


PYTHON

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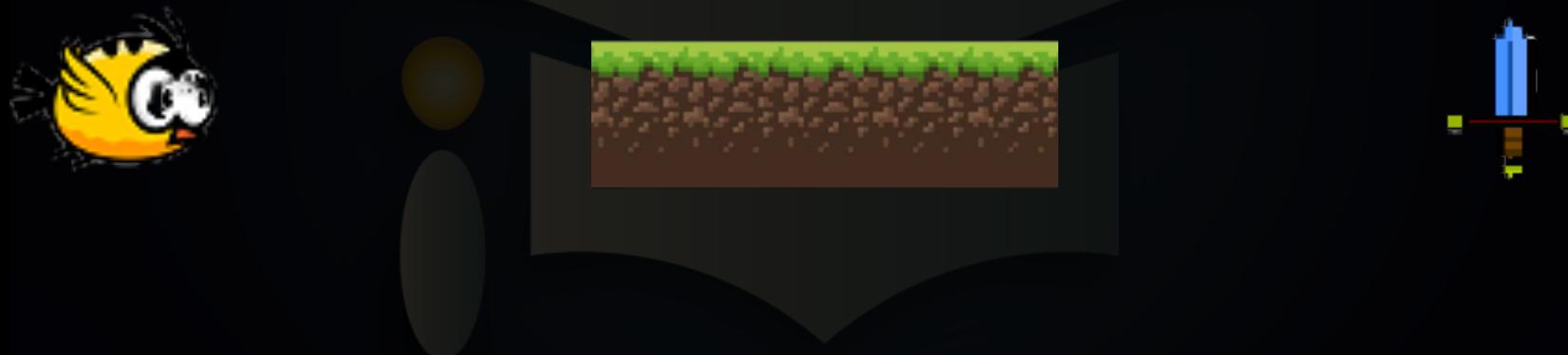
OBJECT ORIENTED PROGRAMMING

What is meant by OOP

**Object Oriented programming is a
programming paradigm which based on
the concept of Objects and Classes**

Objects

The Data and the Functions that belongs to single entity can be grouped in single object



Each Object Hold Its Specific Information

Attributes



Player Name, x-position, y-position, Width, Height



Variables

Methods



collision, movement, Score-calculation



Functions

An object not only contains attributes but also some action. Those actions are basically functions

What is the difference between Class and Object



Class



Object

Putting the data (attributes) and methods
together as a single unit is called Encapsulation

Declaration Of Methods and Attributes

There are two declaration methods in OOP

Public

Private

The Attributes which are usually declared as PRIVATE
can only be accessed inside the class

The Methods which are usually declared as PUBLIC
can be accessed outside the class

NOTE : IN PYTHON YOU ARE SUPPOSE TO DECLARE ATTRIBUTES AS COMMENTS

What is a Constructor ?

Constructor are Functions which are used for initializing the attributes / Properties of a class



```
def __init__():
```

Constructor In Python

QUESTION

P1

name : "Ghost"

age : 21

getAge ()

Object 1

P2

name : "Ninja"

age : 19

getAge ()

Object 2

Player

name :

age :

displayName ()

Class

Defining a class

```
class Player():

    #PRIVATE name : String
    #PRIVATE age : Integer

    def __init__(self, playername, playerage):
        self.name = playername
        self.age = playerage

    def displayName(self):
        return self.name
```

Creating Objects

```
P1 = Player("Ghost", 21)  
P2 = Player("Ninja", 19)  
  
temp1 = P1.displayName()  
print(temp1)  
temp2 = P2.displayName()  
print(temp2)
```

