Introduction to Python

Introduction:

- Using Programming languages and technologies we develop applications.
- Applications are used to store data and perform operations on data.

Types of applications:

Standalone apps:

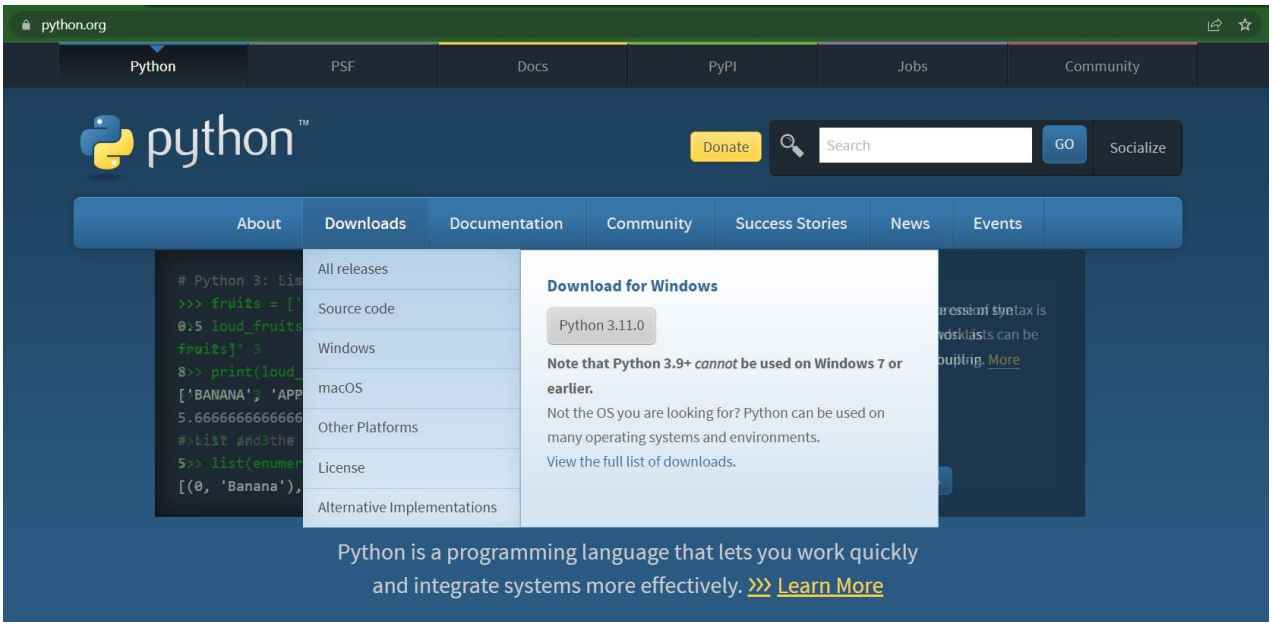
- The application runs from single machine.
- Internet connection is not required to run the application.
- Application needs to be installed on machine.
- **Examples:** VLC, MS-office, Anti-virus, Browser, **Programming languages**.

Web apps:

- The application runs from multiple machines in a network.
- Internet connection is required to run the application.
- Application installed in server and run from the clients.
- **Examples:** Gmail, YouTube, IRCTC, Flip Kart etc.

Download python:

- Python is an Open-Source Technology.
- We can download and install Python software from official website www.python.org

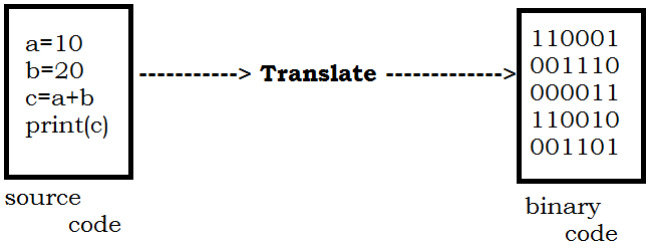


Python is used to develop both Standalone and Web applications:

- Core + Advance python + GUI + DBMS = Standalone app development
- Core + Advance + DBMS + HTML + CSS + JavaScript + Django = Web app develop

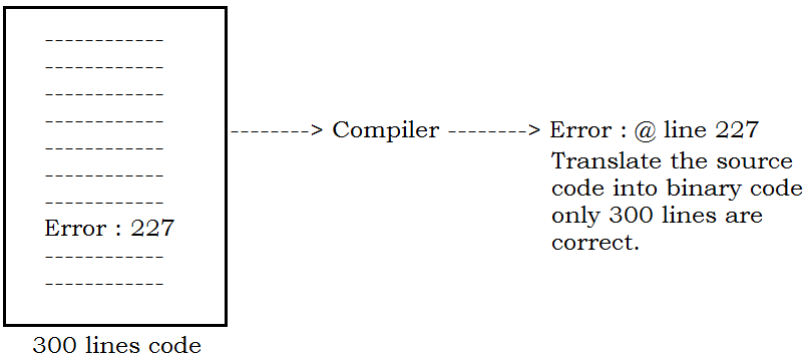
Translators:

- Programmer can define only source code.
- We need to convert the source code into binary code before run.
- We use 2 translators to convert Source code into byte code.
    - Compiler
    - Interpreter



Compiler:

- Compiler checks the source code syntactically correct or not.
- If we define the code correctly, it converts source code into byte code.
- Compiler shows error message with line number if there is a syntax error.



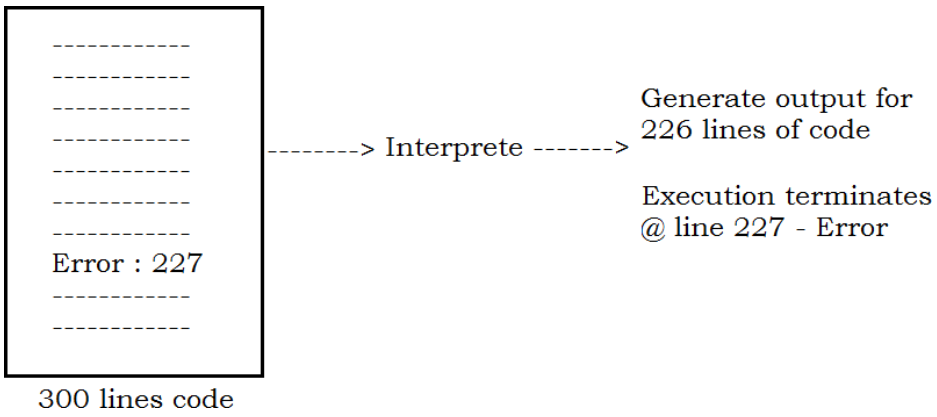
Note: Java programming language use compilation

```
class Program
{
        public static void main(String[] args)
        {
                int a=10;
                System.out.println("a val : " + a);
                int b=20;
                System.out.println("b val : " + b);
                System.out.println("c val : " + c);
        }
}
```

Compile: Error @ line – 11 (variable "c" not present)

Interpreter:

- Line by line translation of source code into binary code.
- Python uses interpreter for program execution.



Note: Python programming uses interpretation

```
a=10
print("a val :",a)
b=20
print("b val :",b)
print("c val :",c)
```

Output:

```
a val : 10
b val : 20
NameError: name 'c' is not defined
```

Python(Programming & Scripting):

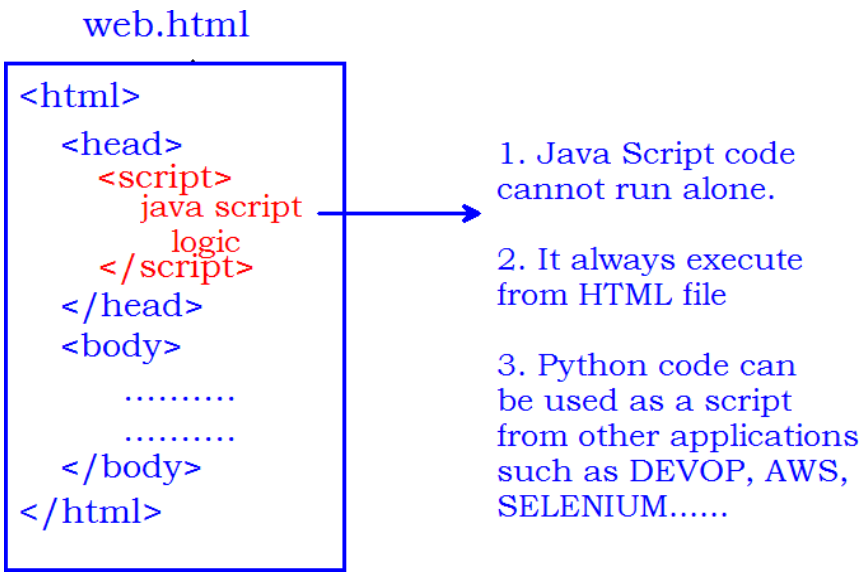
- Programming language are directly used to develop applications.
  - **Examples:** C, C++, PythonJava, .Net etc.
- Scripting languages always run from another program.
  - **Examples:** JavaScript, TypeScript, Python….

Program:

- A set of instructions.
- Program runs alone.

Script:

- Script is a set of Instructions
- Scripts is a program that always execute from another program.
- JavaScript is the best example of Scritping language.
- JavaScript code always run with HTML program.



Python is Dynamic:

- Every programming language is used to develop applications
- Application is used to store and process the data.
- Generally we allocate memory to variables in 2 ways
    1. Static memory allocation
    2. Dynamic memory allocation

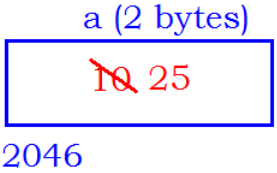
Static memory:

- Static means "fixed memory"
- The languages which are supporting primitive types allowed allocating static memory.
- Primitive variable size and type are fixed.
- Primitive variable stores data directly.
- Compiler raises error when data limit or type is deviated from specified.

Primitive : Variable stores the data

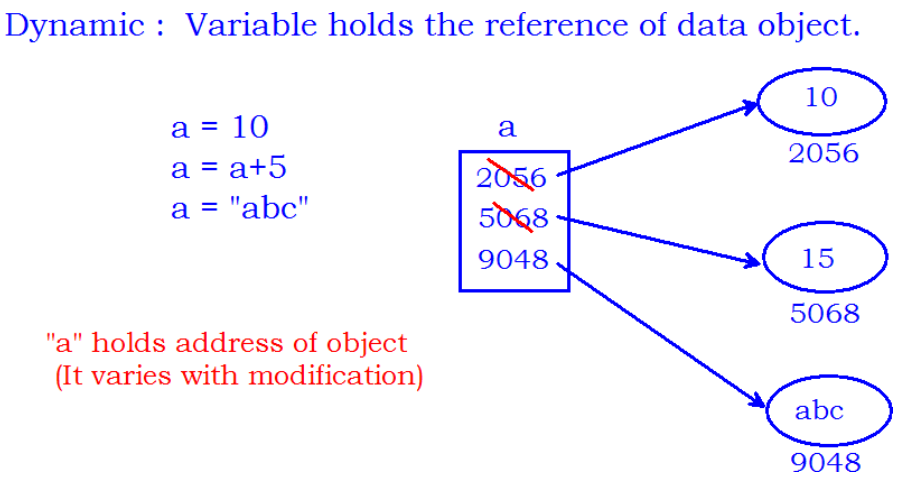
In C :

```
int  a ;
a = 10 ;
a = a+15 ;
a = 23.45 ; -> Error : only integer allowed
a = 50000 ; -> Error : Can store a value between -32768 to +32767
```



Dynamic memory:

- Python is dynamic.
- Dynamic memory means type and size of data can vary.
- Python can store information in Object format.
- Dynamic variables cannot store the data directly.
- Dynamic variables store the reference of Object which holds data.
- In Python, object location changes every time when we modify the data.




```
>>> a=10
>>> print(a)
10
>>> print("Address :",id(a))
Address : 1628169120

>>> a=a+15
>>> print(a)
25
>>> print("Address :",id(a))
Address : 1628169360

>>> a="python"
>>> print(a)
python
>>> print("Address :",id(a))
Address : 48576832
```

Python Variables

Variable:

- Variable is an identity of memory location.
- Variables used to store values
- You can assign any value to a variable using the "=" operator.

```
# Example:
x = 10
```

Variables can be of different types in Python, such as integer, float, string, boolean, etc.

```
# Example:
age = 25
height = 5.7
name = "Amar"
is_student = True
```

You can assign the same value to multiple variables at once using the "=" operator.

```
# Example:
x = y = z = 0
```

Variables can be updated with new values as the program runs.

```
# Example:
x = 10
x = x + 1
```

Variables can be deleted using the "del" keyword.

```
# Example:
x = 10
del x
```

Python allows you to assign values to variables in a single line

```
# Example:
x, y, z = 10, 20, 30
```

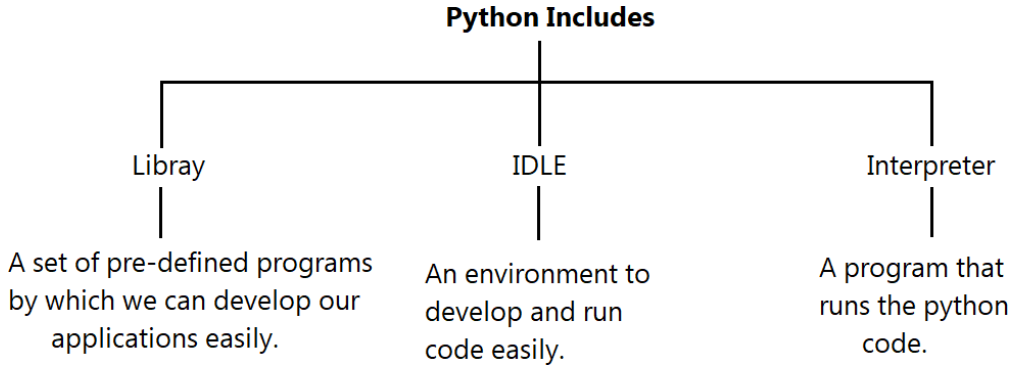
Python variables are case-sensitive, which means "a" and "A" are different variables.

```
# Example:
a = 10
A = 20
```

You can use underscores in variable names for better readability.

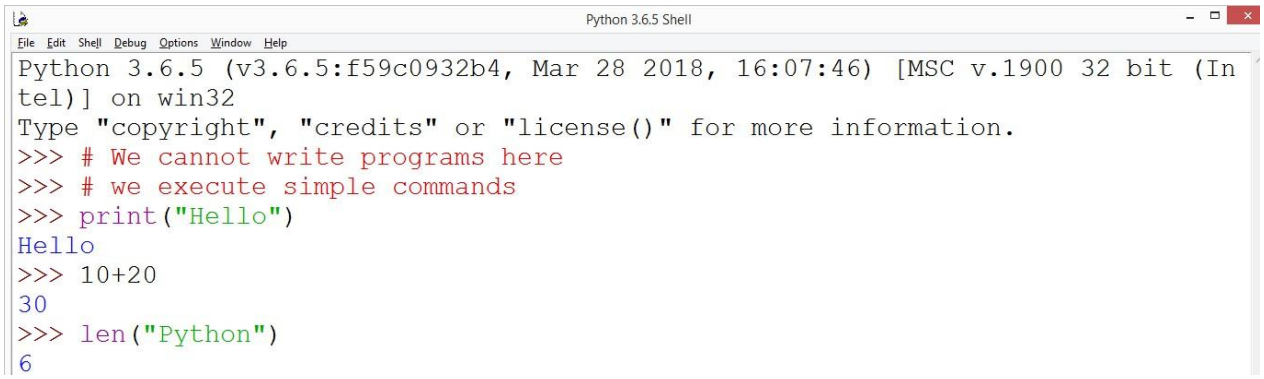
```
# Example:
my_variable = 10
```

Edit and Run python program:



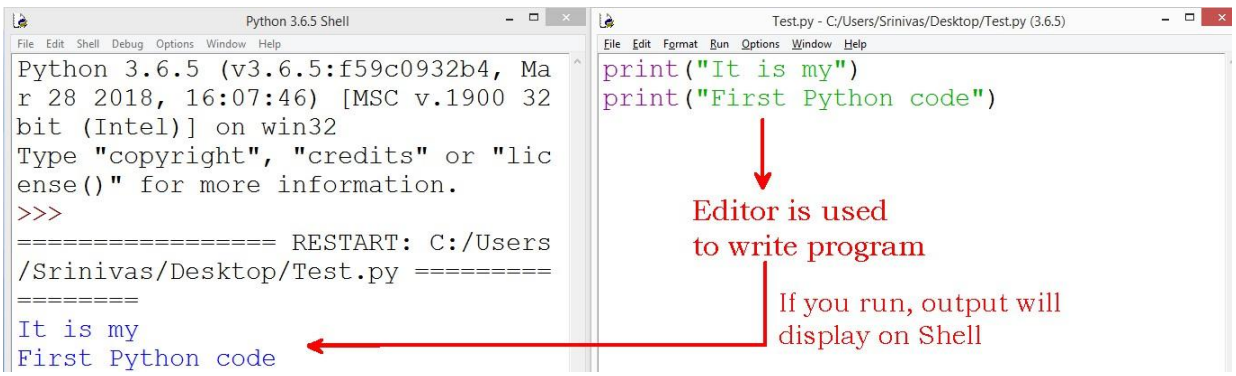
Working with IDLE:

- Once python installed, we can open IDLE by searching its name.
- A shell window will be opened where we can run only commands.



