ĐẠI HỌC ĐÀ NẴNG

TRƯỜNG ĐẠI HỌC CÔNG NGHỆ THÔNG TIN VÀ TRUYỀN THÔNG VIỆT - HÀN

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# Chapter 3
# Object-Oriented Programming in Python

KHMT
Computer Science

## Chapter Content

## Class & Object

- Class:
  - Is  the template or blueprint from which objects are made
  - Can be defined as a collection of object
- Including:
  - Data: attribute/ field/ instance variable
  - Methods
  - Constructor
  - …
- Object:
  - is an instance of class
  - Attribute and Methods

- Example to define a class:

```
class Human:                                              → define a class
    def __init__(self, n, prof):                          → define a __init__ method
        self.name = n                                     → define an attribute (ex: name)
        self.professional = prof                          → define an attribute (ex: professional)
    def make(self):                                       → define a make method
        if self.professional == "A Tenis Player":
            print(self.name, "play Tenis")
        elif self. professional == "Performer":
            print(self.name, "Shooting on film ")
    def say(self):                                        → define a say method
        print(self.name, "say: How are you?")
```

- A Function created in a class then it’s called a method
- The _init_() method is a special method, it’s used to define the attributes and It’s called when a Object is created
- A self parameter is the default parameter

## Class & Object

- Object:
  - Create a Object: ObjectName = ClassName(Attribute)
  - Call a Method: ObjectName.MethodName()
  - Access a Attribute: ObjectName.Attribute
  - Example:

```
class oto:        # Define a oto class
     def __init__(self, c, num):
          self.color = c
          self.numberWheel = num
     def Start_the_oto(self):
          print("Starting...")
     def Turn_on_the_light(self):
          print("Turn on!")
my_oto = oto("blue", 6)    # Make a my_oto object
print("Color of Oto is: " + my_oto.color)
print("Number of Wheel is: " + str(my_oto.numberWheel))
```

- Organize the storage and use of class-objects :
  - In large projects, for easy management:
    - Step 1: Define classes and save in a separate file (Module file)
    - Step 2:
      - Create a main program file
      - Use those classes in the main program:

        ```
        from   Class_file    import *
        ```

      - Create an object from the class and use attributes and methods :
        - Create a Object: ObjectName = ClassName(Attribute)
        - Call a Method:   ObjectName.MethodName()
        - Access a Attribute: ObjectName.Attribute

## Class & Object

- Example
- Step 1: Make a file oto_class.py:

```
class oto:
        def __init__(self, t):
              self.ten = t
        def start(self):
               print(“Starting up...")
```

- Step 2: Make a file class_test.py:

```
from oto_class import *
my_oto = oto("audi")
print("This is a: " + my_oto.ten)
print("It is: " + my_oto.start())
```

- Example: Define a class: InputOutString which have 2 method:
  - getString: to get a string entered by the user from the keyboard.
  - printString: prints the string to the screen as an uppercase string.

```
class InputOutString:
    def __init__(self, c):
        self.str = c

    def getString(self):
        self.str = input("Enter a string:")

    def printString(self):
        print(self.str.upper())
st=''
strObj = InputOutString(st)
strObj.getString()
strObj.printString()
```

# Class & Object

**Example 4:** Make a file dientich.py which has a class DT with 2 attributes: length and width; a method Tinh_DT() to calculate a rectangular area. Then, make a file Test_dt.py to create an object from the DT class to calculate and print the area of rectangle. Requirement: the length and width is inputed from keyboard.

**Step 1**: Make a file **dientich.py**:

```
class DT():
    def __init__(self, l, w):
        self.length = l
        self.width = w
    def Tinh_DT(self):
        s = self.length * self.width
        print(" the area of
rectangle is", s)
```

**Step 2**: Make a file test_dt.py:

```
from dientich import *
lenghtValue=int(input(“Enter a length:"))
widthValue = int(input(“Enter a width:"))
S = DT(lenghtValue, widthValue)
S.Tinh_DT())
```

- Attributes:
  - Concept: The data held by an object is represented by its attributes
  - Types:
    - Class variables : defined within the scope of the class, but outside of any methods
    - Instance variables: are tied to the instance (objects) than class

## Class & Object

- Example:

```
class Person:
    # instance_count is class variable
    instance_count = 0
    def __init__(self, name, age):
        Person.instance_count += 1
    # name, age are instance variables
        self.name = name
        self.age = age
```