Practice Question

Picture	
Description : STRING Width : INTEGER Height : INTEGER FrameColour : STRING	// stores a description of the picture // stores the width e.g. 30 // stores the height e.g. 40 // stores the colour e.g. black
Constructor() GetDescription() GetHeight() GetWidth() GetColour() SetDescription()	// takes all four values as parameters and sets them to the private attributes // returns the description of the picture // returns the height // returns the width // returns the frame colour // takes the new description as a parameter and writes the value to description

```
class Picture():
    #PRIVATE Description : String
    #PRIVATE Width : Integer
    #PRIVATE Height : Integer
    #PRIVATE FrameColour : String
    def __init__(self, D, W, H, F):
        self.Description = D
        self.Width = int(W)
        self.Height = int(H)
        self.FrameColour = F

    def GetDescription(self):
        return self.Description

    def GetHeight(self):
        return self.Height

    def GetWidth(self):
        return self.Width

    def GetColour(self):
        return self.FrameColour

    def SetDescription(self, New):
        self.Description = New
```

TreasureChest	
question : STRING answer : INTEGER points : INTEGER	// stores the question // stores the answer // stores the maximum possible number of points available for this chest
constructor()	// takes question, answer and points as parameters and creates an instance of an object
getQuestion()	// returns the question
checkAnswer()	// takes the user's answer as a parameter and returns True if it is correct, otherwise returns False
getPoints()	// takes the number of attempts as a parameter and returns the number of points awarded

(a) Create a new program.

Write program code to declare the class TreasureChest.

Do **not** write any other methods.

The attributes are private.

If you are using the Python programming language, include attribute declarations using comments.

```
|class TreasureChest():
|    #PRIVATE question : String
|    #PRIVATE answer : Integer
|    #PRIVATE points : Integer
|
|    def __init__(self, ques, ans, Point):
|        self.question = ques
|        self.answer = ans
|        self.points = Point
```

(c) The main program repeats each question until the user inputs the correct answer. The number of points awarded depends on the number of attempts before the user gives the correct answer.

(i) The class `TreasureChest` has a method `getQuestion()` that returns the question.

Write the method `getQuestion()`.

(ii) The class `TreasureChest` has a method `checkAnswer()` that takes the user's answer as a parameter. It returns `True` if the answer is correct and `False` otherwise.

Write the method `checkAnswer()`.

```
def getQuestion(self):  
    return self.question  
  
def checkAnswer(self, userAnswer):  
  
    if userAnswer == self.answer:  
        return True  
    else:  
        return False
```

(iii) The class `TreasureChest` has a method `getPoints()` that takes the number of attempts as a parameter.

- If the number of attempts is 1, it returns the value of `points`.
- If the number of attempts is 2, it returns the integer value of `points` divided by 2 (`DIV 2`).
- If the number of attempts is 3 or 4, it returns the integer value of `points` divided by 4 (`DIV 4`).
- If the number of attempts is not 1 or 2 or 3 or 4, it returns 0 (zero).

For example, a question is worth 100 points and the user took 2 attempts to give the correct answer. The user is awarded 50 points ($100 \text{ DIV } 2$).

Write the method `getPoints()`.

```
def getPoints(self, attempts):

    if attempts == 1:
        return int(self.points)

    elif attempts == 2:
        temp = self.points // 2
        return int(temp)

    elif attempts == 3 or attempts == 4:
        temp = self.points // 4
        return int(temp)

    else:
        return 0
```

```
class TreasureChest():
    #PRIVATE question : String
    #PRIVATE answer : Integer
    #PRIVATE points : Integer

    def __init__(self, ques, ans, Point):
        self.question = ques
        self.answer = ans
        self.points = Point

    def getQuestion(self):
        return self.question

    def checkAnswer(self, userAnswer):
        if userAnswer == self.answer:
            return True
        else:
            return False

    def getPoints(self, attempts):
        if attempts == 1:
            return int(self.points)
        elif attempts == 2:
            temp = self.points // 2
            return int(temp)
        elif attempts == 3 or attempts == 4:
            temp = self.points // 4
            return int(temp)
        else:
            return 0
```

Balloon	
Health : INTEGER	The health of the balloon
Colour : STRING	The colour of the balloon
DefenceItem : STRING	The item the balloon uses to defend itself
Constructor()	Initialises the defence item and colour using the parameters Initialises health to 100
ChangeHealth()	Takes the change as a parameter and adds this to the health
GetDefenceItem()	Returns the defence item of the object
CheckHealth()	If the health is 0 or less, it returns TRUE, otherwise it returns FALSE

- (a) The constructor takes the name of the defence item and the balloon's colour as parameters and sets these to the attributes. The health is initialised to 100.

