Introduction

1.1 Python language:

Python is one of the most popular and widely used programming languages, and is an excellent language for new programmers to start with. They can be used in everything from video games and language processing, to data analysis and machine learning. It was created by Guido van Rossum, and released in 1991.

Python is a high-level, compiled, interactive, and object-oriented programming language. It is highly readable, as it uses simple English words, unlike other languages that use symbols, and its spelling and syntax are simple, which makes learning Python easy compared to other programming languages.

***بايثون- هي واحدة من أشهر لغات البرمجة وأكثرها استخدامًا، وهي لغة ممتازة ليبدأ بها المبرمجون الجدد. يمكن استخدامها في كل المجالات، بدءًا من ألعاب الفيديو ومعالجة اللغات، وحتى تحليل البيانات والتعلم الآلي.**

بايثون هي لغة برمجة عالية المستوى، ومُترجمة (interpreted) وتفاعلية وكائنية. وتتمتع بمقروئية عالية، إذ تستخدم كلمات إنجليزية بسيطة، على خلاف اللغات الأخرى التي تستخدم الرموز، كما أنّ قواعدها الإملائية والصياغية بسيطة، ما يجعل تعلم لغة بايثون سهلًا موازنةً بلغات برمجة أخرى.

1.2 Features of Python language:

Python has several advantages over other programming languages, including:

1. Ease of learning: The Python language is easy to learn, as it consists of a few keywords, and is characterized by a simple and clear syntax.
2. Readability: Python code is clear, organized, and easy to read.
3. Easy to Maintain: Python code is very easy to maintain.
4. Extensive Standard Library: The Python Standard Library contains a large number of portable packages that are compatible with UNIX, Windows, and macOS systems.

5. Interactive mode: Python supports interactive mode, making it possible to execute code directly on the command line and debug the code.
6. Python portability: Python can run on a wide range of platforms and devices, while maintaining the same interface on all of them.
7. Extensibility: One of the most important features of Python is that it has a huge number of modules that can expand the capabilities of the language in all areas of development, such as data analysis, 2D and 3D graphics, game development, embedded systems, scientific research, website development and other fields.
8. Databases: Python provides interfaces to all major databases.
9. Graphics: Python supports graphical applications.
10. Support for large programs: Python is suitable for large and complex programs.

1.3 What can Python do?

1. Python can be used on a server to create web applications.
2. Python can be used alongside software to create workflows.
3. Python can connect to database systems. It can also read and modify files.
4. Python can be used to handle big data and perform complex mathematics.
5. Python can be used for rapid prototyping, or for production-ready software development.

Requirements: You must have Python installed, as well as a local programming environment set up on your computer. To write a program , we will create a new file with the extension(.py)

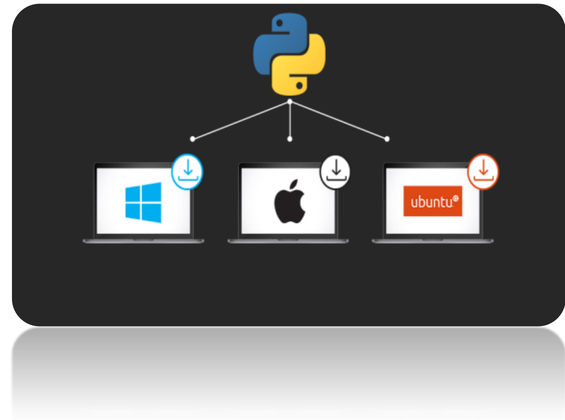
1.4 Python Getting Started

1.4.1 Python Install:

*لتنصيب اللغة :

Use this web link:

https://www.python.org/downloads/



1.4.2 Python Output \\ print() function

*دالة الطباعة Print( )

We use the print() function to output data to the standard output device (screen). We can also output data to a file, but this will be discussed later. It displays or outputs what we put in parentheses.

An example of its use is given below..

```
Print ('Hallow')
Print (10+20)
Print ('ahmed','ali')
```

Another example is given below:

```
d = 20
print('The value of a is', d)
Output\\ The value of a is 20
```

1.4.3 String Concatenation:

To concatenate, or combine, two strings you can use the + operator.

Example: Merge variable a with variable b into variable c:

```
a = "Hello"
b = "World"
c = a + b
print(c)
```

Output\\ HelloWorld

we can combine strings and numbers by using the format() method. The format() method takes the passed arguments, formats them, and places them in the string where the placeholders { } are:

Example: Use the format() method to insert numbers into strings:

```
age = 36
txt = "My name is John, and I am {}"
print(txt.format(age))
```

Output\\ My name is John, and I am 36

The format() method takes unlimited number of arguments, and are placed into the respective placeholders:

Example:

```
quantity = 3
itemno = 567
price = 49.95
myorder = "I want {} pieces of item {} for {} dollars."
print(myorder.format(quantity, itemno, price))
```

Output\\ I want 3 pieces of item 567 for 49.95 dollars.

1.4.4 Boolean Values:

In programming you often need to know if an expression is True or False.

You can evaluate any expression in Python, and get one of two answers, True or False.

When you compare two values, the expression is evaluated and Python returns the Boolean answer:

Example

```
print(10 > 9)
print(10 == 9)
print(10 < 9)
```

```
output\\True
        False
        False
```

1.4.5 Python User Input

Python allows for user input.That means we are able to ask the user for input.

The method is a bit different in Python 3.6 than Python 2.7.

Python 3.6 uses the input() method.

Python 2.7 uses the raw_input() method.

The following example asks for the username, and when you entered the username, it gets printed on the screen:

Python 3.6

```
username = input("Enter username:")
print("Username is: " + username)
```

```
output\\ Enter username: 12345
Username is: 12345
```

1.4.6 Python Comments

- Comments can be used to explain Python code.
- Comments can be used to make the code more readable.
- Comments can be used to prevent execution when testing code.

1- Creating a Comment

Comments starts with a #, and Python will ignore them:

Example

```
#This is a comment
print("Hello, World!")
```

Comments can be placed at the end of a line, and Python will ignore the rest of the line:

Example

```
print("Hello, World!") #This is a comment
```

A comment does not have to be text that explains the code, it can also be used to prevent Python from executing code:

Example

```
#print("Hello, World!")
print("Cheers, Mate!")
```

2- Multi Line Comments

Python does not really have a syntax for multi line comments.

To add a multiline comment you could insert a # for each line:

Example

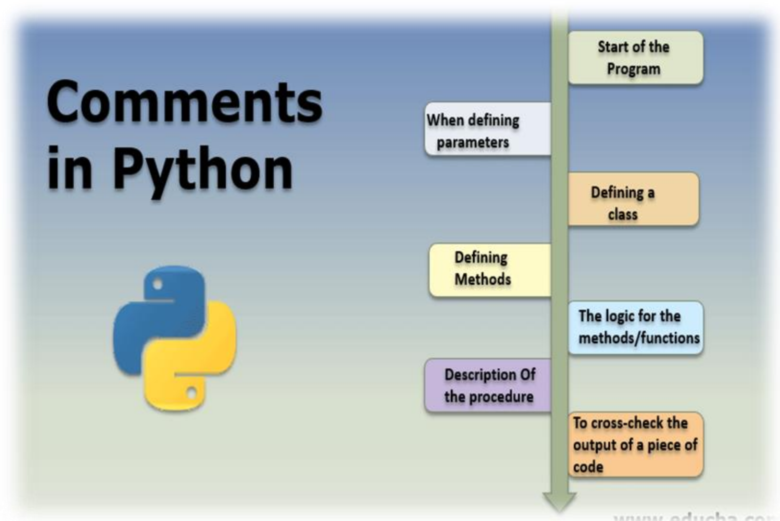
```
#This is a comment
#written in
#more than just one line
print("Hello, World!")
```

Or, not quite as intended, you can use a multiline string.

Since Python will ignore string literals that are not assigned to a variable, you can add a multiline string (triple quotes) in your code, and place your comment inside it:

Example

```
"""
This is a comment
written in
more than just one line
"""
print("Hello, World!")
```



1.4.7 Variables

Variables are containers for storing data values.

Creating Variables

Python has no command for declaring a variable.

A variable is created the moment you first assign a value to it.

Example

```
x = 5
y = "John"
print(x)
print(y)
```

Example

```
x = 4       # x is of type int
x = "Sally" # x is now of type str
print(x)

output\\
```

1.4.8 Python Casting

Specify a Variable Type.

There may be times when you want to specify a type on to a variable. This can be done with casting. Python is an object-orientated language, and as such it uses classes to define data types, including its primitive types.

Casting in python is therefore done using constructor functions:

- **int() -** constructs an integer number from an integer literal, a float literal (by removing all decimals), or a string literal (providing the string represents a whole number)

- **float() -** constructs a float number from an integer literal, a float literal or a string literal (providing the string represents a float or an integer)

- **str() -** constructs a string from a wide variety of data types, including strings, integer literals and float literals If you want to specify the data type of a variable, this can be done with casting.