- Constructor:
  - Concept: is a special type of method (function) which is used to initialize the instance members of the class.
  - Constructors can be of two types:
    - Parameterized Constructor
    - Non-parameterized Constructor

# Class & Object

- Syntax: `__init__(<parameter>)`
- Example:

```
class Employee:
    def __init__(self, name, id):
        self.id = id
        self.name = name

    def display(self):
        print("ID:%d \nName:%s" %(self.id,self.name))

emp1 = Employee("John", 101)
emp2 = Employee("David", 102)
```

## Class & Object

- Method
  - Instance method
  - Class method
  - Static method
  - Special method
  - Getter, setter method

# Class & Object

- Instance method
  - Concept: it is tied to an instance of the class
  - Example:

```python
class Employee:
    id = 0
    name = "Devansh"
    def display(self):
        print(self.id,self.name)
```

- Display(seft) is a instance method
- “**self**” is used as a reference variable, which refers to the current object. It is always the first argument in the function definition. However, using self is optional in the function call

- Class method
  - Concept: behaviour that is linked to the class rather than an individual object
  - Example:

```
class Employee:
    id = 0
    name = "Devansh"
   @classmethod
   def increment_id(cls):
       id+=1
   def display(self):
       print(self.id,self.name)
```

- **increment_id(cls)** is a class method
- Is decorated with "**@classmethod**" keyword and take a first parameter with **"cls"**

- Static method
  - Concept: is defined within a class but are not tied to either the class nor any instance of the class
  - Example:

```
class Employee:
    id = 0
    name = "Devansh"
  @staticmethod
  def static_function():
      print(“Static method”)
```

- is decorated with the **@staticmethod** decorator
- the same as free standing functions but are defined within a class

- Special method
  - Start and end with a double underbars ('__').
  - It's called when a Object is created
  - You should never name one of your own methods or functions __<something>__ unless you intend to (re)define some default behaviour.
  - Example:
    - __init__()
    - __str__()
    - __dict__()
    - __doc__()
    - __module__()

- Getter and setter methods
  - Concept: used to access the values of objects
  - Getter methods: decorated with the @property decorator
  - Setter methods: decorated with the @attribute_name.setter decorator

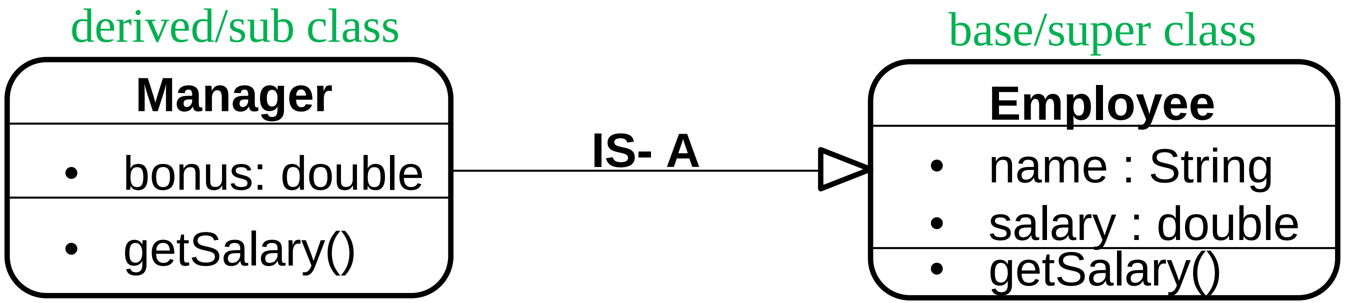
- Example about Getter and setter methods:

```
class Example:
    # Attribute
    __domain = ''
    # Getter
    @property
    def domain(self):
        return self.__domain
    # Setter
    @domain.setter
    def domain(self, domain):
        self.__domain = domain
```

## Inheritance

- Concept: the child class acquires the properties and can access all the data members and functions defined in the parent class
- Note:
  - Reuse code
  - Method Overriding
- Syntax:

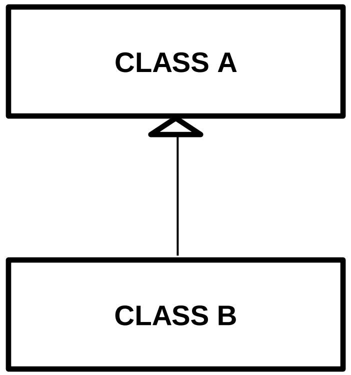
```
class derived-class(base class):
        <derived class-body>
```



