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

CERTIFICATE

Name: Umang Raichura ___________

Roll No: 380 Programme: BSc IT 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)

Class: S.Y. B.Sc. IT Sem- III **Roll No: 380**

Subject: Data Structures

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8	23/10/2020	Write a program for inorder, postorder and preorder traversal of tree.	

Git repository link:- Data-Structures-practicals

1 Implement the following for Array:

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

What is searching?
Searching is the process of finding a given value position in a list of values. It decides whether a search key is present in the data or not. It is the algorithmic process of finding a particular item in a collection of items.

What are some searching algorithms?
Linear Search :
A simple approach is to do a linear search, i.e

- Start from the leftmost element of arr[] and one by one compare x with each element of arr[]
- If x matches with an element, return the index.
- If x doesn't match with any of elements, return -1.

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.

Sorting:

Sorting means arranging the elements of a list in a specific order.

There are many sorting algorithms like:

- Bubble sort
- Merge sort
- Selection Sort
- Insersion Sort
- Quick sort etc

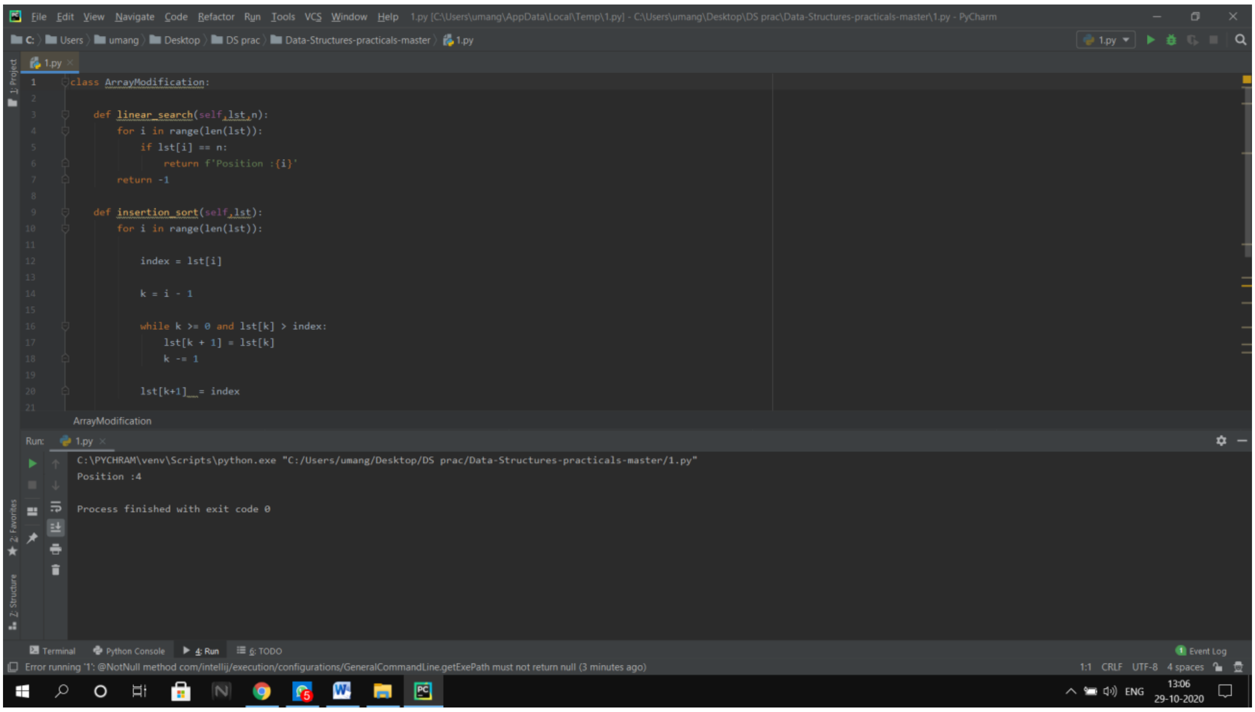
Merging:

Merging means to join two list.

Reversing:

Reversing means the to arrang e the elements of the list in reverse order.

In the Code below one of the searchig and sorting techniuques have been applied.



```
class ArrayModification:

    def linear_search(self,lst,n):
        for i in range(len(lst)):
            if lst[i] == n:
                return f'Position :{i}'
        return -1

    def insertion_sort(self,lst):
        for i in range(len(lst)):

            index = lst[i]

            k = i - 1

            while k >= 0 and lst[k] > index:
                lst[k + 1] = lst[k]
                k -= 1

            lst[k+1] = index

```

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/1.py"
Position :4

Process finished with exit code 0
```

```
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (3 minutes ago)
```

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

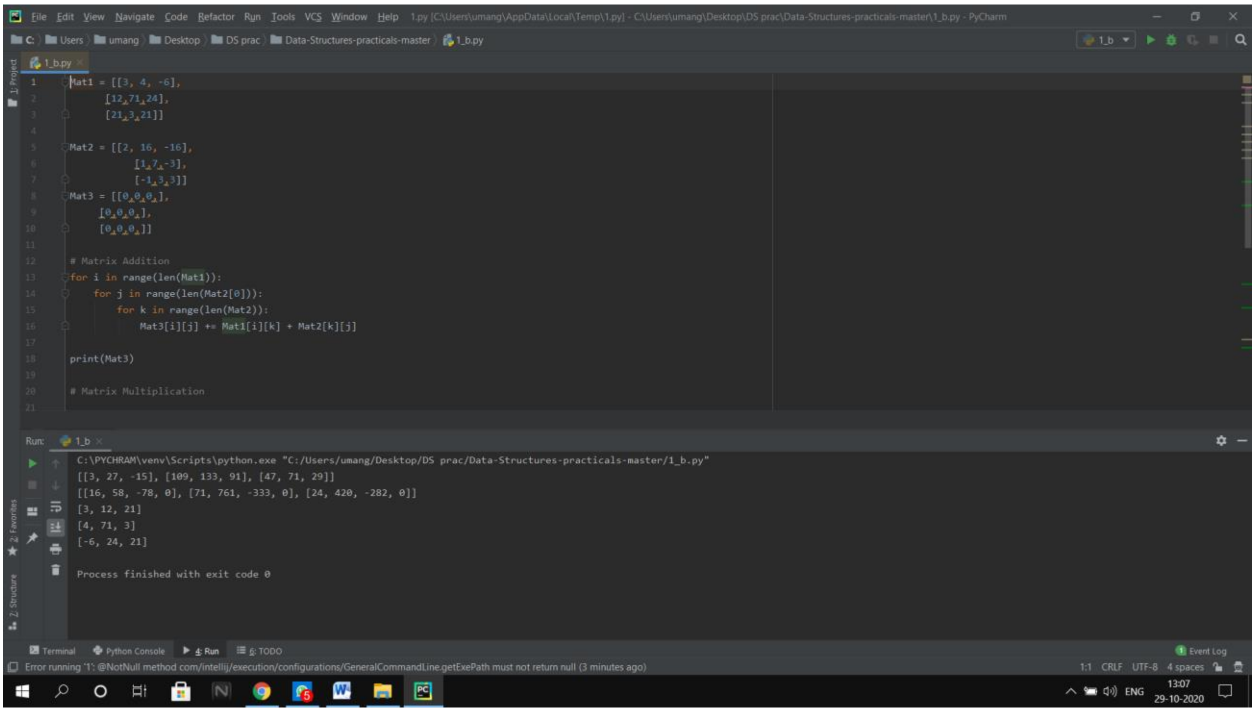
Theory

Matrix Addition: Matrix addition is the operation of adding two matrices by adding the corresponding entries together. The matrix can be added only when the number of rows and columns of the first matrix is equal to the number of rows and columns of the second matrix.

Matrix Multiplication: We can multiply two matrices if, and only if, the number of columns in the first matrix equals the number of rows in the second matrix. Otherwise, the product of two matrices is undefined.

Matrix Transpose: If A=[aij] be a matrix of order m x n, then the matrix obtained by interchanging the rows and columns of A is known as Transpose of matrix A. Transpose of matrix A is represented by AT.

Code and Output:



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\1_b.py - PyCharm
C: › Users › umang › Desktop › DS prac › Data-Structures-practicals-master › 1_b.py
1_b.py
Run: 1_b
Terminal
Python Console
4: Run
6: TODO
Event Log
1:1 CRLF UTF-8 4 spaces
ENG
13:07
29-10-2020

```python
Mat1 = [[3, 4, -6],
        [12,71,24],
        [21,3,21]]

Mat2 = [[2, 16, -16],
            [1,7,-3],
            [-1,3,3]]
Mat3 = [[0,0,0,],
      [0,0,0,],
      [0,0,0,]]

# Matrix Addition
for i in range(len(Mat1)):
    for j in range(len(Mat2[0])):
        for k in range(len(Mat2)):
            Mat3[i][j] += Mat1[i][k] + Mat2[k][j]

print(Mat3)

# Matrix Multiplication
```

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/1_b.py"
[[3, 27, -15], [109, 133, 91], [47, 71, 29]]
[[16, 58, -78, 0], [71, 761, -333, 0], [24, 420, -282, 0]]
[3, 12, 21]
[4, 71, 3]
[-6, 24, 21]

Process finished with exit code 0
```

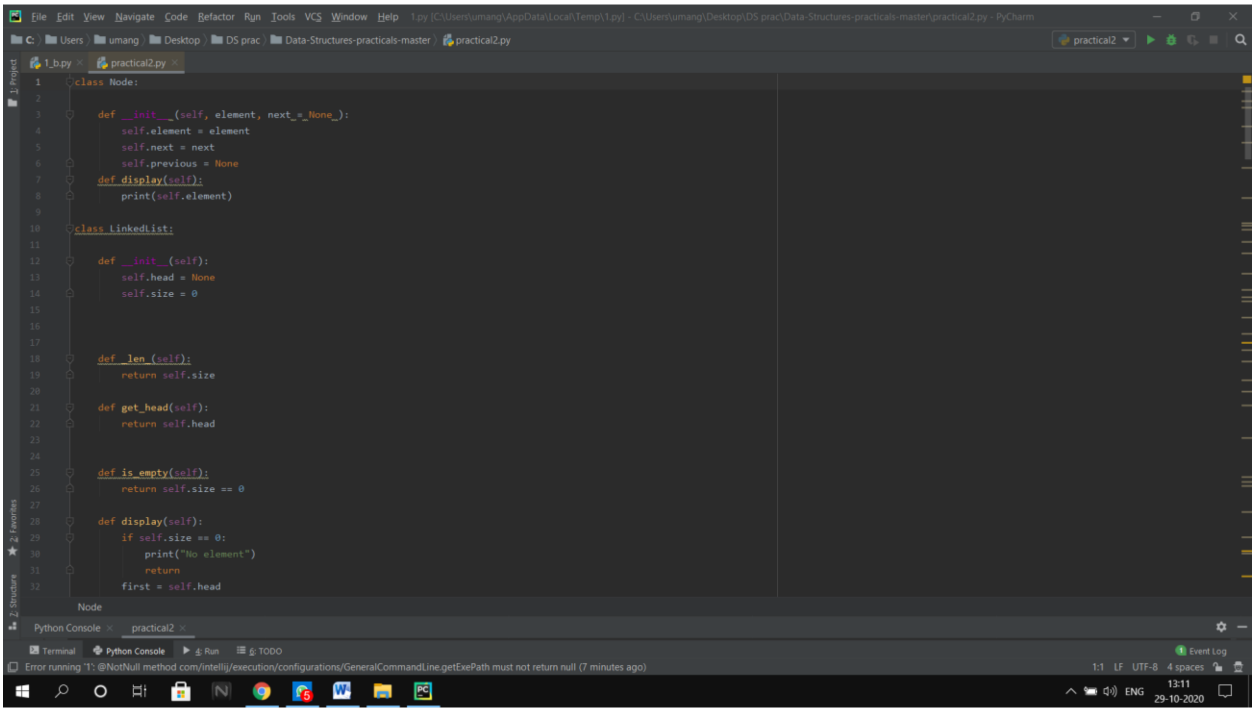
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (3 minutes ago)

2.

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

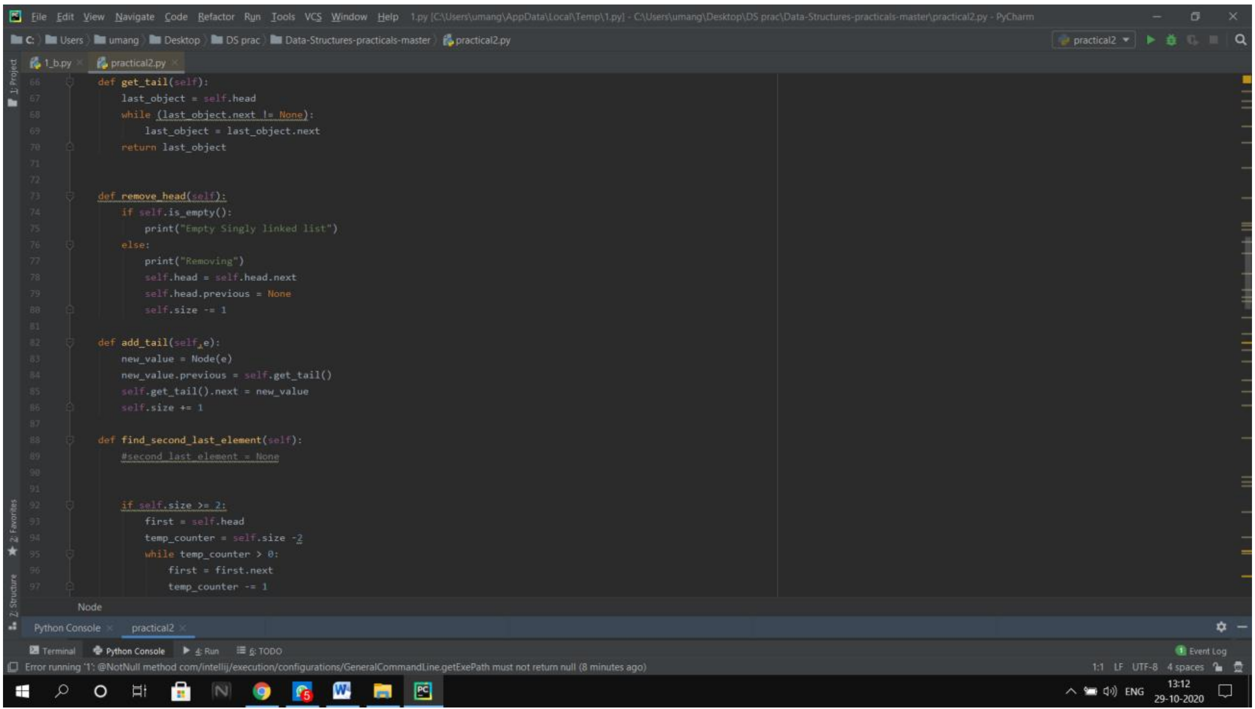
Theory

Singly Linked List:
A singly linked list, in its simplest form, is a collection of nodes that collectively form a linear sequence. Each node stores a reference to an object that is an element of the sequence, as well as a reference to the next node of the list
Doubly Linked List:
In a singly linked list, each node maintains a reference to the node that is immediately after it. However, there are limitations that stem from the asymmetry of a singly linked list. To provide greater symmetry, we define a linked list in which each node keeps an explicit reference to the node before it and a reference to the node after it.
Such a structure is known as a doubly linked list. These lists allow a greater variety of O (1)-time update operations, including insertions and deletions at arbitrary positions within the list. We continue to use the term "next" for the reference to the node that follows another, and we introduce the term "prey" for the reference to the node that precedes it. With array-based sequences, an integer index was a convenient means for describing a position within a sequence. However, an index is not convenient for linked lists as there is no efficient way to find the jth element; it would seem to require a traversal of a portion of the list.
When working with a linked list, the most direct way to describe the location of an operation is by identifying a relevant node of the list. However, we prefer to encapsulate the inner workings of our data structure to avoid having users directly access nodes of a list.


