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Getting Started with Python

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Index

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= History of python

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= =>Python Programming Language Concevied in the Year 1980
=>Python Programming Language Implementation(Bring into action) was started in the year 1989
=>Python Programming Language Officially Released in the Year 1991 Feb 20th
=>Python Programming Language Developed by "GUIDO VAN ROSSUM".
=>Python Programming Language Developed at Centrum Wiskunde Informatica(CWI) in Nether Lands and Executed on Ameba OS.
=>ABC Programming Language is the predecessor of Python Programming Language.
=>Python Programming Language Maintained by a Non-Commercial Organization called "Python Software Foundation (PSF) " and whose official webside is www.python.org
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Versions in Python

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=>Python Programming contains 3 Types of Versions. They are
1) Python 1.x Here 1 is called Major Version and Here x Represents 0 1 2 3 ....etc(outdated)
2) Python 2.x---Here 2 is called Major Version and Here x Represents 0 1 2 3 4 5 6 7 (o3) Python 3.x---->Here 3 is called Major Version and Here x Represents 0 1 2 3 4 5 6 7 8 9 10 11 (Preview Version) 12 (Future Version)

=>Python Software does not provide Backward Compatability.
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Python Inspired From

=>Functional Programming from C
=>Object Oriented Programming Principles from C++ OOPs
=>Modular programming Language from Modulo3
=>Scripting Programming Language from PERL

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Features of Python Programming

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=>Features of a language are nothing but services or facilities provided by Language Developers and avilable in Language which are used by Programmers for developing Real Time Applications.
=>Python programming Provides 11 Features. They are

1. Simple
2. Freeware and Open Source
3. Dynamicall Typed
4. Platform Indepedent
5. Interpreted
6. High Level
7. Robust (Strong)
8. Both Procedure and Object Oriented Programming Language
9. Extensible
10.Embedded
11. Support for Third Party APIs such as Numpy ,Pandas, matplotlib, seaborn, NLP, keras , scipy and scikt

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1. Simple

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=>Python is one of the simple Proghramming language, bcoz of 3 important Technical Features.They are

1. Python Programming Provides "Rich set of Modules (Libraries). So that Python Programmer can re-use the pre-defined modules and develop real time application easily. ----------------------
Def. of Module:

A module is a collection Functions, Variables and Class names
Examples: math, cmath, calendar, random......etc

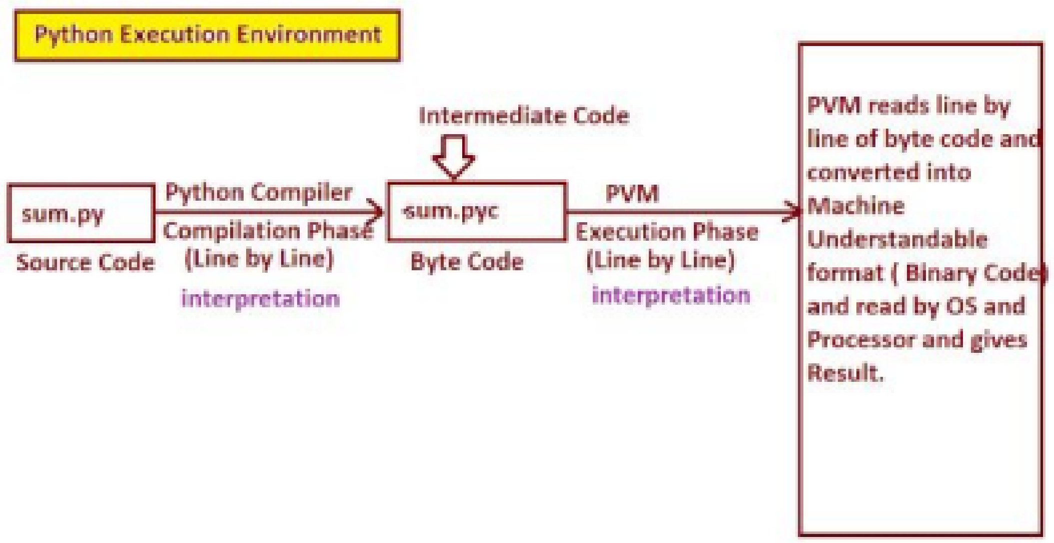
2. Python Programming Provides In-built facilty "Garbage Collector". So that Garbage Collector Collects Un-used Memory space and Improves peformanace of python Real Time Applications.

Definition of Garbage Collector:

=>A Garbage Collector is one of the Python In-buillt background Program, which is running behind of Every Python Regular program and whose Role is to Collecto or Remove Un-used Memory space and imporives peformanace of python Real Time Applications.

Hence Garbage Collector takes care about automatic memory management.

3. Python Programming Provides User-Freindly Syntaxes. So that we can develop Error-Free Program in Limited Span of time.


Python Execution Environment
Intermediate Code
sum.py
Source Code
Python Compiler
Compilation Phase
(Line by Line)
interpretation
sum.pyc
Byte Code
PVM
Execution Phase
(Line by Line)
interpretation
PVM reads line by line of byte code and converted into Machine Understandable format (Binary Code) and read by OS and Processor and gives Result.

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3. Dynamically Typed
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=>In Industry, we have two types of Programming Languages. They are

1. Static Typed Programming Languages
2. Dynamically Typed Programming Languages

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1. Static Typed Programming Languages

=>In This Programming Languages, It is mandatory to declare Variables by Using variable Declration where it contains Data Tyepes and Variables Names.
=>Without Variable Declaration, we cant store the data.

Examples: C,C++,JAVA,C#.Net...etc

```
int a,b,c // Variable Declaration--Mandatory.
a=10
b=20
c=a+b
```

----

2. Dynamically Typed Programming Languages

=>In This Programming Languages,It is not necessary to use Variable Declration.
=>Internally, depends on type of Value we store or assign to a variable, automatically Python Execution Environment will allocate memory space by using Appropriate Data Types.

Examples Software: Python

Examples:

```
>>> a=10
>>> b=20
>>> c=a+b
>>> print(a,type(a))-------------10 <class 'int'>
>>> print(b,type(b))-------------20 <class 'int'>
>>> print(c,type(c))------------30 <class 'int'>
```
=>In Python Programming, All Values are stored in the form of OBJECTS and Behind of object there exist CLASS.

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4. Platform Indepedent

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=>In IT, "Platform" is nothing but type of OS Being Used to run the application.
=>In IT, we have two Types of Programming Languages. They are

1. Platform Dependent languages.
2. Platform Independent languages.

- 1. Platform Dependent languages.

--- =>A Language is said to Platform Dependent iff whose data types differs their memory space from One OS another OS.

Examples: C,CPP...etc

- 2. Platform Independent languages.

--- =>A Language is said to Platform Independent iff whose data types takes Same memory space on All Types OSes. (Java Slogan)

=>A Language is said to Platform Independent iff whose OBJECTS takes Same memory space on All Types OSes and There Restriction on size of Data whoch is presesnt in object(Behid of objects there exist class). (Python Slogan)

Example: Java , PYTHON

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6. High Level Programming

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=>In general, we have two types of Programming languages. They are
a) Low Level Programming Languages.
b) High Level Programming Languages.

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a) Low Level Programming Languages:

=>In These Programming Languages, we represent the data in lower level data like Binary, Octal and Hexa decimal and This type data is not by default understanble by Programmers and end users.

```
Examples: - a=0b1111110000111101010---binary data
            b=0o23-----octal
            c=0xface----Hexa Decimal
```
----

b) High Level Programming Languages.
--- In These Programming Languages, Even we represent the data in lower level data like Binary, Octal and Hexa decimal , the High Level Programming Languages automatically converts into Decimal number System data, which is understanble by Programmers and end-users and python is one High Level Programming Language.

Example : Python
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Robust (Strong)

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=>Python is one of the Robust bcoz of "Exception Handling".

Definition of Exception: Every RuntimeError(Invalid Input) is called Exception

Every Exception in any language by default gives Technical Error Messages. Which are understanble by Programmer but not by End-Users. This Process is Not recommended in Industry.
=>Industry alway recommndes to generate User-Friendly Error Messages by Using Exception Handling.

Definition of Exception Handling:- The Process of Converting Technical Error Messages into User-Friendly Error Messages is called Exception Handling.

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2. Freeware and Open Source

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=>FreeWare

=>If any software is downloaded freely from Official Websites then that software is called FreeWare.
Examples: Python, Java...etc

=>OpenSource:

=>The standard Python name is CPYTHON.
=>Many Software Company vendors came foward and Customized the CPYTHON and the customized versions of CPYTHON used in their companies as In-house tools. =>The Customized Versions of CPYTHON are called "Python Distributions". =>Some of the Python Distributions are

1. JPython or Jython----->Used for Running JAVA Based Applications
2. IronPython or IPython--->Uswed for Running C#.Net Applications.
3. Mirco Python------------------>Used developing Micro Controller Applications.
4. Stackless Python-----Used Developing Concurrency Applications.
5. Anakonda Python-----Used for Dealing BigData / Hadoop Applications
6.Ruby Python------->Used to Ruby on Rails Based Applications
................................etc

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9. Extensible

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=>Extensible feature in Python refers that we can write some of Python Code in Other languages Like C, CPP, Java, HTML...etc.
=>It means that it can be extended to other languages and makes other languages programmer easy in writing and Re-using code of Python and Hence Python Extensible Language.

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10.Embedded

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=>Embedded feature of Python refers, Python Program can also call Orther language codes.
=>For Example. Inside Python Program, we can use C, C++ and Java Code .

Note: Python is one of the comfortable Programming Language and not a Fastest Programming language.

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11. Support for Third Party APIs such as Numpy ,Pandas
, matplotlib, seaborn, NLP, keras , scipy and scikt

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=>Python Programming Uses Third Party Modules for

Complex Mathematical Operations(numpy--Travis),
Data Analysis and Data Analytics---(Pandas--WES MCKINNEy---www.pandas.org)
Data Visualization------Matplot lib...etc

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Literals and Its Types

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=>A Literal is nothging but a value passing as input to the program.
=>In Python Programming, Primarly, Literals are classified into 5 types. They are

1. Integer Literals------Example---> 234 567 23
2. String Literals--------Examples--->"Python", "Rossum", "Ram"
3. Float Literals---------Examples----> 34.56 4.5 99.99 0.999
4. Boolean Literals-----Examples-----> True False
5. Date Literals-----------Examples:----> 29-08-2022, 17-08-2022...etc

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Identifiers or Variables

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=>We know that all types of Literals are stored in main memory by allocating Sufficient amount of Memory with help of Data Types. To Process the Data / Literals stored in main memory, we must give distinct names to the created memory space and these distinct names makes us to identify the values and they are also called IDENTIFIERS.
=>Duting Program Execution IDENTIFIER Values can be changed / Varying and hence

IDENTIFIERs are called VARIABLES.
=>Hence All Types of LITERALS Must Be stored in the form of VARIABLES.
=>In Python Programming All Variables are called Objects.

Definition of Variable

=>A Variable is one of the Identifier whose can value(s) can be changed during Program execution.
=>In Programming Language to do any data processing, we must use Variables / Obejcts (Python).

- ---
Rules for Using Variables or Identifiers in Python Program

- ---
=>To Use Variables in Python Programming, We use the following Rules.

1. A Variable Name is a combination of
Alphabets, Digits and a Special Symbol Under Score(_).
2. First Letter of the Variable Names must starts Either with Alphabet or Special Symbol Under Score (_)

Examples:

```
sal=23------valid
$sal=45----Invalid
@name="python"----Invalid
-sal=45-----Invalid
2sal=56----Invalid
456=3.4---Invalid
_sal_=45--valid
_=56---valid
__=5.6--valid
--=45----invalid
```

3. Within the variable name, No special symbols are allowed except Under Score (_)

Examples:

```
 tot sal=45----Invalid
tot_marks=456--valid
tot#sal=56-----NameError
```

4. No Keywords to be used as Variable Names (bcoz Keywords are the Reserved Words and they give special Meaning to the compilers) .

Example:

```
if=45---------Invalid
else=67---invalid
for=4.5----Invalid
if1=56--Valid
_else=67--valid
_for_=5.6--valid
```

Note:All Class Name can be used as Variable Names bcoz Class Names are not Keywords

5. All Variable Name are Case Sensitive

```
Examples:
----------------
>>> age=99----------------Valid
>>> AGE=98---------------Valid
>>> Age=97---------------Valid
>>> aGe=96--------------Valid
>>> print(age,AGE,Age,aGe)----- 99 98 97 96
>>> a=12
>>> A=13
>>> print(a,A)---------- 12 13
```

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Data Types in Python

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=>The Purpose of Data Types in Python is that " To allocate Sufficient amount of memory space for storing inputs in main memory of computer".
=>In Python Programming, We have 14 Data Types and They are Classified into 6 types.

I. Fundamental Category Data Types

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1. int
2. float
3. bool
4. complex

II.Sequence Category Data Types

----

1. str
2. bytes
3. bytearray
4. range

III. List Category Data Types (Collections Data Types or Data Structures)

----

1. list
2. tuple

IV. Set Category Data Types (Collections Data Types or Data Structures)

----

1. set
2. frozenset

VI. Dict Category Data Types (Collections Data Types or Data Structures)

----

1. dict

VI. NoneType Category Data Types

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1. NoneType

===
I. Fundamental Category Data Types
===
=>The purpose of Fundamental Category Data Types is that " To store Single Value". =>In Python Programming, we have 4 data types in Fundamental Category. They are

1. int
2. float
3. bool
4. complex

=======================================
1. int
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Properties

=>'int' is one of the pre-defined class and treated as Fundamental Data Type. =>The purpose of int data type is that " To store Integer Data or Whole Numbers or Integral Values(Numbers or digits without decial Places) and Different Number System data". ---------------- Examples:

Python Instructions Output

```
-------------------------------- -------------------------------------- >>> a=100
>>> b=123
>>> c=a+b
>>> print(a,type(a))------------------------------100 <class 'int'>
>>> print(b,type(b))------------------------------123 <class 'int'>
>>> print(c,type(c))------------------------------223 <class 'int'>
```

=>with int data type we can also Store Different types of Number Systems Values. =>In Programming languages, we we have 4 Types of Number Systems. They are

1. Decimal Number System (default)
2. Binary Number System
3. Octal Number System
4. Hexa Decimal Number System

- 1. Decimal Number System (default)

=>This is one of the default number System.
=>This Number System Conatins
Digits: 0 1 2 3 4 5 6 7 8 9 ------Total Digits =10
Base : 10
=>All Base 10 Literals are called Integer Data.
=>By default python Execution Environment always displays the result in the form decimal number System.

- 2. Binary Number System

- =>This Number System Conatins
Digits: 0 1 ------Total Digits =2
Base : 2
=>All Base 2 Literals are called Binary Data.
=>To Store Binary Data in python environment, The Binary Data Must be preceded by a letter 'b' or 'B'
=>Syntax: varname=0b Binary data
(OR)
varname=0B Binary data
=>When we store the Binary data in python environment,python Execution Environment converts automatically into decimal number System data.
Examples:

```
>>> a=0b1010
>>> print(a,type(a))---------------------------10 <class 'int'>
>>> bin(10)----------------------------------'0b1010'
>>> a=0B1111
>>> print(a,type(a))--------------------------15 <class 'int'>
>>> a=0b10120-------------------------------SyntaxError: invalid digit '2' in binary literal
```

- 3. Octal Number System

- =>This Number System Conatins
Digits: 0 1 2 3 4 5 6 7 ------Total Digits =8
Base : 8
=>All Base 8 Literals are called Octal Data.
=>To Store Octal Data in python environment, The Octal Data Must be preceded by a letter 'o' or 'O'
=>Syntax: varname=0o Octal data
(OR)
varname=0O Octal data
=>When we store the Octal data in python environment,python Execution Environment converts automatically into decimal number System data.
Examples:

```
>>> a=0o27
>>> print(a,type(a))-------------23 <class 'int'>
>>> oct(a)-----------------------'0o27'
>>> a=0O123
>>> print(a,type(a))------------83 <class 'int'>
>>> oct(83)-----------------'0o123'
>>> a=0o148-------------SyntaxError: invalid digit '8' in octal literal
```

- -----------
4. Hexa Decimal Number System

- =>This Number System Conatins
Digits: 0 1 2 3 4 5 6 7 8 9
A(10) B(11) C(12) D(13) E(14) F(15) ------Total Digits =16

Base : 8

=>All Base 16 Literals are called Hexa Decimal Data.

