

# **LAB-EXPERIMENTS**

**Experiments submitted in partial fulfillment of  
the requirements for the award of**

**(Semester-1)  
Master of Technology  
IN  
ARTIFICIAL INTELLIGENCE**

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## **EXPERIMENT 1**

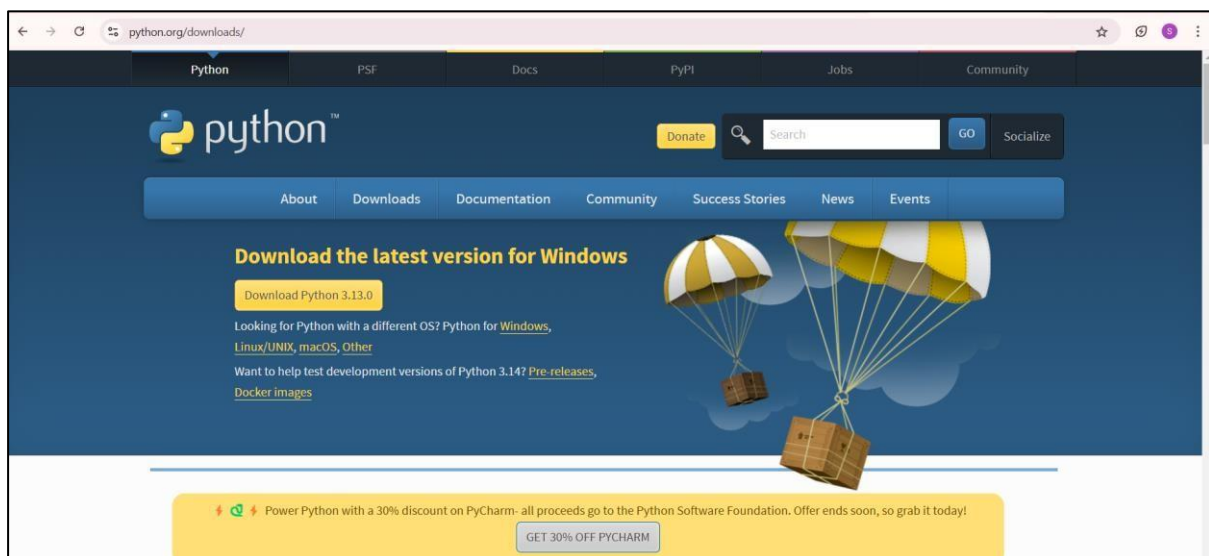
**OBJECTIVE:** Install Python and write basic programs to explore its syntax and functionality.

### **THEORY:**

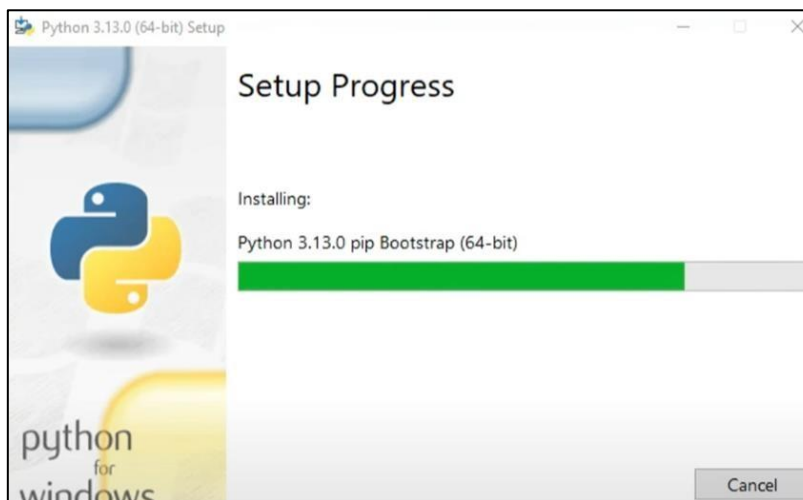
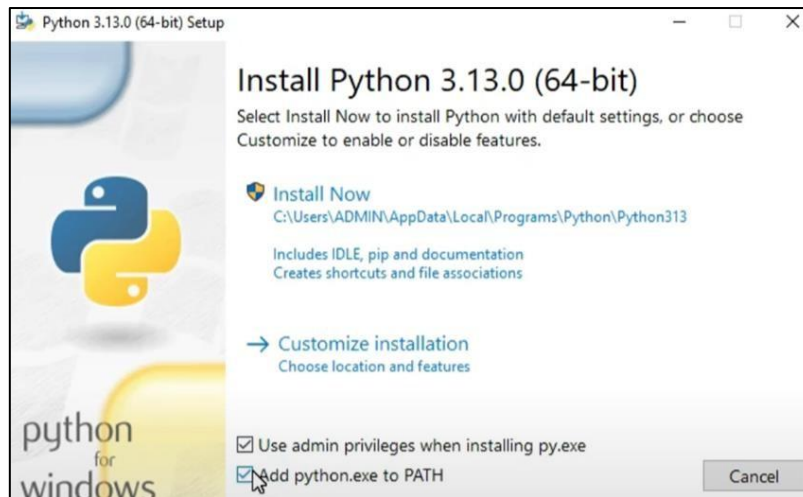
Python is a high-level, interpreted programming language created by Guido van Rossum in 1991. Known for its simplicity and readability, Python uses indentation for defining code blocks, making it beginner-friendly. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. Python is dynamically typed and has an extensive standard library that simplifies complex tasks like file handling, data manipulation, and web development. Its versatility makes it widely used in various fields such as web development, data science, artificial intelligence, automation, and game development. Python's large community and open-source nature further enhance its adaptability and resource availability.

### **INSTALLATION STEPS:**

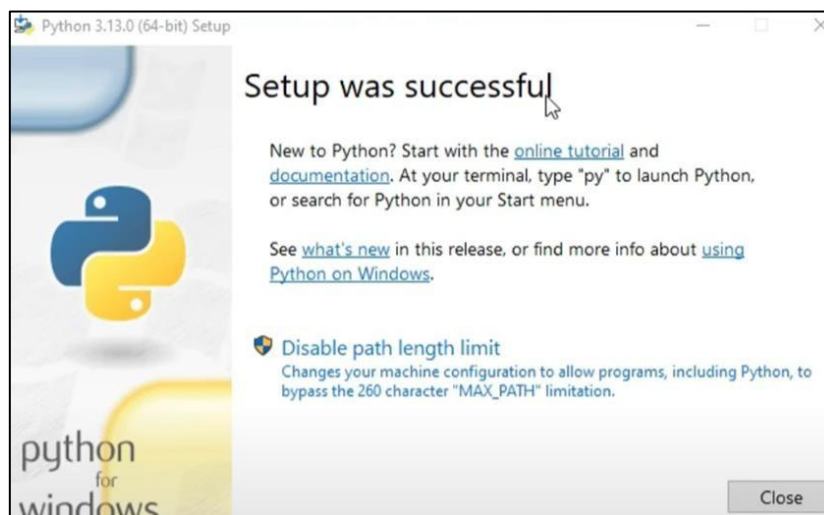
1. Download Python:
  - a. Visit the official Python website.
  - b. Go to the Downloads section and select the appropriate installer for your operating system (Windows, macOS, or Linux).



2. Install Python:
  - a. Run the downloaded installer.
  - b. During installation, check the box Add Python to PATH. This ensures you can use Python from the command line.



- c. Click on Customize Installation if needed, but the default settings work for most users.
3. Verify Installation:



- a. Open a terminal or command prompt and type:
  - i. `python --version`

```
C:\Users\ADMIN>python --version
Python 3.13.0
```

### **CODE:**

# Simple Program to perform arithmetic operations on two numbers

```
a = 7
```

```
b = 2
```

```
print("sum: ", a+b)
```

```
print("diff: ", a-b)
```

```
print("mult: ", a*b)
```

```
print("div: ", a/b)
```

```
print("mod: ", a%b)
```

```
print("floor: ", a//b)
```

```
print("power: ", a**b)
```

### **RESULTS:**

```
[8]: # Arithmetic operators in python

a = 7
b = 2

print("sum: ", a+b)
print("diff: ", a-b)
print("mult: ", a*b)
print("div: ", a/b)
print("mod: ", a%b)
print("floor: ", a//b)
print("power: ", a**b)

sum:  9
diff:  5
mult:  14
div:  3.5
mod:  1
floor:  3
power:  49
```

## **EXPERIMENT 2**

**OBJECTIVE:** Demonstrate python operators and develop code for given problem statements:

- 1) Datatype Conversion:
  - a. convert char to int, and find octal, hex value of given value
  - b. convert string to tuple, set and list
- 2) Types of operators:
  - a. perform arithmetic operations on 2 numbers
  - b. demonstrate use of comparison, logical, identity, membership operators

### **THEORY:**

Operators are used to perform operations on variables and values. Python divides the operators in the following groups:

- Arithmetic operators - Arithmetic operators are used with numeric values to perform common mathematical operations
- Assignment operators - Assignment operators are used to assign values to variables
- Comparison operators - Comparison operators are used to compare two values
- Logical operators - Logical operators are used to combine conditional statements
- Identity operators - Identity operators are used to compare the objects, not if they are equal, but if they are actually the same object, with the same memory location
- Membership operators - Membership operators are used to test if a sequence is presented in an object
- Bitwise operators - Bitwise operators are used to compare (binary) numbers

### **CODE:**

1. Convert char to int, and find octal, hex value of given value

```
# Convert char to int
```

```
a = '4'
```

```
b = ord(a)
```

```
print(b)
```

```
print(type(b))
```

```
# Find hex value of given int
```

```
b = hex(56)
```

```
print(b)
```

```
print(type(b))
```

```
# Convert int to octal
```

```
b = oct(56)
```

```
print(b)
```

```
print(type(b))
```

2. Convert string to tuple, set and list

```
x = 'javaTpoint'
y=tuple(x)
print("after converting the string to a tuple: ", end="")
print(y)
```

```
y = set(x)
print("after converting the string to a set: ", end="")
print(y)
```

```
y = list(x)
print("after converting the string to a list: ", end="")
print(y)
```

3. Perform arithmetic operations on 2 numbers

```
# Arithmetic operators in python
a = 7
b = 2
print("sum: ", a+b)
print("diff: ", a-b)
print("mult: ", a*b)
print("div: ", a/b)
print("mod: ", a%b)
print("floor: ", a//b)
print("power: ", a**b)
```

4. Demonstrate use of comparison, logical, identity, membership operators

```
# Comparison Operators
a=5
b=2
print(a==b)
print(a!=b)
print(a>b)
print(a<b)
print(a<=b)
print(a>=b)
```

```
# Logical Operators
a=5
b=6
print((a>2) and (b>=6))
print((a>2) or (b>=6))
```

```
# Identity operators
```



```

x1=5
y1=5
x2='Hello'
y2='Hello'
x3=[1,2,3]
y3=[1,2,3]
print(x1 is not y1)
print(x2 is y2)
print(x3 is y3)

```

## **RESULTS:**

1.

```

[1]: a = '4'
      b = ord(a)
      print(b)
      print(type(b))

52
<class 'int'>

[2]: b = hex(56)
      print(b)
      print(type(b))

0x38
<class 'str'>

[3]: b = oct(56)
      print(b)
      print(type(b))

0o70
<class 'str'>

```

2.

```

[6]: x = 'javaTpoint'
      y=tuple(x)
      print("after converting the string to a tuple: ", end="")
      print(y)

      y = set(x)
      print("after converting the string to a set: ", end="")
      print(y)

      y = list(x)
      print("after converting the string to a list: ", end="")
      print(y)

after converting the string to a tuple: ('j', 'a', 'v', 'a', 'T', 'p', 'o', 'i', 'n', 't')
after converting the string to a set: {'a', 'T', 'n', 'i', 't', 'o', 'p', 'j', 'v'}
after converting the string to a list: ['j', 'a', 'v', 'a', 'T', 'p', 'o', 'i', 'n', 't']

```

3.

```
[8]: # Arithmetic operators in python

a = 7
b = 2

print("sum: ", a+b)
print("diff: ", a-b)
print("mult: ", a*b)
print("div: ", a/b)
print("mod: ", a%b)
print("floor: ", a//b)
print("power: ", a**b)

sum: 9
diff: 5
mult: 14
div: 3.5
mod: 1
floor: 3
power: 49
```

4.

```
[19]: # Comparison Operators

a=5
b=2

print(a==b)
print(a!=b)
print(a>b)
print(a<b)
print(a<=b)
print(a>=b)

False
True
True
False
False
True

[22]: # Logical Operators

a=5
b=6
print((a>2) and (b>=6))
print((a>2) or (b>=6))

True
True

[26]: # Identity operators
x1=5
y1=5
x2='Hello'
y2='Hello'
x3=[1,2,3]
y3=[1,2,3]

print(x1 is not y1)
print(x2 is y2)
print(x3 is y3)

False
True
False
```

### **EXPERIMENT 3**

**OBJECTIVE:** Demonstrate conditional and loop statements and develop code for given problem statements:

1. Conditional Statements –
  - 1) WAP to take input from a user and then check whether it is a number or a character. If it is a char, determine whether it is Upper case or lower case
  - 2) WAP that displays the user to enter a number between 1 to 7 and then displays the corresponding day of the week

2. Looping -

- 1) Demonstrate nested looping
    - i. Nested loop to print given pattern

```
*  
  
* *  
  
* * *  
  
* * * *
```

- 2) Demonstrate while loop inside for loop
  - 3) WAP to print the pattern

```
1  
2 2  
3 3 3  
4 4 4 4  
5 5 5 5 5
```

- 4) WAP using for loop to calculate factorial of a number
  - 5) WAP that displays all leap years from 1900 to 2101
  - 6) WAP to sum the series numbers -  $1 + 1/2 + \dots + 1/n$  using for loop

### **THEORY:**

Conditional statements are used to execute a block of code based on a condition. They enable decision-making in a program. The primary conditional statements in Python include:

1. if statement: Executes a block of code if the condition is true.
2. if-else statement: Executes one block if the condition is true and another if it is false.
3. if-elif-else statement: Allows multiple conditions to be checked sequentially.

