

OOP

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1 Exercise 0

Implement a "Calculator" that is able to perform the 4 basic operation :add, subtract, multiply, divide The result should be something like the following

```
[1]: from Exercise_0 import *
if __name__=="__main__":
    c=Calculator('Casio')
    c.add(2,3)
    c.sub(2,3)
    c.mul(2,3)
    c.div(2,3)
```

```
2 + 3 = 5
2 - 3 = -1
2 * 3 = 6
2 / 3 = 0.667
```

2 Exercise 1

Implement a "Point" class that is able to represent 2-D points.
The class must contains the methods to obtain the results shown below

```
[2]: from Exercise_1 import *
if __name__=="__main__":
    a=Point(7,1)
    b=Point(1,1)
    print(a.distance(b))

    a.move(2,2)
    print(a)
```

```
6.0
(9,3)
```

Tips and tricks:

- The formula for the distance between two points is

$$d(P_1, P_2) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

- To use the square root function you need to import math and use math.sqrt like below

```
[19]: import math
print(math.sqrt(4))
```

2.0

3 Exercise 2

Implement a "Line" class that is able to represent 2-D lines. Using the class "Points" of the previous exercise and this one try to obtain the following results

```
[2]: from Exercise_2 import *
if __name__=="__main__":
    l=Line(3,2)
    print(l)

    a=Point(0,1)
    b=Point(2,2)
    l.line_from_points(a,b)

    l=Line(1,0)
    a=Point(1,5)
    print(l.distance(a))

    m=Line(-1,0)
    i=l.intersection(m)
    print(i)
```

Line: y=3x+2
2.82842712474619
(0.0,0.0)

Tips and tricks

- The formula to obtain the equation from 2 points is

$$y = (y_2 - y_1)/(x_2 - x_1)x - (y_2 - y_1)/(x_2 - x_1)x_1 + y_1$$

- The formula for the distance between a line and a point is

$$d(P, r) = \frac{|ax_P + by_P + c|}{\sqrt{a^2 + b^2}}$$

- the formula to find the intersection is

$$P\left(\frac{q_2 - q_1}{m_1 - m_2}, m_1 \frac{q_2 - q_1}{m_1 - m_2} + q_1\right)$$

4 Create a "client" for your main

In all the exercises we made before we were able to run the main just once but in most cases that's not really useful, we would like to create a client-style main to be able to execute the same code in different ways according to some commands and then quit when we've finished. An easy method to do this is shown below for the Exercise 1.

```
[ ]: if __name__=="__main__":
    #We want to run the script untile the user input a specific command to quit
    #(in this case "q")
    while True:
        #Putting \ in a string allows us to continue writing in the next line
        user_input=input("The available command are:\n\
d:Distance between 2 points\n\
m:Move a point according to a vector\n\
q:Quit\n")
        if user_input=="d":
            #Ask the user two points and calculate the distance
            pass
        elif user_input=="m":
            #Ask the user a point and a vector to apply
            pass
        elif user_input=="q":
            #exit from the loop
            break
        else:
            print("Command not recognized")
    print("Goodbye!")
```

This we'll be useful in the next exercises

5 Exercise 3

In this exercise we want to create a "Deck" class and a "Card" class to represent a poker deck of cards. The requirements are

1. The Deck should have a *deal()* method that pick a card (or multiple card from the deck) and remove them from the deck
2. The Deck should have a *shuffle()* method
3. The Card class should have a suit (Hearts, Diamonds, Clubs, Spades) and a value (A,2,3,4,5,6,7,8,9,10,J,Q,K)

Tips and tricks

- Pay attention to consider the case of trying to draw more cards than the actual number of cards in the deck.
- In the Python package *random* there is a function that may help you to shuffle the deck, look [here](#)

6 Exercise 4

Create the classes "Contact" and "AddressBook" All the contacts are stored in a file named "contacts.txt", they specify name,surname and e-mail like the following example

Matteo,Orlando,matteo.orlando@polito.it

The "AddressBook" class must be able to read the content of the file and perform CRUD (Create,Read,Update,Delete). The Update is the most difficult so i suggest to begin with the other.

