Intermediate python - Functions - 1

One should look for what is and not what he thinks should be. (Albert Einstein)

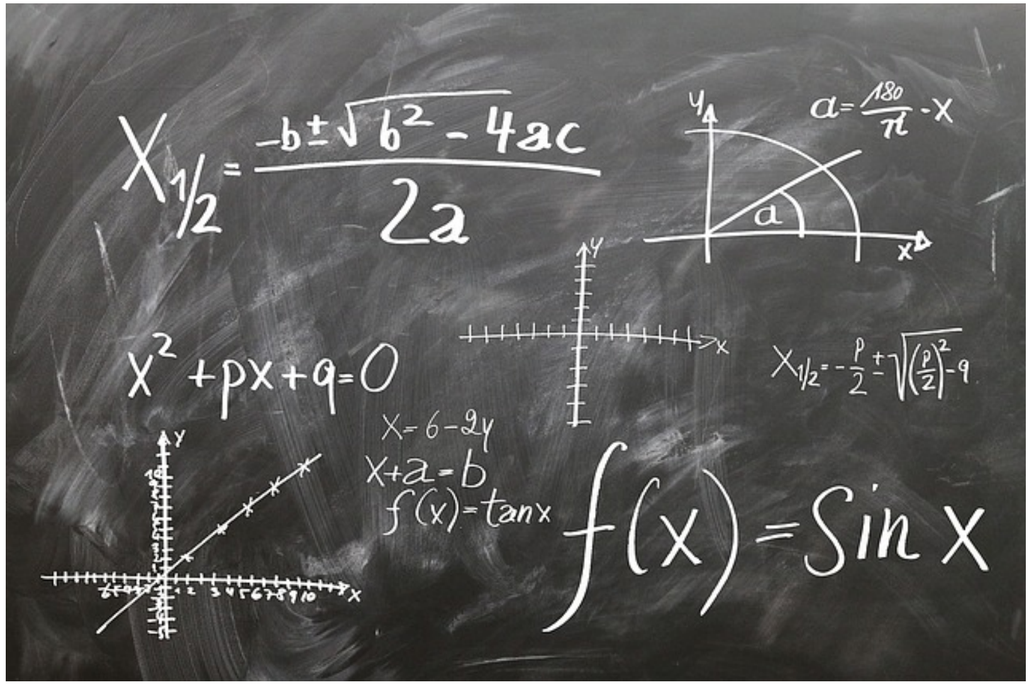
Functions: Topic introduction

In this part of the course, we will cover the following concepts:

- Function definition and use cases
- Function implementation in Python

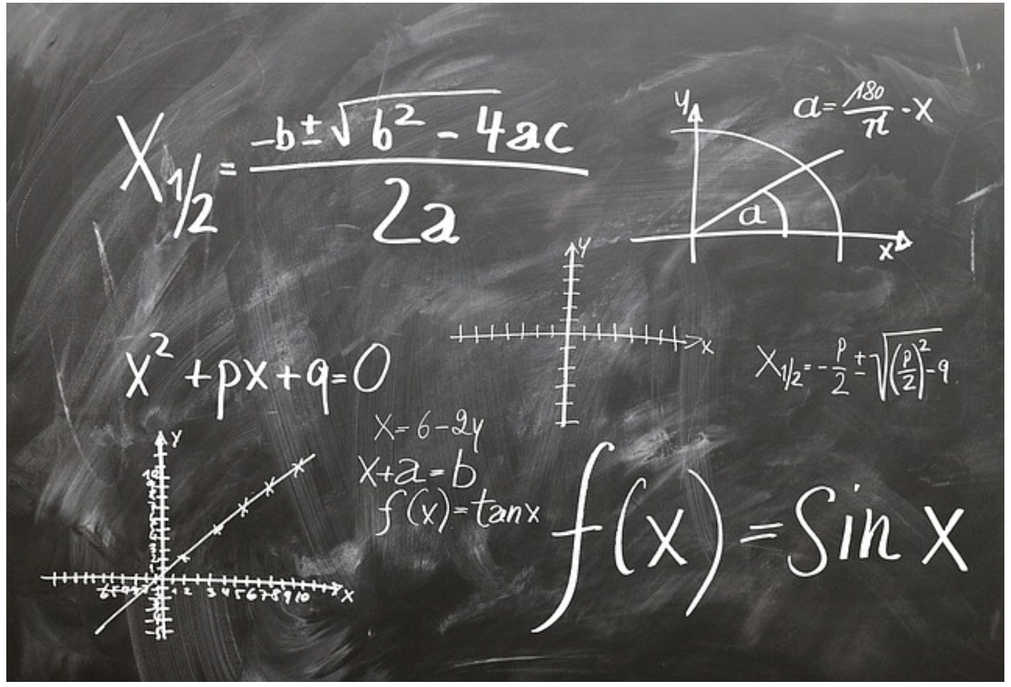
Chat question

- What do you see in the image below? What does it make you think of?
- Share your thoughts in the chat or out loud



Chat question

- When you hear the word **function**, you might imagine mathematical symbols
- What is a function in Python programming?



Module completion checklist

Objective	Complete
Identify the use cases and types of functions in Python	
Implement functions in Python	

Types of functions in Python

There are **two** basic types of functions in Python:

- Built-in functions:
  - These are part of the Python language that have already been built and are available for end-users
  - Example: `print()`, `len()`, `abs()`
- User-defined functions:
  - These are functions that a user can create according to a specific use case or functionality
- We will now see how we can write our own functions in Python

How functions apply to programming

- In programming, functions serve a very similar purpose as in mathematics
- They help us **abstract** from operations on actual numbers and let us **define** those operations through a set of variables
- The **logic** of operations does not change, but the **value** of variables changes
- This makes it easy to reuse such blocks and only pass new values to those variables

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User-defined functions in Python

- Functions can:
  - Have `0` or more arguments
  - Perform `1` or more actions
  - Return some value(s) or no value(s)
- The simplest possible function will have no arguments and will not return any value

- We can **define** a function, using a `def` construct that includes:
  - a `name` for function
  - an `action` or `actions` to perform when the function is triggered

```
# Define a function that prints the value of `Pi`.
def PrintPi():      #<- function name
    print(3.14)     #<- action to perform
```

- To "trigger" the function, we can **call** it by its name

```
PrintPi()
```

```
3.14
```

Functions in Python with one or more arguments

- Most of the time, you will create or use a function that has at least `1` **argument**
- When we need to define a function with argument(s), the `def` construct includes:
  - a `name` for function
  - at least 1 argument in `parentheses`
  - an `action` or `actions` to perform when the function is triggered

```
# Define a function that prints the value of `Pi`
# and takes a number of decimal points to which we want to round the number.
def PrintPi(num_decimals):                #<- function name + argument(s)
    pi = 3.14159265359                    #<- action to perform
    rounded_pi = round(pi, num_decimals) #<- action to perform
    print(rounded_pi)                     #<- action to perform
```

```
# Print value of pi rounded to 4 decimal points.
PrintPi(4)
```

```
3.1416
```

Functions in Python that return a value

- Functions can also **return value(s)** in addition to some `actions` they perform
- When we need to define a function with or without argument(s) that returns value(s), we use a `def` construct that includes
  - A `name` for function
  - At least `0` or more `arguments` in parentheses
  - An `action` or `actions` to perform when the function is triggered
  - A `return` value or values

```
# Define a function that prints the value of `Pi`,
# takes a number of decimal points to which we want to round the number,
# and returns the value back to us.
def GetPi(num_decimals):                    #<- function name + argument(s)
    pi = 3.14159265359                      #<- action to perform
    rounded_pi = round(pi, num_decimals)    #<- action to perform
    return rounded_pi                       #<- value to return
```

Functions in Python that return a value (cont'd)

- Let's print the value that `GetPi()` returns

```
# Return a value of pi rounded to 4 decimal points.
print(GetPi(4))
```

```
3.1416
```

- A function that returns a value can also be assigned to a **variable**
- Now the value returned and assigned to a variable can be **re-used** throughout the code

```
# Return a value of pi rounded to 4 decimal points.
# Assign it to a variable.
pi_4 = GetPi(4)
print(pi_4)
```

```
3.1416
```