=>To Store Hexa Decimal Data in python environment, The Hexa Decimal Data Must be preceded by a letter 'x' or 'X'

=>Syntax: varname=0x Hexa Decimal data

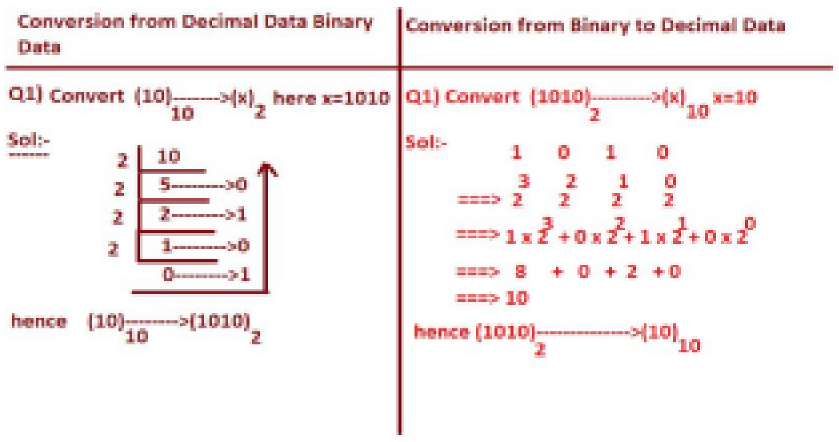
(OR)

varname=0X Hexa Decimal data

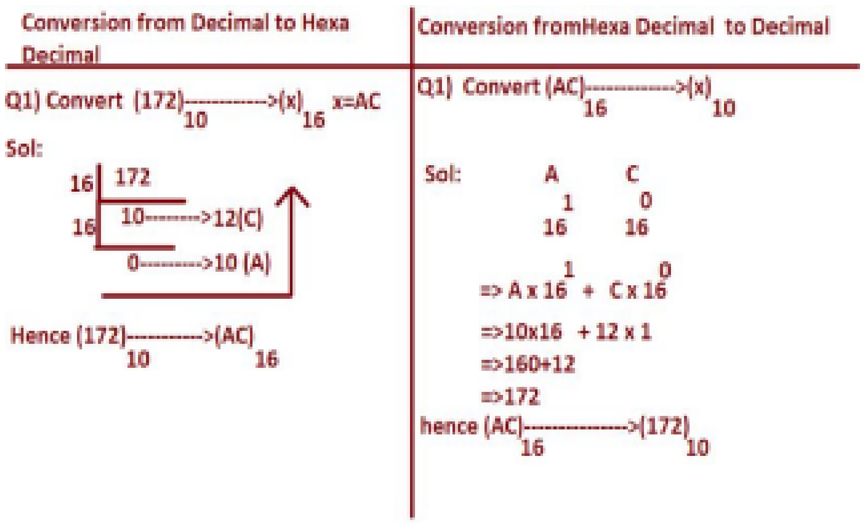
=>When we store the Hexa Decimal data in python environment,python Execution Environment converts automatically into decimal number System data.

Examples:

```
>>> a=0xAC
>>> print(a,type(a))------------------------172 <class 'int'>
>>> hex(172)--------------------------------'0xac'
>>> a=0xBEE
>>> print(a,type(a))----------------------3054 <class 'int'>
>>> hex(3054)-----------------------------'0xbee'
>>> a=0XFacE
>>> print(a,type(a))--------------------64206 <class 'int'>
>>> a=0xBEER------------------------SyntaxError: invalid hexadecimal literal
```



Conversion from Decimal Data Binary Data
Q1) Convert $(10)_{10}$------->$(x)_2$ here x=1010
Sol:-
2 | 10
2 | 5-------->0
2 | 2-------->1
2 | 1-------->0
0-------->1
hence $(10)_{10}$-------->$(1010)_2$
Conversion from Binary to Decimal Data
Q1) Convert $(1010)_2$---------->$(x)_{10}$ x=10
Sol:-
1 0 1 0
===> 2^3 2^2 2^1 2^0
===> $1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$
===> 8 + 0 + 2 + 0
===> 10
hence $(1010)_2$-------------->$(10)_{10}$



Conversion from Decimal to Hexa Decimal

Q1) Convert $(172)_{10}$------------>$(x)_{16}$ x=AC

Sol:

16 | 172

16 | 10--------->12(C)

0---------->10 (A)

Hence $(172)_{10}$----------->$(AC)_{16}$

Conversion fromHexa Decimal to Decimal

Q1) Convert $(AC)_{16}$-------------->$(x)_{10}$

Sol: A C

16^1 16^0

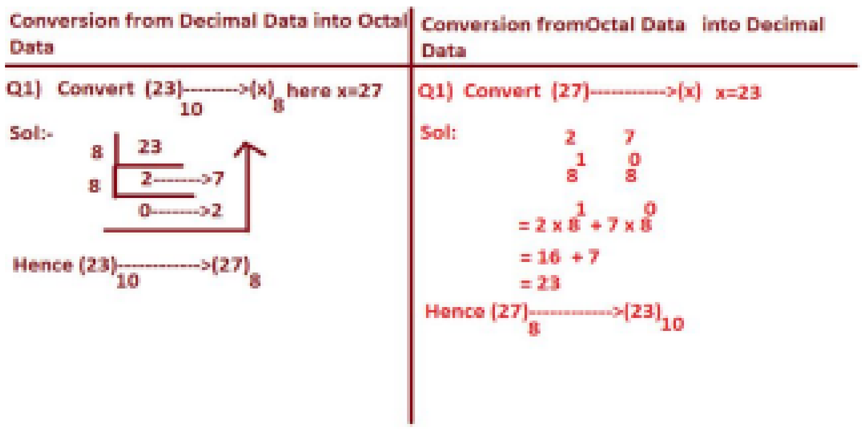
$\Rightarrow A \times 16^1 + C \times 16^0$

$\Rightarrow 10 \times 16 + 12 \times 1$

$\Rightarrow 160+12$

$\Rightarrow 172$

hence $(AC)_{16}$---------------->$(172)_{10}$



Conversion from Decimal Data into Octal Data

Q1) Convert $(23)_{10}$--------->$(x)_8$ here x=27

Sol:-

8 | 23

8 | 2-------->7

0-------->2

Hence $(23)_{10}$------------->$(27)_8$

Conversion fromOctal Data into Decimal Data

Q1) Convert (27)------------>(x) x=23

Sol: 2 7

8^1 8^0

$= 2 \times 8^1 + 7 \times 8^0$

$= 16 + 7$

$= 23$

Hence $(27)_8$-------------->$(23)_{10}$

==

2. float

==

Properties:

=>'float' is one of the pre-defined class and treated as Fundamental data Type. =>The purpose of float data type is that " To store Real Constant Values OR Floating Point Values (Numbers with Decimal Places)".

=>Example: Percentage of Marks, Taxable income for Financial year 22-23..etc

=>float data type can stores the data which belongs to Scientific Notation. =>The Advantage of Scientific Notation is that " It Takes Less Memory Space for Extremly Large Floting Point Values."

=>float data type does not support to store directly the values of Binary, Ocral and Hexa Decimal Number Systems. But it allows to store only Deciaml Number System Values (Default)

Examples:

```
>>> a=12.34
>>> print(a,type(a))---------------------12.34 <class 'float'>
>>> a=10
>>> b=2.3
>>> c=a+b
>>> print(a,type(a))------------------10 <class 'int'>
>>> print(b,type(b))-----------------2.3 <class 'float'>
>>> print(c,type(c))-----------------12.3 <class 'float'>
----------------------------------------------------------------------------
>>> a=2e3
>>> print(a,type(a))---------------------------2000.0 <class 'float'>
>>> a=10e-2
>>> print(a,type(a))---------------------0.1 <class 'float'>
>>> a=0.000000000000000000000000000000000000000000000000000001
>>> print(a,type(a))------------------1e-54 <class 'float'>
---------------------------------------------------------------------------
>>> a=0b1010.0b1010----------------SyntaxError: invalid decimal literal
>>> a=0b1010.34----------------------SyntaxError: invalid syntax
>>> a=0xACC.0b1010--------------SyntaxError: invalid decimal literal
>>> a=0o23.0o45------------------SyntaxError: invalid decimal literal
-----------------------------------------------------------
```
==

3. bool

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Properties

=>'bool' is one of the pre-defined class and treated as Fundamental Data Type.
=>The purpose of bool data type is that "To Store True and False Values". =>In Python Programming , True and Fase are of the KeyWords and They are the values for bool data type.
=>Internally, The value of True is 1 and the value of False is 0

- Examples:

```
>>> a=True
>>> print(a,type(a))---------------True <class 'bool'>
>>> b=False
>>> print(b,type(b))---------------False <class 'bool'>
>>> a=true-----------------------------NameError: name 'true' is not defined. Did you mean: 'True'?
>>> b=false-----------------NameError: name 'false' is not defined. Did you mean: 'False'?
----------------------------------------------------------------------------------------------------------
>>> a=True
>>> print(a,type(a))--------------------True <class 'bool'>
>>> b=False
>>> print(b,type(b))-------------------False <class 'bool'>
>>> print(a+b)-------------------------1
>>> print(False+False)------------0
>>> print(False-True)----------------1
>>> print(True+True+False)----------2
>>> print(2*True-4+False)------------2
>>> print(0b1010+True+1)------------12
>>> print(0b1111*False+2*True)------2
>>> print(0b100*2+3*True)------------11
```

```
>>> print(True>False)-------------------True
>>> print(True>1)-------------------------False
>>> print(True>=0b0000001)-----------True
>>> print(False>=0.0)---------------------True
>>> print(True*False>True)-----------False
```

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4. complex

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=>Properties

=>'complex' is one of the pre-defined class and treated as Fundamental Data Type.
=>The purpose of complex data type is that " To Store and Process Complex Data".
=>The Generale Notation of Complex Data Type is shown bellow.

a+bj or a-bj
=>here 'a' is called Real Part
=>here 'b' is called Imginary Part
=>Here 'j' represents sqrt(-1)

=>Internally , The real and imginary parts are by default belongs to float.
=>To Extract or get Real Part from Complex object, we use a pre-defined attribute called "real"

Syntax:- Complexobj.real

=>To Extract or get Imaginary Part from Complex object, we use a pre-defined attribute called "imag"

Syntax:- Complexobj.imag

Examples:

```
>>> a=2+3j
>>> print(a,type(a))---------------------------(2+3j) <class 'complex'>
>>> b=4-5j
>>> print(b,type(b))--------------------------(4-5j) <class 'complex'>
>>> c=-2-4j
>>> print(c,type(c))--------------------------(-2-4j) <class 'complex'>
---------------------------------------------
>>> a=1.4+3.4j
>>> print(a,type(a))-------------------------(1.4+3.4j) <class 'complex'>
>>> b=-3.5-5.6j
>>> print(b,type(b))-------------------------(-3.5-5.6j) <class 'complex'>
>>> c=10+2.3j
>>> print(c,type(c))-------------------------(10+2.3j) <class 'complex'>
----------------------------------------
>>> a=0+2j
>>> print(a,type(a))------------------------2j <class 'complex'>
>>> b=9.5j
>>> print(b,type(b))----------------------9.5j <class 'complex'>
---------------------------------------------------------------
>>> a=10.4+3j
>>> print(a,type(a))-------------------(10.4+3j) <class 'complex'>
>>> a.real------------------------10.4
>>> a.imag---------------------3.0
>>> a=9.5j
>>> print(a,type(a))------------9.5j <class 'complex'>
>>> a.real----------------------0.0
>>> a.imag------------------9.5
>>> a.imagiary----------------AttributeError: 'complex' object has no attribute
'imagiary' ------------------------------------------
>>> a=-3.4-4.5j
>>> print(a,type(a))-------------(-3.4-4.5j) <class 'complex'>
>>> a.real-------------------- -3.4
>>> a.imag----------------- -4.5
--------------------------------------------------------------------------------------------
>>> (12+4j).real--------------------12.0
>>> (12+4j).imag------------------4.0
>>> (-0-2.3j).real-------------------0.0
>>> (-0-2.3j).imag-------------------2.3
>>> (0b1111+0b1010j).real----------SyntaxError: invalid binary literal
>>> (0b1111+0b1010j).imag---------SyntaxError: invalid binary literal
==============================X==================================
= =====
```

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II.Sequence Category Data Types

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=>The purpose of Sequence Category Data Types is that " To srore Sequence of Values ".
=>We have 4 data types int Sequence Category . They are

1. str
2. bytes
3. bytearray
4. range

- ----

===

1. str (Part-1)

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=>"str" is one of the pre-defined class and treated as Sequence Data Type, =>The purpose of str data type is that " To store Text Data or Numeric Data or Alpha-numeric Data and special symbols enclosed within Single or Double Quotes or Tripple Single or Tripple Double Quotes."

=>Def. of str (String):

=>A String is sequnece or Collection of Characters or Numbers or Alpha-numeric Data and special symbols enclosed within Single or Double Quotes or Tripple Single or Tripple Double Quotes.

Types of str data

=>In Python Programming, We have 2 types of str data. They are
1. Single Line String Data
2. Multi Line String Data
----
1. Single Line String Data

```
=>Syntax: " String Data "
--------------- (OR)
                                          ' String data '
```

=>Single Line string data always enclosed within Double or Single Quotes. =>Double or Single Quotes are not useful for organizing Multi Line String Data.
----
2. Multi Line String Data

```
=>Syntax: " " " String Line 1
                                          String Line 2
                                          ------------------
                                          String Line n " " "
                                                    (OR)
                              ' ' ' String Line 1
                                          String Line 2
                                          ------------------
                                          String Line n ' ' '
```
=>With Tripple Double Quotes or Tripple Single Quotes we can organize Multi Line String data and also we can organize Single Line String data.

Examples:

```
>>> s1="Guido Van Rossum"
>>> print(s1,type(s1))---------------------------Guido Van Rossum <class 'str'>
>>> s2="123456"
>>> print(s2,type(s2))---------------------------123456 <class 'str'>
>>> s2="Python3.10.6"
>>> print(s2,type(s2))---------------------------Python3.10.6 <class 'str'>
>>> s3='Travis Oliphant'
>>> print(s3,type(s3))--------------------------Travis Oliphant <class 'str'>
>>> s4='1234python%$'
>>> print(s4,type(s4))--------------------------1234python%$ <class 'str'>
>>> s5='A'
>>> print(s5,type(s5))---------------------------A <class 'str'>
>>> s6='6'
>>> print(s6,type(s6))-------------------------6 <class 'str'>
>>> s7='$%^&@'
>>> print(s7,type(s7))--------------------------$%^&@ <class 'str'>
---------------------------------
>>> s1="Python Programming"
>>> print(s1,type(s1))--------------------Python Programming <class 'str'>
>>> s2='Python Programming'
>>> print(s2,type(s2))-------------------Python Programming <class 'str'>
-----------------------------------------------------
>>> addr1="Guido van Rossum
                                              SyntaxError: unterminated string literal
(detected at line 1)
>>> addr1='Guido van Rossum
                                              SyntaxError: unterminated string literal
(detected at line 1)
----------------------------------------------
>>> addr1="""Guido Van Rossum
... FNO:3-4, Red Sea Side
... Python Software Foundation
... Nether Lands
... Pin-57 """
>>> print(addr1, type(addr1))
                                       Guido Van Rossum
                                      FNO:3-4, Red Sea Side
                                      Python Software Foundation
                                      Nether Lands
                                       Pin-57 <class 'str'>

---------------------------------
>>> addr2='''Travis Oliphant
... Numpy Organization
... FNO-34-56 Nether lands
... PIN-45 '''
>>> print(addr2,type(addr2))
                               Travis Oliphant
                               Numpy Organization
                               FNO-34-56 Nether lands
                               PIN-45 <class 'str'>
--------------------------------------------------------------------------------------
>>> s1="""Python Programming"""
>>> print(s1,type(s1))-----------------Python Programming <class 'str'>
>>> s1='''Python Programming'''
>>> print(s1,type(s1))------------------Python Programming <class 'str'>
>>> s2="""K"""
>>> print(s2,type(s2))-----------------K <class 'str'>
>>> s2='''K'''
>>> print(s2,type(s2))------------------K <class 'str'>
-----------------------------------------------------------------------------------
```

==

Operations on str data (Part-1)

==

=>On str data, we can perform 2 types of Operations. They are

1. Indexing Operation
2. Slicing Operations

----
1. Indexing Operation

=>The Process of Obtaining Single Character from given str object by passing valid Index is called Indexing.
=>Syntax:
-------------- strobj [Index]

=>Here strobj is an object of <class, 'str'>
=>Index can be either +Ve Indexing or -Ve Indexing
=>If we enter valid Index value then we get Corresponding Charcter from strobj.
=>If we enter invalid Index value then we get IndexError.