File Edit View Navigate Code Refactor Run Tools VCS Window Help
1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical2.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical2.py
practical2
1_b.py
practical2.py
1: Project
2: Favorites
Z: Structure
Node
Python Console
practical2
Terminal
Python Console
4: Run
6: TODO
Event Log
1:1 LF UTF-8 4 spaces
ENG
13:11
29-10-2020

```python
class Node:

    def __init__(self, element, next = None ):
        self.element = element
        self.next = next
        self.previous = None
    def display(self):
        print(self.element)

class LinkedList:

    def __init__(self):
        self.head = None
        self.size = 0



    def __len__(self):
        return self.size

    def get_head(self):
        return self.head


    def is_empty(self):
        return self.size == 0

    def display(self):
        if self.size == 0:
            print("No element")
            return
        first = self.head
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (7 minutes ago)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Node
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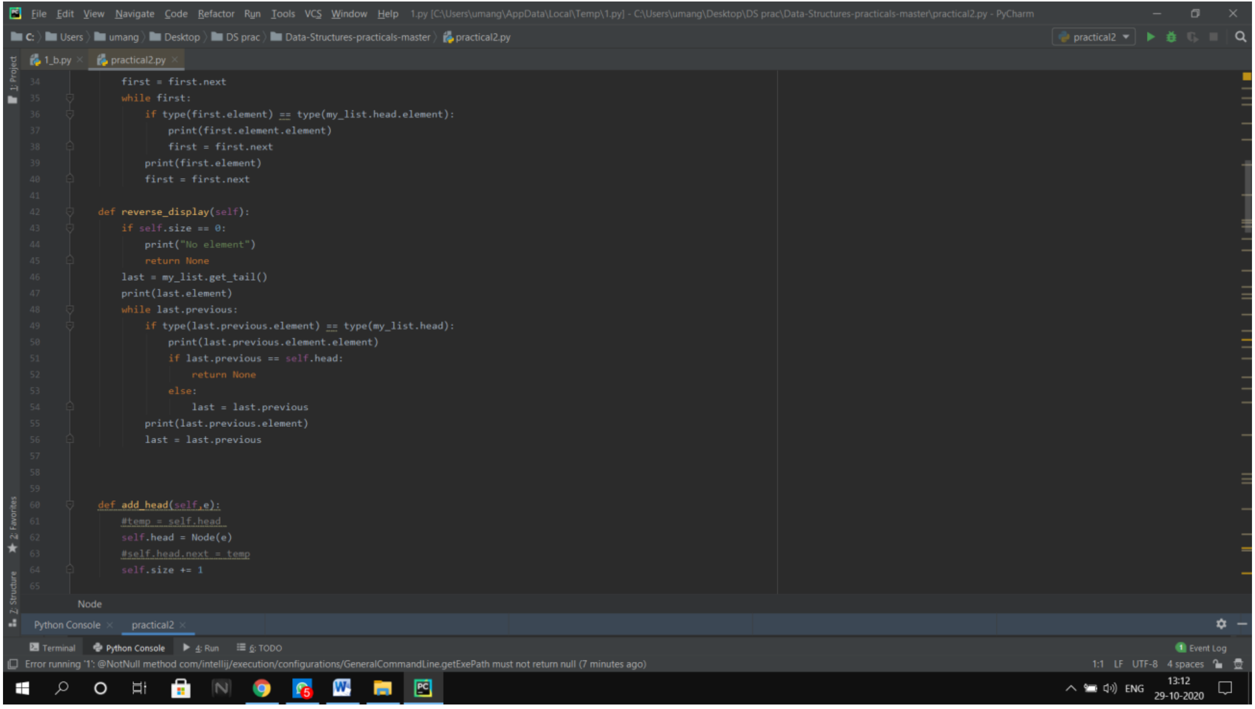
ENG 13:12 29-10-2020

```
    def get_tail(self):
        last_object = self.head
        while (last_object.next != None):
            last_object = last_object.next
        return last_object


    def remove_head(self):
        if self.is_empty():
            print("Empty Singly linked list")
        else:
            print("Removing")
            self.head = self.head.next
            self.head.previous = None
            self.size -= 1

    def add_tail(self,e):
        new_value = Node(e)
        new_value.previous = self.get_tail()
        self.get_tail().next = new_value
        self.size += 1

    def find_second_last_element(self):
        #second_last_element = None


        if self.size >= 2:
            first = self.head
            temp_counter = self.size -2
            while temp_counter > 0:
                first = first.next
                temp_counter -= 1
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (8 minutes ago)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Node
Python Console practical2
Terminal Python Console 4: Run 6: TODO Event Log
1:1 LF UTF-8 4 spaces
ENG 13:12 29-10-2020

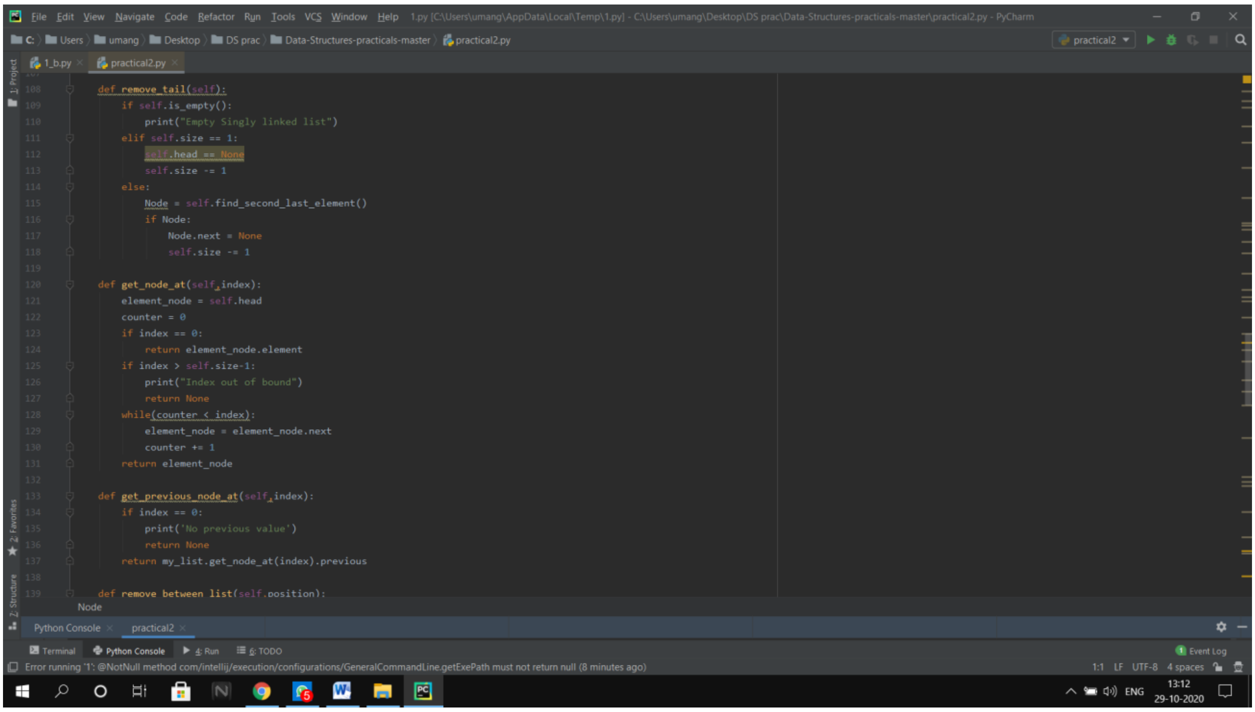
```
        first = first.next
        while first:
            if type(first.element) == type(my_list.head.element):
                print(first.element.element)
                first = first.next
            print(first.element)
            first = first.next

    def reverse_display(self):
        if self.size == 0:
            print("No element")
            return None
        last = my_list.get_tail()
        print(last.element)
        while last.previous:
            if type(last.previous.element) == type(my_list.head):
                print(last.previous.element.element)
                if last.previous == self.head:
                    return None
                else:
                    last = last.previous
            print(last.previous.element)
            last = last.previous



    def add_head(self,e):
        #temp = self.head
        self.head = Node(e)
        #self.head.next = temp
        self.size += 1
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (7 minutes ago)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Node
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practical2
Terminal
Python Console
4: Run
6: TODO
Event Log
1:1 LF UTF-8 4 spaces
ENG
13:12
29-10-2020

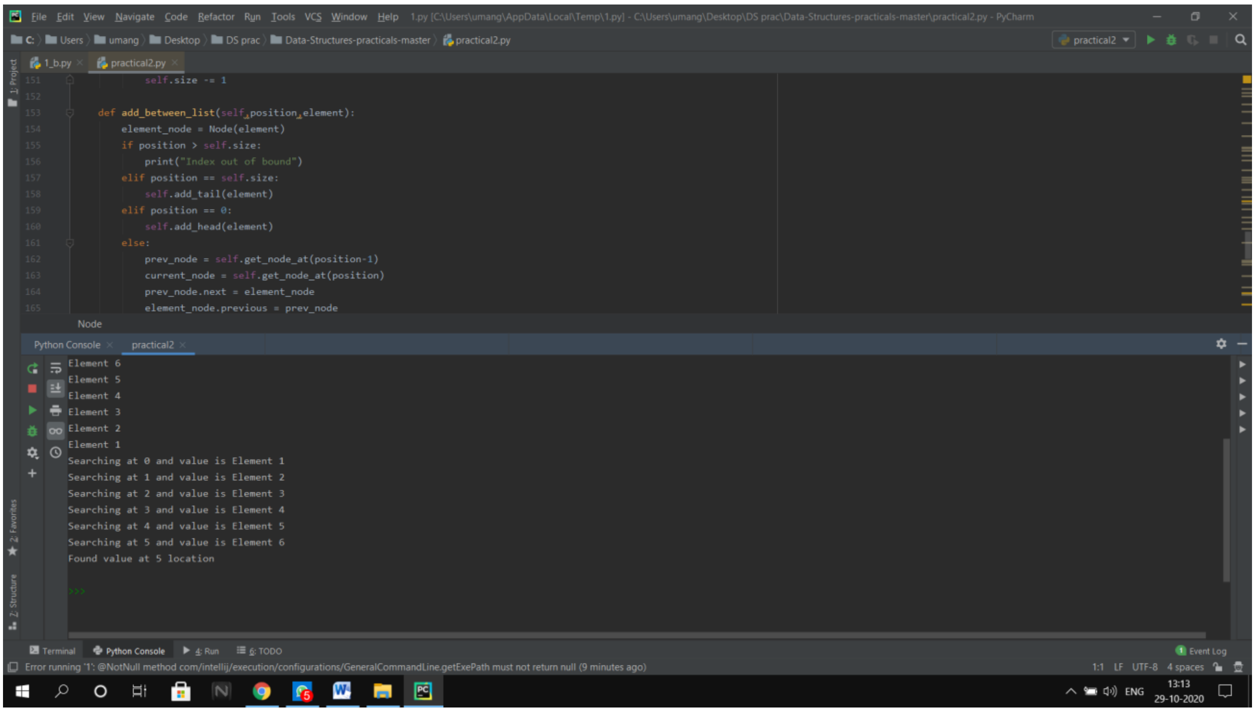
```
    def remove_tail(self):
        if self.is_empty():
            print("Empty Singly linked list")
        elif self.size == 1:
            self.head == None
            self.size -= 1
        else:
            Node = self.find_second_last_element()
            if Node:
                Node.next = None
                self.size -= 1

    def get_node_at(self,index):
        element_node = self.head
        counter = 0
        if index == 0:
            return element_node.element
        if index > self.size-1:
            print("Index out of bound")
            return None
        while(counter < index):
            element_node = element_node.next
            counter += 1
        return element_node

    def get_previous_node_at(self,index):
        if index == 0:
            print('No previous value')
            return None
        return my_list.get_node_at(index).previous

    def remove between list(self.position):
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (8 minutes ago)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Python Console
4: Run
6: TODO
Event Log
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ENG
13:13
29-10-2020

```
            self.size -= 1

    def add_between_list(self,position,element):
        element_node = Node(element)
        if position > self.size:
            print("Index out of bound")
        elif position == self.size:
            self.add_tail(element)
        elif position == 0:
            self.add_head(element)
        else:
            prev_node = self.get_node_at(position-1)
            current_node = self.get_node_at(position)
            prev_node.next = element_node
            element_node.previous = prev_node
```

```
Element 6
Element 5
Element 4
Element 3
Element 2
Element 1
Searching at 0 and value is Element 1
Searching at 1 and value is Element 2
Searching at 2 and value is Element 3
Searching at 3 and value is Element 4
Searching at 4 and value is Element 5
Searching at 5 and value is Element 6
Found value at 5 location

>>>
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (9 minutes ago)

3. Implement the following for Stack:

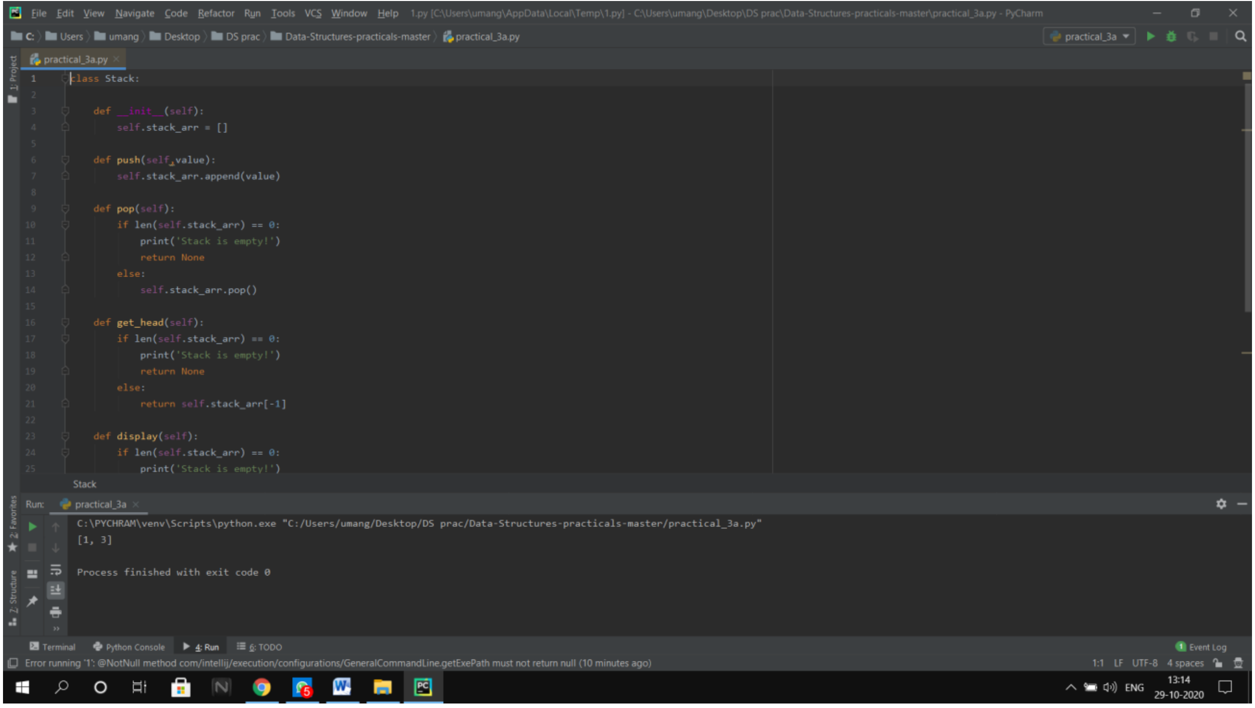
a.

Aim: Perform Stack operations using Array implementation.

Theory

Stack:
A stack is a collection of objects that are inserted and removed according to the last-in, first-out (LIFO) principle. A user may insert objects into a stack at any time, but may only access or remove the most recently inserted object that remains (at the so-called “top” of the stack). We can implement a stack quite easily by storing its elements in a Python list. The list class already supports adding an element to the end with the append method, and removing the last element with the pop method, so it is natural to align the top of the stack at the end of the list.
Stack is an abstract data type (ADT) such that an instance S supports the following two methods:
S.push(e): Add element e to the top of stack S.
S.pop(): Remove and return the top element from the stack S;
an error occurs if the stack is empty.

Code and output:



```
class Stack:

    def __init__(self):
        self.stack_arr = []

    def push(self,value):
        self.stack_arr.append(value)

    def pop(self):
        if len(self.stack_arr) == 0:
            print('Stack is empty!')
            return None
        else:
            self.stack_arr.pop()

    def get_head(self):
        if len(self.stack_arr) == 0:
            print('Stack is empty!')
            return None
        else:
            return self.stack_arr[-1]

    def display(self):
        if len(self.stack_arr) == 0:
            print('Stack is empty!')
```

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_3a.py"
[1, 3]

Process finished with exit code 0
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (10 minutes ago)

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practical_3a
practical_3a.py
Stack
Run: practical_3a
Terminal
Python Console
4: Run
6: TODO
Event Log
1:1 LF UTF-8 4 spaces
ENG
13:14
29-10-2020

b.

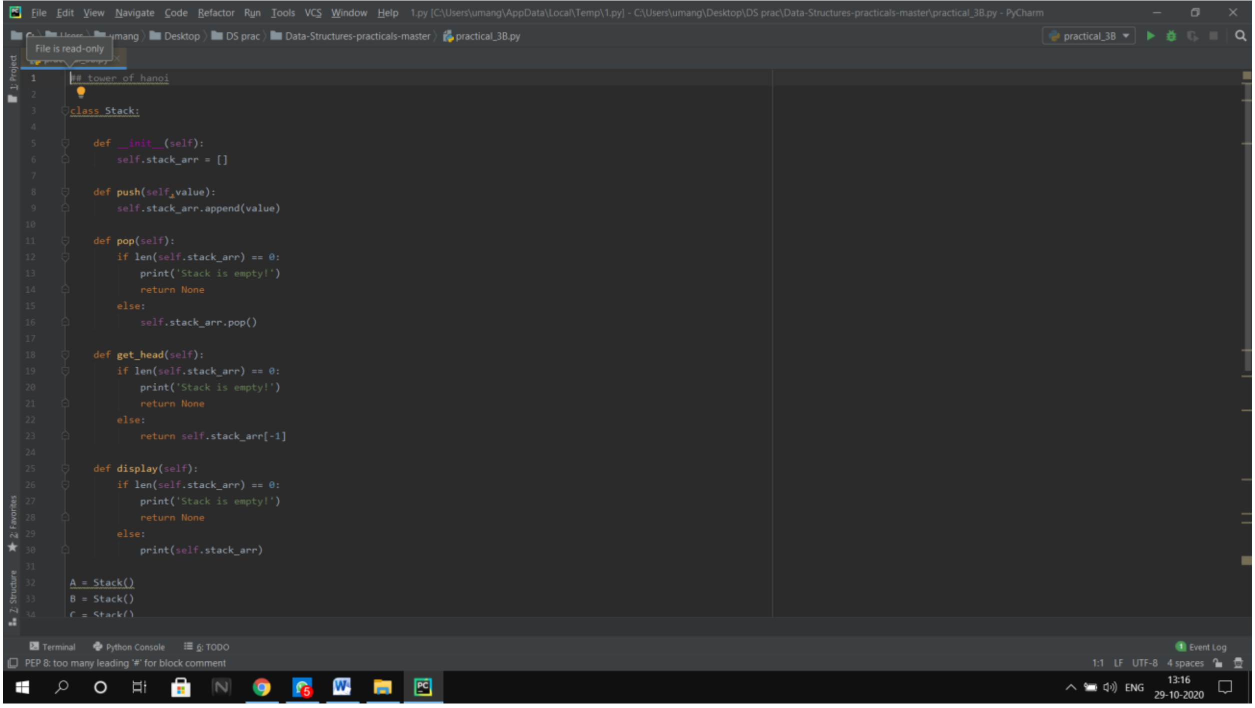
Aim: Implement Tower of Hanoi

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.
To write an algorithm for Tower of Hanoi, first we need to learn how to solve this problem with lesser number of disks, say → 1 or 2. We mark three towers with name, source, destination and aux (only to help moving the disks). If we have only one disk, then it can easily be moved from source to destination peg.
If we have 2 disks −
First, we move the smaller (top) disk to aux peg.
Then, we move the larger (bottom) disk to destination peg.
And finally, we move the smaller disk from aux to destination peg.
So now, we are in a position to design an algorithm for Tower of Hanoi with more than two disks. We divide the stack of disks in two parts. The largest disk (nth disk) is in one part and all other (n-1) disks are in the second part.
Our ultimate aim is to move disk n from source to destination and then put all other (n1) disks onto it. We can imagine to apply the same in a recursive way for all given set of disks. Each peg is a Stack object.

Code and output


File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_3B.py - PyCharm
umang › Desktop › DS prac › Data-Structures-practicals-master › practical_3B.py
File is read-only
practical_3B
1: Project
2: Favorites
Z: Structure
Terminal
Python Console
6: TODO
Event Log
1:1 LF UTF-8 4 spaces
ENG
13:16
29-10-2020

```
## tower of hanoi

class Stack:

    def __init__(self):
        self.stack_arr = []

    def push(self,value):
        self.stack_arr.append(value)

    def pop(self):
        if len(self.stack_arr) == 0:
            print('Stack is empty!')
            return None
        else:
            self.stack_arr.pop()

    def get_head(self):
        if len(self.stack_arr) == 0:
            print('Stack is empty!')
            return None
        else:
            return self.stack_arr[-1]

    def display(self):
        if len(self.stack_arr) == 0:
            print('Stack is empty!')
            return None
        else:
            print(self.stack_arr)

A = Stack()
B = Stack()
C = Stack()
```

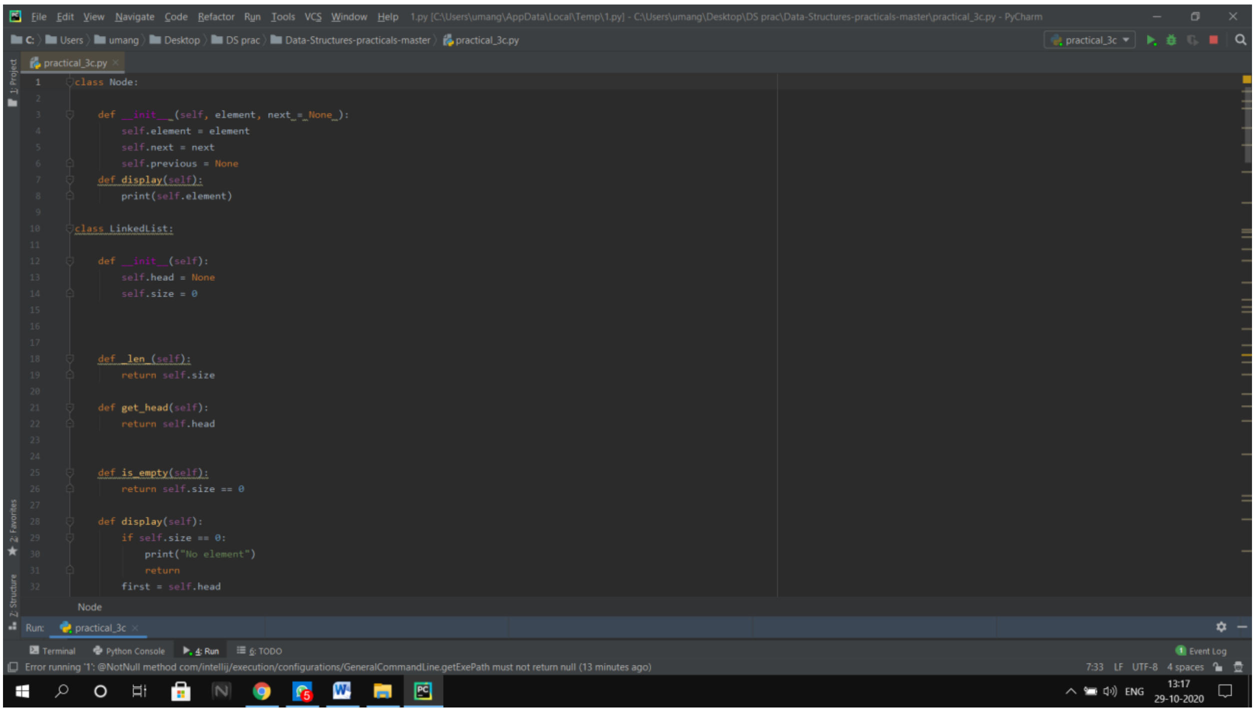
PEP 8: too many leading '#' for block comment

c.

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

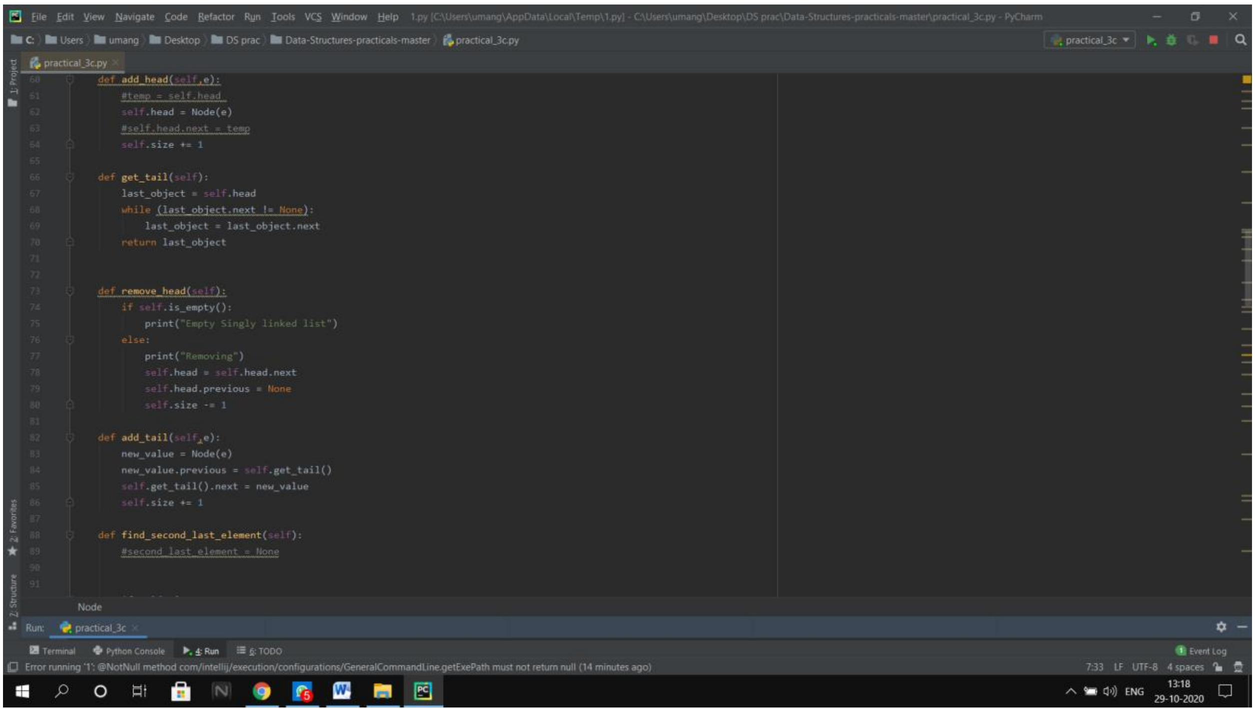
Theory

Different operations can be performed on the polynomials like addition, subtraction, multiplication, and division. A polynomial is an expression within which a finite number of constants and variables are combined using addition, subtraction, multiplication, and exponents. Adding and subtracting polynomials is just adding and subtracting their like terms. The sum of two monomials is called a binomial and the sum of three monomials is called a trinomial. The sum of a finite number of monomials in x is called a polynomial in x. The coefficients of the monomials in a polynomial are called the coefficients of the polynomial. If all the coefficients of a polynomial are zero, then the polynomial is called the zero polynomial.
Two polynomials can be added by using arithmetic operator plus (+). Adding polynomials is simply “combining like terms” and then add the like terms.
Every Polynomial in the program is a Doubly Linked List object. The corresponding terms are added and displayed in the form of an expression.



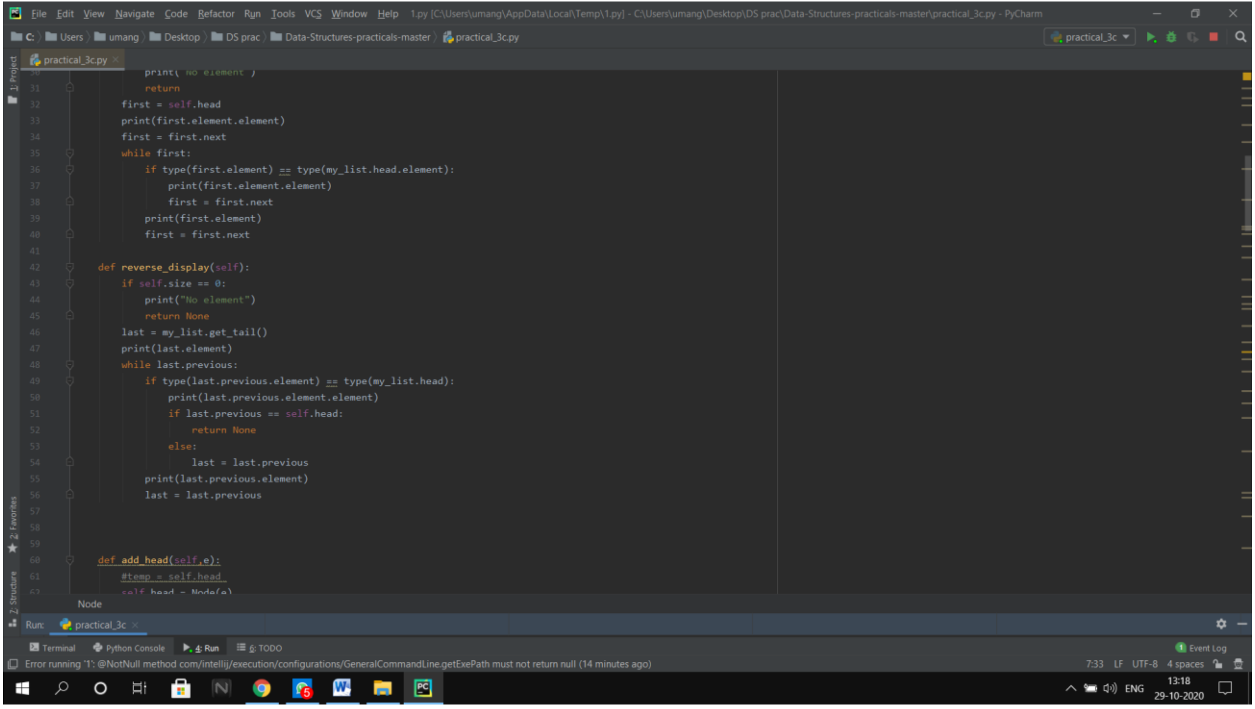
```python
class Node:

    def __init__(self, element, next = None ):
        self.element = element
        self.next = next
        self.previous = None
    def display(self):
        print(self.element)

class LinkedList:

    def __init__(self):
        self.head = None
        self.size = 0



    def __len__(self):
        return self.size

    def get_head(self):
        return self.head


    def is_empty(self):
        return self.size == 0

    def display(self):
        if self.size == 0:
            print("No element")
            return
        first = self.head
```

```
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (13 minutes ago)
```



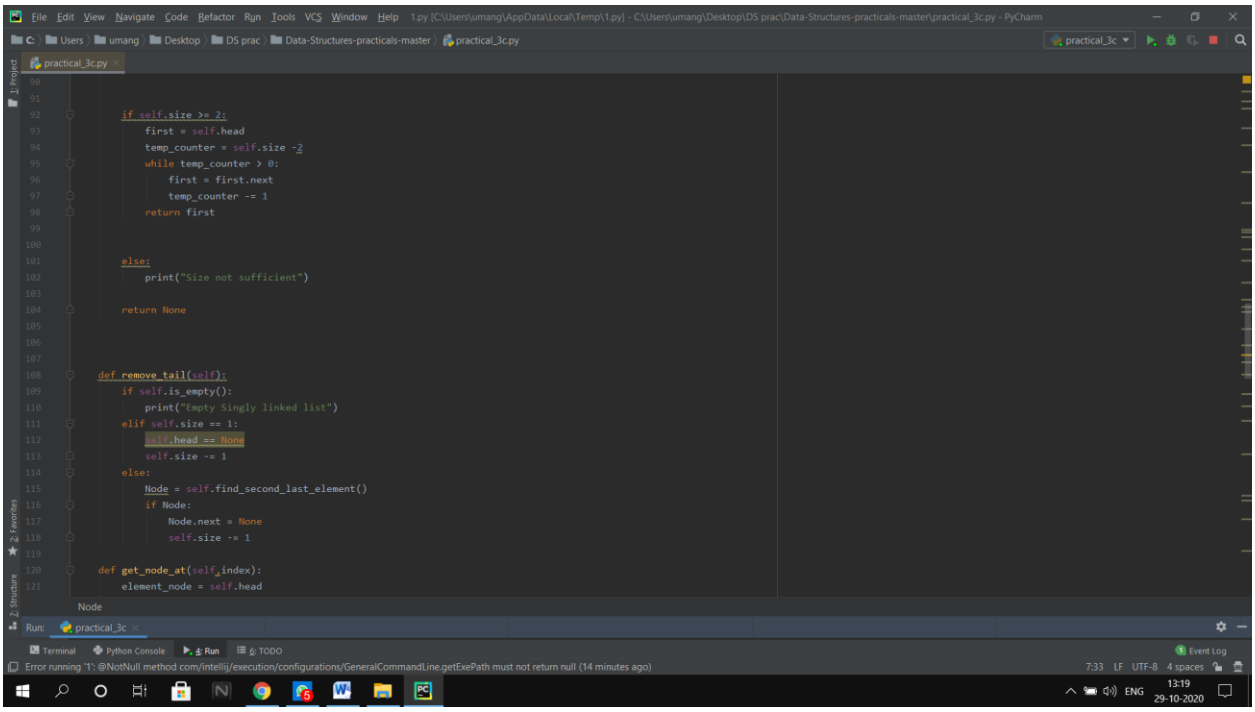
```
    def add_head(self,e):
        #temp = self.head
        self.head = Node(e)
        #self.head.next = temp
        self.size += 1

    def get_tail(self):
        last_object = self.head
        while (last_object.next != None):
            last_object = last_object.next
        return last_object


    def remove_head(self):
        if self.is_empty():
            print("Empty Singly linked list")
        else:
            print("Removing")
            self.head = self.head.next
            self.head.previous = None
            self.size -= 1

    def add_tail(self,e):
        new_value = Node(e)
        new_value.previous = self.get_tail()
        self.get_tail().next = new_value
        self.size += 1

    def find_second_last_element(self):
        #second_last_element = None
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (14 minutes ago)



```
            print("No element")
            return
        first = self.head
        print(first.element.element)
        first = first.next
        while first:
            if type(first.element) == type(my_list.head.element):
                print(first.element.element)
                first = first.next
            print(first.element)
            first = first.next

    def reverse_display(self):
        if self.size == 0:
            print("No element")
            return None
        last = my_list.get_tail()
        print(last.element)
        while last.previous:
            if type(last.previous.element) == type(my_list.head):
                print(last.previous.element.element)
                if last.previous == self.head:
                    return None
                else:
                    last = last.previous
            print(last.previous.element)
            last = last.previous



    def add_head(self,e):
        #temp = self.head
        self.head = Node(e)
```