Write program code to declare the class `Balloon` and its constructor. Do not write any other methods.

Use your language appropriate constructor.

All attributes should be private. If you are writing in Python include attribute declarations using comments.

```
class Balloon():

    #PRIVATE Health : Integer
    #PRIVATE Colour : String
    #PRIVATE DefenceItem : string

    def __init__(self, col, defence):
        self.Colour = col
        self.DefenceItem = defence
        self.Health = 100
```

- (b)** The get method `GetDefenceItem()` returns the defence item of the object.

Amend your program code to include the get method `GetDefenceItem()`.

- (c)** The object's method `ChangeHealth()` takes an integer number as a parameter and adds this to the health attribute of the object.

Amend your program code to include the method `ChangeHealth()`.

- (d)** The object's method `CheckHealth()` returns `TRUE` if the health of the object is 0 or less (no health remaining) and returns `FALSE` otherwise (health remaining).

Amend your program code to include the method `CheckHealth()`.

```
def GetDefenceItem(self):
    return self.DefenceItem

def ChangeHealth(self, newHealth):
    self.Health = self.Health + newHealth

def CheckHealth(self):
    if self.Health <= 0:
        return True
    else:
        return False
```

(e) Amend the main program to:

- take as input a defence item and colour from the user
- create a new balloon with the identifier `Balloon1` using the data input.

```
userDefence = input("Enter the Defence Item: ")  
userColour = input("Enter the Colour: ")  
  
Balloon1 = Balloon(userColour, userDefence)
```

(f) The function `Defend()`:

- takes a balloon object as a parameter
- takes as input the strength of an opponent from the user
- uses the `ChangeHealth()` method to subtract the strength input from the object's health
- outputs the defence item of the balloon
- checks the health of the object and outputs an appropriate message if it has no health remaining, or if it has health remaining
- returns the amended balloon object.

Write program code to declare the function `Defend()`.

```
def Defend(BallonObject):

    strength = int(input("Enter the Strength: "))
    BallonObject.ChangeHealth(-strength)

    print("Your Defence is:", BallonObject.GetDefenceItem())

    if BallonObject.CheckHealth() == True:
        print("No health left and your defence failed")
    else:
        print("Health Remaining and your defence worked")
```

(g) (i) Amend the main program to call the function `Defend()`.

(ii) Test your program using the following inputs:

- balloon defence method "Shield"
- balloon colour "Red"
- strength of opponent 50

Take a screenshot to show the output.

```
Balloon1 = Defend(Balloon1)
```

```
C:\Users\muham\PycharmProjects\pythonProject5\venv\Scripts\  
Enter the Defence Item: Shield  
Enter the Colour: Red  
Enter the Strength: 50  
Your Defence is: Shield  
Health Remaining and your defence worked
```

- 5 A tennis club is developing a program to store details of the lessons it offers. The programmer has designed the class `Lesson` for the details of the lessons.

The following class diagram shows the design for the `Lesson` class.

Lesson	
LessonType : STRING	// initialised in constructor to the parameter // value passed to the constructor
Instructor : STRING	// initialised in constructor to the parameter // value passed to the constructor
<hr/>	
Constructor()	// method used to create and initialise an // object
GetLessonType()	// returns LessonType value
GetInstructor()	// returns Instructor value
GetFee()	// returns the cost of a lesson
SetLessonType()	// sets the LessonType to the parameter value
SetInstructor()	// sets the Instructor to the parameter value

- (a) Write **program code** for the `Constructor()` method.