Loop statements allow repetitive execution of a block of code as long as a condition is satisfied. Python supports two main types of loops:

1. for loop: Iterates over a sequence (like a list, tuple, or string) or a range.

2. while loop: Repeats execution as long as the condition remains true.

Control Statements in Loops - Python provides additional control statements to modify loop behaviour:

- break: Exits the loop prematurely.
- continue: Skips the current iteration and continues with the next.
- pass: Acts as a placeholder and does nothing.

These statements make Python programs more dynamic and adaptable to complex logic.

### **CODE:**

```
# WAP to take input from a user and then check whether it is a number or a character.
# If it is a char, determine whether it is Upper case or lower case
```

```
inp = input("Enter the input: ")
''' USING IN-BUILT LIBRARIES '''
print()
print("*** USING IN-BUILT LIBRARIES ***")
if (inp.isalpha()):
    print("It's a Char")
    if inp.isupper():
        print("and in upper case")
    elif inp.islower():
        print("and in lower case")
    else:
        print("and has both cases")
elif(inp.isnumeric()):
    print("It's a number")
else:
    print("Invalid Input")
```

```
''' ALTERNATE APPROACH '''
print()
print("*** USING CODE ***")
l1 = [0,0,0] #It will have 3 elements. First is No. of upper case char, second is no. of lower case
chars, third is no. of integers
len1 = len(inp)
flag = 0
for i in inp:
    in_ascii = ord(i)
    if in_ascii in range(65,91) or in_ascii in range(97, 123):
```

```

    flag = 1
    if in_ascii in range(65,91):
        l1[0] +=1
    else:
        l1[1] +=1
    elif in_ascii in range(48, 58):
        flag = 2
        l1[2] +=1
if flag == 1:
    if l1[0] == len1:
        print("It's a Char")
        print("and in upper case")
    elif l1[1] == len1:
        print("It's a Char")
        print("and in lower case")
    elif l1[0]+l1[1] == len1:
        print("It's a Char")
        print("and has both cases")
    else:
        print("Invalid Input")
elif flag == 2:
    if l1[2] == len1:
        print("It's a number")
    else:
        print("Invalid Input")
else:
    print("Invalid Input")

```

# WAP that displays the user to enter a number between 1 to 7 and then displays the corr day of the week

```

print("*** Program that displays the user to enter a number between 1 to 7 and then displays the corr day of the week ***")

```

```

num = int(input("Enter the number: "))

```

```

if num >= 1 and num <= 7:

```

```

    if num == 1:

```

```

        print ("Monday")

```

```

    if num == 2:

```

```

        print ("Tuesday")

```

```

    if num == 3:

```

```

        print ("Wednesday")

```

```

    if num == 4:

```

```

        print ("Thursday")

```

```

    if num == 5:

```

```

        print ("Friday")

```

```

    if num == 6:

```

```

    print ("Saturday")
if num == 7:
    print ("Sunday")
else:
    print("Incorrect number")

```

```

# Nested loop to print pattern
for i in range(1,6):
    for j in range(1, i+1):
        print("*", end = " ")
    print()

```

```

# While loop inside for loop
names = ["Kelly", "Jessa", "Emma"]
for name in names:
    count = 0
    while(count<5):
        print(name, end=' ')
        count+=1
    print()

```

```

# WAP to print the pattern
for i in range(1, 6):
    for k in range(1, 6-i):
        print(" ", end=" ")
    for j in range(1,i+1):
        print(i, " ", end=" ")

    print()

```

```

# Alternate approach
n=5
for i in range(1, n+1):
    for k in range(n, i, -1):
        print(" ", end=" ")
    for j in range(1,i+1):
        print(i, " ", end=" ")
    print()

```

```

# Calculating factorial
fact = 1
for i in range(2,n+1):
    fact *= i

```

```
print("Factorial is: ", fact)
```

```
# WAP that displays all leap years from 1900 to 2101
```

```
year = int(input("Enter the year (1900-2101) to check whether leap year: "))
```

```
if year%100 == 0:
```

```
    if year%400 == 0:
```

```
        print("Leap year")
```

```
    else:
```

```
        print("Not leap year")
```

```
else:
```

```
    if year%4 == 0:
```

```
        print("Leap year")
```

```
    else:
```

```
        print("Not leap year")
```

```
# WAP to sum the series numbers -  $1 + 1/2 + \dots + 1/n$  using for loop
```

```
n = int(input("Enter the number: "))
```

```
s = 0
```

```
for i in range(1, n+1):
```

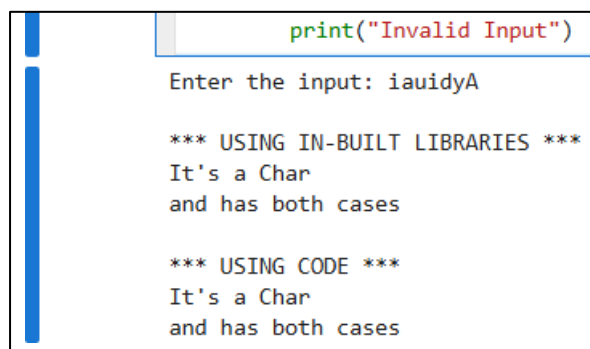
```
    s += (1/i)
```

```
print("Sum of series is: ", s)
```

## **RESULTS:**

### 1. Conditional Statements –

a.



```
print("Invalid Input")
Enter the input: iauidyA

*** USING IN-BUILT LIBRARIES ***
It's a Char
and has both cases

*** USING CODE ***
It's a Char
and has both cases
```

b.

```
[14]: # WAP that displays the user to enter a number between 1 to 7 and then displays the corr day of the week

print("*** Program that displays the user to enter a number between 1 to 7 and then displays the corr day of the week ***")

num = int(input("Enter the number: "))

if num >= 1 and num <= 7:
    if num == 1:
        print("Monday")
    if num == 2:
        print("Tuesday")
    if num == 3:
        print("Wednesday")
    if num == 4:
        print("Thursday")
    if num == 5:
        print("Friday")
    if num == 6:
        print("Saturday")
    if num == 7:
        print("Sunday")
else:
    print("Incorrect number")

*** Program that displays the user to enter a number between 1 to 7 and then displays the corr day of the week ***
Enter the number: 4
Thursday
```

## 2. Looping –

a.

```
•[1]: # Nested Loop to print pattern

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

*
* *
* * *
* * * *
* * * * *
```

b.

```
[4]: # While loop inside for loop

names = ["Kelly", "Jessa", "Emma"]

for name in names:
    count = 0
    while(count<5):
        print(name, end=' ')
        count+=1
    print()

Kelly Kelly Kelly Kelly Kelly
Jessa Jessa Jessa Jessa Jessa
Emma Emma Emma Emma Emma
```



c.

```
[28]: # WAP to print the pattern

v for i in range(1, 6):
v     for k in range(1, 6-i):
v         print(" ", end=" ")
v     for j in range(1,i+1):
v         print(i, " ", end=" ")

        print()

# Alternate approach
n=5
v for i in range(1, n+1):
v     for k in range(n, i, -1):
v         print(" ", end=" ")
v     for j in range(1,i+1):
v         print(i, " ", end=" ")
        print()
```

```

      1
    2 2
  3 3 3
4 4 4 4
5 5 5 5 5

      1
    2 2
  3 3 3
4 4 4 4
5 5 5 5 5
```

d.

```
# Calculating factorial
fact = 1
v for i in range(2,n+1):
    fact *= i
print("Factorial is: ", fact)
```

```
Enter the number to check whether prime or composite: 4
Number is composite
Factorial is: 24
```

e.

```
[22]: # WAP that displays all leap years from 1900 to 2101

year = int(input("Enter the year (1900-2101) to check whether
if year%100 == 0:
    if year%400 == 0:
        print("Leap year")
    else:
        print("Not leap year")
else:
    if year%4 == 0:
        print("Leap year")
    else:
        print("Not leap year")

Enter the year (1900-2101) to check whether leap year: 2004
Leap year
```

f.

```
[24]: # WAP to sum the series numbers - 1 + 1/2 + ... + 1/n using for loop

n = int(input("Enter the number: "))
s = 0
for i in range(1, n+1):
    s += (1/i)
print("Sum of series is: ", s)

Enter the number: 3
Sum of series is:  1.8333333333333333
```

## **EXPERIMENT 4**

**OBJECTIVE:** Demonstrate list operations and develop code for given problem statements:

1. Demonstrate list slicing and list cloning
2. Demonstrate use of list methods- insert, append, extend, reverse, reversed, remove, pop
3. List comprehension
4. Looping in lists
5. WAP to print index of values in a list
6. Sum and average of elements in list

### **THEORY:**

A list is a versatile and mutable data structure in Python that stores an ordered collection of items. Items in a list can be of different data types, such as integers, strings, or even other lists. Lists are defined using square brackets and elements are separated by commas.

Operations on lists include:

1. Accessing Elements: Elements can be accessed using their index, starting from zero. Negative indexing allows access from the end of the list.
2. Modifying Elements: Lists are mutable, so elements can be updated by assigning a new value to a specific index.
3. Adding Elements: Elements can be added using methods like append (to add one element) and extend (to add multiple elements).
4. Removing Elements: Methods like remove, pop, and clear are used to delete elements or empty the list.
5. Slicing: Slicing is used to access a range of elements from the list.
6. Iterating: Loops can be used to iterate over the elements of a list.

