Python Tutorial

What is python?

Python is a simple, general purpose, high level, and object-oriented programming language.Python is an interpreted scripting language also.

Python programming language (latest Python 3) is being used in web development, Machine Learning applications, along with all cutting-edge technology in Software Industry. Python Programming Language is very well suited for Beginners, also for experienced programmers with other programming languages like C++ and Java.

History Of Python –

Python was developed by Guido van Rossum in the late eighties and early nineties at the National Research Institute for Mathematics and Computer Science in the Netherlands.

Python 3.10. 0 is the newest major release of the Python programming language, and it contains many new features and optimizations.

Why Used Python?

Python is currently the most widely used multi-purpose, high-level programming language.
The various areas of Python use are given below.

- Data Science
- Data Mining
- Desktop Applications
- Console-based Applications
- Mobile Applications
- Software Development
- Artificial Intelligence
- Web Applications
- Enterprise Applications
- 3D CAD Applications
- Machine Learning
- Computer Vision or Image Processing Applications.
- Speech Recognitions

Why Learn Python?

Python provides many useful features to the programmer. These features make it most popular and widely used language. We have listed below few-essential feature of Python.

- Easy to use and Learn
- Expressive Language
- Interpreted Language
- Object-Oriented Language
- Open-Source Language
- Extensible
- Learn Standard Library
- GUI Programming Support - Tkinter
- Integrated
- Embeddable
- Dynamic Memory Allocation
- Wide Range of Libraries and Frameworks

Python Popular Frameworks and Libraries

Python has wide range of libraries and frameworks widely used in various fields such as machine learning, artificial intelligence, web applications, etc. We define some popular frameworks and libraries of Python as follows.

Web development (Server-side) - Django, Flask, Pyramid, CherryPy

GUIs based applications - Tkinter, PyGTK, PyQt, PyJs, etc.

Machine Learning - TensorFlow, PyTorch, **Scikit-learn**, Matplotlib, Scipy, etc.

Mathematics - Numpy, Pandas, etc.

Difference between Python and Java?

Parameter	Python	Java
Code	Python has less lines of code.	Java has longer lines of code.
Framework	Compared to JAVA, Python has lower number of Frameworks. Popular ones are DJango, Flask.	Java has large number of Frameworks. Popular ones are Spring, Hibernate, etc.
Syntax	Syntax is easy to remember almost similar to human language.	Syntax is complex as it throws error if you miss semicolon or curly braces.
Key Features	Less line no of code, Rapid deployment and dynamic typing.	Self memory management, Robust, Platform independent
Speed	Python is slower since it uses interpreter and also determines the data type at run time.	Java is faster in speed as compared to python.
Databases	Python's database access layers are weaker than Java's JDBC. This is why it rarely used in enterprises.	(JDBC)Java Database Connectivity is most popular and widely used to connect with database.
Machine Learning Libraries	Tensorflow, Pytorch.	Weka, Mallet, Deeplearning4j, MOA

How to download and install python in MAC/Windows OS?

Download The python.

Step 1 – Type Python in crome browser.

Step 2 – Click on python official website.
   https://www.python.org/

Step 3 – Keep the mouse cursor in downloads.

Step 4 – If you are using widows OS then click on windows

Step 5 – If you are using mac OS then click on Mac.

Step 5 – Select the latest version.

Step 6 – Download.

Install Python

Step 1 – Go to the download folder

Step 2 – Select python

Step 3 – double click on python folder

Step 4 – Choose the Path.

Step 5 – After all steps click on done.

Check Python is install or not.

Step 1 – Open cmd or terminal.

Step 2 – Type python --version

Virtual environment

virtualenv is used **to manage Python packages for different projects**. Using virtualenv allows you to avoid installing Python packages globally which could break system tools or other projects. You can install virtualenv using pip.

```
# Create a virtual environment to isolate our package dependencies locally
      python3 -m venv env
      source env/bin/activate
```

```
 # On Windows use
     `env\Scripts\activate`
```

Installing Jupyter Noteboook / VS Code/PyCharm for Windows

Step 1 – Type pycharm download in the browser.
Step 2 - Click on first link
Step. 3 – download Community version.

Python Basic syntax –

There is no use of curly braces or semicolon in Python programming language. It is English-like language. But Python uses the indentation to define a block of code. Indentation is nothing but adding whitespace before the statement when it is needed.

Ex –
```
def XYZ:
        print("abc")
```

If we don't have any statement, then we can write pass keyword inside the function.

```
def XYZ:
        pass
```

In the above example, the statements that are same level to right belong to the function. Generally, we can use four whitespaces to define indentation, also we can use tab keyword.

Useful Tips– tab keyword is used to provide indentation space and shift+tab to provide back step.

Python First Program

Unlike the other programming languages, Python provides the facility to execute the code using few lines. **For Example** - Suppose we want to print the **"Hello World"** program in Java; it will take three lines to print it.

```java
public class HelloWorld {
 public static void main(String[] args){
// Prints "Hello, World" to the terminal window.
  System.out.println("Hello World");
 }
 }
```

On the other hand, we can do this using one statement in Python.

```python
print("Hello World")
```

Both programs will print the same result, but it takes only one statement without using a semicolon or curly braces in Python.

Quize -

Quize 1 – Which syntax is correct?

```
def ABC:
Statement1
…………………
…………………
Statement n
```

```
def ABC:
        Statement 1
            ……………………..
            ……………………..
        statement n
```

Example 1: Add Two Numbers

```python
# This program adds two numbers

num1 = 1.5
num2 = 6.3

# Add two numbers
sum = num1 + num2

# Display the sum
print('The sum of {0} and {1} is {2}'.format(num1, num2, sum))
```

Example 2: Add Two Numbers With User Input

```python
# Store input numbers
num1 = input('Enter first number: ')
num2 = input('Enter second number: ')

# Add two numbers
sum = float(num1) + float(num2)

# Display the sum
print('The sum of {0} and {1} is {2}'.format(num1, num2, sum))
```

Differences between Python 2.x and Python 3.x with examples

❖ Division operator
❖ print function
❖ Unicode
❖ Xrange
❖ Error Handling
❖ __future__ module

1. Division operator - If we are porting our code or executing python 3.x code in python 2.x, it can be dangerous if integer division changes go unnoticed (since it doesn't raise any error). It is preferred to use the floating value (like 7.0/5 or 7/5.0) to get the expected result when porting our code.

Ex - print 7 / 5
     print -7 / 5

     Output in Python 2.x
     1
     -2

     Output in Python 3.x :
     1.4
     -1.4

2. print function

- This is the most well-known change. In this, the **print** keyword in Python 2.x is replaced by the **print()** function in Python 3.x. However, parentheses work in Python 2 if space is added after the **print** keyword because the interpreter evaluates it as an expression.

Ex- print 'Hello, Geeks'   # Python 3.x doesn't support
    print('Hope You like these facts')

Note - if we use parentheses in python 2.x then there is no issue but if we don't use parentheses in python 3.x, we get SyntaxError.

3. Unicode

- In Python 2, an implicit str type is ASCII. But in Python 3.x implicit str type is Unicode.

Ex - print(type('default string'))
    print(type(b'string with b '))

    '''Output in Python 2.x (Bytes is same as str)
      <type 'str'>
      <type 'str'>

    Output in Python 3.x (Bytes and str are different)
     <class 'str'>
     <class 'bytes'>
     '''

Python 2.x also supports Unicode

Ex - print(type('default string '))
       print(type(u'string with b '))

       '''
       Output in Python 2.x (Unicode and str are different)

       <type 'str'>

       <type 'unicode'>

       Output in Python 3.x (Unicode and str are same)

       <class 'str'>

       <class 'str'>

       '''

4. Xrange - xrange() of Python 2.x doesn't exist in Python 3.x. In Python 2.x, range returns a list i.e. range(3) returns [0, 1, 2] while xrange returns a xrange object i. e., xrange(3) returns iterator object which works similar to Java iterator and generates number when needed.

If we need to iterate over the same sequence multiple times, we prefer range() as range provides a static list. xrange() reconstructs the sequence every time. xrange() doesn't support slices and other list methods. The advantage of xrange() is, it saves memory when the task is to iterate over a large range.

In Python 3.x, the range function now does what xrange does in Python 2.x, so to keep our code portable, we might want to stick to using a range instead. So Python 3.x's range function *is* xrange from Python 2.x.

Ex - for x in xrange(1, 5):
       print(x)

Ex - for x in range(1, 5):
       print(x)

   '''

   Output in Python 2.x
   1 2 3 4
   1 2 3 4

   Output in Python 3.x
   NameError: name 'xrange' is not defined
   '''

Error Handling - There is a small change in error handling in both versions. In python 3.x, 'as' keyword is required.

EX-
```
try:
    trying_to_check_error
except NameError, err:
    print err, 'Error Caused'   # Would not work in Python 3.x

'''
```
Output in Python 2.x:

name 'trying_to_check_error' is not defined Error Caused

Output in Python 3.x :

```
File "a.py", line 3

    except NameError, err:
              ^
SyntaxError: invalid syntax
'''
```

```
try:

    trying_to_check_error

except NameError as err: # 'as' is needed in Python 3.x

    print (err, 'Error Caused')



'''
Output in Python 2.x:

(NameError("name 'trying_to_check_error' is not defined",), 'Error Caused')

Output in Python 3.x :

name 'trying_to_check_error' is not defined Error Caused

'''
```

6. __future__ module

This is basically not a difference between the two versions, but a useful thing to mention here. The idea of the __future__ module is to help migrate to Python 3.x.
If we are planning to have Python 3.x support in our 2.x code, we can use **_future_** imports in our code.
For example, in the Python 2.x code below, we use Python 3.x's integer division behavior using the __future__ module.

```
# In below python 2.x code, division works
# same as Python 3.x because we use  __future__
```

Ex -
```
from __future__ import division

print 7 / 5
print -7 / 5
```

Output -
```
1.4
-1.4
```

```
from __future__ import print_function
print("IAmLearningPython")
```

Output –
IAmLearningPython

Python Variables

What is a Variable in Python?

A Python variable is a reserved memory location to store values. In other words, a variable in a python program gives data to the computer for processing.

Python Variable Types

Every value in Python has a datatype. Different data types in Python are Numbers, List, Tuple, Strings, Dictionary, etc. Variables in Python can be declared by any name or even alphabets like a, aa, abc, etc.

How to Declare and use a Variable

```
a=100.0
print (a)
```

Re-declare a Variable

You can re-declare Python variables even after you have declared once.
Here we have Python declare variable initialized to f=0.
Later, we re-assign the variable f to value "py99"

```
# Declare a variable and initialize it
f = 0
Print(f)
# re-declaring the variable works
f = 'py9999'
Print(f)
```

Example

```
# Declare a variable and initialize it
x = 0
y=1
print(x)
print(y)

# re-declaring the variable works
y = 'python'
print(y)
```

Python String Concatenation and Variable

Let's see whether you can concatenate different data types like string and number together. For example, we will concatenate "xyz" with the number "99".

Unlike Java, which concatenates number with string without declaring number as string, while declaring variables in Python requires declaring the number as string otherwise it will show a TypeError

Example

```
a="xyz"
b = 99
print(a+b)
```

Python Variable Types: Local & Global

here are two types of variables in Python, Global variable and Local variable. When you want to use the same variable for rest of your program or module you declare it as a global variable, while if you want to use the variable in a specific function or method, you use a local variable while Python variable declaration.

Let's understand this Python variable types with the difference between local and global variables in the below program.

1. Let us define variable in Python where the variable "f" is **global** in scope and is assigned value 101 which is printed in output.
2. Variable f is again declared in function and assumes **local** scope. It is assigned value "I am learning Python." which is printed out as an output. This Python declare variable is different from the global variable "f" defined earlier
3. Once the function call is over, the local variable f is destroyed. when we again, print the value of "f" is it displays the value of global variable f=101

Declare a variable and initialize it

```
f = 101
Print(f)
# Global vs. local variables in functions

def someFunction():
# global f
    f = 'I am learning Python'
    print(f)
someFunction()
Print(f)
```

```
# Declare a variable and initialize it
    f = 101
    print(f)
    # Global vs. local variables in functions
    def someFunction():
    # global f
       f = 'I am learning Python'
       print(f)
    someFunction()
    print(f)
```

While Python variable declaration using the keyword **global,** you can reference the global variable inside a function.
Variable "f" is **global** in scope and is assigned value 101 which is printed in output
Variable f is declared using the keyword **global**. This is **NOT** a **local variable**, but the same global variable declared earlier. Hence when we print its value, the out put is 101
We changed the value of "f" inside the function. Once the function call is over, the changed value of the variable "f" persists.when we again, print the value of "f" is it displays the value "changing global variable"

Example -

```
f = 101;
print f
# Global vs.local variables in functions
def someFunction():
  global f
  print f
  f = "changing global variable"
someFunction()
print f
```

Example -

```
f = 101;
print(f)
# Global vs.local variables in functions
def someFunction():
  global f
  print(f)
  f = "changing global variable"
someFunction()
print(f)
```

Delete a variable

You can also delete Python variables using the command **del** "variable name".

