Python Programming Language

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Python Introduction

What is Python?

Python is a popular programming language. It is being used in

- Machine Learning Applications
- Scientific Applications
- Software Development
- Web development
- Desktop Applications
- Web scraping
- Game Development

The most recent major version of Python is Python 3.

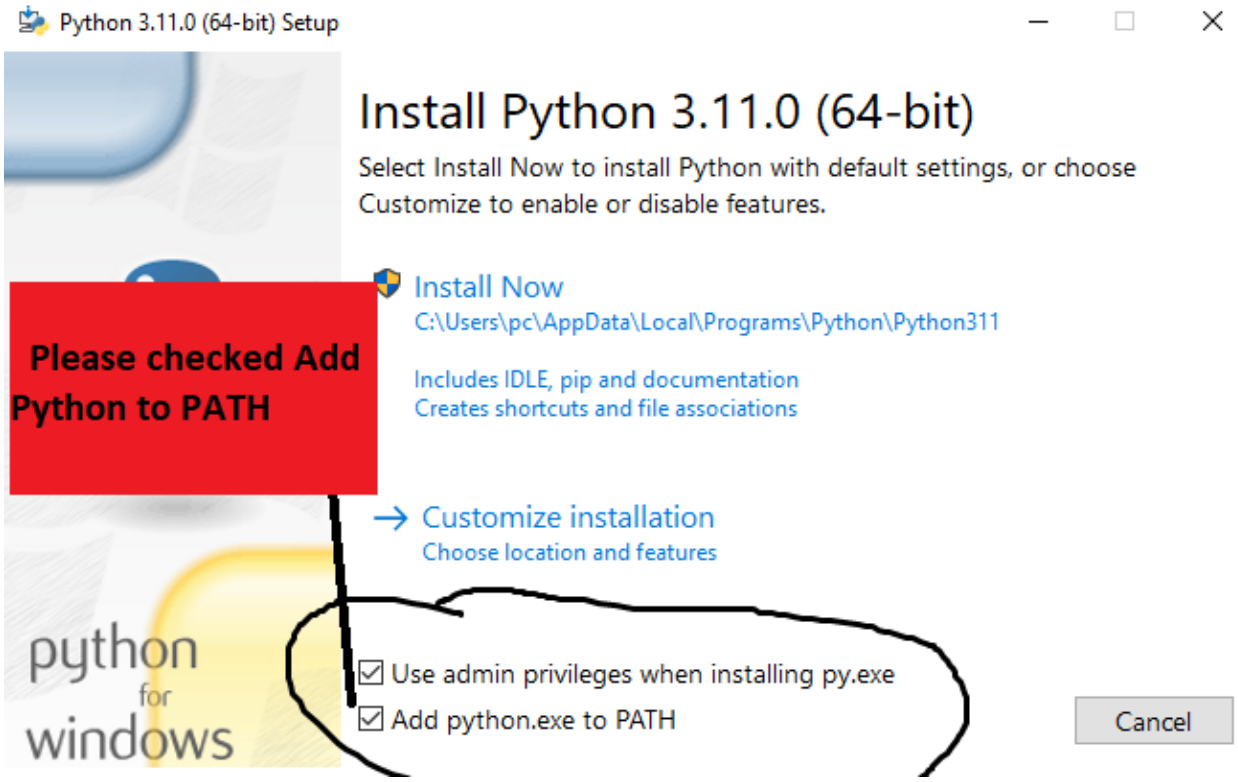
Organizations using Python:

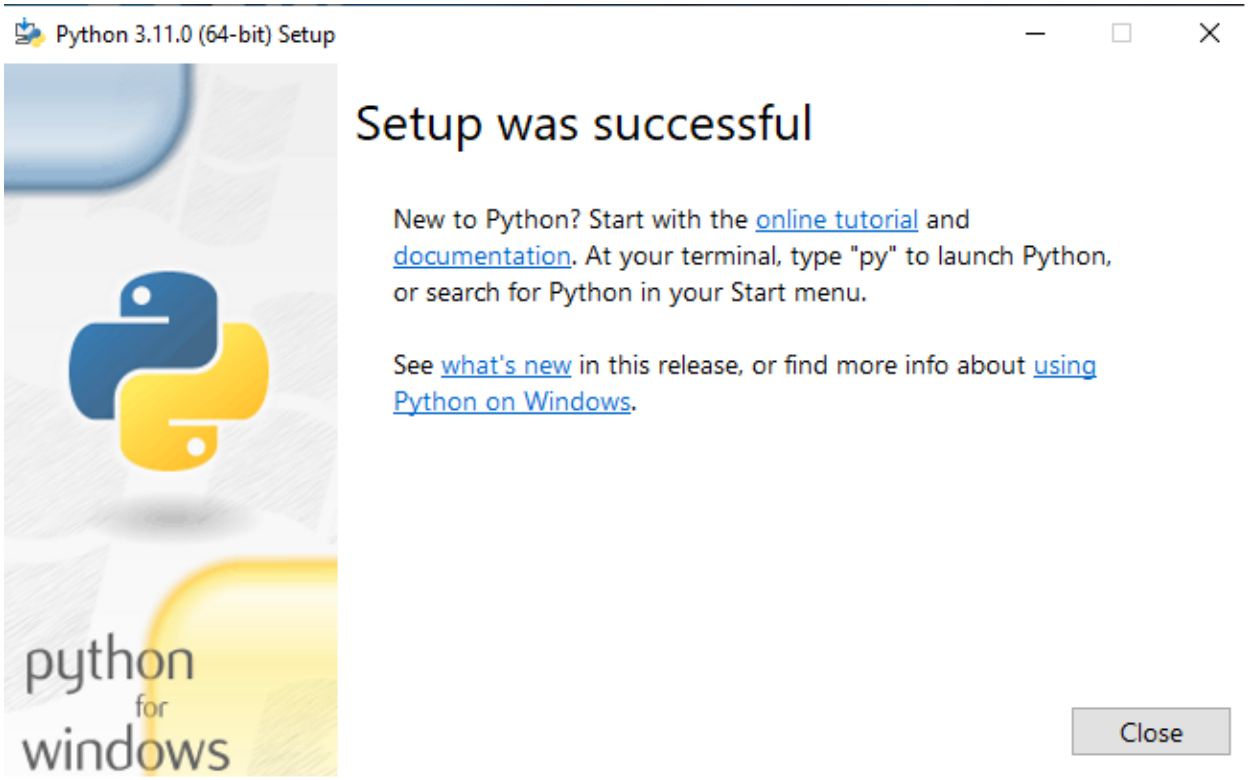
- Google(Components of Google spider and Search Engine)
- Yahoo(Maps)
- YouTube
- Mozilla
- Dropbox
- Microsoft
- Cisco
- Spotify
- Quora

