MALAD KANDIVALI EDUCATION SOCIETY'S

NAGINDAS KHANDWALA COLLEGE OF COMMERCE, ARTS & MANAGEMENT STUDIES & SHANTABEN NAGINDAS KHANDWALA COLLEGE OF SCIENCE
MALAD [W], MUMBAI – 64
AUTONOMOUS INSTITUTION

(Affiliated To University Of Mumbai)

Reaccredited 'A' Grade by NAAC | ISO 9001:2015 Certified

<u>CERTIFICATE</u>

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Roll No: <u>356</u>   Programme: BSc CS   Semester: III

This is certified to be a bonafide record of practical works done by the above student in the college laboratory for the course **Data Structures (Course Code: 2032UISPR)** for the partial fulfilment of Third Semester of BSc IT during the academic year 2020-21.

The journal work is the original study work that has been duly approved in the year 2020-21 by the undersigned.

_____   _____

External Examiner   Mr. Gangashankar Singh

(Subject-In-Charge)

Date of Examination: (College Stamp)

Subject: Data Structures

INDEX

Sr No	Date	Topic	Sign
1	04/09/2020	Implement the following for Array: a) Write a program to store the elements in 1-D array and provide an option to perform the operations like searching, sorting, merging, reversing the elements. b) Write a program to perform the Matrix addition, Multiplication and Transpose Operation.	
2	11/09/2020	Implement Linked List. Include options for insertion, deletion and search of a number, reverse the list and concatenate two linked lists.	
3	18/09/2020	Implement the following for Stack: a) Perform Stack operations using Array implementation. b. b) Implement Tower of Hanoi. c) WAP to scan a polynomial using linked list and add two polynomials. d) WAP to calculate factorial and to compute the factors of a given no. (i) using recursion, (ii) using iteration	
4	25/09/2020	Perform Queues operations using Circular Array implementation.	
5	01/10/2020	Write a program to search an element from a list. Give user the option to perform Linear or Binary search.	
6	09/10/2020	WAP to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.	
7	16/10/2020	Implement the following for Hashing: a) Write a program to implement the collision technique. b) Write a program to implement the concept of linear probing.	
8	23/10/2020	Write a program for inorder, postorder and preorder traversal of tree.	

Practical no: 1- A

Aim: Write a program to store the elements in 1-D array and provide an option to perform the operations like searching, sorting, merging, reversing the elements.

Theory: Array is a container which can hold a fix number of items and these items should be of the same type. Most of the data structures make use of arrays to implement their algorithms. Following are the important terms to understand the concept of Array.

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

Index − Each location of an element in an array has a numerical index, which is used to identify the element.

Basic Operations

Following are the basic operations supported by an array.

Traverse − print all the array elements one by one.

Insertion − Adds an element at the given index.

Search − Searches an element using the given index or by the value.

Sorting-Means Arranging the Element in particular order. i.e. Ascending or Descending order

File   Edit   Format   Run   Options   Window   Help

```python
#Python program to perform matrix operations, matrix addition,matrix subtraction,matrix multiplication - addition

mat1 = [[1, 2], [3, 4]]
mat2 = [[1, 2], [3, 4]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] + mat2[i][j]
        print("Addition of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()


#Python program to perform matrix operations, matrix addition,matrix subtraction,matrix multiplication - subtraction

mat1 = [[9, 2], [5, 3]]
mat2 = [[8, 1], [4, 2]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] - mat2[i][j]
        print("Subtraction of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()



#Python program to multiply two matrices

mat1 = [[9, 2], [5, 3]]
```

File   Edit   Format   Run   Options   Window   Help

```python
        print(mat3[i][j], end = "")
        print()


#Python program to perform matrix operations, matrix addition,matrix subtraction,matrix multiplication - subtraction

mat1 = [[9, 2], [5, 3]]
mat2 = [[8, 1], [4, 2]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] - mat2[i][j]
        print("Subtraction of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()



#Python program to multiply two matrices

mat1 = [[9, 2], [5, 3]]
mat2 = [[8, 1], [4, 2]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] * mat2[i][j]
        print("Multiplication of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()
```

Python 3.4.3 Shell

File   Edit   Shell   Debug   Options   Window   Help

```
Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.1600 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ============================== RESTART ==============================
>>>
Addition of two matrices
Addition of two matrices
Addition of two matrices
Addition of two matrices
2
4
6
8
Subtraction of two matrices
Subtraction of two matrices
Subtraction of two matrices
Subtraction of two matrices
1
1
1
1
Multiplication of two matrices
Multiplication of two matrices
Multiplication of two matrices
Multiplication of two matrices
72
2
20
6
>>>
```

2

PRACTICAL 1 -B

Aim : Write a program to perform the Matrix addition, Multiplication and Transpose Operation.