In the below example of Python delete variable, we deleted variable f, and when we proceed to print it, we get error "**variable name is not defined**" which means you have deleted the variable.

Example -

```
f = 11;
print(f)
del(f)
print(f)
```

Summary:

- Variables are referred to "envelop" or "buckets" where information can be maintained and referenced. Like any other programming language Python also uses a variable to store the information.
- Variables can be declared by any name or even alphabets like a, aa, abc, etc.
- Variables can be re-declared even after you have declared them for once
- Python constants can be understood as types of variables that hold the value which can not be changed. Usually, Python constants are referenced from other files. Python define constant is declared in a new or separate file which contains functions, modules, etc.
- Types of variables in Python or Python variable types : Local & Global
- Declare local variable when you want to use it for current function
- Declare Global variable when you want to use the same variable for rest of the program
- To delete a variable, it uses keyword "del".

Python Operators: Arithmetic, Logical, Comparison, Assignment, Bitwise & Precedence

What is operators?

The operator can be defined as a symbol which is responsible for a particular operation between two operands. Operators are the pillars of a program on which the logic is built in a specific programming language.

Types Of Operators

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

Arithmetic Operators

Arithmetic Operators perform various arithmetic calculations like addition, subtraction, multiplication, division, %modulus, exponent, etc. There are various methods for arithmetic calculation in Python like you can use the eval function, declare variable & calculate, or call functions.

Ex – Addition

```
x= 4
y= 5
Z =  x+y
print(x + y)
o/p = 9
```

Similarly, you can use other arithmetic operators like for multiplication(*), division (/), substraction (-), etc.

Ex – Division

```
print (7 / 5)
print(7 / 5)
o/p = 1.4
o/p = -1.4
```

```python
a = 10
b=20

def addval(a,b):
    c= a+b
    print(c)

addval(a,b)
```

Comparison Operators

Comparison Operators In Python compares the values on either side of the operand and determines the relation between them. It is also referred to as relational operators. Various comparison operators in python are (==, != , <>, >,<=, etc.)

Ex - For comparison operators we will compare the value of x to the value of y and print the result in true or false.

```
x = 4
y = 5
print(('x > y  is', x>y))
```

Likewise, you can try other comparison operators (x < y, x==y, x!=y, etc.)

Ex-

```
a= 20
b= 20
print(a <= b)
```

Assignment Operators

Assignment Operators in **Python** are used for assigning the value of the right operand to the left operand. Various assignment operators used in Python are (+=, − = , *=, /= , etc.).

```
num1 = 4
num2 = 5
Num3 =0
Num3 += num1
Num3 = num3+num1
print(("Line  1 - Value of num1 : ", num1))
print(("Line  2 - Value of num2 : ", num2))
```

Example of compound assignment operator

We can also use a compound assignment operator, where you can add, subtract, multiply right operand to left and assign addition (or any other arithmetic function) to the left operand.

Step 1: Assign value to num1 and num2

Step 2: Add value of num1 and num2 (4+5=9)

Step 3: To this result add num1 to the output of Step 2 (9+4)

Step 4: It will print the final result as 13

```
num1 = 4
num2 = 5
res = num1 + num2
```

Logical Operators or Bitwise Operators

Logical operators in Python are used for conditional statements are true or false. Logical operators in Python are AND, OR and NOT. For logical operators following condition are applied.

- For AND operator – It returns TRUE if both the operands (right side and left side) are true
- For OR operator- It returns TRUE if either of the operand (right side or left side) is true
- For NOT operator- returns TRUE if operand is false

Ex –

```
a = true
b = false
print(('a and b is', a and b))
print(('a or b is', a or b))
print(('not a is', not a))
```

Membership Operators

These operators test for membership in a sequence such as lists, strings or tuples. There are two membership operators that are used in Python. (in, not in). It gives the result based on the variable present in specified sequence or string.

Ex -

```
x = 4
y = 8
list = [1, 2, 3, 4, 5 ]
if ( x in list ):
   print("Line 1 - x is available in the given list")
else:
   print("Line 1 - x is not available in the given list")
if ( y not in list ):
   print("Line 2 - y is not available in the given list")
else:
   print("Line 2 - y is available in the given list")
```

- Declare the value for x and y
- Declare the value of list
- Use the "in" operator in code with if statement to check the value of x existing in the list and print the result accordingly
- Use the "not in" operator in code with if statement to check the value of y exist in the list and print the result accordingly
- Run the code- When the code run it gives the desired output

Identity Operators

Identity Operators in Python are used to compare the memory location of two objects. The two identity operators used in Python are (is, is not).

Operator is: It returns true if two variables point the same object and false otherwise

Operator is not: It returns false if two variables point the same object and true otherwise

A = (20/10)+30*120-30**(40+60)

Operators (Decreasing order of precedence)	Meaning
**	Exponent
*, /, //, %	Multiplication, Division, Floor division, Modulus
+, −	Addition, Subtraction
<= < > >=	Comparison operators
= %= /= //= -= += *= **=	Assignment Operators
is is not	Identity operators
in not in	Membership operators
not or and	Logical operators

Ex-

```
x = 20
y = 20
if ( x is y ):
    print("x & y  SAME identity")
y=30
if ( x is not y ):
    print("x & y have  DIFFERENT identity")
```

Summary:

- Operators in a programming language are used to perform various operations on values and variables. In Python, you can use operators like
- There are various methods for arithmetic calculation in Python as you can use the eval function, declare variable & calculate, or call functions
- Comparison operators often referred as relational operators are used to compare the values on either side of them and determine the relation between them
- Python assignment operators are simply to assign the value to variable
- Python also allows you to use a compound assignment operator, in a complicated arithmetic calculation, where you can assign the result of one operand to the other.
- For AND operator – It returns TRUE if both the operands (right side and left side) are true
- For OR operator- It returns TRUE if either of the operand (right side or left side) is true
- For NOT operator- returns TRUE if operand is false
- There are two membership operators that are used in Python. (in, not in).
- It gives the result based on the variable present in specified sequence or string
- The two identify operators used in Python are (is, is not)
- It returns true if two variables point the same object and false otherwise
- Precedence operator can be useful when you have to set priority for which calculation need to be done first in a complex calculation.

Python Comments

Python Comment is an essential tool for the programmers. Comments are generally used to explain the code. We can easily understand the code if it has a proper explanation. A good programmer must use the comments because in the future anyone wants to modify the code as well as implement the new module; then, it can be done easily.

Types of comments.

1. Single line
2. Multi-line comments
3. Docstrings Comment

Single line -

To apply the comment in the code we use the hash(#) at the beginning of the statement or code.

Ex -

```
#This is the print statement
print("Hello  Python")
```

Multi-line comments

We must use the hash(#) at the beginning of every line of code to apply the multiline Python comment.

Ex -

```
# First line of the comment
# Second line of the comment
# Third line of the comment
a,b = 5 ,10
print("The sum is:", a+b )
```

Docstrings Comment

The docstring comment is mostly used in the module, function, class or method. It is a documentation Python string.

Ex -

```python
def intro():
    """
    This function prints  Hi python
     hello
     hi
    """
    print("Hi  python")

intro()
```

Output: Hi python

We can check a function's docstring by using the __doc__ attribute.
Generally, four whitespaces are used as the indentation. The amount of indentation depends on user, but it must be consistent throughout that block.

Ex -

```python
def intro():
    """
    This function prints  Hi python
    """
    print(" Hi python ")
intro.__doc__
```

Output: '\n This function prints Hello Joseph\n '

Data Types

Variables can hold values, and every value has a data-type. Python is a dynamically typed language; hence we do not need to define the type of the variable while declaring it. The interpreter implicitly binds the value with its type.

a = 5

The variable **a** holds integer value five and we did not define its type. Python interpreter will automatically interpret variables **a** as an integer type.
Python enables us to check the type of the variable used in the program. Python provides us the **type()** function, which returns the type of the variable passed.

EX –
a=10
b="Hi Python"
c = 10.5
print(type(a))
print(type(b))
print(type(c))

Output-
<type 'int'> <type 'str'><type 'float'>

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

Text Type:	str
Numeric Types:	int, float, complex
Sequence Types:	list, tuple, range
Mapping Type:	dict
Set Types:	set, frozenset
Boolean Type:	bool
Binary Types:	bytes, bytearray, memoryview
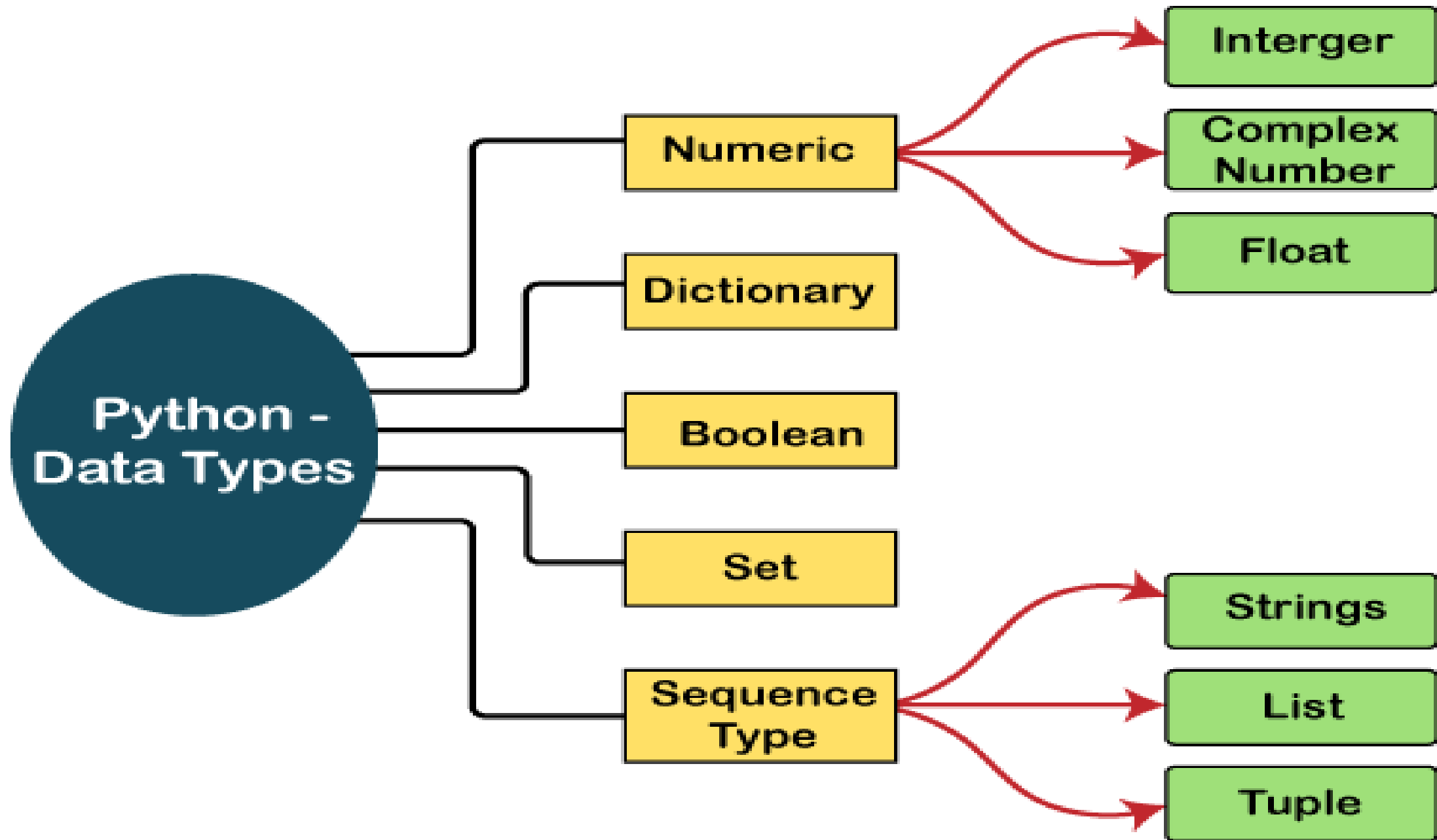
Numbers

Number stores numeric values. The integer, float, and complex values belong to a Python Numbers data-type. Python provides the **type()** function to know the data-type of the variable. Similarly, the **isinstance()** function is used to check an object belongs to a particular class.

