  - whereby a result can only be `True` or `False`
- Python allows the following:
  - `if` statements
  - `if ... else ...` statement
  - `if ... elif ... else` statement
  - Nested `if` statements

Conditional Statements (3)

`if` Statements

- Often referred to as a decision-making statement
- Used to control the flow of execution for statements and to test an expression
    - tests logically whether a condition is `True` or `False`

```
if variable == value:
    ...
```

`if else` Statements

- Known as an alternative execution, whereby there are two possibilities
    - the condition statement determines which of the two statements gets executed
- The `else` is used as the ultimate result for a test expression
    - this result is only met if all other statements are `False`

```
if variable == value:
    ...
else:
    ...
```

Conditional Statements (4)

`else if` Statements

- `elif` is a keyword in Python to replace the `else if` conditions from other languages
- The condition allows for two or more possibilities, known as a **chained conditional**

```
if variable > value:
    ...
elif variable < value:
    ...
else:
    ...
```

Nested `if` Statements

- `if` statements can be written inside each other, and is known as **nesting**

```
if variable == value:
    if variable == value:
        ...
    else:
        if variable == value:
            ...
        elif variable == value:
            ...
        else:
            ...
elif variable != value:
    ...
else:
    ...
```

Control Statements

Control Statements (1)

- Typically, statements in code will be executed sequentially
- There are some situations which require a block of code to be repeated
  - i.e. summing numbers, entering multiple data points, capturing user input
- Control statements, otherwise known as **loop statements** are required
- Python has two loop structures:
  - `while` - conditional loops
  - `for` - counter controlled loops

Control Statements (2)

Structure of a Loop

- Loop structures can be likened to a conditional statement
  - they run on a `True` or `False` set of values
  - the loop will continuously loop until the condition is `True`
  - the loop will terminate when the condition is `False`
- Loops can run for a desired length of time
  - or until a user-defined flag terminates it
- Loops are great for re-using code
  - limiting the number of statements that are required
  - re-uses the same conditional arguments for testing instead of hundreds

Control Statements (3)

`while` Loops

- `while` loops, are loops that will execute zero or more times before it is terminated

```python
while variable < value:
    ...
    variable += 1
```

- If you are doing an incremental loop, you need to manually increase the variable
    - hence the `variable += 1`

Control Statements (4)

`for` Loops

- A `for` loop is a loop designed to increment a counter for a given range of values
- They are best suited for problems that need to iterate a specific number of times
  - i.e. looping through a directory or set of files
- The structure of a `for` loop consists of the following:

1. Initialisation of a counter
2. Test the counter-variable:
   a. less than: `start < stop`
   b. greater than: `start > stop`
3. Update the counter-variable

```
for variable in range(x, y, step):
    ...
```

Control Statements (5)

Terminating Loops

- `break` statements can be used to stop the loop if a condition is evaluated to `True`

```python
whileExample1 = 0
while whileExample1 < 10:
    print(f"whileExample1 -> {whileExample1}", end="\n\n")
    if whileExample1 == 5:
        break
    whileExample1 += 1
```

```
whileExample1 -> 0
whileExample1 -> 1
whileExample1 -> 2
whileExample1 -> 3
whileExample1 -> 4
whileExample1 -> 5
```

Functions

Functions (1)

- Functions are a block of reusable code that can be used to perform a single action
- They provide an aspect of modularity to your code and ensure a high-degree of code reuse

Creating a Function

- Functions in Python begin with the `def` keyword followed by a function **name** and a set of brackets (`()`)
- The code within the function then starts with after the colon (“`:`”) at the end of the brackets, and is indented once

```
def function_name():
  ...
```

Functions (2)

Using a Function

- Functions can be called by using their function name, followed by a set of round brackets (`()`)
  - this is often known as the **function caller**

```
def hello():
    print("Hello 5062CEM")
hello()
```

```
hello() -> Hello 5062CEM
```

Functions (3)

Returning Values from a Function

- Functions can also return data from inside it using the `return` statement
- Useful if you have performed some operations inside a function and need to use the output

```python
def hello():
    return "Hello 5062CEM"
hello()
```

```
hello() -> Hello 5062CEM
```

Functions (4)

Parameters and Arguments

- Data can be passed through to a function, and these are known as either *parameters* or *arguments*
- *Parameter* and *argument* can be used for the same thing
  - simply it is data passed into a function
- But they do have a slightly different meaning:
  - **parameter** is the variable listed inside the brackets in the function definition
  - **argument** is the value sent to the function
- Parameters are specified after the declaration of the function name and inside the set of round brackets (`()`)
  - you are able to add as many parameters as you want, separating them with a comma (`,`)

```python
def hello(name):
    return f"Hello {name} and welcome to 5062CEM."
hello("Ian")
hello("Terry")
hello("Daniel")
```

```
hello(“Ian Cornelius”) -> Hello Ian Cornelius and welcome to 5062CEM.
hello(“Terry Richards”) -> Hello Terry Richards and welcome to 5062CEM.
hello(“Daniel Goldsmith”) -> Hello Daniel Goldsmith and welcome to 5062CEM.
```

Functions (5)