Example

```
x = str(3)    # x will be '3'
y = int(3)    # y will be 3
z = float(3)  # z will be 3.0
```

Example

```
x = int(1)    # x will be 1

y = int(2.8)  # y will be 2

z = int("3")  # z will be 3
```

Example

```
x = float(1)     # x will be 1.0

y = float(2.8)   # y will be 2.8

z = float("3")   # z will be 3.0

w = float("4.2") # w will be 4.2
```

1.4.9 Python Data Types

Built-in Data Types

In programming, data type is an important concept. Variables can store data of different types, and different types can do different things.

Python has the following data types built-in by default, in these categories:

Getting the Data Type

You can get the data type of any object by using the type() function:

Example

Print the data type of the variable x:

```
x = 5
print(type(x))
```

```
output\\ <class 'int'>
```

Setting the Data Type

In Python, the data type is set when you assign a value to a variable:

Example	Data Type
x = "Hello World"	str
x = 20	int
x = 20.5	float
x = 1j	complex
x = ["apple", "banana", "cherry"]	list
x = ("apple", "banana", "cherry")	tuple
x = range(6)	range

x = {"name" : "John", "age" : 36}	**dict**
x = {"apple", "banana", "cherry"}	**set**
x = True	**bool**

1.4.10 Python Numbers:

There are three numeric types in Python:

- **int**
- **float**
- **complex**

Variables of numeric types are created when you assign a value to them:

Example

```
x = 1    # int
y = 2.8  # float
z = 1j   # complex
```

((End of lecture 1))

2.1 Python Operators:

Operators are used to perform operations on variables and values.

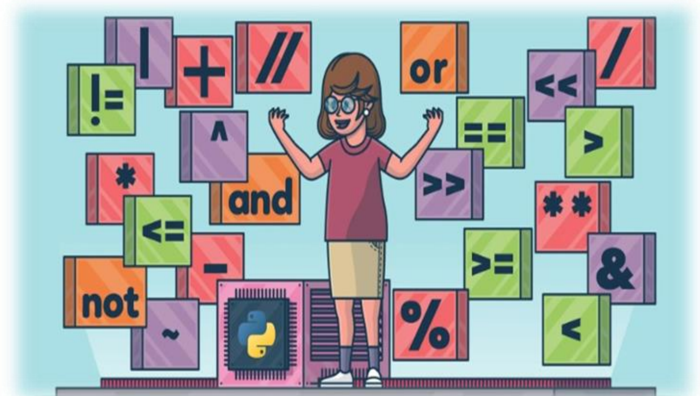
In the example below, we use the + operator to add together two values:

Example

```
print(10 + 5)
```

Python divides the operators in the following groups:

- Arithmetic operators
- Assignment operators
- Comparison operators
- Logical operators
- Identity operators
- Membership operators
- Bitwise operators



2.1.1 Python Arithmetic Operators

Arithmetic operators are used with numeric values to perform common mathematical operations:

Operator	Name	Example
+	**Addition**	**x + y**

-	Subtraction	x - y
*	Multiplication	x * y
/	Division	x / y
%	Modulus	x % y
**	Exponentiation	x ** y
//	Floor division	x // y

2.1.2 Python Assignment Operators:

Assignment operators are used to assign values to variables:

Operator	Example	Same As
=	x = 5	x = 5
+=	x += 3	x = x + 3
-=	x -= 3	x = x - 3
*=	x *= 3	x = x * 3
/=	x /= 3	x = x / 3

%=	x %= 3	x = x % 3
//=	x //= 3	x = x // 3
**=	x **= 3	x = x ** 3
&=	x &= 3	x = x & 3
|=	x |= 3	x = x | 3
^=	x ^= 3	x = x ^ 3
>>=	x >>= 3	x = x >> 3
<<=	x <<= 3	x = x << 3

2.1.3 Python Logical Operators

Logical operators are used to combine conditional statements:

Operator	Description	Example
and	Returns True if both statements are true	x < 5 and x < 10
Or	Returns True if one of the statements is true	x < 5 or x < 4
Not	Reverse the result, returns False if the result is true	not(x < 5 and x < 10)

2.1.4 Python Bitwise Operators

Bitwise operators are used to compare (binary) numbers:

Operator	Name	Description
&	AND	Sets each bit to 1 if both bits are 1
|	OR	Sets each bit to 1 if one of two bits is 1
^	XOR	Sets each bit to 1 if only one of two bits is 1
~	NOT	Inverts all the bits
<<	Zero fill left shift	Shift left by pushing zeros in from the right and let the leftmost bits fall off
>>	Signed right shift	Shift right by pushing copies of the leftmost bit in from the left, and let the rightmost bits fall off

2.1.5 Python Comparison Operators:

Comparison operators are used to compare two values:

Operator	Name	Example
==	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

2.1.6 Python Identity Operators:

Identity operators are used to compare the objects, not if they are equal, but if they are actually the same object, with the same memory location:

Operator	Description	Example
is	Returns True if both variables are the same object	x is y
is not	Returns True if both variables are not the same object	x is not y

2.1.7 Python Membership Operators:

Membership operators are used to test if a sequence is presented in an object:

Operator	Description	Example
in	**Returns True if a sequence with the specified value is present in the object**	**x in y**
not in	**Returns True if a sequence with the specified value is not present in the object**	**x not in y**

H.W\\ Operator Precedence

Operator precedence describes the order in which operations are performed.

H.W\\

1. `print((6 + 3) - (6 + 3))`
2. `print(100 + 5 * 3)`
3. `print(5 + 4 - 7 + 3)`
4. Multiply 10 with 5, and print the result.

   What's output for all line code above??

2.2 Python Strings

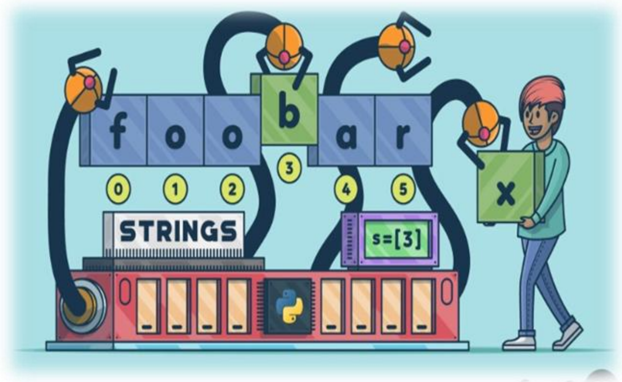
Strings in python are surrounded by either single quotation marks, or double quotation marks.

'hello' is the same as "hello".

You can display a string literal with the print() function:

Example

```
print("Hello")
print('Hello')
```



1- Assign String to a Variable

Assigning a string to a variable is done with the variable name followed by an equal sign and the string:

Example

```
a = "Hello"

print(a)

output\\ Hello
```

2- Multiline Strings

You can assign a multiline string to a variable by using three double quotes Or three single quotes :

Example

```
a = """ Shift left by pushing zeros in from the right

and let the leftmost bits fall off."""
print(a)
```

output\\ Shift left by pushing zeros in from the right

and let the leftmost bits fall off.

3- Strings are Arrays

Like many other popular programming languages, strings in Python are arrays of bytes representing unicode characters.

However, Python does not have a character data type, a single character is simply a string with a length of 1.

Square brackets can be used to access elements of the string.

Example

Get the character at position 1 (remember that the first character has the position 0):

```
a = "Hello, World!"
print(a[1])
```

output\\ e

4- String Length

To get the length of a string, use the **len()** function.

Example

The len() function returns the length of a string:

```
a = "Hello, World!"
print(len(a))
```

output\\ 13

5- Python - Slicing Strings

You can return a range of characters by using the slice syntax. Specify the start index and the end index, separated by a colon, to return a part of the string.

Example

Get the characters from position 2 to position 5 (not included):

```
b = "Hello, World!"
print(b[2:5])
```

output\\ llo

Note: The first character has index 0.

1) Slice From the Start

By leaving out the start index, the range will start at the first character:

Example

Get the characters from the start to position 5 (not included):

```
b = "Hello, World!"
print(b[:5])
```

output\\Hello

2) Slice To the End

By leaving out the end index, the range will go to the end:

Example

Get the characters from position 2, and all the way to the end:

```
b = "Hello, World!"
print(b[2:])
```

output\\ llo, World!

3) Negative Indexing

Use negative indexes to start the slice from the end of the string:

Example

Get the characters:

From: "o" in "World!" (position -5)

To, but not included: "d" in "World!" (position -2):

```
b = "Hello, World!"
print(b[-5:-2])


output\\ orl
```

6- Looping Through a String:

Since strings are arrays, we can loop through the characters in a string, with a for loop.

Example

```
for x in "banana":
 print(x)


output\\ b

         a

         n

         a

         n

         a
```

7- Check String:

To check if a certain phrase or character is present in a string, we can use the keyword in.

Example

```
txt = "The best things in life are free!"
print("free" in txt)

output\\ True
```

Example

```
txt     = "The     best     things     in     life     are     free!"
print("expensive" not in txt)

output\\ True
```

8- Python - Modify Strings:

Python has a set of built-in methods that you can use on strings.