Python creates Number objects when a number is assigned to a variable. For example;

```
a = 5
print("The type of a", type(a))
b = 40.5
print("The type of b", type(b))
c = 1+3j
print("The type of c", type(c))
print(" c is a complex number", isinstance(1+3j,complex))
```

Output:
The type of a <class 'int'>
 The type of b <class 'float'>
The type of c <class 'complex'>
c is complex number: True

❖ **Int -** Integer value can be any length such as integers 10, 2, 29, -20, -150 etc. Python has no restriction on the length of an integer. Its value belongs to **int**

❖ **Float -** Float is used to store floating-point numbers like 1.9, 9.902, 15.2, etc. It is accurate upto 15 decimal points.

❖ **complex -** A complex number contains an ordered pair, i.e., x + iy where x and y denote the real and imaginary parts, respectively. The complex numbers like 2.14j, 2.0 + 2.3j, etc.

Sequence Type

In Python, sequence is the ordered collection of similar or different data types. Sequences allows to store multiple values in an organized and efficient fashion. There are several sequence types in Python –

   ❖ String
   ❖ List
   ❖ Tuple

String

A string is a collection of one or more characters put in a single quote, double-quote or triple quote. In python there is no character data type, a character is a string of length one. It is represented by str class.

String handling in Python is a straightforward task since Python provides built-in functions and operators to perform operations in the string.

In the case of string handling, the operator + is used to concatenate two strings as the operation *"hello"+" python"* returns *"hello python"*.
The operator * is known as a repetition operator as the operation "Python" *2 returns 'Python Python'.

Ex-
# Creating a String with single Quotes
String1 = 'Welcome to the Python World'
print("String with the use of Single Quotes: ")
print(String1)

Output –
Welcome to the Python World

```
String1 = "I'm a Python"
print("\nString with the use of Double Quotes: ")
print(String1)
print(type(String1))
```

Output –
I'm a Geek <class 'str'>

```
String1 = '''I'm a Python "and" I live in a world of " Program"'''
print("\nString with the use of Triple Quotes: ")
print(String1)
print(type(String1))
```

Output –
I'm a Python and I live in a world of " Program"

Creating String with triple Quotes allows multiple lines \

String1 = '''Python
    For
    Life'''
print("\nCreating a multiline String: ")
print(String1)

Output –
Creating a multiline String:
'Python
For
Life

Ex-
str1 = 'hello world'   #string str1
str2 = ' how are you' #string str2
print (str1[0:2])   #printing first two character using slice operator
print (str1[4]).   #printing 4th character of the string
print (str1*2)   #printing the string twice
print (str1 + str2)   #printing the concatenation of str1 and str2

he
h
Hello world Hello world
Hello world how are you

LIST –

Lists are just like dynamically sized arrays, declared in other languages (vector in C++ and ArrayList in Java).
Lists need not be homogeneous always which makes it the most powerful tool in Python.
A single list may contain DataTypes like Integers, Strings, as well as Objects.
Lists are mutable, and hence, they can be altered even after their creation.
L1 = [1,'a',7.5,2,15,'b','jiya','a','a']
      (0,1,2,3,4,5)

List in Python are ordered and have a definite count. The elements in a list are indexed according to a definite sequence and the indexing of a list is done with 0 being the first index. Each element in the list has its definite place in the list, which allows duplicating of elements in the list, with each element having its own distinct place and credibility.

Note- Lists are a useful tool for preserving a sequence of data and further iterating over it.

We can use slice [:] operators to access the data of the list. The concatenation operator (+) and repetition operator (*) works with the list in the same way as they were working with the strings.

Creating a List

Lists in Python can be created by just placing the sequence inside the square brackets[]. Unlike Sets, a list doesn't need a built-in function for the creation of a list.

L1 =[]
L2 = [11,23,'a','xyz']
L2 =list(11,23,'a','xyz')

Set Ex-
Set1= set('a',12,31)

Note – Unlike Sets, the list may contain mutable elements.

1.Creating a List

```
List1 = []
print("Blank List: ")
print(List)
```

2.Creating a List of numbers

```
list1 = [10,20,30]
print("\nList of numbers: ",list1)
print(List)
```

3.Creating a List of strings and accessing

```
# using index
List1 = ["I", "am", "fine"]
print("\nList Items: ")
print(List1[0])
print(List1[2])
```

4.Creating a Multi-Dimensional List

```
# (By Nesting a list inside a List)
List1 = [['I', am'], ['fine']]
print("\nMulti-Dimensional List: ")
print(List1)
```

OutPut –

Blank List:
[]

List of numbers:
[10, 20, 14]

List Items
I
Fine

Multi-Dimensional
List: [[I', am'], [fine']]

Tuple

Tuple is a collection of Python objects much like a list. The sequence of values stored in a tuple can be of any type, and they are indexed by integers. Tuple is an immutable.

Values of a tuple are syntactically separated by 'commas'. Although it is not necessary, it is more common to define a tuple by closing the sequence of values in parentheses. This helps in understanding the Python tuples more easily.

A tuple is similar to the list in many ways. Like lists, tuples also contain the collection of the items of different data types. The items of the tuple are separated with a comma (,) and enclosed in parentheses ().
A tuple is a read-only data structure as we can't modify the size and value of the items of a tuple.

Ex –

```
tup = ("hi", "Python", 2)
# Checking type of tup
print (type(tup))

#Printing the tuple
print (tup)

# Tuple slicing
print (tup[1:])
print (tup[0:1])
```

==Tuple concatenation using + operator==
print (tup + tup)

==Tuple repatation using * operator==
print (tup * 3)

==Adding value to tup. It will throw an error.==
t[2] = "hi"

Output –
 <class 'tuple'>
 ('hi', 'Python', 2)
 ('Python', 2)
 ('hi',)
('hi', 'Python', 2, 'hi', 'Python', 2)
('hi', 'Python', 2, 'hi', 'Python', 2, 'hi', 'Python', 2)

 Traceback (most recent call last):
 File "main.py", line 14, in <module>
 t[2] = "hi";
 TypeError: 'tuple' object does not support item assignment

Creating a Tuple with Mixed Datatypes.

Tuples can contain any number of elements and of any datatype (like strings, integers, list, etc.). Tuples can also be created with a single element, but it is a bit tricky. Having one element in the parentheses is not sufficient, there must be a trailing 'comma' to make it a tuple.

```
# Creating tuple with Mixed Datatype
Tuple1 = (5, 'Welcome', 7, 'Geeks')
print("\nTuple with Mixed Datatypes: ")
print(Tuple1)

# Creating a Tuple
# with nested tuples
Tuple1 = (0, 1, 2, 3)
Tuple2 = ('python', 'geek')
Tuple3 = (Tuple1, Tuple2)
print("\nTuple with nested tuples: ")
print(Tuple3)
```

```python
# Creating a Tuple
# with repetition
Tuple1 = ('Geeks',) * 3
print("\nTuple with repetition: ")
print(Tuple1)

# Creating a Tuple
# with the use of loop
Tuple1 = ('Geeks')
n = 5
print("\nTuple with a loop")
for i in range(int(n)):
    Tuple1 = (Tuple1,)
    print(Tuple1)
```

SET

Python Set is the unordered collection of the data type. It is iterable, mutable(can modify after creation), and has unique elements. In set, the order of the elements is undefined; it may return the changed sequence of the element. The set is created by using a built-in function **set(),** or a sequence of elements is passed in the curly braces and separated by the comma. It can contain various types of values. Consider the following example.

Ex- set2 = {'James', 2, 3,'Python'}

Set is an unordered collection of data type that is iterable, mutable and has no duplicate elements. The order of elements in a set is undefined though it may consist of various elements.
The major advantage of using a set, as opposed to a list, is that it has a highly optimized method for checking whether a specific element is contained in the set.

Creating a Set

Sets can be created by using the built-in **set()** function with an iterable object or a sequence by placing the sequence inside curly braces, separated by 'comma'.
Note – A set cannot have mutable elements like a list or dictionary, as it is mutable.

A set contains only unique elements but at the time of set creation, multiple duplicate values can also be passed. Order of elements in a set is undefined and is unchangeable. Type of elements in a set need not be the same, various mixed up data type values can also be passed to the set.

```
set1 = set()

set2 = {'James', 2, 3,'Python'}

#Printing Set value
print(set2)

# Adding element to the set
set2.add(10)
print(set2)

#Removing element from the set
set2.remove(2)
print(set2)
```

```python
# Creating a Set
set1 = set()
print("Initial blank Set: ")
print(set1)

# Creating a Set with the use of a String
set1 = set("welcomeToPython")
print("\nSet with the use of String: ")
print(set1)

# Creating a Set with the use of Constructor
# (Using object to Store String)
String = welcomeToPython '
set1 = set(String)
print("\nSet with the use of an Object: " )
print(set1)

# Creating a Set with the use of a List
set1 = set(["welcome", "to", "python"])
print("\nSet with the use of List: ")
print(set1)
```

Dictionary

Dictionary is an unordered set of a key-value pair of items. It is like an associative array or a hash table where each key stores a specific value. Key can hold any primitive data type, whereas value is an arbitrary Python object.
The items in the dictionary are separated with the comma (,) and enclosed in the curly braces { }.

Dictionary in Python is an unordered collection of data values, used to store data values like a map, which, unlike other Data Types that hold only a single value as an element, Dictionary holds **key:value** pair. Key-value is provided in the dictionary to make it more optimized.

Note – Keys in a dictionary don't allow Polymorphism.

Creating a Dictionary

In Python, a Dictionary can be created by placing a sequence of elements within curly **{}** braces, separated by 'comma'. Dictionary holds pairs of values, one being the Key and the other corresponding pair element being its **Key:value**. Values in a dictionary can be of any data type and can be duplicated, whereas keys can't be repeated and must be *immutable*.

Note – Dictionary keys are case sensitive, the same name but different cases of Key will be treated distinctly.

```
# Creating a Dictionary with Integer Keys
Dict = {1: 'Geeks', 2: 'For', 3: 'Geeks'}
print("\nDictionary with the use of Integer Keys: ")
print(Dict)

# Creating a Dictionary with Mixed keys
Dict = {'Name': 'Geeks', 1: [1, 2, 3, 4]}
print("\nDictionary with the use of Mixed Keys: ")
print(Dict)
```

Dictionary can also be created by the built-in function dict(). An empty dictionary can be created by just placing to curly braces{}.

```
# Creating an empty Dictionary
Dict = {}
print("Empty Dictionary: ")
print(Dict)
```

```python
# Creating a Dictionary with dict() method
Dict = dict({1: 'Geeks', 2: 'For', 3:'Geeks'})
print("\nDictionary with the use of dict(): ")
print(Dict)

# Creating a Dictionary with each item as a Pair
Dict = dict([(1, 'Geeks'), (2, 'For')])
print("\nDictionary with each item as a pair: ")
print(Dict)
```

Nested Dictionary

EX -
```python
Dict = {1: 'Geeks', 2: 'For',
        3:{'A' : 'Welcome', 'B' : 'To', 'C' : 'Geeks'}}

print(Dict)
```

EX-

d = {1:'Jimmy', 2:'Alex', 3:'john', 4:'mike'}

<mark># Printing dictionary</mark>
print (d)

<mark># Accesing value using keys</mark>
print("1st name is "+d[1])
print("2nd name is "+ d[4])

print (d.keys())
print (d.values())

Boolean

Boolean type provides two built-in values, True and False. These values are used to determine the given statement true or false. It denotes by the class bool. True can be represented by any non-zero value or 'T' whereas false can be represented by the 0 or 'F'. Consider the following example.

```python
# Python program to check the boolean type
print(type(True))
print(type(False))
print(false)
```

Arrays

An array is defined as a collection of items that are stored at contiguous memory locations. It is a container which can hold a fixed number of items, and these items should be of the same type. An array is popular in most programming languages like C/C++, JavaScript, etc.