Writing and executing programs:

- We can write and execute programs from editor
- Go to File menu
- Select "new" file – Opens an editor
- Write code and Save with .py extension
- Run – with shortcut f5



Operators and Control Statements

Operator:

- Operator is a symbol that performs operation on one or more operands.
- The member on which operator operates is called the operand.
- In the expression a = 5+9,
  a, 5,9 are operands
  =, + are operators

Python supports the following operators:

1. Arithmetic Operators
2. Comparison (Relational) Operators
3. Assignment Operators
4. Logical Operators
5. Bitwise Operators
6. Membership Operators
7. Identity Operators

Arithmetic operators:

Arithmetic operators are used to perform mathematical operations like addition, subtraction, multiplication etc.

Operators are +, - , * , / , % , // , **

Operator	Meaning	Example
+	Add 2 operands	X+Y
-	Subtract right from left	X-Y
*	Multiply 2 operands	X*Y
/	Divide left with right	X/Y
%	Divide and returns Remainder	X%Y
//	Floor division - division that results into whole number adjusted to the left in the number line	X//Y
**	Exponent - left operand raised to the power of right	X**Y

a = 5 , b = 2

2) 5 (2.5 5 0 a/b = 2.5	2) 5 (2 4 1 a%b = 1	2) 5 (2.5 5 0 a//b = 2 ← floor value of 2.5	5^2 = 25 a**b = 25

Division (/) : Operator divide and returns quotient. Result is float value.

Remainder (%): It returns the remainder after division. It performs operation only on integers.

Division	Mod

>>> 5/2
2.5
 	
>>> 10/3
3.3333333333333335
 	
>>> 10/5
2.0
	>>> 5%2
	1
	>>> 10%4
	2
	>>> 5.0%2.5
	0.0
	>>> 5.0%2
	1.0

Floor division (//): Returns floor value after divide.

Exponent (**): returns the power value of specified base.

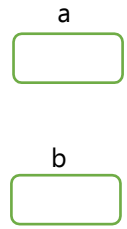
>>> 10/3
3.3333333333333335
>>> 10//3
3
>>> 10/4
2.5
>>> 10//4
2
	>>> 2**2
	4
	>>> 2**4
	16
	>>> 3**3
	27

print("Arithmetic operations")

```
print("5+2 :", 5+2)
print("5-2 :", 5-2)
print("5*2 :", 5*2)
print("5/2 :", 5/2)
print("5%2 :", 5%2)
print("5//2 :", 5//2)
print("5**2 :", 5**2)
```

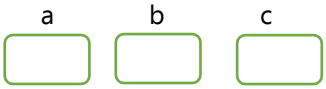
Complete this work sheet Arithmetic Operators

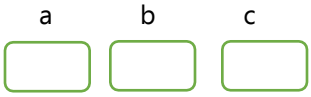
a=10 a=20 a=30 a=40 a=50 print(a)	a 	a=5 a=a+1 a=a+1 a=a+1 a=a+1 print(a)	a
a=5 a=a+1 a=a+2 a=a+3 a=a+4 print(a)	a 	a=15 a=a+5 a=a+4 a=a+3 a=a+4 print(a)	a

a, x = 5, 1 a=a+x x = x+1 a=a+x x = x+1 a=a+x print(a, x) 	a, b = 5, 1 a=a+b b = b-1 a=a+b b= b-1 a=a+b print(a, b) 

n=2;
int s=n*n;
print(s);
 
	n=2;
	int c=n*n*n;
	print(c);
	 

n=2;
int s=n*n;
int c=n*n*n;
print(s+c);
 
	bal=5000;
	int amt=3500;
	bal = bal + amt;
	print(bal);
	 

a=5, b=3;
int c=a+b;
print(c);
 
	a=5, b=3;
	a=b;
	b=a;
	print(a,b);
	 

a=5, b=3, c;
c=a;
a=b;
b=c;
print(a,b);
 
	a=2, b=3;
	a=a+b;
	b=a+a;
	print(a,b);
	 

a=2, b=3;
a=a+b;
b=a-b;
a=a-b;
print(a,b);
 
	a=2, b=3;
	a=a*b;
	b=a//b;
	a=a//b;
	print(a,b);
	 

n=234;
int d=n%10;
print(d);
 
	n=234;
	int d=n//10;
	print(d);
	 

sum=0, i=1;
sum=sum+i;
i=i+1;
sum=sum+i;
i=i+1;
sum=sum+i;
print(sum);
 
	fact=1, i=1;
	fact=fact*i;
	i=i+1;
	fact=fact*i;
	i=i+1;
	fact=fact*i;
	print(fact);
	 

n=2345, rev=0;
rev=rev*10+n%10;
n=n//10;
Print(rev, n);
rev=rev*10+n%10;
n=n//10;
Print(rev, n);
	rev=rev*10+n%10;
	n=n//10;
	Print(rev, n);
	rev=rev*10+n%10;
	n=n//10;
	Print(rev, n);

Python Input()

Reading input from End-user :

- The input() function is used read data from user.
- The function prompts the message to enter the value
    - **input(prompt)**
- The function waits for the user to enter the value followed by pressing the "Enter" key.
- The function reads the input as string.

Reading the name and display:

```
print("Enter your name :")
name = input()
print("Hello,",name)
```

We can give the prompt while reading input

```
name = input("Enter your name : ")
print("Hello,",name)
```

Every input value will be returned in String format only.

```
print("Enter 2 numbers :")
a = input()
b = input()
c = a+b   # "5" + "6" = "56"
print("Sum :",c)
```

We need to convert the string type input values into corresponding type to perform operations.

int( ) :

- It is pre-defined function
- It can convert input value into integer type.
- On success, it returns integer value
- On failure(if the input is not valid, raised error)

Adding 2 numbers

```
print("Enter 2 numbers :")
a = input()
b = input()
c = int(a)+int(b)
print("Sum :",c)
```

Data Conversion Functions

int( ) :

- It is pre-defined function
- It can convert input value into integer type.
- On success, it returns integer value
- On failure(if the input is not valid, raised error)

```
>>> int(10)
10
>>> int(23.45)
23
>>> int(True)
1
>>> int(False)
0
>>> int("45")
45
>>> int("python") # Error : Invalid input
```

Adding 2 numbers:

```
print("Enter 2 numbers :")
a = input()
b = input()
c = int(a)+int(b)
print("Sum :",c)
```

We can give the prompt directly while calling input() function.

```
x = int(input("First Num :"))
y = int(input("Second Num :"))
print("Sum : ",x+y)
```

float() :

- converts the input value into float type.
- Raise error if the input is not valid.

```
>>> float(2.3)
2.3
>>> float(5)
5.0
>>> float(True)
1.0
>>> float("3.4")
3.4
```

```
>>> float("abc")
ValueError: could not convert string to float: 'abc'
```

bool():

- Returns a boolean value depends on input value.
- boolean values are pre-defiend (True , False)

```
>>> bool(True)
True
>>> bool(-13)
True
>>> bool(0.0013)
True
>>> bool(0)
False
>>> bool("abc")
True
>>> bool("   ")
True
>>> bool("")
False
>>> bool(False)
False
>>> bool("False")
True
```

str(): convert any input int string type.

```
>>> str(3)
'3'
>>> str(2.3)
'2.3'
>>> str(True)
'True'
```

bin(): Returns binary value for specified decimal value.

```
>>> bin(10)
'0b1010'
>>> bin(8)
'0b1000'
```

Character System:

- File is a collection of bytes.
- Every symbol occupies 1 byte memory in File.
- Every symbol stores into memory in binary format.
- Symbol converts into binary based on its ASCII value.
- Character system is the representation of all symbols of a language using constant integer values.
- Examples are ASCII and UNICODE.

ASCII : (Americans Standard Code for Information Interchange)

- Represents all symbols 1 language using constants
- The range is 0 - 255
- A language is at most having 256 symbols.
- 1 byte range is (0-255) - 2^8 value
- Hence we represent a symbol using 1 byte memory.

A-65	a-97	0-48	#-35
B-66	b-98	1-49	$-36
..	..	..	..
..	..	..	..
Z-90	z-122	9-57	..

26 + 26 + 10 + 150 < 256 symbols

chr(): Return the symbol for specified integer value.
ord(): Returns the integer for specified symbol.

```
>>> chr(65)
'A'
>>> chr(50)
'2'
>>> ord('a')
97
>>> ord('$')
36
>>> ord('1')
49
```

Programs On Arithmetic Operators

Adding 2 numbers:

```
num1 = float(input("Enter the first number: "))
num2 = float(input("Enter the second number: "))
sum = num1 + num2
print("The sum of", num1, "and", num2, "is", sum)
```

Arithmetic Operations:

```
num1 = float(input("Enter the first number: "))
num2 = float(input("Enter the second number: "))

sum = num1 + num2
difference = num1 - num2
product = num1 * num2
quotient = num1 / num2
remainder = num1 % num2
floordiv = num1 // num2

print("Sum:", sum)
print("Difference:", difference)
print("Product:", product)
print("Quotient:", quotient)
print("Remainder :", remainder)
print("Floor Division :", floordiv)
```

Program to display the last digit of given number:

```
num = int(input("Enter a number: "))
last_digit = num % 10
print("The last digit of", num, "is", last_digit)
```

```
num = int(input("Enter a number: "))
num = num//10
print("The number with the last digit removed is", num)
```

Progam to remove last digit of given number:

Find Total and Average of 4 numbers:

```
mark1 = float(input("Enter the first mark: "))
mark2 = float(input("Enter the second mark: "))
mark3 = float(input("Enter the third mark: "))
mark4 = float(input("Enter the fourth mark: "))
average = (mark1 + mark2 + mark3 + mark4) / 4
print("The average of the four marks is", average)
```

Find sum of square and cube of given number:

```
num = int(input("Enter a number: "))
square = num ** 2
cube = num ** 3
sum = square + cube
print("The sum of the square and cube of", num, "is", sum)
```

Calculate Total Salary for given basic Salary:

```
basic_salary = float(input("Enter the basic salary: "))

# Calculate the allowances and deductions
hra = 0.2 * basic_salary
da = 0.1 * basic_salary
pf = 0.05 * basic_salary

# Calculate the gross and net salary
gross_salary = basic_salary + hra + da
net_salary = gross_salary - pf

# Print the result
print("Basic salary:", basic_salary)
print("HRA:", hra)
print("DA:", da)
print("PF:", pf)
print("Gross salary:", gross_salary)
print("Net salary:", net_salary)
```

Swapping 2 numbers:

```
num1 = float(input("Enter the first number: "))
num2 = float(input("Enter the second number: "))

# Before swapping
print("Before swapping:")
print("num1 =", num1)
print("num2 =", num2)

# Swap the values
temp = num1
num1 = num2
num2 = temp

# After swapping
print("After swapping:")
print("num1 =", num1)
print("num2 =", num2)
```

Swapping 2 number without third variable:

```
# Take input from the user
num1 = float(input("Enter the first number: "))
num2 = float(input("Enter the second number: "))

# Swap the values without using a third variable
num1, num2 = num2, num1

# After swapping
print("After swapping:")
print("num1 =", num1)
print("num2 =", num2)
```

```
// Swap the values without using a third variable
num1 = num1 + num2;
num2 = num1 - num2;
num1 = num1 - num2;
```

Another Way:

Relational operators:

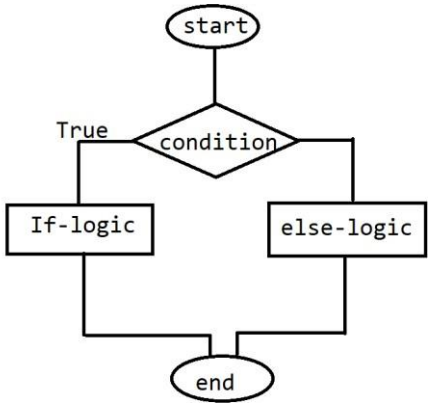
- Operators are > , < , >= , <= , == , !=
- These operators validate the relation among operands and return a boolean value.
- If relation is valid returns True else False

Program to understand Relational operators:

```
print("Relational operations")
print("5>3 :", 5>3)
print("5==3 :", 5==3)
print("5<3 :", 5<3)
print("5!=3 :", 5!=3)
print("5>=3 :", 5>=3)
print("5<=3 :", 5<=3)
```

If-else Conditional Statement:

```
Syntax :
    if(condition) :
        ......
        if-logic
        ......
    else:
        ......
        else-logic
        ......
```



Check the Number is Zero or Not

```
n = int(input("Enter number : "))
if(n==0):
    print("Number equals to zero")
else:
    print("Number is not zero")
```

Check the Number is Positive or Not

```
n = int(input("Enter number : "))
if(n>=0):
    print("Positive Number")
else:
    print("Negative Number")
```

Check the 2 numbers equal or not

```
n1 = int(input("Enter First num : "))
n2 = int(input("Enter Second num : "))
if(n1==n2):
    print("Equal numbers")
else:
    print("Not equal Numbers")
```

Check the first number greater than second number or not

```
n1 = int(input("Enter First num : "))
n2 = int(input("Enter Second num : "))
if(n1>n2):
    print("First Number is big")
else:
    print("Second Number is big")
```

Check the person eligible for vote or not

```
age = int(input("Enter age : "))
if(age>=18):
    print("Eligible for vote")
else:
    print("Not eligible for vote")
```

Check the number is divisible by 7 or not

```
num = int(input("Enter number : "))
if(num%7==0):
    print("Divisible by 7")
else:
    print("Not divisible by 7")
```

Check the number is even or not

```
num = int(input("Enter number : "))
if(num%2==0):
    print("Even Number")
else:
    print("Not Even")
```

Check the last digit of number is zero or not

```
num = int(input("Enter number : "))
if(num%10==0):
    print("Last digit is zero")
else:
    print("Last digit is not zero")
```

Check the sum of 2 numbers equal to 10 or not

```
n1 = int(input("Enter First number : "))
n2 = int(input("Enter Second number : "))
if(n1+n2==10):
    print("Equal to 10")
else:
    print("Not equal to 10")
```

Check last digits of given 2 numbers equal or not

```
n1 = int(input("Enter First number : "))
n2 = int(input("Enter Second number : "))
if(n1%10 == n2%10):
    print("Equal")
else:
    print("Not equal")
```

Check the average of 3 numbers greater than 60 or not

```
print("Enter 3 numbers :")
n1 = int(input())
n2 = int(input())
n3 = int(input())

if((n1+n2+n3)/3 > 60):
    print("avg Greater than 60")
else:
    print("Not")
```

Check the last digit of number is divisible by 3 or not

```
n = int(input("Enter num : "))
if((n%10)%3==0):
    print("Last digit divisible by 3")
else:
    print("Not divisible")
```

Logical operators: These operators returns True or False be validating more than one expression

Operator	Meaning	Example
and	True if both the operands are true	x and y
or	True if either of the operands is true	x or y
not	True if operand is false (complements the operand)	not x

And examples:	Or examples:	Not examples:

>>> True and True
True
>>> 5>3 and 3>2
True
>>> True and False
False
>>> False and True
False
>>> False and False
False
>>> 5>3 and 5!=5
False
	>>> False or False
	False
	>>> False or True
	True
	>>> True or False
	True
	>>> True or True
	True
	>>> 3>5 or 5>2
	True
		>>> not True
		False
		>>> not False
		True
		>>> not 5>3
		False
		>>> not 3!=3
		True

Check the Number Divisible by 3

N%3==0 (3, 6, 9, 12....)