### **CODE:**

```
# List slicing
```

```
list1 = ['physics', 'chem', 1997, 2000]
```

```
list2 = [1,2,3,4,5,6,7,8]
```

```
print(list2[1:5])
```

```
# List methods- insert, append, extend, reverse, reversed, remove, pop, slicing,
```

```
List = ['G', 'E', 'E', 'K', 'S', 'F', 'O', 'R', 'G', 'E', 'E', 'K', 'S']
```

```
print(List)
```

```

Sliced_list = List[:-6]
print("Sliced: ", Sliced_list)
l2 = List[-6:-1]
print(l2)
l3 = List[::-1]
print(l3)

```

```

# List Comprehension
# Syntax - [expression(element) for element in oddList if condition]
l1 = [x**2 for x in range(1,11) if x%2 == 1]
print(l1)

```

```

# List Comprehension
# Syntax - [expression(element) for element in oddList if condition]
l1 = [x**2 for x in range(1,11) if x%2 == 1]
print(l1)

```

```

# Looping in lists
ls = [1,'a',"abc",[2,3,4,5],8.9]
i = 0
while i < (len(ls)):
    print(ls[i])
    i+=1
# Program to print index of values in a list
l1 = [1,2,3,4,5]
for i in range(len(l1)):
    print("index: ", i)

```

```

# Sum and average of list items
l1 = [1,2,3,4,5,6,7,8,9,10]
s = 0
for i in l1:

```

```

s+=i
print("Sum = ", s)
print("Avg = ", s/len(l1))

```

## RESULTS:

1)

```

[32]: # List slicing

list1 = ['physics', 'chem', 1997, 2000]
list2 = [1,2,3,4,5,6,7,8]
print(list2[1:5])

[2, 3, 4, 5]

```

2)

```

[1]: # List methods- insert, append, extend, reverse, reversed, remove, pop, slicing,

List = ['G', 'E', 'E', 'K', 'S', 'F', 'O', 'R', 'G', 'E', 'E', 'K', 'S']
print(List)

Sliced_list = List[:-6]
print("Sliced: ", Sliced_list)

l2 = List[-6:-1]
print(l2)

l3 = List[::-1]
print(l3)

['G', 'E', 'E', 'K', 'S', 'F', 'O', 'R', 'G', 'E', 'E', 'K', 'S']
Sliced:  ['G', 'E', 'E', 'K', 'S', 'F', 'O']
['R', 'G', 'E', 'E', 'K']
['S', 'K', 'E', 'E', 'G', 'R', 'O', 'F', 'S', 'K', 'E', 'E', 'G']

```

3)

```

[1]: # List Comprehension
# Syntax - [expression(element) for element in oddList if condition]

l1 = [x**2 for x in range(1,11) if x%2 == 1]
print(l1)

[1, 9, 25, 49, 81]

```

4)

```

[3]: ls = [1, 'a', "abc", [2,3,4,5], 8.9]
i = 0
while i < (len(ls)):
    print(ls[i])
    i+=1

1
a
abc
[2, 3, 4, 5]
8.9

```

5)

```
[13]: # Program to print index of values in a list

l1 = [1,2,3,4,5]
v for i in range(len(l1)):
    print("index: ", i)

index: 0
index: 1
index: 2
index: 3
index: 4
```

6)

```
l1 = [1,2,3,4,5,6,7,8,9,10]
s = 0
v for i in l1:
    s+=i
print("Sum = ", s)
print("Avg = ", s/len(l1))

Sum = 55
Avg = 5.5
```

## **EXPERIMENT 5**

**OBJECTIVE:** Demonstrate arrays and tuples and develop code for given problem statements:

1. Operations in array - Create array in python, Demonstrate functions in arrays - insert(), append(), Slicing in array, updating elements in array
2. Create an empty tuple, create tuple using string, create tuple using list, and create a tuple with mixed datatypes
3. Write a program to demonstrate use of nested tuples. Also, WAP that has a nested list to store toppers details. Edit the details and reprint the details.
4. Creating a tuple using Loop
5. WAP to swap two values using tuple assignment
6. WAP using a function that returns the area and circumference of a circle whose radius is passed as an argument
7. WAP that scans an email address and forms a tuple of username and domain

### **THEORY:**

Arrays are collections of elements of the same data type stored in contiguous memory locations. They are more efficient for numerical computations and are particularly useful for handling large datasets when all elements share the same type. Arrays require importing the array module and are suitable for numerical operations.

Tuples are immutable collections of items that can hold elements of mixed data types. Once created, the elements of a tuple cannot be modified. Tuples are defined using parentheses and are often used to store fixed collections of data. Tuples support operations such as indexing, slicing, iteration, and unpacking. They are ideal for representing data that should remain constant.

### **CODE:**

```
# Creating array in python
import array as arr
a = arr.array('i', [1,2,3])
print(a)
for i in range(0,3):
    print(a[i], end=" ")

# Demonstrate the functions in arrays like insert(), append()
a = arr.array('i', [1,2,3])
print("Array of integers (Before): ", a)
a.insert(1,4)
print("Array of integers (After Inserting): ",a)
b = arr.array('d', [1,2,3])
print("Array of floats (Before): ", b)
b.append(4.4)
print("Array of floats (After appending): ", b)
```

```

# Slicing
import array as arr
l = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
a = arr.array('i', l)
print("Initial Array: ")
for i in (a):
    print(i, end = " ")
sliced_array = a[3:8]
print("\nSlicing elements in a range 3-8: ")
print(sliced_array)
sliced_array = a[5:]
print("\nElements sliced from 5th element till the end: ")
print(sliced_array)
sliced_array=a[:]
print("\nPrinting all elements using slice operation: ")
print(sliced_array)

```

```

# Array Updation
import array
arr = array.array('i', [1,2,3,1,2,5])
for i in range(0,6):
    print(arr[i], end = " ")
print("\nAfter updation")
arr[2]=6
for i in range(0,6):
    print(arr[i], end=" ")

```

```

# Create empty tuple:
tuple1 = ()
print(tuple1)

```

```

# Create tuple using string:
tuple1 = ('Hello', 'Sam')
print(tuple1)

```

```

# Create tuple using list:
list1 = ['Hello', 'Sam']
print(tuple(list1))

```

```

# Create a tuple using built-in function:
tuple1 = tuple('Sam')
print(tuple1)

```

```

# Creating a tuple with mixed datatypes
tuple1 = (5, 'aiojdio', 7, 'JFidsof')
print(tuple1)

```



```
# Nested tuples
```

```
t1 = (1,2,3)
t2 = ('a', 'b', 'c')
t3 = (t1, t2)
print(t3)
```

```
# Program to demonstrate use of nested tuples
```

```
Toppers = (("arav", 97, "B.Sc."), ("raghav", 87, "BCA"))
for i in Toppers:
    print(i)
```

```
# WAP that has a nested list to store toppers details. Edit the details and reprint the details.
```

```
# Eg - l1 = ["Arav", "MSC", 92]
```

```
l1 = [["Arav", "MSC", 92], ["Student2", "MBA", 99], ["Student3", "MTech", 94], ["Student4", "BSC", 95]]
```

```
print("The original list of toppers is: ", l1)
print("Enter the metadata you wish to edit: ")
print("\nChoose the name of the student you wish to edit the details for. Press")
for i in range(len(l1)):
    print(f'{i}. To edit the details of student {l1[i][0]}')
ch1 = int(input("Enter your choice: "))
```

```
print("Press\n1. To edit the name\n2. To edit the branch\n3. To edit the marks")
ch2 = int(input("Enter your choice (1/2/3): "))
```

```
if ch1 not in range(len(l1)):
    print("Wrong Student index chosen!")
else:
```

```
    if ch2 == 1:
        new_name = input("Enter the new name: ")
        l1[ch1][0] = new_name
    elif ch2 == 2:
        new_name = input("Enter the new branch: ")
        l1[ch1][1] = new_name
    elif ch2 == 3:
        new_name = input("Enter the new marks: ")
        l1[ch1][2] = new_name
    else:
        print("Wrong choice entered!")
```

```
print("New list is: ", l1)
```

```
# Creating a tuple using Loop
```

```
t1 = ('Sam')
```

```
n = 5
```

```
for i in range(int(n)):
```

```
    t1 = (t1,)
```

```
    print(t1)
```

```
# WAP to swap two values using tuple assignment
```

```
t1 = (2,3)
```

```
print("Tuple is: ", t1)
```

```
print("Before swap: ")
```

```
a, b = t1
```

```
print(f'Value of a is {a} and value of b is {b}')
```

```
print("After swap: ")
```

```
(a, b) = (b, a)
```

```
print(f'Value of a is {a} and value of b is {b}')
```

```
# WAP using a function that returns the area and circumference of a circle whose radius is  
passed as an argument
```

```
import math
```

```
def func1(r):
```

```
    area = math.pi * r * r
```

```
    circum = 2 * math.pi * r
```

```
    return (area, circum)
```

```
rad = int(input("Enter radius: "))
```

```
(ar, circum) = func1(rad)
```

```
print("Area is: ", ar)
```

```
print("Circumference is: ", circum)
```

```
# WAP that scans an email address and forms a tuple of username and domain
```

```
email = input("Enter the email address: ")
```

```
email = email.split("@")
```

```
email_tuple = tuple(email)
```

```
print(email_tuple)
```

## **RESULTS:**

1.

```
[48]: # Creating array in python

import array as arr
a = arr.array('i', [1,2,3])
print(a)
v for i in range(0,3):
    print(a[i], end=" ")

array('i', [1, 2, 3])
1 2 3
```

```
[5]: # Demonstrate the functions in arrays like insert(), append()
a = arr.array('i', [1,2,3])
print("Array of integers (Before): ", a)
a.insert(1,4)
print("Array of integers (After Inserting): ",a)

b = arr.array('d', [1,2,3])
print("Array of floats (Before): ", b)
b.append(4.4)
print("Array of floats (After appending): ", b)

Array of integers (Before): array('i', [1, 2, 3])
Array of integers (After Inserting): array('i', [1, 4, 2, 3])
Array of floats (Before): array('d', [1.0, 2.0, 3.0])
Array of floats (After appending): array('d', [1.0, 2.0, 3.0, 4.4])
```

```

import array as arr
l = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
a = arr.array('i', l)
print("Initial Array: ")
v for i in (a):
    print(i, end = " ")

sliced_array = a[3:8]
print("\nSlicing elements in a range 3-8: ")
print(sliced_array)
sliced_array = a[5:]
print("\nElements sliced from 5th element till the end: ")
print(sliced_array)
sliced_array=a[:]
print("\nPrinting all elements using slice operation: ")
print(sliced_array)

```

Initial Array:

1 2 3 4 5 6 7 8 9 10

Slicing elements in a range 3-8:

array('i', [4, 5, 6, 7, 8])

Elements sliced from 5th element till the end:

array('i', [6, 7, 8, 9, 10])

Printing all elements using slice operation:

array('i', [1, 2, 3, 4, 5, 6, 7, 8, 9, 10])

```

[12]: # Array Updation
import array

arr = array.array('i', [1,2,3,1,2,5])
v for i in range(0,6):
    print(arr[i], end = " ")

print("\nAfter updation")
arr[2]=6
v for i in range(0,6):
    print(arr[i], end=" ")

```

1 2 3 1 2 5

After updation

1 2 6 1 2 5

2.

```
[2]: # TUPLES

# Create empty tuple:
tuple1 = ()
print(tuple1)

# Create tuple using string:
tuple1 = ('Hello', 'Sam')
print(tuple1)

# Create tuple using list:
list1 = ['Hello', 'Sam']
print(tuple(list1))

# Create a tuple using built-in function:
tuple1 = tuple('Sam')
print(tuple1)

# Creating a tuple with mixed datatypes
tuple1 = (5, 'aiojdio', 7, 'JFidsof')
print(tuple1)

()
('Hello', 'Sam')
('Hello', 'Sam')
('S', 'a', 'm')
(5, 'aiojdio', 7, 'JFidsof')
```

3.

```
[22]: # Nested tuples

t1 = (1,2,3)
t2 = ('a', 'b', 'c')
t3 = (t1, t2)
print(t3)

((1, 2, 3), ('a', 'b', 'c'))
```

```
[39]: # Program to demonstrate use of nested tuples

Toppers = (("arav", 97, "B.Sc."), ("raghav", 87, "BCA"))
v for i in Toppers:
    print(i)

('arav', 97, 'B.Sc.')
('raghav', 87, 'BCA')
```

The original list of toppers is: [['Arav', 'MSC', 92], ['Student2', 'MBA', 99], ['Student3', 'MTech', 94], ['Student4', 'BSC', 95]]  
Enter the metadata you wish to edit:

Choose the name of the student you wish to edit the details for. Press

- 0. To edit the details of student Arav
- 1. To edit the details of student Student2
- 2. To edit the details of student Student3
- 3. To edit the details of student Student4

Enter your choice: 0

Press

- 1. To edit the name
- 2. To edit the branch
- 3. To edit the marks

Enter your choice (1/2/3): 1

Enter the new name: student1

New list is: [['student1', 'MSC', 92], ['Student2', 'MBA', 99], ['Student3', 'MTech', 94], ['Student4', 'BSC', 95]]

4.

```
[25]: # Creating a tuple using Loop
t1 = ('Sam')
n = 5
v for i in range(int(n)):
    t1 = (t1,)
    print(t1)

('Sam',)
(('Sam',),)
((( 'Sam',),),)
(((( 'Sam',),),),)
((((('Sam',),),),),)
((((('Sam',),),),),),)
```