Array is an idea of storing multiple items of the same type together and it makes easier to calculate the position of each element by simply adding an offset to the base value. A combination of the arrays could save a lot of time by reducing the overall size of the code. It is used to store multiple values in single variable. If you have a list of items that are stored in their corresponding variables like this:

The array can be handled in Python by a module named **array**. It is useful when we have to manipulate only specific data values. Following are the terms to understand the concept of an array:

Element - Each item stored in an array is called an element.

Index - The location of an element in an array has a numerical index, which is used to identify the position of the element.

Array Representation

An array can be declared in various ways and different languages. The important points that should be considered are as follows:

Index starts with 0.

We can access each element via its index.

The length of the array defines the capacity to store the elements.

Creating a Array

Array in Python can be created by importing array module. **array(*data_type*, *value_list*)** is used to create an array with data type and value list specified in its arguments.

# Creation of Array
# importing "array" for array creations
import array as arr

```python
# creating an array with integer type
a = arr.array('i', [1, 2, 3])

# printing original array
print ("The new created array is : ", end =" ")
for i in range (0, 3):
    print (a[i], end =" ")
print()

# creating an array with float type
b = arr.array('d', [2.5, 3.2, 3.3])

# printing original array
print ("The new created array is : ", end =" ")
for i in range (0, 3):
    print (b[i], end =" ")
```

Output -
The new created array is : 1 2 3
The new created array is : 2.5 3.2 3.3

Type Conversion in Python

Python defines type conversion functions to directly convert one data type to another which is useful in day-to-day and competitive programming. This article is aimed at providing information about certain conversion functions.
There are two types of Type Conversion in Python:
Implicit Type Conversion
Explicit Type Conversion
Let's discuss them in detail.

Implicit Type Conversion

In Implicit type conversion of data types in Python, the Python interpreter automatically converts one data type to another without any user involvement. To get a more clear view of the topic see the below examples.

Ex-

x = 10
print("x is of type:",type(x))

y = 10.6
print("y is of type:",type(y))

x = x + y
print(x)
print("x is of type:",type(x))

x is of type: <class 'int'>
y is of type: <class 'float'>
20.6
x is of type: <class 'float'>

Explicit Type Conversion

In Explicit Type Conversion in Python, the data type is manually changed by the user as per their requirement. Various forms of explicit type conversion are explained below:

1. **int(a, base)**: This function converts **any data type to integer**. 'Base' specifies the **base in which string is** if the data type is a string.

    2. float(): This function is used to convert **any data type to a** floating-point **number**

Ex-

```
# initializing string
s = "10010"

# initializing string
Print(int(s))
# printing string converting to int base 2
c = int(s,2)
print ("After converting to integer base 2 : ", end="")
print (c)

# printing string converting to float
e = float(s)
print ("After converting to float : ", end="")
print (e)
```

After converting to integer base 2 : 18
After converting to float : 10010.0

3. ord() : This function is used to convert a **character to integer.**
4. hex() : This function is to convert **integer to hexadecimal string**.
5. oct() : This function is to convert **integer to octal string**.

```
# using  ord(), hex(), oct()
# initializing  integer
s = '4'

# printing character converting to integer
c = ord(s)
print ("After converting character to integer : ",end="")
print (c)

# printing integer converting to hexadecimal string
c = hex(56)
print ("After converting 56 to hexadecimal string : ",end="")
print (c)
```

c = oct(56)
print ("After converting 56 to octal string : ",end="")
print (c)

Output –
After converting character to integer : 52
After converting 56 to hexadecimal string : 0x38
After converting 56 to octal string : 0o70

6. tuple() : This function is used to **convert to a tuple**.
7. set() : This function returns the **type after converting to set**.
8. list() : This function is used to convert **any data type to a list type**.

s = 'python'

```
# printing string converting to tuple
c = tuple(s)
print ("After converting string to tuple : ",end="")
print (c)

# printing string converting to set
c = set(s)
print ("After converting string to set : ",end="")
print (c)

# printing string converting to list
c = list(s)
print ("After converting string to list : ",end="")
print (c)
```

Output-

After converting string to tuple : ('g', 'e', 'e', 'k', 's')
 After converting string to set : {'k', 'e', 's', 'g'}
 After converting string to list : ['g', 'e', 'e', 'k', 's']

9. dict() : This function is used to **convert a tuple of order (key,value) into a dictionary**.
10. str() : Used to **convert integer into a string.**
11. complex(real,imag) : This function **converts real numbers to complex(real,imag) number.**

```
# using  dict(), complex(), str()
 # initializing  integers
a = 1
b = 2

# initializing  tuple
tup = (('a', 1) ,('f', 2), ('g', 3))

# printing integer converting to complex number
c = complex(1,2)
print ("After converting integer to complex number : ",end="")
print (c)

# printing integer converting to string
c = str(a)
print ("After converting integer to string : ",end="")
print (c)
```

c = dict(tup)
print ("After converting tuple to dictionary : ",end="")
print (c)

Output-

After converting integer to complex number : (1+2j)
After converting integer to string : 1
After converting tuple to dictionary : {'a': 1, 'f': 2, 'g': 3}

12. chr(number): This function **converts number to its corresponding ASCII character.**

a = chr(76)
b = chr(77)
print(a)
print(b)

Output –
L
M

Taking input in Python

Developers often have a need to interact with users, either to get data or to provide some sort of result. Most programs today use a dialog box as a way of asking the user to provide some type of input. While Python provides us with two inbuilt functions to read the input from the keyboard.

1. input (prompt)
2. raw_input (prompt)

input( ) : This function first takes the input from the user and convert it into string. Type of the returned object always will be <type 'str'>. It does not evaluate the expression it just return the complete statement as String. For

example –
a use of input()

val = input("Enter your value: ")
print(val)

How the input function works in Python :

When input() function executes program flow will be stopped until the user has given an input.
The text or message display on the output screen to ask a user to enter input value is optional i.e. the prompt, will be printed on the screen is optional.
Whatever you enter as input, input function convert it into a string. if you enter an integer value still input() function convert it into a string. You need to explicitly convert it into an integer in your code using typecasting.

```
# Program to check input
# type in Python

num = input ("Enter number :")
print(num)
name1 = input("Enter name : ")
print(name1)


# Printing type of input value
print ("type of number", type(num))
print ("type of name", type(name1))
```

raw_input ( ) : This function works in older version (like Python 2.x). This function takes exactly what is typed from the keyboard, convert it to string and then return it to the variable in which we want to store.

For example –
g = raw_input("Enter your name : ")
print g

Output - Enter your name :

Here, **g** is a variable which will get the string value, typed by user during the execution of program. Typing of data for the raw_input() function is terminated by enter key. We can use raw_input() to enter numeric data also. In that case we use typecasting.For more details on typecasting refer [this](#).

Taking input from console in Python

What is Console in Python? Console (also called Shell) is basically a command line interpreter that takes input from the user i.e one command at a time and interprets it. If it is error free then it runs the command and gives required output otherwise shows the error message.

Taking multiple inputs from user in Python

The developer often wants a user to enter multiple values or inputs in one line. In C++/C user can take multiple inputs in one line using scanf but in Python user can take multiple values or inputs in one line by two methods.

- Using split() method
- Using List comprehension

Using split() method :

This function helps in getting multiple inputs from users. It breaks the given input by the specified separator. If a separator is not provided then any white space is a separator. Generally, users use a split() method to split a Python string but one can use it in taking multiple inputs.

Syntax : input().split(separator, maxsplit)

```python
# Python program showing how to multiple input using split

# taking two inputs at a time
x, y = input("Enter two values: ").split()
print("Number of boys: ", x)
print("Number of girls: ", y)
print()

# taking three inputs at a time
x, y, z = input("Enter three values: ").split()
print("Total number of students: ", x)
print("Number of boys is : ", y)
print("Number of girls is : ", z)
print()

# taking two inputs at a time
a, b = input("Enter two values: ").split()
print("First number is {} and second number is {}".format(a, b))
print()
```

```
# taking multiple inputs at a time and type casting using list() function
x = list(map(int, input("Enter multiple values: ").split()))
print("List of students: ", x)
```

- **Using List comprehension :**
  List comprehension is an elegant way to define and create list in Python. We can create lists just like mathematical statements in one line only. It is also used in getting multiple inputs from a user.

```
# Python program showing how to take multiple input using List comprehension

# taking two input at a time
x, y = [int(x) for x in input("Enter two values: ").split()]
print("First Number is: ", x)
print("Second Number is: ", y)
print()


# taking three input at a time
x, y, z = [int(x) for x in input("Enter three values: ").split()]
print("First Number is: ", x)
print("Second Number is: ", y)
print("Third Number is: ", z)
print()
```

```python
# taking two inputs at a time
x, y = [int(x) for x in input("Enter two values: ").split()]
print("First number is {} and second number is {}".format(x, y))
print()

# taking multiple inputs at a time
x = [int(x) for x in input("Enter multiple values: ").split()]
print("Number of list is: ", x)
```

Note: The above examples take input separated by spaces. In case we wish to take input separated by comma (,), we can use the following:

```python
# taking multiple inputs at a time separated by comma
x = [int(x) for x in input("Enter multiple value: ").split(",")]
print("Number of list is: ", x)
```

How to print without newline in Python?

Generally, people switching from C/C++ to Python wonder how to print two or more variables or statements without going into a new line in python. Since the python print() function by default ends with a newline. Python has a predefined format if you use print(a_variable) then it will **go to the next line automatically.**

Ex -
print("python")
print("hellopython")

But sometimes it may happen that we don't want to go to the next line but want to print on the same line. So what we can do?

Ex -
Input : print("python") print("hellopython")
Output : python hellopython
Input : a = [1, 2, 3, 4]
Output : 1 2 3 4

The solution discussed here is totally dependent on the python version you are using.

Print without newline in Python 2.x

```
# Python 2 code for printing on the same line printing python and hellopython in the same line

print("python"),
print("hellopython")

# array
a = [1, 2, 3, 4]

# printing a element in same
# line
for i in range(4):
    print(a[i]),
```

Output –
python hellopython
1 2 3 4

Print without newline in Python 3.x

```python
# Python 3 code for printing on the same line printing
# python and hellopython in the same line

print("hello", end =" ")
print("hellopython")


# array
a = [1, 2, 3, 4]


# printing a element in same
# line
for i in range(4):
    print(a[i], end =" ")
```

Output –
python hellopython
1 2 3 4

Print without newline in Python 3.x without using for loop

```python
# Print without newline in Python 3.x without using for loop

l=[1,2,3,4,5,6]

# using * symbol prints the list
# elements in a single line
print(*l)

#This code is contributed by anuragsingh1022
```

Output - 1 2 3 4 5 6

▪ Python | Output using print() function

Python print() function prints the message to the screen or any other standard output device.
Syntax: print(value(s), sep= ' ', end = '\n', file=file, flush=flush)
Parameters:
- **value(s) :** Any value, and as many as you like. Will be converted to string before printed.
- **sep='separator' :** (Optional) Specify how to separate the objects, if there is more than one.Default :' '
- **end='end':** (Optional) Specify what to print at the end.Default : '\n'
- **file :** (Optional) An object with a write method. Default :sys.stdout
- **flush :** (Optional) A Boolean, specifying if the output is flushed (True) or buffered (False). Default: False
- **Returns:** It returns output to the screen.

Though it is not necessary to pass arguments in the print() function, it requires an empty parenthesis at the end that tells python to execute the function rather calling it by name. Now, let's explore the optional arguments that can be used with the print() function.

▪ String Literals

String literals in python's print statement are primarily used to format or design how a specific string appears when printed using the print() function.

\n : This string literal is used to add a new blank line while printing a statement.
"" : An empty quote ("") is used to print an empty line.

Ex-

```python
print(" Python \n Python is the best language for programming .")
```

Output:

```
Python
Python is the best language for programming.
```

- **end= " " statement**

The end keyword is used to specify the content that is to be printed at the end of the execution of the print() function. By default, it is set to "\n", which leads to the change of line after the execution of print() statement.
Example: Python print() without new line.

Ex –

```python
# This line will automatically add a new line before the next print statement
print (" Python is the best language for programming")

# This print() function ends with "**" as set in the end argument.
print (" Python is the best language for programming ", end= "**")
print("Welcome to python")
```

Output –

```
Python is the best language for programming
Python is the best language for programming **Welcome to python
```

▪ flush Argument

The I/Os in python are generally buffered, meaning they are used in chunks. This is where flush comes in as it helps users to decide if they need the written content to be buffered or not. By default, it is set to false. If it is set to true, the output will be written as a sequence of characters one after the other. This process is slow simply because it is easier to write in chunks rather than writing one character at a time. To understand the use case of the flush argument in the print() function, let's take an example.