1) Upper Case:

Example

The **upper()** method returns the string in upper case:

```
a = "Hello, World!"
print(a.upper())



output\\ HELLO, WORLD!
```

2) Lower Case:

Example

The **lower()** method returns the string in lower case:

```
a = "Hello, World!"
print(a.lower())

output\\ hello, world!
```

3) Replace String:

Example

The **replace()** method replaces a string with another string:

```
a = "Hello, World!"
print(a.replace("H", "J"))



output\\ Jello, World!
```

((End of lecture 2))

3.1 Python If ... Else

Python Conditions and If statements

Python supports the usual logical conditions from mathematics:

- **Equals:** a == b
- **Not Equals:** a != b
- **Less than:** a < b
- **Less than or equal to:** a <= b
- **Greater than:** a > b
- **Greater than or equal to:** a >= b

These conditions can be used in several ways, most commonly in "if statements" and loops.

An " **if statement** " is written by using the **if** keyword.

Example

```
a = 33
b = 200
if b > a:
  print("b is greater than a")
```

output\\ b is greater than a

In this example we use two variables, **a** and **b**, which are used as part of the **if statement** to test whether **b** is greater than **a**. As **a** is **33**, and **b** is **200**, we know that **200** is greater than **33**, and so we print to screen that "**b is greater than a**".

1- Indentation

Python relies on indentation (whitespace at the beginning of a line) to define scope in the code. Other programming languages often use curly-brackets for this purpose.

Example

If statement, without indentation (will raise an error):

```
a = 33
b = 200
if b > a:
print("b is greater than a") # you will get an error
```

2- Elif

The **elif** keyword is pythons way of saying "if the previous conditions were not true, then try this condition".

Example

```
a = 33
b = 33
if b > a:
  print("b is greater than a")
elif a == b:
  print("a and b are equal")
```

output\\ a and b are equal

In this example **a** is equal to **b**, so the first condition is not true, but the **elif** condition is true, so we print to screen that "**a and b are equal**".

3- Else

The **else** keyword catches anything which isn't caught by the preceding conditions.

Example

```
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")
```

output\\ a is greater than b

In this example **a** is greater than **b**, so the first condition is not true, also the **elif** condition is not true, so we go to the **else** condition and print to screen that "**a is greater than b**".

You can also have an **else** without the **elif**:

Example

```
a = 200
b = 33
if b > a:
  print("b is greater than a")
else:
  print("b is not greater than a")
```

output\\ b is not greater than a

H.w

```
a = 330

b = 330

print("A") if a > b else print("=") if a == b else print("B")
```

output

4- And

The **and** keyword is a logical operator, and is used to combine conditional statements:

Example

Test if a is greater than b, AND if c is greater than a:

```
a = 200
b = 33
c = 500
if a > b and c > a:
  print("Both conditions are True")
```

output\\ Both conditions are True

5- Or

The **or** keyword is a logical operator, and is used to combine conditional statements:

Example

Test if a is greater than b, OR if a is greater than c:

```
a = 200
b = 33
```

```
c = 500
if a > b or a > c:
  print("At least one of the conditions is True")
```

output\\ At least one of the conditions is True

6- Use in an if statement:

Example

Print only if "free" is present:

```
txt = "The best things in life are free!"
if "free" in txt:
  print("Yes, 'free' is present.")
```

output\\ Yes, 'free' is present

7- Check if NOT

To check if a certain phrase or character is NOT present in a string, we can use the keyword **not in**.

Example

Check if "expensive" is NOT present in the following text:

```
txt = "The best things in life are free!"
print("expensive" not in txt)
```

output\\ True

Use it in an if statement:

Example

print only if "expensive" is NOT present:

```
txt = "The best things in life are free!"
if "expensive" not in txt:
  print("No, 'expensive' is NOT present.")
```

output\\ No, 'expensive' is NOT present.

8- Nested If

You can have **if** statements inside **if** statements, this is called ***nested*** **if** statements.

Example

```
x = 41
if x > 10:
  print("Above ten,")
  if x > 20:
    print("and also above 20!")
  else:
    print("but not above 20.")
```

output\\ Above ten,
and also above 20!

3.2 Python For Loops

A **for** loop is used for iterating over a sequence (that is either a list, a tuple, a dictionary, a set, or a string).

This is less like the for keyword in other programming languages, and works more like an iterator method as found in other object-orientated programming languages.

With the **for** loop we can execute a set of statements, once for each item in a list, tuple, set etc.

Example

Print each fruit in a fruit list:

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

```
output\\ apple
         banana
         cherry
```

1- Looping Through a String

Since strings are arrays, we can loop through the characters in a string, with a **for loop**.

Example

Loop through the letters in the word "banana":

```
for x in "banana":
  print(x)
```

output\\b
a
n
a
n
a

2- The break Statement

With the **break** statement we can stop the loop before it has looped through all the items:

Example

Exit the loop when x is "banana":

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

output\\ apple
banana

Example

Exit the loop when x is "banana", but this time the break comes before the print:

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

output\\ apple

3- The continue Statement

With the **continue** statement we can stop the current iteration of the loop, and continue with the next:

Example

Do not print banana:

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

output\\ apple

cherry

4- The range() Function

To loop through a set of code a specified number of times, we can use the **range()** function,

The **range()** function returns a sequence of numbers, starting from 0 by default, and increments by 1 (by default), and ends at a specified number.

Example

Using the range() function:

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

output\\ 0

1

2

3

4

5

Example

Using the start parameter:

```
for x in range(2, 6):
  print(x)
```

output\\ 2

3

4

5

5- Nested Loops

A nested loop is a loop inside a loop.

The "inner loop" will be executed one time for each iteration of the "outer loop":

Example

Print each adjective for every fruit:

```
adj = ["red", "big", "tasty"]
fruits = ["apple", "banana", "cherry"]

for x in adj:
  for y in fruits:
    print(x, y)
```

output\\ red apple

red banana

red cherry

big apple

big banana

big cherry

tasty apple

tasty banana

tasty cherry

H.w\\ use for loop to print this figure in screen:

```
P
Py
Pyt
Pyth
Pytho
Python
Pytho
Pyth
Pyt
Py
p
```

3.3 Python While Loops

With the **while** loop we can execute

a set of statements as long as a condition is true.

Example

Print i as long as i is less than 6:

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

output\\1

2

3

4

5

The while loop requires relevant variables to be ready, in this example we need to define an indexing variable, **i**, which we set to **1.**

1- The break Statement

With the **break** statement we can stop the loop even if the while condition is true:

Example

Exit the loop when i is 3:

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

output\\1
2
3

2-The continue Statement

With the **continue** statement we can stop the current iteration, and continue with the next:

Example

Continue to the next iteration if i is 3:

```
i = 0
while i < 6:
  i += 1
  if i == 3:
    continue
  print(i)
```

output\\ 1
2
4
5
6

3-The else Statement

With the **else** statement we can run a block of code once when the condition no longer is true:

Example

Print a message once the condition is false:

```
i = 1
while i < 6:
  print(i)
  i += 1
else:
  print("i is no longer less than 6")
```

```
output\\ 1
         2
         3
         4
         5
          i is no longer less than 6
```

H.w\\ how print the following output:

6 * 1 = 6

6 * 2 = 12

6 * 3 = 18

6 * 4 = 24

6 * 5 = 30

((End of lecture 3))

4.1 Python Lists

mylist = ["apple", "banana", "cherry"]

1) List

Lists are used to store multiple items in a single variable.

Lists are one of 4 built-in data types in Python used to store collections of data, the other 3 are **Tuple**, **Set**, and **Dictionary**, all with different qualities and usage.

Lists are created using square brackets:

Example

Create a List:

```
thislist = ["apple", "banana", "cherry"]
print(thislist)


output\\ ['apple', 'banana', 'cherry']
```

2) List Items

List items are ordered, changeable, and allow duplicate values.

List items are indexed, the first item has index [0], the second item has index [1] etc.

3) Ordered

When we say that lists are ordered, it means that the items have a defined order, and that order will not change.

If you add new items to a list, the new items will be placed at the end of the list.

Note: There are some list methods that will change the order, but in general: the order of the items will not change.

4) Changeable

The list is changeable, meaning that we can change, add, and remove items in a list after it has been created.

5) Allow Duplicates

Since lists are indexed, lists can have items with the same value:

Example

```
thislist = ["apple", "banana", "cherry", "apple", "cherry"]
print(thislist)
```

```
output\\ ['apple', 'banana', 'cherry', 'apple', 'cherry']
```

6) List Length

To determine how many items a list has, use the **len()** function:

Example

```
thislist = ["apple", "banana", "cherry"]
print(len(thislist))
```

```
output\\ 3
```

7) List Items - Data Types

List items can be of any data type(String, int and boolean data types):

Example

```
list1 = ["apple", "banana", "cherry"]
list2 = [1, 5, 7, 9, 3]
list3 = [True, False, False]
```

A list can contain different data types:

Example

```
list1 = ["abc", 34, True, 40, "male"]
```

8) Python - Access List Items

Access Items

List items are indexed and you can access them by referring to the index number:

Example

Print the second item of the list:

```
thislist = ["apple", "banana", "cherry"]
print(thislist[1])
```

output\\ banana

Note: The first item has index 0.