Use the appropriate constructor method for your chosen programming language.

```
class Lesson():
    #Private LessonType : String
    #Private Instructor : String
    def __init__(self, LessonTypeP, InstructorP):
        self.LessonType = LessonTypeP
        self.InstructorP = InstructorP
```

(b) Write program code for the GetLessonType () method.

```
def GetLessonType(self):  
    return self.LessonType
```

(c) Fee is the cost that a customer will pay for a lesson.

The method GetFee () validates the parameter value. The method is sent a parameter value that represents the skill level of the customer: beginner, intermediate or advanced.

The parameter will be a character:

- 'B' for beginner
- 'I' for intermediate
- 'A' for advanced.

The method must check the parameter value is a valid character ('B', 'I' or 'A') and return the correct fee. It must return -1 if it is not a valid character.

The fees are:

- \$45 for a beginner
- \$50 for an intermediate
- \$55 for an advanced.

Write **program code** for the GetFee () method.

```
def GetFee(self, Level):
    if Level == "B":
        return 45
    elif Level == "I":
        return 50
    elif Level == "A":
        return 55
    else:
        return -1
```

- (d) The tennis club only offers nine different types of lesson. The lesson objects are stored in a 1D array.

Write **pseudocode** to declare an array `LessonArray` to store the nine lesson objects.

- (e) The tennis club has the lesson 'Improve Your Serve' that has David as the instructor.

Write **program code** to create the lesson 'Improve Your Serve' as an instance of the class `Lesson`. The object needs to be stored in the third element of the array `LessonArray`.

```
#Declare LessonArray : Array [0:8] OF Lesson  
LessonArray = ["", "", "", "", "", "", "", "", ""]  
LessonArray[2] = Lesson("Improve Your Serve", "David")
```

How To Declare Attribute As Private In Python

`self.__LessonType`

`self.__Fees`

`self.__Name`

Double UnderScore is used to make the attribute Private

```
def __init__(self, LessonTypeP, InstructorP):  
    self.__LessonType = LessonTypeP  
    self.__InstructorP = InstructorP
```

Concept Of Inheritance

Part Time Employee

Attributes

Name : String

Age : Integer

Hourlyrate: Integer

Methods

GetName()

DailyWage()

Full Time Employee

Attributes

Name : String

Age : Integer

MonthlyRate: Integer

Methods

GetName()

YearlySalary()

Some Properties and Functions are repeated

```
class PartTimeEmployee():
    #PRIVATE Name : String
    #PRIVATE Age : Integer
    #PRIVATE HourlyRate : Integer
    def __init__(self, NameP, AgeP, HourlyRateP):
        self.__Name = NameP
        self.__Age = AgeP
        self.__HourlyRate = HourlyRateP

    def GetName(self):
        return self.__Name

    def DailyWage(self, HoursWorked):
        temp = HoursWorked * self.__HourlyRate
        return temp
```

```
class FullTimeEmployee():
    # PRIVATE Name : String
    # PRIVATE Age : Integer
    # PRIVATE MonthlyRate : Integer
    def __init__(self, NameP, AgeP, MonthlyRateP):
        self.__Name = NameP
        self.__Age = AgeP
        self.__MonthlyRate = MonthlyRateP

    def GetName(self):
        return self.__Name

    def YearlySalary(self):
        temp = self.__MonthlyRate * 12
        return temp
```

Part Time

Attributes

Hourlyrate: Integer

Methods

DailyWage()

Employee
Attributes

Name : String

Age : Integer

Methods

GetName()

Full Time

Attributes

MonthlyRate: Integer

Methods

YearlySalary()

```
class Employee():
    # PRIVATE Name : String
    # PRIVATE Age : Integer
    def __init__(self, NameP, AgeP):
        self.__Name = NameP
        self.__Age = AgeP

    def GetName(self):
        return self.__Name
```

```
class PartTime(Employee):

    # PRIVATE HourlyRate : Integer
    def __init__(self, NameP, AgeP, HourlyRateP):
        super().__init__(NameP, AgeP)
        self.__HourlyRate = HourlyRateP

    def DailyWage(self, HoursWorked):
        temp = HoursWorked * self.__HourlyRate
        return temp
```

```
class FullTime(Employee):

    # PRIVATE MonthlyRate : Integer
    def __init__(self, NameP, AgeP, MonthlyRateP):
        super().__init__(NameP, AgeP)
        self.__MonthlyRate = MonthlyRateP

    def YearlySalary(self):
        temp = self.__MonthlyRate * 12
        return temp
```

```
worker = PartTime("Bhatti", 50, 20)
PermanentWorker = FullTime("Sheikh", 60, 3000)
print(PermanentWorker.GetName())
print(PermanentWorker.YearlySalary())
```