Example:

Imagine you are building a countdown timer, which appends the remaining time to the same line every second. It would look something like below:

3>>>2>>>1>>>Start

The initial code for this would look something like below;

Ex-

```
import time
count_seconds = 3
for i in reversed(range(count_seconds + 1)):
        if i > 0:
                print(i, end='>>>')
                time.sleep(1)
        else:
                print('Start')
```

So, the above code adds text without a trailing newline and then sleeps for one second after each text addition. At the end of the countdown, it prints Start and terminates the line. If you run the code as it is, it waits for 3 seconds and abruptly prints the entire text at once.

- **Separator**

The print() function can accept any number of positional arguments. These arguments can be separated from each other using a **","** **separator**. These are primarily used for formatting multiple statements in a single print() function.

Example:
b = "for"
print("Python", b , " Language ")

Output – Python for Language

- **file Argument**

Contrary to popular belief, the print() function doesn't convert the messages into text on the screen. These are done by lower-level layers of code, that can read data(message) in bytes. The print() function is an interface over these layers, that delegates the actual printing to a stream or **file-like object**. By default, the print() function is bound to *sys.stdout* through the file argument.

Example: Python print() to file

```
import io
# declare a dummy file
dummy_file = io.StringIO()

# add message to the dummy file
print('Hello Python!!', file=dummy_file)

# get the value from dummy file
dummy_file.getvalue()
```

Output - 'Hello Python!!\n'

Example : Using print() function in Python

```
# Python 3.x program showing how to print data on a screen

# One object is passed
print(" ")
HelloPython
x = 5
# Two objects are passed
print("x =", x)
```

```python
# code for disabling the softspace feature
print('G', 'F', 'G', sep=")

# using end argument
print("Python", end='@')
print(" HelloPython ")
```

Python Conditions(if-else)

Decision making is the most important aspect of almost all the programming languages. As the name implies, decision making allows us to run a particular block of code for a particular decision. Here, the decisions are made on the validity of the particular conditions. Condition checking is the backbone of decision making.

In python, decision making is performed by the following 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.

| Statement	Description
If Statement	The if statement is used to test a specific condition. If the condition is true, a block of code (if-block) will be executed.
If - else Statement	The if-else statement is similar to if statement except the fact that, it also provides the block of the code for the false case of the condition to be checked. If the condition provided in the if statement is false, then the else statement will be executed.
Nested if Statement	Nested if statements enable us to use if ? else statement inside an outer if statement.

If statements

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

The if statement is used to test a particular condition and if the condition is true, it executes a block of code known as if-block. The condition of if statement can be any valid logical expression which can be either evaluated to true or false.

The syntax of the if-statement is given below.

if expression:

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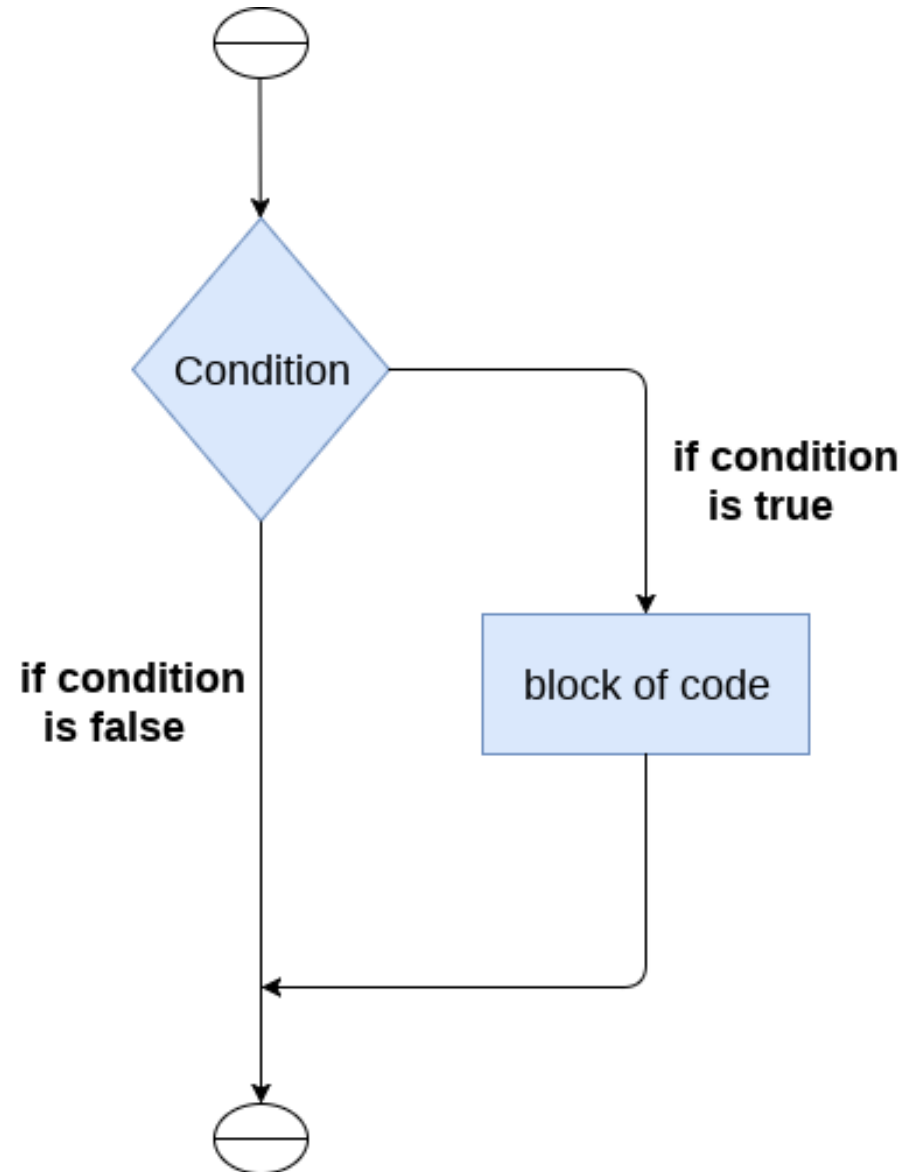
```python
# If statement:
a = 33
b = 200
if b > a:
    print("b is greater than a")
```

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".

Ex 2-

```python
num = int(input("enter the number?"))
if num%2 == 0:
    print("Number is even")
```

Output:
enter the number?10
Number is even

```
a = int(input("Enter a? "));
b = int(input("Enter b? "));
c = int(input("Enter c? "));
if a>b and a>c:
    print("a is largest");
if b>a and b>c:
    print("b is largest");
if c>a and c>b:
    print("c is largest");
```

Output –
Enter a? 100
Enter b? 120
Enter c? 130
c is largest

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.

Generally, four spaces are given to indent the statements which are a typical amount of indentation in python. Indentation is the most used part of the python language since it declares the block of code. All the statements of one block are intended at the same level indentation. We will see how the actual indentation takes place in decision making and other stuff in python.

Ex-
#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
```

== The elif statement

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

The elif statement enables us to check multiple conditions and execute the specific block of statements depending upon the true condition among them. We can have any number of elif statements in our program depending upon our need. However, using elif is optional.

The elif statement works like an if-else-if ladder statement in C. It must be succeeded by an if statement.
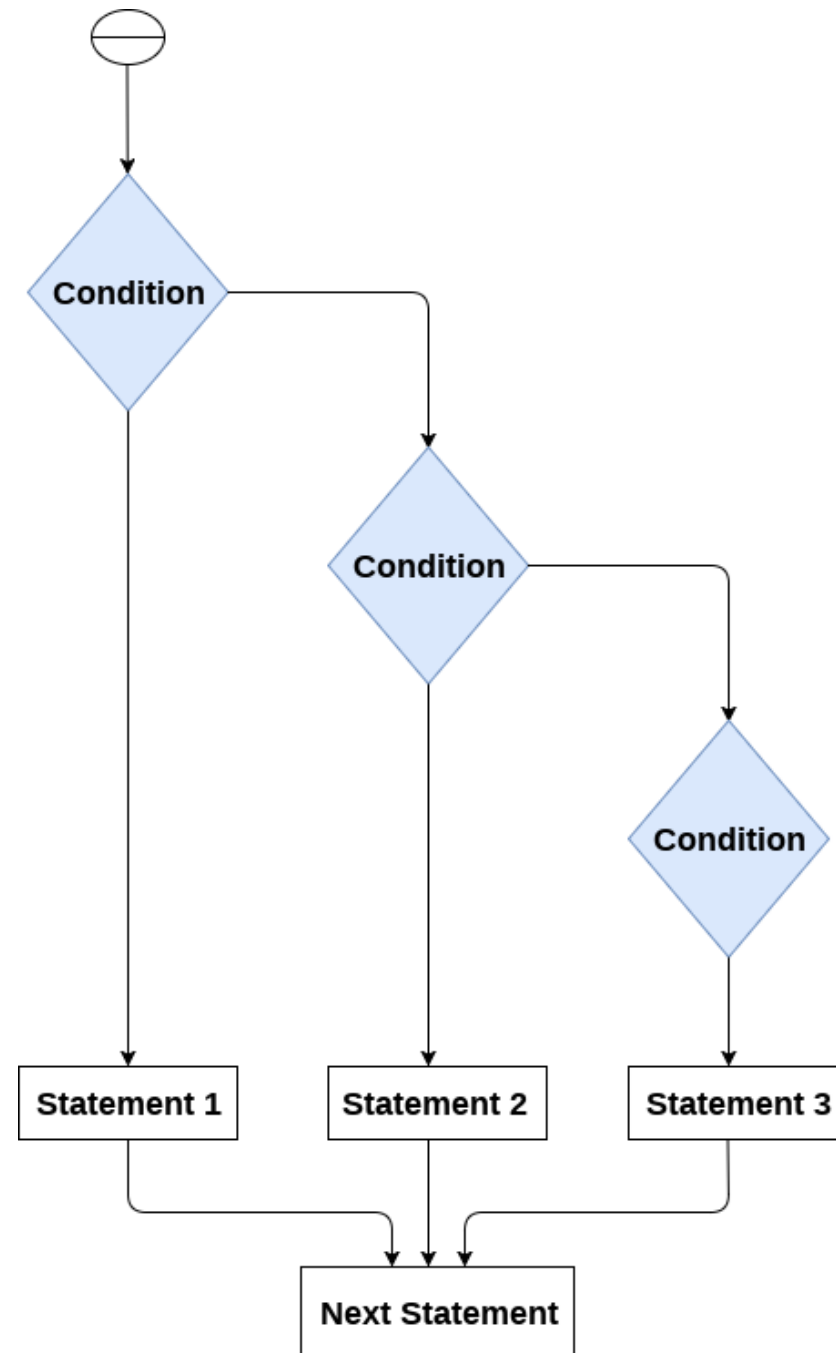
if expression 1:
   # block of statements
elif expression 2:
   # block of statements
elif expression 3:
   # block of statements
else:
   # block of statements

Ex-
a = 33
b = 33
if b > a:
  print("b is greater than a")
elif a == b:
  print("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".

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

The if-else statement provides an else block combined with the if statement which is executed in the false case of the condition.

If the condition is true, then the if-block is executed. Otherwise, the else-block is executed.
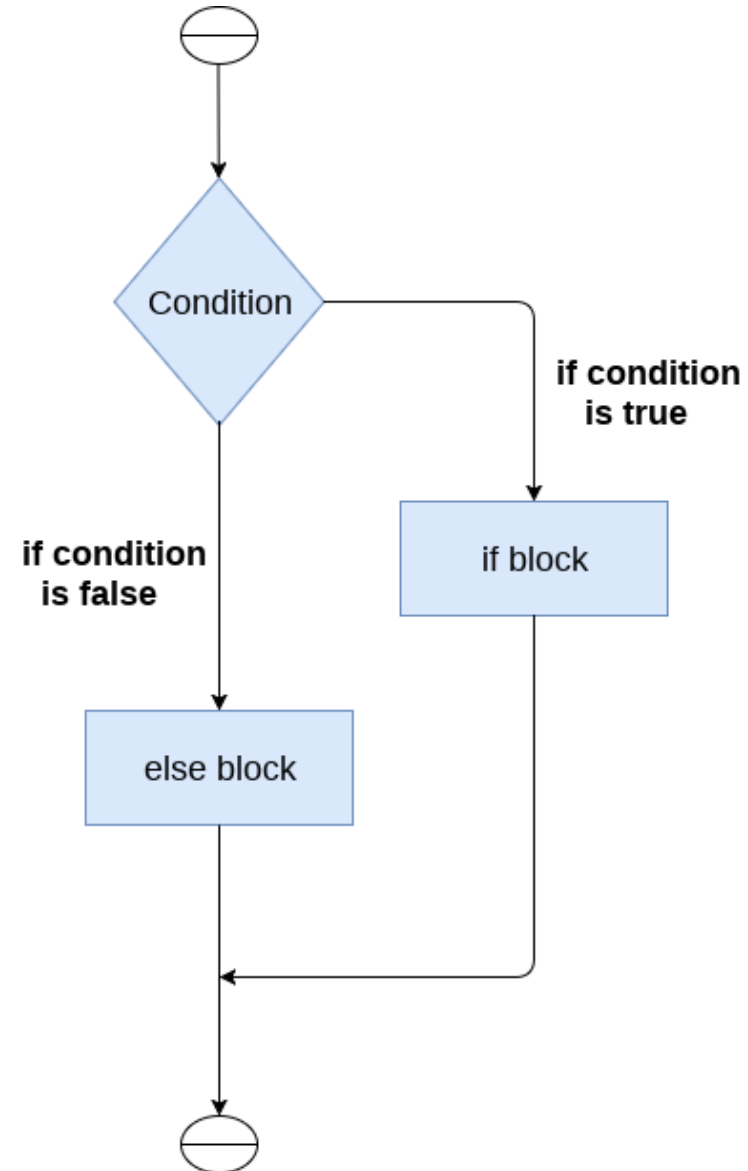
The syntax of the if-else statement is given below.

if condition:

    #block of statements

else:

    #another block of statements (else-block)

Ex – Program to check whether a number is even or not.