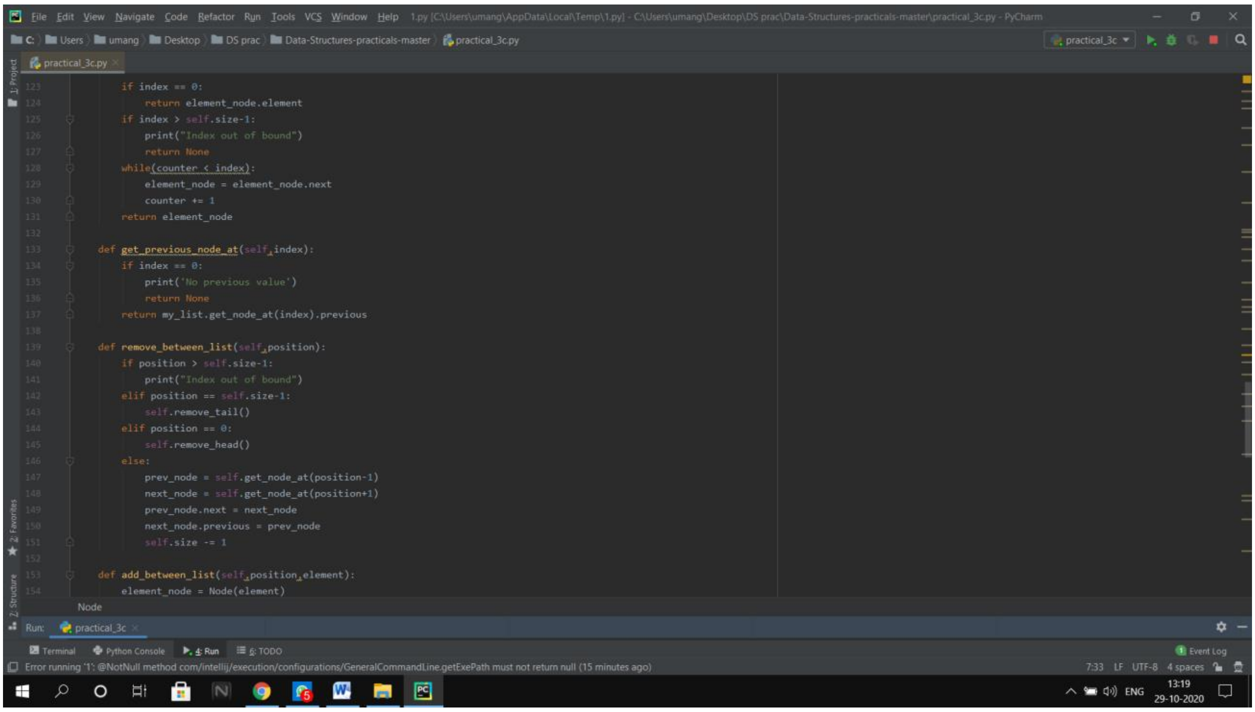
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (14 minutes ago)



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_3c.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_3c.py
practical_3c
practical_3c.py
1: Project
2: Favorites
Z: Structure
Node
Run: practical_3c
Terminal
Python Console
4: Run
6: TODO
Event Log
7:33 LF UTF-8 4 spaces
ENG
13:19
29-10-2020

```
        if self.size >= 2:
            first = self.head
            temp_counter = self.size -2
            while temp_counter > 0:
                first = first.next
                temp_counter -= 1
            return first


        else:
            print("Size not sufficient")

        return None



    def remove_tail(self):
        if self.is_empty():
            print("Empty Singly linked list")
        elif self.size == 1:
            self.head == None
            self.size -= 1
        else:
            Node = self.find_second_last_element()
            if Node:
                Node.next = None
                self.size -= 1

    def get_node_at(self,index):
        element_node = self.head
```

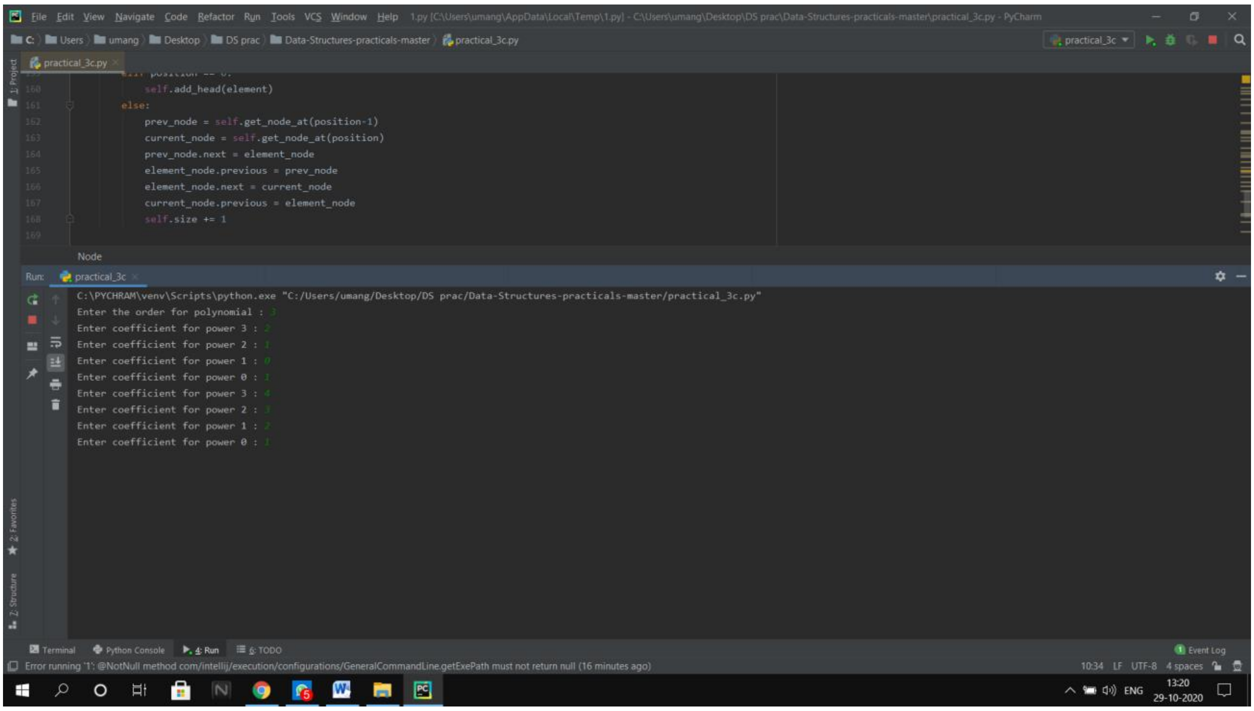
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (14 minutes ago)



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_3c.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_3c.py
practical_3c
practical_3c.py
1: Project
2: Favorites
Z: Structure
Node
Run: practical_3c
Terminal
Python Console
4: Run
6: TODO
Event Log
7:33 LF UTF-8 4 spaces
ENG
13:19
29-10-2020

```
        if index == 0:
            return element_node.element
        if index > self.size-1:
            print("Index out of bound")
            return None
        while(counter < index):
            element_node = element_node.next
            counter += 1
        return element_node

    def get_previous_node_at(self,index):
        if index == 0:
            print('No previous value')
            return None
        return my_list.get_node_at(index).previous

    def remove_between_list(self,position):
        if position > self.size-1:
            print("Index out of bound")
        elif position == self.size-1:
            self.remove_tail()
        elif position == 0:
            self.remove_head()
        else:
            prev_node = self.get_node_at(position-1)
            next_node = self.get_node_at(position+1)
            prev_node.next = next_node
            next_node.previous = prev_node
            self.size -= 1

    def add_between_list(self,position,element):
        element_node = Node(element)
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (15 minutes ago)



```
        elif position == 0:
            self.add_head(element)
        else:
            prev_node = self.get_node_at(position-1)
            current_node = self.get_node_at(position)
            prev_node.next = element_node
            element_node.previous = prev_node
            element_node.next = current_node
            current_node.previous = element_node
            self.size += 1
```

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_3c.py"
Enter the order for polynomial : 3
Enter coefficient for power 3 : 2
Enter coefficient for power 2 : 1
Enter coefficient for power 1 : 0
Enter coefficient for power 0 : 1
Enter coefficient for power 3 : 4
Enter coefficient for power 2 : 3
Enter coefficient for power 1 : 2
Enter coefficient for power 0 : 1
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (16 minutes ago)

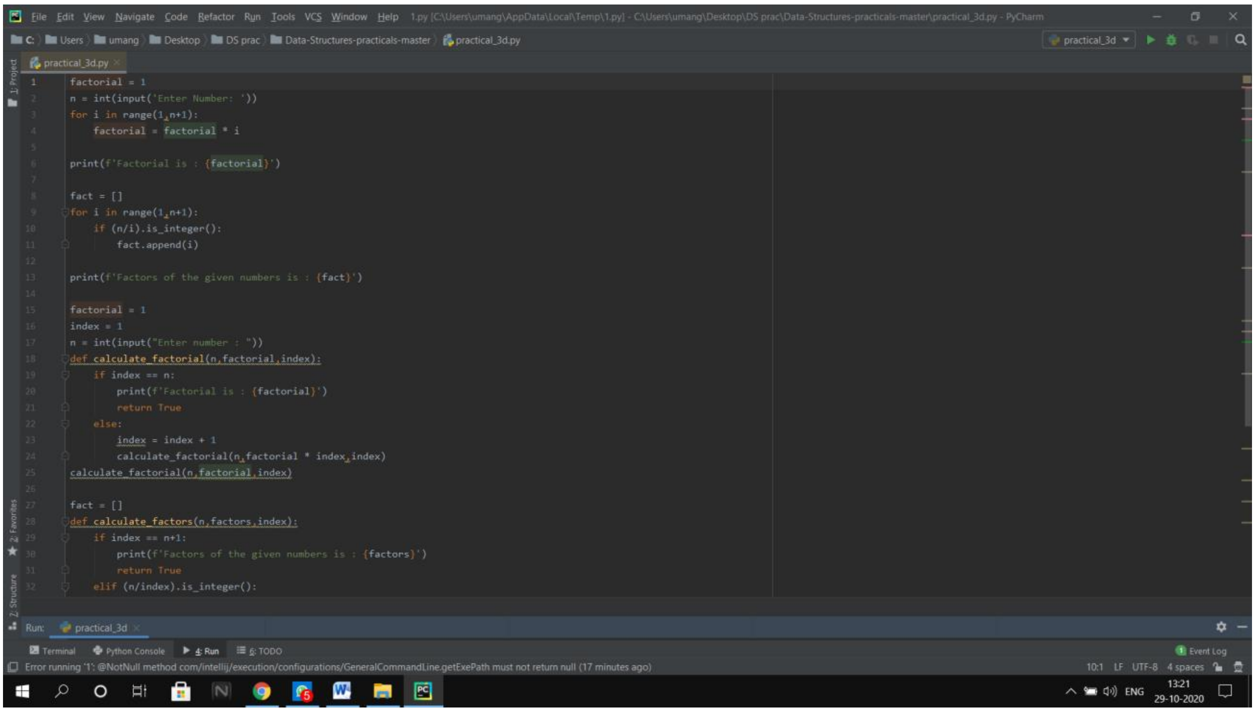
File Edit View Navigate Code Refactor Run Tools VCS Window Help
C: › Users › umang › Desktop › DS prac › Data-Structures-practicals-master › practical_3c.py
practical_3c.py
Node
Run: practical_3c
Terminal
Python Console
4: Run
6: TODO
Event Log
10:34 LF UTF-8 4 spaces
ENG
13:20
29-10-2020

d.

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

Theory

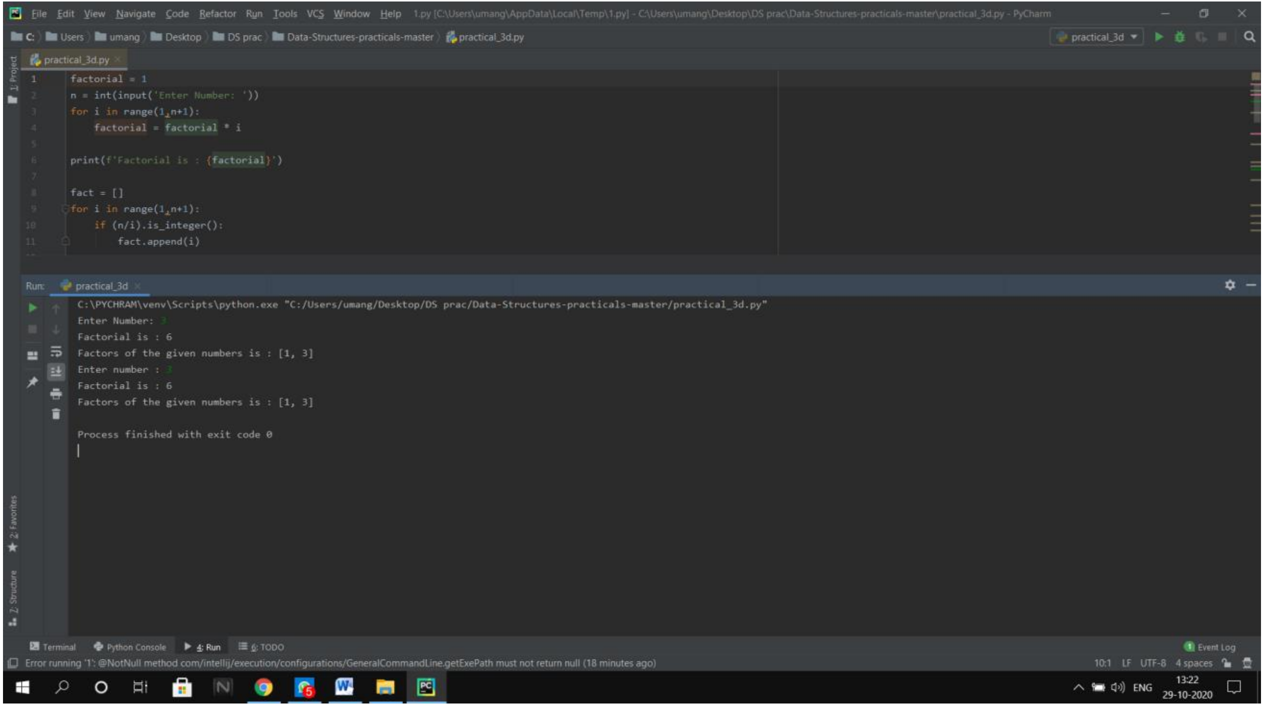
Factorial:
The factorial of a number is the product of all the integers from 1 to that number. For example, the factorial of 6 (denoted as 6!) is 1*2*3*4*5*6 = 720.
Factorial is not defined for negative numbers and the factorial of zero is one, 0! = 1.
You can find it using recursion as well as iteration to calculate the factorial of a number.
Factorial:
Factors are the numbers you multiply to get another number. For instance, factors of 15 are 3 and 5, because 3×5 = 15. Some numbers have more than one factorization (more than one way of being factored). For instance, 12 can be factored as 1×12, 2×6, or 3×4. A number that can only be factored as 1 time itself is called "prime".
You can find it using recursion as well as iteration to calculate the factors of a number.



1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_3d.py - PyCharm

```
factorial = 1
n = int(input('Enter Number: '))
for i in range(1,n+1):
    factorial = factorial * i

print(f'Factorial is : {factorial}')

fact = []
for i in range(1,n+1):
    if (n/i).is_integer():
        fact.append(i)

print(f'Factors of the given numbers is : {fact}')

factorial = 1
index = 1
n = int(input("Enter number : "))
def calculate_factorial(n,factorial,index):
    if index == n:
        print(f'Factorial is : {factorial}')
        return True
    else:
        index = index + 1
        calculate_factorial(n,factorial * index,index)
calculate_factorial(n,factorial,index)

fact = []
def calculate_factors(n,factors,index):
    if index == n+1:
        print(f'Factors of the given numbers is : {factors}')
        return True
    elif (n/index).is_integer():
```

```
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (17 minutes ago)
```



1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_3d.py - PyCharm

```
factorial = 1
n = int(input('Enter Number: '))
for i in range(1,n+1):
    factorial = factorial * i

print(f'Factorial is : {factorial}')

fact = []
for i in range(1,n+1):
    if (n/i).is_integer():
        fact.append(i)
```

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_3d.py"
Enter Number: 3
Factorial is : 6
Factors of the given numbers is : [1, 3]
Enter number : 3
Factorial is : 6
Factors of the given numbers is : [1, 3]

Process finished with exit code 0
```

```
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (18 minutes ago)
```

4.
Aim: Perform Queues operations using Circular Array implementation.

Theory

Queue

the queue abstract data type defines a collection that keeps objects in a sequence, where element access and deletion are restricted to the first element in the queue, and element insertion is restricted to the back of the sequence. This restriction enforces the rule that items are inserted and deleted in a queue according to the first-in, first-out (FIFO) principle. The queue abstract data type (ADT) supports the following two fundamental methods for a queue Q:

Q.enqueue(e): Add element e to the back of queue Q.