9) Negative Indexing

Negative indexing means start from the end

-1 refers to the last item, **-2** refers to the second last item etc.

Example

Print the last item of the list:

```
thislist = ["apple", "banana", "cherry"]
print(thislist[-1])
```

output\\ cherry

10) Range of Indexes

You can specify a range of indexes by specifying where to start and where to end the range. When specifying a range, the return value will be a new list with the specified items.

Example

Return the third, fourth, and fifth item:

```
thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]
print(thislist[2:5])
```

output\\ ['cherry', 'orange', 'kiwi']

Note: The search will start at index 2 (included) and end at index 5 (not included).

Remember that the first item has index 0.

By leaving out the start value, the range will start at the first item:

Example

```
thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]
print(thislist[:4])
```

output\\ ['apple', 'banana', 'cherry', 'orange']

11) Python - Add List Items

Append Items

To add an item to the end of the list, use the **append()** method:

Example

```
thislist = ["apple", "banana", "cherry"]
thislist.append("orange")
print(thislist)
```

output\\ ['apple', 'banana', 'cherry', 'orange']

12) Python - Remove List Items

Remove Specified Item

The **remove()** method removes the specified item.

Example

Remove "banana":

```
thislist = ["apple", "banana", "cherry"]
thislist.remove("banana")
print(thislist)
```

output\\ ['apple', 'cherry']

Remove Specified Index

The **pop()** method removes the specified index.

Example

Remove the second item:

```
thislist = ["apple", "banana", "cherry"]
thislist.pop(1)
print(thislist)
```

output\\ ['apple', 'cherry']

13) Python - Loop Lists

Loop Through a List

You can loop through the list items by using a for loop:

Example

Print all items in the list, one by one:

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

```
output\\ apple
        banana
        cherry
```

14) Loop Through the Index Numbers

You can also loop through the list items by referring to their index number.

Use the **range()** and **len()** functions to create a suitable iterable.

Example

Print all items by referring to their index number:

```
thislist = ["apple", "banana", "cherry"]
for i in range(len(thislist)):
  print(thislist[i])
```

```
output\\ apple
        banana
        cherry
```

15) Python - Sort Lists

Sort List Alphanumerically

List objects have a **sort()** method that will sort the list alphanumerically, ascending, by default:

Example

Sort the list alphabetically:

```
thislist = ["orange", "mango", "kiwi", "pineapple", "banana"]
thislist.sort()
print(thislist)
```

output\\ ['banana', 'kiwi', 'mango', 'orange', 'pineapple']

Example

Sort the list numerically:

```
thislist = [100, 50, 65, 82, 23]
thislist.sort()
print(thislist)
```

output\\ [23, 50, 65, 82, 100]

Sort Descending

To sort descending, use the keyword argument **reverse = True:**

Example

Sort the list descending:

```
thislist = ["orange", "mango", "kiwi", "pineapple", "banana"]
thislist.sort(reverse = True)
print(thislist)
```

output\\ ['pineapple', 'orange', 'mango', 'kiwi', 'banana']

Example

Sort the list descending:

```
thislist = [100, 50, 65, 82, 23]
thislist.sort(reverse = True)
print(thislist)
```

output\\ [100, 82, 65, 50, 23]

16) Python - Join Lists

Join Two Lists

There are several ways to join, or concatenate, two or more lists in Python.

One of the easiest ways are by using the **+ operator**.

Example

Join two list:

```
list1 = ["a", "b", "c"]
list2 = [1, 2, 3]
list3 = list1 + list2
print(list3)
```

output\\ ['a', 'b', 'c', 1, 2, 3]

Another way to join two lists is by appending all the items from list2 into list1, one by one:

Example

Append list2 into list1:

```
list1 = ["a", "b" , "c"]
list2 = [1, 2, 3]
for x in list2:
  list1.append(x)
print(list1)
```

output\\ ['a', 'b', 'c', 1, 2, 3]

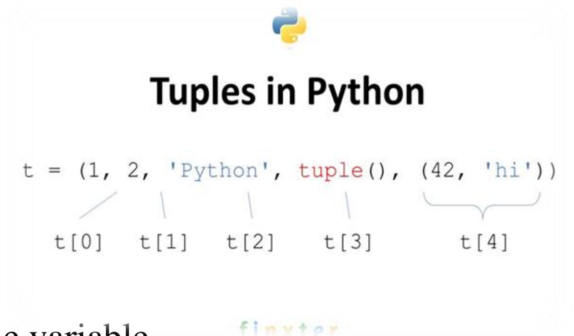
17) List Methods

Python has a set of built-in methods that you can use on lists.

Method	Description
append()	Adds an element at the end of the list
clear()	Removes all the elements from the list
copy()	Returns a copy of the list
count()	Returns the number of elements with the specified value
extend()	Add the elements of a list (or any iterable), to the end of the current list
index()	Returns the index of the first element with the specified value
insert()	Adds an element at the specified position
pop()	Removes the element at the specified position
remove()	Removes the item with the specified value
reverse()	Reverses the order of the list
sort()	Sorts the list

H.w نفذ مجموعة امثلة عن الطرق أعلاه في المختبر

4.2 Python Tuples



mytuple = ("apple", "banana", "cherry")

Tuples are used to store multiple items in a single variable.

Tuple is one of 4 built-in data types in Python used to store collections of data, the other 3 are **List**, **Set**, and **Dictionary**, all with different qualities and usage.

A tuple is a collection which is ordered and **unchangeable**.

Tuples are written with round brackets.

Example

1) Create a Tuple:

```
thistuple = ("apple", "banana", "cherry")
print(thistuple)
```

output\\ ('apple', 'banana', 'cherry')

2) Tuple Items - Data Types

Tuple items can be of any data type (String, int and boolean data types) :

Example

```
tuple1 = ("apple", "banana", "cherry")
tuple2 = (1, 5, 7, 9, 3)
tuple3 = (True, False, False)
```

A tuple can contain different data types:

Example

Different types of tuples

```
# Empty tuple

my_tuple = ()

print(my_tuple)
```

```
# Tuple having integers
my_tuple = (1, 2, 3)
print(my_tuple)
# tuple with mixed datatypes
my_tuple = (1, "Hello", 3.4)
print(my_tuple)
# nested tuple
my_tuple = ("mouse", [8, 4, 6], (1, 2, 3))
print(my_tuple)
```

output\\ ( )

```
(1, 2, 3)
(1, 'Hello', 3.4)
('mouse', [8, 4, 6], (1, 2, 3))
```

3) Python - Access Tuple Items

Like (list) نفس حالة الـ

4) Add Items

Since tuples are immutable, they do not have a build-in **append()** method, but there are other ways to add items to a tuple.

1. **Convert into a list**: Just like the workaround for *changing* a tuple, you can convert it into a list, add your item(s), and convert it back into a tuple.

Example

Convert the tuple into a list, add "orange", and convert it back into a tuple:

```
thistuple = ("apple", "banana", "cherry")
y = list(thistuple)
y.append("orange")
thistuple = tuple(y)
```

output\\ H.W

2. **Add tuple to a tuple**. You are allowed to add tuples to tuples, so if you want to add one item, (or many), create a new tuple with the item(s), and add it to the existing tuple:

Example

Create a new tuple with the value "orange", and add that tuple:

```
thistuple = ("apple", "banana", "cherry")
y = ("orange",)
thistuple += y
print(thistuple)
```

output\\ ('apple', 'banana', 'cherry', 'orange')

5) Python - Loop Tuples

Like list.

6) Tuple Methods

Python has two built-in methods that you can use on tuples.