```
num = int(input("enter the number?"))
if num%2 == 0:
    print("Number is even...")
else:
    print("Number is odd...")
```

Output –
enter the number?10
Number is even

Ex- : Program to check whether a person is eligible to vote or not.

```
age = int (input("Enter your age? "))
if age>=18:
    print("You are eligible to vote !!");
else:
    print("Sorry! you have to wait !!");
```

Output –
Enter your age? 90
You are eligible to vote !!

```
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")
```

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.

Ex -

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

- Shorthand If

If you have only one statement to execute, you can put it on the same line as the if statement.

Ex- One line if statement:
if a > b: print("a is greater than b")

- Shorthand If ... Else

If you have only one statement to execute, one for if, and one for else, you can put it all on the same line:

Ex - One line if else statement:
a = 2
b = 330
print("A") if a > b else print("B")

This technique is known as **Ternary Operators**, or **Conditional Expressions**.

You can also have multiple else statements on the same line:
Ex - One line if else statement, with 3 conditions:

a,b = 330,330
print("A") if a > b else print("=") if a == b else print("B")

- **And**

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

Ex- 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")

- **Or**

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

Ex- 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")

- **Nested If**

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

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

- **The pass Statement**

if statements cannot be empty, but if you for some reason have an if statement with no content, put in the pass statement to avoid getting an error.

Ex -
```
a = 33
b = 200
if b > a:
  pass
```

Control Flow

The flow of the programs written in any programming language is sequential by default. Sometimes we may need to alter the flow of the program. The execution of a specific code may need to be repeated several numbers of times.

For this purpose, The programming languages provide various types of loops which are capable of repeating some specific code several numbers of times. Consider the following diagram to understand the working of a loop statement.

Why we use loops in python?

The looping simplifies the complex problems into the easy ones. It enables us to alter the flow of the program so that instead of writing the same code again and again, we can repeat the same code for a finite number of times. For example, if we need to print the first 10 natural numbers then, instead of using the print statement 10 times, we can print inside a loop which runs up to 10 iterations.
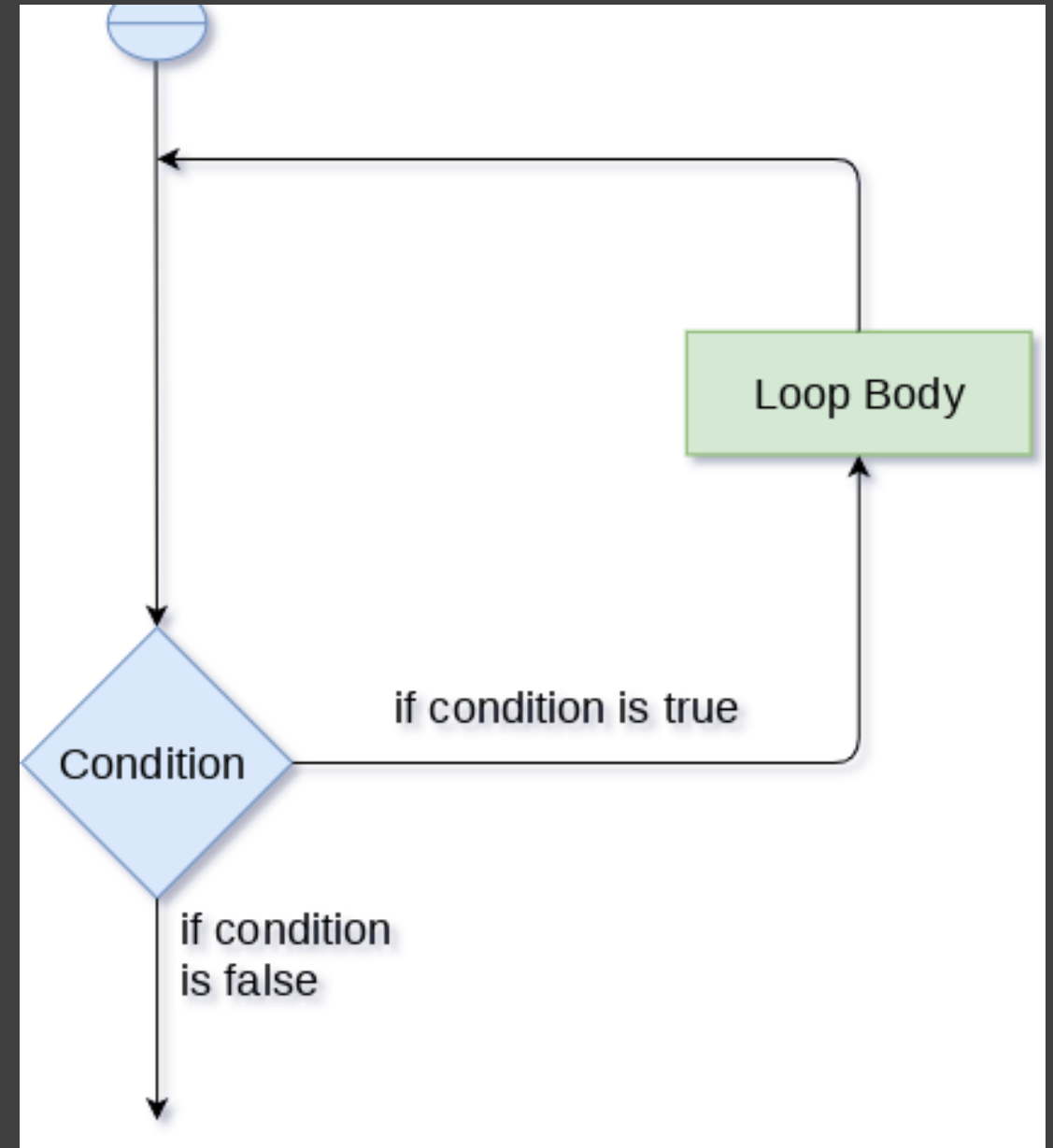
Advantages of loops

There are the following advantages of loops in Python.

- It provides code re-usability.
- Using loops, we do not need to write the same code again and again.
- Using loops, we can traverse over the elements of data structures (array or linked lists).

There are the following loop statements in Python.

Loop Statement	Description
for loop	The for loop is used in the case where we need to execute some part of the code until the given condition is satisfied. The for loop is also called as a per-tested loop. It is better to use for loop if the number of iteration is known in advance.
while loop	The while loop is to be used in the scenario where we don't know the number of iterations in advance. The block of statements is executed in the while loop until the condition specified in the while loop is satisfied. It is also called a pre-tested loop.
do-while loop	The do-while loop continues until a given condition satisfies. It is also called post tested loop. It is used when it is necessary to execute the loop at least once (mostly menu driven programs).

Python for loop

The for **loop in Python** is used to iterate the statements or a part of the program several times. It is frequently used to traverse the data structures like list, tuple, or dictionary.

The syntax of for loop in python is given below.

for iterating_var **in** sequence:

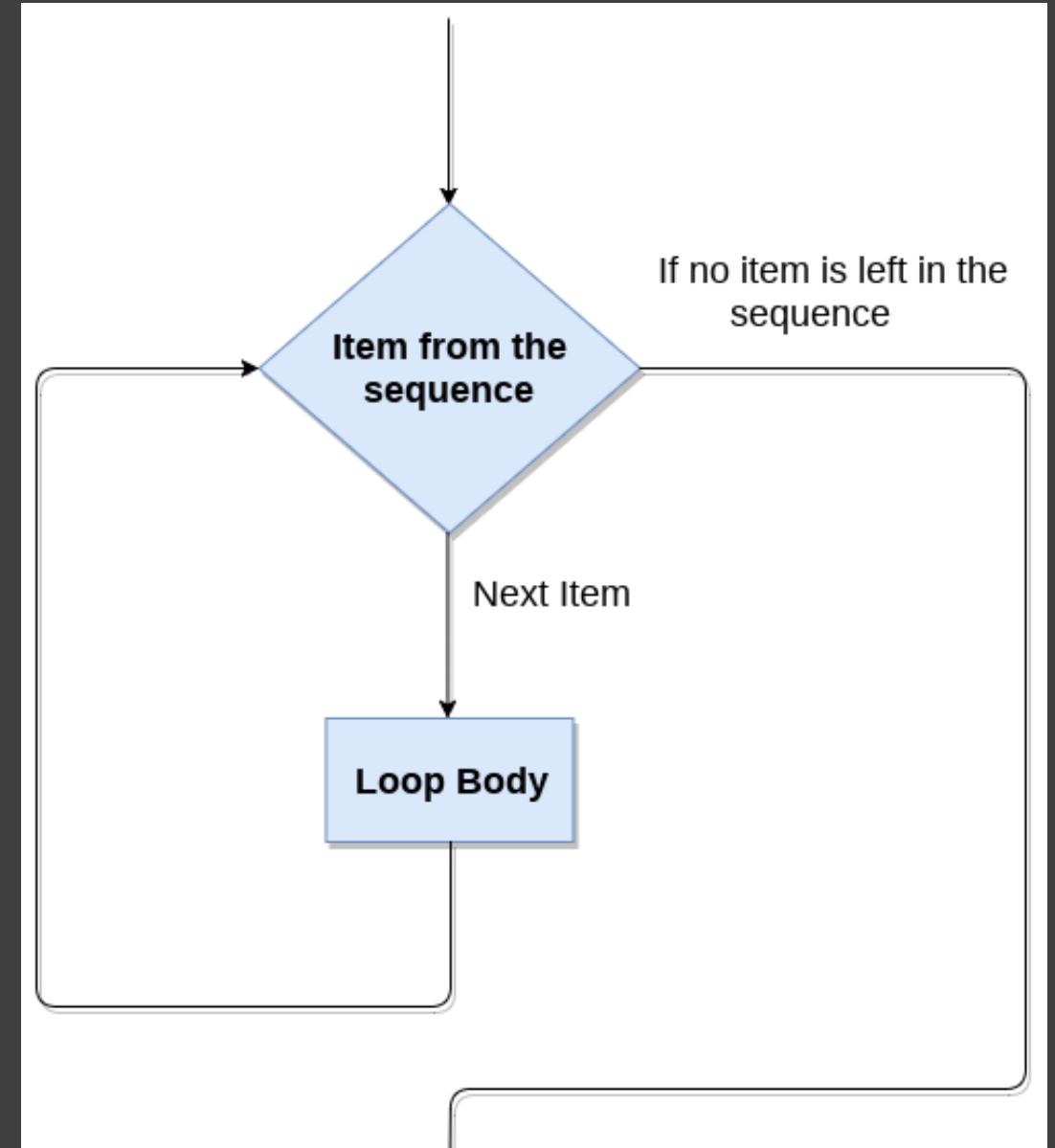   statement(s)

For loop Using Sequence

Ex1: Iterating string using for loop
str = "Python"
for i **in** str:
   print(i)

Output –
P
Y
T
H
O
N

```
list = [1,2,3,4,5,6,7,8,9,10]
n = 5
for i in list:
    c = n*i
    print(c)
```

Output -
5
10
15
20
25
30
35
40
45
50

```
list = [10,30,23,43,65,12]
sum = 0
for i in list:
    sum = sum+i
print("The sum is:",sum)
```

Output –

The sum is: 183

The range() function

The **range()** function is used to generate the sequence of the numbers. If we pass the range(10), it will generate the numbers from 0 to 9. The syntax of the range() function is given below.

Syntax: range(start,stop,step size)

- The start represents the beginning of the iteration.
- The stop represents that the loop will iterate till stop-1. The **range(1,5)** will generate numbers 1 to 4 iterations. It is optional.
- The step size is used to skip the specific numbers from the iteration. It is optional to use. By default, the step size is 1. It is optional.

Ex-1: Program to print numbers in sequence.