Python installation & IDE & Python Syntax

Download Python

Download and install from the Python website https://www.python.org/





Below is the command to check whether python is installed or not

python --version

IDE :-

There are many Python IDE's but we prefer Visual Studio.

Python Syntax

print("Hello World")

The Python Command Line
Python can be executed from the command line
Below is the command to run Python from the command line:

C:\Users\User Name>python

Python Comments & Indentation

Comments

Comments are used to explain Python code.

There are 2 types of comments in Python

1. # Commnet Text

2. """ Multiple Line Comment Example Multiple Line Comment Example
    a. Multiple Line Comment Example Multiple Line Comment Example
    b. Multiple Line Comment Example Multiple Line Comment Example
    c. Multiple Line Comment Example Multiple Line Comment Example
    d. Multiple Line Comment Example Multiple Line Comment Example
    e. """

Python Indentation

Python Variables

x = 10
age = 23
name = "Mike"

Variable Name

A variable name can only contain alpha-numeric characters and underscores (A-z, 0-9, and _)
A variable name must start with a letter or the underscore character
A variable name cannot start with a number
Variable names are case-sensitive (address, Address and Address are three different variables)

In case of multiple words, we can use either technique for better readability.

Camel Case

myVariableName = "Mike"
studentAge = "22"

Pascal Case

MyVariableName = "Rohan"
StudentAge = "25"

Snake Case

my_variable_name = "John"
student_age = "26"

Assign One Value to Multiple Variables

x = y = z = 10

Assign Many Values to Multiple Variables

name, qty, price = “Banana”, 12, 2.50

Case-Sensitive

Variable names are case-sensitive. I.e age , Age, AGE are all different variables

Variable Type

```
x = 50
y = "Mike"
print(type(x))
print(type(y))
```

Casting

x = “12”

x = float(x)

x = int(x)

Can not add int and string

```
x = 50
y = "20"
y = x + int(y)
print(z)
```

Variable Deletion

```
x = 50
print(x)
del x
print(x)
```

Python Input / Output

Output

```
print("This is an example of print")

print("This is an example of print", "This is an another example of print")

name = "Mike"

print(name)

#In case of string, we can concatenate
print("My name is "+ name )

#in case of int, the above statement will not work

age = "10"

Print ( f " Your age is {age}")

Print ( f " Your age is {age}" , end = ")
Print ( f " Your age is {age}")
```

Python input

```
x = input ( "Enter your name ")

age = int(input ( "Enter your age"))

price = float(input ( "Enter the price"))
```

Exercise

Write a program to swap the two numbers.

Python Data Types

Python has the following standard data types −

1. Numbers
2. Boolean Type
3. String
4. List
5. Tuple
6. Set
7. Dictionary

1. Numbers

There are three numeric types in Python:

1. int
2. float
3. Complex

```
x = 12   # int
y = 4.52  # float
z = 5j   # complex or z = 1+5j

a = -100  # int
```

Number can be converted in each other:

```
a = float(x)
b = int(y)
```

2. Booleans

Boolean has two values: True or False.

```
x =  True
y = Flase
print( 9 > 7)
```

a = bool(12)

Python Strings

A sting is a set of characters and can be created by using single quotation marks, or double quotation.

x = “This is an example of string”
Name =”Mike”

print(x)

Multiline Strings

**x = """Lorem ipsum dolor sit amet,
consectetur adipiscing elit,
sed do eiusmod tempor incididunt
ut labore et dolore magna aliqua."""**

print(x)

Strings are Arrays

x = “Python Program”

print(x[5])

```
print(x[-2])
print(x[10])
print(x[-8])
```

String Length

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

String “in” and “not in”

```
x = "The world is a awesome place"
print(“world” in x )
print(“bad” in x )

x = "Python is an easy language"
print(“hard” not in x )
print(“easy” not in x )
```

Slicing Strings

Return the sub string by using slice syntax

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

```
x = “Python Program”
print(x[2:5])
```

Slice From the Start

```
x = “Python Program”
print(x[:5])
```

Slice to the end

```
x = “Python Program”
print(x[3:])
```

Negative Indexing

Get the characters from position -7 to position -3 (not included)

```
x = “Python Program”
print(x[-7:-3])
```

Slice From the Start

```
x = “Python Program”
print(x[:-2])
```

Slice to the end

```
x = “Python Program”
print(x[-9:])
```

String Concatenation

```
x = “Hello”
y = “World”
z =  x + y
print(z)
```

```
z =  x +’ ’+ y
print(z)
```

String Format

we can combine strings and numbers by using the format() method!

```
quantity = 5
item = “Apple”
price = 21.50
str= "I want {} kg {} for {} dollars."
print(str.format(quantity, item , price))
```

```
quantity = 5
item = “Apple”
price = 21.50
str= "I want {1} kg {2} for {0} dollars."
print(str.format(price, quantity, item))
```

Escape Sequencing

If we want to put single or double quotes in any string, we can't as string already contains Single and Double quote.

```
#Python is a "great" language
txt = "Python is a \"great\" language"
print(txt)

#I'm a programmer
txt = 'I\'m a programmer'
print(txt)
```