Method	Description
count()	Returns the number of times a specified value occurs in a tuple
index()	Searches the tuple for a specified value and returns the position of where it was found

H.w نفذ مجموعة امثلة عن الطرق أعلاه في المختبر

H.W\\ what's the outputs of the following:

1- letters = ('p', 'r', 'o', 'g', 'r', 'a', 'm', 'i', 'z')

```
print(letters[-1])
print(letters[-3])
```

2- my_tuple = ('p', 'r', 'o', 'g', 'r', 'a', 'm', 'i', 'z')

```
print(my_tuple[1:4])
print(my_tuple[:-7])
print(my_tuple[7:])
print(my_tuple[:])
```

3- my_tuple = ('a', 'p', 'p', 'l', 'e',)

```
print(my_tuple.count('p'))
print(my_tuple.index('l'))
```

4- languages = ('Python', 'Swift', 'C++')

```
print('C' in languages)
print('Python' in languages)
```

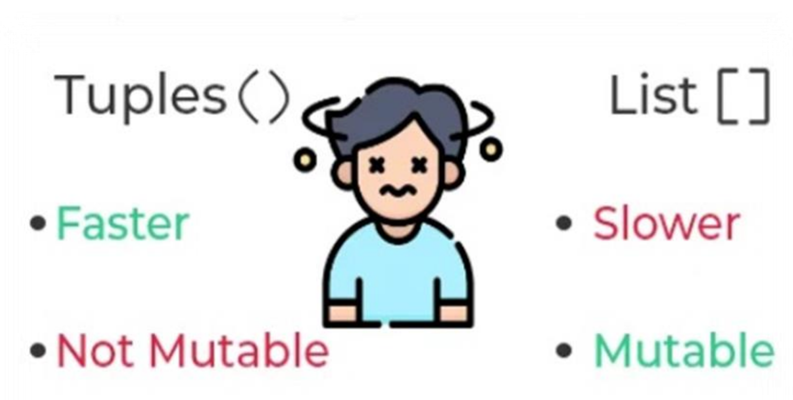
5- var1 = ("hello")

```
print(type(var1))
var2 = ("hello",)
print(type(var2))
var3 = "hello",
print(type(var3))
```

4.3 Advantages of Tuple over List in Python

Since tuples are quite similar to lists, both of them are used in similar situations. However, there are certain advantages of implementing a tuple over a list:

1. We generally use tuples for heterogeneous (different) data types and lists for homogeneous (similar) data types.
2. Since tuples are immutable, iterating through a tuple is faster than with a list. So there is a slight performance boost.
3. Tuples that contain immutable elements can be used as a key for a dictionary. With lists, this is not possible.
4. If you have data that doesn't change, implementing it as tuple will guarantee that it remains write-protected.



((End of lecture 4))

5.1 Python Sets

myset = {"apple", "banana", "cherry"}

Sets are used to store multiple items in a single variable.

Set is one of **4** built-in data types in Python used to store collections of data, the other 3 are **List, Tuple**, **and Dictionary**, all with different qualities and usage.

A set is a collection which is *unordered, unchangeable**, and *unindexed.*

*** Note: Set *items* are unchangeable, but you can remove items and add new items.**

Sets are written with curly brackets.

Example

Create a Set:

```
thisset = {"apple", "banana", "cherry"}
print(thisset)

output\\{'banana', 'cherry', 'apple'}
```

Example

```
# create a set of integer type

student_id = {112, 114, 116, 118, 115}

print('Student ID:', student_id)

# create a set of string type

vowel_letters = {'a', 'e', 'i', 'o', 'u'}
```

```
print('Vowel Letters:', vowel_letters)

# create a set of mixed data types

mixed_set = {'Hello', 101, -2, 'Bye'}

print('Set of mixed data types:', mixed_set)
```

outputs\\ Student ID: {112, 114, 115, 116, 118}

Vowel Letters: {'i', 'u', 'o', 'a', 'e'}

Set of mixed data types: {'Bye', 101, -2, 'Hello'}

1- Python - Access Set Items

You cannot access items in a set by referring to an index or a key.

But you can loop through the set items using a **for** loop, or ask if a specified value is present in a set, by using the **in** keyword.

Example

Loop through the set, and print the values:

```
thisset = {"apple", "banana", "cherry"}
for x in thisset:
  print(x)
```

output\\ apple

banana

cherry

Example

Check if "banana" is present in the set:

```
thisset = {"apple", "banana", "cherry"}
print("banana" in thisset)
```

output\\ True

2- Python - Add Set Items

Once a set is created, you cannot change its items, but you can add new items. To add one item to a set use the **add()** method.

Example

Add an item to a set, using the add() method:

```
thisset = {"apple", "banana", "cherry"}

thisset.add("orange")

print(thisset)

output\\ {'orange', 'banana', 'apple', 'cherry'}
```

Example

```
numbers = {21, 34, 54, 12}

print('Initial Set:',numbers)

# using add() method

numbers.add(32)

print('Updated Set:', numbers)

output\\  Initial Set: {34, 12, 21, 54}

          Updated Set: {32, 34, 12, 21, 54}
```

3- Python - Remove Set Items

To remove an item in a set, use the **remove()**, or the **discard()** method.

Example

Remove "banana" by using the remove() method:

```
thisset = {"apple", "banana", "cherry"}

thisset.remove("banana")
print(thisset)
```

output\\ {'cherry', 'apple'}

Example

Remove "banana" by using the discard() method:

```
thisset = {"apple", "banana", "cherry"}

thisset.discard("banana")
print(thisset)
```

output\\ {'apple', 'cherry'}

Note: If the item to remove does not exist, discard() will NOT raise an error.

4- Python - Loop Sets

You can loop through the set items by using a **for** loop:

Example

Loop through the set, and print the values:

```
thisset = {"apple", "banana", "cherry"}
for x in thisset:
  print(x)
```

```
output\\ apple
         cherry
         banana
```

5- Python - Join Sets

Join Two Sets

There are several ways to join two or more sets in Python.

You can use the **union()** method that returns a new set containing all items from both sets, or the **update()** method that inserts all the items from one set into another:

Example

The union() method returns a new set with all items from both sets:

```
set1 = {"a", "b" , "c"}
set2 = {1, 2, 3}

set3 = set1.union(set2)
print(set3)
```

```
output\\ {1, 2, 3, 'a', 'c', 'b'}
```

6- Set Methods

Python has a set of built-in methods that you can use on sets.

Method	Description
add()	Adds an element to the set
clear()	Removes all the elements from the set
copy()	Returns a copy of the set
difference()	Returns a set containing the difference between two or more sets
difference_update()	Removes the items in this set that are also included in another, specified set
discard()	Remove the specified item
intersection()	Returns a set, that is the intersection of two other sets
intersection_update()	Removes the items in this set that are not present in other, specified set(s)
isdisjoint()	Returns whether two sets have a intersection or not
issubset()	Returns whether another set contains this set or not
issuperset()	Returns whether this set contains another set or not

pop()	Removes an element from the set
remove()	Removes the specified element
union()	Return a set containing the union of sets
update()	Update the set with the union of this set and others

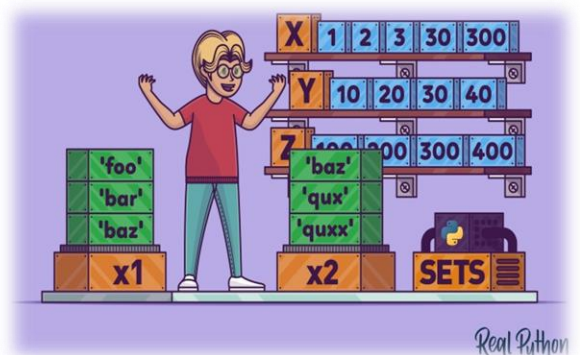
H.w\\ نفذ مجموعة من الأمثلة في المختبر عن الطرق أعلاه

H.w

1- companies = {'Lacoste', 'Ralph Lauren'}

```
tech_companies = ['apple', 'google', 'apple']
companies.update(tech_companies)
print(companies)
```

Output\\



2- even_numbers = {2,4,6,8}

```
print('Set:',even_numbers)
# find number of elements
print('Total Elements:', len(even_numbers))
```

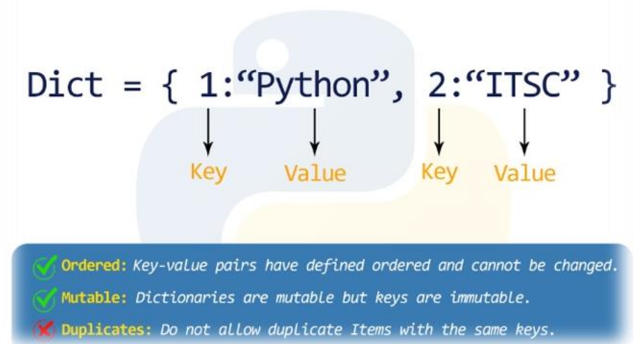
output\\

3- use the `==` operator to check whether two sets are equal or not.

A = {1, 3, 5} , B = {3, 5, 1}

5.2 Python Dictionaries

```
thisdict = {
  "brand": "Ford",
  "model": "Mustang",
  "year": 1964
}
```



Dictionaries are used to store data values in key:value pairs.

A dictionary is a collection which is ordered*, changeable and do not allow duplicates.

As of Python version 3.7, dictionaries are *ordered*. In Python 3.6 and earlier, dictionaries are *unordered*.

Dictionaries are written with curly brackets, and have keys and values:

Example

Create and print a dictionary:

```
thisdict = {
  "brand": "Ford",
  "model": "Mustang",
  "year": 1964
}
print(thisdict)
```

output\\ {'brand': 'Ford', 'model': 'Mustang', 'year': 1964}

1- Dictionary Items

Dictionary items are ordered, changeable, and does not allow duplicates.

Dictionary items are presented in key:value pairs, and can be referred to by using the key name.