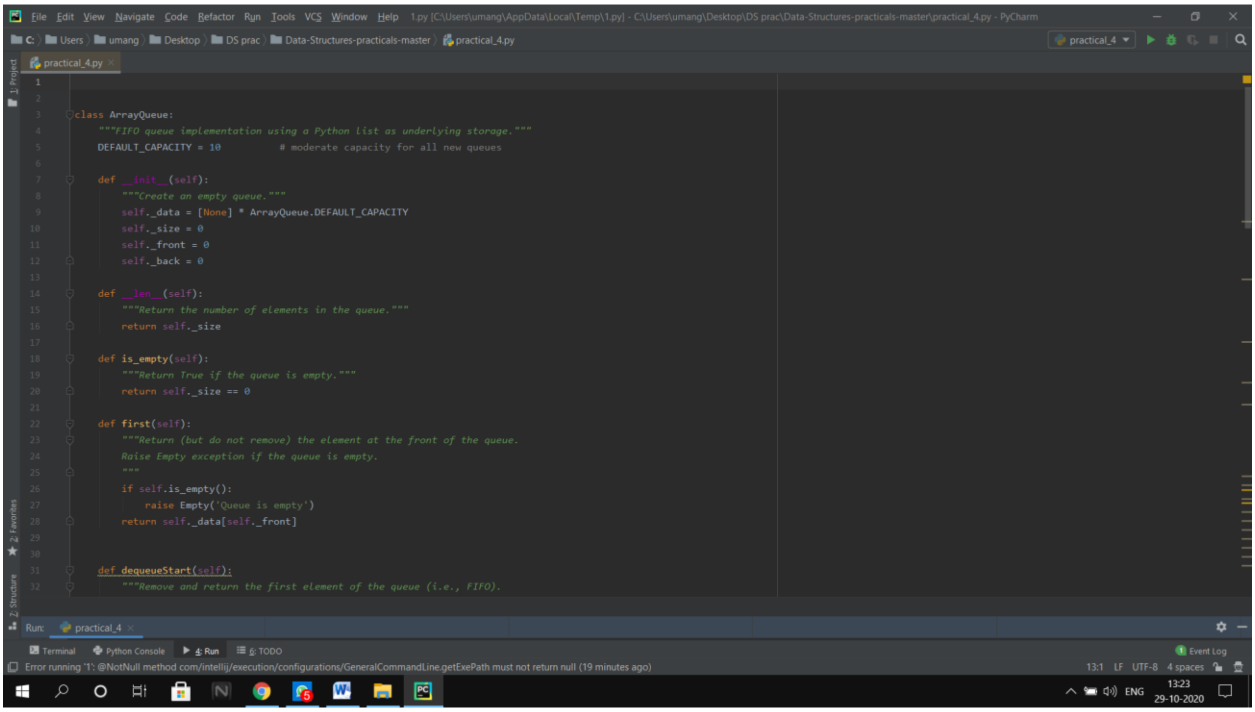
Q.dequeue( ): Remove and return the first element from queue Q; an error occurs if the queue is empty.

For the stack ADT, we created a very simple adapter class that used a Python list as the underlying storage.

Double Ended Queue

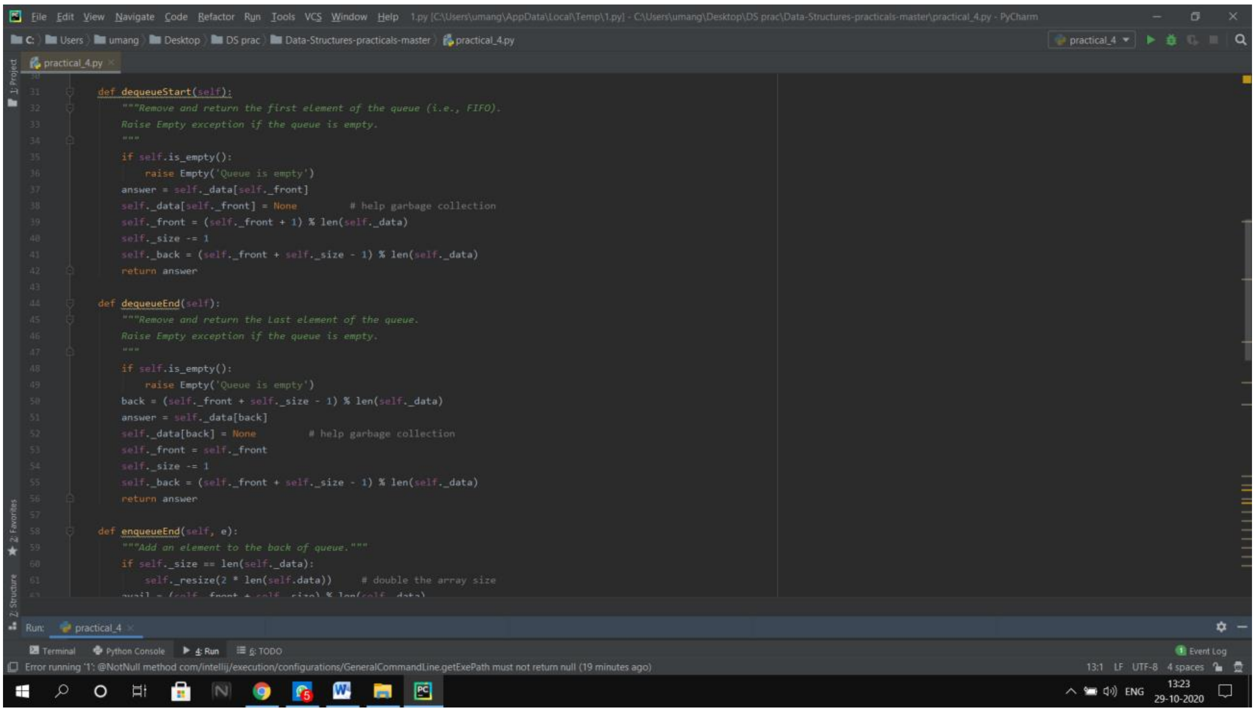
We next consider a queue-like data structure that supports insertion and deletion at both the front and the back of the queue. Such a structure is called a double ended queue, or deque, which is usually pronounced “deck” to avoid confusion with the dequeue method of the regular queue ADT, which is pronounced like the abbreviation “D.Q.”

The deque abstract data type is more general than both the stack and the queue ADTs.



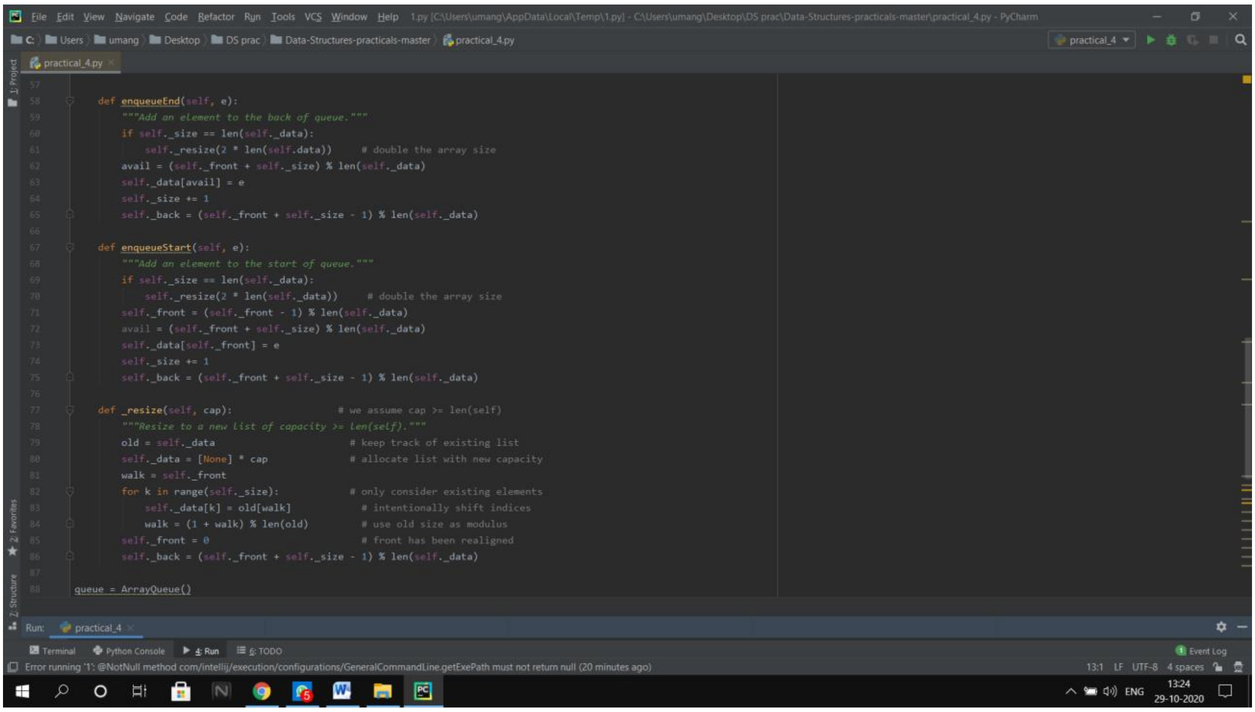
```

class ArrayQueue:
    """FIFO queue implementation using a Python list as underlying storage."""
    DEFAULT_CAPACITY = 10          # moderate capacity for all new queues

    def __init__(self):
        """Create an empty queue."""
        self._data = [None] * ArrayQueue.DEFAULT_CAPACITY
        self._size = 0
        self._front = 0
        self._back = 0

    def __len__(self):
        """Return the number of elements in the queue."""
        return self._size

    def is_empty(self):
        """Return True if the queue is empty."""
        return self._size == 0

    def first(self):
        """Return (but do not remove) the element at the front of the queue.
        Raise Empty exception if the queue is empty.
        """
        if self.is_empty():
            raise Empty('Queue is empty')
        return self._data[self._front]


    def dequeueStart(self):
        """Remove and return the first element of the queue (i.e., FIFO).
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (19 minutes ago)



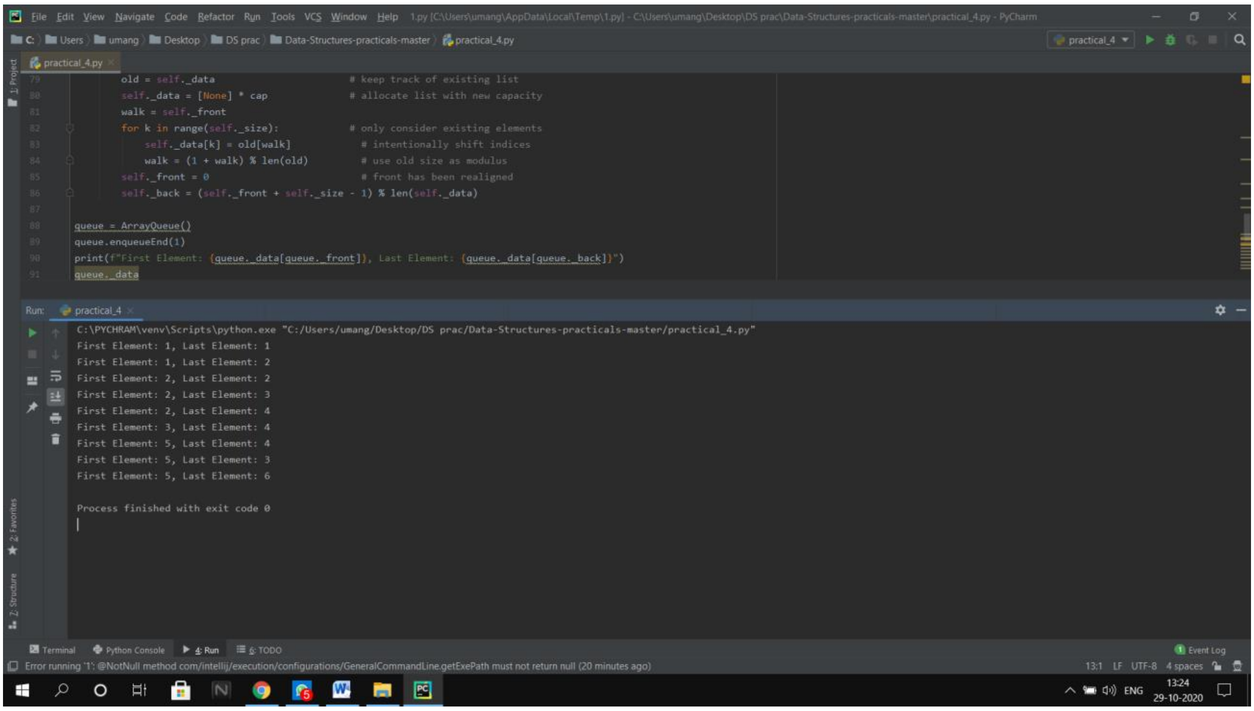
```
    def dequeueStart(self):
        """Remove and return the first element of the queue (i.e., FIFO).
        Raise Empty exception if the queue is empty.
        """
        if self.is_empty():
            raise Empty('Queue is empty')
        answer = self._data[self._front]
        self._data[self._front] = None          # help garbage collection
        self._front = (self._front + 1) % len(self._data)
        self._size -= 1
        self._back = (self._front + self._size - 1) % len(self._data)
        return answer

    def dequeueEnd(self):
        """Remove and return the Last element of the queue.
        Raise Empty exception if the queue is empty.
        """
        if self.is_empty():
            raise Empty('Queue is empty')
        back = (self._front + self._size - 1) % len(self._data)
        answer = self._data[back]
        self._data[back] = None          # help garbage collection
        self._front = self._front
        self._size -= 1
        self._back = (self._front + self._size - 1) % len(self._data)
        return answer

    def enqueueEnd(self, e):
        """Add an element to the back of queue."""
        if self._size == len(self._data):
            self._resize(2 * len(self.data))     # double the array size
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (19 minutes ago)



```
    def enqueueEnd(self, e):
        """Add an element to the back of queue."""
        if self._size == len(self._data):
            self._resize(2 * len(self.data))     # double the array size
        avail = (self._front + self._size) % len(self._data)
        self._data[avail] = e
        self._size += 1
        self._back = (self._front + self._size - 1) % len(self._data)

    def enqueueStart(self, e):
        """Add an element to the start of queue."""
        if self._size == len(self._data):
            self._resize(2 * len(self._data))     # double the array size
        self._front = (self._front - 1) % len(self._data)
        avail = (self._front + self._size) % len(self._data)
        self._data[self._front] = e
        self._size += 1
        self._back = (self._front + self._size - 1) % len(self._data)

    def _resize(self, cap):                    # we assume cap >= len(self)
        """Resize to a new list of capacity >= len(self)."""
        old = self._data                       # keep track of existing list
        self._data = [None] * cap              # allocate list with new capacity
        walk = self._front
        for k in range(self._size):            # only consider existing elements
            self._data[k] = old[walk]          # intentionally shift indices
            walk = (1 + walk) % len(old)       # use old size as modulus
        self._front = 0                        # front has been realigned
        self._back = (self._front + self._size - 1) % len(self._data)

queue = ArrayQueue()
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (20 minutes ago)



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_4.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_4.py
practical_4
practical_4.py
1: Project
Run: practical_4
2: Favorites
Z: Structure
Terminal
Python Console
4: Run
6: TODO
Event Log
13:1 LF UTF-8 4 spaces
ENG
13:24
29-10-2020

```python
        old = self._data                        # keep track of existing list
        self._data = [None] * cap               # allocate list with new capacity
        walk = self._front
        for k in range(self._size):             # only consider existing elements
            self._data[k] = old[walk]            # intentionally shift indices
            walk = (1 + walk) % len(old)         # use old size as modulus
        self._front = 0                          # front has been realigned
        self._back = (self._front + self._size - 1) % len(self._data)

queue = ArrayQueue()
queue.enqueueEnd(1)
print(f"First Element: {queue._data[queue._front]}, Last Element: {queue._data[queue._back]}")
queue._data
```

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_4.py"
First Element: 1, Last Element: 1
First Element: 1, Last Element: 2
First Element: 2, Last Element: 2
First Element: 2, Last Element: 3
First Element: 2, Last Element: 4
First Element: 3, Last Element: 4
First Element: 5, Last Element: 4
First Element: 5, Last Element: 3
First Element: 5, Last Element: 6

Process finished with exit code 0
```