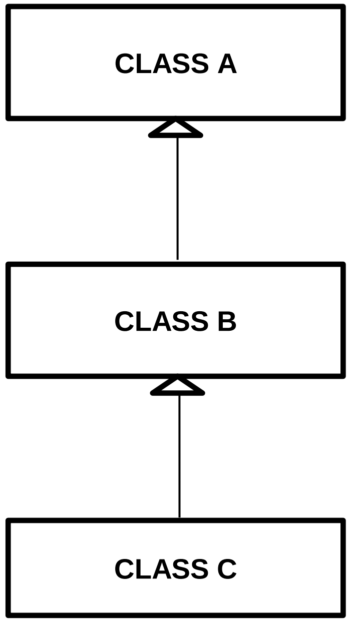
# Class & Object

- Inheritance

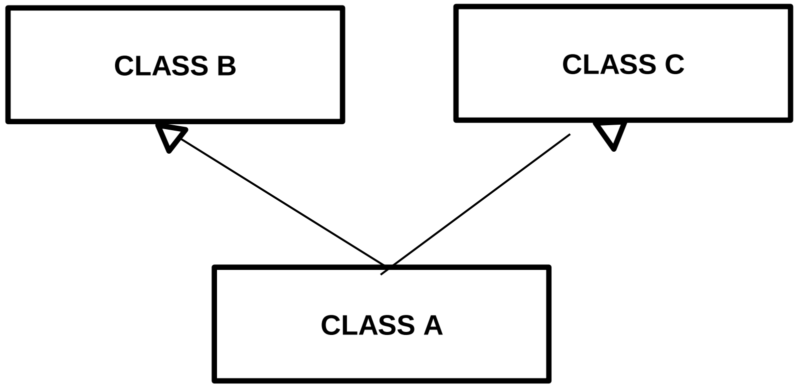
**Single**



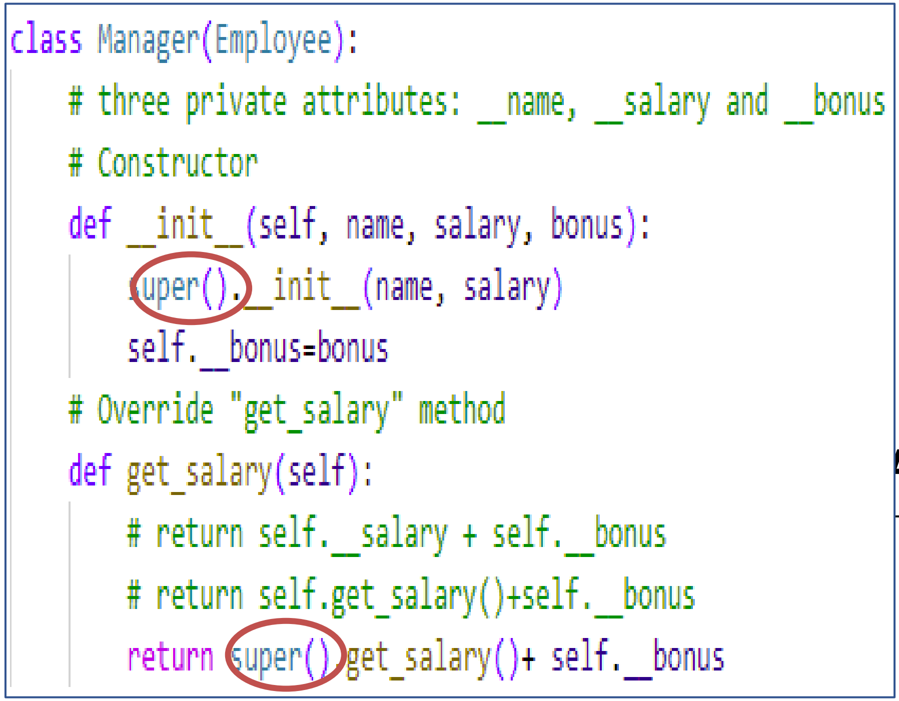
**Multi-level inheritance**



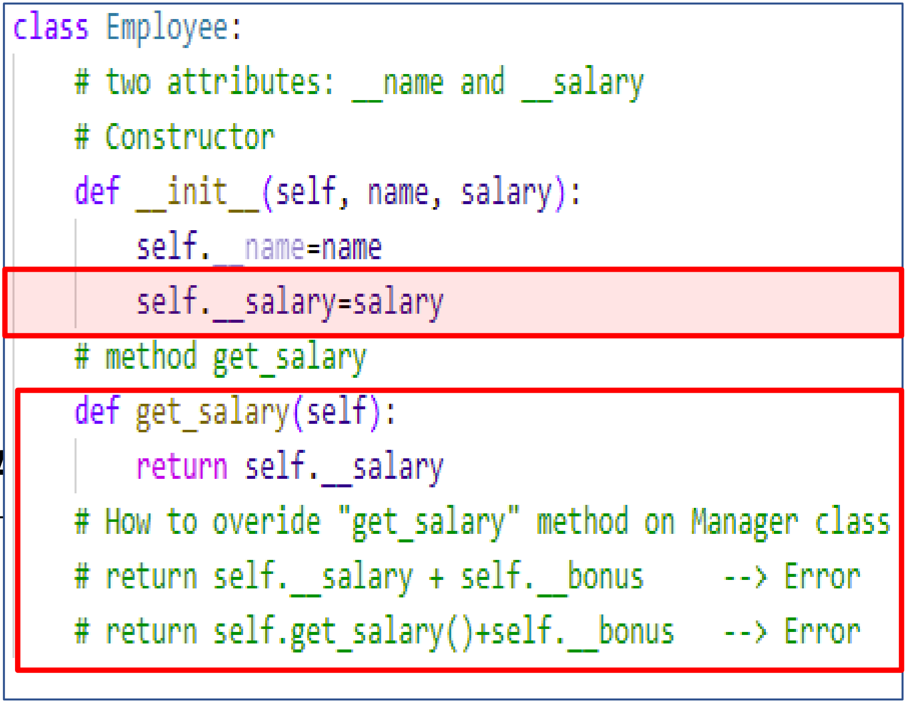
**Multiple - inheritance**



- Inheritance
  - “super()”: is used to call method and constructor of parent class

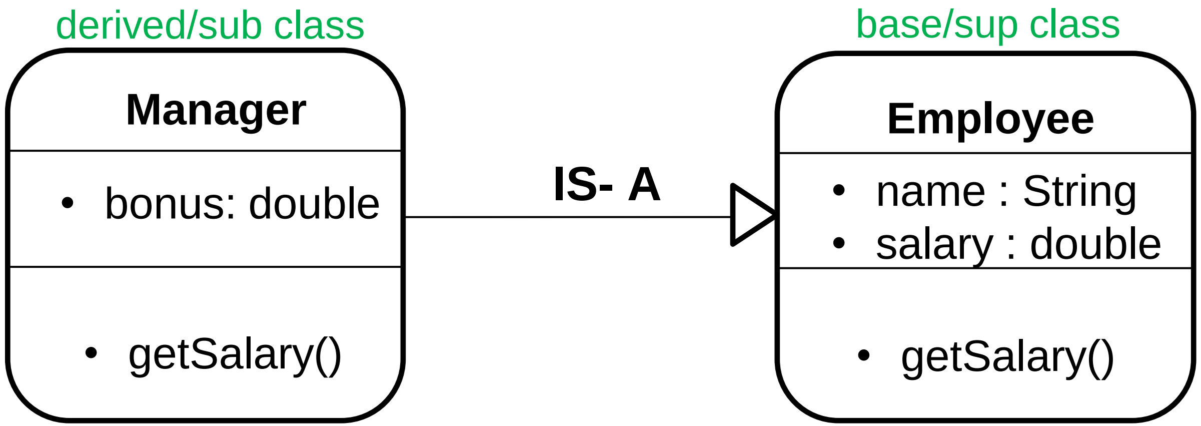


```python
class Manager(Employee):
    # three private attributes: __name, __salary and __bonus
    # Constructor
    def __init__(self, name, salary, bonus):
        super().__init__(name, salary)
        self.__bonus=bonus
    # Override "get_salary" method
    def get_salary(self):
        # return self.__salary + self.__bonus
        # return self.get_salary()+self.__bonus
        return super().get_salary()+ self.__bonus
```