Examples:

```
>>> s="PYTHON"
>>> print(s[3])-------------------H
>>> print(s[-2])-------------------O
>>> print(s[4])-------------------O
>>> print(s[-6])-----------------P
>>> print(s[0])------------------P
>>> print(s[-5])-----------------Y
>>> print(s[-1])----------------N
>>> print(s[3])-----------------H
>>> print(s[-3])--------------H
>>> print(s[-13])--------------IndexError: string index out of range
---------------------------------------------------
>>> s="PYTHON"
>>> print(s,type(s))---------------PYTHON <class 'str'>
>>> len(s)-----------------6
>>> s="Python Prog"
>>> len(s)------------------ 11
>>> print(s[34])--------------IndexError: string index out of range
```

- --------------
2. Slicing Operations

- --------------
=>The Process of obtaining Range of Characters or Sub String from given Str object is called Slicing .
=>Slicing Operation can performed by using 5 Syntaxes.-

- -------------
Syntax-1: Strobj[Begin Index : End Index]

This Syntax obtains range of characters from BeginIndex to EndIndex-1 provided Begin Index<End Index Otherwise we never get any output (' ')

Examples

```
>>> s="PYTHON"
>>> print(s,type(s))------------------------PYTHON <class 'str'>
>>> print( s[0:4] )---------------------------PYTH
>>> print( s[4:0] )--------------------- Empty
>>> s[4:0]--------------------------------' '
>>> print( s[2:5] )----------------------THO
>>> print( s[0:6] )--------------------PYTHON
>>> print( s )-----------------------PYTHON
>>> print(s[-6:-3])----------------PYT
>>> print(s[-4:-1])----------------THO
>>> print(s[-1:-6])------------------ Empty
>>> print(s[2:6])---------------------THON
>>> print(s[2:-2])---------------------- TH ( Most Imp )
>>> print(s[1:-1])---------------------- YTHO
>>> print(s[-1:-6])-------------------- empty
>>> s[-1:-6]------------------------------' '
>>> s[2:-1]-------------------------------'THO'
>>> s[-6:4]--------------------------------'PYTH'
>>> s[2:-4]----------------------------- ' ' ( Empty String )
```

Syntax-2: StrObj[BeginIndex :]

=>In This Syntax We specified Begin Index and Did't not specify End Index. =>If we don't Specify End Index then PVM always takes End Character Index as End Index OR len(strobj)-1

Examples:

```
>>> s="PYTHON"
>>> print(s,type(s))-----------------PYTHON <class 'str'>
>>> s[2:]---------------------'THON'
>>> s[1: ]--------------------'YTHON'
>>> s[0: ]--------------------'PYTHON'
>>> s[-4: ]-------------------'THON'
>>> s[-6: ]-------------------'PYTHON'
>>> s[-3: ]------------------'HON'
```

- -----

Syntax-3: StrObj[: EndIndex]

=>In This Syntax We specified End Index and Did't not specify Begin Index. =>If we don't Specify Begin Index then PVM always takes First Character Index as Begin Index.

Examples:

```
>>> s="PYTHON"
>>> print(s,type(s))-------------------------------PYTHON <class 'str'>
>>> s[:4]--------------------------------------------'PYTH'
>>> s[:3]--------------------------------------------'PYT'
>>> s[:6]--------------------------------------------'PYTHON'
>>> s[:-4]------------------------------------------'PY'
>>> s[:-5]------------------------------------------'P'
>>> s[:-3]-----------------------------------------'PYT'
>>> s[:0]-------------------------' ' empty
>>> s[:-6]------------------------ ' ' empty
```

Syntax-4: StrObj[:]

=>In This Syntax We Did't not specify Begin Index and End Index.

=>If we don't Specify Begin Index then PVM always takes First Character Index as Begin Index and If we don't Specify End Index then PVM always takes Last Character Index as End Index (OR) len(strobj)-1 as End Index.

Examples:

```
>>> s="PYTHON"
>>> print(s,type(s))----------------------------PYTHON <class 'str'>
>>> s[:]-------------------------------------------'PYTHON'
>>> s[0:]-----------------------------------------'PYTHON'
>>> s[:-6]-----------------------------------------' ' Empty
>>> s[:6]------------------------------------------- 'PYTHON'
>>> s[-6:]-------------------------------------------'PYTHON'
>>> s[:-5]-------------------------------------------'P'
>>> s[:-4]------------------------------------------'PY'
>>> s[-3:]-------------------------------------------'HON'
>>> s[-6:6]-----------------------------------------'PYTHON'
```
--- -----

Most IMP:

--- ---

```
>>> s="PYTHON"
>>> print(s,type(s))---------------PYTHON <class 'str'>
>>> s[-13:-6]---------------------' '
>>> s[-13:6]----------------------'PYTHON'
>>> s[0:123]----------------------'PYTHON'
>>> s[-123:345]----------------------'PYTHON'
```

NOTE:- All the Above Syntaxes are obtaining Range of Characters In Forward Direction.

--- -----

Syntax-5 : Strobj[BeginIndex :End Index : Step]

Rules:

1) Here BeginIndex , End Index and Step can either +VE INDEX and -VE INDEX

2) If the value of STEP is +VE then PVM takes the Range of Characters from Begin Index to End Index-1 in Forward Direction provided Begin Index<End Index otherwise we get empty String(' ')

3) if the value of STEP is -VE then PVM Takes Range of Characters from BeginIndex to End Index+1 in Backward Direction provided Begin Index > End Index

4) When we are retrieving the data in forward Direction if the EndIndex Value is 0 then we never get any result / outout.

5) When we are retrieving the data in backward Direction if the EndIndex Value is -1 then we

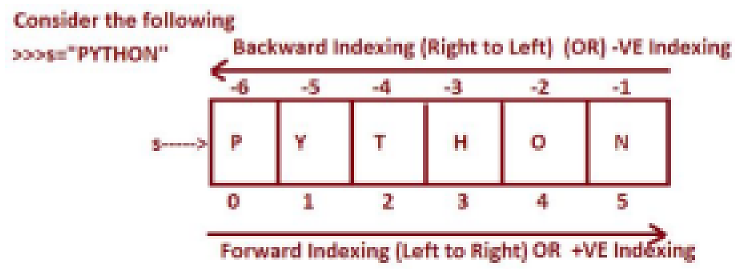
never get any result / outout.

Examples:

```
----------------------
>>> s="PYTHON"
>>> print(s,type(s))---------------------PYTHON <class 'str'>
>>> s[0:6:1]-----------------------------'PYTHON'
>>> s[0:6:2]-----------------------------'PTO'
>>> s[2:4:1]----------------------------'TH'
>>> s[-6: :1]----------------------------'PYTHON'
>>> s[:6:1]------------------------------'PYTHON'
>>> s[:-2:2]---------------------------'PT'
-----------------------------
>>> s[6:2:2]---------------------' '
----------------------------------
>>> s="PYTHON"
>>> print(s,type(s))------------------PYTHON <class 'str'>
>>> s[0:6:2]-------------------------'PTO'
>>> s[0:6:-2]------------------- ' '
>>> s[5:0:-1]----------------------- 'NOHTY'
>>> s[5: :-1]------------------------ 'NOHTYP'
>>> s[-1:-7:-1]-------------------'NOHTYP'
>>> s[-1:-7:-2]------------------'NHY'
>>> s[::-1]--------------------'NOHTYP'
---------------------------------
>>> s="MADAM"
>>> s==s[::-1]--------------------True
>>> s="LIRIL"
>>> s[::]==s[::-1]-------------------True
>>> "MALAYALAM"=="MALAYALAM"[::-1] ----------------------True
>>> "RACECAR"[::]=="RACECAR"[::][::-1] -----------------True
>>> "PYTHON"=="PYTHON"[::-1]------------False
>>> print("KVR"[::3])-------------------K
>>> "KVR"[::3]=="KVR"[::-1][-1]-----------------True
----------------------------
>>> s="PYTHON"
>>> print(s)---------------PYTHON
>>> s="PYTHON PROG"
>>> s[::-1]------------------'GORP NOHTYP'
>>> s="121"
>>> s==s[::-1]------------------True
>>> "8558"=="8558"[::-1]-------------True
-------------------------
>>> s="PYTHON"
>>> print(s)
PYTHON
>>> s[2:-1:1]-------------------'THO'
>>> s[2:0:1]--------------------' ' (Rule-5)
>>> s[1:0:2]-------------------' '
>>> s[-6:-1:-1]--------------- ' ' (Rule-6)
>>> s[-3:-1:-2]-----------------' '
```

- -------------

```
>>> s="PYTHON"
>>> print(s)----------------------PYTHON
>>> s[-6:6:-2]------------------' '
>>> s[2:-1:-2]-----------------' '
>>> s[1:-1:3]-----------------'YO'
>>> s[1:-1:-3]----------------' '
>>> s[1::-3]----------------'Y'
>>> s[-2::-2]--------------------OTP'
>>> s[-2::-2][::-1]------------'PTO'
```


Consider the following
>>>s="PYTHON"
Backward Indexing (Right to Left) (OR) -VE Indexing
-6 -5 -4 -3 -2 -1
s----->
P Y T H O N
0 1 2 3 4 5
Forward Indexing (Left to Right) OR +VE Indexing

===
Type Casting Techniques in Python
===

=>The Process of Converting One Type of Possible Value into Another Type of Value is called Type Casting.
=>Fundamentally, we have 5 types of Type Casting Techniques. They are

1. int()
2. float()
3. bool()
4. complex()
5. str()

- ======================================
1. int()
======================================

=>int() is used converting any Possible Type of Value into int type Value

=>Syntax:- varname=int(float / bool / complex / str)

Examples: float into int--->Possible

```
----------------
>>> a=12.34
>>> print(a,type(a))--------------------------12.34 <class 'float'>
>>> b=int(a)
>>> print(b,type(b))-------------------------12 <class 'int'>
>>> a=0.99
>>> print(a,type(a))-----------------------0.99 <class 'float'>
>>> b=int(a)
>>> print(b,type(b))---------------------0 <class 'int'>
---------------------------------------
Examples: bool into int--->Possible
------------------------------------------
>>> a=True
>>> print(a,type(a))---------------True <class 'bool'>
>>> b=int(a)
>>> print(b,type(b))-------------- 1 <class 'int'>
>>> a=False
>>> print(a,type(a))---------------False <class 'bool'>
>>> b=int(a)
>>> print(b,type(b))---------------- 0 <class 'int'>
--------------------------------------------------------------------------------------------
Examples:complex into int--->Not Possible
--------------------------------------------------------------------------------
>>> a=2+3j
>>> print(a,type(a))---------------------(2+3j) <class 'complex'>
>>> b=int(a)------------------TypeError: int() argument must be a string, a bytes-like object or a
real number, not 'complex'
--------------------------------------------------------------------------------------------
Examples:
--------------------------------------------------------------------------------
Case-1: Str int------->int-----Possible
-----------------
>>> a="123" # str in
>>> print(a,type(a))-----------------123 <class 'str'>
>>> b=int(a)
>>> print(b, type(b))--------------123 <class 'int'>
--------------------------------------------------------------------------------
Case-2: Str float---->int--->Not Possible
--------------
>>> a="12.34" # Str float
>>> print(a,type(a))---------------12.34 <class 'str'>
>>> b=int(a)-------------ValueError: invalid literal for int() with base 10: '12.34'
--------------------------------------------------------------------------------
Case-3: Str bool------> int--->Not Possible
--------------------------------------------------------------------------------
>>> a="True" # str bool
>>> print(a,type(a))-----------------True <class 'str'>
>>> b=int(a)------------------------ValueError: invalid literal for int() with base 10: 'True'
--------------------------------------------------------------------------------
Case-4: str complex--->int---->Not Possible
--------------------------------------------------------------------------------
```

```
>>> a="2+3j"
>>> print(a,type(a))------------------------------2+3j <class 'str'>
>>> b=int(a)-----------------------ValueError: invalid literal for int() with base 10: '2+3j'
```

Case-5----Pure Str--->int--->Not Possible

```
>>> a="KVR"
>>> print(a,type(a))-----------------KVR <class 'str'>
>>> b=int(a)-------------------------ValueError: invalid literal for int() with base 10: 'KVR'
```

===

2. float()

===

=>float() is used converting any Possible Type of Value into float type Value

=>Syntax:- varname=float(int / bool / complex / str)

Example: int----->float--->Possible

```
>>> a=10
>>> print(a,type(a))---------------10 <class 'int'>
>>> b=float(a)
>>> print(b,type(b))---------------10.0 <class 'float'>
```

Example: bool----->float--->Possible

```
>>> a=True
>>> print(a,type(a))--------------------True <class 'bool'>
>>> b=float(a)
>>> print(b,type(b))---------------------1.0 <class 'float'>
>>> a=False
>>> print(a,type(a))---------------------False <class 'bool'>
>>> b=float(a)
>>> print(b,type(b))-------------------0.0 <class 'float'>
```

Example: complex----->float--->Not Possible

```
>>> a=2.3+4.5j
>>> print(a,type(a))------------------(2.3+4.5j) <class 'complex'>
>>> b=float(a)-------------TypeError: float() argument must be a string or a real number, not 'complex'
>>> a=2.3+4.5j
>>> print(a,type(a))--------------(2.3+4.5j) <class 'complex'>
>>> b=float(a.real)
>>> print(b,type(b))--------------2.3 <class 'float'>
>>> b=float(a.imag)
>>> print(b,type(b))-----------4.5 <class 'float'>
```

Example:

Case-1 str int----->float -->Possible

```
---------------------------------------------------
>>> a="12"
>>> print(a,type(a))------------12 <class 'str'>
>>> b=float(a)
>>> print(b, type(b))----------12.0 <class 'float'>
---------------------------------------------------
Case-2 str float----->float -->Possible
---------------------------------------------------
>>> a="12.34"
>>> print(a,type(a))-----------------12.34 <class 'str'>
>>> b=float(a)
>>> print(b, type(b))-----------------12.34 <class 'float'>
---------------------------------------------------------------------------
Case-3 str bool----->float -->Not Possible
------------------------------------------------------------------------------
>>> a="True"
>>> print(a,type(a))-----------------True <class 'str'>
>>> b=float(a)------------ValueError: could not convert string to float: 'True'
-----------------------------------------------------------------------------------
Case-4 str complex----->float -->Not Possible
------------------------------------------------------------------------------
>>> a="2+3.5j"
>>> print(a,type(a))----------------------------------2+3.5j <class 'str'>
>>> b=float(a)----------------------------------------ValueError: could not convert string to float:
'2+3.5j'
-------------------------------------------------------------------------------------
Case-5 Pure str ----->float -->Not Possible
------------------------------------------------------------------------------
>>> a="Python.kvr"
>>> print(a,type(a))---------------------Python.kvr <class 'str'>
>>> b=float(a)------------------ValueError: could not convert string to float: 'Python.kvr'
-------------------------------------------------------------------------------------------------------------
- ----
```

==

3. bool()

==

=>bool() is used converting any Possible Type of Value into bool type Value

=>Syntax:- varname=bool(int / float / complex / str)
=>ALL NON-ZERO VALUES ARE TREATED AS TRUE
=>ALL ZERO VALUES ARE TREATED AS FALSE

```
-----------------------------------------------------------------------------------------------------------
Example: int----->bool---->Possible
-----------------------------------------------------------------------------------------------------------
>>> a=10
>>> print(a,type(a))-----------------------------10 <class 'int'>
>>> b=bool(a)
>>> print(b,type(b))-----------------------------True <class 'bool'>
>>> a=-123
>>> print(a,type(a))------------------------------123 <class 'int'>
>>> b=bool(a)
>>> print(b,type(b))----------------------------True <class 'bool'>
>>> a=0
>>> print(a,type(a))----------------------------0 <class 'int'>
>>> b=bool(a)
>>> print(b,type(b))---------------------------False <class 'bool'>
-----------------------------------------------------------------------------------------------------------
Example: float----->bool---->Possible
-----------------------------------------------------------------------------------------------------------
>>> a=12.34
>>> print(a,type(a))
12.34 <class 'float'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
>>> a=0.0
>>> print(a,type(a))
0.0 <class 'float'>
>>> b=bool(a)
>>> print(b,type(b))
False <class 'bool'>
>>>
>>>
>>> a=0.000000000000000000000000000000000000000000000000000000001
>>> print(a,type(a))
1e-57 <class 'float'>
>>> print(b,type(b))
False <class 'bool'>
>>>
>>> a=0.000000000000000000000000000000000000000000000000000000001
>>> print(a,type(a))
1e-57 <class 'float'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
>>> a=0.0000000000000000000000000000000000000000000000000000
>>> print(a,type(a))
0.0 <class 'float'>
>>> b=bool(a)
>>> print(b,type(b))
False <class 'bool'>
-----------------------------------------------------------------------------------------------
Example: complex----->bool---->Possible
-----------------------------------------------------------------------------------------------------------
>>> a=2+3j
>>> print(a,type(a))
(2+3j) <class 'complex'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
>>> a=0+0j
>>> print(a,type(a))
```

```
0j <class 'complex'>
>>> b=bool(a)
>>> print(b,type(b))
False <class 'bool'>
```