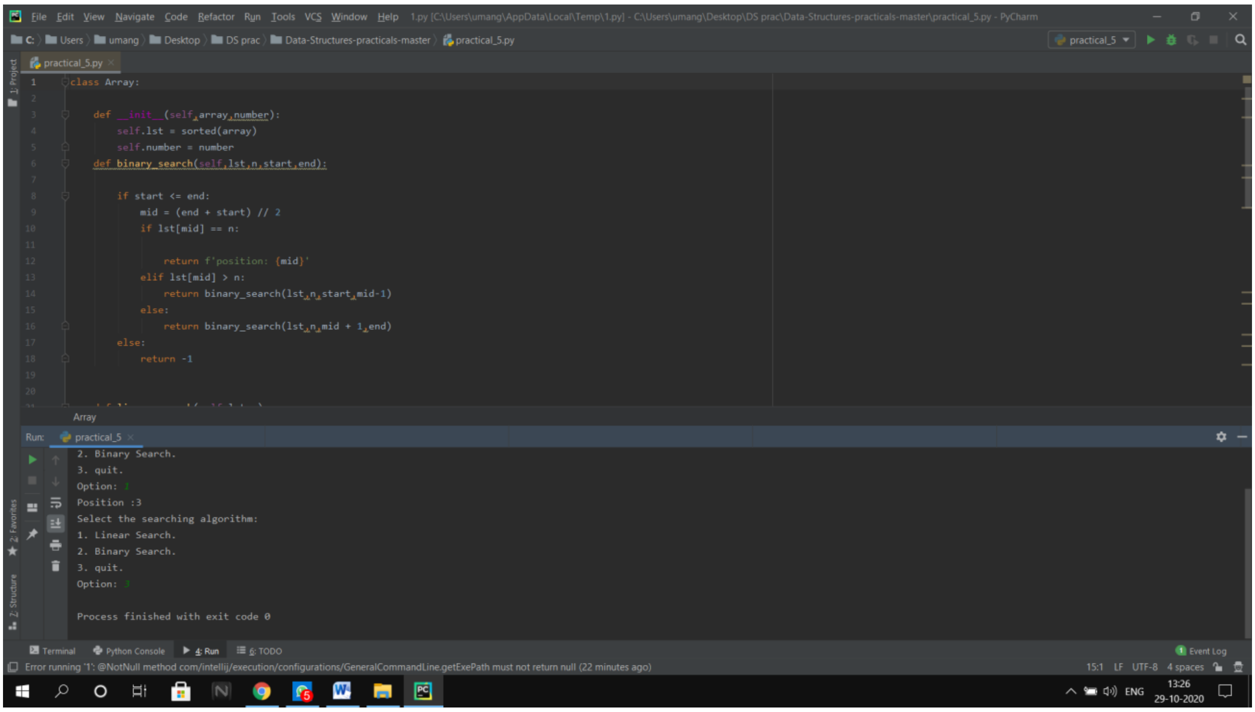
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (20 minutes ago)

5.

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

Theory

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.
Linear Search: A Linear Search is the most basic type of searching algorithm. A Linear Search sequentially moves through your collection (or data structure) looking for a matching value. In other words, it looks down a list, one item at a time, without jumping.


File Edit View Navigate Code Refactor Run Tools VCS Window Help
1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_5.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_5.py
practical_5
practical_5.py
Array
Run: practical_5
Terminal
Python Console
4: Run
6: TODO
Event Log
15:1 LF UTF-8 4 spaces
ENG
13:26
29-10-2020

```python
class Array:

    def __init__(self,array,number):
        self.lst = sorted(array)
        self.number = number
    def binary_search(self,lst,n,start,end):

        if start <= end:
            mid = (end + start) // 2
            if lst[mid] == n:

                return f'position: {mid}'
            elif lst[mid] > n:
                return binary_search(lst,n,start,mid-1)
            else:
                return binary_search(lst,n,mid + 1,end)
        else:
            return -1
```

```
2. Binary Search.
3. quit.
Option: 1
Position :3
Select the searching algorithm:
1. Linear Search.
2. Binary Search.
3. quit.
Option: 3

Process finished with exit code 0
```

```
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (22 minutes ago)
```

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

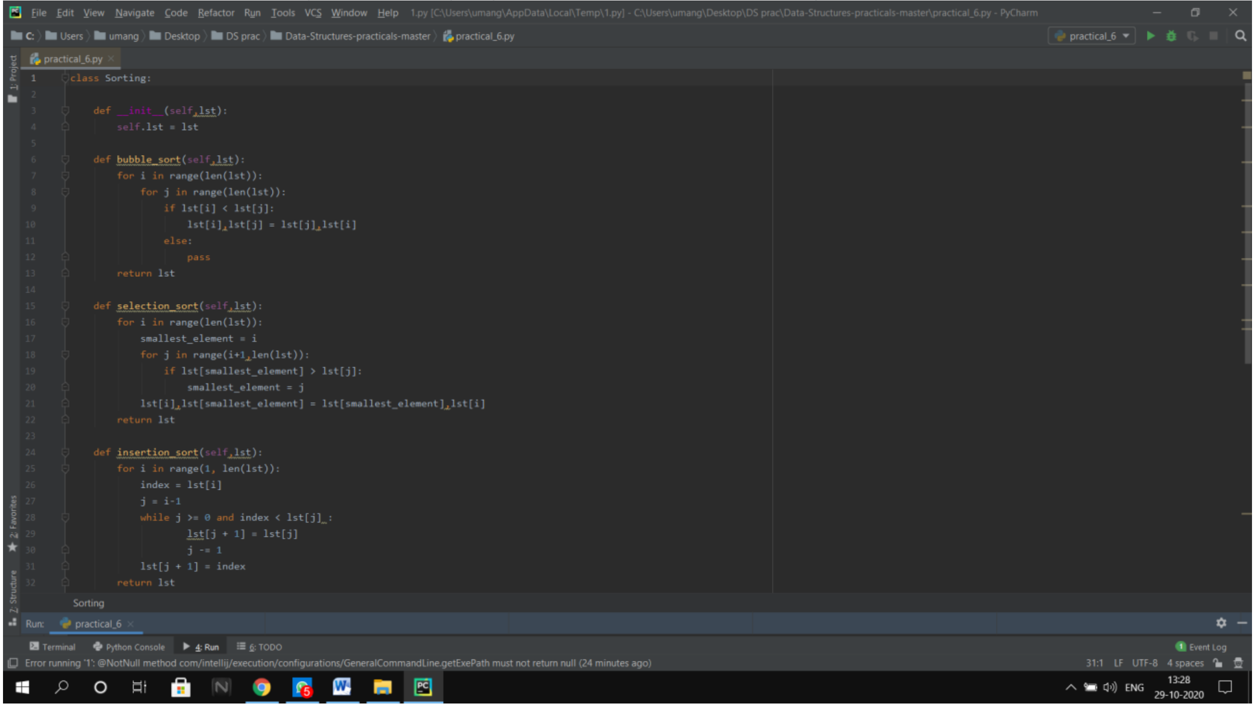
Bubble sort : Bubble sort is a simple sorting algorithm. This sorting algorithm is comparison-based algorithm in which each pair of adjacent elements is compared and the elements are swapped if they are not in order. This algorithm is not suitable for large data sets as its average and worst case complexity are of O(n2) where n is the number of items.

Insertion Sort : This is an in-place comparison-based sorting algorithm. Here, a sub-list is maintained which is always sorted. For example, the lower part of an array is maintaine

to be sorted. An element which is to be 'insert'ed in this sorted sub-list, has to find its appropriate place and then it has to be inserted there. Hence the name, insertion sort.

Selection Sort : Selection sort is a simple sorting algorithm. This sorting algorithm is an in-place comparison-based algorithm in which the list is divided into two parts, the sorted part at the left end and the unsorted part at the right end. Initially, the sorted part is empty and the unsorted part is the entire list.

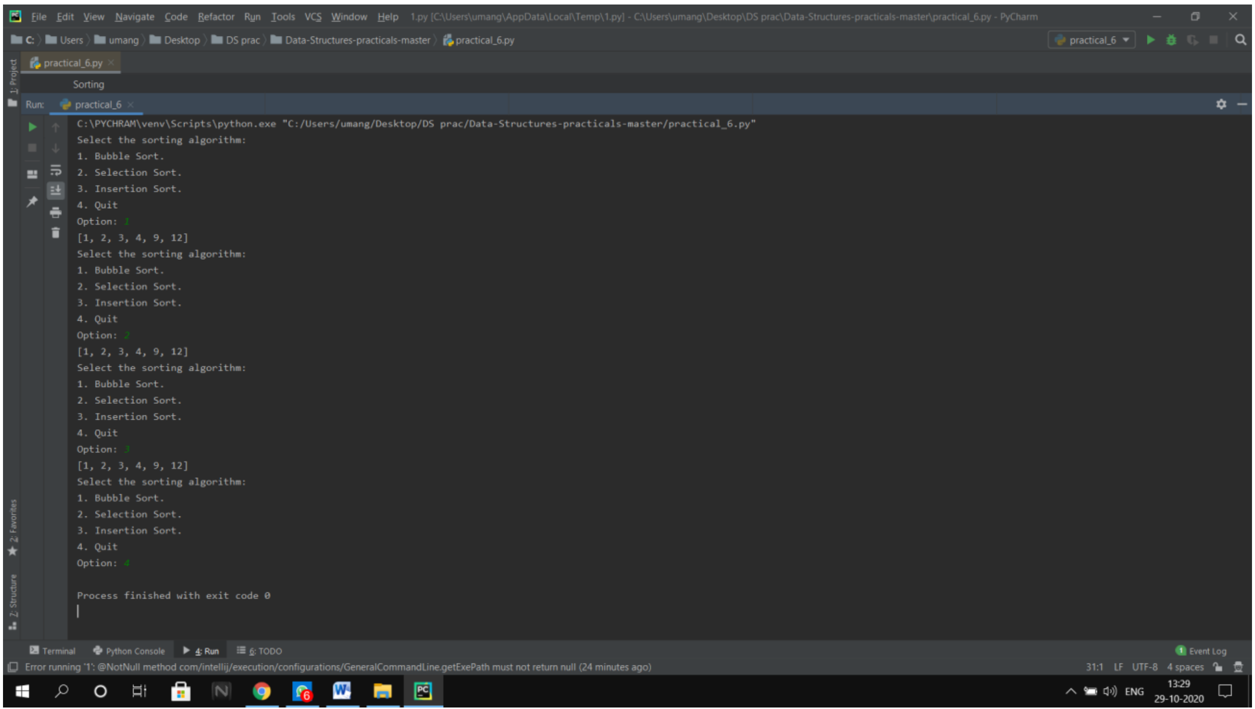
The smallest element is selected from the unsorted array and swapped with the leftmost element, and that element becomes a part of the sorted array. This process continues moving unsorted array boundary by one element to the right.



File Edit View Navigate Code Refactor Run Tools VCS Window Help
1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_6.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_6.py
practical_6
practical_6.py
1: Project
2: Favorites
Z: Structure
Sorting
Run: practical_6
Terminal
Python Console
4: Run
6: TODO
Event Log
31:1 LF UTF-8 4 spaces
ENG
13:28
29-10-2020

```python
class Sorting:

    def __init__(self,lst):
        self.lst = lst

    def bubble_sort(self,lst):
        for i in range(len(lst)):
            for j in range(len(lst)):
                if lst[i] < lst[j]:
                    lst[i],lst[j] = lst[j],lst[i]
                else:
                    pass
        return lst

    def selection_sort(self,lst):
        for i in range(len(lst)):
            smallest_element = i
            for j in range(i+1,len(lst)):
                if lst[smallest_element] > lst[j]:
                    smallest_element = j
            lst[i],lst[smallest_element] = lst[smallest_element],lst[i]
        return lst

    def insertion_sort(self,lst):
        for i in range(1, len(lst)):
            index = lst[i]
            j = i-1
            while j >= 0 and index < lst[j] :
                    lst[j + 1] = lst[j]
                    j -= 1
            lst[j + 1] = index
        return lst
```

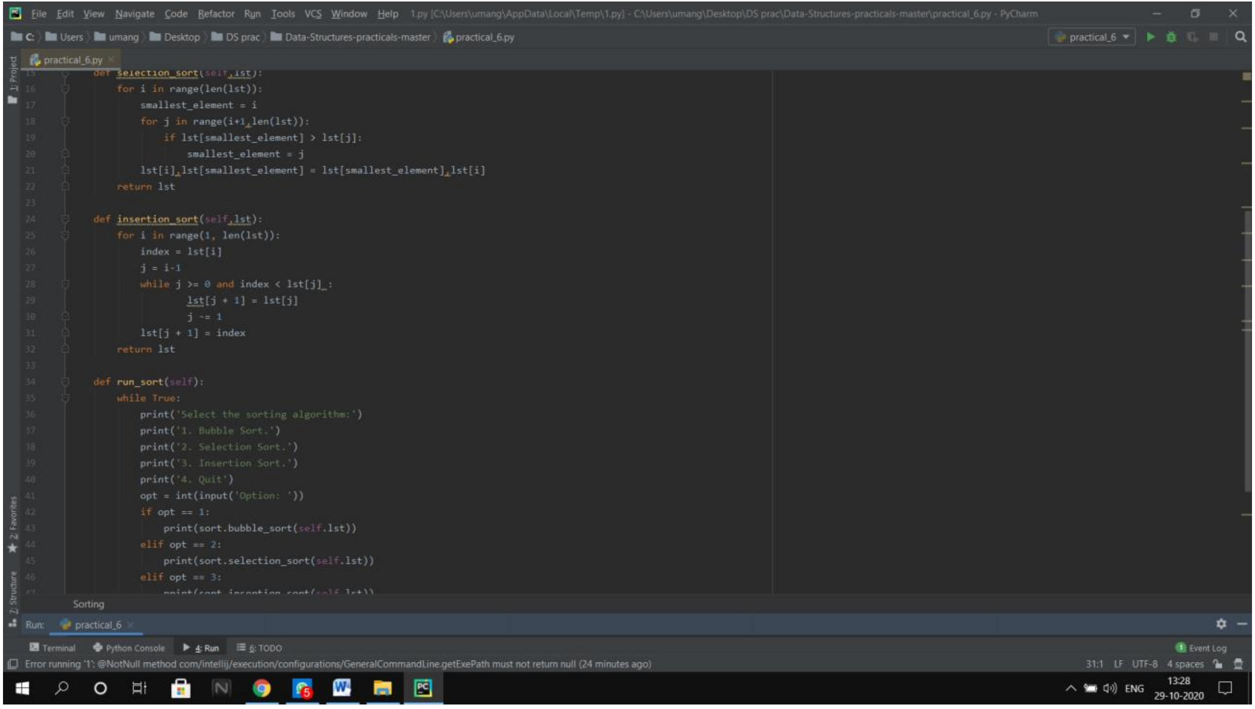
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (24 minutes ago)



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_6.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_6.py
practical_6
practical_6.py
Sorting
Run: practical_6
Terminal
Python Console
4: Run
6: TODO
Event Log
31:1 LF UTF-8 4 spaces
ENG
13:29
29-10-2020

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_6.py"
Select the sorting algorithm:
1. Bubble Sort.
2. Selection Sort.
3. Insertion Sort.
4. Quit
Option: 1
[1, 2, 3, 4, 9, 12]
Select the sorting algorithm:
1. Bubble Sort.
2. Selection Sort.
3. Insertion Sort.
4. Quit
Option: 2
[1, 2, 3, 4, 9, 12]
Select the sorting algorithm:
1. Bubble Sort.
2. Selection Sort.
3. Insertion Sort.
4. Quit
Option: 3
[1, 2, 3, 4, 9, 12]
Select the sorting algorithm:
1. Bubble Sort.
2. Selection Sort.
3. Insertion Sort.
4. Quit
Option: 4

Process finished with exit code 0
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (24 minutes ago)