Theory: Matrix is a special case of two dimensional array where each data element is of strictly same size. So every matrix is also a two dimensional array but not vice versa. Matrices are very important data structures for many mathematical and scientific calculations. As we have already discussed two dimensional array data structure in matrices .

In Python, we can implement a matrix as nested list (list inside a list).

For example X=[[1,2],[4,5,[3,6]] would represent a 3x2 matrix.

The first row can be selected as . And, the element in first row, first column can be selected as .

Multiplication of two matrices X and Y is defined only if the number of columns in X is equal to the number of rows Y.

If X is a n x matrix and Y is a mx matrix then, it is defined as dimension.

Prac1b.py - C:/DS/Prac1b.py (3.4.3)

File Edit Format Run Options Window Help

```
#Python program to perform matrix operations, matrix addition,matrix subtraction,matrix multiplication - addition

mat1 = [[1, 2], [3, 4]]
mat2 = [[1, 2], [3, 4]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] + mat2[i][j]
        print("Addition of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()


#Python program to perform matrix operations, matrix addition,matrix subtraction,matrix multiplication - subtraction

mat1 = [[9, 2], [5, 3]]
mat2 = [[8, 1], [4, 2]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] - mat2[i][j]
        print("Subtraction of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()


#Python program to multiply two matrices

mat1 = [[9, 2], [5, 3]]
```

Prac1b.py - C:/DS/Prac1b.py (3.4.3)

File Edit Format Run Options Window Help

```
    print()


#Python program to perform matrix operations, matrix addition,matrix subtraction,matrix multiplication - subtraction

mat1 = [[9, 2], [5, 3]]
mat2 = [[8, 1], [4, 2]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] - mat2[i][j]
        print("Subtraction of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()


#Python program to multiply two matrices

mat1 = [[9, 2], [5, 3]]
mat2 = [[8, 1], [4, 2]]
mat3 = [[0, 0], [0, 0]]

for i in range(0, 2):

    for j in range(0, 2):

        mat3[i][j] = mat1[i][j] * mat2[i][j]
        print("Multiplication of two matrices")
for i in range(0, 2):
    for j in range(0, 2):
        print(mat3[i][j], end = "")
        print()
```

3

Python 3.4.3 Shell

File Edit Shell Debug Options Window Help

Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.1600 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ============================ RESTART ============================
>>>
Addition of two matrices
Addition of two matrices
Addition of two matrices
Addition of two matrices
2
4
6
8
Subtraction of two matrices
Subtraction of two matrices
Subtraction of two matrices
Subtraction of two matrices
1
1
1
1
Multiplication of two matrices
Multiplication of two matrices
Multiplication of two matrices
Multiplication of two matrices
72
2
20
6
>>> |

Practical 2

Aim :-Implement Linked List. Include options for insertion, deletion and search of a number, reverse the list and concatenate two linked lists **Theory:**

A linked list is a sequence of data elements, which are connected together via links. Each data element contains a connection to another data element in form of a pointer. Python does not have linked lists in its standard library. We implement the concept of linked lists using the concept of nodes as discussed in the previous chapter. We have already seen how we create a node class and how to traverse the elements of a node. In this chapter we are going to study the types of linked lists known as singly linked lists. In this type of data structure there is only one link between any two data elements. We create such a list and create additional methods to insert, update and remove elements from the list. Code

```python
# Name  :Sneha
# Rollno:4073
# Class :SYCS
class Stack():
    def __init__(self):
        self.items = ['4','3','2','1','bhavya']

    def end(self, item):
        self.items.append(item)
        print(item)

    def peek(self):
        if self.items:
            return self.items[-1]
        else:
            return None

    def size(self):
        if self.items:
            return len(self.items)
        else:
            return None

    def display(self):
        for i in self.items:
            print(i)
```

```python
print("Display the values one by one :")
s.display()
print("peek (End  Value) :", s.peek())
print("treverse the values : ")
s.traverse()
#Shotting element
print("Shotting the values : ")
s.shoting_element()
#reversing the list
print("Reversing  the values : ")
s.reverse()

print("remove value from particular index which is defined earlier")
s.remove_value_from_particular_index(0)

s1=merge1()
print("merge")
s1.merge()
```

Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54)
n32
Type "help", "copyright", "credits" or "license()" for more
>>>
===== RESTART: C:\Users\sneha\Downloads\DS-m
===
-1
6
7
search the specific value :
found Value : -2
Display the values one by one :
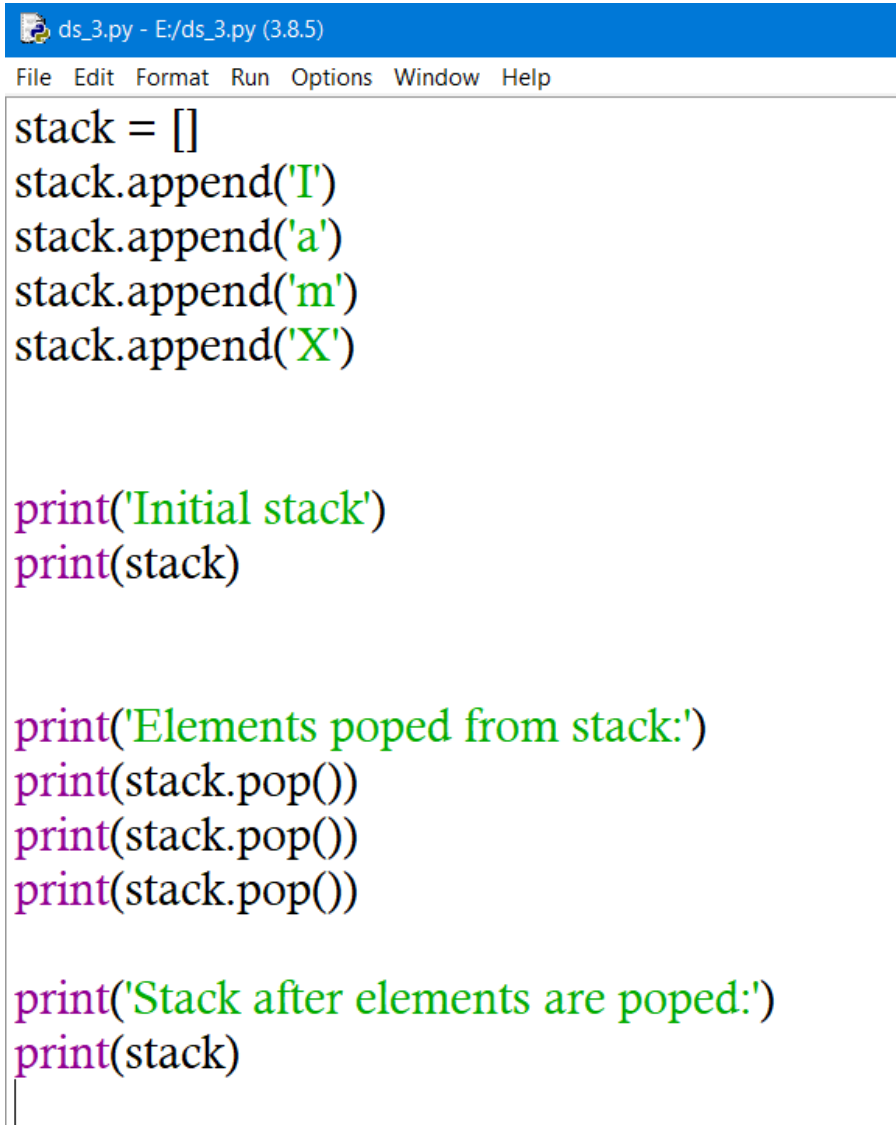-2
-1
5
-2
4
3
2
1

Practical :3-a

Aim: Implement the following for Stack

Theory:

Array is a container which can hold a fix number of items and these items should be of the same type. Most of the data structures make use of arrays to implement their algorithms. Following are the important terms to understand the concept of Array.

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

Index – Each location of an element in an array has a numerical index, which is used to identify the element.

```
ds_3.py - E:/ds_3.py (3.8.5)
File  Edit  Format  Run  Options  Window  Help
stack = []
stack.append('I')
stack.append('a')
stack.append('m')
stack.append('X')


print('Initial stack')
print(stack)


print('Elements poped from stack:')
print(stack.pop())
print(stack.pop())
print(stack.pop())

print('Stack after elements are poped:')
print(stack)
```

Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54) [MSC v.1924

n32

Type "help", "copyright", "credits" or "license()" for more information.

>>>

============================== RESTART: E:/ds_3.py

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

Initial stack

['I', 'a', 'm', 'X']

Elements poped from stack:

X

m

a

Stack after elements are poped:

['I']

>>>

Practical 3b

Aim: Implement Tower of Hanoi

Theory: Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:

1)   Only one disk can be moved at a time.

2)   Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack.

