DEPARTMENT OF COMPUTER & SOFTWARE ENGINEERING

COLLEGE OF E&ME, NUST, RAWALPINDI

EC-350 Artificial Intelligence and Decision Support System

LAB MANUAL – 02

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Student Name: _____

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LAB # 2: OBJECT ORIENTED DESIGN PRACTICES IN PYTHON

Lab Objective:

- To study object-oriented design practices in python.
- Applying object-oriented constructs to create hierarchical data structures.

Hardware/Software required:

Hardware: Desktop/ Notebook Computer
Software Tool: Python 3.10.0

Lab Description:

Python supports object-oriented programming constructs that can be utilized to create sophisticated codebase employing decent data structures. In this lab, different object-oriented programming constructs will be revised, and they will be used to create different algorithms employing different data structures.

1. Classes

Classes are the fundamental constructs in object-oriented paradigms, and they are used to hold methods and variables related to common entity. All the attributes within the class can be accessed through its instance or object. Following examples shows the usage of classes:

Example 1:

```
class MyClass:
    i = 12345    #Class Variable
    def f(self):
        return 'hello world'
x = MyClass()  #object of MyClass
print (x.i)
print (x.f())
```

Example 2:

```
class Shape:
    def __init__(self,x,y): # Constructor
        self.x = x        # Instance Variable
        self.y = y        # Instance Variable
        description = "This shape has not been described yet"
```

```
    author = "Nobody has claimed this shape yet"


  def area(self):
    return self.x * self.y
  def perimeter(self):
    return 2 * self.x + 2 * self.y
  def describe(self,text):
    self.description = text
  def authorName(self,text):
    self.author = text
  def scaleSize(self,scale):
    self.x = self.x * scale
    self.y = self.y * scale


a=Shape(3,4)
print a.area()
```

2. Inheritance

All classes have a property that they can inherit from other classes. This is one of the fundamental concepts of object-oriented design practices. Python also supports inheritance. Following code snippet describes how you can inherit from another classes:

```
class Square(Shape):
  def __init__(self, x):
    self.x = x
    self.y = x


class DoubleSquare(Square):
  def __init__(self,y):
    self.x = 2 * y
```

```
        self.y = y
    def perimeter(self): # Method Overriding
        return 2 * self.x + 3 * self.y
```

3. Modules

A module allows you to logically organize your Python code. Grouping related code into a module makes the code easier to understand and use. A module is a Python object with arbitrarily named attributes that you can bind and reference.

Simply, a module is a file consisting of Python code. A module can define functions, classes and variables. A module can also include runnable code. For example:

Define a module.py file and write a following code script.

```
# Define a variable:
Age = 78
# Define a method
def Print():
    print ("hello")
# Define a class
class Piano:
    def __init__(self):
        self.Type = input("What type of piano? ")
        self.Height = input("What height (in feet)? ")
        self.Price = input("How much did it cost? ")
        self.Age = input("How old is it (in years)? ")

    def PrintDetails(self):
        print ("This piano is a/an " + self.Height + " foot",)
        print (self.Type, "piano, " + self.Age, "years old and costing "\
        + self.Price + " dollars.")
```

Now make a main.py file and import the module:

```
import module


print (module.Age)
module.Print()
o=module.Piano()
o.PrintDetails()
```

4. Trees

Python does not have in-built support for trees. So, we would be utilizing classes to create trees.
For example:

```
class Tree():
    def __init__(self):
        self.left = None
        self.right = None
        self.data = None


root = Tree()
root.data = "root"
root.left = Tree()
root.left.data = "left"
root.right = Tree()
root.right.data = "right"


root.left.left = Tree()
root.left.left.data = "left 2"
root.left.right = Tree()
root.left.right.data = "left-right"


print(root.left.left.data)
```

Lab Tasks:

Q1: Create a class named 'Complex' that must have the following attributes:

Variables named 'Real' and 'Imaginary'

Methods named Magnitude () and Orientation ()

Take a complex number from user in main and print its magnitude and orientation. You have a liberty to create methods signature as you like.

Q2: Compute an 8-point Discrete Fourier Transform (DFT) of the following real-valued discrete sequence:

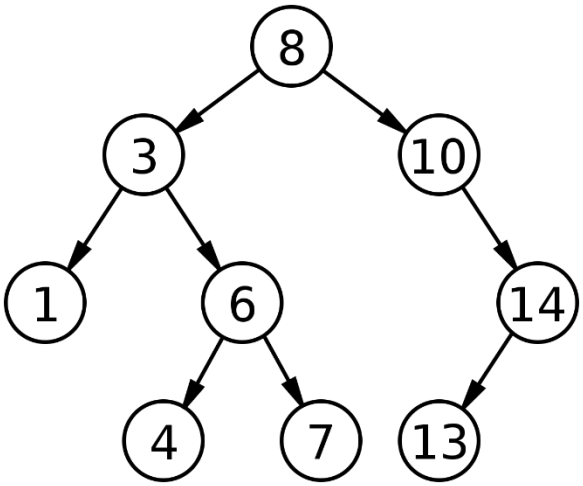
$$x = [2, 2, 2, 2, 2, 2, 2, 2]$$

After computing DFT, Use the previously created 'Complex' class and print the magnitude and phase spectra. DFT can be computed as:

$$X[k] = \sum_{n=0}^{M-1} x[n] e^{-j\frac{2\pi}{N}kn}$$

where M is the length of input sequence, k ranges from 0 to $N - 1$ and $N = 8$.

Q3: Create the following Binary Search Tree and search for the node '13'. You can hard code the tree as well, but it is better if you create it dynamically at run time (You must have learned in Data Structures & Algorithms). Also, tell the time performance of searching the node '13' in Big-O notation.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