Example

Print the "brand" value of the dictionary:

```
thisdict = {
  "brand": "Ford",
  "model": "Mustang",
  "year": 1964
}
print(thisdict["brand"])
```

output\\ Ford

2- python - Access Dictionary Items

You can access the items of a dictionary by referring to its key name, inside square brackets:

Example

Get the value of the "model" key:

```
thisdict = {
  "brand": "Ford",
  "model": "Mustang",
  "year": 1964
}
x = thisdict["model"]
```

output\\ Mustang

Example

Add a new item to the original dictionary, and see that the keys list gets updated as well:

```
car = {
"brand": "Ford",
"model": "Mustang",
"year": 1964
}
```

```
x = car.keys()
print(x) #before the change
car["color"] = "white"
print(x) #after the change
```

```
output\\  dict_keys(['brand', 'model', 'year'])

          dict_keys(['brand', 'model', 'year', 'color'])
```

3- Removing Items

There are several methods to remove items from a dictionary:

Example

The pop() method removes the item with the specified key name:

```
thisdict = {
  "brand": "Ford",
  "model": "Mustang",
  "year": 1964
}
thisdict.pop("model")
print(thisdict)
```

```
output\\ {'brand': 'Ford', 'year': 1964}
```

4- Python - Loop Dictionaries

Loop Through a Dictionary

You can loop through a dictionary by using a for loop.

When looping through a dictionary, the return value are the *keys* of the dictionary, but there are methods to return the *values* as well.

Example

Print all key names in the dictionary, one by one:

```
thisdict ={

  "brand": "Ford",

  "model": "Mustang",

  "year": 1964

}

    for x in thisdict:
     print(x)


output\\brand
           model
           year
```

Example

Print all *values* in the dictionary, one by one:

```
thisdict ={

  "brand": "Ford",

  "model": "Mustang",

  "year": 1964

}

    for x in thisdict:
        print(thisdict[x])


    output\\ Ford

                 Mustang

                 1964
```

5- Dictionary Methods

Python has a set of built-in methods that you can use on dictionaries.

Method	Description
clear()	Removes all the elements from the dictionary
copy()	Returns a copy of the dictionary
fromkeys()	Returns a dictionary with the specified keys and value
get()	Returns the value of the specified key
items()	Returns a list containing a tuple for each key value pair
keys()	Returns a list containing the dictionary's keys
pop()	Removes the element with the specified key
popitem()	Removes the last inserted key-value pair
setdefault()	Returns the value of the specified key. If the key does not exist: insert the key, with the specified value
update()	Updates the dictionary with the specified key-value pairs
values()	Returns a list of all the values in the dictionary

H.w\\ نفذ مجموعة من الأمثلة في المختبر عن الطرق أعلاه

H.W

1- # Membership Test for Dictionary Keys

```
squares = {1: 1, 3: 9, 5: 25, 7: 49, 9: 81}
print(1 in squares)
print(2 not in squares)
# membership tests for key only not value
print(49 in squares)
```

output

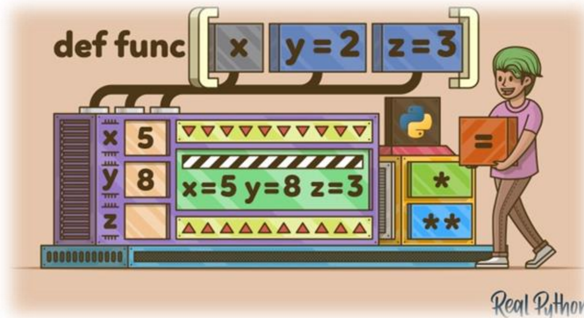
2-

```
student_id = {111: "Eric", 112: "Kyle", 113: "Butters"}
print("Initial Dictionary: ", student_id)
student_id[112] = "Stan"
print("Updated Dictionary: ", student_id)
```

output

((End of lecture 5))

6.1 Python Functions



A function is a block of code which only runs when it is called.

You can pass data, known as parameters, into a function.

A function can return data as a result.

Types of function

There are two types of function in Python programming:

- **Standard library functions** - These are built-in functions in Python that are available to use.
- **User-defined functions** - We can create our own functions based on our requirements.

1- Creating a Function

In Python a function is defined using the **def** keyword:

The syntax to declare a function is:

```
def function_name(arguments):
    # function body
    return
```

Here,

- def - keyword used to declare a function
- function_name - any name given to the function

- arguments - any value passed to function
- return (optional) - returns value from a function

Example

```
def my_function():
  print("Hello from a function")
```

2- Calling a Function

To call a function, use the function name followed by parenthesis:

Example

```
def my_function():
    print("Hello from a function")

  my_function()


output\\ Hello from a function
```

3- Arguments

Information can be passed into functions as arguments.

Arguments are specified after the function name, inside the parentheses. You can add as many arguments as you want, just separate them with a comma.

The following example has a function with one argument (fname). When the function is called, we pass along a first name, which is used inside the function to print the full name:

Example

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

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

***Arguments* are often shortened to *args* in Python documentations.**

4- Parameters or Arguments?

The terms ***parameter*** and ***argument*** can be used for the same thing: information that are passed into a function.

From a function's perspective:

A parameter is the variable listed inside the parentheses in the function definition.

An argument is the value that is sent to the function when it is called.

5- Number of Arguments

By default, a function must be called with the correct number of arguments. Meaning that if your function expects 2 arguments, you have to call the function with 2 arguments, not more, and not less.

Example

This function expects 2 arguments, and gets 2 arguments:

```
def my_function(fname, lname):
  print(fname + " " + lname)

my_function("Emil", "Refsnes")
```

output\\ Emil Refsnes

As mentioned earlier, a function can also have arguments. An argument is a value that is accepted by a function. For example,

Example

```
# function with two arguments

def add_numbers(num1, num2):
```

```
    sum = num1 + num2

    print('Sum: ',sum)


# function with no argument

def add_numbers():
```

If we create a function with arguments, we need to pass the corresponding values while calling them. For example,

Example

```
# function call with two values

add_numbers(5, 4)


# function call with no value

add_numbers()
```

Here, add_numbers(5, 4) specifies that arguments num1 and num2 will get values 5 and 4 respectively.

Example

```
def add_numbers(num1, num2):

    sum = num1 + num2

    print("Sum: ",sum)

    add_numbers(5, 4)

    Output\\ Sum: 9
```

6- Passing a List as an Argument

You can send any data types of argument to a function (string, number, list, dictionary etc.), and it will be treated as the same data type inside the function.

E.g. if you send a List as an argument, it will still be a List when it reaches the function:

Example

```
def my_function(food):
  for x in food:
    print(x)

fruits = ["apple", "banana", "cherry"]

my_function(fruits)
```

```
output\\  apple

          banana

          cherry
```

7- Return Values

A Python function may or may not return a value. If we want our function to return some value to a function call, we use the return statement. For example,

Example

```
def my_function(x):
  return 5 * x

print(my_function(3))
print(my_function(5))
print(my_function(9))
```

output\\ 15

25

45

Note: The return statement also denotes that the function has ended. Any code after return is not executed.

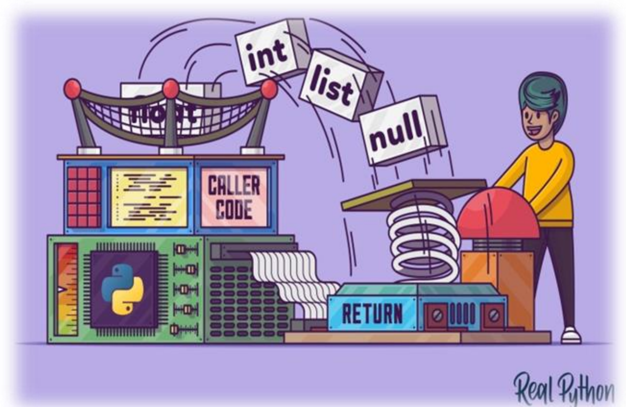
Example

```
def find_square(num):
    result = num * num
    return result
# function call
square = find_square(3)

print('Square:',square)
```

Output\\ Square: 9

Example

```
# function that adds two numbers
def add_numbers(num1, num2):
    sum = num1 + num2
    return sum
# calling function with two values
result = add_numbers(5, 4)

print('Sum: ', result)
```



Output\\ Sum: 9

8- Python Variable Scope

In Python, we can declare variables in three different scopes: local scope, global, and nonlocal scope. A variable scope specifies the region where we can access a variable. For example,

```
def add_numbers():
    sum = 5 + 4
```

Here, the **sum** variable is created inside the function, so it can only be accessed within it (local scope). This type of variable is called a local variable.

Based on the scope, we can classify Python variables into three types:

1. Local Variables
2. Global Variables
3. Nonlocal Variables

1- Local Scope

A variable created inside a function belongs to the *local scope* of that function, and can only be used inside that function.

Example

A variable created inside a function is available inside that function:

```
def myfunc():
  x = 300
  print(x)

myfunc()


output\\ 300
```

Example

```
def greet():
    message = 'Hello'
        print('Local', message)

greet()
# try to access message variable
# outside greet() function
print(message)
```

Output\\ Local Hello

NameError: name 'message' is not defined

2- Global Scope

A variable created in the main body of the Python code is a global variable and belongs to the global scope.