Example: Str int,float,complex,bool and pure str are possible to convert into bool type
Here bool type True provided len(strobj) is >0
                              Here bool type Frue provided len(strobj) is ==0

```
>>> a="123"
>>> print(a,type(a))
123 <class 'str'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
>>> a="0"
>>> len(a)
1
>>> print(a,type(a))
0 <class 'str'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>

>>> a="False"
>>> print(a,type(a))
False <class 'str'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
>>> a="12.34"
>>> print(a,type(a))
12.34 <class 'str'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
>>> a=" "
>>> print(a,type(a))
 <class 'str'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
>>> a=""
>>> len(a)
0
>>> print(a,type(a))
 <class 'str'>
>>> b=bool(a)
>>> print(b,type(b))
False <class 'bool'>
```

```
>>> a="KVR"
>>> print(a,type(a))
KVR <class 'str'>
>>> b=bool(a)
>>> print(b,type(b))
True <class 'bool'>
```
==

=====================================

complex()

=====================================

=>complex() is used converting any Possible Type of Value into complex type Value

=>Syntax:- varname=complex(int / float / bool / str)

Examples: int------>complex----->Possible

```
>>> a=12
>>> print(a,type(a))--------------------------12 <class 'int'>
>>> b=complex(a)
>>> print(b,type(b))-----------------------(12+0j) <class 'complex'>
```

Examples: float------>complex----->Possible

```
>>> a=2.3
>>> print(a,type(a))----------------2.3 <class 'float'>
>>> b=complex(a)
>>> print(b,type(b))-----------------(2.3+0j) <class 'complex'>
```

Examples: bool------>complex----->Possible

```
>>> a=True
>>> print(a,type(a))----------------------True <class 'bool'>
>>> b=complex(a)
>>> print(b,type(b))---------------------(1+0j) <class 'complex'>
>>> a=False
>>> print(a,type(a))---------------------False <class 'bool'>
>>> b=complex(a)
>>> print(b,type(b))---------------------0j <class 'complex'>
```

Examples:

```
>>> a="12" # str int-----complex--Possible
>>> print(a,type(a))----------------------12 <class 'str'>
>>> b=complex(a)
>>> print(b,type(b))--------------------(12+0j) <class 'complex'>
----------------------------------------------------------
>>> a="12.45" #str float------complex---->Possible
>>> print(a,type(a))-----------------12.45 <class 'str'>
>>> b=complex(a)
>>> print(b,type(b))----------------(12.45+0j) <class 'complex'>
```

```
----------------------------------------------------------
>>> a="True" # str bool----->complex----Not Possible
>>> print(a,type(a))----------------True <class 'str'>
>>> b=complex(a)-------------ValueError: complex() arg is a malformed string
---------------------------------------------------------------------------------------
>>> a="KVR-PYTHON" # Pure Str-------->Complex--Not Possible
>>> print(a,type(a))-------------------------KVR-PYTHON <class 'str'>
>>> b=complex(a)--------------ValueError: complex() arg is a malformed string
-----------------------------------------------x-------------------------------------------------------------
--------
```

==

5. str()

==

=>str() is used converting all types of values into str type value.

=>Syntax:- varname=str (int / float / bool / complex)

Examples:

```
>>> a=123
>>> print(a,type(a))--------------------------123 <class 'int'>
>>> b=str(a)
>>> print(b,type(b))--------------------------123 <class 'str'>
>>> b---------------------------------------- '123'
>>> a=12.34
>>> print(a,type(a))-----------------------12.34 <class 'float'>
>>> b=str(a)
>>> print(b,type(b))----------------------12.34 <class 'str'>
>>> b----------------------------------------'12.34'

>>> a=True
>>> print(a,type(a))--------------------True <class 'bool'>
>>> b=str(a)
>>> print(b,type(b))-------------------True <class 'str'>
>>> b---------------------------------------'True'
>>> a=2+3.5j
>>> print(a,type(a))---------------------(2+3.5j) <class 'complex'>
>>> b=str(a)
>>> print(b,type(b))--------------------(2+3.5j) <class 'str'>
>>> b---------------------------------------'(2+3.5j)'
=======================================X=============================
= ==
```

==

2. bytes

==

Properties:

=>"bytes" if one of the pre-defined class and treated as Sequence Data Type.

=>Cipher Text

=>The Internal Implementation of bytes data type is that "End-to-End Encryption (OR) Cipher Text (OR) Encrypted Data" of Normal Text.

=>The bytes data stores the data in the range of 0 to 256 (It stores from 0 to 255 (256-1) only)
=>bytes data type does not contains any symbolic notation but we can convert other type of values into bytes type values by using bytes().
=>Syntax: varname=bytes(object)
=>An object of bytes belongs to Immutable bcoz bytes' object does not support item assignment
=>An object of bytes data type supports Both Indexing and Slicing Operations. =>An object of bytes maintains Insertion Order (i.e Which ever order we insert the data in the same order Value will display)

Examples:

```
>>> l1=[10,20,30,40,256]
>>> print(l1,type(l1))-----------------------[10, 20, 30, 40, 256] <class 'list'>
>>> b=bytes(l1)------------------ValueError: bytes must be in range(0, 256)
>>> l1=[10,0,-20,30,40,255]
>>> print(l1,type(l1))----------------[10, 0, -20, 30, 40, 255] <class 'list'>
>>> b=bytes(l1)-------------------ValueError: bytes must be in range(0, 256)

>>> l1=[10,0,30,40,255]
>>> print(l1,type(l1))---------------------[10, 0, 30, 40, 255] <class
'list'> >>> b=bytes(l1)
>>> print(b, type(b),id(b))------------b'\n\x00\x1e(\xff' <class 'bytes'> 2043775384912
>>> b[-1]-------------------------255
>>> b[0]---------------------------10
>>> b[0]=123----------------TypeError: 'bytes' object does not support item assignment
---------------------------------------------------
>>> l1=[10,0,30,40,255]
>>> print(l1,type(l1))---------------------[10, 0, 30, 40, 255] <class
'list'> >>> b=bytes(l1)
>>> print(b, type(b),id(b))----------b'\n\x00\x1e(\xff' <class 'bytes'> 2043775382752
>>> for kvr in b:
... print(kvr)
                                         ...
                                         10
                                         0
                                         30
                                         40
                                         255
>>> t1=(10,20,30,10,255,45)
>>> print(t1,type(t1))--------------------(10, 20, 30, 10, 255, 45) <class 'tuple'>
>>> b=bytes(t1)
>>> print(b,type(b),id(b))------------b'\n\x14\x1e\n\xff-' <class 'bytes'> 2043775382800
>>> for v in b:
... print(v)
                                         ...
                                         10
                                         20
                                         30
                                         10
                                         255
```

```
                                        45
>>> b[0:4]-------------------b'\n\x14\x1e\n'
>>> for v in b[0:4]:
... print(v)
                                        ...
                                        10
                                        20
                                        30
                                        10
>>> for v in b[::-1]:
... print(v)
                                        ...
                                        45
                                        255
                                        10
                                        30
                                        20
                                        10
```

==================================X==================================
= ==

Mutable and Immutable

==

=>A Mutable object is one, whose content can be changed at Same Memory Address.

=>Examples: list, bytearray,set,dict

=>An immutable object is one, which will satisfy the following Properties

a) The value immutable object can't be changed at Same Memory Address (OR) In otherwords, Value of Immutable object can be changed and place the modified Value in New Memory Address by eliminating Old Memory Address by Garbage Collector.

b) Immutable objects does not support Item Assigmnent.

Examples: int, float, bool, complex, str, bytes, range, tuple, set,frozenset, etc
===================================x===================================
= =

==

3. bytearray

==

Properties:

=>"bytearray" if one of the pre-defined class and treated as Sequence Data Type. =>The Internal Implementation of bytearray data type is that "End-to-End Encryption (OR) Cipher Text (OR) Encrypted Data" of Normal Text.
=>The bytearray data stores the data in the range of 0 to 256 (It stores from 0 to 255 (256-1) only)
=>bytearray data type does not contains any symbolic notation but we can convert other type of values into bytearray type values by using bytearray().
=>Syntax: varname=bytearray(object)
=>An object of bytearray belongs to Mutable bcoz bytearray object supports item assignment

=>An object of bytearray data type supports Both Indexing and Slicing Operations. =>An object of bytearray maintains Insertion Order (i.e Which ever order we insert the data in the same order Value will display)
=>NOTE:- The Functionality of bytearray is exactly similar to bytes but an object of bytes belongs to immutable where as an object of bytearray is mutable.
===
Examples:

```
>>> l1=[10,20,30,40,0,256]
>>> print(l1,type(l1))-----------------------------[10, 20, 30, 40, 0, 256] <class
'list'> >>> b=bytearray(l1)--------------------ValueError: byte must be in range(0,
256) >>> l1=[10,-20,30,40,0,255]
>>> print(l1,type(l1))------------------[10, -20, 30, 40, 0, 255] <class 'list'> >>>
b=bytearray(l1)----------------------ValueError: byte must be in range(0, 256)
-----------------------------------------------------
>>> l1=[10,20,30,40,0,255]
>>> print(l1,type(l1))-----------------[10, 20, 30, 40, 0, 255] <class 'list'>
>>> b=bytearray(l1)
>>> print(b,type(b),id(b))----bytearray(b'\n\x14\x1e(\x00\xff') <class 'bytearray'>
2376795361136 >>> for k in b:
... print(k)
                                   ...
                                   10
                                   20
                                   30
                                   40
                                   0
                                   255
>>> b[0]=120 # Item Assigment---Possible--Mutable
>>> for k in b:
... print(k)
                                   ...
                                   120
                                   20
                                   30
                                   40
                                   0
                                   255
>>> print(b,type(b),id(b))--bytearray(b'x\x14\x1e(\x00\xff') <class 'bytearray'> 2376795361136
>>> for k in b:
... print(k)
                          ...
                          120
                          20
                          30
                          40
                          0
                          255
>>> b[1]-------------------------20
>>> b[1:4]---------------------bytearray(b'\x14\x1e(')
>>> for k in b[1:4]:
```

```
... print(k)
                                        ...
                                        20
                                        30
                                        40
>>> for k in b[::-1]:
... print(k)
                                        ...
                                        255
                                        0
                                        40
                                        30
                                        20
                                        120
```
===============================X===================================
= =

==

4. range

==

Properties

=>"range" is one of the pre-defined class and treated as Sequece Data Type =>The purpose of range data type is that "To store or generate Sequence of Numerical Integer Values by maintainining Equal Interval of Value."
=>On the object of range data type, we can perform Both Indexing and Slicing Operations =>An object of range belongs to immutable.
=>An object of range maintains Insertion Order.
=>To store or generate Sequence of Numerical Integer Values by maintainining Equal Interval of Value, range data type provides 3 Syntaxes. They are.

=>Syntax-1: varname=range(Value)
=>This Syntax generates Range of Values from 0 to Value-1
Examples:

```
>>> r=range(10)
>>> print(r,type(r))----------------range(0, 10) <class 'range'>
>>> for v in r:
... print(v)
                                        ...
                                        0
                                        1
                                        2
                                        3
                                        4
                                        5
                                        6
                                        7
                                        8
                                        9
>>> for k in range(6):
... print(k)
```

```
                                        ...
                                        0
                                        1
                                        2
                                        3
                                        4
                                        5
```

=>Syntax-2: varname=range(Begin , End)

=>This generates Range of Values from Begin to End-1
Examples:

```
>>> r=range(10,16)
>>> print(r,type(r))------------range(10, 16) <class 'range'>
>>> for v in r:
... print(v)
                                        ...
                                        10
                                        11
                                        12
                                        13
                                        14
                                        15

>>> for k in range(6):
... print(k)
                                               ...
                                               0
                                               1
                                               2
                                               3
                                               4
                                               5
```
=>NOTE: In the above Two Syntaxes, the default STEP is 1

=>Syntax-3: varname=range(Begin, End, Step)
=>This generates Range of Values from Begin to End-1 by maintaining Step as Equal Interval.
--- Examples:

```
>>> r=range(10,21,3)
>>> print(r,type(r))---------------------range(10, 21, 3) <class 'range'>
>>> for v in r:
... print(v)
                                ...
                                10
                                13
                                16
                                19
>>> for v in range(2,21,2):
... print(v)
```

```
                                                ...
                                                2
                                                4
                                                6
                                                8
                                                10
                                                12
                                                14
                                                16
                                                18
                                                20
>>> for v in range(1,21,2):
... print(v)
                                                ...
                                                1
                                                3
                                                5
                                                7
                                                9
                                                11
                                                13
                                                15
                                                17
                                                19
```

Programming Examples:

Q1) 0 1 2 3 4 5 6 7 8 9 -------range(10)

```
>>> for v in range(10):
... print(v)
                                    ...
                                    0
                                    1
                                    2
                                    3
                                    4
                                    5
                                    6
                                    7
                                    8
                                    9
```

Q2) 10 11 12 13 14 15---range(10,16)

```
>>> for v in range(10,16):
... print(v)
                          ...
                          10
                          11
                          12
                          13
                          14
                          15
```

Q3) 300 301 302 303 304 305---range(300,306) >>> for v in range(300,306):

```
... print(v)
...
                          300
                          301
                          302
                          303
                          304
                          305
```

Q4) 10 9 8 7 6 5 4 3 2 1-----range(10,0,-1)

```
>>> for v in range(10,0,-1):
... print(v)
                                          ...
                                          10
                                          9
                                          8
                                          7
                                          6
                                          5
                                          4
                                          3
                                          2
                                          1
```

Q5) -10 -11 -12 -13 -14 -15------range(-10,-16,-1)

```
>>> for v in range(-10,-16,-1):
... print(v)
...
                                  -10
                                  -11
                                  -12
                                  -13
                                  -14
                                  -15
```

Q6) 100 110 120 130 140 150--range(100,151,10)

```
>>> for k in range(100,151,10):
... print(k)
                                  ...
                                  100
                                  110
                                  120
                                  130
                                  140
                                  150
```

```
>>>
```

- Q7) 1000 900 800 700 600 500-----range(1000,499,-100)

```
>>> for v in range(1000,499,-100):
... print(v)
                    ...
                    1000
                    900
                    800
                    700
                    600
                    500
```

- Q8) -5 -4 -3 - 2 -1 0 1 2 3 4 5----range(-5,6)

```
>>> for v in range(-5,6,1):
... print(v)
                              ...
                              -5
                              -4
                              -3
                              -2
                              -1
                              0
                              1
                              2
                              3
                              4
                              5
>>> for v in range(-5,6):
... print(v)
                              ...
                              -5
                              -4
                              -3
                              -2
                              -1
                              0
                              1
                              2
                              3
                              4
                              5
```

- >>> r=range(500,601,50)

```
>>> r[0]
500
>>> r[1]
550
```

```
>>> r[-1]
600
>>> r[2]
600
>>> r=range(500,601,10)
>>> r[-1]
600
>>> for v in r:
... print(v)
...
500
510
520
530
540
550
560
570
580
590
600
>>> for v in r[5:]:
... print(v)
...
550
560
570
580
590
600
>>> for v in r[5:][::-1]:
... print(v)
...
600
590
580
570
560
550
--------------------------------------------------------------------------------
>>> r=range(500,601,10)
>>> print(r,type(r))
range(500, 601, 10) <class 'range'>
>>> r[0]
500
>>> r[1]
510
>>> r[2]
520
>>> r[1]=700-------------------TypeError: 'range' object does not support item assignment
---------------------------------------------------------------------------------------------------------------
```

```
- ----
>>> print(range(50,60)[5])------------------55
>>> for v in range(50,60)[5:7]:
... print(v)
                                   ...
                                   55
                                   56
>>> for v in range(50,60)[::-2]:
... print(v)
                                               ...
                                               59
                                               57
                                               55
                                               53
                                               51
```
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==
====

List Category Data Types (Collections Data Types or Data Structures)

==
====

=>The purpose of List Category Data Types in python is that " To Store Multiple Values either of Same Type or Different Type or Both the Types with Unique and Duplicate in single object."
=>We have two data type in List Category. They are

1. list (Mutable)
2. tuple (Immutable)

==

list

==

Index

=>Purpose of list
=>Operations on list

1) Indexing
2) slicing

=>Pre-Defined Functions in list

1) append()
2) insert()
3) remove()
4) pop(index)
5) pop()
   Note: del operator
6) count()
7) index()
8) reverse()
9) sort()
10) extend()

11) copy()---- Shallow and Deep copy
=>Inner List / Nested List
=>Pre-defined Function in inner / nested list
===
= ======
Properties of list

- ----------
=>'list' is one of the pre-defined class and treated as List data type.
=>The purpose of list data type is that "To Store Multiple Values either of Same Type or Different Type or Both the Types with Unique and Duplicate in single object. =>The Elements of list must written or Organized or stored within Square Brackets and the elements separated by Comma.
=>An object of list maintains Insertion Order.
=>On the object of list, we can perform both Indexing and Slicing Operations. =>An object of list belongs to Mutable bcoz it allows us to update the values of list at same address.
=>We can convert any type of value into list type value by using list()

Syntax: listobj=list(object)

=>by using list data type, we can create two types of list objects. They are

1) empty list
2) non-empty list

----
1) empty list

Syntax: varname=[]
(OR)
varname=list()
=>An empty list is one, which does not contain any elements and whose length=0

- ----
2) non-empty list

- ----
Syntax: varname=[Val1,Val2...Val-n]
=>A non-empty list is one, which contains elements and whose length>0