What Is Meant By Inheritance ?

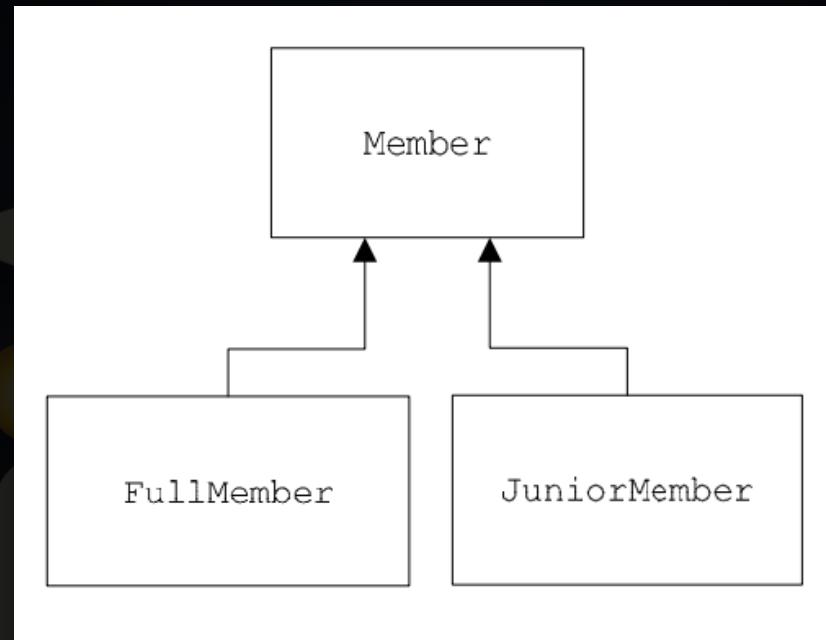
- . The derived class can use the properties from the Parent Class Without Redeclaring them**
- . The derived class can use the Methods from the Parent Class Without Redeclaring them**
- . Can extend the Properties from the Parent Class**
- . Can extend the Methods from the Parent Class**

4 A sports club stores data about its members. A program is to be written using an object-oriented programming language.

A Member class is designed. Two subclasses have been identified:

- FullMember
- JuniorMember

(a) Draw an inheritance diagram for these classes.



(b) The design for the Member class consists of

- properties
 - MemberName
 - MemberID
 - SubscriptionPaid
- methods
 - SetMemberName
 - SetMemberID
 - SetSubscriptionPaid

Write **program code** for the class definition of the superclass Member.

```
class Member():
    #PRIVATE MemberName : String
    #PRIVATE MemberID : String
    #PRIVATE SubscriptionPaid : Boolean
    def __init__(self):
        self.__MemberName = ""
        self.__MemberID = ""
        self.__SubscriptionPaid = False

    def SetMemberName(self, MemberNameP):
        self.__MemberName = MemberNameP

    def SetMemberID(self, MemberIDP):
        self.__MemberID = MemberIDP

    def SetSubscriptionPaid(self, SubscriptionPaidP):
        self.__SubscriptionPaid = SubscriptionPaidP
```