String Methods:

There are many string manipulation functions in Python, you can find complete ref here on Python site https://docs.python.org/2.5/lib/string-methods.html

Some important string function are listed below:

upper()

Return a copy of the string converted to uppercase.

```
x = "Hello, World!"
print(x.upper())  # returns HELLO WORLD
```

lower()

Return a copy of the string converted to lowercase.

```
x = "Hello, World!"
print(x.lower())   # returns hello, world!
```

capitalize()

Return a copy of the string with only its first character capitalized.

```
x = "hello, world!"
print(x.capitalize())    # returns Hello, world!
```

strip()

Return a copy of the string with the leading and trailing characters removed.

```
x = " Hello, World!  "
print(x.strip())  # returns Hello, World!
```

lstrip()

Return a copy of the string with leading characters removed.

```
x = "  Hello, World!  "
print(x.lstrip())   # returns Hello, World!
```

rstrip()

Return a copy of the string with trailing characters removed.

```
x = "Hello, World!  "
print(x.rstrip())         # returns Hello, World!
```

replace(old, new)

Return a copy of the string with all occurrences of substring old replaced by new.

```
x = "Hello, World!"
print(x.replace("Hello", "Hey"))  # returns Hey, World!
```

split(sep)

Return a list of the words in the string, using sep as the delimiter string.

```
a = "Hello, World!"
print(a.split(",")) # returns ['Hello', ' World!']
```

islower()

Return true if all cased characters in the string are lowercase

```
x = "hello, world!"
print(x.islower()) #returns true
```

title()

Return a titlecased version of the string:

```
x = "hello world!"
print(x.title()) #returns Hello World
```

Python Operators

Operators are used to perform operations on variables and values.

In the example below, + is the operator used to add two variables x and y

```
x = 10
y = 15
z = x + y
```

Below are the different types of Python operators:

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

Arithmetic operators

Arithmetic operators are used to performing mathematical operations like addition, subtraction, multiplication, and division.

Operator	Name	Syntax
+	Addition	x + y
-	Subtraction	x - y
*	Multiplication	x * y
/	Division	x / y
%	Modulus	x % y
**	Exponentiation	x ** y

Operator	Name	Syntax
//	Floor division	x // y

Comparison Operators

Comparison operators are used to compare two values.It either returns True or False according to the condition.

Operator	Name	Syntax
==	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

Logical Operators

Logical operators are used to combine conditional statements.

Operator	Description	Syntax
and	Returns True if both statements are true	x > y and a < b
or	Returns True if one of the statements is true	x > y or a < b
not	Reverse the result, returns False if the result is true	not (x > y or a < b)

Bitwise Operators

Bitwise operators are used to compare (binary) numbers.

Operator	Name	Description	Syntax
&	Bitwise AND	Sets each bit to 1 if both bits are 1	x & y
|	Bitwise OR	Sets each bit to 1 if one of two bits is 1	x | y
~	Bitwise NOT	Inverts all the bits(0 to 1 and 1 to 0)	~x
^	Bitwise XOR	Sets each bit to 1 if only one of two bits is 1	x ^ y
<<	Bitwise left shift	Shift left by pushing zeros in from the right and let the leftmost bits fall off	x << 2
>>	Bitwise right shift	Shift right by pushing copies of the leftmost bit in from the left, and let the rightmost bits fall off	x >> 3

Assignment Operators

Assignment operators are used to assign values to variables.

Operator	Syntax	Same as
=	x =10	x =10
+=	x +=y	x = x + y
-=	x -=y	x = x - y
*=	x *=y	x = x * y
/=	x /=y	x = x / y
%=	x %=y	x = x % y
//=	x //=y	x = x // y
**=	x **=y	x = x ** y
&=	x &=y	x = x & y

Operator	Syntax	Same as
|=	x |=y	x = x | y
^=	x ^=y	x = x ^ y
>>=	x >>=y	x = x >> y
<<=	x <<=y	x = x << y

Identity operators

is and is not are the identity operators both are used to check if two values are located on the same part of the memory.

Operator	Description	Syntax
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

Membership Operators

in and not in are the membership operators; used to test whether a sequence is presented in an object or not.

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

Python if else

```
if condition:
   # Statements to execute if
   # condition is true
```

```
x = 100

y = 20

if x > y:

  print("x is greater than y")
```

else

```
x = 100

y = 20

if x > y:

  print("x is greater than y")

else:

  print("x is not greater than y")
```

If -elif - else:

Short Hand If:

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

Short Hand If ... Else (Also known as Ternary Operators)

```
a = 2

b = 330

print(a) if a > b else print(b)
```

Nested If

The pass Statement

```
If x > y
```

```
pass
```

While Loop

There are two types of loop in Python:

while loops

for loops

While Loop

```
while expression:
   Statement1
   statement2
```

Example:

```
i = 1
while i < 11:
  print(i)
  i += 1
```

While loop with else

```
i = 1
while i < 11:
  print(i)
  i += 1
else:
  print("Loop is ended")
```

The else clause is only executed when while condition becomes false

Exercise:

1. Write a program to sum all the numbers between 1 to 100 using a while loop.

2. Write a program to print all the even numbers between 1 to 100 using a while loop.

3. Write a program to check whether a number is prime or not.

4. Write a program to prints all the characters except vowels (a, e, i, o, u) in a string given by the user.

5. Write a program to find the sum of all the odd numbers between 1 to 100 using a while loop.

For Loop

A for loop is used for iterating over a sequence

```
for var in iterable:
    # statements
```

Looping Through a String

```
name = "Python"
for x in name:
  print(x)
```

The range(start, end, step) Function

It's a built-in function that is used when a user needs to perform an action a specific number of times

```
for x in range(10):
  print(x)


for x in range(1, 11):
  print(x)


for x in range(1, 11, 2):
  print(x)
```

For loop with else

Executed when the for loop is finished

```
for x in range(1, 11):
```

```
  print(x)
else:
  print("Finally finished!")
```