Check the Number Divisible by 5

N%5==0 (5, 10, 15, 20....)

Check the Number Divisible by both 3 and 5

N%3==0 and N%5==0 (15, 30, 45, 60....)

Check the Number Divisible by either 3 or 5

N%3==0 and N%5==0 (3, 5, 6, 9, 10, 12, 15...)

Program to check the Number Divisible by both 3 and 5:

```
n = int(input("enter number : "))
if n%3==0 and n%5==0:
    print("Divisible by 3 and 5")
else:
    print("Not divisible")
```

Check the person age between 20 and 50:

```
age = int(input("enter age : "))
if age>=20 and age<=50:
    print("Age between 20 and 50")
else:
    print("Not in between")
```

Check the Number is Single Digit or Not:

```
n = int(input("enter num : "))
if n>=0 and n<=9:
    print("Single Digit")
else:
    print("Not Sigle Digit")
```

Check the Number is Two Digit or Not:

```
n = int(input("enter num : "))
if n>=10 and n<=99:
    print("Two Digit")
else:
    print("Not Two Digit")
```

Check the Character is Upper case Alphabet or Not:

```
ch = input("enter character : ")
if ch>='A' and ch<='Z':
    print("Upper case Alphabet")
else:
    print("Not")
```

Check the Character is Lower case Alphabet or Not:

```
ch = input("enter character : ")
if ch>='a' and ch<='z':
    print("Lower case Alphabet")
else:
    print("Not")
```

Check the Character is Digit or Not:

```
ch = input("enter character : ")
if ch>='0' and ch<='9':
    print("Digit")
else:
    print("Not")
```

Character is Vowel or Not:

```
ch = input("enter character : ")
if ch=='a' or ch=='e' or ch=='i' or ch=='o' or ch=='u':
    print("Vowel")
else:
    print("Not")
```

Check the Character is Alphabet or Not:

```
ch = input("enter character : ")
if((ch>='A' and ch<='Z') or (ch>='a' and ch<='z')):
    print("Alphabet")
else:
    print("Not")
```

Check the Student passed in all 3 subjects or not with minimum 35 marks:

```
subj1 = int(input("Enter subj1 score: "))
subj2 = int(input("Enter subj2 score: "))
subj3 = int(input("Enter subj3 score: "))
if subj1 >= 35 and subj2 >= 35 and subj3 >= 35:
    print("Pass")
else:
    print("Fail")
```

Check A greater than both B and C:

```
print("Enter 3 numbers : ")
x = int(input())
y = int(input())
z = int(input())
if(x>y and x>z):
   print("Yes")
else:
    print("No")
```

Check given 3 numbers equal or not:

```
print("Enter 3 numbers : ")
x = int(input())
y = int(input())
z = int(input())
if(x==y and y==z and z==x):
    print("Equal numbers")
else:
    print("Not equal numbers")
```

Check given 3 numbers unique (not equal):

```
print("Enter 3 numbers : ")
x = int(input())
y = int(input())
z = int(input())
if(x!=y and y!=z and z!=x):
    print("Unique numbers")
else:
    print("Not unique numbers")
```

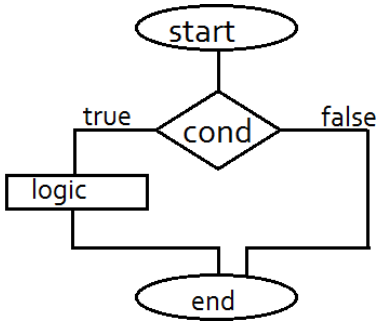
Check any 2 numbers are equal among the given 3 numbers:

```
print("Enter 3 numbers : ")
x = int(input())
y = int(input())
z = int(input())
if(x==y or y==z or z==x):
    print("Any 2 equal")
else:
    print("Not equal numbers")
```

If-block: Execute a block of instructions only if the given condition if true

Syntax :

```
if (condition) :
    .....
    logic
    .....
```



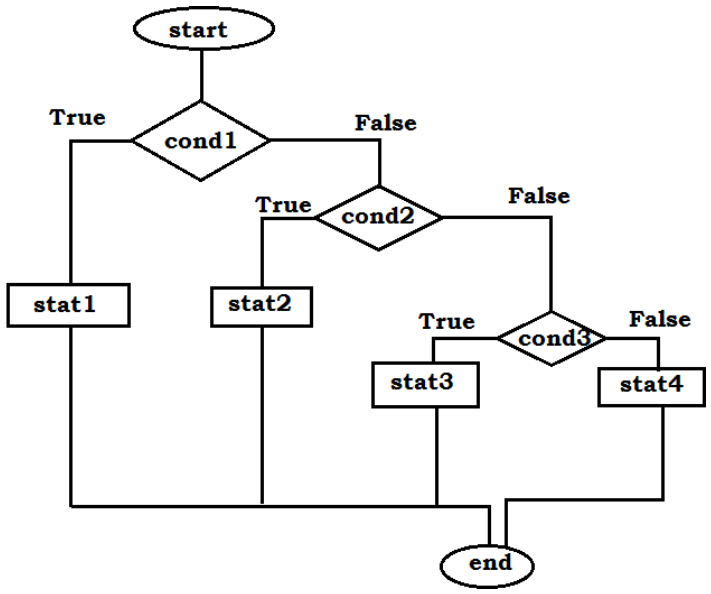
Program to give 20% discount to customer if the bill amount is > 5000

```
print("Enter bill amount :")
bill = float(input())
if(bill>5000):
    discount = 0.2*bill
    bill = bill-discount

print("Plz pay : ", bill)
```

if-elif-else: if-elif-else is a control flow structure in programming that allows a program to execute different blocks of code based on one or more conditions.

Syntax :

```
if(cond1) :
    stat1

elif(cond2) :
    stat2

elif(cond3) :
    stat3

else :
    stat4
```



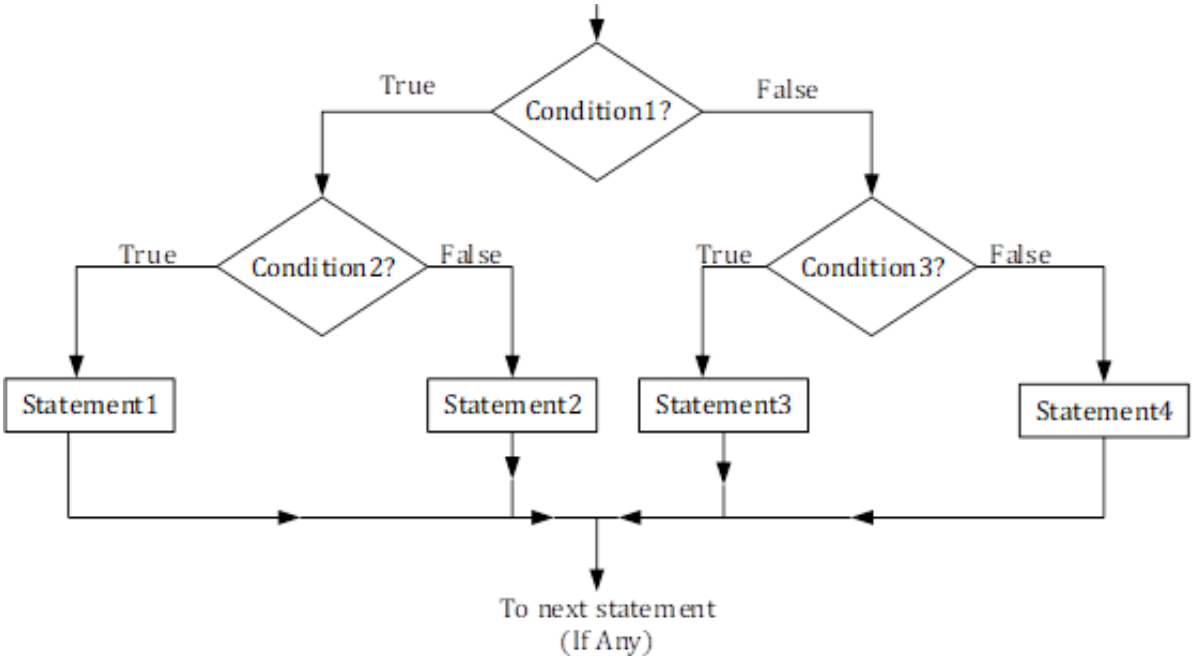
Check the Given number is Single Digit or Two Digit or Three Digit or Other

```
n = int(input("Enter number :"))
if(n>=0 and n<=9):
    print("Single digit")
elif(n>=10 and n<=99):
     print("Two digit")
elif(n>=100 and n<=999):
    print("Three digit")
else:
    print("Other digits number")
```

```
ch = input("Enter character :")
if(ch>='A' and ch<='Z'):
    print("Upper case alphabet")
elif(ch>='a' and ch<='z'):
    print("Lower case alphabet")
elif(ch>='0' and ch<='9'):
    print("Digit")
else:
   print("Symbol")
```

Check the given character is Upper case or Lower case or Digit or Symbol:

Nested-If: Writing if block inside another if block



Check the number is even or not only if the Number is positive

```
n = int(input("Enter number :"))
if n>=0:
    if n%2==0:
        print("Even number")
    else:
        print("Not even number")
else:
    print("Negative")
```

```
print("Enter 2 integers :")
a = int(input())
b = int(input())
if(a!=b):
    if(a>b):
        print("a is big")
    else:
        print("b is big")
else:
    print("equal numbers given")
```

Check the biggest of 2 numbers only if the 2 numbers are not equal:

Display Student Grade only if the Student passed in all subjects:

```
print("Enter 3 subject marks :")
m1 = int(input())
m2 = int(input())
m3 = int(input())

if(m1>=40 and m2>=40 and m3>=40):
    avg = (m1+m2+m3)/3
    if(avg>=75):
        print("Distinction")
    elif(avg>=60):
        print("A-Grade")
    elif(avg>=50):
        print("B-Grade")
    else:
        print("C-Graade")
else:
    print("Fail")
```

Bitwise operators:

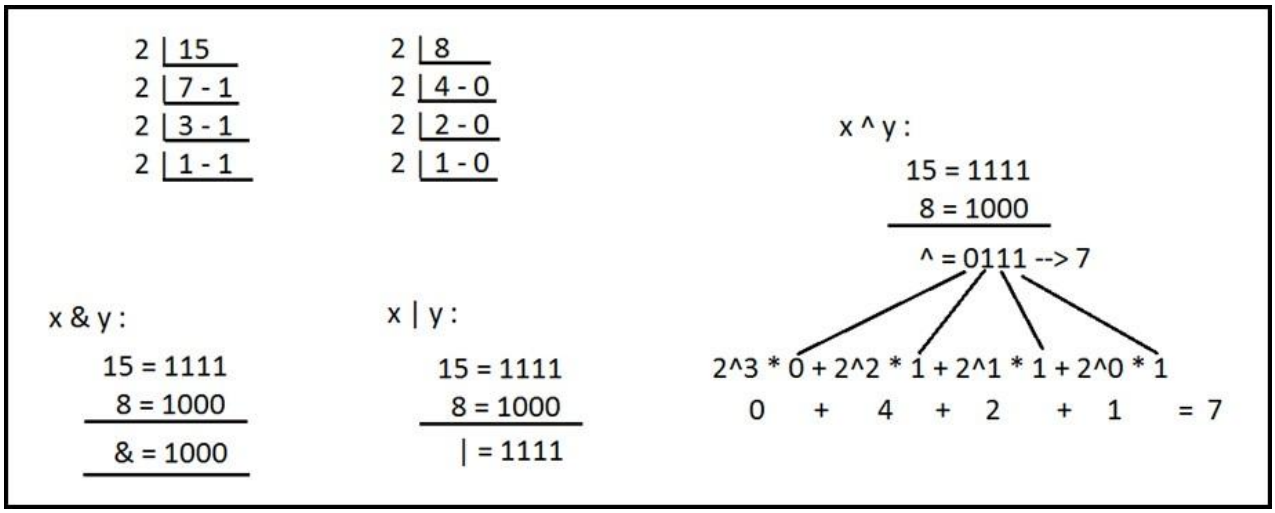
- Bitwise operators act on operands as if they were string of binary digits. It operates bit by bit, hence the name.
- For example, 2 is 10 in binary and 7 is 111.
- In the table below: Let x = 10 (0000 1010 in binary) and y = 4 (0000 0100 in binary)

Operator	Meaning	Example
&	Bitwise AND	x& y = 0 (0000 0000)
|	Bitwise OR	x | y = 14 (0000 1110)
~	Bitwise NOT	~x = -11 (1111 0101)
^	Bitwise XOR	x ^ y = 14 (0000 1110)
>>	Bitwise right shift	x>> 2 = 2 (0000 0010)
<<	Bitwise left shift	x<< 2 = 40 (0010 1000)

Bitwise truth table:

x	y	x&y	x|y	x^y
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0

```
>>> x=15
>>> y=8
>>> x&y
8
>>> x|y
15
>>> x^y
```



Shift operators:

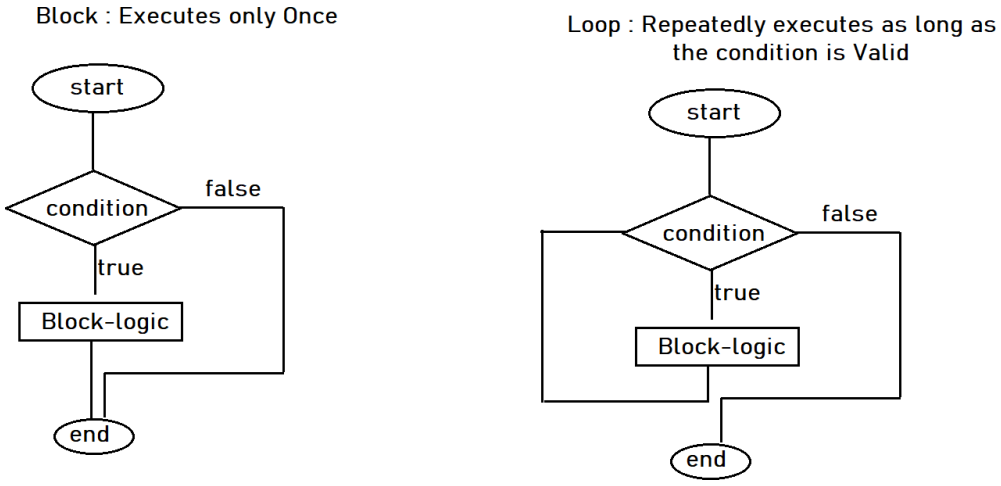
- These are used to move the bits in the memory either to right side or to left side.
- Moving binary bits in the memory change the value of variable.
- These operators return the result in decimal format only.
- Operators are Right shift (>>) and Left shift (<<)

```
>>> x=8
>>> x>>2
2
>>> x<<2
32
```

Right shift: n/2^s → 8/2^2 → 8/4 → 2
Left shift : n*2^s → 8*2^2 → 8*4 → 32

Introduction to Loops

Loop: A Block of instructions execute repeatedly as long the condition is valid.