- (c) Additionally a `DateOfBirth` property is required for the `JuniorMember` class.
- (i) Write **program code** for the class definition for the subclass `JuniorMember`.

```
class JuniorMember(Member):
    #PRIVATE DateOfBirth : String
    def __init__(self):
        super().__init__()
        self.__DateOfBirth = ""

    def SetDateOfBirth(self, Date):
        self.__DateOfBirth = Date

    def SetMemberName(self, MemberNameP):
        super().SetMemberName(MemberNameP)

    def SetMemberID(self, MemberIDP):
        super().SetMemberID(MemberIDP)

    def SetSubscriptionPaid(self, SubscriptionPaidP):
        super().SetSubscriptionPaid(SubscriptionPaidP)
```

- (ii) Write **program code** to create a new instance of `JuniorMember`. Use identifier `NewMember` with the following data:
name Ahmed with member ID 12347, born on 12/11/2001, who has paid his subscription.

```
NewMember = JuniorMember()  
NewMember.SetMemberName("Ahmed")  
NewMember.SetMemberID("12347")  
NewMember.SetSubscriptionPaid(True)  
NewMember.SetDateOfBirth("12/11/2001")
```

super().

super() is a built-in Python function that provides a way to access methods and attributes of a superclass from a subclass. It is used to call the implementation of a method that is defined in a superclass, which has been overridden in a subclass.

```
class Vehicle:  
    def drive(self):  
        print("Driving the vehicle")  
  
class Car(Vehicle):  
    def drive(self):  
        super().drive()  
        print("Driving the car")  
  
# Create an instance of the Car class  
my_car = Car()  
  
# Call the drive method on the Car instance  
my_car.drive()
```

How to identify if you should use super(). or not

If you want to extend the methods used in Super Class
then you should use super().Method

Additionally is the Key Word to Identify

Containment

Containment is a fundamental concept in Object-Oriented Programming (OOP) that refers to the ability to include one object inside another object.

- 1 A vending machine allows users to insert coins to purchase an item.

The user then enters the code for the item they would like the machine to dispense (give out). The user must re-enter the code until it is valid.

If the code is valid but the user has not inserted enough money for the item chosen, the machine waits for more coins to be inserted. The user then has to re-enter the code.

The user can press cancel at any time to return the money inserted into the machine.

- (b)** The vending machine is part of a program that is written using object-oriented programming (OOP). The vending machine makes use of two classes that are described in the following tables.

All attributes are declared as private.

foodItem	
name : STRING	// the name of the item of food
code : STRING	// the code to be entered for that item to be // selected
cost : REAL	// the cost of the item
constructor(nameP, codeP, costP)	// creates an instance of foodItem // takes the name, code and cost as parameters
getCode()	// returns the code for the item
getCost()	// returns the cost of the item
getName()	// returns the name of the item

vendingMachine	
items : ARRAY[0:3] OF foodItem moneyIn : REAL	// stores four items of type foodItem // stores the total money inserted by the // user, initialised to 0 in the constructor
constructor(item1, item2, item3, item4)	// creates an instance of vendingMachine, // takes four objects of type foodItem as // parameters and stores them in array items
insertMoney()	// takes the value of the coin as a parameter // and adds it to moneyIn
checkValid ()	// takes a code as a parameter and checks it is // valid against the food item codes
getItemName()	// takes the array index as a parameter and // returns the name of the food items

- (i) Write **program code** to declare the class vendingMachine. You are only required to write program code for the attribute declarations and the constructor.

If you are writing in Python, include attribute declarations using comments.

Use your programming language's constructor method.

```
class vendingMachines():
    # PRIVATE Items : Array [0:3] OF foodItems
    # PRIVATE moneyIn : Real
    def __init__(self, item1, item2, item3, item4):
        self.__items = []
        self.__items.append(item1)
        self.__items.append(item2)
        self.__items.append(item3)
        self.__items.append(item4)
        self.__moneyIn = 0
```

- (ii) The method `checkValid()` takes the food item code as a parameter. It checks the code against each element in `items` and returns:
- `-1` if the code is not valid
 - `-2` if the code is valid, but the `moneyIn` is less than the cost of the item
 - the index of the item, if the code is valid and the `moneyIn` is greater than or equal to the cost of the item.