Pass Statement

```
for i in range(1, 11)
    pass
```

Exercise:

1. Write a program to sum all the numbers between 1 to 100 using a for loop.

2. Write a program to print all the even numbers between 1 to 100 using a for loop.

3. Write a program to check whether a number is prime or not using for loop.

4. Write a program to prints all the characters except vowels (a, e, i, o, u) in a string given by the user.

5. Write a program to find the sum of all the odd numbers between 1 to 100 using a for loop.

Python Continue and Break

Continue Statement

Continue Statement returns the control to the beginning of the loop in both while and for loop

```
# Prints all letters except 'e',  and 'o'
str = "Hello World!"
for letter in str:
    if letter == 'e' or letter == 'o':
        continue
    print(‘Letter :', letter)
```

Break Statement

The break statement break the loop and brings control out of the loop.

```
#break the loop as soon 'e' or ‘o’ comes
str = ‘Hello World!’
for letter in str:
    if letter == 'e' or letter == 'o':
        break
print(‘Letter :', letter)
```

In case of break, “loop else” statement will not be executed as it executes after finishing of the loop.

Python List

There are 4 types of built-in data types used to store collections of data.

1. List
2. Tuple
3. Set
4. Dictionary

List

Lists are used to store multiple items in a single variable. Lists are created using square brackets:

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

List item can be any type of data type like int, float, string, boolean, list tuple, set etc

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

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

Ordered

Items in the list 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

Changeable

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

Allow Duplicates

Duplicate items are allowed in any list

Access Items

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

fruit_list = ["apple", "orange", "banana", "cherry", "kiwi", "melon", "mango"]
print( fruit_list[-3] )
```

Slicing of a List

```
fruit_list = ["apple", "orange", "banana", "cherry", "kiwi", "melon", "mango"]
print( fruit_list[2:6] )
print( fruit_list[2:] )
print( fruit_list[:6] )

print( fruit_list[-6:-2] )
print( fruit_list[-6:] )
print( fruit_list[:-2] )
```

len() function

Returns the length

type() function

Returns the type

```
fruit_list = ["apple", "orange", "banana", "cherry", "kiwi", "melon", "mango"]
print( len( fruit_list ) )
print( type( fruit_list ) )
```

The list() Constructor

It is also possible to use the list() constructor to make a list.

```
fruit_list = list(("apple", "orange", "banana", "cherry", "kiwi", "melon", "mango"))
print( fruit_list )
```

Check if Item Exists

```
if ( "mango" in fruit_list ):
        print("Yes mango is in the fruits list")
```

Update, Add, Remove item from a list

Update

```
fruit_list = ["apple", "orange", "banana", "cherry", "kiwi", "melon", "mango"]
fruit_list[0] = "green apple"
print( fruit_list )
```

Add

The append() method add an item to the end of the list

```
fruit_list = ["apple", "orange", "banana"]
print( fruit_list )
fruit_list.append("mango")
print( fruit_list )
```

The insert() method add an item at a specified index

```
fruit_list.insert(1, "cherry")
print( fruit_list )
```

Remove

The remove() method removes the specified item.

```
fruit_list.remove("orange")
print( fruit_list )
```

The pop() method removes the specified index. By default it removes last item

```
fruit_list.pop(1)
print( fruit_list )
```

```
fruit_list.pop(1)
print( fruit_list )
```

The del keyword also removes the specified index:

```
del fruit_list [0]
print( fruit_list )
```

The del keyword can also delete the list completely.

```
del fruit_list
print( fruit_list )
```

Looping Through a List

```
fruit_list = ["apple", "orange", "banana", "cherry", "kiwi", "melon", "mango"]
for x in fruit_list:
        print( x )

#using len() function
numbers = [20, 50, 68, 89, 100]
sum = 0
for x in numbers:
        sum += x

print(sum )

#using range() and len() function
numbers = [20, 50, 68, 89, 100]
sum = 0
for x in range( len( numbers ) ):
        sum += numbers[x]

print(sum )

#using while loop
numbers = [20, 50, 68, 89, 100]
sum = 0
i = 0
while i < len( numbers ):
        sum += numbers[i]
        i += 1
print(sum )
```

List Comprehension

If you have list of number and want to create new list only containing even number, below is the code to achieve this.

```
numbers = [20, 50, 68, 89, 100, 119, 34, 8, 19]

even_list =[]
for x in numbers:
        if 0 == x%2:
                even_list.append(x)
print( even_list )
```

But by using list comprehension we can achieve this with only one line of code in python

```
numbers = [20, 50, 68, 89, 100, 119, 34, 8, 19]
even_list = [ x for x in numbers if 0 == x%2 ]
print( even_list )
```

The syntax:

newlist = [expression for item in iterable if condition == True]

Multiply List

```
#Multiply list by 2
two_fruit_list = fruit_list * 2
print( two_fruit_list )
```

List Functions

append()
clear()
copy()
count()
extend()
index()
insert()
pop()
remove()
reverse()
sort() & sort(reverse = True)

Python Tuples

Tuples are used to store multiple items in a single variable. Tuples are written with round brackets:

```
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )
print( weekdays )
```

Tupple item can be any type of data type like int, float, string, boolean, list tuple, set etc

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

Tupple items are **ordered**, **unchangeable**, and allow **duplicate** values.

Ordered

Items in the tuple 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

Unchangeable

Tuples are unchangeable, meaning that we cannot change, add or remove items after the tuple has been created.

Allow Duplicates

Duplicate items are allowed in any tuple

Access Items

```
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )
print( weekdays [2]  )
print( weekdays [-3] )
```

Create tuple with one item

If there is only one item in the tuple, add comma

```
weekdays = ("Mon",)
```

```
#not adding command like fruit_list = ("apple") will be invalid
print( weekdays )
```

Slicing of a tuple

```
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )
print( weekdays [1:3] )
print( weekdays [1:] )
print( weekdays [:4] )

print( weekdays [-4:-2] )
print( weekdays [-4:] )
print( weekdays [:-2] )
```

len() function

Returns the length

type() function

Returns the type

```
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )
print( len( weekdays ) )
print( type( weekdays ) )
```

The tuple() Constructor

It is also possible to use the tuple() constructor to make a tuple.