3)   No disk may be placed on top of a smaller disk. CODE:-

```
Prac3b.py - C:/DS/Prac3b.py (3.4.3)
File  Edit  Format  Run  Options  Window  Help
def hanoi(disks, source, auxiliary, target):
    if disks == 1:
        print('Move disk 1 from peg {} to peg {}.'.format(source, target))
        return

    hanoi(disks - 1, source, target, auxiliary)
    print('Move disk {} from peg {} to peg {}.'.format(disks, source, target))
    hanoi(disks - 1, auxiliary, source, target)


disks = int(input('Enter number of disks: '))
hanoi(disks, 'A', 'B', 'C')
```

```
Python 3.4.3 Shell
File  Edit  Shell  Debug  Options  Window  Help
Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.1600 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ============================== RESTART ==============================
>>>
Enter number of disks: 3
Move disk 1 from peg A to peg C.
Move disk 2 from peg A to peg B.
Move disk 1 from peg C to peg B.
Move disk 3 from peg A to peg C.
Move disk 1 from peg B to peg A.
Move disk 2 from peg B to peg C.
Move disk 1 from peg A to peg C.
>>>
```

Practical 3c

Aim : WAP to scan a polynomial using linked list and add two polynomial.

Theory: A linked list is a sequence of data elements, which are connected together via links. Each data element contains a connection to another data element in form of a pointer. Python does not have linked lists in its standard library. We implement the concept of linked lists using the concept of nodes as discussed in the previous chapter. We have already seen how we create a node class and how to traverse the elements of a node. In this chapter we are going to study the types of linked lists known as singly linked lists. In this type of data structure there is only one link between any two data elements. We create such a list and create additional methods to insert, update and remove elements from the list.

CODE

```
Practical 3c.py - C:\Users\sneha\Downloads\DS-master\DS-master\Practical 3c.py (3.8.5)
File  Edit  Format  Run  Options  Window  Help
#Sneha
#SYCS
#4073
def add(A, B, m, n):

        size = max(m, n);
        sum = [0 for i in range(size)]


        for i in range(0, m, 1):
                sum[i] = A[i]


        for i in range(n):
                sum[i] += B[i]

        return sum


def printPoly(poly, n):
        for i in range(n):
                print(poly[i], end = "")
                if (i != 0):
                        print("x^", i, end = "")
                if (i != n - 1):
                        print(" + ", end = "")
```
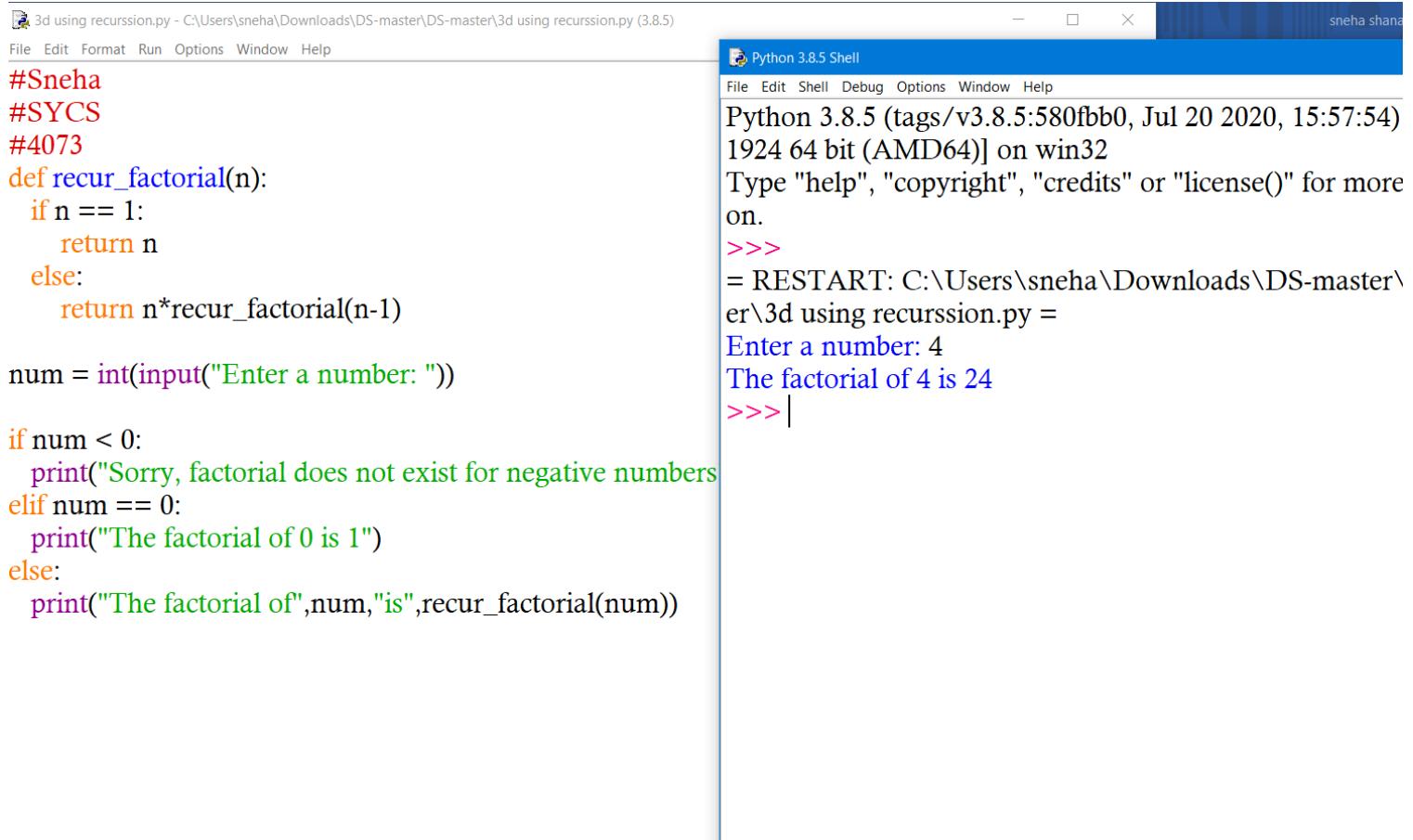
OUTPUT \

Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54) [MSC v.1924 64 l
n32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Users\sneha\Downloads\DS-master\DS-master
==
First polynomial is
5 + 0x^ 1 + 10x^ 2 + 6x^ 3
Second polynomial is
1 + 2x^ 1 + 4x^ 2
sum polynomial is
6 + 2x^ 1 + 14x^ 2 + 6x^ 3
>>>

Practical 3d

Aim:

d. WAP to calculate factorial and to compute the factors of a given no. (i) using recursion, (ii) using iteration.

(i) using recursion

```
#Sneha
#SYCS
#4073
def recur_factorial(n):
    if n == 1:
        return n
    else:
        return n*recur_factorial(n-1)

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

if num < 0:
    print("Sorry, factorial does not exist for negative numbers")
elif num == 0:
    print("The factorial of 0 is 1")
else:
    print("The factorial of",num,"is",recur_factorial(num))
```
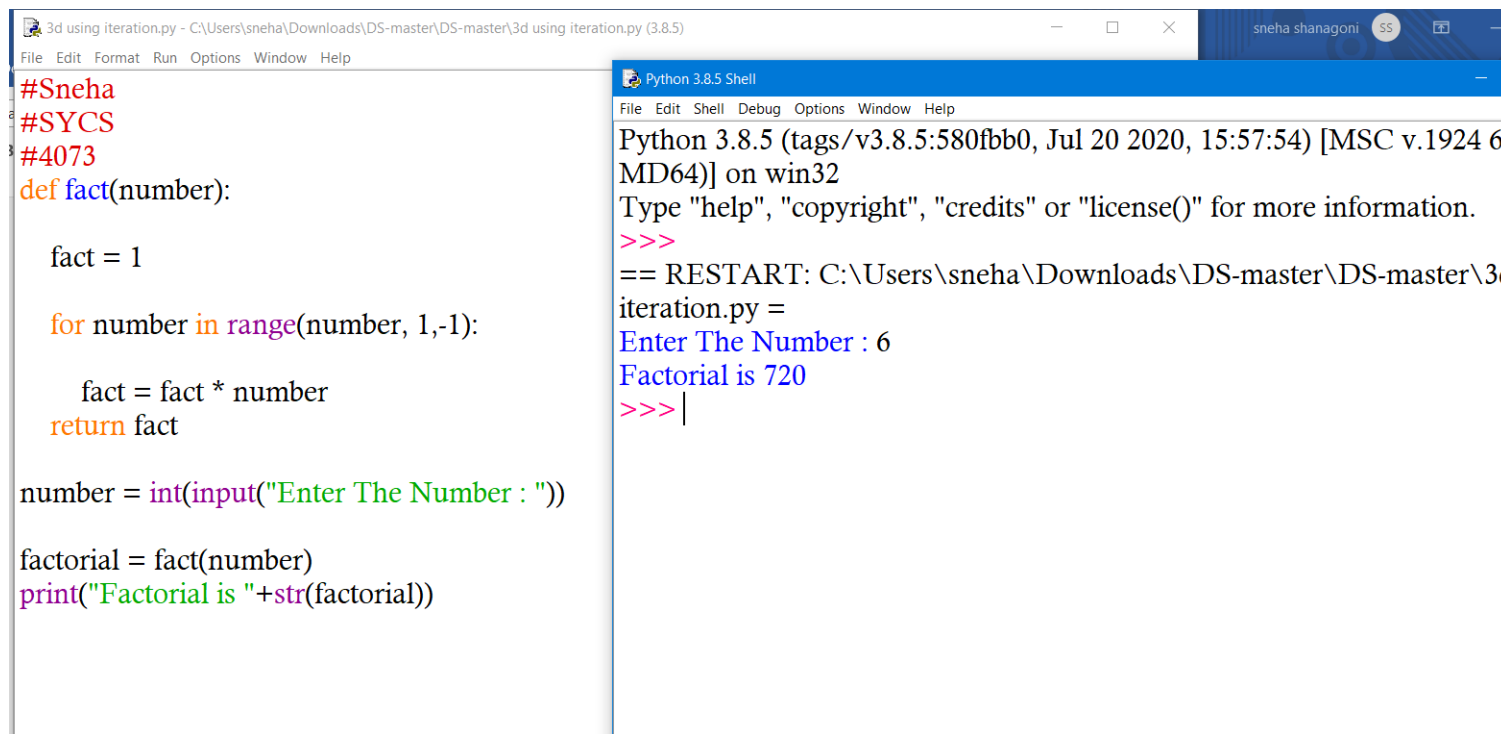
```
Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54)
1924 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more
on.
>>>
= RESTART: C:\Users\sneha\Downloads\DS-master\
er\3d using recurssion.py =
Enter a number: 4
The factorial of 4 is 24
>>>
```