Functions in Python: general structure

- Here is a general outline of a function that takes arguments and returns something in Python
- The arguments, actions, and returned values are all up to you to define based on what you are trying to achieve

```
def FunctionName(argument1, argument2, ...):
    action1
    action2
    ...
    return something
```

Functions in Python: MakeFullName

- Let's define a function that concatenates the *first name* and *last name* into a **full name**

```
# Define a function that concatenates
# first and last names.
def MakeFullName(first_name, last_name):
    full_name = first_name + ' ' + last_name
    return full_name
```

- Here are the components of the function definition broken down:
  - `def` defines a function
  - `MakeFullName` is the name of our function
  - The two arguments it takes are specified in the parentheses: `first_name` and `last_name`
  - The `return` statement controls what gets returned when someone uses the function (i.e. `full_name`)

Functions in Python: calling a function

- After we have defined a function, we need to test it
- Running a function in programming is usually known as **calling** a function
- Let's call `MakeFullName()` - to do that, we need to call the function by its name and pass any necessary values we want for the arguments of the function

- Let's print out the function results

```
# Call the function.
print(MakeFullName("Harry", "Potter"))
```

```
Harry Potter
```

- If the function returns a value (like a string with full name in this case), we can assign the output of that function to a variable

```
# Call the function and save
# output to variable.
output_name = MakeFullName("Harry", "Potter")
print(output_name)
```

```
Harry Potter
```

Functions in Python: EvaluateCarPrice

- Let's define another function that evaluates the price of a car and gives us the action to do based on the price
- Here are the components of the function definition broken down:
  - `EvaluateCarPrice` is the name of our function
  - The argument it takes is specified in the parentheses: `price`
  - The `return` statement controls what gets returned when someone uses the function (i.e. `action`)

```
def EvaluateCarPrice(price):
    if price > 38000:
        action = "Leave the dealership immediately, this is a rip off!"
    elif price > 22000 and price <= 38000 :
        action = "Take the car and go celebrate, you can afford it!"
    else:
        action = "Leave the dealership immediately, this is a scam!"
    return action
```

Functions in Python: calling a function

```
# Let's set the price of a car to $45,000.
price = 45000
action1 = EvaluateCarPrice(price)
print(action1)
```

```
Leave the dealership immediately, this is a rip off!
```

```
# Let's set the price of a car to $32,000.
price = 32000
action2 = EvaluateCarPrice(price)
print(action2)
```

```
Take the car and go celebrate, you can afford it!
```

```
# Let's set the price of a car to $5,000.
price = 5000
action3 = EvaluateCarPrice(price)
print(action3)
```

```
Leave the dealership immediately, this is a scam!
```

Functions that return two or more values

- Remember that one function can return multiple values
- To demonstrate, let's define another function that evaluates monthly sales data by profit
- Our data will take the form of a dictionary with `month: amount` key-value pairs
  - `MostProfitableMonth` is the name of our function
  - The argument it takes is a dictionary `sales_data`
  - It returns a **tuple** of the two values: `biggest_month` and `biggest_amt` for the month with the most profit

```
def MostProfitableMonth(sales_data):

    biggest_amt = 0
    biggest_month = None

    for month, amt in sales_data.items():
        if amt >= biggest_amt:
            biggest_amt = amt
            biggest_month = month

    return (biggest_month, biggest_amt)
```

Question

What is the data type of `sales_data.items()`?

a. tuple

b. list

c. array

Functions that return two or more values (cont'd)

```
# Let's define a dictionary with sales data.
year_sales = {'January': 1045, 'February': 1008, 'March': 1025,
                    'April': 1080, 'May': 1100, 'June': 1050, 'July': 1050,
                    'August': 950, 'September': 1010, 'October': 1500,
                    'November': 1450, 'December': 1380}
```

- To **save the output** of a function that returns 2 or more values, assign the function call output to the same number of variables as there are outputs in the function in the same order

```
# Assign output of function to variables in correct order.
best_sales_month, best_sales_amt = MostProfitableMonth(year_sales)
print("Best month:", best_sales_month)
```

```
Best month: October
```

```
print("Best amount:", best_sales_amt)
```

```
Best amount: 1500
```