```
weekdays = tuple(( "Mon", "Tue", "Wed", "Thu", "Fri" ))
print( weekdays )
```

Update, Add, Remove item from a tuple

Tuples are unchangeable, meaning that you cannot change, add, or remove items once the tuple is created. But there are some ways to do that.

First change tuple in a list using list constructor and perform any add/update/remove operation and then convert the list into a tuple again using tuple constructor.

```
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )
weekdays_list = list(weekdays )
#once list has been created, we can perform any of list #operation on it

weekdays_list.append("Sat")
weekdays = tuple( weekdays_list)
print( weekdays )
```

Add tuple to a tuple

```
weekdays_sun = ("Sun",)
weekdays = weekdays + weekdays_sun
print( weekdays )
```

The del keyword can also delete the tuple completely.

```
del weekdays
print( weekdays )
```

Unpacking a Tuple

in Python, we can extract the tuple values into variables.

```
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )
(day1, day2, day3, day4, day5 ) = weekdays
print( day1 )
print( day2 )
print( day3 )
print( day4 )
print( day5 )
```

Looping Through a Tuple

```
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )

for day in weekdays :
        print( day )

for day in range( len( weekdays ) ):
        print( weekdays[day] )

#using while loop
i = 0
while i < len( weekdays ):
        print( weekdays[day])
        i += 1
```

Multiply Tuples

```
#Multiply tuple by 2
weekdays = ( "Mon", "Tue", "Wed", "Thu", "Fri" )
two_weeks = weekdays * 2
print( two_weeks )
```

List Functions

count()
index()

Python Sets

Sets

Sets are used to store multiple items in a single variable. Sets are created using curly brackets:
+

```
countries = {"Pakistan", "USA", "Japan", "Canada"}
print( countries )
```

List items are unindexed.

Set items are **unordered**, **unindexed**, **unchangeable**, and **duplicate** values are not allowed.

Unordered

Set do not have a defined order.

Unchangeable

Set items are unchangeable but you can remove items and add new items

Duplicates Not Allowed

Duplicate items are allowed in any set

```
countries = {"Pakistan", "USA", "Japan", "Canada", "Japan"}
print( countries )
```

Access Items

As sets are not index, item can not be accessible by index but we can loop through the items using a for loop,

```
countries = {"Pakistan", "USA", "Japan", "Canada", "Japan"}
for name in countries:
        print( name  )
```

len() function

Returns the length

type() function

Returns the type

```
print( len( countries ) )
print( type( countries ) )
```

The set() Constructor

It is also possible to use the list() constructor to make a list.

```
countries = set(("Pakistan", "USA", "Japan", "Canada", "Japan"))
print( fruit_list )
```

Check if Item Exists

```
if ( "USA" in countries ):
        print("Yes USAis in the country list")
```

Update, Add, Remove item from a set

Update

Once a set is created, we cannot change its items, but we can add new items or remove any item.

Add

The add() method add an item to the set

```
countries = set(("Pakistan", "USA", "Japan", "Canada"))
countries.add("UK")
print( countries)
```

Remove

The remove() and discard() are the two methods to removes the specified item from the set..

```
countries.remove("USA")
print( countries )
```

The del keyword can also delete the set completely.

```
del countries
print( countries )
```

Set Functions

add()
clear()
copy()
difference()
difference_update()
discard()
intersection()
intersection_update()
isdisjoint()
issubset()
issuperset()
pop()
remove()
symmetric_difference()
ymmetric_difference_update()
union()
update()

Python Dictionaries

Dictionary

Dictionaries are used to store data values in key:value pairs. We can create a Dictionary using curly brackets, and have keys and values:

```
person = {
        "name": "Edward",
        "country": "USA",
        "birth_year": 1975
        }
```

Dictionary item can contain any type of data type like int, float, string, boolean, list tuple, set, dictionary etc

We can't refer to an dictionary item by using an index.

List items are **ordered**, **changeable**, and **duplicate** values are not allowed.

Ordered

Dictionary's Items have a defined order, and that order will not change.

Changeable

Dictionaries are changeable, meaning that we can change, add or remove items after the it has been created.

Duplicates Not Allowed

Duplicate items are not allowed in any Dictionary

Access Items

We can access the items of a dictionary by referring to its key name

```
person = {
                    "name": "Edward",
                    "country": "USA",
                    "birth_year": 1975
                    }
print( person ["country"] )

#There is also a get method to access the items

print( person.get("country")  )
```

len() function

Returns the length

type() function

Returns the type

```
print( len( person ) )
print( type( person ) )
```

The dict() Constructor

It is also possible to use the list() constructor to make a list.
c

```
print( person )
```

Check if Item Exists

```
if ( "country" in person ):
        print("Yes country is in the dictionary")
```

Get all Keys

The keys() method will return a list of all the keys in the dictionary.

```
x = person.keys()
```

Get all Values

The keys() method will return a list of all the keys in the dictionary.

```
x = person.values()
```

The list of the values is a view of the dictionary, meaning that any changes done to the dictionary will be reflected in the values list.

```
x = person.values()

print(x) #before the change

person["country"] = "Pakistan"

print(x) #after the change
```

Get Items

The items() method will return each item in a dictionary, as tuples in a list.

```
x = thisdict.items()
```

Update, Add, Remove item from a dic

Update

```
person = {
                "name": "Edward",
                "country": "USA",
                "birth_year": 1975
        }
person["name"] = "Jack"
print( person )
```

Add

```
person = {
                "name": "Edward",
```

```
            "country": "USA",
            "birth_year": 1975
        }
person["industry"] = "Software"
print( person )
```

Remove

There are several methods to remove items from a dictionary

```
person.pop("country")
print( person )

del person["name"]
print( person)
```

The del keyword can also delete the list completely.