Global variables are available from within any scope, global and local.

Example

```
# declare global variable
message = 'Hello'
def greet():
    print('Local', message)

greet()
print('Global', message)
```

Output\\Local Hello

Global Hello

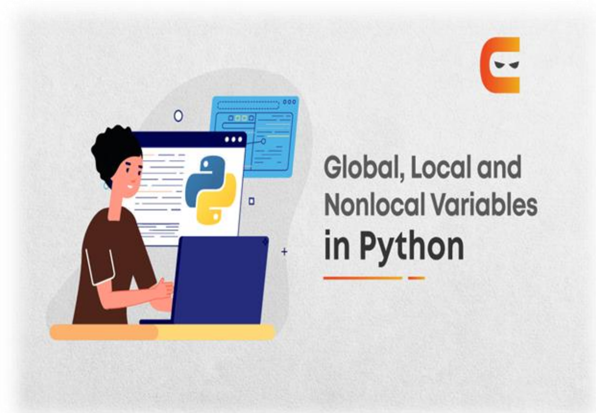
This time we can access the **message** variable from outside of the greet() function.

This is because we have created the **message** variable as the global variable.

Example

A variable created outside of a function is global and can be used by anyone:

```
x = 300

def myfunc():
  print(x)

myfunc()

print(x)
```



output\ 300

300

Example

The function will print the local x, and then the code will print the global x:

```
x = 300

def myfunc():
  x = 200
  print(x)

myfunc()

print(x)
```

output\\ 200

300

Example

To change the value of a global variable inside a function, refer to the variable by using the global keyword:

```
x = 300

def myfunc():
  global x
  x = 200

myfunc()

print(x)


output\\ 200
```

3- Python Nonlocal Variables

In Python, nonlocal variables are used in nested functions whose local scope is not defined. This means that the variable can be neither in the local nor the global scope.

We use the nonlocal keyword to create nonlocal variables.For example,

Example

```
# outside function

def outer():

    message = 'local'


    # nested function

    def inner():

        # declare nonlocal variable

        nonlocal message


        message = 'nonlocal'
```

```
        print("inner:", message)

    inner()
    print("outer:", message)

outer()
```

Output\\inner: nonlocal

outer: nonlocal

In the above example, there is a nested inner() function. We have used the nonlocal keywords to create a nonlocal variable.

6.2 Python Library Functions

In Python, standard library functions are the built-in functions that can be used directly in our program. For example,

- `print()` - prints the string inside the quotation marks
- `sqrt()` - returns the square root of a number
- `pow()` - returns the power of a number

These library functions are defined inside the module. And, to use them we must include the module inside our program.

For example, sqrt() is defined inside the math module.

Example

```
import math
# sqrt computes the square root
square_root = math.sqrt(4)
```

```
print("Square Root of 4 is",square_root)

# pow() comptes the power
power = pow(2, 3)

print("2 to the power 3 is",power)
```

Output\\ Square Root of 4 is 2.0

2 to the power 3 is 8

In the above example, we have used

- **math.sqrt(4) - to compute the square root of 4**
- **pow(2, 3) - computes the power of a number i.e. 2^3**

Here, notice the statement,

import math

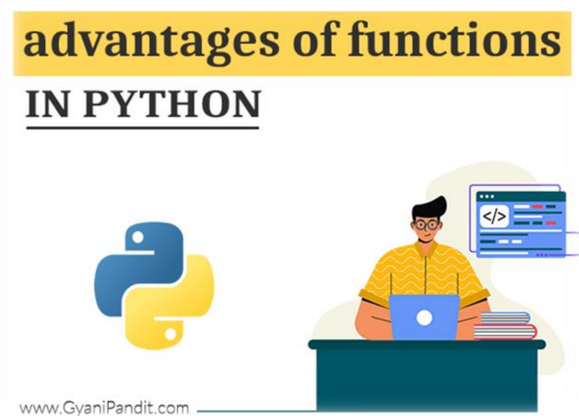
Since sqrt() is defined inside the math module, we need to include it in our program.

6.3 Benefits of Using Functions

1. Code Reusable - We can use the same function multiple times in our program which makes our code reusable. For example,

Example

```
# function definition
def get_square(num):
    return num * num

for i in [1,2,3]:
    # function call
    result = get_square(i)
    print('Square of',i, '=',result)
```



Output\\Square of 1 = 1

Square of 2 = 4

Square of 3 = 9

In the above example, we have created the function named get_square() to calculate the square of a number. Here, the function is used to calculate the square of numbers from 1 to 3.

Hence, the same method is used again and again.

2. Code Readability - Functions help us break our code into chunks to make our program readable and easy to understand.

H.W\\

1- Define a function that accepts 2 values and return its sum, subtraction and multiplication.

2- Define a function that accepts roll number and returns whether the student is present or absent.

3-Define a function in python that accepts 3 values and returns the maximum of three numbers.

4-Define a function that accepts a number and returns whether the number is even or odd.

5-Define a function that returns Factorial of a number.

6-Define a function that accepts lowercase words and returns uppercase words.

7-Define a function that accepts radius and returns the area of a circle.

8-Write a Python function to find the maximum of three numbers

9-Write a Python function to sum all the numbers in a list.

10-Write a Python program to reverse a string.

11-Write a Python program to print the even numbers from a given list.

12- Write a Python function that accepts different values as parameters and returns a list.

13- Write a Python function that returns a dictionary.

14- Write a Python function that returns a tuple.

15- Write a Python function that returns the following:

5

4

3

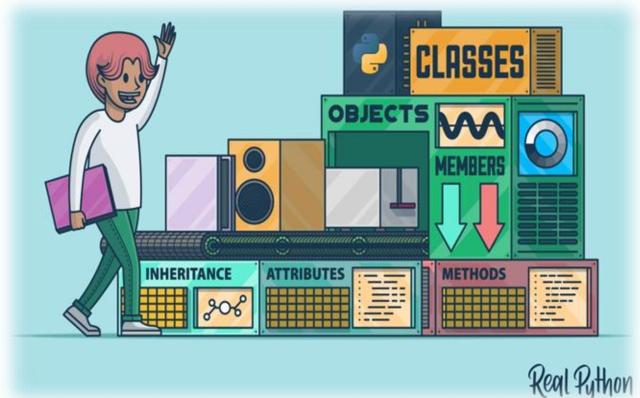
2

1

stop

((End of lecture 6))

7.1 Python Classes and Object



Python is an object oriented programming language.

Almost everything in Python is an object, with its properties and methods. A Class is like an object constructor, or a "blueprint" for creating objects.

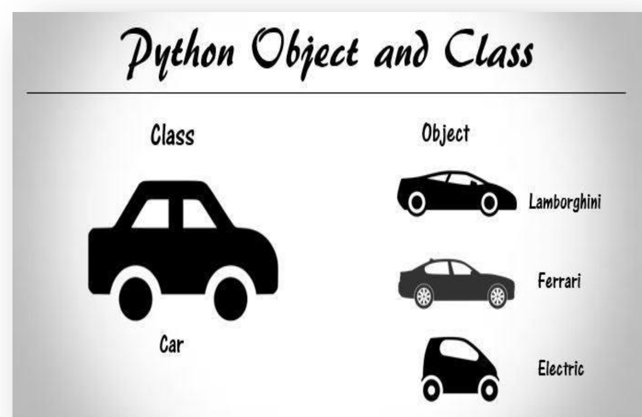
1- Create a Class

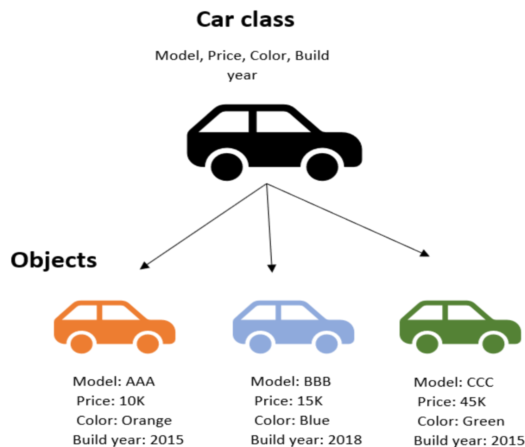
To create a class, use the keyword class:

Example

Create a class named MyClass, with a property named x and function named increment :

```
class MyClass:

  name='ali'
  age = 30          #variable

  def myfunc (self):      # function

      print( self.name, self.age)
```





2- Create Object

Now we can use the class named MyClass to create objects:

Example

Create an object named p1, and print the value of x:

```
p1 = MyClass()
print (p1.name,p1.age)

p1.myfunc ()
```

استدعاء الدالة وهنا self يقصد به اسم object

```
class MyClass:

  def increment (self, name,age):

    self. name =name

    self.age=age

    print (self name,self.age)

  p1 = MyClass()

  p1.increment ('ALI', 20)
```

```
class MyClass:

  def myfunc (self):

    self.name = 'ALI'
    self.age =30
    print (self.name, self.age)

  p1 = MyClass()

  p1. myfunc t()
```

3- The __init__() Function

The examples above are classes and objects in their simplest form, and are not really useful in real life applications.