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_6.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_6.py
practical_6
practical_6.py
Sorting
Run: practical_6
Terminal
Python Console
4: Run
6: TODO
Event Log
31:1 LF UTF-8 4 spaces
ENG
13:28
29-10-2020

```
    def selection_sort(self,lst):
        for i in range(len(lst)):
            smallest_element = i
            for j in range(i+1,len(lst)):
                if lst[smallest_element] > lst[j]:
                    smallest_element = j
            lst[i],lst[smallest_element] = lst[smallest_element],lst[i]
        return lst

    def insertion_sort(self,lst):
        for i in range(1, len(lst)):
            index = lst[i]
            j = i-1
            while j >= 0 and index < lst[j] :
                    lst[j + 1] = lst[j]
                    j -= 1
            lst[j + 1] = index
        return lst

    def run_sort(self):
        while True:
            print('Select the sorting algorithm:')
            print('1. Bubble Sort.')
            print('2. Selection Sort.')
            print('3. Insertion Sort.')
            print('4. Quit')
            opt = int(input('Option: '))
            if opt == 1:
                print(sort.bubble_sort(self.lst))
            elif opt == 2:
                print(sort.selection_sort(self.lst))
            elif opt == 3:
                print(sort.insertion_sort(self.lst))
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (24 minutes ago)

7. Implement the following for Hashing:

a.

Aim: Write a program to implement the collision technique.

Theory

Hash Table is a data structure which stores data in an associative manner. In a hash table, data is stored in an array format, where each data value has its own unique index value. Access of data becomes very fast if we know the index of the desired data.

Thus, it becomes a data structure in which insertion and search operations are very fast irrespective of the size of the data. Hash Table uses an array as a storage medium and uses hash technique to generate an index where an element is to be inserted or is to be located from.

Hashing

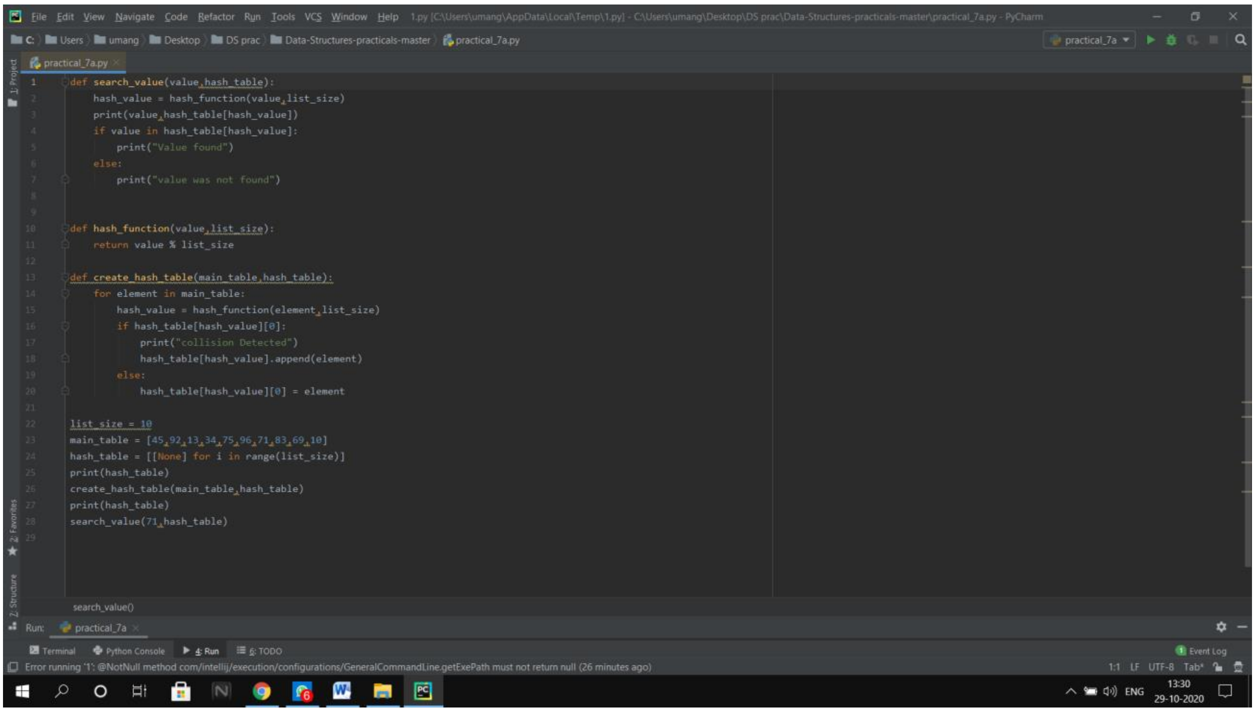
Hashing is a technique to convert a range of key values into a range of indexes of an array. We're going to use modulo operator to get a range of key values. Consider an example of hash table of size 20, and the following items are to be stored. Item are in the (key,value) format.

In computer science, a collision or clash is a situation that occurs when two distinct pieces of data have the same hash value, checksum, fingerprint, or cryptographic digest.[1]

Due to the possible applications of hash functions in data management and computer security (in particular, cryptographic hash functions), collision avoidance has become a fundamental topic in computer science.

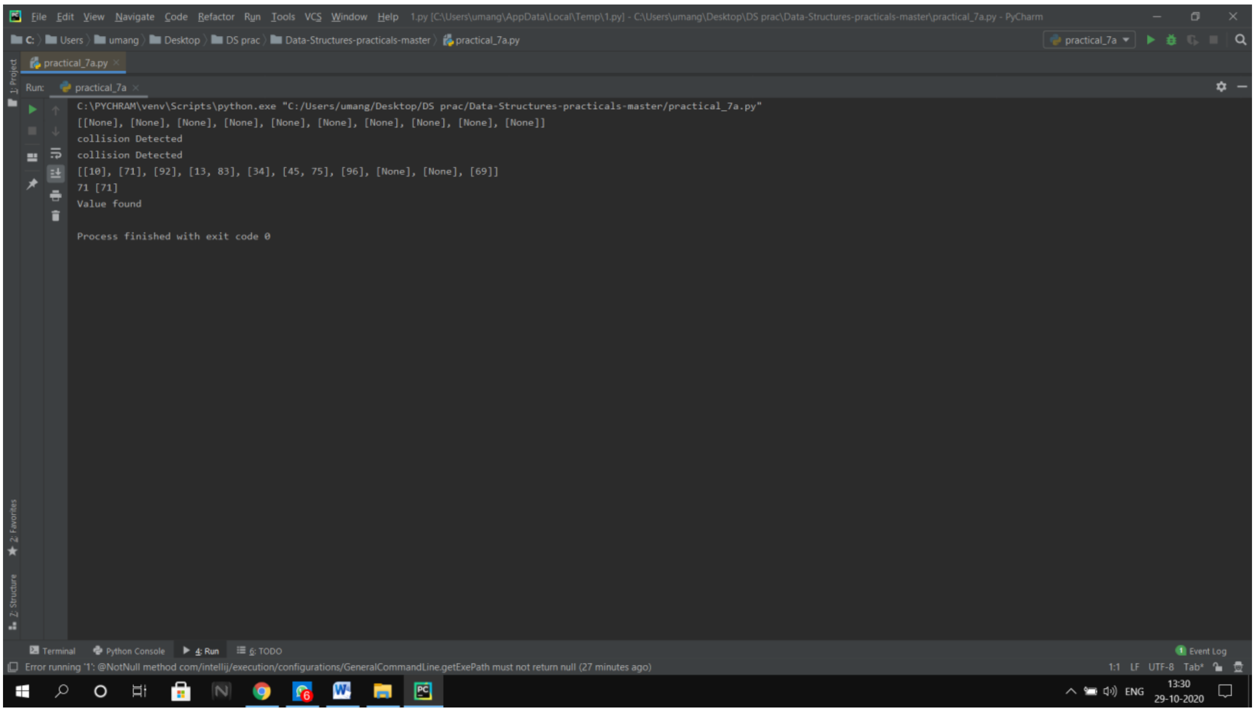
Collisions are unavoidable whenever members of a very large set (such as all possible person names, or all possible computer files) are mapped to a relatively short bit string. This is merely an instance of the pigeonhole principle.

The impact of collisions depends on the application. When hash functions and fingerprints are used to identify similar data, such as homologous DNA sequences or similar audio files, the functions are designed so as to maximize the probability of collision between distinct but similar data, using techniques like locality-sensitive hashing. Checksums, on the other hand, are designed to minimize the probability of collisions between similar inputs, without regard for collisions between very different inputs.


File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_7a.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_7a.py
practical_7a
practical_7a.py
search_value()
Run: practical_7a
Terminal Python Console 4: Run 6: TODO Event Log
1:1 LF UTF-8 Tab*
ENG 13:30 29-10-2020

```python
def search_value(value,hash_table):
    hash_value = hash_function(value,list_size)
    print(value,hash_table[hash_value])
    if value in hash_table[hash_value]:
        print("Value found")
    else:
        print("value was not found")


def hash_function(value,list_size):
    return value % list_size

def create_hash_table(main_table,hash_table):
    for element in main_table:
        hash_value = hash_function(element,list_size)
        if hash_table[hash_value][0]:
            print("collision Detected")
            hash_table[hash_value].append(element)
        else:
            hash_table[hash_value][0] = element

list_size = 10
main_table = [45,92,13,34,75,96,71,83,69,10]
hash_table = [[None] for i in range(list_size)]
print(hash_table)
create_hash_table(main_table,hash_table)
print(hash_table)
search_value(71,hash_table)
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (26 minutes ago)


File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_7a.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_7a.py
practical_7a
practical_7a.py
Run: practical_7a
Terminal Python Console 4: Run 6: TODO Event Log
1:1 LF UTF-8 Tab*
ENG 13:30 29-10-2020

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_7a.py"
[[None], [None], [None], [None], [None], [None], [None], [None], [None], [None]]
collision Detected
collision Detected
[[10], [71], [92], [13, 83], [34], [45, 75], [96], [None], [None], [69]]
71 [71]
Value found

Process finished with exit code 0
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (27 minutes ago)

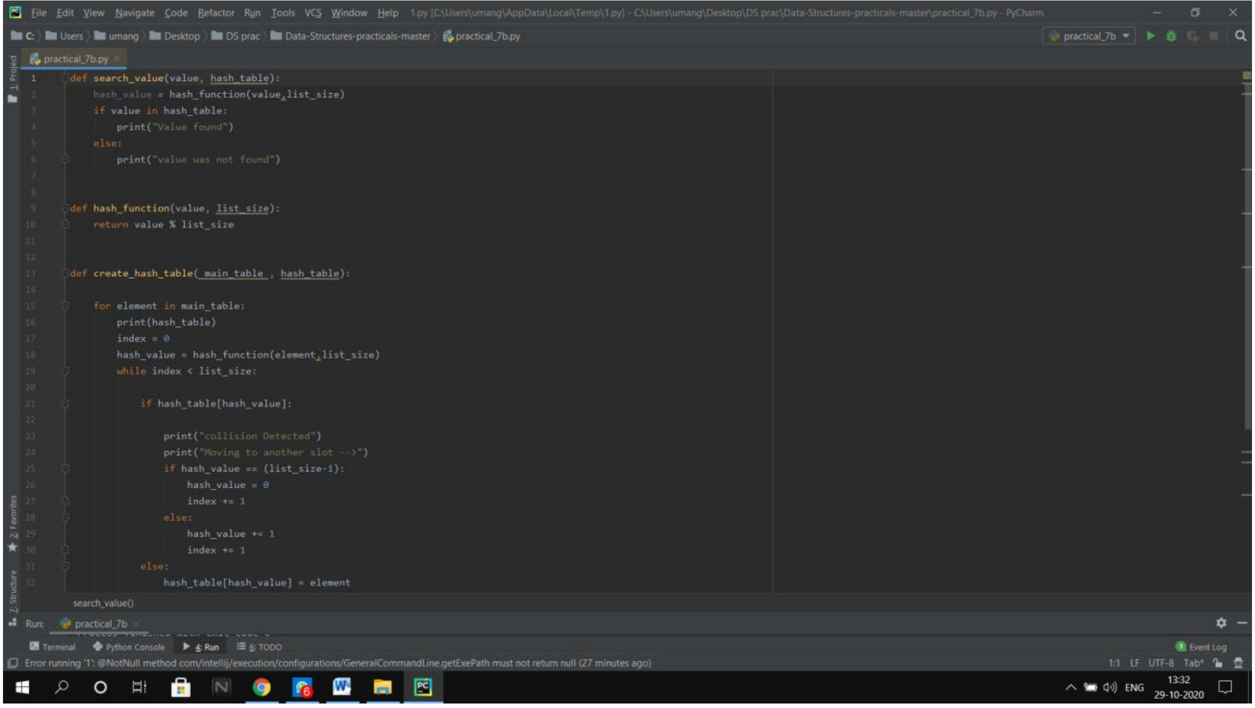
b.

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

Theory

Linear probing is a scheme in computer programming for resolving collisions in hash tables, data structures for maintaining a collection of key–value pairs and looking up the value associated with a given key. It was invented in 1954 by Gene Amdahl, Elaine M. McGraw, and Arthur Samuel and first analyzed in 1963 by Donald Knuth.

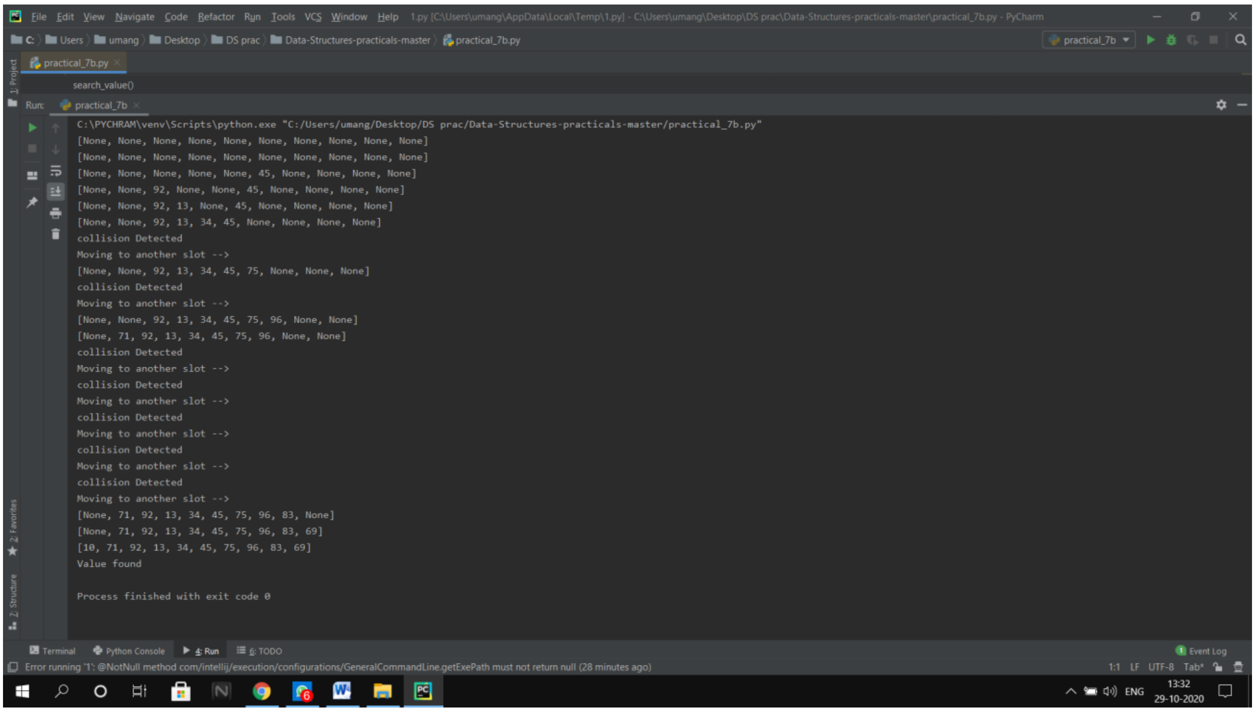
Along with quadratic probing and double hashing, linear probing is a form of open addressing. In these schemes, each cell of a hash table stores a single key–value pair. When the hash function causes a collision by mapping a new key to a cell of the hash table that is already occupied by another key, linear probing searches the table for the closest following free location and inserts the new key there. Lookups are performed in the same way, by searching the table sequentially starting at the position given by the hash function, until finding a cell with a matching key or an empty cell.



```
def search_value(value, hash_table):
    hash_value = hash_function(value,list_size)
    if value in hash_table:
        print("Value found")
    else:
        print("value was not found")


def hash_function(value, list_size):
    return value % list_size


def create_hash_table( main_table , hash_table):

    for element in main_table:
        print(hash_table)
        index = 0
        hash_value = hash_function(element,list_size)
        while index < list_size:

            if hash_table[hash_value]:

                print("collision Detected")
                print("Moving to another slot -->")
                if hash_value == (list_size-1):
                    hash_value = 0
                    index += 1
                else:
                    hash_value += 1
                    index += 1
            else:
                hash_table[hash_value] = element
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (27 minutes ago)

File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_7b.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_7b.py
practical_7b
practical_7b.py
search_value()
Run: practical_7b
Terminal Python Console 4: Run 6: TODO
Event Log
1:1 LF UTF-8 Tab*
ENG 13:32 29-10-2020