```
del person
print( person)
```

Looping Through a List

```
#x is the key
for x in person:
    print( x )

#print all values
for x in person:
    print( person[x] )

#x is the value
for x in person.values():
    print( x )


#x is the key
for x in person.keys():
    print( x )

#x is the key and y is  the value
```

```
for x,y in person.items():
        print( x )
        print( y )
```

Dictionary Functions

clear()

Removes all the elements from the dictionary

```
person.clear()
```

copy()

```
another_person =  person.copy()
print( another_person  )

#We can also use dict() function to copy
third_person =  dict(person)
print( third_person )
```

update()

The update() method will update the dictionary with the items from a given argument. If the item does not exist, the item will be added.

```
#below code will update the key country to Pakistan as key exists #already.
person.update({"country": "Pakistan"})
print(person)

below code will add the new key city as key doesn't exist.
person.update({"city": "New Delhi"})

print(person)
```

Dictionary Functions

clear()
copy()
fromkeys()

get()
items()
keys()
pop()
popitem()
setdefault()
update()
values()

Python Functions

A function is a block of statements which we have to define.

Only defining function will do nothing, we have to call it to perform any action.

We may pass arguments when we call the function.

A function may or may not return the value

```
def fun():
  print("Hello")

fun()
```

Function with Arguments

```
def fun( name ):
  print("Hello ", name )

fun( "David" )
fun( "Rohan" )
fun( "Mike" )
```

Numbers of arguments

We can any number of arguments in the function definition.

```
def fun( name, age  ):
  print( f" Hello {name}, you age is {age}" )

fun( "David", 25 )
fun( "Rohan", 20 )
fun( "Mike", 40 )
```

```
def sum( a, b ):
        s = a + b
        print( f" Sum = {s}" )

sum( 10, 25 )
```

Functions should be called with the same numbers of arguments defined in the function defination.
Below code will give an error as sum function requires 2 arguments in order to call:

```
sum( 10 )
```

Default Parameter Value

We can set default value of any argument in the function definition and can call that function without argument.

```
def sum( a, b = 10 ):
        s = a + b
        print( f" Sum = {s}" )

sum( 20 )
sum( 10, 25 )
```

Passing any data type as an Argument

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

fruit_list = [Apple", "Orange", "Banana"]

display_fruits( fruit_list )
```

Return Values

Function may have a return value

```
def sum( a, b = 10 ):
        s = a + b
        return s

sum = sum( 20, 25 )

print(sum)
```

Pass Statement

```
def test():
        pass
```

Keyword Arguments

You can also call the function with the *key* = *value* syntax.

```
def print_numbers( a, b, c ):
        print(a)
        print(b)
        print(c)

print_numbers( c = 30, b = 20, a = 10 )
```

Arbitrary Arguments, *args

If we dont know how many arguments, we need to pass at the time of function calling, we can add the * before the parameter name in the function definition.

In this way, function will receive tuple of arguments and can access accordingly.

```
def test_function( *numbers ):
         print(numbers)
```

```
my_function(10, 20, 30, 40)
my_function( 30, 40 )
```

Arbitrary Keyword Arguments, **kwargs

If we dont know how many keyword arguments, we need to pass at the time of function calling, we can add the ** before the parameter name in the function definition.

In this way, function will receive dictionary of arguments and can access accordingly.

```
def test_function( **numbers ):
        print(numbers)

my_function( d = 10, a = 20, a = 30, b = 40)
my_function( x = 30, y = 40 )
```

Passing a any type of data as an Argument

We can pass any type of data in the function calling and it will be treated as the same data type inside the function

Function Recursion

Python also support recusion in the function, recursion means that a function calls itself. One of the example of recursion in the solving factorial problem.

In the blow function, If we want to print “Hello World” 5 times.

```
def print_rec( i ):
    if i <= 5 :
        print("Hello World!")
        print_rec( i+1 )
        return
    else:
        return

print_rec( 1 )
```

Lambda Function

It can take any number of arguments, but can only have one expression. It is also known as an anonymous function.

```
lambda arguments : expression
```

```
fun1 = lambda a, b : a * b

print(fun1(5, 6))
```

Best use of lambda function is to use it inside another function how?

```
def lambda_multiple ( n )
        return lambda a : a * n

x = lambda_multiple ( 10 )
print( x (2) )
```

Variable Scope

Scope is the region where we can create and access any variable.

There are two types of scope in Python.

1. Local Scope
2. Global Scope

Local Scope

A variable created inside any function can be used inside that function.

```
def func_scope():
  x = 10
  print(x)

func_scope()
print(x) # Will print the error
```

Global Scope

A variable created outside any function can be used anywhere in the program.

```
x = 10
def func_scope():
  print(x)

func_scope()
```

Global Keyword

If we try to change any global variable inside any function like in the below code, value will be changed only inside the function and will be remain the same outside the function.

```
x = 10
def func_scope():
        x = 20
        print(x)

func_scope()
print(x)
```

use the global keyword if you want to make any change to a global variable inside any function.

```
x = 10
def func_scope():
        global x
        x = 20
        print(x)

func_scope()
print(x)
```

Python Modules

There are two types of modules in Python

1. Built-in Modules
2. User Defined Modules

Built-in Modules

There are sever al built-in modules in Python, To use any moudle, just need to iimport the module.

The import Statement

```
import math
x = math.sqrt(25)
print(x)

p = math.pi
print(p)

a = math.pow(5, 3)
print(a)
```

The from...import Statement

Instead of loading the full module, you can choose to import only parts from a module, by using the from keyword

```
#from math import sqrt
from math import sqrt, pow
x = sqrt(25)
print(x)

a = pow(5, 3)
print(a)
```

Random Module

```
import random
```

```
print(random.randint(10, 50))
```

Import as alias

By using the “as” keyword, You can create an alias when you import a module,

```
import math as m
x = m.sqrt(25)
print(x)
```

dir() Function

The dir() is the function which returns the list all the function and variable names in a module

```
import math
print(dir(math))
```

User-Defined Modules

User-defined module is nothing but it’s a python file that may contain variables and functions.