```
for i in range(10):
    print(i,end = ' ')
```

Output –
0 1 2 3 4 5 6 7 8 9

Ex - 2: Program to print table of given number.

```python
n = int(input("Enter the number "))
for i in range(1,11):
    c = n*i
    print(n,"*",i,"=",c)
```

Output -
Enter the number
10 10 * 1 = 10
10 * 2 = 20
10 * 3 = 30
10 * 4 = 40
10 * 5 = 50
10 * 6 = 60
10 * 7 = 70
10 * 8 = 80
10 * 9 = 90
10 * 10 = 100

Ex - 3: Program to print even number using step size in range().

```python
n = int(input("Enter the number "))
for i in range(2,n,2):
    print(i)
```

Output –
Enter the number 20
2
4
6
8
10
12
14
16
18

We can also use the **range()** function with sequence of numbers. The **len()** function is combined with range() function which iterate through a sequence using indexing. Consider the following example.

list = ['Peter','Joseph','Ricky','Devansh']
for i **in** range(len(list)):
   print("Hello",list[i])

Output –
Hello Peter
Hello Joseph
Hello Ricky
Hello Devansh

Python allows us to nest any number of for loops inside a **for** loop. The inner loop is executed n number of times for every iteration of the outer loop. The syntax is given below.

Syntax -
for iterating_var1 **in** sequence: #outer loop
   for iterating_var2 **in** sequence: #inner loop
     #block of statements
#Other statements

Ex-1: Nested for loop
```
# User input for number of rows
rows = int(input("Enter the rows:"))
# Outer loop will print number of rows
for i in range(0,rows+1):
# Inner loop will print number of Astrisk
   for j in range(i):
      print("*",end = ")
   print()
```

Enter the rows:3
*
**
***

```
rows = int(input("Enter the rows"))
for i in range(0,rows+1):
    for j in range(i):
        print(i,end = '')
    print()
```

```
1
22
333
4444
55555
```

Using else statement with for loop

Unlike other languages like C, C++, or Java, Python allows us to use the else statement with the for loop which can be executed only when all the iterations are exhausted. Here, we must notice that if the loop contains any of the break statement, then the else statement will not be executed.

```
for i in range(0,5):
    print(i)
else:
    print("for loop completely exhausted, since there is no break.")
```

Output-

```
0
1
2
3
4
for loop completely exhausted, since there is no break.
```

```
for i in range(0,5):
    print(i)
    break;
else:print("for loop is exhausted");
print("The loop is broken due to break statement...came out of the loop")
```

In the above example, the loop is broken due to the break statement; therefore, the else statement will not be executed. The statement present immediate next to else block will be executed.

Output: 0

The loop is broken due to the break statement...came out of the loop. We will learn more about the break statement in next tutorial.

Python While loop

The Python while loop allows a part of the code to be executed until the given condition returns false. It is also known as a pre-tested loop.

It can be viewed as a repeating if statement. When we don't know the number of iterations then the while loop is most effective to use.

The syntax is given below.

while expression:

    statements

Here, the statements can be a single statement or a group of statements. The expression should be any valid Python expression resulting in true or false. The true is any non-zero value and false is 0.

While loop Flowchart
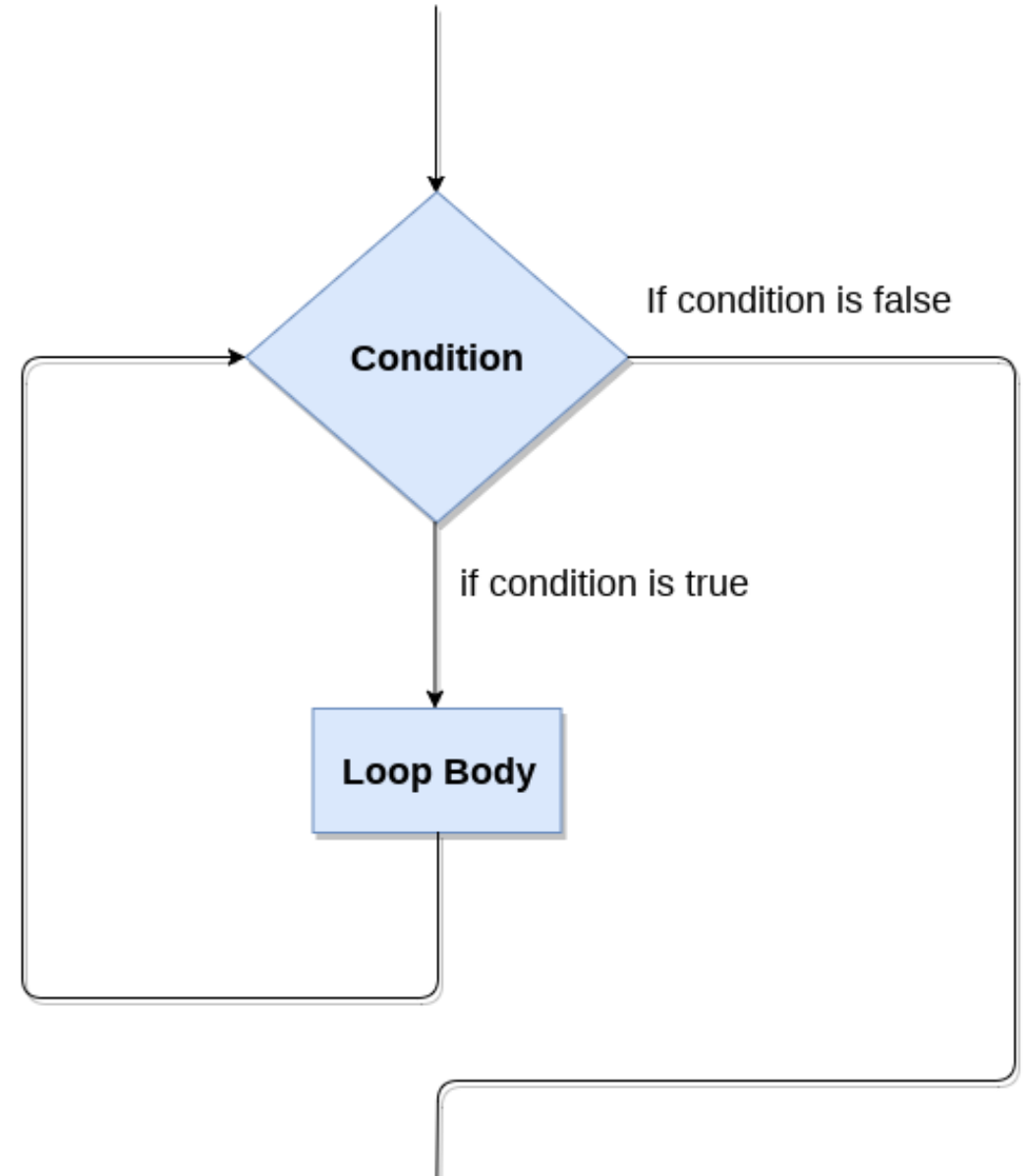
Loop Control Statements

We can change the normal sequence of **while** loop's execution using the loop control statement. When the while loop's execution is completed, all automatic objects defined in that scope are demolished. Python offers the following control statement to use within the while loop.

1. Continue Statement - When the continue statement is encountered, the control transfer to the beginning of the loop. Let's understand the following example.

2. Break Statement - When the break statement is encountered, it brings control out of the loop

3. Pass Statement - The pass statement is used to declare the empty loop. It is also used to define empty class, function, and control statement. Let's understand the following example.

Ex-1: Continue Statement

```
# prints all letters except 'a' and 't'
i = 0
str1 = 'javatpoint'
while i < len(str1):
    if str1[i] == 'a' or str1[i] == 't':
        i += 1
        continue
    print('Current Letter :', a[i])
    i += 1
```

Output:
Current Letter : j
Current Letter : v
Current Letter : p
Current Letter : o
Current Letter : i
Current Letter : n

Ex-2: Break Statement

The control transfer is transfered
when **break** statement soon it sees t

i = 0
str1 = 'javatpoint'

while i < len(str1):
   if str1[i] == 't':
     i += 1
      break
   print('Current Letter :', str1[i])
   i += 1

Output:
Current Letter : j Current Letter : a Current Letter : v Current
Letter : a

Ex -3: Pass Statement

# An empty loop
str1 = 'javatpoint'
i = 0
while i < len(str1):
   i += 1
   pass
print('Value of i :', i)

Output:
Value of i : 10

i=1
#The **while** loop will iterate until condition becomes **false**.
While(i<=10):
   print(i)
   i=i+1

Output –
1
2
3
4
5
6
7
8
9
10

i=1
number=0
b=9
number = **int**(input("Enter the number:"))
while i<=10:
   print("%d X %d = %d \n"%(number,i,number*i))
   i = i+1

Output -
Enter the number:10
 10 X 1 = 10
 10 X 2 = 20
 10 X 3 = 30
 10 X 4 = 40
 10 X 5 = 50
 10 X 6 = 60
 10 X 7 = 70
 10 X 8 = 80
 10 X 9 = 90
 10 X 10 = 100

<mark>Infinite while loop</mark>

If the condition is given in the while loop never becomes false, then the while loop will never terminate, and it turns into the **infinite while loop.**

Any **non-zero** value in the while loop indicates an **always-true** condition, whereas zero indicates the always-false condition. This type of approach is useful if we want our program to run continuously in the loop without any disturbance.

Ex-1:

```
while (1):
    print("Hi! we are inside the infinite while loop")
```

Output:
Hi! we are inside the infinite while loop Hi! we are inside the infinite while loop

Ex-2:

```
var = 1
while(var != 2):
    i = int(input("Enter the number:"))
    print("Entered value is %d"%(i))
```

Output -
Enter the number:10
Entered value is 10
Enter the number:10
Entered value is 10
Enter the number:10
Entered value is 10
Enter the number:10
Entered value is 10
Infinite time

Using else with while loop

Python allows us to use the else statement with the while loop also. The else block is executed when the condition given in the while statement becomes false. Like for loop, if the while loop is broken using break statement, then the else block will not be executed, and the statement present after else block will be executed. The else statement is optional to use with the while loop. Consider the following example.

```
i=1
while(i<=5):
    print(i)
    i=i+1
else:
    print("The while loop exhausted")
```

```
i=1
while(i<=5):
    print(i)
    i=i+1
    if(i==3):
        break
else:
    print("The while loop exhausted")
```

1 2

In the above code, when the break statement encountered, then while loop stopped its execution and skipped the else statement.

Ex-3: Program to print Fibonacci numbers to given limit.