- ----
Examples:

```
>>> l1=[10,20,30,10,40]
>>> print(l1,type(l1))-------------------------------[10, 20, 30, 10, 40] <class
'list'> >>> l1=[111,"Rossum",34.56,True,"Python"]
>>> print(l1,type(l1))-----------------------------[111, 'Rossum', 34.56, True, 'Python'] <class 'list'>
>>> l1[0]--------------------------------------------111
>>> l1[-1]------------------------------------------'Python'
>>> l1[0:3]----------------------------------------[111, 'Rossum', 34.56]
-----------------------------------------------------
>>> print(l1,type(l1))-------------------------[111, 'Rossum', 34.56, True, 'Python'] <class 'list'>
>>> print(l1,type(l1),id(l1))----[111, 'Rossum', 34.56, True, 'Python'] <class 'list'>
2902431303872
```

```
>>> l1[0]=222
>>> print(l1,type(l1),id(l1))---[222, 'Rossum', 34.56, True, 'Python'] <class 'list'>
2902431303872
---------------------------------------
>>> l1=[]
>>> print(l1,type(l1))------------------[] <class 'list'>
>>> len(l1)------------------------------0
>>> l2=list()
>>> print(l2type(l2))-------------------[] <class 'list'>
>>> len(l2)--------------------------------0
>>> l3=[10,"Rossum","PSF",3.4,True]
>>> print(l3,type(l3))--------------------[10, 'Rossum', 'PSF', 3.4, True] <class 'list'>
>>> len(l3)-----------------------------5
----------------------------------------------------------------------------------------------------------
>>> s="PYTHON"
>>> print(s,type(s))-----------------PYTHON <class 'str'>
>>> l1=list(s)
>>> print(l1,type(l1))----------------['P', 'Y', 'T', 'H', 'O', 'N'] <class 'list'>
--------------------------------
>>> l1=[10,20,30,40]
>>> b=bytes(l1)
>>> print(b,type(b))-----------------------b'\n\x14\x1e(' <class 'bytes'>
>>> l2=list(b)
>>> print(l2,type(l2))--------------------[10, 20, 30, 40] <class 'list'>
----------------------------------------------------------------------------
>>> l1=[10,20,30,40]
>>> l1[2]-------------------------30
>>> l1[-2]-------------------------30
>>> l1[::2]-----------------------[10, 30]
>>> l1[::-1]-----------------------[40, 30, 20, 10]
>>> l1[::]-------------------------[10, 20, 30, 40]
```

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==

Pre-Defined Functions in list

==

=>Along with the operations on list like Indexing and Slicing, we can perform many more operations by using pre-defined function of list object.
=>The pre-defined functions of list are given bellow.

--- ---------

1) append():

=>Syntax: listobj.append(Value)
=>This Function is used for adding Value at the end of existing elements of list(known as appending)

Examples:

```
>>> l1=[10,"Rossum"]
>>> print(l1,type(l1),id(l1))------------------------[10, 'Rossum'] <class 'list'> 2902435500480
>>> len(l1)--------------2
>>> l1.append(23.45)
>>> print(l1,type(l1),id(l1))----[10, 'Rossum', 23.45] <class 'list'> 2902435500480
>>> l1.append("KVR")
>>> print(l1,type(l1),id(l1))---[10, 'Rossum', 23.45, 'KVR'] <class 'list'> 2902435500480
>>> l1.append(True)
>>> l1.append(2+3.5j)
>>> print(l1,type(l1),id(l1))---[10, 'Rossum', 23.45, 'KVR', True, (2+3.5j)] <class 'list'>
>>> len(l1)----6
-----------------------------------------------------
>>> l1=[]
>>> print(l1,len(l1), id(l1))------------------[] 0 2902435500544
>>> l1.append(10)
>>> l1.append("Raj")
>>> l1.append(10.34)
>>> l1.append("Hyd")
>>> print(l1,len(l1), id(l1))----------------[10, 'Raj', 10.34, 'Hyd'] 4 2902435500544
------------------------------------------------------------------------------------------------------------
- ---------
```

2) insert()

=>Syntax:- listobj.insert(Index, Value)
=>Here Index can be either +Ve or -Ve
=>Value can be any type.
=>This Function is used for Inserting the Specific Value at specified index.

Examples:

```
>>> l1=[10,20,30,"Python","DJango",34.56]
>>> print(l1,id(l1))--------------------[10, 20, 30, 'Python', 'DJango', 34.56] 2902431529344
>>> l1.insert(3,"Rossum")
>>> print(l1,id(l1))-----[10, 20, 30, 'Rossum', 'Python', 'DJango', 34.56] 2902431529344
>>> l1[-3]="PYTH"
>>> print(l1,id(l1))----[10, 20, 30, 'Rossum', 'PYTH', 'DJango', 34.56]
2902431529344 >>> l1.insert(1,234.99)
>>> print(l1,id(l1))----[10, 234.99, 20, 30, 'Rossum', 'PYTH', 'DJango', 34.56] 2902431529344
--------------------------------
>>> l1=list()
>>> print(l1,id(l1))---------------[] 2902435501056
>>> l1.insert(0,"KVR")
>>> print(l1,id(l1))----------------['KVR'] 2902435501056
>>> l1.insert(0,1111)
>>> print(l1,id(l1))----------------[1111, 'KVR'] 2902435501056
>>> l1.insert(2,"HYD")
>>> print(l1,id(l1))--------------[1111, 'KVR', 'HYD'] 2902435501056
-----------------------------
>>> l1=[10,20,30]
>>> print(l1,id(l1))
[10, 20, 30] 2902435496128
>>> l1.append("Python")
>>> print(l1,id(l1))
[10, 20, 30, 'Python'] 2902435496128
```

```
>>> l1.insert(30,"Rossum") # Most IMP
>>> print(l1,id(l1))----------[10, 20, 30, 'Python', 'Rossum'] 2902435496128
```

- ---------

3) remove() Based on Value

- ---------

=>Syntax: listobj.remove(Value)
=>This Function is used for removing First Occurence of The specific value from list object. =>If the specific value does not exist in list object then we get ValueError Examples:

```
>>> l1=[10,20,30,10,40,50,60]
>>> print(l1,id(l1))-------------[10, 20, 30, 10, 40, 50, 60] 2902431529344
>>> l1.remove(20)
>>> print(l1,id(l1))---------------[10, 30, 10, 40, 50, 60] 2902431529344
>>> l1.remove(10)
>>> print(l1,id(l1))-----------[30, 10, 40, 50, 60] 2902431529344
>>> l1.remove(50)
>>> print(l1,id(l1))-------------[30, 10, 40, 60] 2902431529344
>>> l1.remove(100)---------ValueError: list.remove(x): x not in list
----------------------------------------
>>> l1=[]
>>> l1.remove(3)--------------ValueError: list.remove(x): x not in list
>>> list().remove(100)------ValueError: list.remove(x): x not in list
```

- ---------

4) pop(index): Based Index

Syntax: listobj.pop(Index)
=>This Function is used for removing the element of listobj based Index.
=>If index value is invalid then we get IndexError

Examples:

```
>>> l1=[10,20,10,30,40,50,60,30]
>>> print(l1,id(l1))-------------[10, 20, 10, 30, 40, 50, 60, 30]
2902435496128 >>> l1.pop(2)-----------10
>>> print(l1,id(l1))----------[10, 20, 30, 40, 50, 60, 30] 2902435496128
>>> l1.pop(-1)---------------30
>>> print(l1,id(l1))-------------[10, 20, 30, 40, 50, 60] 2902435496128
>>> l1.pop(2)---------------30
>>> print(l1,id(l1))------------[10, 20, 40, 50, 60] 2902435496128
----------------------
>>> list().pop(4)--------------IndexError: pop from empty list
>>> [].pop(3)-----------------IndexError: pop from empty list
```

- ---------

5) pop() :

- ---------

=>Syntax:- list.pop()

=>This Function is used for Removing Last Element of List object
=>When we call pop() on empty list then we get IndexError

Examples:

```
>>> lst=[10,"Rossum",45.67,True,2+3j]
>>> print(lst,type(lst))-------------------[10, 'Rossum', 45.67, True, (2+3j)] <class 'list'>
>>> lst.pop()----------(2+3j)
>>> print(lst,type(lst))----------[10, 'Rossum', 45.67, True] <class 'list'>
>>> lst.pop()------------True
>>> print(lst,type(lst))-------------[10, 'Rossum', 45.67] <class 'list'>
>>> lst.pop()----------45.67
>>> print(lst,type(lst))-------------[10, 'Rossum'] <class 'list'>
>>> lst.pop()-----------'Rossum'
>>> print(lst,type(lst))-----------[10] <class 'list'>
>>> lst.pop()---------------10
>>> print(lst,type(lst))-------------[] <class 'list'>
>>> lst.pop()----------------IndexError: pop from empty list
>>> list().pop()-------------IndexError: pop from empty list
------------------------------------------------
>>> lst=[10,20,30,40,50]
>>> print(lst)----------------[10, 20, 30, 40, 50]
>>> lst.insert(2,300)
>>> print(lst)------------------[10, 20, 300, 30, 40, 50]
>>> lst.pop()----------------50
```

- ---------
NOTE: del operator
=>del operator is used for deleting Elements of any mutable object either based on Index or Based on Slicing or Total Object.
```
=>Syntax1: del object[Index]
                                   del object[Begin:End:Step]
                                   del object
```
=>With "del" operator we can't delete Immutable Content But we can delete complete Immutable Object.

Examples:

```
>>> lst=[10,"Rossum",45.67,True,2+3j,"Python"]
>>> print(lst)--------------------[10, 'Rossum', 45.67, True, (2+3j), 'Python']
>>> del lst[3] # Deleting Based on Index
>>> print(lst)-------------------[10, 'Rossum', 45.67, (2+3j), 'Python']
>>> del lst[2:4] # Deleting Based on Slicing
>>> print(lst)----------------------[10, 'Rossum', 'Python']
>>> del lst # Deleting Entire Object
>>> print(lst)----------------NameError: name 'lst' is not defined. Did you mean: 'list'?
------------------------------------------------
>>> s="PYTHON"
>>> print(s,type(s),id(s))----------------PYTHON <class 'str'>
2073554063472 >>> s=s+"Prog"
>>> print(s,type(s),id(s))-----------------PYTHONProg <class 'str'> 2073554063280
>>> del s[0]------------------------TypeError: 'str' object doesn't support item deletion
>>> del s[0:3]--------------------TypeError: 'str' object does not support item deletion
>>> del s # Deleting Immutable object
>>> s-------------------------NameError: name 's' is not defined
```

- ---------
6) copy()

- ---------
=>Syntax: object2=object1.copy()
=>This Function is used for Copying the content of one object into another object (Implementation of Sallow Copy)

Example:

Examples:

```
>>> l1=[10,"Rossum"]
>>> print(l1,id(l1))---------------------[10, 'Rossum'] 2073549864512
>>> l2=l1.copy() # Shallow Copy
>>> print(l2,id(l2))--------------------[10, 'Rossum'] 2073554063744
>>> l1.append("Python")
>>> l1.append("Python")
>>> l2.insert(1,"PSF")
>>> print(l1,id(l1))----------------[10, 'Rossum', 'Python', 'Python'] 2073549864512
>>> print(l2,id(l2))----------------[10, 'PSF', 'Rossum'] 2073554063744
```

- --------
Examples:----Deep Copy

```
>>> l1=[10,"Rossum"]
>>> print(l1,id(l1))-----------------------[10, 'Rossum'] 2073554059392
>>> l2=l1 # Deep Copy
>>> print(l2,id(l2))------------------------[10, 'Rossum'] 2073554059392
>>> l1.append("Python")
>>> print(l1,id(l1))------------------------[10, 'Rossum', 'Python'] 2073554059392
>>> print(l2,id(l2))------------------------[10, 'Rossum', 'Python'] 2073554059392
>>> l2.insert(2,"PSF")
>>> print(l1,id(l1))-----------------------[10, 'Rossum', 'PSF', 'Python'] 2073554059392 >>>
print(l2,id(l2))-----------------------[10, 'Rossum', 'PSF', 'Python'] 2073554059392
```

- ----
NOTE:- Slice Based Copy

- ---
```
>>> lst1=[10,20,30,40,50,60]
>>> print(lst1,id(lst1))---------------[10, 20, 30, 40, 50, 60] 2073692289216
>>> lst2=lst1[0:3] # Slice Based Copy
>>> print(lst2,id(lst2))---------------------[10, 20, 30] 2073692289792
>>> lst2.append(12.34)
>>> lst1.append(70)
>>> print(lst1,id(lst1))-------------------[10, 20, 30, 40, 50, 60, 70] 2073692289216
>>> print(lst2,id(lst2))------------------[10, 20, 30, 12.34] 2073692289792 >>>
>>> lst3=lst1[::] # Slice Based Copy
>>> print(lst3,id(lst3))-----------------[10, 20, 30, 40, 50, 60, 70] 2073686948288
>>> lst3.insert(1,"KVR")
>>> lst1.append(80)
>>> print(lst1,id(lst1))---------------[10, 20, 30, 40, 50, 60, 70, 80] 2073692289216
>>> print(lst3,id(lst3))---------------[10, 'KVR', 20, 30, 40, 50, 60, 70]
2073686948288
```
--- 7) count():

- Syntax:- listobj.count(Value)

=>This Function is used for Counting Number of Occurences of a Specified Element.
=>If the Specified Element does not exist in list object then we get 0

Examples:

```
>>> lst=[10,20,30,40,10,20,10,60]
>>> print(lst)
[10, 20, 30, 40, 10, 20, 10, 60]
>>> lst.count(10)-----------------3
>>> len(lst)----------------------8
>>> lst.count(20)---------------2
>>> lst.count(30)----------------1
>>> lst.count(300)--------------0
>>> lst.count("H")-------------0
--------------------------------------------------
>>> list().count(10)---------------0
>>> [].count("")-------------------0
```

- 7) index()

- =>Syntax:- listobj.index(Value)

=>This Function is used for finding Index of First Occurence of Sppecified Element.
=>If the Sppecified Element not existing in list object then we get ValueError.

Examples:

```
>>> lst=[10,20,30,10,60,70,80,20,45]
>>> print(lst)------------------[10, 20, 30, 10, 60, 70, 80, 20, 45]
>>> lst.index(10)-------------0
>>> lst.index(20)----------1
>>> lst.index(60)------------4
>>> lst.index(45)-----------8
>>> lst.index(145)--------------ValueError: 145 is not in list
>>> list().index("KVR")---------ValueError: 'KVR' is not in list
>>> [10,20,30].index(10)---------0
>>> [10,20,30].index(100)--------ValueError: 100 is not in list
>>> [10,20,30].index("10")-----------ValueError: '10' is not in list
```

- 8) reverse()

- =>Syntax: listobj.reverse()
=>This Function is used for obtaining reverse the content of listobject (nothing but front to back and back to front)

Examples:

```
>>> l1=[10,20,30,-4,-5,100,12,45]
>>> print(l1,id(l1))------------------------[10, 20, 30, -4, -5, 100, 12, 45] 2670070726208
>>> l1.reverse()
>>> print(l1,id(l1))------------------------[45, 12, 100, -5, -4, 30, 20, 10] 2670070726208
>>> l1=["Python","java","R","DS"]
>>> print(l1,id(l1))------------------------['Python', 'java', 'R', 'DS']
2670074921088 >>> l1.reverse()
>>> print(l1,id(l1))------------------------['DS', 'R', 'java', 'Python']
2670074921088
```
----
9) sort()
--- =>This function is used for sorting the Homogeneous (Similar) data either in Ascending Order (reverse = False) or in Descending Order (reverse=True)
=>When we call sort() on list object where it contains Hetrogeneous (different) data then we get TypeError.