Just create a file and save with “.py” extension

my_module.py

```
def my_func():
        print("This is from my module")

my_variable  = "100"
```

Importing user-defined module is the same as import in built module.

The reload() Function

reload() function from importlib is used to import a previously imported module again

```
import math
import importlib
importlib.reload(math)
```

Python Package

A package is a library that contains modules and sub-packages.

Package

module1.py
module2.py
__init__.py

Need to import modules in __init__.py file

```
import module2
import module2
```

What is PIP?

PIP is a package manager

pip --version

pip install pip

NumPy Package

NumPy is a Python library used for working with arrays.
It stores the value of the same data type.

pip install numpy

In Python we have lists that serve the purpose of arrays, but they are slow to process.

```
import numpy

arr = numpy.array([10, 20, 30, 40, 50])

print(arr)
print(arr[1])
print(arr[1:4])
```

```
print(arr.sum())
```

Python Classes/Objects

Python is an object-oriented programming language (OOPs)

Create a Class

```
class Person:
  name= "Jon"

p1 = Person()
print( p1.name )
```

Create a Class using Constructors

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

p1 = Person(25)
print( p1.age )

p2 = Person(30)
print( p2.age )
```

The __init__() Function

The __init__() function is always executed when the class is being initiated and this is the function which assign values to object properties.

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

  def display_age(self):
    print( " Age is :", self.age )
```

```
p1 = Person(25)
p1.display_age()

p2 = Person(30)
p2.display_age()
```

Here age is the class property and display_age is the class method. A class might have any number of properties and methods.

The pass Statement

```
class Person:
  pass
```

Python Inheritance

In Python, You can inherit all the methods and properties from a class into another class. This is called inheritance.

The parent class is the class being inherited from, also called the base class.

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

```
class A:
  def __init__(self, a):
    self.a = a

  def display_a(self):
    print( " a =", self.a )

class B (A):
  def __init__(self, a, b):
     super().__init__(a)
     self.b = b

  def display_b(self):
    print( " a =", self.a, " b =",self.b  )


o1 = B(10,20)
print(o1.a)
print(o1.b)
o1.display_a()
o1.display_b()
```

Types of Inheritecne

B is inherited by class .

1. Single inheritance

2. Multiple inheritance

A class inherits from more than one class

3. Multilevel inheritance

Class C is derived from class B and class B itself is derived from class A

4. Hierarchical inheritance

Many classes are derived from a single class

5. Hybrid inheritance

Class B and Class C are derived from a single class A and class D is derived from class B and C.

Difference between Public, Protected and Private

Public Members in Python

Attributes are always public and can be accessed using the dot (.) within the class and outside the class using its object

```
class A:
  def __init__(self, a):
    self.a = a

  def display(self):
    print( " a =", self.a )

o1 = A(10)
print(o1.a)
o1.display()
```

Protected Members in Python

Protected method are created by using prefix _ (single underscore)

```
class A:
  def __init__(self, a):
    self._a = a

  def display(self):
```

```
    print( " a =", self._a )

o1 = A(10)
print(o1._a)
o1.display()
```

Private members in Python

Private members are created by using prefix __ (double underscore) and cannot be accessed directly via its object.

```
class A:
  def __init__(self, a):
    self.__a = a

  def display(self):
    print( " a =", self.__a )

class B(A):
  def __init__(self, a):
    super().__init__( a )

  def display(self):
    print( " a =", self._A__a )

o1 = A(10)
print(o1._A__a)
o1.display()
```

Operator Overloading

As we have already seen that we can use operators like +, -, <, > etc with data type like int, loat string etc. you can also use these operators with the class objects.

```
class A():
  def __init__(self, n):
    self.a = n
  def __add__(self, x):
    return self.a + x.a


a1 = A(10)
a2 = A(100)
print(a1+a2)
```

+	__add__(self, other)
–	__sub__(self, other)
*	__mul__(self, other)
&	__and__(self, other)
<	__lt__(self, other)
>	__gt__(self, other)
<=	__le__(self, other)
>=	__ge__(self, other)
==	__eq__(self, other)
!=	__ne__(self, other)

Magic Methods

In Python are the special methods that start and end with the double underscores. They are called automatically on a certain action.

__init__ method is invoked when an instance of a class is created.

__str__() method is invoked when we print any object of a class

```
class Test():
  def __init__(self, n):
    self.a = n
  def __str__(self, x):
    return self.a


t1= Test(10)
print(t1)
```

__main__ and __name__ in Python

__name__ is the special variable which value will be __main__ in the top level scope (in the main file), If it is import as a module, them __name__ value will not be __main__ but it will be the name of the file.

test.py

```
def my_fun():
  print("This is a call from function")


print("This is the debugging code")
my_fun()
```

a.py

```
import test
print( "In a.py", __name__)
```

You can put condition to check name

test.py

```
def my_fun():
  print("This is a call from function")
print ( __name__ )
if __name__ == '__main__':
     print("This is the debugging code")
     my_fun()
```

Exceptions Handling

Exceptions Handling is very important feature to handle the run time error.

Whenever code in try block generate an error, the except block will be executed.

```
try:
  x = 10
  Y = 0
  z = x / y    ssdd
  print( z )
except:
  print("An exception occurred")


try:
  x = 10
  Y = 0
  z = x / y
  print( z )
except Exception as e:
  print("An exception occurred", e)
```

try

The try block lets you test a block of code for errors.

except

The except block lets you handle the error.

else

The else block lets you execute code when there is no error.

```
try:
  x = 10
  Y = 0
  z = x / y
  print( z )
except Exception as e:
  print("An exception occurred", e)
else:
  print("No Error in try block")
```

finally

The finally block lets you execute code, regardless of the result of the try- and except blocks.

```
try:
  x = 10
  Y = 0
  z = x / y
  print( z )
except Exception as e:
  print("An exception occurred", e)
else:
  print("No Error in try block")
finally:
  print("This is the finally block")
```

Type Of Exception

ZeroDivisionError

NameError

File Handling in Python

You can perform several operation with file like creating, reading, updating, and deleting files.

```
f = open(<file-name>, <access-mode>, <buffering>)
```

File Handling Access Mode

"r" - Open an existing file for a read operation

"w" - Open an existing file for a write operation. If the file already contains some data then it will be overridden. creates the file if it does not exist

"a" - open an existing file for append operation. It won't override existing data

"r+" - To read and write data into the file. The previous data in the file will not be deleted.