5.

```
[12]: # WAP to swap two values using tuple assignment

t1 = (2,3)
print("Tuple is: ", t1)
print("Before swap: ")
a, b = t1
print(f'Value of a is {a} and value of b is {b}')

print("After swap: ")
(a, b) = (b, a)
print(f'Value of a is {a} and value of b is {b}')
```

Tuple is: (2, 3)  
 Before swap:  
 Value of a is 2 and value of b is 3  
 After swap:  
 Value of a is 3 and value of b is 2

6.

```
[5]: # WAP using a function that returns the area and circumference of a circle whose radius is passed as an argument

import math
def func1(r):
    area = math.pi * r * r
    circum = 2 * math.pi * r
    return (area, circum)

rad = int(input("Enter radius: "))
(ar, circum) = func1(rad)
print("Area is: ", ar)
print("Circumference is: ", circum)

Enter radius: 7
Area is: 153.93804002589985
Circumference is: 43.982297150257104
```

7.

```
[21]: # WAP that scans an email address and forms a tuple of username and domain

email = input("Enter the email address: ")
email = email.split("@")
email_tuple = tuple(email)
print(email_tuple)

Enter the email address: ieu@iosdf
('ieu', 'iosdf')
```

## **EXPERIMENT 6**

**OBJECTIVE:** Demonstrate functions and modules and develop code for given problem statements:

1. Create a function to return the square of the number
2. Demonstrate Pass by Reference and Pass by value
3. WAP that subtracts two numbers using a function
4. WAP using functions and return statements to check whether a number is even or odd
5. WAP to calculate simple interest. Suppose the customer is a Senior citizen and is being offered 12% ROI. For all other customers, ROI is 10%.
6. Program to find certain power of a number using recursion

### **THEORY:**

Functions in Python are reusable blocks of code designed to perform a specific task. They help organize and modularize programs, making them more readable and easier to debug. Functions can take inputs (parameters) and return outputs using the return statement. Python supports built-in functions as well as user-defined functions created using the def keyword.

Modules are files containing Python code, such as functions, classes, or variables, that can be reused in other programs. They enable code reusability and better organization by grouping related functionality together. Python provides standard modules, such as math and os, and also allows creating custom modules. Modules are imported into a program using the import statement.

### **CODE:**

```
# Defining the function
def square(num):
    # Returns the square of the number
    return num**2

obj = square(6)
print(obj)

# Pass by Reference and Pass by value

def square(item_list):
    # Returns the square of the number
    squares = []
    for i in item_list:
        squares.append(i**2)
    return squares

# Pass by reference
```



```
num = [1,2,3,4,5]
obj = square(num)
print(obj)
```

```
# Pass by value
obj = square([1,2,3,4,5])
print(obj)
```

```
# WAP that subtracts two numbers using a function
def func(a,b):
    return a - b
a = int(input("Enter num1: "))
b = int(input("Enter num1: "))
print("num1 - num2 = ", func(a,b))
```

```
# WAP using functions and return statements to check whether a number is even or odd
def func(a):
    if (a%2 == 0):
        return "Even"
    else:
        return "Odd"
a = int(input("Enter num1: "))
print("Number is", func(a))
```

```
# WAP to calculate simple interest.
# Suppose the customer is a Senior citizen and is being offered 12% ROI. For all other
customers, ROI is 10%.
age = int(input("Enter age of person: "))
principal = float(input("Enter principal amount: "))
time = int(input("Enter time in years: "))
if age>=60:
    r=12
else:
    r=10
si = principal*r*time/100
print("Simple Interest is: ", si)
```

```
# Program to find certain power of a number using recursion
def func1(n,i):
    if i == 0:
        return 1
    else:
        return n*func1(n,i-1)
func1(2,6)
```

## **RESULTS:**

1.

```
[16]: # User defined function

# Defining the function
v def square(num):
    # Returns the square of the number
    return num**2

obj = square(6)
print(obj)

36
```

2.

```
[19]: # Pass by Reference and Pass by value

v def square(item_list):
    # Returns the square of the number
    squares = []
    v for i in item_list:
        squares.append(i**2)
    return squares

# Pass by reference
num = [1,2,3,4,5]
obj = square(num)
print(obj)

# Pass by value
obj = square([1,2,3,4,5])
print(obj)

[1, 4, 9, 16, 25]
[1, 4, 9, 16, 25]
```

3.

```
[47]: # WAP that subtracts two numbers using a function

v def func(a,b):
    return a - b

a = int(input("Enter num1: "))
b = int(input("Enter num1: "))
print("num1 - num2 = ", func(a,b))

Enter num1: 5
Enter num1: 2
num1 - num2 = 3
```

4.

```
[51]: # WAP using functions and return statements to check whether a number is even or odd

def func(a):
    if (a%2 == 0):
        return "Even"
    else:
        return "Odd"

a = int(input("Enter num1: "))
print("Number is", func(a))

Enter num1: 3
Number is Odd
```

5.

```
[62]: # WAP to calculate simple interest.
# Suppose the customer is a Senior citizen and is being offered 12% ROI. For all other customers, ROI is 10%.

age = int(input("Enter age of person: "))
principal = float(input("Enter principal amount: "))
time = int(input("Enter time in years: "))

if age >= 60:
    r = 12
else:
    r = 10
si = principal * r * time / 100
print("Simple Interest is: ", si)

Enter age of person: 66
Enter principal amount: 10000
Enter time in years: 1
Simple Interest is: 1200.0
```

6.

```
[20]: # Program to find certain power of a number using recursion

def func1(n,i):
    if i == 0:
        return 1
    else:
        return n*func1(n,i-1)

func1(2,6)

[20]: 64
```

## **EXPERIMENT 7**

**OBJECTIVE:** Demonstrate Set operations and develop code for given problem statements:

1. Set Operations - Create set, Add items in set, Add items from another set into this set, Add elements of a list to the set, Remove item, Remove item using discard()
2. WAP that creates 2 sets squares and cubes in range 1 to 10. Demonstrate the use of update, pop, remove and clear function
3. WAP that creates two sets one of even numbers in the range 1 to 10 and the other as all composite numbers in range 1 to 20. Demonstrate the use of all(), issuperset(), len() and sum() on the sets.

### **THEORY:**

A set is an unordered and unindexed collection of unique elements in Python. Sets are defined using curly braces or the set() function. They are mutable but do not allow duplicate values. Sets are primarily used for operations involving uniqueness and membership testing.

Set operations include:

1. Union: Combines elements from two sets, removing duplicates.
2. Intersection: Identifies common elements between two sets.
3. Difference: Retrieves elements present in one set but not in another.
4. Symmetric Difference: Finds elements that are in either of the sets but not in both.
5. Subset and Superset: Checks if one set is a subset or superset of another.
6. Adding and Removing Elements: Elements can be added or removed using methods like add and remove.

Sets are efficient for mathematical operations and membership tests due to their underlying hash table implementation.

### **CODE:**

# SETS

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

```
# Add items in set  
thisset.add("orange")  
print(thisset)
```

```
# Add items from another set into this set
```

```
tropical = {"mango", "papaya"}
thisset.update(tropical)
print(thisset)
```

```
# Add elements of a list to the set
l1 = ["mango2", "papaya2"]
thisset.update(l1)
print(thisset)
```

```
# Remove item
thisset.remove("mango2")
print(thisset)
```

```
# Remove item using discard()
thisset.discard("banana")
print(thisset)
```

```
# WAP that creates 2 sets squares and cubes in range 1 to 10. Demonstrate the use of update,
pop, remove and clear function
```

```
set1 = set()
set2 = set()
for i in range(1, 11):
    set1.add(i*i)
    set2.add(i*i*i)
print("Set1 after adding squares: ", set1)
print("Set2 after adding cubes: ", set2)
```

```
print("\nDemonstrating the use of update function: ")
set3 = {"mango"}
set1.update(set3)
print("Set1 after update: ", set1)
```

```
print("\nDemonstrating the use of pop function: ")
print(set1.pop())
```

```
print("\nDemonstrating the use of remove function: ")
set1.remove("mango")
print(set1)
```

```
print("\nDemonstrating the use of clear function: ")
set1.clear()
print(set1)
```

```
# WAP that creates two sets one of even numbers in the range 1 to 10 and the other as all
composite numbers in range 1 to 20
```

# Demonstrate the use of all(), issuperset(), len() and sum() on the sets.

```
set1 = {i for i in range(1, 11) if i % 2 == 0 }  
print("Set of even numbers: ",set1)
```

```
set2 = set()
```

```
c = 0  
for i in range(2, 21):  
    for j in range(2, i):  
        if i%j ==0:  
            c+=1  
    if c!=0:  
        set2.add(i)  
    c = 0  
print("Set of composite numbers: ", set2)
```

```
# all() function returns True if all elements are True, else returns False  
print("\nDemonstrating use of all() function: ")  
print(all(set1))
```

```
set1.remove(2)  
print("\nRemoving '2' from set1: ", set1)
```

```
print("\nDemonstrating use of issuperset() function: ")  
print(set2.issuperset(set1))
```

```
print("\nDemonstrating use of len() function: ")  
print(len(set2))
```

```
print("\nDemonstrating use of sum() function: ")  
print("Sum of elements of set1: ", sum(set1))
```

## **RESULTS:**

1.

```
[40]: # SETS

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

print("banana" in thisset)

<class 'set'>
True

[41]: # Add items in set
thisset.add("orange")
print(thisset)

{'orange', 'apple', 'banana', 'cherry'}

[42]: # Add items from another set into this set
tropical = {"mango", "papaya"}
thisset.update(tropical)
print(thisset)

# Check why this is the order after concatenation
{'apple', 'banana', 'mango', 'orange', 'papaya', 'cherry'}

[43]: # Add elements of a list to the set
l1 = ["mango2", "papaya2"]
thisset.update(l1)
print(thisset)

{'apple', 'banana', 'mango', 'papaya2', 'orange', 'papaya', 'mango2', 'cherry'}

[44]: # Remove item

thisset.remove("mango2")
print(thisset)

{'apple', 'banana', 'mango', 'papaya2', 'orange', 'papaya', 'cherry'}

[45]: # Remove item using discard() --- It will not raise an error if item does not exist in the set.

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

{'apple', 'mango', 'papaya2', 'orange', 'papaya', 'cherry'}
```

2.

```
set1 = set()
set2 = set()
v for i in range(1, 11):
    set1.add(i*i)
    set2.add(i*i*i)
print("Set1 after adding squares: ", set1)
print("Set2 after adding cubes: ", set2)

print("\nDemonstrating the use of update function: ")
set3 = {"mango"}
set1.update(set3)
print("Set1 after update: ", set1)

print("\nDemonstrating the use of pop function: ")
print(set1.pop())

print("\nDemonstrating the use of remove function: ")
set1.remove("mango")
print(set1)

print("\nDemonstrating the use of clear function: ")
set1.clear()
print(set1)
```

Set1 after adding squares: {64, 1, 4, 36, 100, 9, 16, 49, 81, 25}  
Set2 after adding cubes: {64, 1, 512, 8, 1000, 343, 216, 729, 27, 125}

Demonstrating the use of update function:  
Set1 after update: {64, 1, 4, 36, 100, 'mango', 9, 16, 49, 81, 25}

Demonstrating the use of pop function:  
64

Demonstrating the use of remove function:  
{1, 4, 36, 100, 9, 16, 49, 81, 25}

Demonstrating the use of clear function:  
set()

3.

```
Set of even numbers: {2, 4, 6, 8, 10}
Set of composite numbers: {4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20}

Demonstrating use of all() function:
True

Removing '2' from set1: {4, 6, 8, 10}

Demonstrating use of issuperset() function:
True

Demonstrating use of len() function:
11

Demonstrating use of sum() function:
Sum of elements of set1: 28
```



## **EXPERIMENT 8**

**OBJECTIVE:** Demonstrate dictionary operations and develop code for given problem statements:

1. Dictionary Operations –
  - a. Accessing values in a Dictionary, Updating a dict, adding new values, Delete particular entries, Clear whole dict, Delete whole dict
  - b. Dictionary methods – len(), copy(), dictionary to string, Fromkeys(), get(), items(), setdefault(), Update(), values()
2. WAP to merge two dictionaries with a third one
3. Iterating through a dictionary
4. WAP to Sort dictionary by values

### **THEORY:**

A dictionary is a mutable, unordered collection of key-value pairs in Python. Keys in a dictionary must be unique and immutable, while values can be of any data type and can repeat. Dictionaries are defined using curly braces with key-value pairs separated by colons.