Note: Block executes only once whereas Loop executes until condition become False

Python Supports 3 types of Loops:

1. For Loop
2. While Loop
3. While - else Loop

For Loop: We use for loop only when we know the number of repetitions. For example,

- Print 1 to 10 numbers
- Print String elements
- Print Multiplication table
- Print String character by character in reverse order

While loop: We use while loop when we don't know the number of repetitions.

- Display contents of File
- Display records of Database table

While – else : while-else loop is a type of loop that combines a while loop with an else statement that is executed after the loop has completed. The else block is executed only if the while loop completed normally

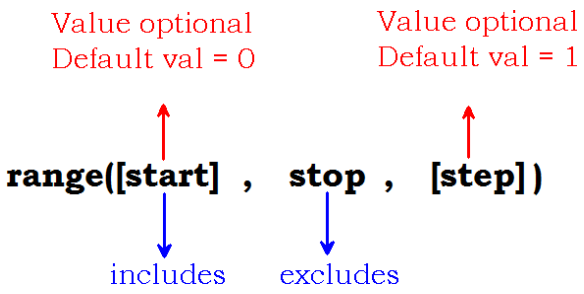
For Loop

for loop:

- "for" is a keyword.
- for loop executes a block repeatedly as long as the condition is valid.
- for loop uses range() function for loop repetition.

range():

- The range() function in Python generates a sequence of numbers within a given range.
- It takes up to three arguments: start (optional), stop (required), and step (optional).
- The sequence generated by the range() function is commonly used in for loops.



Print the numbers from 0 to 9:

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

Print the numbers from 3 to 8:

```
for i in range(3,9):
    print(i)
```

Print the numbers from 10 to 1:

```
for i in range(10, 0, -1):
    print(i)
```

Print every third number from 0 to 20:

```
for i in range(0, 21, 3):
    print(i)
```

Print the even numbers from 0 to 10:

```
for i in range(0, 11, 2):
    print(i)
```

Print the odd numbers from 1 to 9:

```
for i in range(1, 10, 2):
    print(i)
```

Print the even numbers from 10 to 0:

```
for i in range(10, -1, -2):
        print(i)
```

Display values side by side:

```
for i in range(1,6):
        # print(i)
        # print(i, end=' ') -> print values with spaces
        # print(i, end='\t') -> print values with tab spaces
        print(i, end='\n') # print values in new lines
```

Sum of First N numbers:

```
n = int(input("Enter a positive integer: "))
sum = 0
for i in range(1, n+1):
            sum += i
print("The sum of the first", n, "natural numbers is:", sum)
```

Find factorial for given number:

```
n = int(input("Enter a positive integer: "))
factorial = 1
for i in range(1, n+1):
        factorial *= i
print("The factorial of", n, "is:", factorial)
```

Multiplication table program:

```
n = int(input("Enter a positive integer: "))
for i in range(1, 11):
        product = i * n
        print(n, "x", i, "=", product)
```

Print even numbers from 1 to 10:

```
n = int(input("Enter a positive integer: "))
print("Even numbers from 1 to", n, "are:")
for i in range(1, n+1):
        if i % 2 == 0:
                print(i)
```

Print factors for given number:

```
n = int(input("Enter a positive integer: "))
print("Factors of", n, "are:")
for i in range(1, n+1):
        if n % i == 0:
                print(i)
```

Prime number program:

```
n = int(input("Enter a positive integer: "))
is_prime = True
for i in range(2, n):
        if n % i == 0:
                is_prime = False
                break
if is_prime:
print(n, "is a prime number")
else:
print(n, "is not a prime number")
```

Perfect number program:

```
n = int(input("Enter a positive integer: "))
sum = 0
for i in range(1, n//2 + 1):
        if n % i == 0:
                sum += i

if sum == n:
        print(n, "is a perfect number")
else:
print(n, "is not a perfect number")
```

Fibonacci Series program:

```
n = int(input("Enter the number of terms: "))
a, b = 0, 1
for i in range(1, n+1):
        print(a)
        c = a + b
        a, b = b, c
```

Multiplication tables in the given range:

```
for n in range(5, 11):

    for i in range(1,11):
        print(n,'*',i,'=',n*i)
```

Factorials in the Given range:

```
for n in range(1,8):

    fact=1
    for i in range(1,n+1):
        fact=fact*i
    print("factorial of",n,"is",fact)
```

Prime numbers in given range:

```
for n in range(1,51):

    factors=0
    for i in range(1,n+1):
        if(n%i==0):
            factors=factors+1

    if(factors==2):
        print(n,"is prime")
```

Perfect numbers in given range:

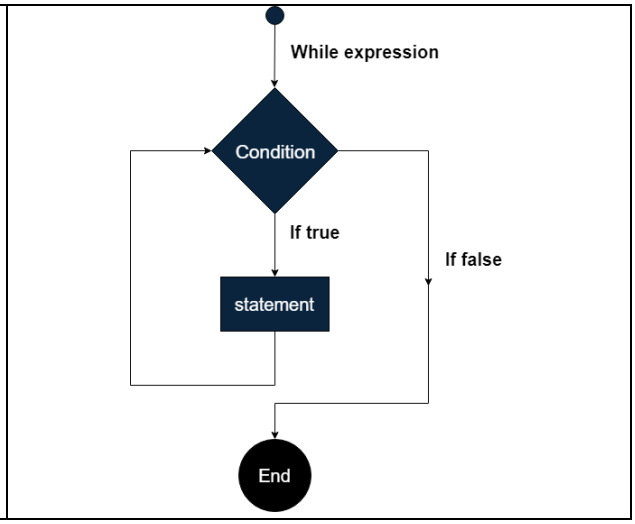
```
for n in range(1,10000):

    sum=0
    for i in range(1,n):
        if(n%i==0):
            sum=sum+i

    if(n==sum):
        print(n,"is perfect")
```

while loop:

- We use while loop when we dont know the number of iterations.
- **Examples:** Reading a File, Display records in dataabse.

Syntax:

```
while(condition):
        statements;
```



Check the even numbers until user quits:

```
while(True):
        n = int(input("enter num : "))
        if(n%2==0):
                print(n,"is even")
        else:
                print(n,"is odd")

        print("Do you check another num(y/n) :")
        ch = input()
        if(ch=='n'):
                break
```

Display Multiplication tables until user quits:

```
while(True):
        n = int(input("Enter table num : "))
        for i in range(1,11):
                print(n,'*',i,'=',n*i)

        print("Do you print another table(y/n) :")
        ch = input()
        if(ch=='n'):
                break
```

Menu Driven Program to perform all arithmetic operations:

```
while(True):
        print("1. Add")
        print("2. Subtract")
        print("3. Multiply")
        print("4. Divide")
        print("5. Quit")

        ch = int(input("enter choice :"))
        if(ch==1):
                print("Enter 2 numbers:")
                a=int(input())
                b=int(input())
                print("Res : ", a+b)
        elif(ch==2):
                print("Enter 2 numbers:")
                a=int(input())
                b=int(input())
                print("Res : ", a-b)
        elif(ch==3):
                print("Enter 2 numbers:")
                a=int(input())
                b=int(input())
                print("Res : ", a*b)
        elif(ch==4):
                print("Enter 2 numbers:")
                a=int(input())
                b=int(input())
                print("Res : ", a/b)
        elif(ch==5):
                break
        else:
                print("Invalid choice")
```

Count digits in the given number:

```
n = int(input("enter num : "))
count=0
while(n!=0):
        n=n//10
        count=count+1
print("Digits count : ", count)
```

Sum of digits in the given number:

```
n = int(input("Enter a number: "))
sum = 0
while n > 0:
        digit = n % 10
        sum += digit
        n //= 10
print("The sum of digits is:", sum)
```

Display only Even digits:

```
n = int(input("Enter a number: "))
while n > 0:
        digit = n % 10
        if digit % 2 == 0:
                print(digit)
        n //= 10
```

Sum of Even digits:

```
n = int(input("Enter a number: "))
sum = 0
while n > 0:
        digit = n % 10
        if digit % 2 == 0:
                sum += digit
        n //= 10
print("The sum of even digits is:", sum)
```

Largest digit in the given number:

```
n = int(input("Enter a number: "))
max_digit = 0
while n > 0:
    digit = n % 10
    if digit > max_digit:
        max_digit = digit
    n //= 10

print("The largest digit is:", max_digit)
```

Display First digit in the given number:

```
n = int(input("Enter a number: "))
while n >= 10:
    n //= 10

print("The first digit is:", n)
```

Sum of First and Last Digits in the given number:

```
n = int(input("Enter a number: "))
last_digit = n % 10
first_digit = n
while first_digit >= 10:
    first_digit //= 10

sum = first_digit + last_digit
print("The sum of the first and last digits is:", sum)
```

Reverse number program:

```
n = int(input("Enter a number: "))
reverse = 0

while n != 0:
    digit = n % 10
    reverse = (reverse * 10) + digit
    n //= 10

print("The reversed number is:", reverse)
```

Strong number program:

```
n = int(input("Enter a number: "))
temp = n
sum = 0

while temp != 0:
    digit = temp % 10
    fact = 1
    for i in range(1, digit + 1):
        fact *= i
    sum += fact
    temp //= 10

if sum == n:
    print(n, "is a strong number")
else:
    print(n, "is not a strong number")
```

ArmStrong Number program:

```
num = int(input("Enter a number: "))
sum = 0
temp = num

# find the number of digits
n = len(str(num))

# calculate sum of cubes of each digit
while temp > 0:
    digit = temp % 10
    sum += digit ** n
    temp //= 10

# display the result
if num == sum:
    print(num, "is an Armstrong number")
else:
    print(num, "is not an Armstrong number")
```

Break and Continue

break:

- It is a keyword
- It is called branching statement
- It is used to terminate the flow of a loop(for or while)

```
while True:
    print("Hi")
    print("Hello")
    break
```

Break loop on condition:

```
for i in range(10):
    if i==5:
        break
    print("i val :",i)
```

continue:

- It is a keyword.
- It is used to skip the current iteration in loop execution.

```
for i in range(1,11):
    if i==5:
        continue
    print("i val :",i)
```

```
for i in range(1,11):
    if i==3 or i==6:
        continue
    print("i val :",i)
```

Patterns Programming

Code:	Pattern:
for i in range(1,6): for j in range(1,6): print("*", end=" ") print()	* *

Code:	Pattern:

for i in range(1,6):
  for j in range(1,6):
  print(i, end=" ")
  print()
	1 1 1 1 1
	2 2 2 2 2
	3 3 3 3 3
	4 4 4 4 4
	5 5 5 5 5

Code:	Pattern:

for i in range(1,6):
  for j in range(1,6):
  print(j, end=" ")
  print()
	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Code:	Pattern:

for i in range(1,6,1):
  for j in range(1,i+1,1):
  print(j, end=' ')
  print()
	1
	1 2
	1 2 3
	1 2 3 4
	1 2 3 4 5

Code:	Pattern:

for i in range(5,0,-1):
  for j in range(1,i+1,1):
  print(j, end=' ')
  print()
	1 2 3 4 5
	1 2 3 4
	1 2 3
	1 2
	1

Code:	Pattern:

for i in range(5,0,-1):
  for j in range(5,i-1,-1):
  print(j, end=' ')
  print()
	5
	5 4
	5 4 3
	5 4 3 2
	5 4 3 2 1

Code:	Pattern:

for i in range(1,6,1):
  for j in range(5,i-1,-1):
  print(j, end=' ')
  print()
	5 4 3 2 1
	5 4 3 2
	5 4 3
	5 4
	5

Code:	Pattern:

for i in range(1,6,1):
  for j in range(i,0,-1):
  print(j, end=' ')
  print()
	1
	2 1
	3 2 1
	4 3 2 1
	5 4 3 2 1

Code:	Pattern:

for i in range(5,0,-1):
  for j in range(i,0,-1):
  print(j, end=' ')
  print()
	5 4 3 2 1
	4 3 2 1
	3 2 1
	2 1
	1

Code:	Pattern:

for i in range(1,10):
  for j in range(1,10):
  if(i==5 or j==5):
  print("+", end=" ")
  else:
  print(" ", end=" ")
  print()
	+
	+
	+
	+
	+ + + + + + + + +
	+
	+
	+
	+

Code:	Pattern:

for i in range(1,10):
  for j in range(1,10):
  if(i==1 or j==1 or i==9 or j==9):
  print("+", end=" ")
  else:
  print(" ", end=" ")
  print()
	+ + + + + + + + +
	+ +
	+ +
	+ +
	+ +
	+ +
	+ +
	+ + + + + + + + +

Code:	**Pattern:**

for i in range(1,10):
  for j in range(1,10):
  if(i==j or j==10-i):
  print("+", end=" ")
  else:
  print(" ", end=" ")
  print()
	+ +
	 + +
	  + +
	  + +
	  +
	  + +
	  + +
	 + +
	+ +

Code:	**Pattern:**

for i in range(1,10):
  for j in range(1,10):
  if(i==1 or i==9 or i==j or j==10-i):
  print("+", end=" ")
  else:
  print(" ", end=" ")
  print()
	+ + + + + + + + +
	 + +
	  + +
	  + +
	  +
	  + +
	  + +
	 + +
	+ + + + + + + + +

Code:	**Pattern:**

for i in range(1,10):
  for j in range(1,10):
  if((i==1 and j<=5) or j==5 or (i==9 and j>=5) or (j==9 and i<=5) or i==5 or (j==1 and i>=5)):
  print("+", end=" ")
  else:
  print(" ", end=" ")
  print()
	+ + + + + +
	  + +
	  + +
	  + +
	+ + + + + + + + +
	+ +
	+ +
	+ +
	+ + + + +

Functions in Python

Functions:

- A block of instructions that performs a task.
- Function takes input, process the input and returns the output.
- "def" is a keyword is used to define functions in python programming.

Syntax:

```
def  identity(arguments) :
        ……
        Logic
        ……
```

Ex:

```
def  add(a, b):
        c=a+b
        return c
```

Every function consists:

1. Function definition: Function definition is a block which contains the logic.
2. Function call : It is a single statement used to access the function definition.

Definition:

```
def  add(a, b):
        c=a+b
        return c
```

Call:

```
res = add(10,20)
```

Basic functional programming:

- Function execute only when we call that function.
- Calling is a single statement used to access the function logic

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

fun() # calling
```

Note : We cannot call a function before it has defined.

```
fun() # error :
def fun():
    print("Hello...")
    return
```

The main advantage of functions is code re-usability. We can call the function many times once we defined.

```
def test():
    print("logic..")
    return

test()
test()
test()
```

One source file(.py file) can have more than one function definition. Functions get executed in the order we invoke.

```
def m1():
    print("m1 .... ")
    return

def m2():
    print("m2 .... ")
    return

m2()
m1()
```

We can access one function from another function.

```
def m1():
    print("control in m1...")
    return

def m2():
    print("control in m2...")
    m1() #calling
    print("control back to m2 from m1...")
    return

print("Program starts...")
m2() #calling
print("Program ends...")
```

Classification of functions: The way of passing input and returning output, functions classified into

1. No arguments and No return values
2. With arguments and No return values
3. With arguments and With return values
4. No arguments and With return value
5. Recursion

No arguments and No return values:

- Defining a function without arguments. No need to pass input values while calling the function. 'return' statement is optional.

```
def sayHi():
    print("Hi to all...")
    return

sayHi()
sayHi()
sayHi()
```

With arguments and No return values:

- Defining a function with arguments(variables)
- Function takes input and it can be any type.
- We need to pass parameter values while calling the function.

```
def printMessage(msg):
    print("Message is :",msg)
    return

printMessage("Live Tution")
printMessage("Python")
printMessage("Tutorials")
```

With arguments and with return values:

- Defining a function with arguments and return values
- The value returned by function need to collect into variable.
- Function returned value back to the calling function.

```
def add(a,b):
    c=a+b
    return c
print("sum :",add(3,5))
print("sum :",add(5,8))
```

No arguments and with return values:

- Defining a function with no arguments
- Function returns a value from its definition.