=>Syntax: listobj.sort() ---- Display the data in Ascending Order

=>Syntax: listobj.sort(reverse=False)---Display the data in Ascending Order (default value of reverse is False)

=>Syntax: listobj.sort(reverse=True)---Display the data in Descending Order

Examples:

```
>>> l1=[10,-4,23,15,56,3,-5,34,0]
>>> print(l1,id(l1))---------------[10, -4, 23, 15, 56, 3, -5, 34, 0]
2670070726208 >>> l1.sort()
>>> print(l1,id(l1))---------------------[-5, -4, 0, 3, 10, 15, 23, 34, 56] 2670070726208
>>> l2=["Travis","Kinney","Rossum","Trump","Biden","Dennis","Anil"] >>>
print(l2)----['Travis', 'Kinney', 'Rossum', 'Trump', 'Biden', 'Dennis', 'Anil'] >>>
l2.sort()
>>> print(l2)----['Anil', 'Biden', 'Dennis', 'Kinney', 'Rossum', 'Travis', 'Trump']
-----------------------------------------------------
>>> l3=[10,"Rossum",34.56,True]
>>> l3.sort()---------TypeError: '<' not supported between instances of 'str' and 'int'
----------------------------
>>> l2=["Travis","Kinney","Rossum","Trump","Biden","Dennis","Anil"] >>>
print(l2)---------['Travis', 'Kinney', 'Rossum', 'Trump', 'Biden', 'Dennis', 'Anil'] >>>
l2.sort()
>>> print(l2)-------------['Anil', 'Biden', 'Dennis', 'Kinney', 'Rossum', 'Travis', 'Trump']
>>> l2.reverse()
>>> print(l2)------------['Trump', 'Travis', 'Rossum', 'Kinney', 'Dennis', 'Biden', 'Anil']
```

```
---------------------------------
>>> l1=[10,-4,23,15,56,3,-5,34,0]
>>> print(l1,id(l1))-----------------[10, -4, 23, 15, 56, 3, -5, 34, 0] 2670074921088
>>> l1.sort()
>>> print(l1,id(l1))------------------[-5, -4, 0, 3, 10, 15, 23, 34, 56] 2670074921088
>>> l1.reverse()
>>> print(l1,id(l1))--------------[56, 34, 23, 15, 10, 3, 0, -4, -5] 2670074921088
------------------------
>>> l1=[10,-4,23,15,56,3,-5,34,0]
>>> print(l1,id(l1))----------------[10, -4, 23, 15, 56, 3, -5, 34, 0] 2670070726208
>>> l1.sort(reverse=True)
>>> print(l1,id(l1))----------------[56, 34, 23, 15, 10, 3, 0, -4, -5] 2670070726208
-----------------------------------------------------------
>>> l1=[10,-4,23,15,56,3,-5,34,0]
>>> print(l1,id(l1))
[10, -4, 23, 15, 56, 3, -5, 34, 0] 2670070726208
>>> l1.sort(reverse=False) # OR l1.sort()
>>> print(l1,id(l1))------------------[-5, -4, 0, 3, 10, 15, 23, 34, 56] 2670070726208
---------------------
>>> l1=[10,-4,23,15,56,3,-5,34,0]
>>> print(l1,id(l1))-------------[10, -4, 23, 15, 56, 3, -5, 34, 0] 2670074921088
>>> l1.sort()
>>> print(l1,id(l1))-------------[-5, -4, 0, 3, 10, 15, 23, 34, 56] 2670074921088
```

- 10) extend()

- => Syntax: listobj1.extend(listobj2)

=>This Function is used for extending the functionality of listobj1 with the values of listobj2.
=>At any point time, extend() takes one list object as argument
=>If we want extend the functionality of one list object with multiple objects then we can use + operator.
=>Syntax:- listobj1=listobj1+listobj2+......listobj-n

Examples:

```
>>> l1=[10,20,30]
>>> l2=["RS","TR","SD"]
>>> l1.extend(l2)
>>> print(l1)------------[10, 20, 30, 'RS', 'TR', 'SD']
>>> print(l2)------------['RS', 'TR', 'SD']
--------------------------
>>> l1=[10,20,30]
>>> l2=["RS","TR","SD"]
>>> l2.extend(l1)
>>> print(l1)------------[10, 20, 30]
>>> print(l2)-----------['RS', 'TR', 'SD', 10, 20, 30]
----------------------------------------------
>>> l1=[10,20,30]
>>> l2=["RS","TR","SD"]
>>> l3=["Python","R"]
>>> l1.extend(l2,l3)---------------TypeError: list.extend() takes exactly one argument (2 given)
NOTE:
>>> l1=l1+l2+l3
>>> print(l1)-------------[10, 20, 30, 'RS', 'TR', 'SD', 'Python', 'R']
------------------------------------------------------------------------------------
```

11) clear()
=>Syntax: listobj.clear()
=>This Function is used removing all the elements of non-empotylist
=>

Examples:

```
>>> l1=[10,-4,23,15,56,3,-5,34,0]
>>> print(l1,id(l1))------------[10, -4, 23, 15, 56, 3, -5, 34, 0] 2670074921088
>>> len(l1)-----------------9
>>> l1.clear()
>>> print(l1,id(l1))----------[] 2670074921088
>>> len(l1)--------------------0
--------------------------------------
>>> print([].clear())-----------None
>>> print(list().clear())--------None
--------------------------------------------------------------------------
```

==
Copy Techniques in Python
==

=>In Python Programming, we have 2 types of Copy Techniques. They are

1. Shallow Copy
2. Deep Copy

- ----
1. Shallow Copy

- ----

=>The Properties of Shallow Copy are
a) Initial Content of Both the Objects are Same.
b) Both the Objects Memory Address are Different
c) Modifications are Indepedent (Whatever the modifications we do on any one
object they are not reflecting another object)

=>To Implement Shallow Copy, we use copy().
=>Syntax: object2=object1.copy()

Examples:

```
>>> l1=[10,"Rossum"]
>>> print(l1,id(l1))---------------------[10, 'Rossum'] 2073549864512
>>> l2=l1.copy() # Shallow Copy
>>> print(l2,id(l2))--------------------[10, 'Rossum'] 2073554063744
>>> l1.append("Python")
>>> l1.append("Python")
>>> l2.insert(1,"PSF")
>>> print(l1,id(l1))----------------[10, 'Rossum', 'Python', 'Python'] 2073549864512
>>> print(l2,id(l2))----------------[10, 'PSF', 'Rossum'] 2073554063744
```

- ----
2. Deep Copy

- ----
=>The Properties of Deep Copy are

a) Initial Content of Both the Objects are Same.
b) Both the Objects Memory Address are Same
c) Modifications are Depedent (Whatever the modifications we do on any one
object they are reflecting to another object)

=>To Implement Deep Copy, we use Assigment Operator (=)
=>Syntax: object2 = object1

Examples:

```
>>> l1=[10,"Rossum"]
>>> print(l1,id(l1))-----------------------[10, 'Rossum'] 2073554059392
>>> l2=l1 # Deep Copy
>>> print(l2,id(l2))------------------------[10, 'Rossum'] 2073554059392
>>> l1.append("Python")
>>> print(l1,id(l1))------------------------[10, 'Rossum', 'Python'] 2073554059392
>>> print(l2,id(l2))------------------------[10, 'Rossum', 'Python'] 2073554059392
>>> l2.insert(2,"PSF")
>>> print(l1,id(l1))-----------------------[10, 'Rossum', 'PSF', 'Python'] 2073554059392 >>>
print(l2,id(l2))-----------------------[10, 'Rossum', 'PSF', 'Python'] 2073554059392
```

- ----

==

Inner List OR Nested List

==

=>The Process of defining one list in another list is called Inner or Nested List
=>Syntax:
----

listobj=[Val1, Val2.......[Val11,Val12..] , [Val21,Val22.....], Val-n]

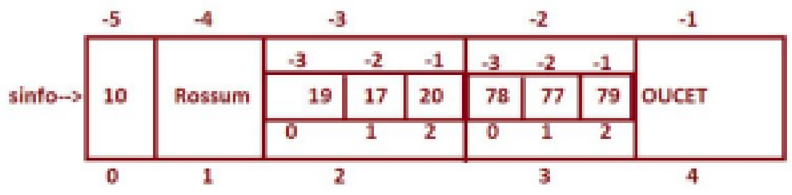
=>here [Val11,Val12..] is one Inner List
=>Here [Val21,Val22.....] is another Inner list

=>[Val1, Val2......., Val-n] is called Outer List

- ----
Examples:

```
>>> sinfo=[10,"Rossum",[19,17,20] , [78,77,79] ,"OUCET" ]
>>> sinfo[0]--------------------10
>>> sinfo[-1]------------------- 'OUCET'
>>> sinfo[1]--------------------- 'Rossum'
>>> sinfo[2]--------------------[19, 17, 20]
>>> print(sinfo[2],type(sinfo[2]))---------------[19, 17, 20] <class 'list'> >>>
print(sinfo[2],type(sinfo[2]), type(sinfo))--------[19, 17, 20] <class 'list'> <class 'list'> >>>
print(sinfo[-2],type(sinfo[-2]), type(sinfo))--------[78, 77, 79] <class 'list'> <class 'list'>
>>> print(sinfo[0],type(sinfo[0]), type(sinfo))---------10 <class 'int'> <class 'list'>
----------------------------------------
>>> sinfo=[10,"Rossum",[19,17,20] , [78,77,79] ,"OUCET" ]
>>> print(sinfo)------------[10, 'Rossum', [19, 17, 20], [78, 77, 79], 'OUCET']
>>> sinfo[2][-1]------------20
>>> sinfo[2][::]-------------[19, 17, 20]
>>> sinfo[2][::-1]------------[20, 17, 19]
>>> sinfo[2][2]=18
>>> print(sinfo)---------------[10, 'Rossum', [19, 17, 18], [78, 77, 79],
'OUCET'] >>> sinfo[2].sort()
>>> print(sinfo)---------------[10, 'Rossum', [17, 18, 19], [78, 77, 79],
'OUCET'] >>> sinfo[-2].sort(reverse=True)
>>> print(sinfo)-----------------[10, 'Rossum', [17, 18, 19], [79, 78, 77], 'OUCET']
>>> sinfo[2][0:2]--------------[17, 18]
>>> sinfo[2][::2]--------------[17, 19]
>>> sinfo[-3].remove(18)
>>> print(sinfo)-----------------[10, 'Rossum', [17, 19], [79, 78, 77],
'OUCET'] >>> del sinfo[-2][1:]
>>> print(sinfo)---------------[10, 'Rossum', [17, 19], [79], 'OUCET']
>>> sinfo[2].clear()
>>> print(sinfo)-------------[10, 'Rossum', [], [79], 'OUCET']
>>> del sinfo[2]
>>> print(sinfo)----------------[10, 'Rossum', [79], 'OUCET']
>>> del sinfo[-2]
>>> print(sinfo)--------------------[10, 'Rossum', 'OUCET']
>>> im=[16,17,14]
>>> sinfo.insert(2,im)
>>> print(sinfo)------------------------[10, 'Rossum', [16, 17, 14],
'OUCET'] >>> sinfo.insert(3,[67,74,66])
>>> print(sinfo)--------------------[10, 'Rossum', [16, 17, 14], [67, 74, 66],
'OUCET'] ---------------------------------------------------------------
>>> print(sinfo)------------[10, 'Rossum', [16, 17, 14], [67, 74, 66], 'OUCET']
>>> k=["PYTHON","R"]
>>> sinfo[2].insert(1,k)
>>> print(sinfo)-----------[10, 'Rossum', [16, ['PYTHON', 'R'], 17, 14], [67, 74, 66], 'OUCET']
```

consider the follolwing
sinfo=[10, 'Rossum', [19, 17, 20], [78, 77, 79], 'OUCET']



==

2) tuple

==

=>'tuple' of the one of the pre-defined class and treated as list data type.
=>The purpose of tuple data type is that "To store Collection of Values or multiple values either of Same type or different type or both the types with unique and duplicate." =>The elements of tuple must be stored within braces ( ) and the elements must separated by comma.
=>An object of tuple maintains inerstion Order.
=>On the object of tuple, we can perform Both Indexing and Slicing.
=>An object of tuple belongs to immutable bcoz tuple' object does not support item assignment
=>To convert any other object into tuple type object, we use tuple()
Syntax:- tupleobject=tuple(another object)
=>We can create two types of tuple objects. They are
a) empty tuple
b) non-empty tuple

a) empty tuple:

=>An empty tuple is one, which does not contain any elements and length is 0 =>Syntax:- tupleobj=()
or
tupleobj=tuple()

Examples:

```
>>> t=()
>>> print(t,type(t),id(l))------------ () <class 'tuple'>
2722448959680
>>> len(t)----------- 0
>>> l1=tuple()
>>> print(l1,type(l1),id(l1))------------- () <class 'tuple'>  2722452472064
>>> len(l1)------------------ 0
```
----

b) non-empty tuple:

=>A non-empty tuple is one, which contains elements and length is >0
Syntax:- tplobj=(val1,val2...val-n)
(OR)
tplobj=val1,val2...val-n

- --------
Note: The Functionality of tuple is exactly similar to list but an object of list belongs to mutable and an object of tuple belongs to immutable.

- --------
Examples:

```
>>> t1=(10,20,30,40,10,10)
>>> print(t1,type(t1))----------------(10, 20, 30, 40, 10, 10) <class 'tuple'>
>>> t2=(10,"Ram",34.56,True,2+4.5j)
>>> print(t2,type(t2),id(t2))-------------(10, 'Ram', 34.56, True, (2+4.5j)) <class 'tuple'>
>>> t2[0]----------------10
>>> t2[1]------------------'Ram'
>>> t2[-1]-----------------(2+4.5j)
>>> t2[1:4]---------------------('Ram', 34.56, True)
>>> t2[2]=56.78-----------TypeError: 'tuple' object does not support item assignment
-------------------------------------------------
>>> t1=()
>>> print(t1,len(t1))------------------() 0
 (OR)
>>> t2=tuple()
>>> print(t2,len(t2))--------------------() 0
----------------------------------------------------------
>>> l1=[10,"Rossum"]
>>> print(l1,type(l1))-------------------[10, 'Rossum'] <class 'list'>
>>> t1=tuple(l1)
>>> print(t1,len(t1))---------------(10, 'Rossum') 2
---------------------------------------------------------------------------
>>> a=10,"KVR","Python",True # without braces ( )
>>> print(a,type(a))---------------------------(10, 'KVR', 'Python', True) <class 'tuple'>
>>> a=10,
>>> print(a,type(a))---------------(10,) <class 'tuple'>
>>> a=10
>>> print(a,type(a))-----------10 <class 'int'>
>>> t=tuple(a)-------------TypeError: 'int' object is not iterable
>>> t=tuple(a,)------------TypeError: 'int' object is not iterable
>>> t=tuple((a))-----------TypeError: 'int' object is not iterable
>>> t=(a,) # correct conversion
>>> print(t,type(t))----------------(10,) <class 'tuple'>
>>> print(a,type(a))-----------10 <class 'int'>
```

--X---
=== pre-defined functions in tuple
==

= =>tuple object contains two pre-defined functions. They are

1. count()
2. index()

Examples:

```
>>> t1=(10,10,20,30,10,10,30)
>>> t1.count(10)----------------4
>>> t1.count(30)----------------2
>>> t1.count(300)--------------0
>>> t1.count("KVR")------------0
------------
>>> t1=(10,10,20,30,10,10,30)
>>> t1.index(10)------------0
>>> t1.index(20)------------2
>>> t1.index(230)----------ValueError: tuple.index(x): x not in tuple
---------------------------------------------
>>> t1=(10,10,20,30,10,10,30)
>>> for i,v in enumerate(t1):
... print(i,v)
```

Output

```
                    0 10
                    1 10
                    2 20
                    3 30
                    4 10
                    5 10
                    6 30
```

NOTE: tuple object does not contain the following pre-defined Functions bcoz tuple object belongs to immutable.

1) append()
2) insert()
3) remove()
4) pop(index)
5) pop()
6) copy()
7) clear()
8) reverse()
9) sort()
10) extend()

==

Inner tuple OR Tuple List

==

=>The Process of defining one tuple in another tuple is called Inner or Nested tuple
=>Syntax:

```
tupleobj=(Val1, Val2.......(Val11,Val12..) , ( Val21,Val22.....), Val-n)
```

=>here (Val11,Val12..) is one Inner tuple
=>Here (Val21,Val22.....) is another Inner tuple

=>(Val1, Val2......., Val-n) is called Outer tuple

NOTE:

=>We can define One Tuple Inside of Another Tuple
=>We can define One List Inside of Another List
=>We can define One Tuple Inside of Another List
=>We can define One List Inside of Another Tuple

Examples

```
>>> t1=(10,"Rossum",(15,18,17),(66,67,56),"OUCET")
>>> print(t1,type(t1))-------------(10, 'Rossum', (15, 18, 17), (66, 67, 56), 'OUCET') <class
'tuple'>
>>> t1[2]--------------(15, 18, 17)
>>> print(t1[2],type(t2))------------(15, 18, 17) <class 'tuple'>
>>> print(t1[-2],type(t2))------------(66, 67, 56) <class 'tuple'>
------------------------------
>>> t1=(10,"Rossum",[15,18,17],(66,67,56),"OUCET")
>>> print(t1,type(t1))------(10, 'Rossum', [15, 18, 17], (66, 67, 56), 'OUCET') <class 'tuple'>
>>> print(t1[2],type(t1[2]))-----[15, 18, 17] <class 'list'>
>>> print(t1[3],type(t1[3]))-------(66, 67, 56) <class 'tuple'>
>>> t1[2].insert(1,16)
>>> print(t1,type(t1))------(10, 'Rossum', [15, 16, 18, 17], (66, 67, 56), 'OUCET') <class 'tuple'>
>>> t1[2].sort(reverse=True)
>>> print(t1,type(t1))--------(10, 'Rossum', [18, 17, 16, 15], (66, 67, 56), 'OUCET') <class
'tuple'>
------------------------------------
>>> l1=[10,"Rossum",[15,18,17],(66,67,56),"OUCET"]
>>> print(l1,type(l1))------------[10, 'Rossum', [15, 18, 17], (66, 67, 56), 'OUCET'] <class 'list'>
>>> l1[2].remove(18)
>>> print(l1,type(l1))----------[10, 'Rossum', [15, 17], (66, 67, 56), 'OUCET'] <class 'list'>
```
=================================X==================================
= =======

Special Case:
----
sorted():

=>It is one of the general pre-defined function and is used for Sorting the elements of tuple (in this case) and gives the sorted elements in th form of list(But Sorted Elements will not place in tuple bcoz tuple is immutable).
Syntax: sorted(tuple object)

(OR)

listobj=sorted(tupleobj)

Examples:

```
--------------------
>>> t1=(12,45,-3,3,0,14)
>>> print(t1,type(t1))-------------------(12, 45, -3, 3, 0, 14) <class 'tuple'>
>>> t1.sort()-------------AttributeError: 'tuple' object has no attribute 'sort'
>>> sorted(t1)---------- [-3, 0, 3, 12, 14, 45]
>>> print(t1,type(t1))-----------(12, 45, -3, 3, 0, 14) <class 'tuple'>
>>> x=sorted(t1)
>>> print(x,type(x))--------------[-3, 0, 3, 12, 14, 45] <class 'list'>
                              (OR)
>>> t1=(12,45,-3,3,0,14)
>>> print(t1,type(t1))-------------(12, 45, -3, 3, 0, 14) <class 'tuple'>
>>> l1=list(t1)
>>> print(l1,type(l1))-------------[12, 45, -3, 3, 0, 14] <class 'list'>
>>> l1.sort()
>>> print(l1,type(l1))-----------[-3, 0, 3, 12, 14, 45] <class 'list'>
>>> t1=tuple(l1)
>>> print(t1,type(t1))------(-3, 0, 3, 12, 14, 45) <class 'tuple'>
----------------------------------------------------------------------------------
```

==

Set Categery Data Types(Collections Data Types or Data Structures)

==

=>The purpose of Set Categery Data Types is that " To store Collection or multiple values either of same type or different type or both the types with Unique Values (No duplicates are allowed)".