Operations on dictionaries include:

1. Accessing Values: Values can be retrieved using their corresponding keys.
2. Adding or Updating Entries: New key-value pairs can be added, and existing ones can be updated by assigning a new value to a key.
3. Removing Entries: Entries can be removed using methods like pop, popitem, or clear.
4. Checking Keys: The in operator is used to check if a specific key exists in a dictionary.
5. Iterating: Loops can iterate through keys, values, or key-value pairs.
6. Methods: Built-in methods like keys, values, and items provide views of dictionary contents.

Dictionaries are efficient for storing and retrieving data based on unique keys and are widely used in applications involving mappings or lookups.

### **CODE:**

```
# Accessing values in a Dictionary
dict1 = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}
print(dict1['Name'])
print(dict1['Age'])

# Updating a dict
dict1['Age'] = 8
print(dict1)
```

```

# Add a new entry
dict1['School'] = 'DPS'
print(dict1)

# Delete entries
del dict1['Name']
print(dict1)

# Clear whole dict
dict1.clear()
print(dict1)

# Delete whole dict
del dict1
print(dict1)

# WAP to merge two dictionaries with a third one
a = {'Name': 'Zara', 'Age': 10}
b = {'Gender': 'Female'}
c = {'Senior_Citizen': 'No'}
c.update(b)
c.update(a)
print(c)

# Iterating through a dictionary
dict1 = {"a": "time", "b": "money", "c": "value"}
for key, values in dict1.items():
    print(key, " ", values)
print()
for i in dict1.keys():
    print(i)
for i in dict1.values():
    print(i)

# Sort dictionary by values
dict1 = {"a": 23, "b": 91038, "c": 1, "d": 20, "e": 55}
# print(sorted(dict1, key = dict1.values))
print(dict1)
ls = sorted(dict1.values())
print(ls)
dict2 = {}
for i in ls:
    for j in dict1.keys():
        if dict1.get(j) == i:
            dict2[j] = i
print(dict2)

```

## RESULTS:

1.

```
[7]: # Accessing values in a Dictionary
dict1 = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}

print(dict1['Name'])
print(dict1['Age'])

Zara
7

[8]: # Updating a dict

dict1['Age'] = 8

print(dict1)

{'Name': 'Zara', 'Age': 8, 'Class': 'First'}

[9]: # Add a new entry

dict1['School'] = 'DPS'

print(dict1)

{'Name': 'Zara', 'Age': 8, 'Class': 'First', 'School': 'DPS'}

[10]: # Delete entries

del dict1['Name']

print(dict1)

{'Age': 8, 'Class': 'First', 'School': 'DPS'}

[11]: # Clear whole dict

dict1.clear()

print(dict1)

{}

[12]: # Delete whole dict

del dict1
print(dict1)

-----
NameError                                Traceback (most recent call last)
<ipython-input-12-a1268cd00805> in <module>
      2
      3 del dict1
----> 4 print(dict1)
NameError: name 'dict1' is not defined
```

2.

```
[60]: # WAP to merge two dictionaries with a third one

a = {'Name': 'Zara', 'Age': 10}
b = {'Gender': 'Female'}
c = {'Senior_Citizen': 'No'}

c.update(b)
c.update(a)
print(c)

{'Senior_Citizen': 'No', 'Gender': 'Female', 'Name': 'Zara', 'Age': 10}
```

3.

```
[62]: dict1 = {"a": "time", "b": "money", "c": "value"}

      v for key, values in dict1.items():
          print(key, " ", values)

      print()
      v for i in dict1.keys():
          print(i)
      v for i in dict1.values():
          print(i)

a   time
b   money
c   value

a
b
c
time
money
value
```

4.

```
[74]: # Sort dictionary by values

dict1 = {"a": 23, "b": 91038, "c": 1, "d": 20, "e": 55}

# print(sorted(dict1, key = dict1.values))
print(dict1)

ls = sorted(dict1.values())
print(ls)
dict2 = {}
v for i in ls:
v     for j in dict1.keys():
v         if dict1.get(j) == i:
            dict2[j] = i
print(dict2)

{'a': 23, 'b': 91038, 'c': 1, 'd': 20, 'e': 55}
[1, 20, 23, 55, 91038]
{'c': 1, 'd': 20, 'a': 23, 'e': 55, 'b': 91038}
```

## **EXPERIMENT 9**

**OBJECTIVE:** Demonstrate strings and its related operations and develop code for given problem statements:

- 1) Slicing – WAP to Get the characters from o in “World” to but not included d in "World"
- 2) WAP to display powers of number without using formatting characters
- 3) String methods and functions –
  - i. capitalize(), center(), count(), endswith(), startswith(), find(), index(), rfind(), rindex(), isalnum(), isalpha(), isdigit(), islower(), isupper(), len(), etc.
  - ii. WAP to print following pattern

```
A
AB
ABC
ABCD
ABCDE
ABCDEF
```

- iii. WAP using while loop to iterate a given string
  - iv. WAP that encrypts a message by adding a key value to every character
  - v. WAP that uses split function to split a multi-line string
  - vi. WAP that accepts a string from user and re-displays the same string after removing vowels
- 4) Regular Expressions
  - i. WAP to find patterns that begin with one or more characters followed by space and followed by one or more digits
  - ii. WAP that uses a regex to match strings which start with sequence of digits (atleast 1) followed by a blank and after this add arbitrary characters

### **THEORY:**

A string is a sequence of characters in Python, enclosed in either single quotes, double quotes, or triple quotes for multi-line strings. Strings are immutable, meaning their content cannot be modified after creation.

Operations on strings include:

1. Accessing Characters: Individual characters can be accessed using indexing, starting from 0 for the first character. Negative indexing allows accessing characters from the end of the string.
2. Slicing: A part of the string can be extracted using slicing, specifying a range of indices.
3. Concatenation: Strings can be joined together using the + operator.
4. Repetition: The \* operator is used to repeat a string multiple times.
5. Length: The len() function returns the number of characters in a string.

6. **Case Conversion:** Methods like `upper()`, `lower()`, `capitalize()`, and `title()` modify the case of the string.
7. **Finding Substrings:** Methods like `find()`, `index()`, and `count()` help locate or count occurrences of a substring within the string.
8. **String Replacement:** The `replace()` method allows replacing occurrences of a substring with another string.
9. **Trimming:** Methods like `strip()`, `lstrip()`, and `rstrip()` remove leading or trailing whitespace or specified characters.
10. **Splitting and Joining:** The `split()` method divides a string into a list of substrings based on a delimiter, while `join()` merges a list of strings into a single string.

Strings provide a wide range of methods for manipulation and are commonly used for handling text-based data in Python.

### **CODE:**

```
a = "HelloWorld"
# Get the characters from o in World to but not included d in "World"
print(a[-4:-1])

# WAP to display powers of number without using formatting characters
i=1
while i<=5:
    print(i**1, "\t", i**2, "\t", i**3, "\t", i**4)
    i+=1
print()
print()

i=1
while i<=5:
    print("%d\t%d\t%d\t%d"%(i**1, i**2, i**3, i**4))
    i+=1
print()
print()

i = 1
print("%-4s%-5s%-6s"%(i, i**2, i**3))
print()
print()

i = 1
while i<=5:
    print("%-4d%-5d%-6d"%(i, i**2, i**3))
    i+=1
```

```

# Built-in string methods and functions
s = "hello"
print(s.capitalize())

s = "hello"
print(s.center(10, '*'))

msg = 'he'
str1 = "hellohello"
print(str1.count(msg, 0, len(str1)))

msg = "she is my best friend"
print(msg.endswith("end", 0, len(msg)))

str1 = "the world is beautiful"
print(str1.startswith("th", 0, len(str1)))

msg = "she is my best my friend"
print(msg.find("my", 0, len(msg)))
print(msg.find("mine", 0, len(msg)))

try:
    print(msg.index("mine", 0, len(msg)))
except:
    print("substring not found")

# rfind searches from end
msg = "is this your bag?"
print(msg.rfind("is", 0, len(msg)))

print(msg.rindex("is"))
try:
    print(msg.rindex("z"))
except:
    print("substring not found")

msg = "jamesbond007"
print(msg.isalnum())

print(msg.isalpha())
msg = "jamesbond"
print(msg.isalpha())

msg = "007"
print(msg.isdigit())

```

```

msg = "Hello"
print(msg.islower())

msg = " "
print(msg.isspace())

msg = "Hello"
print(msg.isupper())

print(len(msg))

s = "Hello"
print(s.ljust(10,'%'))

print(s.rjust(10,'*'))
print(s.rjust(10))

s = "-1234"
print(s.zfill(10))

s = " Hello "
print('abc' + s.lstrip() + 'zyx')

print('abc' + s.rstrip() + 'zyx')

print('abc' + s.strip() + 'zyx')

s = "Hello friends"
print(max(s))

s = "Hello Hello Hello"
print(s.replace("He", "Fo"))
print(s.replace("He", "Fo", 2))

s = "The world is beautiful"
print(s.title())

s = "hElLO WorLD"
print(s.swapcase())

s = "abc, def, ghi, jkl"
print(s.split(','))

# WAP to print the pattern
for i in range(1, 7):
    ch = 'A'

```



```

print()
for j in range(1, i+1):
    print(ch, end="")
    ch = chr(ord(ch)+1)

# WAP using while loop to iterate a given string
s = "Welcome to Python"
i = 0
while i < len(s):
    print(s[i], end="")
    i+=1

# WAP that encrypts a message by adding a key value to every character
s = input("Enter the string: ")
key = int(input("Enter the encryption key: "))
new_s = ""
for i in s:
    new_s += chr(ord(i)+key)
print(new_s)

# WAP that uses split function to split a multi-line string
s = "Dear Students, I am pleased to inform you that, there is a workshop on Python in college tomorrow. Everyone should come and there will also be a quiz in Python, whosoever wins will win a gold medal."

print(s.split("\n"))

# WAP that accepts a string from user and re-displays the same string after removing vowels
vowels = ['a', 'e', 'i', 'o', 'u', 'A', 'E', 'I', 'O', 'U']
s = input("Enter the string: ")
for i in s:
    if i not in vowels:
        print(i, end="")

pattern = r"[a-zA-Z]+\s\d+"
# Patterns that begin with one or more characters followed by space and followed by one or more digits
matches = re.finditer(pattern, "LXI 2013,VXI 2015,VDI 20104,Maruti Suzuki Cars available with us")
for match in matches:
    print(match.start(), match.end(), match.span())

# WAP that uses a regex to match strings which start with sequence of digits (atleast 1) followed by a blank and after this add arbitrary characters

pat = r"^\d+\s*"

```

```
pat = r"^[0-9]+ .*"
if re.match(pat, "123 adj"):
    print("Good")
```

## **RESULTS:**

1.

```
[4]: a = "HelloWorld"
      print(a[2:5])

      v for i in range(2, 5):
          print(a[i], end=" ")

      llo
      llo

[7]: # Get the characters from o in World to but not included d in "World"
      print(a[-4:-1])

      orl
```

2.

```

i=1
while i<=5:
    print(i**1, "\t", i**2, "\t", i**3, "\t", i**4)
    i+=1
    print()
    print()

i=1
while i<=5:
    print("%d\t%d\t%d\t%d"%(i**1, i**2, i**3, i**4))
    i+=1
    print()
    print()

i = 1
print("%-4s%-5s%-6s"%(i, i**2, i**3))
print()
print()

i = 1
while i<=5:
    print("%-4d%-5d%-6d"%(i, i**2, i**3))
    i+=1

```

1	1	1	1
2	4	8	16
3	9	27	81
4	16	64	256
5	25	125	625

1	1	1	1
2	4	8	16
3	9	27	81
4	16	64	256
5	25	125	625

```

i    i**2 i**3

```

1	1	1
2	4	8
3	9	27
4	16	64
5	25	125

3.