```
def getPI():
    PI = 3.142
    return PI

print("PI value :",getPI())
```

Recursion:

- Function calling itself is called recursion.
- Calling the function from the definition of same function.
- Function executes from the allocated memory called STACK.
- While executing the program, if the stack memory is full, the program execution terminates abnormally.

```
def tutorials():
    print("Keep reading...")
    tutorials()
    return

tutorials()
```

Factorial of given number using recursion:

```
def fact(n):
    res=0
    if(n==0):
        res=1
    else:
        res=n*fact(n-1)
    return res

n = int(input("Enter n val :"))
print("Factorial val :", fact(n))
```

Argument type functions: Depends on the way of passing input and taking input, functions in python classified into

1. Default arguments function
2. Required arguments function
3. Keyword arguments function
4. Variable arguments function

Default arguments function:

- Defining a function by assigning values to arguments.
- Passing values to these arguments is optional while calling the function.
- We can replace the values of default arguments if required.

```
def default(a,b=20):
    print("a val :",a)
    print("b val :",b)
    return

default(10)
default(50,100)
default(10,"abc")
```

- Argument assigned with value is called default argument
- A Non default argument cannot follows default argument

```
def default(a=10,b):
    print("a val :",a)
    print("b val :",b)
    return
```

Required arguments function:

- Function definition without default arguments.
- We need to pass input value to all positional arguments of function.

```
def required(a,b):
    print("a val :",a)
    print("b val :",b)
    return

#required(10) -> Error:
required(10,20)
required(10,"abc")
```

Keyword arguments function:

- Calling the function by passing values using keys.
- We use arguments names as keys.

```
def keyword(name, age):
    print("Name is :",name)
    print("Age is :",age)
    return

keyword("Annie",21)
keyword(23,"Amar")
```

We can change the order of arguments while passing values using keys.

```
def keyword(name, age):
    print("Name is :",name)
    print("Age is :",age)
    return

keyword(age=23,name="Amar")
```

Keyword functions are useful mostly in default arguments function.

```
def default(a=10,b=20,c=30):
    print("a :",a)
    print("b :",b)
    print("c :",c)
    return

default()
# I want to change value of b=50
default(10,50,30)
# It is easy to use keyword arguments
default(b=50)
```

Variable arguments function:

- Passing different length of values while calling the function.
- We can collect these arguments into pointer type argument variable.

```
def variable(*arr):
    print("Length is :",len(arr))
    print("Elements :",arr)
    return

variable()
```

We can pass different types of data elements also

```
def variable(*arr):
    print("Elements :",arr)
    return

variable(10,20,30,40,50)
variable(10,2.3,"abc")
```

We can process the elements easily using for loop

```
def variable(*arr):
    print("Elements :")
    for ele in arr:
        print(ele)
    return

variable(10,20,30,40,50)
```

Local and Global Variables:

Local variables:

- Defining a variable inside the function.
- Local variables can be accessed only from the same function in which it has defined.
- We access the local variable directly.

```
def test():
    a=10 #local
    print("Inside :",a)
    return

test()
print("Outside :",a) #error :
```

Arguments(parameters):

- Variables used to store input of the function.
- Arguments are working like local variables.
- Arguments can access within that function only.

```
def test(a, b): #a,b are local
    print("Inside :",a)
    print("Inside :",b)
    return

test(10,20)
print("Outside :",a) #error
```

Global variables:

- Defining a variable outside to all the functions.
- We can access the variable directly.
- It is available throughout the application.

```
a=10 #global
def m1():
    print("Inside m1 :",a)
    return

def m2():
    print("Inside m2 :",a)
    return

m1()
m2()
print("Outside :",a)
```

- We can define local & global variables with the same name.
- We access both the variables directly using its identity.
- When we access a variable inside the function, it gives the first priority to local variable.
- If local is not present, then it is looking for Global variable.

```
a=10 #global
def m1():
    a=20 #local
    print("Inside m1 :",a)
    return

def m2():
    print("Inside m2 :",a)
    return

m1()
m2()
print("Outside :",a)
```

global:

- It is a keyword.
- It is used to define, access, modify & delete global variables from the function.
- global statement must be placed inside the function before the use of that variable.

Note: We can access global variable inside the function. We cannot modify the global variable from function directly.

```
a=10

def test():
    print("a  val  :",a)
    a=a+20 #error :
    print("a  val  :",a)
    return

test()
```

We can use global keyword to modify the global variable from the function:

```
a=10

def test():
    global a
    print("a val :",a)

    a=a+20
    print("a val :",a)

    a=a+30
    return

test()
print("a val :",a)
```

We can define global variables from the function using "global" :

```
def test():
    global a
    a=10
    print("Inside :",a)
    return

test()
print("Outside :",a)
```

Introduction to OOPS

Application:

- Programming Languages and Technologies are used to develop applications.
- Application is a collection of Programs.
- We need to design and understand a single program before developing an application.

Program Elements: Program is a set of instructions. Every Program consists,

1. Identity
2. Variables
3. Methods

1. Identity:

- Identity of a program is unique.
- Programs, Classes, Variables and Methods having identities
- Identities are used to access these members.

2. Variable:

- Variable is an identity given to memory location.

  or
- Named Memory Location
- Variables are used to store information of program(class/object)

Syntax	Examples

identity = value;	name = "amar";
	age = 23;
	salary = 35000.00;
	is_married = False;

3. Method:

- Method is a block of instructions with an identity
- Method performs operations on data(variables)
- Method takes input data, perform operations on data and returns results.

Syntax	Example
identity(arguments): body	add(int a, int b): c = a+b return c

Object Oriented Programming:

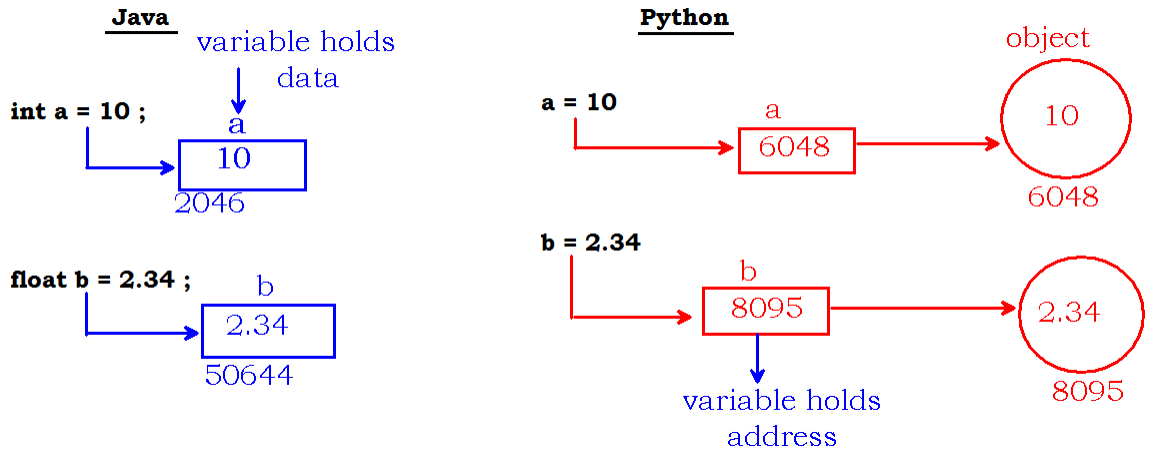
- Python is Object Oriented.
- Python is Fully Object Oriented because it doesn't support primitive data types.
- Languages which are supporting primitive types are called, Partial Object oriented programming languages.
- for example C++, Java, .Net...

Note: Primitive types such as int, float, char occupies fixed memory size and stores specific type of data.

Python is Dynamic:

- Python is dynamic
- Python variable stores address instead of data directly.
- Python stores information in the form of Objects.
- Depends on the data, the size of memory grows and shrinks dynamically.
- A python variable accepts any type of data assignment.

Note: In python, if we modify the value of variable, it changes the location.



id(): A pre-defined function that returns memory address of specified variable.

```
a=10
print("Val :",a)
print("Addr :",id(a))

a=a+5
print("Val :",a)
print("Addr :",id(a))
```

Object Oriented Programming features are:

1. Encapsulation
2. Inheritance
3. Polymorphism
4. Abstraction

Note: We implement Object-Oriented functionality using Classes and Objects

Class: Class contains variables and methods**.** Java application is a collection of classes

Syntax	Example
class ClassName: Variables ; & Methods ;	class Account: num; balance; withdraw(): logic; deposit(): logic;

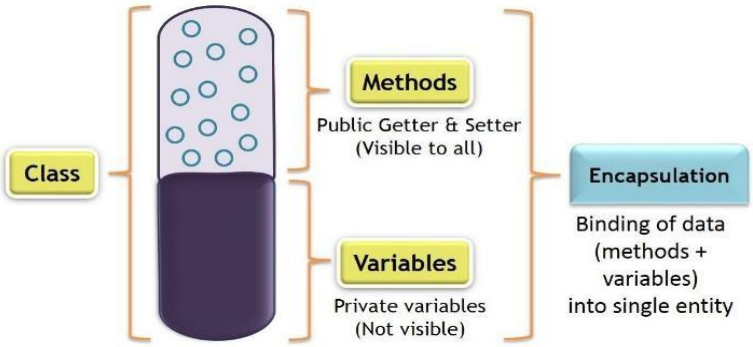
Object: Object is an instance of class. Instance (non static) variables of class get memory inside the Object.

Syntax: refVariableName = ClassName();
Example: acc = Account();

Note: Class is a Model from which we can define multiple objects of same type

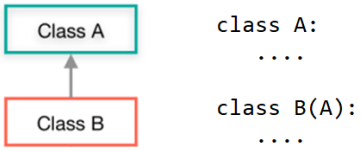
Encapsulation:

- The concept of protecting the data with in the class itself.
- **Implementation rules:**
  - Class is Public (to make visible to other classes).
  - Variables are Private (other objects cannot access the data directly).
  - Methods are public (to send and receive the data).



Inheritance:

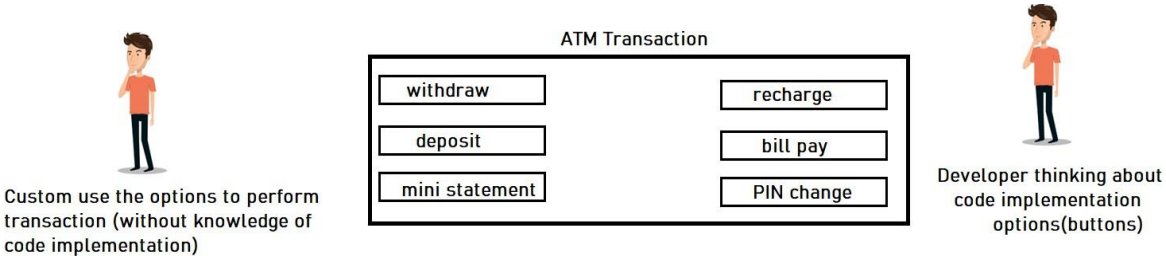
- Defining a new class by re-using the members of other class.
- We can implement inheritance using "extends" keyword.
- **Terminology:**
  - **Parent/Super class:** The class from which members are re-used.
  - **Child/Sub class:** The class which is using the members




```
class A:
   ....

class B(A):
   ....
```

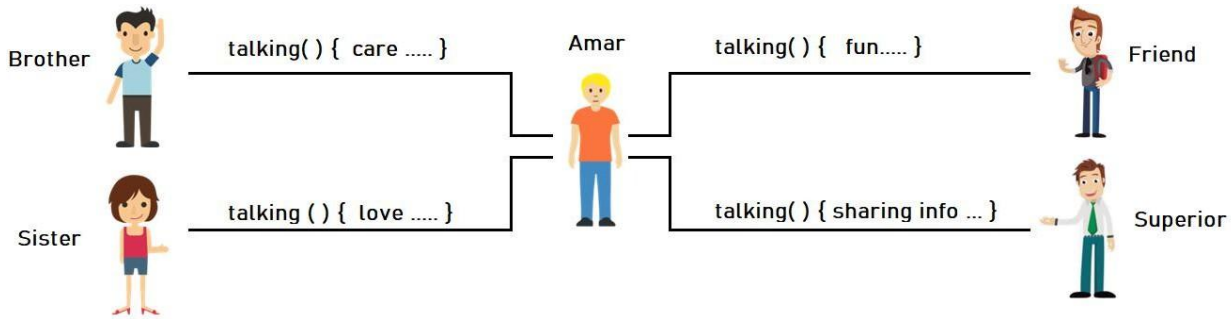
Abstraction:

- Abstraction is a concept of hiding implementations and shows functionality.
- Abstraction describes "What an object can do instead how it does it?".



Polymorphism:

- Polymorphism is the concept where object behaves differently in different situations.



Class Members or Static members:

- Defining variable or method inside the class.
- We can access these members using class name.

Note: Generally, we access the variables and functions directly after definition.

```
a=10
def test():
    print("test")
    return
print("a val :",a)
test()
```

- In Object Oriented application, variables and methods must be defined inside the class.
- "class" is a keyword.
- Defining variable and method inside the class called "static members"
- We need to access static members using identity of class.

```
class Test:
    a=10 # static
    def fun():
        print("static fun")
        return
print("a val :",Test.a)
Test.fun()
```

Connect classes:

- One python file allowed to define any number of classes
- We can access the members of these classes using "class names"

```
    class First:
        def fun():
            print("First class fun")
            return
    class Second:
        def fun():
            print("Second class fun")
            return
    class Access:
        def main():
            print("starts @ main")
            First.fun()
            Second.fun()
            return

    Access.main()
```

Local and Static variables:

- Defining a variable inside method is called local variable
- We access local variables directly but only from the same block in which it has defined.
- Defining a variable inside the class and outside to all methods is called static variable.
- We can access static variable using class name.

```
class Access:
    a=10 #static
    def main():
        a=20 #local
        print("local a :", a)
        print("static a :", Access.a)
        return

Access.main()
```

Global variables:

- Defining variables outside to all classes.
- We access global variables directly.
- When we access variable inside the method, it is looking for local variable first. If the local variable is not present, it accesses the global variable.

```
a=10 #Global
class Access:
    a=20 #Static
    def m1():
        a=30 #Local
        print("Inside m1")
        print(a)
        print(Access.a)
        return

    def m2():
        print("Inside m2")
        print(a)
        print(Access.a)
        return

    def main():
        Access.m1()
        Access.m2()
        return
Access.main()
```

Dynamic members

Dynamic Members:

- The specific functionality of Object must be defined as dynamic.
- We access dynamic members using object.
- We can create object for a class from static context.

Dynamic method:

- Defining a method inside the class by writing "self" variable as first argument.
- "self" is not a keyword.
- "self" is a recommended variable to define Dynamic methods.
- Definition of dynamic method as follows.

```
class Test:
    def m1():
        # static method
        return

    def m2(self):
        # dynamic method
        return

    def __init__(self):
        # constructor
        return
```

self:

- It is used to define dynamic methods and constructor.
- It is not a keyword but it is the **most recommended** variable to define dynamic functionality.
- It is an argument(local variable of that function)
- We can access "self" only from the same function or constructor.
- "self" variable holds object address.

Constructor:

- A special method with pre-defined identity(__init__).
- It is a dynamic method(first argument is self)
- It invokes automatically in the process of Object creation.

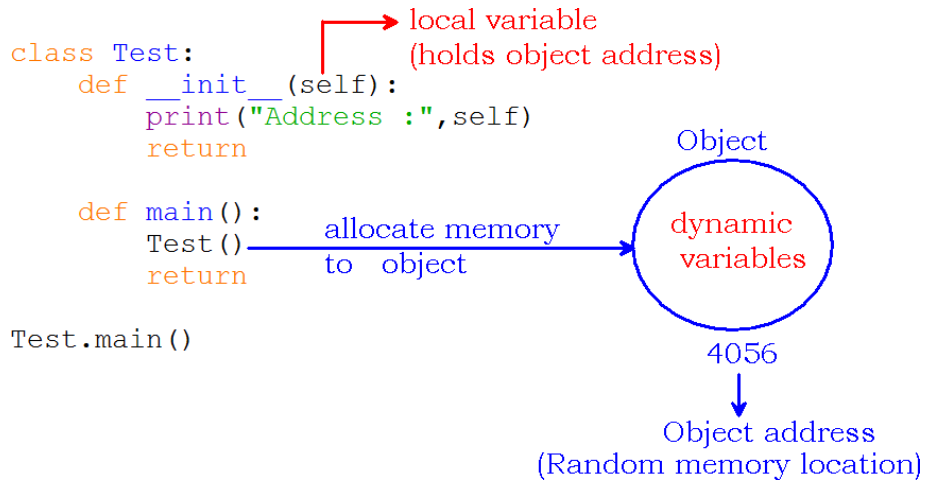
Creating object in main():

- Application execution starts from static context(main).
- We can access non static members using object address.
- We create object(take permission) in static context(main)

```
class Test:
    def _init_(self):
        print("Constructor")
        return

    def main():
        Test() #access constructor
        return

Test.main()
```

Constructor executes every time when we create the object.