7 Exercise 5(todo after the next theory lesson)

Create the classes "Contact" and "AddressBook" All the contacts are stored in a json file named "contacts.json" and are similar to

```
{
    "name": "Cassio",
    "surname": "Zen",
    "email": "cassiozen@gmail.com"
}
```

The "AddressBook" class must be able to read the content of the file and perform CRUD (Create,Read,Update,Delete). The Update is the most difficult so i suggest to begin with the other. Below you can find an example

```
[1]: from Exercise_5 import *
      book=AddressBook()
      book.show()
```

```
Name:Cassio, Surname:Zen, mail:None
Name:Dan, Surname:Abramov, mail:None
Name:Pete, Surname:Hunt, mail:None
Name:Paul, Surname:Shannessy, mail:None
Name:Ryan, Surname:Florence, mail:None
Name:Sebastian, Surname:Markbage, mail:None
```

```
[25]: book.find_by_name('Dan')
```

I found the following results:

Name:Dan, Surname:Abramov, mail:gaearon@somewhere.com

```
[26]: book.remove_contact('Dan')
      book.show()
```

Name:Cassio, Surname:Zen, mail:cassiozen@gmail.com

Name:Pete, Surname:Hunt, mail:floydophone@somewhere.com

Name:Paul, Surname:Shannessy, mail:zpao@somewhere.com

Name:Ryan, Surname:Florence, mail:rpflorence@somewhere.com

Name:Sebastian, Surname:Markbage, mail:sebmarkbage@here.com

```
[27]: book.add_contact('Peter','Parker','notspiderman@marvel.com')
```

```
[28]: book.show()
```

Name:Cassio, Surname:Zen, mail:cassiozen@gmail.com

Name:Pete, Surname:Hunt, mail:floydophone@somewhere.com

Name:Paul, Surname:Shannessy, mail:zpao@somewhere.com

Name:Ryan, Surname:Florence, mail:rpflorence@somewhere.com

Name:Sebastian, Surname:Markbage, mail:sebmarkbage@here.com

Name:Peter, Surname:Parker, mail:notspiderman@marvel.com

Once you've done this you can now create a client to use the functions you implemented in a "user-friendly way" The result should be something like the following

Welcome to the application to manage your contacts

Press 's' to show the list of contacts

Press 'n' to add a contact

Press 'f' to find a contact

Press 'd' to delete a contact

Press 'q' to quit

s

Name:Cassio, Surname:Zen, mail:cassiozen@gmail.com

Name:Dan, Surname:Abramov, mail:gaearon@somewhere.com

Name:Pete, Surname:Hunt, mail:floydophone@somewhere.com

Name:Paul, Surname:Shannessy, mail:zpao@somewhere.com

Name:Ryan, Surname:Florence, mail:rpflorence@somewhere.com

Name:Sebastian, Surname:Markbage, mail:sebmarkbage@here.com

Press 's' tho show the list of contacts

Press 'n' to add a contact

Press 'f' to find a contact

Press 'd' to delete a contact

Press 'q' to quit

g

Command not available

Press 's' tho show the list of contacts

Press 'n' to add a contact

Press 'f' to find a contact

Press 'd' to delete a contact

Press 'q' to quit

q

8 Exercise 6 (todo after the next theory lesson)

The file playerNBA.json contains the list of all the NBA player of this season with their stats and their bio. Each one looks like this:

```
{
  "pos": "G",
  "name": "Stephen Curry",
  "hgt": 75,
  "tid": 9,
  "injury": {
    "gamesRemaining": 0,
    "type": "Healthy"
  },
  "born": {
    "year": 1988,
    "loc": "Akron, OH"
  },
  "weight": 190,
  "ratings": [
    {
      "diq": 40,
      "endu": 74,
      "ins": 46,
      "pss": 74,
      "spd": 86,
```

```

        "tp": 95,
        "jmp": 88,
        "fg": 92,
        "stre": 50,
        "drb": 61,
        "dnk": 92,
        "oiq": 73,
        "reb": 49,
        "ft": 78,
        "hgt": 34
    }
],
"draft": {
    "tid": 9,
    "pick": 7,
    "originalTid": 9,
    "year": 2009,
    "round": 1
}
}