Default Parameter Values

- A function can be called without an argument if a default value has been assigned to the parameter
- The default value will only be evaluated once and makes a difference when the default value is a mutable object
  - i.e. a list, dictionary or an instance of most classes

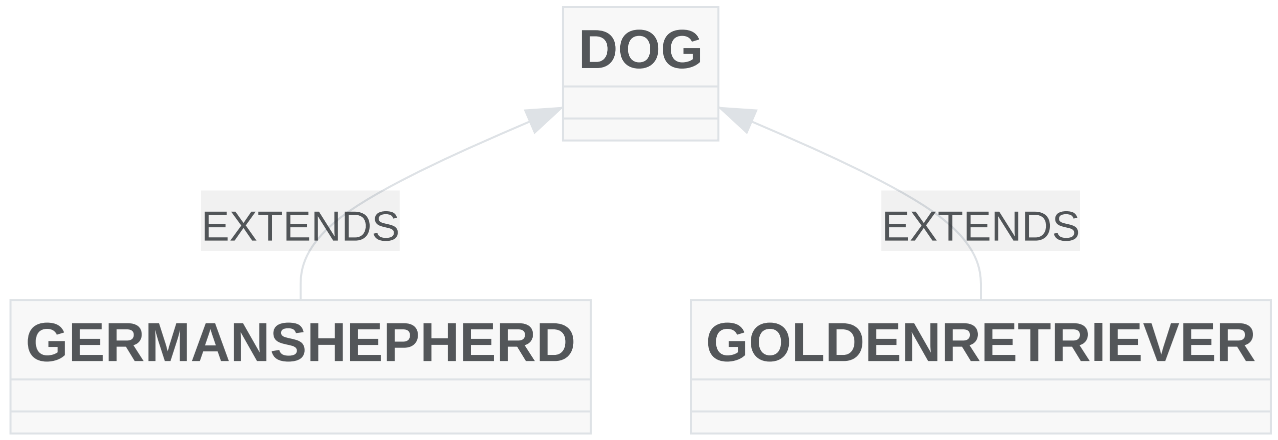
```python
def hello(name="Ian Cornelius", code="5062CEM"):
    return f"Hello {name} and welcome to {code}!"
hello()
hello("Terry Richards")
hello("Terry Richards", "5034CEM")
```

```
hello() -> Hello Ian Cornelius and welcome to 5062CEM!
hello(“Terry Richards”) -> Hello Terry Richards and welcome to 5062CEM!
hello(“Terry Richards”, “5034CEM”) -> Hello Terry Richards and welcome to 5034CEM!
```

Classes and Objects

Classes and Objects (1)

- Classes provide a structure for the objects
- They are used for defining:
  - a set of properties, represented by variables
  - the behaviour, which is represented by functions



Classes and Objects (2)

Creating a Class and Object

- Classes will be defined using the `class` keyword followed by the name you want to give it

```
class myClassName:
    ...
```

- Creating an object is achieved by creating a variable and calling our class name with a set of round brackets (`()`)
  - i.e., `objectExample1 = myClassName()`

Classes and Objects (3)

Using Class Constructors

- All classes consist of an in-built function which is used to execute code when it is being initiated
  - this is the function known as `__init__()`
- This initializer can be used to assign values to an object properties,
  - or other operations that are necessary to perform when an object is in the process of being created
- `__init__()` is called automatically each time the class has been used to create a new object

```python
class Lecturer:
    def __init__(self, _name, _age):
        self.name = _name
        self.age = _age
lecturer1 = Lecturer("Ian Cornelius", 34)
lecturer2 = Lecturer("Terry Richards", 1)
```

Classes and Objects (4)

Class Functions

- Classes can also consist of functions, and these will belong to the object that is created

```python
class Lecturer:
    def __init__(self, _name, _age):
        self.name = _name
        self.age = _age
    def hello(self):
        return f"Hello {self.name}, you are {self.age} years old."
lecturer1 = Lecturer("Ian Cornelius", 34)
lecturer2 = Lecturer("Terry Richards", 1)
```

```
lecturer1.hello() -> Hello Ian Cornelius, you are 34 years old.
lecturer2.hello() -> Hello Terry Richards, you are 1 years old.
```

Classes and Objects (5)

Public and Private

- Variables and functions can be set to private inside a class
    - this will restrict access to the variable *outside* the class
    - however, accessing the variable *inside* the class is permissive
- This is achieved by adding two underscores (`__`) to the beginning of the variable name

```python
class Lecturer:
    def __init__(self, _name: str, _age: int):
        self.name = _name
        self.__age = _age
    def change_age(self, new_age: int) -> None:
        self.__age = new_age
    def get_age(self) -> int:
        return self.__age
lecturer1 = Lecturer("Ian Cornelius", 34)
lecturer1.change_age(35)
```

```
[Before] lecturer1.get_age() -> 34
[After] lecturer1.get_age() -> 35
```

Goodbye

Goodbye (1)

Questions and Support

- Questions? Post them on the **Community Page** on Aula
- Additional Support? Visit the Module Support Page
- Contact Details:
    - Dr Ian Cornelius, ab6459@coventry.ac.uk