Passing a list as an argument

- We can also create a function to operate on a list

```
# Define a function that returns the length of all character strings in a list.
def calculate_lengths(list_of_strings):
  # Define an empty list to store the result.
  lengths = []
  # Use a for loop to access items in the input list.
  for item in list_of_strings:
    lengths.append(len(item))

  return lengths
```

```
result = calculate_lengths(["Monday", "Tuesday", "Saturday"])
print(result)
```

```
[6, 7, 8]
```

Functions that have default arguments

- Let's modify another `MostProfitableMonth` and add another argument
  - This argument will have a **default** value
  - Given a default value, we are not required to provide the other argument
- Let's set the second argument to be `verbose`, which in programming usually signals to print a message with a returned value
- Let's set the default value to `True`

```
def MostProfitableMonth(sales_data, verbose = True):

    biggest_amt = 0
    biggest_month = None

    for month, amt in sales_data.items():
        if amt >= biggest_amt:
            biggest_amt = amt
            biggest_month = month

    if verbose:
        print('The best sales month was', biggest_month, 'with amount sold equal to', biggest_amt)

    return (biggest_month, biggest_amt)
```

Functions that have default arguments (cont'd)

- Let's call the function `MostProfitableMonth()` and provide only the first (required) argument

```
# Assign output of function to variables in correct order.
best_sales_month, best_sales_amt = MostProfitableMonth(year_sales)
```

```
The best sales month was October with amount sold equal to 1500
```

- Let's call the function `MostProfitableMonth()` and set the `verbose` argument to `False`

```
# Assign output of function to variables in correct order.
best_sales_month, best_sales_amt = MostProfitableMonth(year_sales, False)
```

- The output is still the same, but the "verbose" message is no longer printed, so if we need to see it, we would have to do it manually

```
print("Best month:", best_sales_month, "Best amount:", best_sales_amt)
```

```
Best month: October Best amount: 1500
```

Anonymous functions: lambda

- **Anonymous** functions, also known as **lambda** functions, are small **nameless** functions
- They work the same way as conventional functions, but are used as shorthand within other pieces of code
- They are often used as a part or as an argument in other functions

Anonymous functions: syntax

- To write an anonymous function in Python, we use the `lambda` command followed by an **argument** and a `colon :`
- The expression that follows represents an **action** we would like to perform using those arguments

```
print((lambda v: v + " the 5th of November!")("Remember"))
```

```
Remember the 5th of November!
```

- As we can see above, the lambda function does not need to be tied to any name and can be directly called on the argument `"Remember"`

Anonymous functions with multiple arguments

- We can also assign a lambda function to a name for reusability

```
remember = lambda v: v + " the 5th of November!"
print(remember("Remember"))
```

```
Remember the 5th of November!
```

- Anonymous functions can take several arguments separated by a comma

```
y = lambda a, b: a + b
print(y(765, -987))
```

```
-222
```

Function within another function

- In order to make different parts of our code interact with each other, we can also call a function from within another function

```
# Define a function to check if a number is even
or odd.
def even_odd(num):
  if num%2 == 0:            #<- % is the Modulo
operator.
    result = "Even"
  else:
    result = "Odd"
  return result
```

```
# Define a function to print if each element of a
list is even or odd.
def even_odd_list(numbers):
  for num in numbers:
    result = even_odd(num)    #<- Call function on
num an assign its result
    print(num, ": ", result)
```

```
even_odd_list([22,41,16,13])
```

```
22 :  Even
41 :  Odd
16 :  Even
13 :  Odd
```

Knowledge check

Link: ***https://forms.gle/EBJAx1EUsGJ2xMNF9***

Exercise

You are now ready to try Tasks 1-5 in the Exercise for this topic

Module completion checklist

Objective	Complete
Identify the use cases and types of functions in Python	✔
Implement functions in Python	✔

Summary

In this module, we:

- Defined functions and examined their use cases
- Identified and implemented different types of functions

Congratulations on completing this module!