```
class Test:
    def _init_(self):
        print("Constructor")
        return

    def main():
        for i in range(10):
            Test()
        return

Test.main()
```



```
class Test:
    def _init_(self):
        print("Address :",self)
        return

    def main():
        Test()
        return

Test.main()
```

id(): A pre-defined method that returns integer value of specified Object.
type(): Returns the class name of specified object.

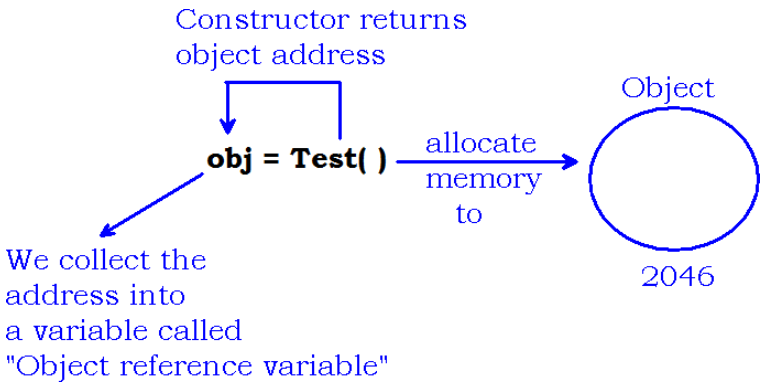
```
class Test:
    def _init_(self):
        print("Address :",id(self))
        print("Name :",type(self))
        return

    def main():
        Test()
        return
Test.main()
```

We cannot access 'self' in main() method to work with object.

```
class Test:
    def __init__(self):
        print("In Constructor :",id(self))
        return

    def main():
        Test()
        print("In main :", id(self))
        return

Test.main()
```

Object reference variable:

- Constructor returns address of Object after creation.
- We can collect the address assigning to any variable.
- The variable stores object address is called "Object reference variable"



We can display object address in main using "object reference variable.

```
class Test:
    def __init__(self):
        print("In Constructor :",id(self))
        return

    def main():
        addr = Test()
        print("In main :", id(addr))
        return

Test.main()
```

Access static and dynamic methods from main:

```
class Test:
    def m1():
        # static method
        return

    def m2(self):
        # dynamic method
        return
```

Default constructor:

- In object creation process, constructor executes implicitly.
- When we don't define any constructor, a default constructor will be added to the source code.
- Default constructor has empty definition – no logic.

```
class Test:

    def main():
        x = Test()
        y = Test()
        print("Address of x : ", id(x))
        print("Address of y : ", id(y))
        return

Test.main()
```

We can define the default constructor explicitly to understand the object creation process.

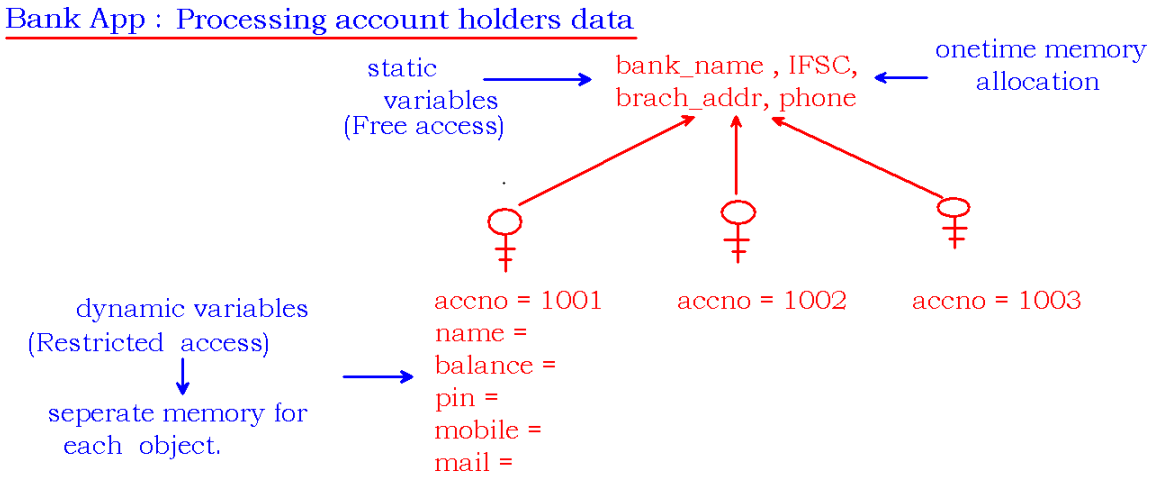
```
class Test:
    def __init__(self):
        print("Object Created :", id(self))
        return

    def main():
        x = Test()
        y = Test()
        print("Address of x : ", id(x))
        print("Address of y : ", id(y))
        return

Test.main()
```

Accessing static and dynamic methods:

```
class Test:
    def main():
        obj = Test()
        Test.m1()
        obj.m2()
        return

    def m1():
        print("Static method")
        return

    def m2(self):
        print("Dynamic method")
        return

Test.main()
```

Dynamic variables:

Static Variables	Dynamic Variables
Static variables store common information of Object.	We create dynamic variables inside the object using 'self' variable.
Static variables get memory only once.	Variables creation must be from constructor.
We can access static variables using class Name	We can access the variables through object address.



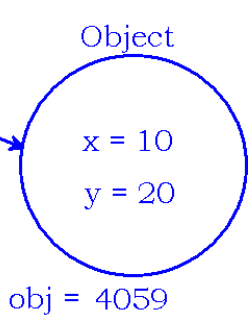
Constructor is used to define dynamic variables:

- Constructor is a special method
- Execute every time automatically in object creation process.
- Constructors used to create dynamic variables.
- As soon as object memory is ready, constructor allocates memory to dynamic variables inside the object.

Access instace variables:

```
class Test :
    def _init_(self):
        self.x = 10
        self.y = 20
        return

    def main():
        obj = Test()
        print("x val :", obj.x)
        print("y val :", obj.y)
        return
Test.main()
```

```
class Test :
    def __init__(self):
        self.x = 10
        self.y = 20
        return

    def main():
        obj = Test()
        print("x val :", obj.x)
        print("y val :", obj.y)
        return

Test.main()
```



Note: In the above program, if we assign values directly to dynamic variables, all objects initializes with same set of values.

```
class Test:
    def _init_(self):
        self.a = 10
        return

    def main():
        t1 = Test()
        print("t1 a val :", t1.a)

        t2 = Test()
        print("t2 a val :", t2.a)
        return

Test.main()
```

Arguments constructor:

- Constructor taking input values to initialize dynamic variables in Object creation process.
- Using arguments constructor, we can set different values to different object variables.
- Arguments are local variables and we can access directly.

```
class Test :
    def _init_(self, a, b):
        self.x = a
        self.y = b
        return
```

```
    def main():
        obj = Test(50,60)
        print("x val :", obj.x)
        print("y val :", obj.y)
        return


Test.main()
```

```
class Test :
    def __init__(self, a, b):
        self.x = a
        self.y = b
        return

    def main():
        obj = Test(50,60)
        print("x val :", obj.x)
        print("y val :", obj.y)
        return

Test.main()
```

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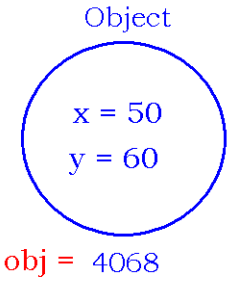
Local variables (direct access)



self.x = a --> local variable "a" value assigning to dynamic variable "x"

- Local variables and dynamic variables can have the same identity.
- We access the local variable directly where as dynamic variable using object address.

```
class Test:
    def _init_(self,a,b):
        self.a = a
        self.b = b
        return

    def main():
        obj = Test(10,20)
        print("a val :", obj.a)
        print("b val :", obj.b)
        return

Test.main()
```

WAP to construct the object by taking user input:

```
class Test:
    def _init_(self,a,b):
        self.a = a
        self.b = b
        return

    def details(self):
        print("a val :", self.a)
        print("b val :", self.b)
        return

    def main():
        print("Enter a, b values :")
        a = input()
        b = input()
        obj = Test(a,b)
        obj.details()
        return

Test.main()
```

Read Emp details and Construct object:

```
class Emp:
    def _init_(self, num, name):
        self.num = num
        self.name = name
        return

    def details(self):
        print("Emp num is :", self.num)
        print("Emp name is :", self.name)
        return

class Access:
    def main():
        print("Enter emp details :")
        num = int(input())
        name = input()
        obj = Emp(num, name)
        obj.details()
        return
Access.main()
```

Account Operations program:

```
class Account:
    def   __init__(self,amt):
        self.balance = amt
        return

    def deposit(self,amt):
        self.balance=self.balance+amt
        print(amt,"deposited")
        return

    def withdraw(self,amt):
        print("Withdrawing :",amt)
        print("Avail bal :",self.balance)
        if(amt<=self.balance):
            print("Collect cash :",amt)
            self.balance=self.balance-amt
        else:
            print("Error : Low balance")
        return

class Bank:
    def main():
        amt = int(input("Enter initial bal : "))
        acc = Account(amt)
        print("Balance is :",acc.balance)

        amt = int(input("Enter deposit amt :"))
        acc.deposit(amt)
        print("After deposit :",acc.balance)

        amt = int(input("Enter withdraw amt :"))
        acc.withdraw(amt)
        print("Final balance :",acc.balance)
        return

Bank.main()
```

Access Modifiers

Access Modifiers:

- Access modifiers are used to set permissions to access the data.
- Python supports 3 access modifiers.
    - private(_ _var)
    - protected (_var)
    - public (var)

Note: Protected members can be discussed with Inheritance concept.

public:

- We can access public members (variables or methods) directly.
- All programs discussed before contains public variables and methods.

```
class Test:
    a=10
    def __init__(self,b):
        self.b = b
        return

class Access:
    def main():
        obj = Test(20)
        print("a val :", Test.a)
        print("b val :", obj.b)
        return

Access.main()
```

Private members:

- A member definition preceded by _ _ is called private member.
- One object(class) cannot access the private members of another object directly.

Note: A class itself can access the private members.

```
class First:
    a = 10 #public
    __b = 20 #private

    def main():
        print("a val :", First.a)
        print("b val :", First.__b)
        return

First.main()
```

Accessing private members of another class results Error:

```
class First:
    a = 10 #public
    __b = 20 #private

class Second:
    def main():
        print("a val :", First.a)
        print("b val :", First.__b)
        return

Second.main()
```

Private dynamic variables creation and Access:

```
class First:
    def __init__(self,x,y):
        self.a = x # 'a' is public
        self.__b = y # 'b' is private
        return

    def main():
        obj = First(10,20)
        print("a val : ", obj.a)
        print("b val : ", obj.__b)
        return

First.main()
```

Accessing private variables from other class results error:

```
class First:
    def _init_(self,x,y):
        self.a = x
        self.__b = y
        return

class Second:
    def main():
        obj = First(10,20)
        print("a val : ", obj.a)
        print("b val : ", obj.__b)
        return

Second.main()
```

Accessing private variables from another class:

- One class cannot access the private information from another class directly.
- A class(object) is allowed to share(send or receive) the private data in communication.
- Communication between objects is possible using methods.
- Two standard methods get() and set() to share the information.

```
class First:
    __a = 10
    def getA():
        return First.__a

class Second:
    def main():
        # print("a val : ", First.__a)
        print("a val : ", First.getA())
        return

Second.main()
```

Accessing dynamic private variable using dynamic get() method:

```
class First:
    def _init_(self,a):
        self._a = a
        return

    def getA(self):
        return self.__a

class Second:
    def main():
        obj = First(10)
        # print("a val : ", obj.__a)
        print("a val : ", obj.getA())
        return

Second.main()
```

Modifying private variables data:

- We cannot set values directly to private variables.
- We use set() method to modify the data.

Note: When we try set the value directly to private variable, the value will be omitted.

```
class First:
    _a=10
    def getA():
        return First._a
    def setA(a):
        First._a = a
        return

class Second:
    def main():
        print("a val :", First.getA())
        First__a=20
        print("a val :", First.getA())
        First.setA(20)
        print("a val :", First.getA())
        return

Second.main()
```

Setting values to dynamic private variables:

```
class First:
    def _init_(self,a):
        self._a = a
        return
    def getA(self):
        return self._a
    def setA(self,a):
        self._a = a
        return

class Second:
    def main():
        obj = First(10)
        print("a val :", obj.getA())
        obj.setA(20)
        print("a val :", obj.getA())
        return

Second.main()
```

Encapsulation: The concept of protecting object information.

Rules:

1. Class is public – Object is visible to other objects in communication.
2. Variables are private – One object cannot access the information of other object directly.
3. Communication between objects using get() and set() methods to share the information.

```
class Emp:
    def  __init__(self,num,name,salary):
        self._num = num
        self._name = name
        self._salary = salary
        return

    def getNum(self):
        return self._num
    def getName(self):
        return self._name
    def getSalary(self):
        return self._salary

    def setNum(self,num):
        self._num = num
        return
    def setName(self,name):
        self._name = name
        return
    def setSalary(self,salary):
        self._salary = salary
        return

class Access:
    def main():
        print("Enter Emp details :")
        num = int(input("Emp Num : "))
        name = input("Emp Name : ")
        salary = float(input("Emp Sal : "))
        obj = Emp(num, name, salary)
        print("Name :",obj.getName())
        return
Access.main()
```

Inheritance in Python

Inheritance:

- Defining an object by re-using the functionality of existing object.
- The main advantage of inheritance in code re-usability.

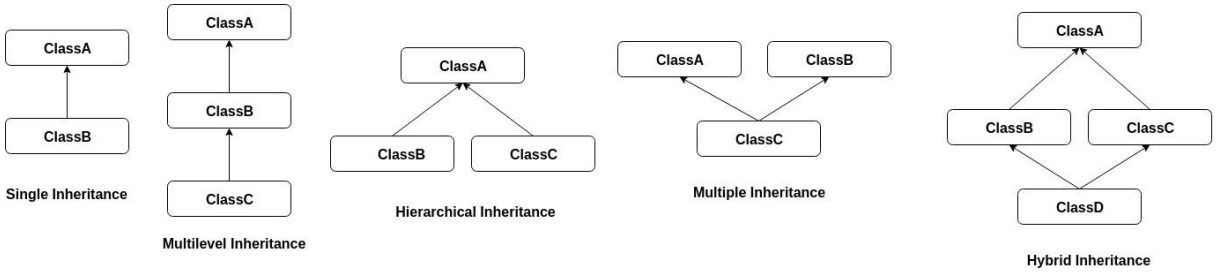
Terminology of inheritance :

- Parent – Child class
- Super – Sub class
- Base – Derived class

.

Types of Inheritance:

- Python supports all types of inheritance supported by Object Oriented Programming.
- The following diagram represents all types



Single Inheritance:

- In parent-child relation, we can access the functionality of Parent through child.
- We cannot access Child functionality using Parent.
- Accessing static members in Parent and Child as follows:

```
class Parent:
    def m1():
        print("Parent's m1")
        return

class Child(Parent):
    def m2():
        print("Child's m2")
        return

class Inheritance:
    def main():
        Child.m1()
        Child.m2()

Inheritance.main()
```

Accessing dynamic functionality in Parent-Child relation:

```
class Parent:
    def m1(self):
        print("Parent's m1")
        return

class Child(Parent):
    def m2(self):
        print("Child's m2")
        return

class Inheritance:
    def main():
        c = Child()
        c.m1()
        c.m2()

Inheritance.main()
```

Method overriding:

- Defining a method in the Child class with same name and same set of arguments of Parent class method.
- When two methods in Parent and Child with the same identity, it gives the first priority to Child object.