"w+" - To write and read data. It will override existing data.

"a+" - To append and read data from the file. It won't override existing data, creates the file if it does not exist

Python File Open

```
f = open("testfile.txt", "r")

print(f.read())

print(f.read(5))

print(f.readline())

f.close()
```

The with statement

```
with open("testfile.txt", "r") as f:
    print(f.read())
```

Write to a File

```
f = open("testfile2.txt", "a") #or f = open("testfile2.txt", "w")
f.write("This is the content to put in testfile2")
f.close()
```

Delete File

```
import os
os.remove("testfile.txt")
```

Python Mysql

Install Module

pip install mysql-connector-python

```
import mysql.connector

mydb = mysql.connector.connect(
  host="localhost",
  user="yourusername",
  password="yourpassword",
  database="mydatabase"
)

mycursor = mydb.cursor()

mycursor.execute("SELECT * FROM customers")

myresult = mycursor.fetchall()
for x in myresult:
  print(x)


sql = "INSERT INTO customers (name, address) VALUES (%s, %s)"
val = ("John", "Highway 21")
mycursor.execute(sql, val)

mydb.commit()
```

NumPy Module

It is a library used in scientific applications.
It is used for working with arrays (numerical data)

NumPy is fast compared to List
NumPy requires less memory of data
It stores same type of data type

How to install
pip install numpy

One dimensional array

```
import numpy as nd
my_array = nd.array([1,10, 20, 40, 50, 45, 34])

# Printthe array
print(my_array)

# Find the type
print(type(my_array))

#access elements
print(my_array[1])

#find array data type
print(my_array.dtype)

# Update array
my_array[1] = 100
print(my_array)

# Slicing
print(my_array[1:4])
```

Two dimensional array

```
import numpy as nd
my_array = nd.array([ [1,2,3,4,5] ,  [11,12, 13,14,15] ,
[21,22,23,24,25]])

# Printthe array
print(my_array)
```

```
# Find the type
print(type(my_array))

#access row
print(my_array[1])

#access elements
print(my_array[1,3])

#find array data type
print(my_array.dtype)
print(my_array.shape)


# Update array
my_array[1,2] = 100
print(my_array)

# Slicing
print(my_array[1:3,2:4 ])


# Conditions in array
print(my_array < 20)

print(my_array < 20)
print(my_array[my_array < 20])

#reshape
print(my_array.reshape(5,3))

#creating array with arange
arr2 = nd.arange(1, 100)
print(arr2)
print(arr2.reshape(11, 9))


#create array with ones
arr_one = nd.ones( (3,5) )
print(arr_one)

#create array with ones
arr_zero = nd.zeros( (3,5) )
print(arr_zero)
```

Pandas

Pandas is a Python library used for working with data sets

Install Pandas

pip install pandas

Create Dataframe

```
#Create Dataframe
my_file = pd.DataFrame( [[10, 20, 30],[100, 200, 300],[100, 200,
300]] )
print(my_file)
```

```
#Create Dataframe with rows and column
my_file = pd.DataFrame( [[10, 20, 30],[100, 200, 300],[100, 200,
300]],['Row1', 'Row2', 'Row3'], ['Col1','Col2', 'Col3']  )
print(my_file)
```

```

#Create Dataframefrom Dictionary
d =  {
    "person1" : {"name":"Qadir", "Salary":12000, "Profile": "SD1"},
    "person2" : {"name":"Mahmood", "Salary":11000, "Profile":
"SD2"},
    "person3" : {"name":"Fazil", "Salary":14000, "Profile": "SD3"}
}

d_file = pd.DataFrame( d )
print(d_file)
```

```

#Create Dataframe using Numpy

dnum = pd.DataFrame( nd.arange(1, 51).reshape(10, 5), ['Row1',
'Row2', 'Row3', 'Row4', 'Row5', 'Row6', 'Row7', 'Row9', 'Row9',
'Row10'], ['Col1','Col2', 'Col3', 'Col4', 'Col5'] )
print(dnum)
#type
print( type(dnum))

#info
dnum.info()

#Top and bottom data
print(dnum.head())
print(dnum.tail())

#describe
```

```
print(dnum.describe())
```

```
#indexing
print(dnum['Col1']) #column
print(dnum[['Col1', 'Col2']]) #column #multiple column
print(dnum.loc['Row1']) #row
```

```
# Save Dataset as csv file
dnum.to_csv('test.csv')
```

```
#Pandas read CSS
import pandas as pd
df = pd.read_csv('names.csv')
print(df)
print(df.describe())
```

To read more about Pandas visit official website

https://pandas.pydata.org/

Common mistakes in python

Indentation Error

```
d = [1, 2, 3, 5, 6]
sum = 0
for x in d:
    s = x*x
sum += s

print(sum)
```

Naming Conflicts

```
len = 100
x = "Hello World!"

print(len(x))

#Same thing with module name like math etc
```

Mutable Default Args

```
def add_names( name , name_list = None):
    if name_list is None :
        name_list = []
```

```
    name_list.append(name)
    print(name_list)

names = ['Adnan', 'Tahir']
add_names('Javed', names)
add_names("Riyaz")
add_names("Qasim")
```

Object Copy Problem

```
a = [10, 20, 30, 40, 50]
print(a)
print(b)
b[1]= 1000
print(b)
print(a)
```