```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_7b.py"
[None, None, None, None, None, None, None, None, None, None]
[None, None, None, None, None, None, None, None, None, None]
[None, None, None, None, None, 45, None, None, None, None]
[None, None, 92, None, None, 45, None, None, None, None]
[None, None, 92, 13, None, 45, None, None, None, None]
[None, None, 92, 13, 34, 45, None, None, None, None]
collision Detected
Moving to another slot -->
[None, None, 92, 13, 34, 45, 75, None, None, None]
collision Detected
Moving to another slot -->
[None, None, 92, 13, 34, 45, 75, 96, None, None]
[None, 71, 92, 13, 34, 45, 75, 96, None, None]
collision Detected
Moving to another slot -->
collision Detected
Moving to another slot -->
collision Detected
Moving to another slot -->
collision Detected
Moving to another slot -->
collision Detected
Moving to another slot -->
[None, 71, 92, 13, 34, 45, 75, 96, 83, None]
[None, 71, 92, 13, 34, 45, 75, 96, 83, 69]
[10, 71, 92, 13, 34, 45, 75, 96, 83, 69]
Value found

Process finished with exit code 0
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (28 minutes ago)

8.
Aim :Write a program for inorder, postorder and preorder traversal of tree.

Theory

Pre-order (NLR)

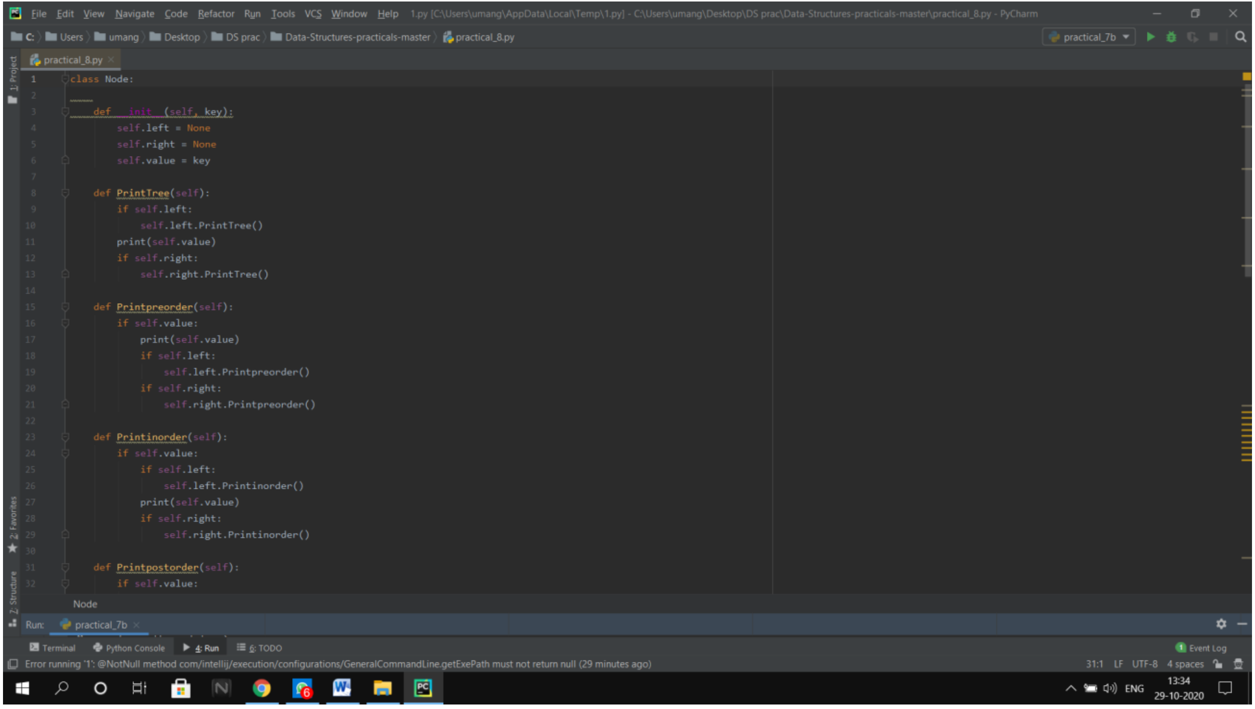
Access the data part of the current node.
Traverse the left subtree by recursively calling the pre-order function.
Traverse the right subtree by recursively calling the pre-order function.
The pre-order traversal is a topologically sorted one, because a parent node is processed before any of its child nodes is done.

In-order (LNR)

Traverse the left subtree by recursively calling the in-order function.
Access the data part of the current node.
Traverse the right subtree by recursively calling the in-order function.
In a binary search tree ordered such that in each node the key is greater than all keys in its left subtree and less than all keys in its right subtree, in-order traversal retrieves the keys in ascending sorted order.[4]

Post-order (LRN)

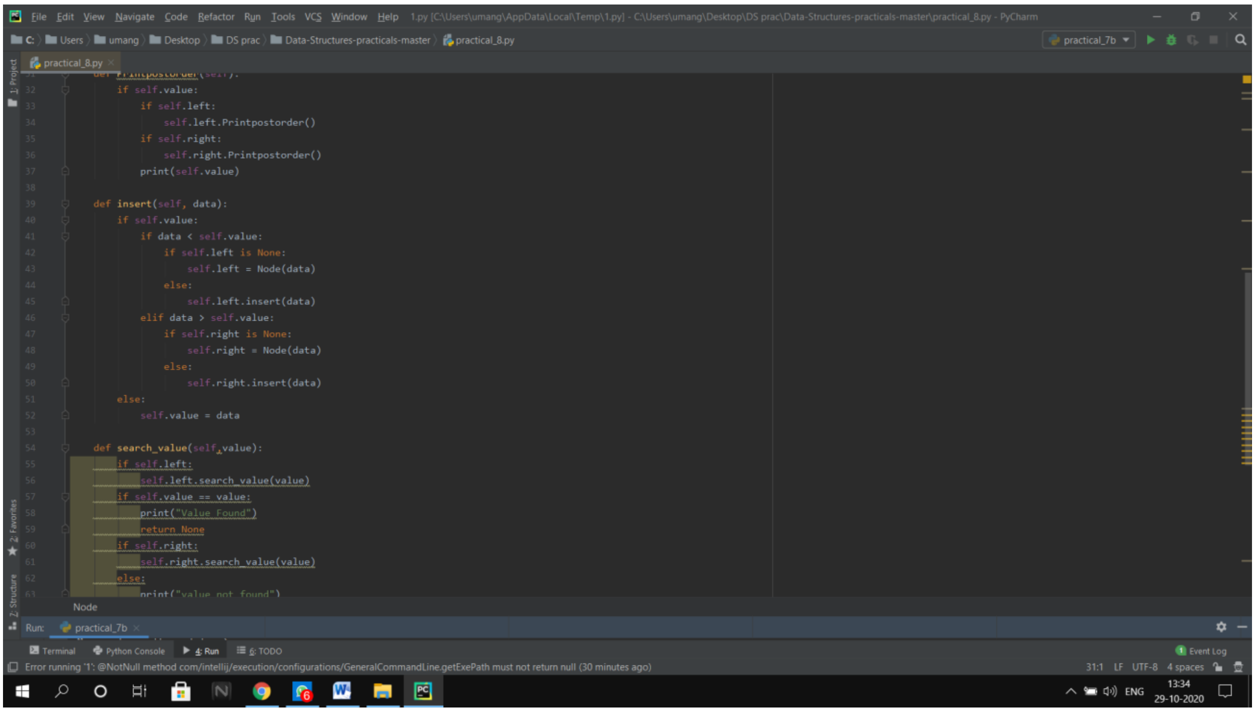
Traverse the left subtree by recursively calling the post-order function.
Traverse the right subtree by recursively calling the post-order function.
Access the data part of the current node.
The trace of a traversal is called a sequentialisation of the tree. The traversal trace is a list of each visited root. No one sequentialisation according to pre-, in- or post-order describes the underlying tree uniquely. Given a tree with distinct elements, either pre-order or post-order paired with in-order is sufficient to describe the tree uniquely. However, pre-order with post-order leaves some ambiguity in the tree structure.



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_8.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_8.py
practical_7b
practical_8.py
1: Project
2: Favorites
7: Structure

```
class Node:

    def __init__(self, key):
        self.left = None
        self.right = None
        self.value = key

    def PrintTree(self):
        if self.left:
            self.left.PrintTree()
        print(self.value)
        if self.right:
            self.right.PrintTree()

    def Printpreorder(self):
        if self.value:
            print(self.value)
            if self.left:
                self.left.Printpreorder()
            if self.right:
                self.right.Printpreorder()

    def Printinorder(self):
        if self.value:
            if self.left:
                self.left.Printinorder()
            print(self.value)
            if self.right:
                self.right.Printinorder()

    def Printpostorder(self):
        if self.value:
```

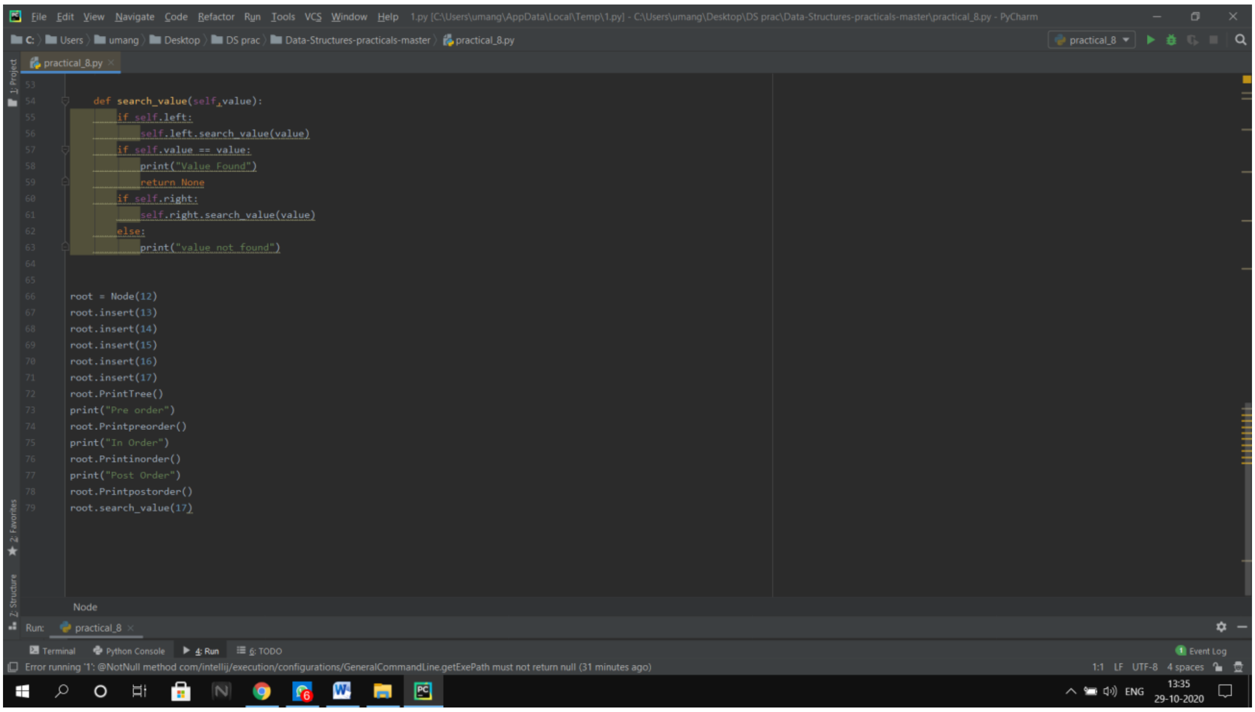
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (29 minutes ago)



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_8.py - PyCharm
C: 〉 Users 〉 umang 〉 Desktop 〉 DS prac 〉 Data-Structures-practicals-master 〉 practical_8.py
practical_7b
practical_8.py
Node
Run: practical_7b
Terminal
Python Console
4: Run
6: TODO
Event Log
31:1 LF UTF-8 4 spaces
ENG
13:34
29-10-2020

```
    def Printpostorder(self):
        if self.value:
            if self.left:
                self.left.Printpostorder()
            if self.right:
                self.right.Printpostorder()
            print(self.value)

    def insert(self, data):
        if self.value:
            if data < self.value:
                if self.left is None:
                    self.left = Node(data)
                else:
                    self.left.insert(data)
            elif data > self.value:
                if self.right is None:
                    self.right = Node(data)
                else:
                    self.right.insert(data)
        else:
            self.value = data

    def search_value(self,value):
        if self.left:
            self.left.search_value(value)
        if self.value == value:
            print("Value Found")
            return None
        if self.right:
            self.right.search_value(value)
        else:
            print("value not found")
```

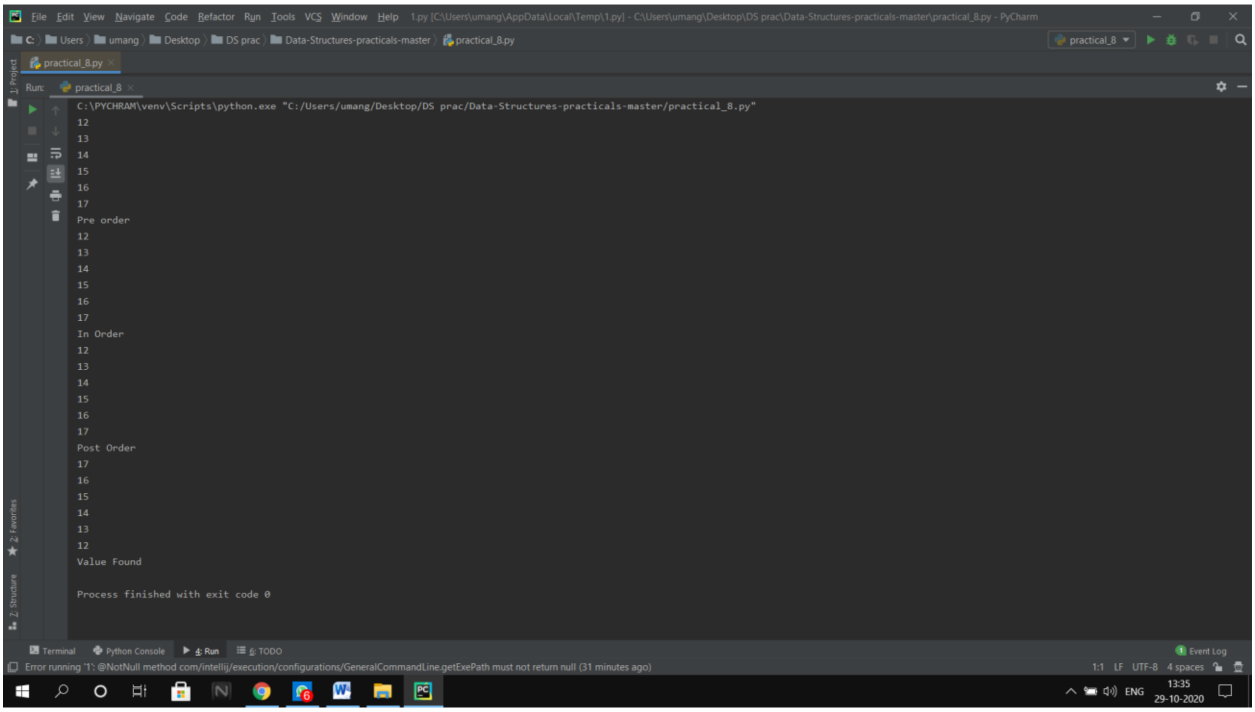
Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (30 minutes ago)



File Edit View Navigate Code Refactor Run Tools VCS Window Help 1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_8.py - PyCharm
C: 〉 Users 〉 umang 〉 Desktop 〉 DS prac 〉 Data-Structures-practicals-master 〉 practical_8.py
practical_8
practical_8.py
Node
Run: practical_8
Terminal
Python Console
4: Run
6: TODO
Event Log
1:1 LF UTF-8 4 spaces
ENG
13:35
29-10-2020

```

    def search_value(self,value):
        if self.left:
            self.left.search_value(value)
        if self.value == value:
            print("Value Found")
            return None
        if self.right:
            self.right.search_value(value)
        else:
            print("value not found")


root = Node(12)
root.insert(13)
root.insert(14)
root.insert(15)
root.insert(16)
root.insert(17)
root.PrintTree()
print("Pre order")
root.Printpreorder()
print("In Order")
root.Printinorder()
print("Post Order")
root.Printpostorder()
root.search_value(17)
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (31 minutes ago)


File Edit View Navigate Code Refactor Run Tools VCS Window Help
1.py [C:\Users\umang\AppData\Local\Temp\1.py] - C:\Users\umang\Desktop\DS prac\Data-Structures-practicals-master\practical_8.py - PyCharm
C: Users umang Desktop DS prac Data-Structures-practicals-master practical_8.py
practical_8.py
Run: practical_8
Terminal
Python Console
4: Run
6: TODO
Event Log
1:1 LF UTF-8 4 spaces
ENG
13:35
29-10-2020

```
C:\PYCHRAM\venv\Scripts\python.exe "C:/Users/umang/Desktop/DS prac/Data-Structures-practicals-master/practical_8.py"
12
13
14
15
16
17
Pre order
12
13
14
15
16
17
In Order
12
13
14
15
16
17
Post Order
17
16
15
14
13
12
Value Found

Process finished with exit code 0
```

Error running '1': @NotNull method com/intellij/execution/configurations/GeneralCommandLine.getExePath must not return null (31 minutes ago)