=>We have 2 data types in Set Categery. They are

1. set (mutable and immutable)
2. frozenset (immutable)

===

==

1. set

==

=>"set" is one of the pre-defined class and treated as set data type.

=>The purpose of set data type is that " To store Collection or multiple values either of same type or different type or both the types with Unique Values (No duplicatesd are allowed)".

=>The elements of set must be organized within curly braces { } and elements must separated by comma,

=>An object of set does not maintain insertion order bcoz PVM displays any order of multiple possibilities.

=>On the object of set, we can't perform Indexing and slicing Operations bcoz set object does not maintain Insertion order.

=>An object of set belongs to immutable (bcoz of 'set' object does not support item assignment) and mutable (bcoz in the case of add()).

=>By using set class, we can two types of set objects. They are

a) empty set
b) non-empty set

a) empty set:

=>An empty set is one, which does not contain any elements and whose length is 0

=>Syntax:- setobj=set()

b) non-empty set:

=>A non-empty set is one, which contains elements and whose length is >0
=>Syntax:- setobj={val1,val2...val-n}

=>To convert one type of object into set type object, we use set()
Syntax: setobj=set(obj)

Examples:

```
>>> s1={10,20,30,40,50,10,10,20,75}
>>> print(s1,type(s1))----------------{50, 20, 40, 10, 75, 30} <class 'set'>
>>> s1={10,20,25,35,10,20}
>>> print(s1,type(s1))------------------{25, 10, 35, 20} <class 'set'>
>>> s1[0]---------------TypeError: 'set' object is not subscriptable
>>> s1[0:3]-------------TypeError: 'set' object is not subscriptable
-----------------------------------------------------------
>>> s1={10,20,30,40,50}
>>>     print(s1,id(s1))------------------------------{50,     20,     40,     10,     30}
1473821509440 >>> s1[0]=100------------TypeError: 'set' object does not support
item assignment >>> s1.add("KVR")
>>> print(s1,id(s1))-----------------{50, 20, 40, 10, 'KVR', 30} 1473821509440
------------------------------------------------------------------------------------
>>> s1=set()
>>> print(s1,type(s1))-----------------{} <class 'set'>
>>> len(s1)-----------0
>>> s2={10,20,30,10,20}
>>> print(s2,type(s2))--------------{10, 20, 30} <class 'set'>
>>> len(s2)------------------3
-----------------------------------------------------------------------------
>>> l1=[10,20,10,20,"Python",23.45]
>>> s1=set(l1)
>>> print(s1)----------------{10, 20, 23.45, 'Python'}
>>> t1=tuple(s1)
>>> print(t1,type(t1))-----------(10, 20, 23.45, 'Python') <class 'tuple'>
>>> t1=list(s1)
>>> print(t1,type(t1))-----------[10, 20, 23.45, 'Python'] <class 'list'>
```
================================X=====================================
= ==

pre-defined functions in set

==

=>on the object of set, we can perform different type of Operations by using pre-defined functions in set object.

- ----
1) add()

- ----
=>This Function is used for adding the elements to set object.
=>Syntax: setobj.add(Value)

Examples:

```
>>> s1={10,20,30}
>>> print(s1,type(s1),id(s1))--------------{10, 20, 30} <class 'set'> 1691649314592
>>> s1.add(12.34)
>>> print(s1,type(s1),id(s1))-------------{10, 20, 12.34, 30} <class 'set'> 1691649314592
>>> s1.add("python")
>>> print(s1,type(s1),id(s1))------------{10, 12.34, 'python', 20, 30} <class 'set'>
1691649314592 >>> s2=set()
>>> print(s2,type(s2),id(s2))----------set() <class 'set'> 1691645340672
>>> s2.add(100)
>>> s2.add("Rajesh")
>>> s2.add("Kasif")
>>> print(s2,type(s2),id(s2))--------{100, 'Kasif', 'Rajesh'} <class 'set'> 1691645340672
>>> s2.add(23.45)
>>> print(s2,type(s2),id(s2))-----{100, 23.45, 'Kasif', 'Rajesh'} <class 'set'> 1691645340672
```

- ---
2) remove()

- ---
=>Syntax:- setobj.remove(Value)
=>This Function is used for removing the element from set object.
=>The element / value does not exist in setobject then we get KeyError(bcoz all the elements of set are Unique and they are called Keys)

Examples:

```
>>> s1={10,"Rajesh",34.56,400,True,2+3j}
>>> print(s1,type(s1))--------{400, True, 34.56, 'Rajesh', 10, (2+3j)} <class 'set'>
>>> print(s1,type(s1),id(s1))---{400, True, 34.56, 'Rajesh', 10, (2+3j)} <class 'set'>
>>> s1.remove(34.56)
>>> print(s1,type(s1),id(s1))----{400, True, 'Rajesh', 10, (2+3j)} <class 'set'> 1691649315936
>>> s1.remove(True)
>>> print(s1,type(s1),id(s1))---{400, 'Rajesh', 10, (2+3j)} <class 'set'> 1691649315936
>>> s1.remove("Rajesh")
>>> print(s1,type(s1),id(s1))----{400, 10, (2+3j)} <class 'set'> 1691649315936
>>> s1.remove("KVR")------KeyError: 'KVR'
>>> set().remove(10)-----------KeyError: 10
```

- ---
3) discard()

- ---
=>Syntax: setobj.discard(value)
=>This Function is used for removing theelement from set object.
=>The element / value does not exist in setobject then we never get KeyError
Examples:

```
>>> s1={10,20,30,40,50,60,70,10}
>>> print(s1,type(s1))------------------{50, 20, 70, 40, 10, 60, 30} <class
'set'> >>> s1.discard(50)
>>> print(s1,type(s1))------------------{20, 70, 40, 10, 60, 30} <class 'set'>
>>> s1.discard(10)
>>> print(s1,type(s1))------------------{20, 70, 40, 60, 30} <class 'set'>
>>> s1.discard(100) # we never get KeyError
>>> print(s1,type(s1))------------------{20, 70, 40, 60, 30} <class 'set'>
>>> s1.discard("Python") # we never get KeyError
>>> s1.remove("Python")-----------KeyError: 'Python'
```

- ---

4) clear()

- ---

=>Syntax: setobj.clear()
=>This function is used for removing all the elements of set object.
Examples:

```
>>> s1={10,20,30,40,50,60,70,10}
>>> print(s1,type(s1))--------------------{50, 20, 70, 40, 10, 60, 30} <class
'set'> >>> len(s1)-----------------------7
>>> s1.clear()
>>> print(s1,type(s1))-----------------set() <class 'set'>
>>> len(s1)------------------0
>>> print( set().clear() )------------None
```

- ---

5) copy() -----------Shallow Copy

- ---

Syntax: setobj2=setobj1.copy()
=>This Function is used for copying the content of one set object into another set object
----
=>Examples:

```
>>> s1={10,20,30,40,50,60,70,10}
>>> print(s1,type(s1),id(s1))-------------{50, 20, 70, 40, 10, 60, 30} <class 'set'>
2424304921600 >>> s2=s1.copy()
>>> print(s2,type(s2),id(s2))----------{50, 20, 70, 40, 10, 60, 30} <class 'set'> 2424308895072
>>> s1.add(12.34)
>>> s2.add("Python")
>>> print(s1,type(s1),id(s1))------{50, 20, 70, 40, 10, 60, 12.34, 30} <class 'set'> 2424304921600
>>> print(s2,type(s2),id(s2))---{50, 20, 'Python', 70, 40, 10, 60, 30} <class 'set'> 2424308895072
```

---

6) isdisjoint()

- ---

=>Syntax: setobj1.isdisjoin(s2)

=>This Function returns True Provided there is no common eleement between setobj1 and

setobj2.
=>This Function returns False Provided there is atleast common eleement between setobj1
 and setobj2.

Examples:

```
>>> s1={10,20,30,40}
>>> s2={"Apple","Mango","kiwi"}
>>> s3={10,50,60}
>>> s1.isdisjoint(s2)--------------True
>>> s1.isdisjoint(s3)--------------False
```

- ---
7) issuperset()

- ---
Syntax: setobj1.issuperset(setobj2)
=>This Function return True provided all elements setobj2 must present setobj1
OR
setobj1 must contains all elements of setobj2

Examples:

```
>>> s1={10,20,30,40}
>>> s2={10,20}
>>> s3={10,20, "Apple","Mango","kiwi"}
>>> s1.issuperset(s2)----------True
>>> s1.issuperset(s3)---------False
```

- ---
8) issubset()

- ---
Syntax: setobj1.issubset(setobj2)
=>This Function return True provided all elements setobj1 must present setobj2
OR
setobj2 must contains all elements of setobj1
Examples:

```
>>> s1={10,20,30,40}
>>> s2={10,20}
>>> s3={10,20, "Apple","Mango","kiwi"}
>>> s2.issubset(s1)---------True
>>> s3.issubset(s1)----------False
>>> s3.issubset(s2)---------False
>>> s2.issubset(s3)-------True
```

- ---
9) union()

- ---

Syntax:- setobj1.union(setobj2)
                                        (OR)
                        setobj3=setob1.union(setobj2)
=>This is used for for obtaining all Unique Elements of setobj1 and setobj2 and result unique values placed in setobj3.

Examples:

```
>>> s1={10,20,30,40}
>>> s2={15,10,25}
>>> s3=s1.union(s2)
>>> print(s1)-----------{40, 10, 20, 30}
>>> print(s2)----------{25, 10, 15}
>>> print(s3)-----------{20, 40, 25, 10, 30, 15}
--------------------------
>>> print(s1.union(s2))-----------{20, 40, 25, 10, 30, 15}
```
-- - ---
10) intersection()
-- - ---
Syntax: setobj1.intersection(setobj2)
                                                    (OR)
            setobj3= setobj1.intersection(setobj2)
=>This function is used for obtaining common elements from setobj1 and setobj2.

Examples:

```
>>> s1={10,20,30,40}
>>> s2={15,10,25}
>>> s3=s1.intersection(s2)
>>> print(s3)------------{10}
>>> s3=s2.intersection(s1)
>>> print(s3)-------------{10}
>>> print(s1.intersection(s2))-------{10}

>>> s1={10,20,30,40}
>>> s2={"Apple","Mango","kiwi"}
>>> print(s1.intersection(s2))------------set()
```
-- - ---
11)difference()
-- - ---
=>Syntax: setobj1.difference(setobj2)
=>This obtains removes common elements from setobj1 and setobj2 and Takes remaining elements from setobj1 and place them setobj3.
Examples:

```
>>> s1={10,20,30,40}
>>> s2={10,15,25}
>>> s3=s1.difference(s2)
>>> print(s1)--------{40, 10, 20, 30}
>>> print(s2)-------------{25, 10, 15}
>>> print(s3)---------{40, 20, 30}
>>> s4=s2.difference(s1)
>>> print(s4)--------{25, 15}

>>> a = {1, 3 ,5}
>>> b = {2, 4, 6}
>>> c = {1, 2}
>>> print(a)---------{1, 3, 5}
>>> print(b)--------{2, 4, 6}
>>> print(c)-------{1, 2}
>>> d=a.difference(b).difference(c)
>>> print(d)--------{3, 5}
>>> d=a.difference(b,c)
>>> print(d)-------------{3, 5}
```

- ---

12) symmetric_difference()

- ---

=>Syntax: setobj1.symmetric_difference(setobj2)
=>This function removes common elements from both setobj1 and setobj2 and Takes remaining elements from both setobj1 and setobj2 and place them setobj3.
Examples:

```
----------------
>>> s1={10,20,30,40}
>>> s2={10,15,25}
>>> s3=s1.symmetric_difference(s2)
>>> print(s1)----------{40, 10, 20, 30}
>>> print(s2)--------{25, 10, 15}
>>> print(s3)--------{40, 15, 20, 25, 30}
>>> s3=s2.symmetric_difference(s1)
>>> print(s3)-------------{40, 15, 20, 25, 30}
--------------------------------------------------------------------------------
```

Use-Case:

```
------------------
>>> cp={"sachin","kohli","rohit"}
>>> tp={"rossum","saroj","rohit"}
-----------------------------------
>>> allcptp=cp.union(tp)
>>> print(allcptp)-----------------{'kohli', 'sachin', 'rohit', 'rossum', 'saroj'}
>>> bothcptp=cp.intersection(tp)
>>> print(bothcptp)--------------{'rohit'}
>>> onlycp=cp.difference(tp)
>>> print(onlycp)-------------{'kohli', 'sachin'}
>>> onlytp=tp.difference(cp)
>>> print(onlytp)-------------{'rossum', 'saroj'}
>>> exclcptp=cp.symmetric_difference(tp)
>>> print(exclcptp)---------------{'sachin', 'rossum', 'kohli', 'saroj'}
```

- MOST IMP Case:

```
>>> allcptp=cp|tp # Bitwise OR Operator ( | )
>>> print(allcptp)------{'kohli', 'sachin', 'rohit', 'rossum', 'saroj'}
>>> bothptp=cp&tp # Bitwise AND Operator ( & )
>>> print(bothcptp)---------{'rohit'}
>>> onlycp=cp-tp # Subtract Operator
>>> print(onlycp)--------{'kohli', 'sachin'}
>>> onlytp=tp-cp # Subtract Operator
>>> print(onlytp)----------{'rossum', 'saroj'}
>>> exclcptp=cp^tp # Biwise XOR Operator ( ^ )
>>> print(exclcptp)--------{'sachin', 'rossum', 'kohli', 'saroj'}

>>> print({10,20,30} & {10,25,67,34})----------{10}
```

- ---
13) update()

- ---
=>Syntax: setobj1.update(setobj2)
=>This Function is used for updating the values of setobj2 with setobj1.