```
class Parent:
    def fun(self):
        print("Parent's fun()")
        return

class Child(Parent):
    def fun(self): #override
        print("Child's  fun()")
        return

class Inheritance:
    def main():
        obj = Child()
        obj.fun()
        return

Inheritance.main()
```

Advantage of overriding:

- Overriding is the concept of updating existing object functionality when it is not sufficient to extended object.
- Re-writing the function logic with the same identity.

Complete Inheritance with Code program:

1. Accessing existing functionality
2. Adding new features
3. Update(override) existing features

```
class Guru:
    def call(self):
        print("Guru - Call")
        return
    def camera(self):
        print("Guru - Camera - 2MP")
        return

class Galaxy(Guru):
    def videoCall(self):
        print("Galaxy - Video Call")
        return
    def camera(self):
        print("Galaxy - Camera - 8MP")
        return

class Inheritance:
    def main():
        g1 = Galaxy()
        g1.call()# Access existing
        g1.videoCall()# new feature
        g1.camera() #updated

        g2 = Guru()
        g2.call()
        g2.camera()
        g2.videoCall() # error:
        return

Inheritance.main()
```

Accessing overridden functionality of Parent class:

super():

- It is pre-defined method.
- It is used to access Parent class functionality(super) from Child(sub).

```
class Grand:
    def fun(self):
        print("Grand")
        return

class Parent(Grand):
    def fun(self):
        super().fun()
        print("Parent")
        return

class Child(Parent):
    def fun(self):
        super().fun()
        print("Child")
        return

class Inheritance:
    def main():
        obj = Child()
        obj.fun()
        return

Inheritance.main()
```

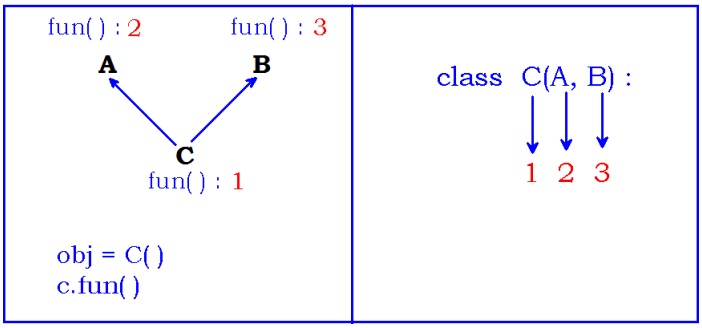
- We can access the functionality of all classes in the hierarchy from one place using super() method.
- We need to specify the Class type along with object reference variable.
- If we specify the Child type, it access Parent functionality.

```
class Grand:
    def fun(self):
        print("Grand")
        return

class Parent(Grand):
    def fun(self):
        print("Parent")
```

```
        return

class Child(Parent):
    def fun(self):
        print("Child")
        return

class Inheritance:
    def main():
        obj = Child()
        obj.fun()
        super(Child, obj).fun()
        super(Parent, obj).fun()
        return

Inheritance.main()
```

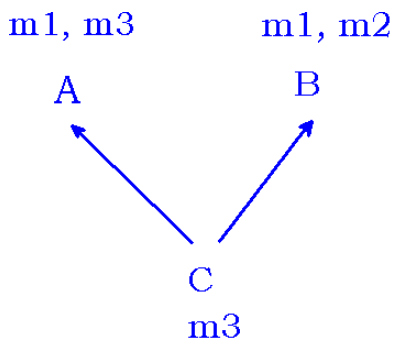
Accessing the functionality in Multiple Inheritance:

- While accessing the functionality of Multiple Inheritance or Hybrid Inheritance, we need to understand the concept of MRO(Method Resolution Order).
- MRO is the concept of how the Interpreter searching for methods while accessing using Child object address.




```
class A:
    def m1(self):
        print("A-m1")
        return

    def m3(self):
        print("A-m3")
        return
```

```
class B:
    def m1(self):
        print("B-m1")
        return

    def m2(self):
        print("B-m2")
        return

class C(A,B):
    def m3(self):
        print("C-m3")
        return

class Multiple:
    def main():
        c = C()
        c.m3()
        c.m2()
        c.m1()
        return

Multiple.main()
```

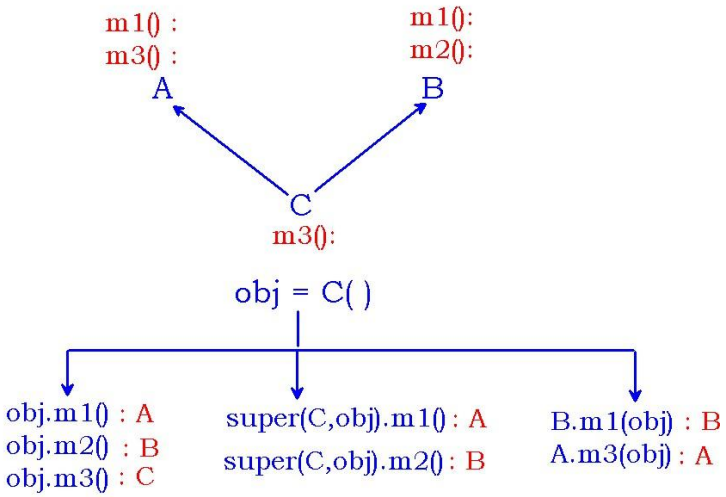


c.m3( ) ---> C - m3
c.m2( ) ---> B - m2
c.m1( ) ---> A - m1

Accessing the complete functionality of all objects in multiple inheritance:

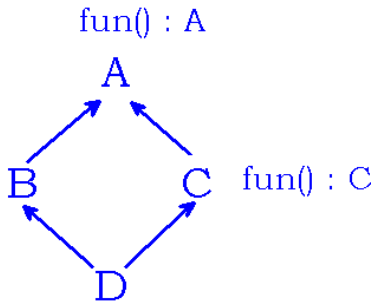
```
class A:
    def m1(self):
        print("A-m1")
        return

    def m3(self):
        print("A-m3")
        return

class B:
    def m1(self):
        print("B-m1")
        return

    def m2(self):
        print("B-m2")
        return

class C(A,B):
    def m3(self):
        print("C-m3")
        return

class Multiple:
    def main():
        obj = C()
        obj.m1()
        obj.m2()
        obj.m3()
        super(C,obj).m1()
        super(C,obj).m2()
        A.m3(obj)
        B.m1(obj)
        return

Multiple.main()
```

```
class A:
    def m1(self):
        print("A-m1")
        return

    def m3(self):
        print("A-m3")
        return

class B:
    def m1(self):
        print("B-m1")
        return

    def m2(self):
        print("B-m2")
        return

class C(A,B):
    def m3(self):
        print("C-m3")
        return
```



Hybrid inheritance:

```
class A:
    def fun(self):
        print("A")
        return

class B(A):
    pass

class C(A):
    def fun(self):
        print("C")
        return

class D(B,C):
    pass

class Hybrid:
    def main():
        obj = D()
        A.fun(obj) ⟶ A
        B.fun(obj) ⟶ A
        C.fun(obj) ⟶ C
        D.fun(obj) ⟶ C
```



Polymorphism in Python

Polymorphism:

- Defining an object(class) that shows different behavior(methods) with the same identity.
- Polymorphism is of 2 types
    - Compile time polymorphism
    - Runtime polymorphism

Compile time polymorphism:

- It is also called "Static binding".
- It is "Method Overloading" technique.
- Defining multiple methods with same name and different set of arguments is called "Overloading".
- Depends on input values, corresponding method executes.

Note: Python doesn't support method overloading. When we define a duplicate method, existing method will be replaced.

```
class Calc:
    def add(a,b):
        res=a+b
        print("Sum of 2 num's :", res)
        return

    def add(a,b,c): # replace exising add() method
        res=a+b+c
        print("Sum of 3 num's :", res)
        return

class Overload:
    def main():
        Calc.add(10,20,30)
        Calc.add(10,20) # error
        return

Overload.main()
```

How can we implement overloading in python?

- In other programming languages, we can define overloading by writing multiple methods either with different types of input or with different length of input.
- As python doesn't support data types, we can pass different types of data into same variables.

```
class Calc:
    def add(a,b):
        res=a+b
        print("Sum :", res)
        return

class Overload:
    def main():
        Calc.add(10,20)
        Calc.add(2.3,4.5)
        Calc.add("Python","Class")
        return

Overload.main()
```

Python supports variables arguments function. We can pass different length of arguments to a single method.

```
class Calc:
    def add(*arr):
        l = len(arr)
        sum = 0
        for ele in arr:
            sum = sum+ele
        print("Sum of",l,"elements :",sum)
        return

class Overload:
    def main():
        Calc.add(10,20)
        Calc.add(10,20,30)
        Calc.add(10,20,30,40,50)
        return

Overload.main()
```

Runtime Polymorphism:

- It is called "dynamic binding".
- It is method "overriding technique".
- Overriding is the concept of defining a method in Child class with the same name and same set of arguments in Parent class method.
- A Child object can shows the functionality of Parent and Child. Hence it is called Polymorphic

```
class Grand:
    def fun(self):
        print("Grand")
        return

class Parent(Grand):
    def fun(self):
        print("Parent")
        return

class Child(Parent):
    def fun(self):
        print("Child")
        return

class Override:
    def main():
        obj = Child()
        obj.fun()
        super(Child,obj).fun()
        super(Parent,obj).fun()
        return

Override.main()
```

Exception Handling in Python

Exception Handling:

- Exception is a "class"
- Exception is a "Runtime Error"
- When exception rises, the flow of execution will be terminated with informal information to the user.

```
class Add:
    def main():
        print("Enter 2 integers :")
        x = int(input())
        y = int(input())
        z = x+y
        print("Sum : ", z)
        print("End...")
        return

Add.main()
```

Note the followings:

- Exception handling is the concept of working with failure cases of logic.
- As a programmer, we need to analyze success cases and failure cases in the transaction to implement the code.

Default Exception handler:

- It is a pre-defined program.
- When exception raises, an object will be created with the complete information of that Error is called "Exception Object".
- It is recommended to handle every exception in the application.
- If we don't handle, the object will be transferred to "Default Exception Handler"

Handling the exceptions:

Try:

- Try block is used to place the doubtful code that may raise exception.
- If exception raises in try block, an exception object will be raised with the error information.

Except:

- Except block is used to collect and handle the exception object which is raised in try block.

Syntax:

```
try :
        ->Doubtful code...
except  <Exception_type>  var :
        ->Handling logic...
```

Reading 2 numbers and perfrom addition operation: Chance of getting ValueError if the user entered invalid input

```
class Demo:
    def main():
        try:
            print("Enter 2 numbers :")
            x = int(input())
            y = int(input())
            z = x+y
            print("Sum :",z)
        except ValueError:
            print("Exception : Invalid input")
        print("End")
        return
Demo.main()
```

try with multi except: One try block can have more than one except blocks to handle different types of exceptions occur in different lines of code. Only one except block executes among we defined.

```
class Division:
    def main():
        try:
            print("Enter 2 numbers :")
            x = int(input())
            y = int(input())
            print("Result :", x/y)

        except ValueError:
            print("Exception : Invalid input")

        except ZeroDivisionError:
            print("Exception : Denominator should not be zero")
        print("End")
        return

Division.main()
```

Exception class:

- "Exception" is pre-defined class.
- "Exception" is the Parent class of all other exception classes.
- Instead of handling multiple exceptions with number of except blocks, we can specify "Exception" type to handle all.
- We need to provide the common the error information to handle using "Exception" class.

Note: We can display the message of Exception object by collecting into variable in "except" block.

```
class Division:
    def main():
        try:
            print("Enter 2 numbers :")
            x = int(input())
            y = int(input())
            z = x/y
            print("Result :",z)

        except Exception as msg:
            print("Exception :",msg)

        return

Division.main()
```

Finally block: It is used to provide "Resource releasing logic". All resources (connected to program) must be closed from finally block.

Note: Finally block executes whether or not an exception has raised in the try block.

```
class Finally:
    def main():
        try:
            x = 10/5
            print("Try block")
        except Exception:
            print("Except block")
        finally:
            print("Finally block")
        return

Finally.main()
```

Finally block executes though exception occurs

```
class Finally:
    def main():
        try:
            x = 10/0
            print("Try block")

        except Exception:
            print("Except block")

        finally:
            print("Finally block")

        return

Finally.main()
```

Open and Close the File using Finally block:

- open() is pre-defined and it is used to open the file in specified path.
- If the file is not present, it raises Exception.

```
class Finally:
    def main():
        try:
            file = open("sample.txt")
            print("File opened...")
        except FileNotFoundError:
            print("Exception : No such file")
        return

Finally.main()
```

- When we connect any resource to the program, we must release that resource.
- close() function is pre-defined and it is used to release any resource.
- Closing statements must be in finally block.

```
class Finally:
    file = None
    def main():
        try:
            Finally.file = open("sample.txt")
            print("File opened...")
```

```
        except FileNotFoundError:
            print("Exception : No such file")

        finally:
            Finally.file.close()
            print("File closed...")
        return

Finally.main()
```

- In the above application, if the file is not present, close() function raises exception as it invokes on "None" value.
- We need to close the file only by checking whether it is pointing to any address on None.

```
class Finally:
    file = None
    def main():
        try:
            Finally.file = open("sample.txt")
            print("File opened...")

        except FileNotFoundError:
            print("Exception : No such file")

        finally:
            if Finally.file != None:
                Finally.file.close()
                print("File closed...")
        return

Finally.main()
```

Custom Exceptions:

- Python library is providing number of exception classes.
- As a programmer, we can define custom exceptions depends on application requirement.
- Every custom exception should extends the functionality of pre-defined Exception class.

raise:

- It is a keyword.
- It is used to raise Custom Exception explicitly by the programmer.

- Pre-defined exceptions will be raised automatically when problem occurs.
- If we don't handle the exception, Default Exception Handler handles.

```
class CustomError(Exception):
    def _init_(self,name):
        self.name=name
        return

class RaiseException:
    def main():
        obj = CustomError("Error-Msg")
        raise obj
        return

RaiseException.main()
```

Handling Custom Exception:

- Generally exception rises inside the function.
- We need to handle the exception while calling the function.
- When exception has raised, the object will be thrown to function calling area.

```
class CustomError(Exception):
    def _init_(self,name):
        self.name=name
        return

class Test:
    def fun():
        obj = CustomError("Message")
        raise obj
        return

class Access:
    def main():
        try:
            Test.fun()
        except CustomError as e:
            print("Exception :",e)
        return

Access.main()
```

Exceptions in Banking application:

- Runtime error is called Exception.
- When we perform the transaction, in case of any error in the middle of transaction called "Runtime error".
- We must define every error as Exception.
- The following example explains how to define Runtime Errors in Banking trasactions.

```
class LowBalanceError(Exception):
    def _init_(self,name):
        self.name = name
        return

class Account:
    def  __init__(self,balance):
        self.balance = balance
        return

    def withdraw(self,amount):
        print("Trying to withdraw :",amount)
        print("Avail bal :",self.balance)
        if amount <= self.balance:
            print("Collect cash :",amount)
            self.balance=self.balance-amount
        else:
            err=LowBalanceError("Low Balance")
            raise err
        return

class Bank:
    def main():
        amount = int(input("enter amount :"))
        acc = Account(amount)
        print("Balance is :",acc.balance)

        amount = int(input("Enter withdraw amt :"))
        try:
            acc.withdraw(amount)
        except LowBalanceError as e:
            print("Exception :",e)
        print("Final Balance is :",acc.balance)
        return

Bank.main()
```

Inner classes

Inner class: Defining a class inside another class. It is also called Nested class.

Syntax:

```
class Outer:
    .....
    logic
    .....
    class Inner:
        .....
        logic
        .....
```

Accessing static functionality:

- Static members we access using class name.
- Inner class can be accessed using Outer class name.