a.

```
[54]: s = "hello"
      print(s.capitalize())
      Hello

[58]: s = "hello"
      print(s.center(10, '*'))
      **hello**

[66]: msg = 'he'
      str1 = "hellohello"
      print(str1.count(msg, 0, len(str1)))
      2

[67]: msg = "she is my best friend"
      print(msg.endswith("end", 0, len(msg)))
      True

[73]: str1 = "the world is beautiful"
      print(str1.startswith("th", 0, len(str1)))
      True
```

```
[2]: msg = "she is my best my friend"
      print(msg.find("my", 0, len(msg)))
      print(msg.find("mine", 0, len(msg)))
      7
      -1

[3]: v try:
      print(msg.index("mine", 0, len(msg)))
      v except:
      print("substring not found")
      substring not found

[4]: # rfind searches from end
      msg = "is this your bag?"
      print(msg.rfind("is", 0, len(msg)))
      5

[5]: print(msg.rindex("is"))
      v try:
      print(msg.rindex("z"))
      v except:
      print("substring not found")
      5
      substring not found

[19]: msg = "jamesbond007"
      print(msg.isalnum())
      True

[21]: print(msg.isalpha())
      msg = "jamesbond"
      print(msg.isalpha())
      False
      True

[22]: msg = "007"
      print(msg.isdigit())
      True
```

[27]:	<pre>msg = "Hello" print(msg.islower())</pre>	False
[28]:	<pre>msg = "  " print(msg.isspace())</pre>	True
[29]:	<pre>msg = "Hello" print(msg.isupper())</pre>	False
[30]:	<pre>print(len(msg))</pre>	5
[4]:	<pre>s = "Hello" print(s.ljust(10,'%'))</pre>	Hello%%%%
[5]:	<pre>print(s.rjust(10,'*')) print(s.rjust(10))</pre>	*****Hello Hello
[48]:	<pre>s = "-1234" print(s.zfill(10))</pre>	-000001234
[54]:	<pre>s = " Hello " print('abc' + s.lstrip() + 'zyx')</pre>	abcHello zyx
[55]:	<pre>print('abc' + s.rstrip() + 'zyx')</pre>	abc Hellozyx
[56]:	<pre>print('abc' + s.strip() + 'zyx')</pre>	abcHellozyx
[59]:	<pre>s = "Hello friends" print(max(s))</pre>	s
[6]:	<pre>s = "Hello Hello Hello" print(s.replace("He", "Fo")) print(s.replace("He", "Fo", 2))</pre>	Follo Follo Follo Follo Follo Hello
[61]:	<pre>s = "The world is beautiful" print(s.title())</pre>	The World Is Beautiful
[63]:	<pre>s = "hEllo WorLD" print(s.swapcase())</pre>	HeLlo wORld
[67]:	<pre>s = "abc, def, ghi, jkl" print(s.split(','))</pre>	['abc', ' def', ' ghi', ' jkl']

b.

```
[76]: v for i in range(1, 7):
      ch = 'A'
      print()
      v for j in range(1, i+1):
        print(ch, end="")
        ch = chr(ord(ch)+1)
```

A  
AB  
ABC  
ABCD  
ABCDE  
ABCDEF

c.

```
[98]: # WAP using while loop to iterate a given string

s = "Welcome to Python"
i = 0
v while i < len(s):
  print(s[i], end="")
  i+=1
```

Welcome to Python

d.

```
[103]: # WAP that encrypts a message by adding a key value to every character

s = input("Enter the string: ")
key = int(input("Enter the encryption key: "))

new_s = ""
v for i in s:
  new_s += chr(ord(i)+key)
print(new_s)
```

Enter the string: HelloWorld  
Enter the encryption key: 3  
KhoorZruog

e.

```
[107]: # WAP that uses split function to split a multi-line string

s = '''Dear Students, I am pleased to inform you that, there is a workshop on Python in college tomorrow.
Everyone should come and there will also be a quiz in Python, whosoever wins will win a gold medal.'''

print(s.split('\n'))
```

['Dear Students, I am pleased to inform you that, there is a workshop on Python in college tomorrow.',  
'Everyone should come and there will also be a quiz in Python, whosoever wins will win a gold medal.']

f.

```
[109]: # WAP that accepts a string from user and re-displays the same string after removing vowels

vowels = ['a', 'e', 'i', 'o', 'u', 'A', 'E', 'I', 'O', 'U']
s = input("Enter the string: ")
for i in s:
    if i not in vowels:
        print(i, end="")

Enter the string: Shuchika Sharma
Shchk Shrma
```

4.

a.

```
[18]: pattern = r"[a-zA-Z]+\s+\d+"
# Patterns that begin with one or more characters followed by space and followed by one or more digits
matches = re.finditer(pattern, "LXI 2013,VXI 2015,VDI 20104,Maruti Suzuki Cars available with us")
for match in matches:
    print(match.start(), match.end(), match.span())

0 8 (0, 8)
9 17 (9, 17)
18 27 (18, 27)
```

b.

```
[47]: # WAP that uses a regex to match strings which start with sequence of digits (atleast 1) followed by a space and any character

pat = r"^\d+\s*"
pat = r"^[0-9]+\s.*"
if re.match(pat, "123 adij"):
    print("Good")

Good
```

## **EXPERIMENT 10**

**OBJECTIVE:** Demonstrate file handling and develop code for given problem statements:

- 1) WAP that copies first 10 bytes of a binary file into another
- 2) WAP that accepts a file name as an input from the user. Open the file and count the number of times a character appears in the file
- 3) WAP to create a new directory in the current directory, WAP that changes current directory to newly created directory new\_dir, WAP to delete new\_dir
- 4) WAP to print the absolute path of a file using os.path.join

### **THEORY:**

File handling in Python allows for the reading and writing of files. Python provides built-in functions and methods for working with text files, enabling operations like opening, reading, writing, and closing files.

Key file operations include:

1. Opening a File: The open() function is used to open a file. It requires the file name and a mode (r, w, a, b, etc.). The most common modes are:
  - r: Read (default mode)
  - w: Write (creates a new file or overwrites an existing file)
  - a: Append (adds to an existing file)
  - b: Binary mode
2. Reading a File: After opening a file in read mode, methods like read(), readline(), and readlines() can be used to retrieve the file's content.
  - read() reads the entire file.
  - readline() reads a single line.
  - readlines() returns all lines as a list.
3. Writing to a File: Files can be written to using the write() method, which adds text to the file. If the file is opened in write or append mode, the write() method can be used to add data.
4. Closing a File: After completing file operations, it is important to close the file using the close() method. This ensures that all changes are saved and the file is properly closed.
5. File Context Manager: The with statement is used to ensure proper file handling. It automatically closes the file once the block of code is executed, even if an error occurs during the process.
6. File Modes: Files can also be opened in binary mode (rb, wb, etc.) for working with non-text files, such as images or audio.



File handling in Python is essential for managing data stored in files, and it offers a simple yet powerful interface for reading and writing file content.

### **CODE:**

```
# WAP that copies first 10 bytes of a binary file into another
with open("file_handling_test/file1.txt", "rb") as f:
```

```
    a = f.read(10)
    print("First 10 bytes of file1: ", a)
```

```
with open("file2.txt", "wb+") as f2:
```

```
    print("File2 contents:")
    print(f2.read())
    f2.seek(0)
    t = f2.write(a)
    f2.seek(0)
    print("File2 contents after copying:")
    print(f2.read())
```

```
# WAP that accepts a file name as an input from the user. Open the file and count the number
of times a character appears in the file
```

```
f = input("Enter the file name: ")
ch = input("Enter the character to be searched: ")
count = 0
with open("file_handling_test/"+f, "r") as f1:
    for line in f1:
        for c in line:
            if c == ch:
                count+=1
print("Count of given character in file: ", count)
```

```
# WAP to create a new directory in the current directory
os.mkdir("new_dir")
```

```
# WAP that changes curr dir to newly created dir new_dir
os.chdir("new_dir")
```

```
# WAP to delete new_dir
os.rmdir("new_dir")
```

### **RESULTS:**

1.

```
[6]: # WAP that copies first 10 bytes of a binary file into another
    v with open("file_handling_test/file1.txt", "rb") as f:
        a = f.read(10)
        print("First 10 bytes of file1: ", a)

    v with open("file2.txt", "wb+") as f2:
        print("File2 contents:")
        print(f2.read())
        f2.seek(0)
        t = f2.write(a)
        f2.seek(0)
        print("File2 contents after copying:")
        print(f2.read())
```

First 10 bytes of file1: b'Hello Worl'

File2 contents:

b''

File2 contents after copying:

b'Hello Worl'

2.

```
# WAP that accepts a file name as an input from the user. Open the file and count the nu

f = input("Enter the file name: ")
ch = input("Enter the character to be searched: ")
count = 0
v with open("file_handling_test/"+f, "r") as f1:
    v for line in f1:
        v for c in line:
            v if c == ch:
                count+=1
v print("Count of given character in file: ", count)
```

Enter the file name: file1.py

Enter the character to be searched: a

Count of given character in file: 9

3.

```
[4]: # WAP to create a new directory in the current directory
      os.mkdir("new_dir")

[5]: os.getcwd()

[5]: 'C:\\Users\\shuch\\NITJ\\Sem1\\CPBP\\Class Work'

[6]: # WAP that changes current directory to newly created dir new_dir
      os.chdir("new_dir")

[7]: os.getcwd()

[7]: 'C:\\Users\\shuch\\NITJ\\Sem1\\CPBP\\Class Work\\new_dir'

[10]: os.chdir("../")

[12]: os.getcwd()

[12]: 'C:\\Users\\shuch\\NITJ\\Sem1\\CPBP\\Class Work'

[11]: # WAP to delete new_dir
      os.rmdir("new_dir")
```

## **EXPERIMENT 11**

**OBJECTIVE:** Demonstrate Classes, Objects and Inheritance and develop code for given problem statements:

- 1) WAP with class Employee that keeps a track of the number of employees in an organization and also stores their name, designation, and salary details.
- 2) WAP that has a class Circle. Use a class variable to define the value of constant pi. Use this class variable to calculate area and circumference of a circle with specified radius.
- 3) WAP that has a class Point. Define another class Location which has 2 objects - location and destination. Also define a function in location that prints the reflection of destination on the x-axis.
- 4) WAP that has classes such as Student, Course, Department. Enroll a student in a course of a particular department. Classes are -
  - a. Student details - name, roll no
  - b. Course - name, code, year and semester
  - c. Department – Name

### **THEORY:**

In Python, classes are templates for creating objects. A class defines the properties (attributes) and behaviours (methods) that the objects created from it will have. Objects are instances of a class, representing specific data and functionality.

Key concepts:

1. **Class Definition:** A class is defined using the class keyword, followed by the class name and a colon. Inside the class, methods are defined using the def keyword.
2. **Object Creation:** An object is created by calling the class name as a function. This initializes an instance of the class, allowing access to its attributes and methods.
3. **Attributes:** Attributes are variables that belong to a class or an object. They can hold data specific to the object or shared by all instances of the class (class variables vs instance variables).
4. **Methods:** Methods are functions defined inside a class. They define the behaviors of the objects and can access and modify the object's attributes. The first parameter of a method is usually self, which refers to the current instance of the class.
5. **Constructor (\_init\_ method):** The \_init\_ method is a special method called a constructor, which is automatically invoked when an object is created. It initializes the object's attributes.
6. **Inheritance:** Inheritance allows a class to inherit attributes and methods from another class, facilitating code reuse and extension of functionality.
7. **Encapsulation:** Encapsulation involves bundling the data (attributes) and methods that operate on the data within a single unit (class). It also restricts access to certain details of an object, usually through private attributes and methods.

8. **Polymorphism:** Polymorphism allows methods to behave differently based on the object that is calling them. This can be achieved through method overriding in subclasses.

Classes and objects in Python enable object-oriented programming, allowing for better organization, reusability, and maintainability of code.

Inheritance is a fundamental concept in object-oriented programming that allows one class to inherit the attributes and methods of another class. In Python, inheritance enables the creation of a new class that is a modified version of an existing class. The new class, called the child class or subclass, inherits features from the existing class, called the parent class or superclass.