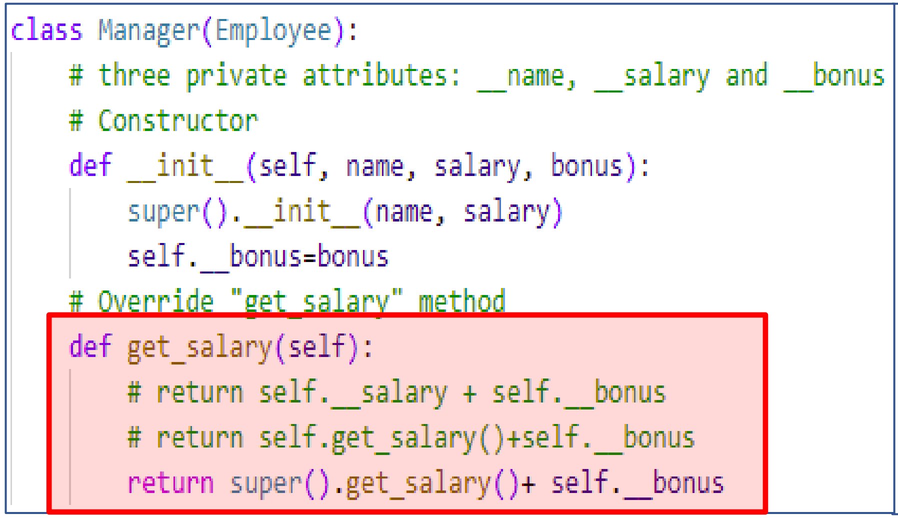


```python
class Employee:
    # two attributes: __name and __salary
    # Constructor
    def __init__(self, name, salary):
        self.__name=name
        self.__salary=salary
    # method get_salary
    def get_salary(self):
        return self.__salary
    # How to overide "get_salary" method on Manager class
    # return self.__salary + self.__bonus       --> Error
    # return self.get_salary()+self.__bonus     --> Error
```

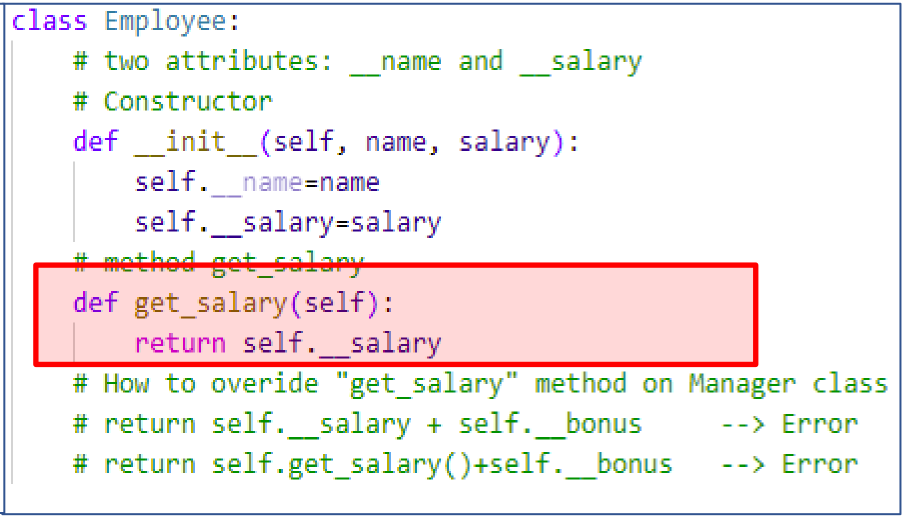
- Polymorphism
  - Polymorphism: one task can be performed in different ways
  - Note: Runtime polymorphism: Method Overriding



- Method Overriding
  - Concept: subclass (child class) has the same method as declared in the parent class, it is known as method overriding
  - Note:
    - Same name and the number of parameters
    - Runtime polymorphism; The prefer in the order: left to right, up to down



```
class Manager(Employee):
    # three private attributes: __name, __salary and __bonus
    # Constructor
    def __init__(self, name, salary, bonus):
        super().__init__(name, salary)
        self.__bonus=bonus
    # Override "get_salary" method
    def get_salary(self):
        # return self.__salary + self.__bonus
        # return self.get_salary()+self.__bonus
        return super().get_salary()+ self.__bonus
```



```
class Employee:
    # two attributes: __name and __salary
    # Constructor
    def __init__(self, name, salary):
        self.__name=name
        self.__salary=salary
    # method get_salary
    def get_salary(self):
        return self.__salary
    # How to overide "get_salary" method on Manager class
    # return self.__salary + self.__bonus      --> Error
    # return self.get_salary()+self.__bonus    --> Error
```

- Abstraction
  - Concept: main goal is to handle complexity by hiding unnecessary details from the user
  - Note:
    - We know “what it does” but we don’t know “how it does”
    - Abstract Base Classes (ABCs)