OUTPUT:-

(ii) using iteration

Code:

```
#Sneha
#SYCS
#4073
def fact(number):

    fact = 1

    for number in range(number, 1,-1):

        fact = fact * number
    return fact

number = int(input("Enter The Number : "))

factorial = fact(number)
print("Factorial is "+str(factorial))
```

Python 3.8.5 Shell

Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54) [MSC v.1924 6
MD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
```
>>>
== RESTART: C:\Users\sneha\Downloads\DS-master\DS-master\3
iteration.py =
Enter The Number : 6
Factorial is 720
>>>
```

OUTPUT:-

Practical : 4

Aim: Perform Queues operations using Circular Array implementation.

Theory: A Circular Queue is a queue data structure but circular in shape, therefore after the last position, the next place in the queue is the first position.

We recommend you to first go through the Linear Queue tutorial before Circular queue, as we will be extending the same implementation.

In case of Linear queue, we did not had the head and tail pointers because we used python **List** for implementing it. But in case of a circular queue, as the size of the queue is fixed, hence we will set a maxSize for our list used for queue implementation. CODE:-

OUTPUT:-

```
#sneha
#SYCS
#4073
class Stack():
    def __init__(self):
        self.items = [1,2,3,4,5]


    def enque(self,item):
        self.items.append(item)
        print(item)


    def deque(self):
        b= self.items
        b.pop()
        print(b)


    def traverse(self):
        a = []
        l = self.items
        for i in l:
            a.append(i)
        print(a)

s=Stack()
```

```
Python 3.8.5 Shell
File   Edit   Shell   Debug   Options   Window   Help
Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54) [MSC v.1924 64 bit (AI
n32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Users\sneha\Downloads\DS-master\DS-master\Pract
===
Adding the element in the queue :
6
initial queue :
[1, 2, 3, 4, 5, 6]
After removing an element from the queue :
[1, 2, 3, 4, 5]
>>>
```

Practical 5

Aim: Write a program to search an element from a list. Give user the option to perform Linear or Binary search.

Thoery:

Searching is a very basic necessity when you store data in different data structures. The simplest approach is to go across every element in the data structure and match it with the value you are searching for. This is known as Linear search. It is inefficient and rarely used, but creating a program for it gives an idea about how we can implement some advanced search algorithms.

Linear Search:

In this type of search, a sequential search is made over all items one by one. Every item is checked and if a match is found then that particular item is returned, otherwise the search continues till the end of the data structure.