Key concepts of inheritance include:

1. **Base and Derived Classes:** The base class (or parent class) is the class from which attributes and methods are inherited, while the derived class (or child class) is the class that inherits these properties and can extend or modify them.
2. **Method Overriding:** A child class can override or replace methods from the parent class. This allows the child class to provide its own implementation of a method that exists in the parent class.
3. **super() Function:** The super() function is used in the child class to call methods from the parent class. It is commonly used in the constructor (`__init__`) to initialize attributes from the parent class.
4. **Types of inheritance**
  1. **Single Inheritance:** In single inheritance, a class (child class) inherits from only one class (parent class). This is the simplest form of inheritance, where the child class can access the attributes and methods of a single parent class.
  2. **Multiple Inheritance:** In multiple inheritance, a class (child class) inherits from more than one class (parent classes). The child class combines the features and behaviours of multiple parent classes. While powerful, it can also lead to complexity, especially if two parent classes have methods or attributes with the same name.
  3. **Multilevel Inheritance:** In multilevel inheritance, a class (child class) inherits from a parent class, and then another class (grandchild class) inherits from the child class. This forms a chain of inheritance, where each class inherits from the class above it in the hierarchy.
  4. **Hierarchical Inheritance:** In hierarchical inheritance, multiple classes inherit from a single parent class. This allows the parent class to define common attributes and methods that are shared by all the child classes.
  5. **Hybrid Inheritance:** Hybrid inheritance is a combination of two or more types of inheritance, such as multiple and multilevel inheritance. It combines different inheritance structures, which may result in a more complex hierarchy. Hybrid inheritance can sometimes cause issues like the "diamond problem," which Python addresses using the method resolution order (MRO).
5. **Access to Parent Class Attributes and Methods:** The child class inherits all the attributes and methods of the parent class, but it can also add new attributes and methods or modify existing ones.

Inheritance promotes code reusability, allows for extending functionality, and makes it easier to maintain and modify code by organizing it into a hierarchical structure.

**CODE:**

# WAP with class Employee that keeps a track of the number of employees in an organisation and also stores their name, designation, and salary details.

```
class Employee:
    global count_of_emp
    count_of_emp = 0

    def __init__(self):
        self.emp = {}
    def enterEmployeeDetails(self):
        i = int(input("Enter Employee id: "))
        n = input("Enter Employee Name: ")
        d = input("Enter Employee Designation: ")
        s = input("Enter Employee Salary: ")
        self.emp.update({str(i): [n, d, s]})
    def displayCount(self):
        print("Total count of employees: ", count_of_emp)
    def displayDetails(self):
        print("List of Employees and their details: ", self.emp)

e1 = Employee()
e1.enterEmployeeDetails()
count_of_emp += 1

e2 = Employee()
e2.enterEmployeeDetails()
count_of_emp += 1

e1.displayDetails()
e2.displayDetails()

e2.displayCount()
```

# WAP that has a class Circle. Use a class variable to define the value of constant pi. Use this class variable to calculate area and circumference of a circle with specified radius.

```
class Circle:
    def __init__(self, radius):
        self.radius = radius
        self.area = 0
        self.circum = 0
```

```

        self.pi = 3.14
    def calcArea(self):
        self.area = self.pi * self.radius * self.radius
    def calcCircum(self):
        self.circum = 2 * self.pi * self.radius
    def printDetails(self):
        print()
        print("Given radius: ", self.radius)
        print("Area of circle: ", self.area)
        print("Circumference of circle: ", self.circum)

```

```

c1 = Circle(7)
c1.calcArea()
c1.calcCircum()

```

```

c2 = Circle(10)
c2.calcArea()
c2.calcCircum()

```

```

c1.printDetails()
c2.printDetails()

```

# WAP that has a class Point. Define another class Location which has 2 objects - location and destination.

# Also define a function in location that prints the reflection of destination on the x-axis.

```

class Point:
    def __init__(self, x, y):
        self.x = x
        self.y = y
        self.x_new = 0
        self.y_new = 0
    def display_point(self):
        print(f'X = {self.x}, Y = {self.y}')

class Location(Point):
    def reflection(self):
        self.y_new = self.y * -1
        self.x_new = self.x
        print(f'X_reflected = {self.x_new}, Y_reflected = {self.y_new}')

```

```

location = Location(1, 2)
destination = Location(10, 20)

```

```

location.display_point()
destination.display_point()

```

```

destination.reflection()
# WAP that has classes such as Student, Course, Department. Enroll a student in a course of a
particular department. Classes are -
# Student details - name, roll no
# Course - name, code, year and semester
# Department - Name

# Base class: Person
class Person:
    def __init__(self, name):
        self.name = name

    def __str__(self):
        return f"Name: {self.name}"

# Student class inheriting from Person
class Student(Person):
    def __init__(self, name, roll_no):
        super().__init__(name)
        self.roll_no = roll_no

    def __str__(self):
        return f"Student Name: {self.name}, Roll No: {self.roll_no}"

# Base class: AcademicEntity
class AcademicEntity:
    def __init__(self, name):
        self.name = name

    def __str__(self):
        return f"{self.__class__.__name__} Name: {self.name}"

# Course class inheriting from AcademicEntity
class Course(AcademicEntity):
    def __init__(self, name, code, year, semester):
        super().__init__(name)
        self.code = code
        self.year = year
        self.semester = semester

    def __str__(self):
        return f"Course Name: {self.name}, Code: {self.code}, Year: {self.year}, Semester: {self.semester}"

```



```

# Department class inheriting from AcademicEntity
class Department(AcademicEntity):
    def __init__(self, name):
        super().__init__(name)
        self.courses = [] # List of courses in the department

    def add_course(self, course):
        self.courses.append(course)

    def __str__(self):
        return f"Department Name: {self.name}"

# Enrollment system for handling enrollments
class Enrollment:
    def __init__(self):
        self.enrollments = {} # Maps students to courses

    def enroll_student(self, student, course, department):
        if student not in self.enrollments:
            self.enrollments[student] = []
        self.enrollments[student].append((course, department))

    def display_enrollments(self):
        for student, courses in self.enrollments.items():
            print(f"\n{student}:")
            for course, department in courses:
                print(f"  Enrolled in {course} of {department}")

# Main menu-driven program
if __name__ == "__main__":
    # Initialize data structures
    students = []
    courses = []
    departments = []
    enrollment_system = Enrollment()

    while True:
        print("\nMenu:")
        print("1. Add Department")
        print("2. Add Course")
        print("3. Add Student")
        print("4. Enroll Student in a Course")
        print("5. Display Enrollments")
        print("6. Exit")

```

```

choice = input("Enter your choice: ")

if choice == "1":
    # Add a department
    dept_name = input("Enter department name: ")
    department = Department(dept_name)
    departments.append(department)
    print(f"Department '{dept_name}' added.")

elif choice == "2":
    # Add a course
    if not departments:
        print("No departments available. Add a department first.")
        continue
    dept_name = input("Enter the department for the course: ")
    department = next((d for d in departments if d.name == dept_name), None)
    if not department:
        print("Department not found.")
        continue
    course_name = input("Enter course name: ")
    course_code = input("Enter course code: ")
    course_year = input("Enter course year: ")
    course_semester = input("Enter course semester: ")
    course = Course(course_name, course_code, course_year, course_semester)
    department.add_course(course)
    courses.append(course)
    print(f"Course '{course_name}' added to department '{dept_name}'.")

elif choice == "3":
    # Add a student
    student_name = input("Enter student name: ")
    student_roll_no = input("Enter student roll number: ")
    student = Student(student_name, student_roll_no)
    students.append(student)
    print(f"Student '{student_name}' added.")

elif choice == "4":
    # Enroll a student in a course
    if not students or not courses:
        print("No students or courses available. Add them first.")
        continue
    student_roll_no = input("Enter student roll number: ")
    student = next((s for s in students if s.roll_no == student_roll_no), None)
    if not student:
        print("Student not found.")
        continue

```

```

course_code = input("Enter course code: ")
course = next((c for c in courses if c.code == course_code), None)
if not course:
    print("Course not found.")
    continue
department = next((d for d in departments if course in d.courses), None)
if not department:
    print("Department for the course not found.")
    continue
enrollment_system.enroll_student(student, course, department)
print(f"Student '{student.name}' enrolled in course '{course.name}'.")

elif choice == "5":
    # Display all enrollments
    enrollment_system.display_enrollments()

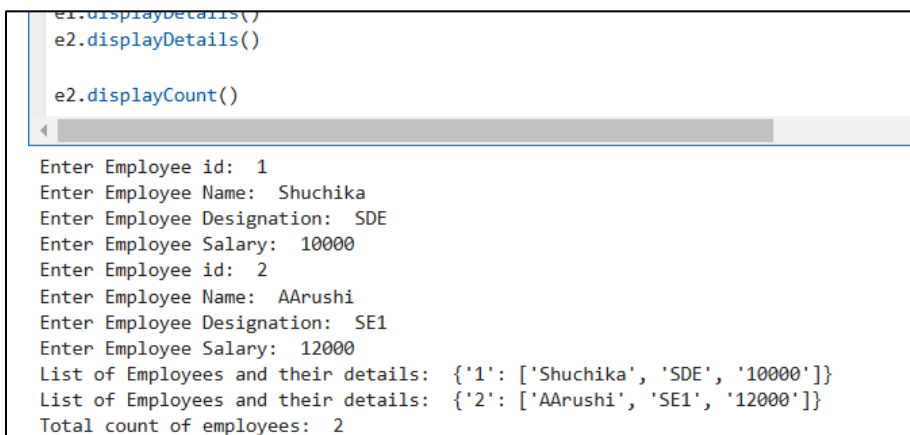
elif choice == "6":
    # Exit the program
    print("Exiting program. Goodbye!")
    break

else:
    print("Invalid choice. Please try again.")

```

## **RESULTS:**

1.



```

e1.displayDetails()
e2.displayDetails()

e2.displayCount()

```

---

```

Enter Employee id: 1
Enter Employee Name: Shuchika
Enter Employee Designation: SDE
Enter Employee Salary: 10000
Enter Employee id: 2
Enter Employee Name: AArushi
Enter Employee Designation: SE1
Enter Employee Salary: 12000
List of Employees and their details: {'1': ['Shuchika', 'SDE', '10000']}
List of Employees and their details: {'2': ['AArushi', 'SE1', '12000']}
Total count of employees: 2

```

2.

```
[26]: # WAP that has a class Circle. Use a class variable to define the value of constant pi. Use this

class Circle:
    def __init__(self, radius):
        self.radius = radius
        self.area = 0
        self.circum = 0
        self.pi = 3.14
    def calcArea(self):
        self.area = self.pi * self.radius * self.radius
    def calcCircum(self):
        self.circum = 2 * self.pi * self.radius
    def printDetails(self):
        print()
        print("Given radius: ", self.radius)
        print("Area of circle: ", self.area)
        print("Circumference of circle: ", self.circum)

c1 = Circle(7)
c1.calcArea()
c1.calcCircum()

c2 = Circle(10)
c2.calcArea()
c2.calcCircum()

c1.printDetails()
c2.printDetails()
```

Given radius: 7  
Area of circle: 153.86  
Circumference of circle: 43.96

Given radius: 10  
Area of circle: 314.0  
Circumference of circle: 62.800000000000004

3.

```
*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 1

Enter title of book: Programming Basics with Python
Enter name of author of book: Sharma, Deepa
Enter price of book: 100

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 1

Enter title of book: Programming Basics with C++
Enter name of author of book: Mark, Sharma, Nicholas
Enter price of book: 200

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 1

Enter title of book: Principles of Soft Computing using Python
Enter name of author of book: S. N. Sivanandam
Enter price of book: 300
```

```

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 1

Enter title of book: Let Us C
Enter name of author of book: Yashavant Kanetkar
Enter price of book: 400

```

```

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 2
-----
Title of book: Programming Basics with Python
Author of book: Sharma, Deepa
Price of book: 100
-----

-----
Title of book: Programming Basics with C++
Author of book: Mark, Sharma, Nicholas
Price of book: 200
-----

-----
Title of book: Principles of Soft Computing using Python
Author of book: S. N. Sivanandam
Price of book: 300
-----

```

```

-----
Title of book: Let Us C
Author of book: Yashavant Kanetkar
Price of book: 400
-----

```

```

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 3
Enter the search keyword in title: python
-----
Title of book: Programming Basics with Python
Author of book: Sharma, Deepa
Price of book: 100
-----

-----
Title of book: Principles of Soft Computing using Python
Author of book: S. N. Sivanandam
Price of book: 300
-----

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 3
Enter the search keyword in title: sharma

```

```

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 4
Enter the search keyword in author name: sharma
-----
Title of book: Programming Basics with Python
Author of book: Sharma, Deepa
Price of book: 100
-----
Title of book: Programming Basics with C++
Author of book: Mark, Sharma, Nicholas
Price of book: 200
-----

*****
Enter your choice:
1. Press 1 to enter a new book into the system.
2. Press 2 to display all records.
3. Press 3 to search book by title and print its details
4. Press 4 to search book by author and print its details
5. Press anything else to exit
Enter your choice: 5
Invalid choice! Exiting the program

```

4.

```

[30]: # WAP that has a class Point. Define another class Location which has 2 objects - Location and destination.
      # Also define a function in Location that prints the reflection of destination on the x-axis.