Write **program code** for the method `checkValid()`.

```
def checkValid(self, code):
    for x in range(0, 4):
        if self.__items[x].getCode == code:
            if self.__items[x].getCost <= self.__moneyIn:
                return x
            else:
                return -2
    return -1
```

(iii) Four objects of type foodItem are declared with the identifiers:

chocolate, sweets, sandwich, apple

Write **program code** to declare an instance of vendingMachine with the identifier machineOne and the objects: chocolate, sweets, sandwich, apple.

```
machineOne = vendingMachines(chocolate, sweets, sandwich, apple)
```

```
class vendingMachines():
    # PRIVATE Items : Array [0:3] OF foodItems
    # PRIVATE moneyIn : Real
    def __init__(self, item1, item2, item3, item4):
        self.__items = []
        self.__items.append(item1)
        self.__items.append(item2)
        self.__items.append(item3)
        self.__items.append(item4)
        self.__moneyIn = 0

    def checkValid(self, code):
        for x in range(0, 4):
            if self.__items[x].getCode == code:
                if self.__items[x].getCost <= self.__moneyIn:
                    return x
                else:
                    return -2
        return -1

machineOne = vendingMachines(chocolate, sweets, sandwich, apple)
```

Practice Question

- 3 Ejaz is creating a program that will allow the user to create quizzes. He is using object-oriented programming (OOP).

There are two classes: `QuestionClass` and `QuizClass`.

The class attributes and methods are in the following tables. All attributes are declared as private.

QuestionClass	
Question : STRING	// stores the question
Answer : STRING	// stores the correct answer
Difficulty : INTEGER	// stores the difficulty as an integer // from 0(easy) to 10(hard)
Constructor(QuestionP, AnswerP, DifficultyP)	// creates an instance of QuestionClass // sets the attributes to the parameter // values
GetQuestion()	// returns the question
GetDifficulty()	// returns the difficulty level
GetAnswer()	// returns the answer

QuizClass

Questions : ARRAY[0:19] OF QuestionClass	// stores maximum 20 questions of // type QuestionClass
NumberOfQuestions : INTEGER	// stores the number of questions // in this quiz
Constructor()	// creates an instance of // QuizClass // initialises NumberOfQuestions // to 0
AddQuestion()	// adds the parameter question to // the array // increments NumberOfQuestions
GetQuestion()	// returns the next question to be // asked
CheckAnswer()	// takes an answer as a parameter // and returns TRUE if correct

- (a) Write **program code** to define the class `QuizClass`. You are only required to write code for the attribute declarations and constructor.

If you are writing in Python, include attribute declarations using comments.

Use your programming language's constructor method.

```
class QuizClass():
    # PRIVATE Questions : Array [0:19] OF QuestionClass
    # PRIVATE NumberofQuestions : Integers
    def __init__(self):
        self.__NumberofQuestions = 0
        self.__Questions = []
        for x in range(20):
            self.__Questions.append(QuestionClass("", "", 0))
```

- (b)** The QuizClass method AddQuestion () takes a question object as a parameter and stores it in the next available location in the array Questions. It returns TRUE if it is successfully stored, and FALSE otherwise.

Write **program code** for the method AddQuestion () .

```
def AddQuestion(self, QuestionObject):

    if self.__NumberofQuestions < 20:
        self.__Questions[self.__NumberofQuestions] = QuestionObject
        self.__NumberofQuestions = self.__NumberofQuestions + 1
    return True

else:
    return False
```

(c) The first quiz is created with the identifier FirstQuiz.

The first question in this quiz is: "What is 100 / 5 ?".

The answer is "20" and the difficulty level is 1.

Write **program code** to:

- declare an instance of QuizClass with the identifier FirstQuiz
- declare an instance of QuestionClass with the identifier Question1
- add Question1 to the array in FirstQuiz using AddQuestion().

```
FirstQuiz = QuizClass()  
Question1 = QuestionClass("What is 100/5", "20", 1)  
FirstQuiz.AddQuestion(Question1)
```