Binary Search:

Search a sorted array by repeatedly dividing the search interval in half. Begin with an interval covering the whole array. If the value of the search key is less than the item in the middle of the interval, narrow the interval to the lower half. Otherwise narrow it to the upper half. Repeatedly check until the value is found or the interval is empty. CODE:-

```
Prac5.py - C:\DS\Prac5.py (3.4.3)
File  Edit  Format  Run  Options  Window  Help
list1 = [1,2,3,4,5,6,7,8,9,10]
print("List = ",list1)
size = len(list1)
def binary_search(x):
    print("BINARY SEARCHING")
    low = 0
    high = len(list1) - 1
    mid = 0
    while low <= high:
        mid = (high + low) // 2
        if list1[mid] < x:
            low = mid + 1
        elif list1[mid] > x:
            high = mid - 1
        else:
            return mid
    return "None it not in the list"


def linear_search(n):
        print("LINEAR SEARCHING")
        if n not in list1:
                print(n,"not in the list")
        else:
                for i in range(size):
                        if list1[i]==n:
                                print("index of ", n," is ",i)

n = input("Enter (L) for Linear search and  (B) for Binary search :")
if n=="L" or n=="l":
        y = int(input("Enter a no. from the given list1 "))
        linear_search(y)
elif n=="B" or n=="b":
        y = int(input("Enter a no. from the given list1 "))
        print("index of ",y," is ",binary_search(y))
else:
        print("Invalid input")
```

File Edit Format Run Options Window Help

```python
list1 = [5,1,78,3,45,12,4,15,44,34,62,54]
print("List = ",list1)
n = len(list1)
def bubbleSort():
    print("Bubble Sorting")
    for i in range(n-1):
        for j in range(0, n-i-1):
            if list1[j] > list1[j+1] :
                list1[j], list1[j+1] = list1[j+1], list1[j]
    print(list1)

def SelectionSort():
        print("Selection Sorting")
        for i in range(n):
                for j in range(i):
                        if list1[i]<list1[j]:
                                list1[i],list1[j] = list1[j],list1[i]
        print(list1)

def InsertionSort():
    print("Insertion Sorting")
    for i in range(1, n):
        c = list1[i]
        j = i-1
        while j >=0 and c < list1[j] :
                list1[j+1] = list1[j]
                j -= 1
        list1[j+1] = c
    print(list1)

inp = input("Enter (B) for Bubble Sort, (S) for elsection Sort and (I) for Insertion Sort \n Enter here:")
if inp=="B" or inp=="b":
        bubbleSort()
elif inp=="S" or inp=="s":
        SelectionSort()
elif inp=="I" or inp=="i":
        InsertionSort()
else:
        print("Invalid input")
```

File Edit Shell Debug Options Window Help

```
Python 3.4.3 (v3.4.3:9b73f1c3e601, Feb 24 2015, 22:43:06) [MSC v.1600 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ============================== RESTART ==============================
>>>
List =  [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
Enter (L) for Linear search and  (B) for Binary search :B
Enter a no. from the given list1 9
BINARY SEARCHING
index of  9  is  8
>>> ============================== RESTART ==============================
>>>
List =  [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
Enter (L) for Linear search and  (B) for Binary search :L
Enter a no. from the given list1 9
LINEAR SEARCHING
index of  9  is  8
>>> |
```

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Practical 6

Aim: WAP to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.

Theory:

Sorting refers to arranging data in a particular format. Sorting algorithm specifies the way to arrange data in a particular order. Most common orders are in numerical or lexicographical order. The importance of sorting lies in the fact that data searching can be optimized to a very high level, if data is stored in a sorted manner. Sorting is also used to represent data in more readable formats. Below we see five such implementations of sorting in python.

Bubble Sort

It is a comparison-based algorithm in which each pair of adjacent elements is compared and the elements are swapped if they are not in order.

Insertion Sort

Insertion sort involves finding the right place for a given element in a sorted list. So in beginning we compare the first two elements and sort them by comparing them. Then we pick the third element and find its proper position among the previous two sorted elements. This way we gradually go on adding more elements to the already sorted list by putting them in their proper position.

Selection Sort

In selection sort we start by finding the minimum value in a given list and move it to a sorted list. Then we repeat the process for each of the remaining elements in the unsorted list. The next element entering the sorted list is compared with the existing elements and placed at its correct position. So at the end all the elements from the unsorted list are sorted.

Practical :7 a

Aim : Implement the following for Hashing

    a. Write a program to implement the collision technique

Hash tables are a type of data structure in which the address or the index value of the data element is generated from a hash function. That makes accessing the data faster as the index value behaves as a key for the data value. In other words Hash table stores key-value pairs but the key is generated through a hashing function.

So the search and insertion function of a data element becomes much faster as the key values themselves become the index of the array which stores the data.

In Python, the Dictionary data types represent the implementation of hash tables. The Keys in the dictionary satisfy the following requirements.