```

```

class Point:
    def __init__(self, x, y):
        self.x = x
        self.y = y
        self.x_new = 0
        self.y_new = 0
    def display_point(self):
        print(f'X = {self.x}, Y = {self.y}')

class Location(Point):
    def reflection(self):
        self.y_new = self.y * -1
        self.x_new = self.x
        print(f'X_reflected = {self.x_new}, Y_reflected = {self.y_new}')

location = Location(1, 2)
destination = Location(10, 20)

location.display_point()
destination.display_point()
destination.reflection()

```

```

X = 1, Y = 2
X = 10, Y = 20
X_reflected = 10, Y_reflected = -20

```

5.

<pre>Menu: 1. Add Department 2. Add Course 3. Add Student 4. Enroll Student in a Course 5. Display Enrollments 6. Exit  Enter your choice: 3 Enter student name: Aarushi Enter student roll number: 1 Student 'Aarushi' added.  Menu: 1. Add Department 2. Add Course 3. Add Student 4. Enroll Student in a Course 5. Display Enrollments 6. Exit  Enter your choice: 3 Enter student name: Shuchika Enter student roll number: 25 Student 'Shuchika' added.  Menu: 1. Add Department 2. Add Course 3. Add Student 4. Enroll Student in a Course 5. Display Enrollments 6. Exit  Enter your choice: 1 Enter department name: AI Department 'AI' added.</pre>	<pre>Menu: 1. Add Department 2. Add Course 3. Add Student 4. Enroll Student in a Course 5. Display Enrollments 6. Exit  Enter your choice: 1 Enter department name: CS Department 'CS' added.  Menu: 1. Add Department 2. Add Course 3. Add Student 4. Enroll Student in a Course 5. Display Enrollments 6. Exit  Enter your choice: 2 Enter the department for the course: CPB Department not found.  Menu: 1. Add Department 2. Add Course 3. Add Student 4. Enroll Student in a Course 5. Display Enrollments 6. Exit  Enter your choice: 2 Enter the department for the course: AI Enter course name: CPBP Enter course code: 101 Enter course year: 2024 Enter course semester: 1 Course 'CPBP' added to department 'AI'.</pre>
--	--

```
Menu:
1. Add Department
2. Add Course
3. Add Student
4. Enroll Student in a Course
5. Display Enrollments
6. Exit

Enter your choice: 2
Enter the department for the course: CS
Enter course name: Cryptography
Enter course code: 301
Enter course year: 2024
Enter course semester: 2
Course 'Cryptography' added to department 'CS'.
```

```
Menu:
1. Add Department
2. Add Course
3. Add Student
4. Enroll Student in a Course
5. Display Enrollments
6. Exit

Enter your choice: 4
Enter student roll number: 1
Enter course code: 101
Student 'Aarushi' enrolled in course 'CPBP'.
```

```
Menu:
1. Add Department
2. Add Course
3. Add Student
4. Enroll Student in a Course
5. Display Enrollments
6. Exit

Enter your choice: 4
Enter student roll number: 25
```

```
6. Exit

Enter your choice: 4
Enter student roll number: 25
Enter course code: 301
Student 'Shuchika' enrolled in course 'Cryptography'.
```

```
Menu:
1. Add Department
2. Add Course
3. Add Student
4. Enroll Student in a Course
5. Display Enrollments
6. Exit

Enter your choice: 5

Student Name: Aarushi, Roll No: 1:
  Enrolled in Course Name: CPBP, Code: 101, Year: 2024, Semester: 1 of Department Name: AI

Student Name: Shuchika, Roll No: 25:
  Enrolled in Course Name: Cryptography, Code: 301, Year: 2024, Semester: 2 of Department Name: CS

Menu:
1. Add Department
2. Add Course
3. Add Student
4. Enroll Student in a Course
5. Display Enrollments
6. Exit

Enter your choice: 6
Exiting program. Goodbye!
```



## **EXPERIMENT 12**

**OBJECTIVE:** Demonstrate polymorphism, error and exception handling and develop code for given problem statements:

- 1) Demonstrate operator overloading
- 2) Demonstrate Method Overriding
- 3) WAP to handle the divide by zero exception
- 4) Demonstrate Raise Exceptions, Instantiating Exceptions, assertion
- 5) WAP that prompts the user to enter a number and prints the square of that number. If no number is entered, then a KeyboardInterrupt is generated
- 6) WAP which infinitely prints natural numbers. Raise the stopIterationException after displaying first 20 numbers to exit from the program
- 7) WAP that randomly generates a number. Raise a UserDefined exception if the number is below 0.1

### **THEORY:**

Polymorphism is a core concept of object-oriented programming that allows methods or functions to operate on objects of different classes through a uniform interface. It enables a single method to behave differently based on the object it is acting upon, thereby supporting flexibility and extensibility in software design. Polymorphism can be classified into two main types:

1. **Compile-time Polymorphism:** Also known as static polymorphism, this type occurs when the method to be invoked is determined at compile-time. Examples include method overloading and operator overloading.
2. **Runtime Polymorphism:** Also known as dynamic polymorphism, this type occurs when the method call is resolved at runtime. It is typically achieved through method overriding in inheritance, where a subclass provides its specific implementation of a method defined in its superclass.

Polymorphism promotes code reusability, maintainability, and the ability to design systems that are scalable and adaptable to change.

Error handling refers to the process of anticipating, detecting, and resolving errors in a program to ensure its smooth execution. Errors can occur due to various reasons such as invalid user input, hardware failures, or logic issues in the code. Errors are broadly categorized into:

1. **Compile-time Errors:** These are syntax or semantic errors detected by the compiler, preventing the program from compiling successfully.
2. **Runtime Errors:** These errors occur during program execution, such as division by zero or accessing invalid memory locations.
3. **Logical Errors:** These occur due to incorrect implementation of algorithms or logic, leading to unintended results.

Effective error handling involves identifying potential error-prone sections of code and incorporating mechanisms to handle errors gracefully, ensuring minimal disruption to program functionality.

Exception handling is a specialized mechanism in programming used to manage runtime errors, known as exceptions, in a structured manner. It allows developers to detect errors, handle them without crashing the program, and ensure normal program flow is restored. Most modern programming languages provide constructs for exception handling, typically through:

1. Try Block: Code that may throw an exception is placed inside the try block.
2. Catch Block: Handles specific types of exceptions. Multiple catch blocks can be used for different exception types.
3. Finally Block: Optional block executed after try and catch blocks, regardless of whether an exception was thrown or caught. It is typically used for cleanup operations.
4. Throw Statement: Used to explicitly throw an exception when a specific error condition occurs.

Exception handling improves program robustness, facilitates debugging, and ensures resource management by preventing resource leaks during error scenarios.

### **CODE:**

```
# Operator overloading
print(3+2)
print("GKTCS" + "Innovation")
print(3*2)
print("GKTCS" * 3)
```

```
# Method Overriding
```

```
class Employee:
    def message(self):
        print("In Employee Class")
```

```
class Company(Employee):
    pass
```

```
class Company2(Employee):
    def message(self):
        print("In Company class")
```

```
emp = Employee()
emp.message()
```

```
comp = Company()
comp.message()
```

```
comp2 = Company2()
comp2.message()
```

```
# WAP to handle the divide by zero exception
```

```
try:
    num = int(input("Enter the numerator: "))
    deno = int(input("Enter the denominator: "))

    q = num/deno
    print('Quotient is: ', q)
except ZeroDivisionError:
    print("Invalid Value of Denominator(Zero)!")
except ValueError:
    print("Values must be integers!!")
```

```
# Raise Exceptions
```

```
try:
    num = 10
    print(num)
    raise ValueError
except:
    print("Exception occurred")
```

```
# Instantiating Exceptions
```

```
try:
    num = 10
    print(num)
    raise ValueError
except Exception as errorobj:
    print(type(errorobj))
    print(errorobj.args)
```

```
# Program to demonstrate the use of assert keyword
```

```
def calculate_average(marks):
    # Ensure the input list is not empty
    assert len(marks) > 0, "The list of marks cannot be empty!"

    return sum(marks) / len(marks)
```

```
try:
    marks_list = [85, 90, 78, 92]
    print("Average Marks:", calculate_average(marks_list))

    empty_list = []
    print("Average Marks:", calculate_average(empty_list)) # This will trigger the assertion
except AssertionError as e:
```

```
print("AssertionError:", e)
```

# WAP that prompts the use to enter a number and prints the square of that number. If no number is entered, then a KeyboardInterrupt is generated

```
try:
    num = int(input("Enter the number: "))
    print(num*num)
except KeyboardInterrupt:
    print("Exception occurred")
```

# WAP which infinitely prints natural numbers. Raise the stopIterationException after displaying first 20 numbers to exit from the program

```
i = 1
try:
    while(True):
        print(i)
        if i>=20:
            raise StopIteration
        i+=1
except StopIteration:
    print("Infinite loop count exceeded 20!")
```

# WAP that randomly generates a number. Raise a UserDefined exception if the number is below 0.1

```
import random
class UserDefinedException(Exception):
    pass

a = random.random()
try:
    print(a)
    if a<0.1:
        raise UserDefinedException

except UserDefinedException:
    print("UserDefinedException raised as value entered is less than 0.1")
```

## **RESULTS:**

1.

```
[12]: # Operator overloading

print(3+2)

print("GKTCS" + "Innovation")

print(3*2)

print("GKTCS" * 3)
```

5  
GKTCSInnovation  
6  
GKTCSGKTCSGKTCS

2.

```
[16]: # Method Overriding

v class Employee:
v     def message(self):
v         print("In Employee Class")

v class Company(Employee):
v     pass

v class Company2(Employee):
v     def message(self):
v         print("In Company class")

emp = Employee()
emp.message()

comp = Company()
comp.message()

comp2 = Company2()
comp2.message()
```

In Employee Class  
In Employee Class  
In Company class

3.

```
[5]: # WAP to handle the divide by zero exception

try:
    num = int(input("Enter the numerator: "))
    deno = int(input("Enter the denominator: "))

    q = num/deno
    print('Quotient is: ', q)
except ZeroDivisionError:
    print("Invalid Value of Denominator(Zero)!")
except ValueError:
    print("Values must be integers!!")

Enter the numerator: a
Values must be integers!!
```

4.

```
[1]: # Program to demonstrate the use of assert keyword

def calculate_average(marks):
    # Ensure the input list is not empty
    assert len(marks) > 0, "The list of marks cannot be empty!"

    return sum(marks) / len(marks)

# Example usage
try:
    marks_list = [85, 90, 78, 92]
    print("Average Marks:", calculate_average(marks_list))

    empty_list = []
    print("Average Marks:", calculate_average(empty_list)) # This will trigger the assertion
except AssertionError as e:
    print("AssertionError:", e)

Average Marks: 86.25
AssertionError: The list of marks cannot be empty!
```

5.

```
[3]: # Assert

# WAP that prompts the use to enter a number and prints the square

try:
    num = int(input("Enter the number: "))
    print(num*num)
except KeyboardInterrupt:
    print("Exception occurred")

Exception occurred
```

6.

```
[19]: # WAP which infinitely prints natural numbers. Raise t

i = 1
try:
    while(True):
        print(i)
        if i>=20:
            raise StopIteration
        i+=1
except StopIteration:
    print("Infinite loop count exceeded 20!")

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Infinite loop count exceeded 20!
```

7.

```
[24]: # WAP that randomly generates a number. Raise a UserDefined exception if the number is below 0.1

import random

class UserDefinedException(Exception):
    pass

a = random.random()
try:
    print(a)
    if a<0.1:
        raise UserDefinedException
except UserDefinedException:
    print("UserDefinedExcpetion raised as value enters is less than 0.1")

0.02677165357859712
UserDefinedExcpetion raised as value enters is less than 0.1
```