Examples:

```
>>> s1={10,20,30}
>>> s2={"Python","Java"}
>>> print(s1,id(s1))----------{10, 20, 30} 2424308898432
>>> print(s2,id(s2))----------{'Java', 'Python'} 2424308895072
>>> s1.update(s2)
>>> print(s1,id(s1))----------{20, 'Java', 10, 'Python', 30}
2424308898432 --------------------------------------
>>> s1={10,20,30}
>>> s2={10,20,"Python"}
>>> print(s1,id(s1))---------{10, 20, 30} 2424308896416
>>> print(s2,id(s2))----------{10, 20, 'Python'} 2424308898432
>>> s1.update(s2)
>>> print(s1,id(s1))----------{20, 10, 'Python', 30} 2424308896416
```

----
14) pop()

=>Syntax: setobj.pop()
=>This Function is used for removing any Arbitary Element from setobject.
=>when we call pop() on empty set() then we get KeyError
Examples:

```
>>> s1={10,"Abinash","Python",45.67,True,2+3j}
>>> s1.pop()-------------True
>>> s1.pop()------------10
>>> s1.pop()------------'Abinash'
>>> s1.pop()------------'Python'
>>> s1.pop()---------------(2+3j)
>>> s1.pop()---------------45.67
>>> s1.pop()-------------KeyError: 'pop from an empty set'
>>> set().pop()-----------KeyError: 'pop from an empty set'
```

Nested or Inner Formulas

Imp Points:

=> Set in Set Not Possible
=>Tuple in set Possible (No use bcoz we can't locate by using Indexing) =>List in set Not Possible (bcoz list is mutable and allows changes) =>set in Tuple Possible (boz tuple permits to locate set object by using indexing) =>Set in list Possible (boz tuple permits to locate set object by using indexing)

Examples:

```
>>> l1=[10,"Akash",{10,20,30},[23,45,23],"OUCET" ]
>>> print(l1,type(l1))
[10, 'Akash', {10, 20, 30}, [23, 45, 23], 'OUCET'] <class 'list'>
>>> print(l1[0],type(l1[0]))-------------10 <class 'int'>
>>> print(l1[1],type(l1[2]))------------Akash <class 'set'>
>>> print(l1[2],type(l1[2]))----------{10, 20, 30} <class 'set'>
>>> l1[2][0]------------TypeError: 'set' object is not subscriptable
>>> l1[:3]---------------[10, 'Akash', {10, 20, 30}]
>>> l1[2].add(23)
>>> print(l1)------------[10, 'Akash', {10, 20, 30, 23}, [23, 45, 23], 'OUCET']
>>> l1[-2][0]------------23
>>> l1[-3][0]--------TypeError: 'set' object is not subscriptable
---------------------
>>> t1=(10,"Akash",{10,20,30},[23,45,23],"OUCET")
>>> print(t1,type(t1))-----------(10, 'Akash', {10, 20, 30}, [23, 45, 23], 'OUCET') <class
'tuple'> >>> print(t1[2],type(t1[2]))----------{10, 20, 30} <class 'set'>
>>> print(t1[2],type(t1[3]))----------{10, 20, 30} <class 'list'>
------------------------
>>> s1={10,"Akash",(10,20,30),(23,45,23),"OUCET"}
 >>> print(s1,type(s1))--------{'OUCET', 'Akash', (23, 45, 23), 10, (10, 20, 30)} <class 'set'>
         >>> print(s1[2],type(s1[2]))---TypeError: 'set' object is not subscriptable >>>
   s1={10,"Akash",[10,20,30],(23,45,23),"OUCET"}----TypeError: unhashable type: 'list'
```

====================================

2. frozenset

====================================

=>'frozenset' is one of the pre-defined class and treated as set data type.
=>The purpose of frozenset data type is that To store multiple values of either of same type or different type or both types with Unique Values in single object."
=>The elements set must organized with curly braces {} and values must separated by comma and those values can converted into frozenset by using frozenset()

Syntax:- frozensetobj1=frozenset(setobj)
                          frozensetobj1=frozenset(listobj)

frozensetobj1=frozenset(tupleobj)

=>An object of frozenset does not maintain insertion Order bcoz PVM displays any possibility of elements of frozenset
=>Since frozenset object does not maintain insertion order, we can't perform Indexing and Slicing Operations (frozenset' object is not subscriptable)
=>An object of frozenset belongs to immutable (in the case frozenset' object does not support item assignment and adding elements also not possible)

Note:-The Functionality of frozenset is similar to set but an object of set belongs to both immutable (in case of item assigment) and mutable (in the case of add()) where as an object frozenset belongs to immutable.

Examples:

```
l1=[10,20,30,40,10]
fs=frozenset(l1)
print(fs,type(fs))----------------frozenset({40, 10, 20, 30}) <class 'frozenset'>
fs.add(100)------------AttributeError: 'frozenset' object has no attribute 'add'
fs[0]=345------------TypeError: 'frozenset' object does not support item assignment
```

```
>>> t1=(10,20,30,10,40,23.45,56)
>>> print(t1,type(t1))-------------------(10, 20, 30, 10, 40, 23.45, 56) <class
'tuple'> >>> fs1=frozenset(t1)
>>> print(fs1,type(fs1))-----------------frozenset({40, 10, 20, 23.45, 56, 30}) <class 'frozenset'>
>>> s1={10,"KVR",34.56,"Python","Java"}
>>> print(s1,type(s1))----------------{34.56, 10, 'KVR', 'Java', 'Python'} <class 'set'>
>>> fs2=frozenset(s1)
>>> print(fs2,type(fs2))------frozenset({34.56, 10, 'KVR', 'Java', 'Python'}) <class 'frozenset'>
>>> fs2[0]-----------------TypeError: 'frozenset' object is not subscriptable >>>
fs2[0:3]---------------TypeError: 'frozenset' object is not subscriptable >>>
fs2[0]=123----------TypeError: 'frozenset' object does not support item assignment >>>
fs2.add(100)------------AttributeError: 'frozenset' object has no attribute 'add'
```

Pre-defined functions in frozenset
----
1) copy()
2) union()
3) intersection()
4) difference()
5) symmetric_difference()

Examples:

```
>>> s1={10,20,30,40}
>>> s2={15,25,30,40}
>>> fs1=frozenset(s1)
>>> fs2=frozenset(s2)
>>> print(fs1)
frozenset({40, 10, 20, 30})
>>> print(fs2)
```

```
frozenset({40, 25, 30, 15})
>>> fs3=fs1.union(fs2)
>>> print(fs3)
frozenset({40, 10, 15, 20, 25, 30})
>>> fs4=fs1.intersection(fs2)
>>> print(fs4)
frozenset({40, 30})
>>> fs5=fs1.difference(fs2)
>>> print(fs5)
frozenset({10, 20})
>>> fs6=fs2.difference(fs1)
>>> print(fs6)
frozenset({25, 15})
>>> fs7=fs2.symmetric_difference(fs1)
>>> print(fs7)
frozenset({10, 15, 20, 25})
>>> fs7=fs1.symmetric_difference(fs2)
>>> print(fs7)
frozenset({10, 15, 20, 25})
-------------------------------------------------------
>>> s1={10,20,30,40}
>>> fs1=frozenset(s1)
>>> fs2=fs1.copy()
>>> print(fs1,id(fs1))-----------------frozenset({40, 10, 20, 30}) 2299638113984 >>> print(fs2,id(fs2))-----------------frozenset({40, 10, 20, 30}) 2299638113984
===========================X================================
=
```

The following Pre-defined functions not found in frozenset

----

1) add()
2) remove()
3) discard()
4) update()
5) pop()
6) clear()

===

= dict Catagery Data Type (Collection Data Types or Data Structures)

===

=>The purpose of dict Catagery Data Type is the "To organize the data in the form of (Key,Value)"
=>To organize the data in the form (key,value), we use a pre-defined class called "dict".
=>"dict" is one of the pre-defined class and treated as dict Catagery Data Type =>The elements of dict must be organized in the form curly braces { } and (key,value) must separated by comma.
=>An object of dict maintains insertion Order.
=>On the object of dict, we can't perform Indexing and Slicing Operations. =>An object of dict belongs to mutable. In otherwords , The Values of Key are belongs to immutable and Values of Value are belongs to mutable
=>By using dict class , we can create two types of dict objects. They

are a) empty dict
b) non-empty dict

a) An empty dict is one, which does not contains any elements and whose length is 0.

Syntax:- dictobj={}
(or)
dictobj=dict()

=>Syntax for adding (Key,value) to empty dict object

```
dictobj[Key1]=Value1
dictobj[Key2]=Value2
-----------------------------
dictobj[Key-n]=Value-n
```

b) A non-empty dict is one, which contains elements and whose length is >0.

Syntax:- dictobj={ Key1:Val1, Key2:Val2.......Key-n:Val-n }

Here Key1,Key2...Key-n are called Keys and They are Unique and they can be either Strs or Numerics

Here Val1,Val2...val-n are called Values and They may be Unique or duplicate and they can be either Strs or Numerics

---

Examples:

```
>>> d1={}
>>> print(d1,type(d1))---------------{} <class 'dict'>
>>> len(d1)---------------0
>>> d2={10:1.2,20:2.5,30:2.5,40:4.5}
>>> print(d2,type(d2))-----------{10: 1.2, 20: 2.5, 30: 2.5, 40: 4.5} <class
'dict'> >>> len(d2)------------4
----------------------------------------------------------------------------------------------------
>>> d3=dict()
>>> print(d3,type(d3), len(d3))-------- {} <class 'dict'> 0
>>> d1={"Rossum":"Python","Ritche":"C", "Gosling":"Java"}
>>> print(d1,type(d1))----{'Rossum': 'Python', 'Ritche': 'C', 'Gosling': 'Java'} <class 'dict'>

>>> d2={10:"Apple",20:"Mango",30:"Kiwi",40:"Sberry"}
>>> print(d2)-----{10: 'Apple', 20: 'Mango', 30: 'Kiwi', 40: 'Sberry'}
-----------------------------------------------------
>>> print(d2[0])--------KeyError: 0
>>> print(d2[10])---------Apple
>>> print(d2[40])--------Sberry
>>> print(d2[400])--------KeyError: 400
-----------------------------------------------------------------
>>> d1={}
>>> print(d1,type(d1),len(d1), id(d1))----{} <class 'dict'> 0 2299637840384
>>> d1[100]="Rossum"
>>> d1[101]="Ritche"
>>> d1[102]="Travis"
>>> d1[103]="MCKinney"
>>> print(d1,type(d1),len(d1), id(d1))----{100: 'Rossum', 101: 'Ritche', 102: 'Travis', 103:

>>> d1[100]="Guido"
>>> print(d1,type(d1),len(d1), id(d1))-----{100: 'Guido', 101: 'Ritche', 102: 'Travis', 103:
```

===============================X==================================
=

==
pre-defined functions in dict data type
==

=>dict object contains the following pre-defined function to perform Various Operations.
----
1) clear()

=>Syntax:- dictobj.clear()
=>This function removes all the (key,Value) from dict object
=>When we call clear() upon empty dict object then we get None

Examples:

```
>>> d1={10:1.2,20:2.3,40:5.6,50:1.2}
>>> print(d1,type(d1), id(d1))------------{10: 1.2, 20: 2.3, 40: 5.6, 50: 1.2} <class 'dict'>
1228171857856
>>> d1.clear()
>>> print(d1,type(d1), id(d1))------------{} <class 'dict'> 1228171857856
>>> print(d1.clear())---------------None
```
----
2) copy()

=>Syntax: dictobj2=dictobj1.copy()
=>This Function is used copying the content of one dict object into another dict object (implementation of shalow copy)

Examples:

```
>>> d1={10:1.2,20:2.3,40:5.6,50:1.2}
>>> print(d1,type(d1), id(d1))-----{10: 1.2, 20: 2.3, 40: 5.6, 50: 1.2} <class 'dict'>
1228176102528
>>> d2=d1.copy()
>>> print(d2,type(d2), id(d2))----{10: 1.2, 20: 2.3, 40: 5.6, 50: 1.2} <class 'dict'>
1228171857856
```
----
3) pop()

=>Syntax: dictobj.pop(Key)
=>This Function is used removing (Key,Value) from non-dict object
=>if we call this function on empty dict object we get KeyError
Examples:

```
>>> d1={10:1.2,20:2.3,40:5.6,50:1.2}
>>> print(d1,type(d1), id(d1))----{10: 1.2, 20: 2.3, 40: 5.6, 50: 1.2} <class 'dict'>
1228176103168
>>> d1.pop(20)---------2.3
```

>>> print(d1,type(d1), id(d1))------{10: 1.2, 40: 5.6, 50: 1.2} <class 'dict'> 1228176103168
>>> d1.pop(40)-----5.6
>>> print(d1,type(d1), id(d1))---{10: 1.2, 50: 1.2} <class 'dict'>
1228176103168 >>> d1.pop(10)-------1.2
>>> print(d1,type(d1), id(d1))---{50: 1.2} <class 'dict'>
1228176103168 >>> d1.pop(50)------1.2
>>> d1.pop(150)------KeyError: 150

----

4) popitem()

=>Syntax: dictobj.popitem()
=>This Function is used removing last entry of (Key,Value) from non-dict object
=>if we call this function on empty dict object we get KeyError
Examples:

>>> d1={10:1.2,20:2.3,40:5.6,50:1.2}
>>> print(d1,type(d1), id(d1))--{10: 1.2, 20: 2.3, 40: 5.6, 50: 1.2} <class 'dict'> 1228171857920
>>> d1.popitem()---(50, 1.2)
>>> print(d1,type(d1), id(d1))---{10: 1.2, 20: 2.3, 40: 5.6} <class 'dict'>
1228171857920 >>> d1.popitem()---(40, 5.6)
>>> print(d1,type(d1), id(d1))---{10: 1.2, 20: 2.3} <class 'dict'>
1228171857920 >>> d1.popitem()--(20, 2.3)
>>> print(d1,type(d1), id(d1))--{10: 1.2} <class 'dict'> 1228171857920
>>> d1.popitem()---(10, 1.2)
>>> print(d1,type(d1), id(d1))--{} <class 'dict'> 1228171857920
>>> d1.popitem()----KeyError: 'popitem(): dictionary is empty'
>>> {}.popitem()-----KeyError: 'popitem(): dictionary is empty'
>>> dict().popitem()---KeyError: 'popitem(): dictionary is empty'

----

5) keys()

=>Syntax: Varname=dictobj.keys()
(OR)
dictobj.keys()
=>This Function is used for obtaining values of Key.

Examples:

>>> d1={10:"Python",20:"Data Sci",30:"Django",40:"Java"}
>>> print(d1,type(d1))-----------{10: 'Python', 20: 'Data Sci', 30: 'Django', 40: 'Java'} <class 'dict'>
>>> d1.keys()------------dict_keys([10, 20, 30, 40])
>>> kvs=d1.keys()
>>> print(kvs)--------------dict_keys([10, 20, 30, 40])
>>> for k in kvs:
... print(k)

...
10
20
30
40

```
>>> for k in d1.keys():
... print(k)
                                         ...
                                         10
                                         20
                                         30
                                         40
```
NOTE:
```
>>> d1={10:"Python",20:"Data Sci",30:"Django",40:"Java"}
>>> print(d1,type(d1))------------{10: 'Python', 20: 'Data Sci', 30: 'Django', 40: 'Java'} <class
'dict'>
>>> k=d1.keys()
>>> print(k)------------------dict_keys([10, 20, 30, 40])
>>> print(k,type(k))----------dict_keys([10, 20, 30, 40]) <class
'dict_keys'> >>> l=list(k)
>>> print(l,type(l))--------------[10, 20, 30, 40] <class 'list'>
>>> print(l[0])-------------10
----------------------------OR---------------------------------
>>> d1={10:"Python",20:"Data Sci",30:"Django",40:"Java"}
>>> print(d1,type(d1))--------{10: 'Python', 20: 'Data Sci', 30: 'Django', 40: 'Java'} <class 'dict'>
>>> list(d1.keys())[0]------------10
```
----

6) values()

```
Syntax: Varname=dictobj.values()
                        (OR)
                        dictobj.values()
```
=>This Function is used for obtaining Values of Value.

Examples:

```
>>> d1={10:"Python",20:"Data Sci",30:"Django",40:"Java"}
>>> print(d1,type(d1))---------------{10: 'Python', 20: 'Data Sci', 30: 'Django', 40: 'Java'} <class
'dict'>
>>> d1.values()------------dict_values(['Python', 'Data Sci', 'Django', 'Java'])
>>> vs=d1.values()
>>> print(vs)---------------dict_values(['Python', 'Data Sci', 'Django', 'Java'])
>>> for v in vs:
... print(v)
                        ...
                        Python
                        Data Sci
                        Django
                        Java
>>> for v in d1.values():
... print(v)
                        Python
                        Data Sci
                        Django
                        Java
```
----

7) items()

Syntax:- varname=dictobj.items()
                                        (OR)
                                        dictobj.items()

=>This Function is used for obtaing (Key,Value) from dict object in the form of list of tuples.

Examples

```
>>> d1={10:"Python",20:"Data Sci",30:"Django",40:"Java"}
>>> print(d1,type(d1))----------{10: 'Python', 20: 'Data Sci', 30: 'Django', 40: 'Java'} <class 'dict'>
>>> d1.items()---dict_items([(10, 'Python'), (20, 'Data Sci'), (30, 'Django'), (40, 'Java')]) >>>
kv=d1.items()
>>> print(kv)--dict_items([(10, 'Python'), (20, 'Data Sci'), (30, 'Django'), (40,
'Java')]) -------------------------
>>> for x in kv:
... print(x)
...
                          (10, 'Python')
                          (20, 'Data Sci')
                          (30, 'Django')
                          (40, 'Java')
>>> for k,v in kv:
... print(k,v)
                                        ...
                                        10 Python
                                        20 Data Sci
                                        30 Django
                                        40 Java
>>> for k,v in kv:
... print(k,"-->",v)
...
                                        10 --> Python
                                        20 --> Data Sci
                                        30 --> Django
                                        40 --> Java
>>> for k,v in d1.items():
```