```
class Outer:
    def m1():
        print("Outer-m1")
        return

    class Inner:
        def m2():
            print("Inner-m2")
            return

class Access:
    def main():
        Outer.m1()
        Outer.Inner.m2()
        return

Access.main()
```

Accessing dynamic functionality:

- We can access dynamic member through object address.
- We create object for inner class with the reference of outer class only.

```
class Outer:
    def m1(self):
        print("Outer-m1")
        return

    class Inner:
        def m2(self):
            print("Inner-m2")
            return

class Access:
    def main():
        obj1 = Outer()
        obj1.m1()

        obj2 = obj1.Inner()
        obj2.m2()
        return

Access.main()
```

We create object directly to inner class as follows:

```
class Outer:
    class Inner:
        def fun(self):
            print("Inner-fun")
            return

class Access:
    def main():
        #obj1 = Outer()
        #obj2 = obj1.Inner()
        #obj2.fun()
        Outer().Inner().fun()
        return

Access.main()
```

Local inner classes:

- Defining a class inside the method.
- To access that class, first control should enter into that function.
- We invoke the functionality of local inner class from that function.

```
class Outer:
    def fun():
        print("Outer-fun")

        class Local:
            def fun():
                print("Outer-Local-fun")
                return

        Local.fun()
        return

class Access:
    def main():
        Outer.fun()
        return

Access.main()
```

We can define duplicate classes in different functions:

```
class Outer:
    def m1():
        print("Outer-m1")

        class Local:
            def fun():
                print("m1-Local-fun")
                return

        Local.fun()
        return

    def m2():
        print("Outer-m2")

        class Local:
            def fun():
```

```
            print("m2-Local-fun")
            return

        Local.fun()
        return

class  Access:
    def main():
        Outer.m1()
        Outer.m2()
        return

Access.main()
```

We can define a local inner class inside another local inner class. But it is complex to access the functionality.

```
class Outer:
    def fun(self):
        print("Outer-fun")

        class Local:
            def fun(self):
                print("Outer-Local-fun")

                class Inner:
                    def fun(self):
                        print("Outer-Local-Inner-fun")
                        return

                Inner().fun()
                return

        Local().fun()
        return

class Access:
    def main():
        Outer().fun()
        return

Access.main()
```

Python Modules

Importance of Modularity:

- When people write large programs they tend to break their code into multiple different files for ease of use, debugging and readability.
- In Python we use modules to achieve such goals.
- Modules are nothing but files with Python definitions and statements.
- The name of the file should be valid Python name (think about any variable name) and in lowercase

Pre-defined modules:

- **threading :** To implement Parallel processing
- **gc :** For Garbage collection
- **tkinter :** To implement GUI programming
- **time :** To find system time and data and to display in different formats
- **numpy :** One, two and Multi dimensional
- **re :** Regular expressions
- **mysql :** Python – MySQL database connectivity

connecting modules using import:

- import is a keyword.
- import is used to connect the modules to access their members.

Function based modules:

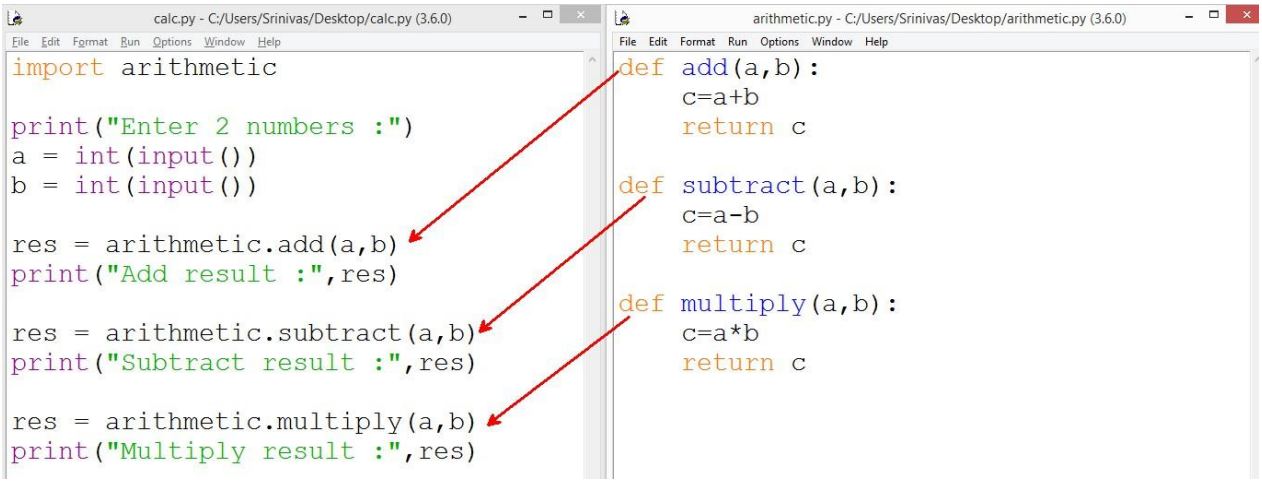
- A module cannot contain classes(object oriented programming).
- We have such type of library modules like time, data and so on.
- We access the functions using module name after import.

arithmetic.py:

```
def add(a,b):
    c=a+b
    return c

def subtract(a,b):
    c=a-b
    return c

def multiply(a,b):
    c=a*b
    return c
```

calc.py:

```
import arithmetic

print("Enter 2 numbers :")
a = int(input())
b = int(input())

res = arithmetic.add(a,b)
print("Add result :",res)

res = arithmetic.subtract(a,b)
print("Subtract result :",res)

res = arithmetic.multiply(a,b)
print("Multiply result :",res)
```



Why we need to call the function using module name after import?

- We can define members with same identity in different modules
- We access the duplicate members from different modules by using the identity of module while accessing.

one.py:

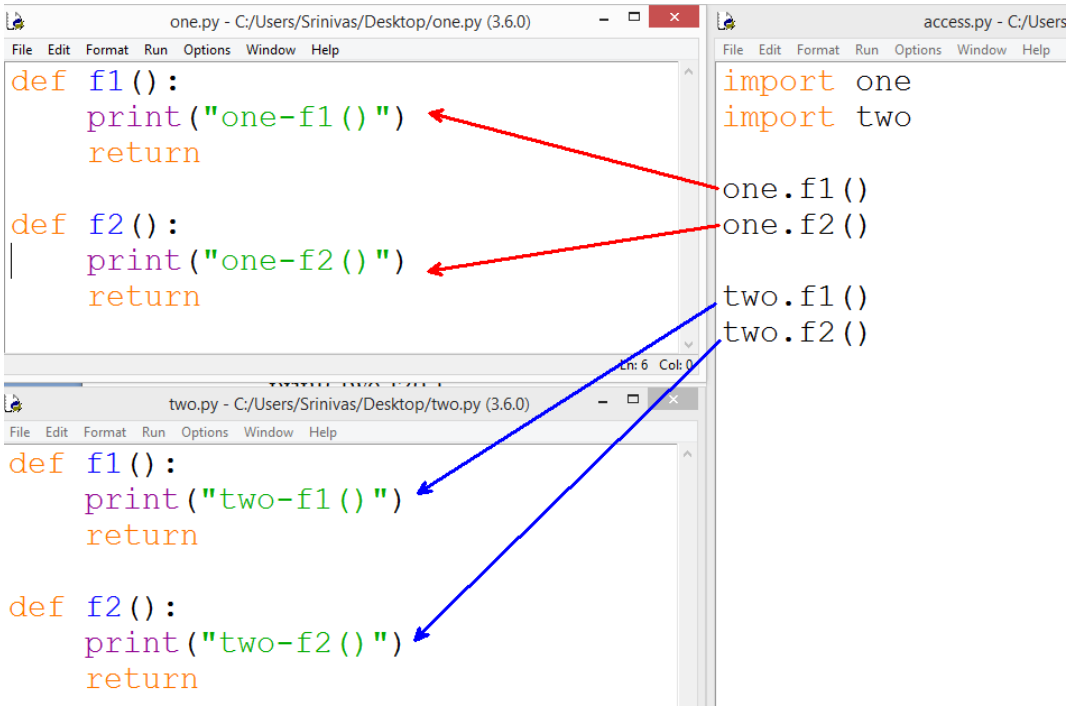
```
def f1():
    print("one-f1()")
    return

def f2():
    print("one-f2()")
    return
```

two.py:

```
def f1():
    print("two-f1()")
    return

def f2():
    print("two-f2()")
    return
```

access.py:

```
import one
import two

one.f1()
one.f2()

two.f1()
two.f2()
```



Class Based modules:

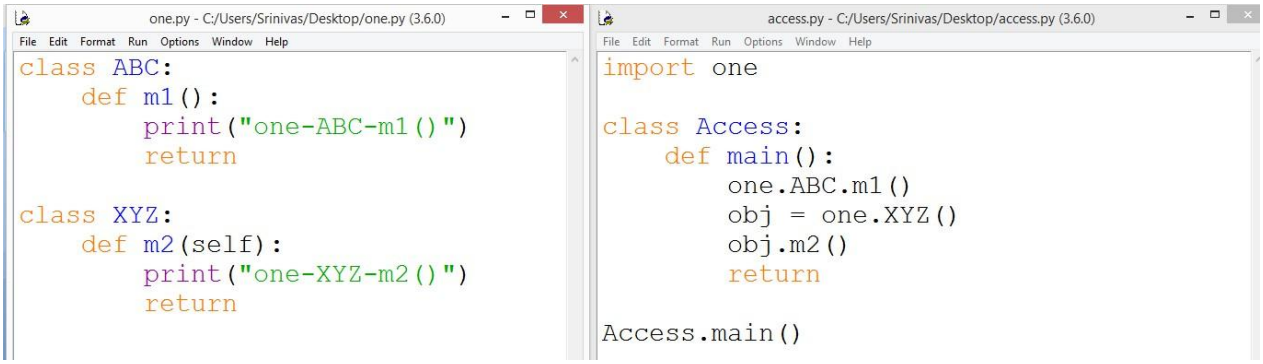
- A module is a collection of classes.
- A class is a collection of variables and methods
- To access the class members we need to import the module.

one.py:

```
class ABC:
    def m1():
        print("one-ABC-m1()")
        return

class XYZ:
    def m2(self):
        print("one-XYZ-m2()")
        return
```

access.py:

```
import one
class Access:
    def main():
        one.ABC.m1()
        obj = one.XYZ()
        obj.m2()
        return

Access.main()
```



from:

- "from is a keyword used to access one or more classes from the specified module.
- Note that, no need to specify the module name along with class name if we import using "from"

Syntax:

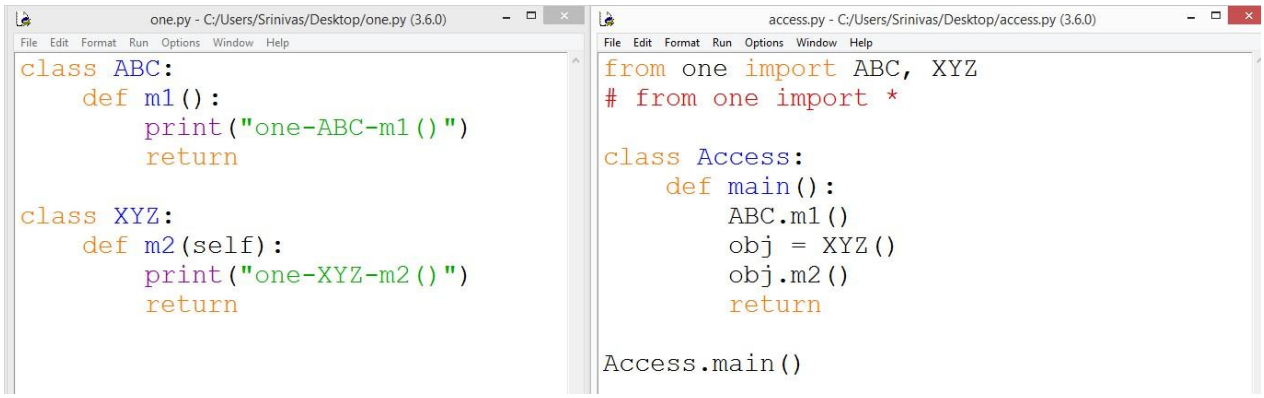
from module import class

Or

from module import *

Or

from module import class1, class2, class3



Accessing duplicate classes from different modules:

One.py:

```
class ABC:
    def m1():
        print("one-ABC-m1()")
        return

class XYZ:
    def m2():
        print("one-XYZ-m2()")
        return
```

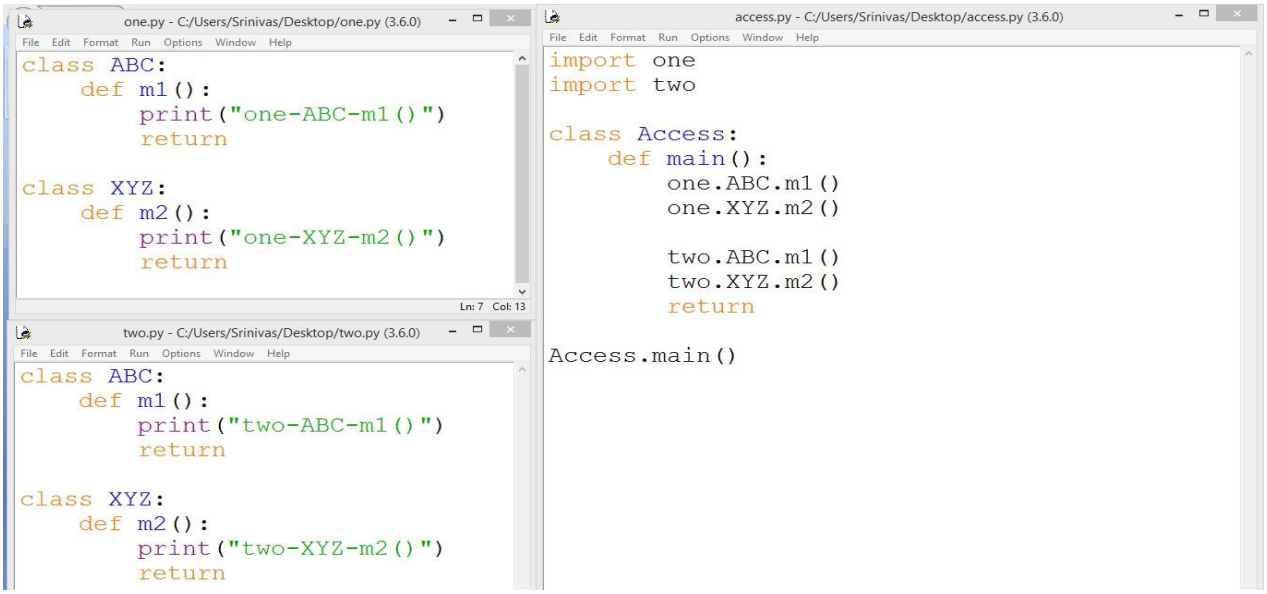
two.py:

```
class ABC:
    def m1():
        print("two-ABC-m1()")
        return

class XYZ:
    def m2():
        print("two-XYZ-m2()")
        return
```

access.py:

```
import one
import two

class Access:
    def main():
        one.ABC.m1()
        one.XYZ.m2()
```

```
        two.ABC.m1()
        two.XYZ.m2()
        return

Access.main()
```



- When we import classes using 'from' keyword, we cannot work with duplicate classes from different modules.
- Duplicate class replace the existing class as follows