To understand the meaning of classes we have to understand the built-in **__init__() function.**

All classes have a function called **__init__(),** which is always executed when the class is being initiated.

Use the **__init__()** function to assign values to object properties, or other operations that are necessary to do when the object is being created:

Example

Create a class named Person, use the __init__() function to assign values for name and age:

```
class Person:
  def __init__(self, name, age):
    self.name = name
    self.age = age

 p1 = Person("John", 36)

 print(p1.name)
 print(p1.age)
```

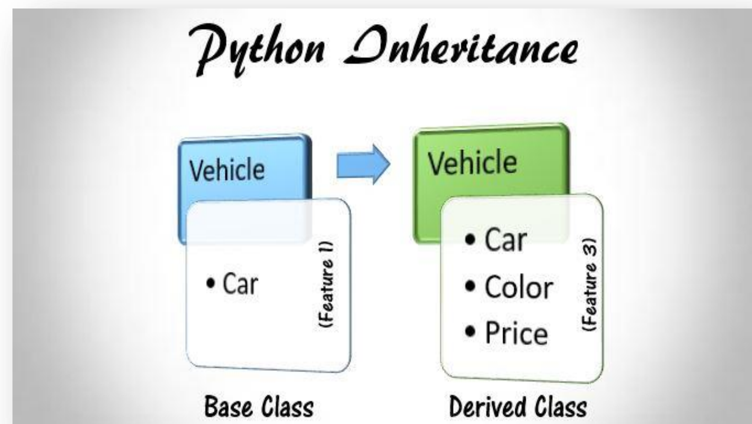
Note: The __init__() **function is called automatically every time the class is being used to create a new object.**

Example

Insert a function that prints a greeting, and execute it on the p1 object:

```
class Person:
  def __init__(self, name, age):
    self.name = name
    self.age = age

  def myfunc(self):
    print("Hello my name is " + self.name)

p1 = Person("John", 36)
p1.myfunc()
```

7.2 Python Inheritance:

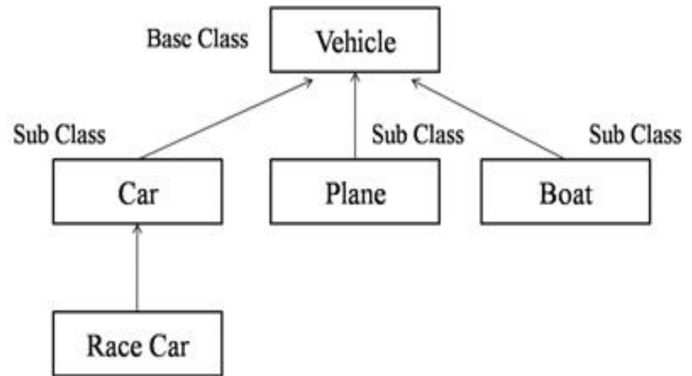


Inheritance allows us to define a class that inherits all the methods and properties from another class.

Parent class is the class being inherited from, also called base class.

Child class is the class that inherits from another class, also called derived class.

1- Create a Parent Class



Any class can be a parent class, so the syntax is the same as creating any other class:

Example

Create a class named Person, with firstname and lastname properties, and a printname method:

```
class Person:
  def __init__(self, fname, lname):
    self.firstname = fname
    self.lastname = lname

  def printname(self):
    print(self.firstname, self.lastname)

#Use the Person class to create an object, and then execute the printname method:

x = Person("John", "Doe")
x.printname()
```

2- Create a Child Class

To create a class that inherits the functionality from another class, send the parent class as a parameter when creating the child class:

Example

Create a class named Student, which will inherit the properties and methods from the Person class:

```
class Student(Person):
  pass
```

Note: Use the pass keyword when you do not want to add any other properties or methods to the class.

Now the Student class has the same properties and methods as the Person class.

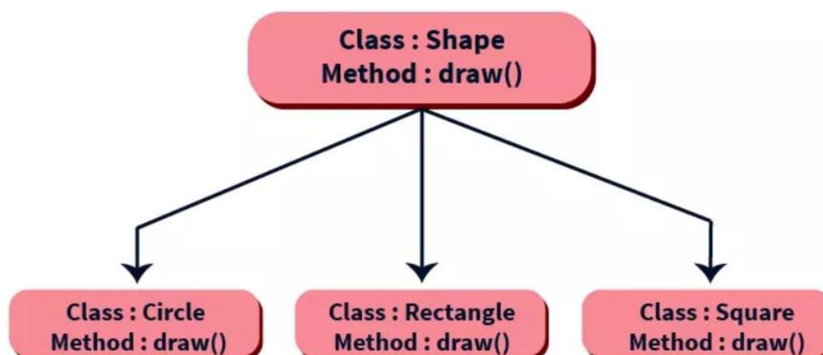
Example

Use the Student class to create an object, and then execute the printname method:

```
x = Student("Mike", "Olsen")
x.printname()
```

❖ Uses of Inheritance

1. Since a child class can inherit all the functionalities of the parent's class, this allows code reusability.
2. Once a functionality is developed, you can simply inherit it. No need to reinvent the wheel. This allows for cleaner code and easier to maintain.
3. Since you can also add your own functionalities in the child class, you can inherit only the useful functionalities and define other required features.



3- Add the __init__() Function

So far we have created a child class that inherits the properties and methods from its parent.

We want to add the __init__() function to the child class (instead of the **pass** keyword).

Note: The __init__() function is called automatically every time the class is being used to create a new object.

Example

Add the __init__() function to the Student class:

```
class Student(Person):
  def __init__(self, fname, lname):
    #add properties etc.
```

When you add the __init__() function, the child class will no longer inherit the parent's __init__() function.

Note: The child's __init__() function overrides the inheritance of the parent's __init__() function.

To keep the inheritance of the parent's __init__() function, add a call to the parent's __init__() function:

Example

```
class Student(Person):
  def __init__(self, fname, lname):
    Person.__init__(self, fname, lname)
```

Now we have successfully added the __init__() function, and kept the inheritance of the parent class, and we are ready to add functionality in the __init__() function.

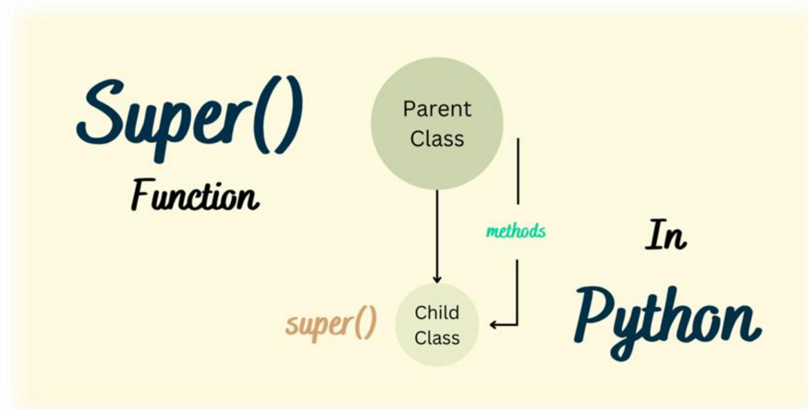
4- Use the super() Function

Python also has a **super()** function that will make the child class inherit all the methods and properties from its parent:

Example

```
class Student(Person):
  def __init__(self, fname, lname):
    super().__init__(fname, lname)
```

By using the **super()** function, you do not have to use the name of the parent element, it will automatically inherit the methods and properties from its parent**.**



❖ Add Properties

Example

Add a property called graduationyear to the Student class:

```
class Student(Person):
  def __init__(self, fname, lname):
    super().__init__(fname, lname)
    self.graduationyear = 2019
```

In the example below, the year **2019** should be a variable, and passed into the **Student** class when creating student objects. To do so, add another parameter in the **__init__() function:**

Example

Add a year parameter, and pass the correct year when creating objects:

```
class Student(Person):
  def __init__(self, fname, lname, year):
    super().__init__(fname, lname)
    self.graduationyear = year

x = Student("Mike", "Olsen", 2019)
```

❖ Add Methods

Example

Add a method called welcome to the Student class:

```
class Student(Person):
  def __init__(self, fname, lname, year):
    super().__init__(fname, lname)
    self.graduationyear = year

  def welcome(self):
    print("Welcome", self.firstname, self.lastname, "to the class of",
self.graduationyear)
```

If you add a method in the child class with the same name as a function in the parent class, the inheritance of the parent method will be overridden.

H.W\\

1) Can create multiple objects from a single class? Answer with example.
2) Write a Python program to create a class representing a Circle. Include methods to calculate its area and perimeter.
3) Write a Python program to create a person class. Include attributes like name, country and date of birth. Implement a method to determine the person's age.
4) Write a Python program to create a calculator class. Include methods for basic arithmetic operations.
5) Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.
6) Write a Python program to create a class representing a shopping cart. Include methods for adding and removing items, and calculating the total price.

((End of lecture 7))