- The keys of the dictionary are hash able i.e. the are generated by hashing function which generates unique result for each unique value supplied to the hash function.
- The order of data elements in a dictionary is not fixed.

Code:

OUTPUT:-

```
# Name  :sneha
# Rollno:4073
# Class :SYCS
class Hash:
    def __init__(self, keys, lowerrange, higherran
        self.value = self.hashfunction(keys,lowerra

    def get_key_value(self):
        return self.value

    def hashfunction(self,keys,lowerrange, highe
        if lowerrange == 0 and higherrange > 0:
            return keys%(higherrange)

if __name__ == '__main__':
    list_of_keys = [23,43,1,87]
    list_of_list_index = [None,None,None,None]
    print("Before : " + str(list_of_list_index))
    for value in list_of_keys:

        list_index = Hash(value,0,len(list_of_keys)
        if list_of_list_index[list_index]:
            print("Collission detected")
        else:
            list_of_list_index[list_index] = value
```

```
Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54) [MSC v.19
n32
Type "help", "copyright", "credits" or "license()" for more informatio
>>>
===== RESTART: C:\Users\sneha\Downloads\DS-master\DS-r
===
Before : [None, None, None, None]
Collission detected
Collission detected
After: [None, 1, None, 23]
>>>
```

PRACTICAL 7b

Aim: b. Write a program to implement the concept of linear probing

Theory:

Hashing is an important Data Structure which is designed to use a special function called the Hash function which is used to map a given value with a particular key for faster access of elements. The efficiency of mapping depends of the efficiency of the hash function used.

In Open Addressing, all elements are stored in the hash table itself. So at any point, size of table must be greater than or equal to total number of keys (Note that we can increase table size by copying old data if needed).

Code:

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```
# Name  :Sneha
# Rollno:4073
# Class :SYCS
class Hash:
    def __init__(self, keys, lowerrange, highe
        self.value = self.hashfunction(keys, lo

    def get_key_value(self):
        return self.value

    def hashfunction(self, keys, lowerrange,
        if lowerrange == 0 and higherrange >
            return keys % (higherrange)


if __name__ == '__main__':
    linear_probing = True
    list_of_keys = [23, 43, 1, 87,32,34,67,77,4
    list_of_list_index = [None]*len(list_of_k
    print("Before : " + str(list_of_list_index))
    for value in list_of_keys:
        # print(Hash(value,0,len(list_of_keys)
        list_index = Hash(value, 0, len(list_of
        print("hash value for " + str(value) +
        if list_of_list_index[list_index]:
            print("Collission detected for " + st
            if linear_probing:
```

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```
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n32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Users\sneha\Downloads\DS-master\DS-master\practical7b.py
===
Before : [None, None, None, None, None, None, None, None, None, None]
hash value for 23 is :3
hash value for 43 is :3
Collission detected for 43
hash value for 1 is :1
hash value for 87 is :7
hash value for 32 is :2
hash value for 34 is :4
Collission detected for 34
hash value for 67 is :7
Collission detected for 67
hash value for 77 is :7
Collission detected for 77
hash value for 45 is :5
Collission detected for 45
hash value for 54 is :4
Collission detected for 54
After: [54, 1, 32, 23, 43, 34, 45, 87, 67, 77]
>>>
```

Practical 8

Aim : Write a program for inorder, postorder and preorder traversal of tree

Theory: Unlike linear data structures (Array, Linked List, Queues, Stacks, etc) which have only one logical way to traverse them, trees can be traversed in different ways. Following are the generally used ways for traversing trees.

Depth First Traversals:

(a) Inorder (Left, Root, Right)

(b) Preorder (Root, Left, Right)

(c) Postorder (Left, Right, Root)

Code:-

```python
# Name  :Sneha
# Rollno:4073
# Class :SYCS
import random

random.seed(23)

class Node:
    def __init__(self, val):
        self.val = val
        self.leftChild = None
        self.rightChild = None


def insert(root, key):
    if root is None:
        return Node(key)

    else:
        if root.val == key:
            return root
        elif root.val < key:
            root.rightChild = insert(root.rightC
        else:
            root.leftChild = insert(root.leftChild

    return root
```

```
Python 3.8.5 (tags/v3.8.5:580fbb0, Jul 20 2020, 15:57:54) [MSC v.1924 64 bit (AMD
n32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
====== RESTART: C:\Users\sneha\Downloads\DS-master\DS-master\practica
===
inorder
4 12 18 20 39 41 47 50 56 69 77

preorder
20 12 4 18 39 77 41 56 50 47 69

postorder
4 18 12 47 50 69 56 41 77 39 20
>>>
```