```python
terms = int(input("Enter the terms "))
# first two intial terms
a = 0
b = 1
count = 0

# check if the number of terms is Zero or negative
if (terms <= 0):
    print("Please enter a valid integer")
elif (terms == 1):
    print("Fibonacci sequence upto",limit,":")
    print(a)
else:
    print("Fibonacci sequence:")
    while (count < terms) :
        print(a, end = ' ')
        c = a + b
        # updateing values
        a = b
        b = c
        count += 1
```

Output:
Enter the terms 10
Fibonacci sequence:
0 1 1 2 3 5 8 13 21 34

Python break statement

The break is a keyword in python which is used to bring the program control out of the loop. The break statement breaks the loops one by one, i.e., in the case of nested loops, it breaks the inner loop first and then proceeds to outer loops. In other words, we can say that break is used to abort the current execution of the program and the control goes to the next line after the loop.

The break is commonly used in the cases where we need to break the loop for a given condition.

The syntax of the break is given below.

#loop statements

break;

Ex-1:

```
list =[1,2,3,4]
count = 1;
for i in list:
    if i == 4:
        print("item matched")
        count = count + 1;
        break
print("found at",count,"location");
```

Output –

item matched
found at 2 location

Ex-2:
```
str = "python"
for i in str:
    if i == 'o':
        break
    print(i);
```
Output:
```
p
y
t
h
```

Ex-3: break statement with while loop
```
i = 0;
while 1:
    print(i," ",end=""),
    i=i+1;
    if i == 10:
        break;
print("came out of while loop");
```
Output:
```
0 1 2 3 4 5 6 7 8 9
came out of while loop
```

Ex-3:
```
n=2
while 1:
    i=1;
    while i<=10:
        print("%d X %d = %d\n"%(n,i,n*i));
        i = i+1;
    choice = int(input("Do you want to continue printing the table, press 0 for no?"))
    if choice == 0:
        break;
    n=n+1
```

Output -
2 X 1 = 2 2 X 2 = 4 2 X 3 = 6 2 X 4 = 8 2 X 5 = 10 2 X 6 = 12 2 X 7 = 14 2 X 8 = 16 2 X 9 = 18 2 X 10 = 20

Do you want to continue printing the table, press 0 for no?1
3 X 1 = 3 3 X 2 = 6 3 X 3 = 9 3 X 4 = 12 3 X 5 = 15 3 X 6 = 18 3 X 7 = 21 3 X 8 = 24 3 X 9 = 27 3 X 10 = 30

Do you want to continue printing the table, press 0 for no?0

Python Continue Statement

The continue statement in Python is used to bring the program control to the beginning of the loop. The continue statement skips the remaining lines of code inside the loop and start with the next iteration. It is mainly used for a particular condition inside the loop so that we can skip some specific code for a particular condition. The continue statement in Python is used to bring the program control to the beginning of the loop. The continue statement skips the remaining lines of code inside the loop and start with the next iteration. It is mainly used for a particular condition inside the loop so that we can skip some specific code for a particular condition.
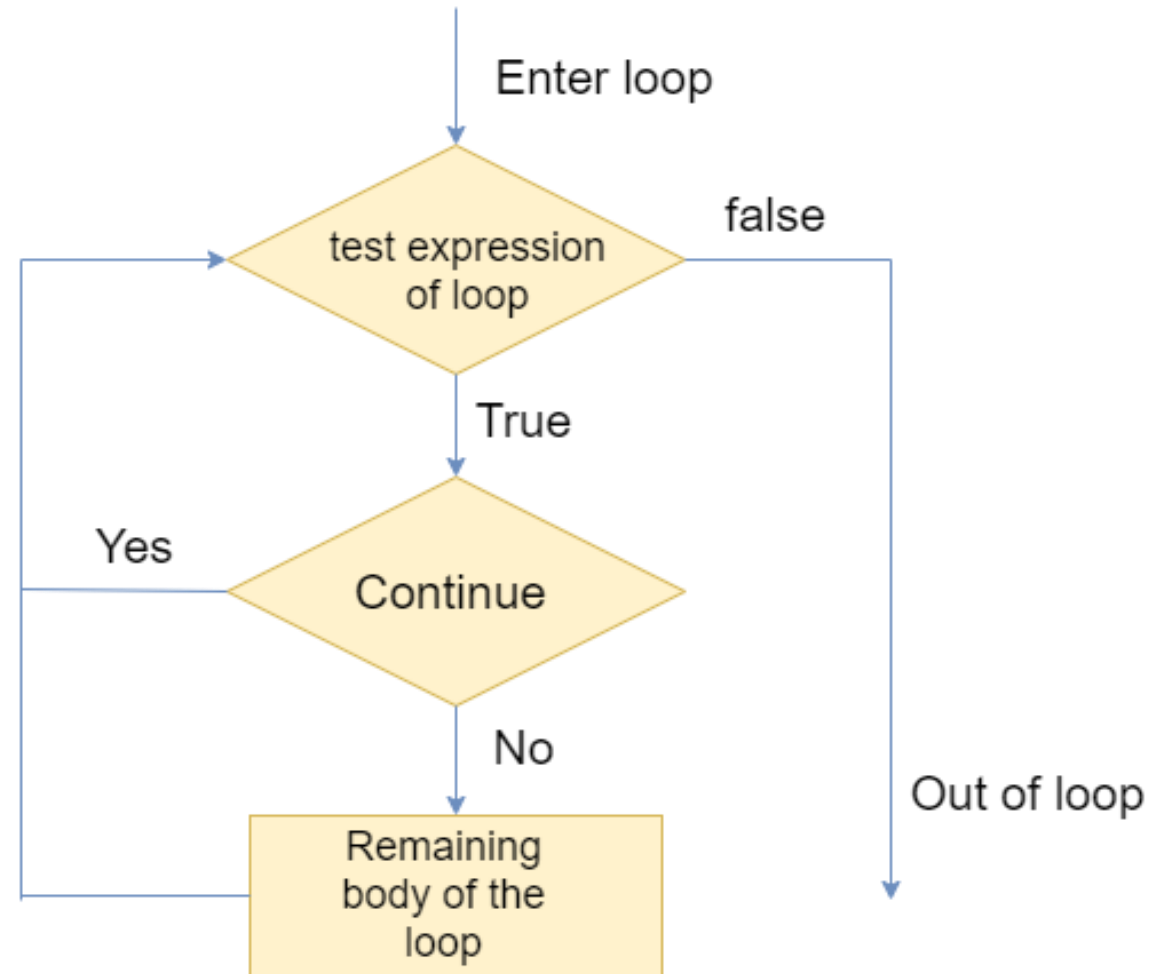
Syntax-

#loop statements

continue

#the code to be skipped

Flow Diagram

Consider the following examples.

```
i = 0
while(i < 10):
   i = i+1
   if(i == 5):
      continue
   print(i)
```

Output:
1
2 3 4 6 7 8 9 10

Observe the output of above code, the value 5 is skipped because we have provided the **if condition** using with **continue statement** in while loop. When it matched with the given condition then control transferred to the beginning of the while loop and it skipped the value 5 from the code.

Ex-2:

```
str = "JavaTpoint"
for i in str:
   if(i == 'T'):
      continue
   print(i)
```

Output:
J
a
v
a
p
o
i
n
t

Pass Statement

The pass statement is a null operation since nothing happens when it is executed. It is used in the cases where a statement is syntactically needed but we don't want to use any executable statement at its place.
For example, it can be used while overriding a parent class method in the subclass but don't want to give its specific implementation in the subclass.

In Python, the pass keyword is used to execute nothing; it means, when we don't want to execute code, the pass can be used to execute empty. It is the same as the name refers to. It just makes the control to pass by without executing any code. If we want to bypass any code pass statement can be used.
It is beneficial when a statement is required syntactically, but we want we don't want to execute or execute it later. The difference between the comments and pass is that comments are entirely ignored by the Python interpreter, where the pass statement is not ignored.

Example - Pass statement
# pass is just a placeholder for
# we will adde functionality later.
values = {'P', 'y', 't', 'h','o','n'}
for val **in** values:
   pass

Pass is also used where the code will be written somewhere but not yet written in the program file. Consider the following example.

```
list = [1,2,3,4,5]
flag = 0
for i in list:
    print("Current element:",i,end=" ");
    if i==3:
        pass
        print("\nWe are inside pass block\n");
        flag = 1
    if flag==1:
        print("\nCame out of pass\n");
        flag=0
```

Current element: 1
Current element: 2
Current element: 3
We are inside pass block Came out of pass
Current element: 4 Current element: 5

```python
for i in [1,2,3,4,5]:
    if(i==4):
        pass
        print("This is pass block",i)
    print(i)
```

Output:
1
2
3
This **is pass** block 4
4
5

We can create empty class or function using the pass statement.
```python
# Empty Function
def function_name(args):
    pass
#Empty Class
class Python:
    pass
```

Python Lists Methods

The list is a most versatile datatype available in Python which can be written as a list of comma-separated values (items) between square brackets. Important thing about a list is that items in a list need not be of the same type.

list1 = ['physics', 'chemistry', 1997, 2000]

Updating Lists
You can update single or multiple elements of lists by giving the slice on the left-hand side of the assignment operator, and you can add to elements in a list with the append() method.

Ex-

list = ['physics', 'chemistry', 1997, 2000];
print "Value available at index 2 : "
print list[2]
list[2] = 2001;
print "New value available at index 2 : "
print list[2]

Output -
Value available at index 2 :
1997
New value available at index 2 :
2001

Sr. No.	Function with Description
1	cmp(list1, list2)Compares elements of both lists.
	Click to add text
2	len(list)Gives the total length of the list.
3	max(list)Returns item from the list with max value.
4	min(list)Returns item from the list with min value.
5	list(seq)Converts a tuple into list.

Python includes following list methods

Sr.No.	Methods with Description
1	list.append(obj)Appends object obj to list
2	list.count(obj)Returns count of how many times obj occurs in list
3	list.extend(seq)Appends the contents of seq to list
4	list.index(obj)Returns the lowest index in list that obj appears
5	list.insert(index, obj)Inserts object obj into list at offset index
6	list.pop(obj=list[-1])Removes and returns last object or obj from list
7	list.remove(obj)Removes object obj from list
8	list.reverse()Reverses objects of list in place
9	list.sort([func])Sorts objects of list, use compare func if given

Tuple Methods Concept

A tuple is a collection of objects which ordered and immutable. Tuples are sequences, just like lists. The differences between tuples and lists are, the tuples cannot be changed unlike lists and tuples use parentheses, whereas lists use square brackets.
Creating a tuple is as simple as putting different comma-separated values. Optionally you can put these comma-separated values between parentheses also.

For example −
tup1 = ('physics', 'chemistry', 1997, 2000);
tup2 = (1, 2, 3, 4, 5);
tup3 = "a", "b", "c", "d";

To write a tuple containing a single value you have to include a comma, even though there is only one value −
tup1 = (50,);

Updating Tuples

Tuples are immutable which means you cannot update or change the values of tuple elements. You are able to take portions of existing tuples to create new tuples as the following example demonstrates −

tup1 = (12, 34.56);
tup2 = ('abc', 'xyz');

Following action is not valid for tuples
tup1[0] = 100;

# So let's create a new tuple as follows
tup3 = tup1 + tup2;
print tup3;

When the above code is executed, it produces the following result −
(12, 34.56, 'abc', 'xyz')

Removing individual tuple elements is not possible. There is, of course, nothing wrong with putting together another tuple with the undesired elements discarded.
To explicitly remove an entire tuple, just use the **del** statement.

For example −
```
tup = ('physics', 'chemistry', 1997, 2000);
print tup;
del tup;
print "After deleting tup : ";
print tup;
```

This produces the following result.
Note an exception raised, this is because after **del tup** tuple does not exist any more −
```
('physics', 'chemistry', 1997, 2000)
After deleting tup :
Traceback (most recent call last):
File "test.py", line 9, in <module>

print tup;
NameError: name 'tup' is not defined
```

No Enclosing Delimiters

Any set of multiple objects, comma-separated, written without identifying symbols, i.e., brackets for lists, parentheses for tuples, etc., default to tuples, as indicated in these short examples −

Ex -
```
print 'abc', -4.24e93, 18+6.6j, 'xyz';
x, y = 1, 2;
print "Value of x , y : ", x,y;
```

When the above code is executed, it produces the following result −
```
abc -4.24e+93 (18+6.6j) xyz
Value of x , y : 1 2
```

Built-in Tuple Functions

Python includes the following tuple functions −

Sr.No.	Function with Description
1	cmp(tuple1, tuple2)Compares elements of both tuples.
2	len(tuple)Gives the total length of the tuple.
3	max(tuple)Returns item from the tuple with max value.
4	min(tuple)Returns item from the tuple with min value.
5	tuple(seq)Converts a list into tuple

Built-in Function	Description
all()	Returns true if all element are true or if tuple is empty
any()	return true if any element of the tuple is true. if tuple is empty, return false
enumerate()	Returns enumerate object of tuple
sum()	Sums up the numbers in the tuple
sorted()	input elements in the tuple and return a new sorted list
tuple()	Convert an iterable to a tuple.

String Methods-