Remote

Sending Message

- Abstract class and abstract method
  - Abstract class:  is a restricted class that cannot be used to create objects (to access it, it must be inherited from another class)
  - Note:
    - Having at least one abstract method
    - Can not be instantiated themselves
    - Abstract method: can only be used in an abstract class, and it does not have a body. The body is provided by the subclass (inherited from).
  - Note:
    - Is declared in subclass

## Abstract Class

- Abstract Base Classes (ABCs) :
  - Can be used to define generic (potentially abstract) behaviour that can be mixed into other Python classes and act as an abstract root of a class hierarchy.
  - There are many built-in ABCs in Python including (but not limited to): IO, numbers, collection,…modules
- Declared an Abstract Class
  - Step 1 :import ABCs, abstract method
  - Step 2: Declared an Abstract Class inheritance from ABC class in step 1
  - Step 3: Declared Abstract Methods

- Abstract Class

  - Example 1:

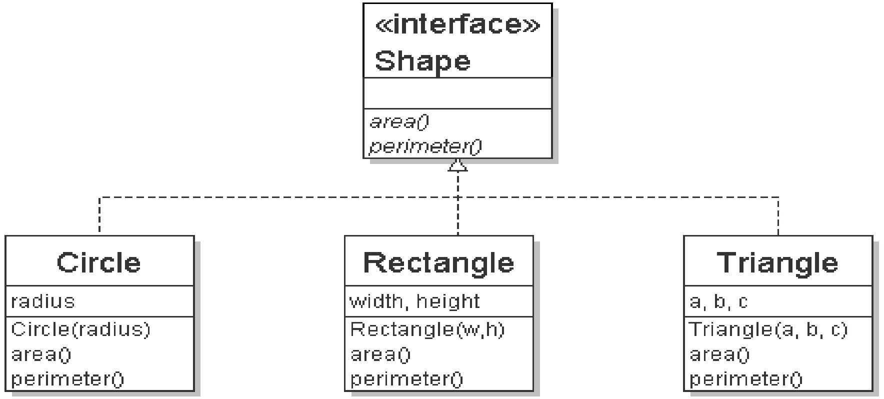
```
from abc import ABC, abstractmethod
class Vidu(ABC):
    @abstractmethod
    def methodName(self):
        pass
```

  - Example 2:

```
from collections import MutableSequence. abstractmethod
class Bag(MutableSequence):
    @abstractmethod
    def methodName(self):
        pass
```

- Interface

  - Interface: this is a contract between the implementors of an interface and the user of the implementation guaranteeing that certain facilities will be provided. Python does not explicitly have the concept of an interface contract (note here interface refers to the interface between a class and the code that utilizes that class).
  - Example: Create an "interface" Shape and subclasses: Circle, Rectangle, Triangle



# Class & Object

- Interface

  - **"Interface" Shape**

```
from abc import ABC, abstractmethod
class Shape(ABC):
    @abstractmethod
    def area(self):
        pass
    @abstractmethod
    def perimeter(self):
        pass
```

  - **Circle Class**

```
class Circle(Shape):
    def __init__(self, radius) -> None:
        super().__init__()
        self.radius=radius
    def area(self):
        return 3.14*self.radius*self.radius
    def perimeter(self):
        return 2*3.14*self.radius
```

  - **Rectangle Class**

```
class Rectangle(Shape):
    def __init__(self, width, height) -> None:
        super().__init__()
        self.width=height
        self.height=height
    def area(self):
        return self.width*self.height
    def perimeter(self):
        return (self.width+self.height)*2
```

- Encapsulation
  - Concept: It is used to restrict access to methods and variables. In encapsulation, code and data are wrapped together within a single unit from being modified by accident.
  - Note:
    - Private Attributes
    - Using getter and setter methods to access data

```
class Student:
    def __init__(self, univer):
        self.__univer=univer
    # getter
    @property
    def univer(self):
        return self.__univer
    # Missing setter method
    # only read data
```

```
a= Student(“VKU")
a.__univer=“VKU University"
print(a.univer)
# result is not changed: “VKU”
```

```
class Student:
    def __init__(self, univer):
        self.__univer=univer
    # setter
    @univer.setter
    def univer(self,univer):
        self.__univer=univer
    # Missing getter method
    # Only write data
```

```
a= Student(“VKU")
a.univer=“VKU University"
print(a.__univer)
# Cannot print
```

## Exercises Chapter 3

- Do exercises from questions 43 to 55 in exercises of Chapter 2 but using object-oriented programming technique