```

The first step is to analyze the data, so we need to create the function to evaluate: 1. The average **ratings** among the players 2. The average **height** and **weight** (in meters and kilograms while they're store in inches and pounds) 3. The average age

You should be able to obtain results like the one below

```

[2]: from Exercise_5 import *
import json
file_content=json.load(open('playerNBA.json'))

```

```

[2]: average_ratings(file_content)

```

```

[2]: {'diq': 40.86353211009176,
      'dnk': 60.25573394495405,
      'drb': 44.97018348623852,
      'endu': 41.286697247706385,
      'fg': 54.263761467889935,
      'ft': 51.10206422018341,
      'hgt': 48.36353211009177,
      'ins': 45.02981651376154,
      'jmp': 53.35206422018351,
      'oiq': 46.380733944954095,
      'pss': 42.470183486238454,
      'reb': 48.62729357798164,
      'spd': 53.27752293577975,
      'stre': 46.24885321100917,
      'tp': 44.92316513761466}

```

```
[3]: average_height(file_content)
```

```
[3]: 2.0031959788690217
```

```
[2]: average_weight(file_content)
```

```
[2]: 97.63100959038039
```

```
[3]: average_age(file_content)
```

```
[3]: 26.212155963302752
```

9 Inheritance

Inheritance is used to create new classes by using existing classes - new ones can both be created by extending and by restricting the existing classes. Let's see a simple example below

```
[7]: class Animal(object):
    """docstring for Animal"""
    def __init__(self, name):
        self.name=name
    #This method is used to define how an object of this class will be
    ↪represented by the function print()
    def __repr__(self):
        return "{} is an animal".format(self.name)
    def jump(self):
        print(f"{self.name} has jumped")

class Quadruped(Animal):
    """docstring for Quadruped"""
    def __init__(self,name):
        Animal.__init__(self,name)
        self.n_of_legs=4
    #This method is used to define how an object of this class will be
    ↪represented by the function print()
    def __repr__(self):
        return "{} is a quadruped".format(self.name)

class Dog(Quadruped):
    """docstring for Dog"""
    def __init__(self, name,family):
        Quadruped.__init__(self,name)
        self.family=family
        self.verse="Woof!"
```



```

    #This method is used to define how an object of this class will be
    →represented by the function print()
    def __repr__(self):
        return "{} is a dog of the family {}".format(self.name,self.family)
    def talk(self):
        print(f"{self.name} says: {self.verse}")

if __name__ == '__main__':
    pongo=Animal('Pongo')
    print(pongo)

    pongo=Quadruped('Pongo')
    print(pongo)
    pongo.jump()

    pongo=Dog('Pongo','Dalmata')
    print(pongo)
    print(pongo.n_of_legs)
    pongo.jump()
    pongo.talk()

```

```

Pongo is an animal
Pongo is a quadruped
Pongo has jumped
Pongo is a dog of the family Dalmata
4
Pongo has jumped
Pongo says: Woof!

```

As you can see according to the way in we instantiate the object we can access to different methods and we can always use the method of the parent-class from the child class

10 Polymorphism

Polymorphism allows us to use method of parent classes and modify them according to our need. An example of this was already shown in the code above as we use the method "`__repr__`" to define how our object will be printed. Another example can be done for the Exercise 1: imagine we want to define a `Point2D` and a `Point3D` and we want to calculate their distance from the origin, we could do as follows

```

[10]: import math
class Point2D(object):
    """Class for a Point object: the available methods are move(x,y) and
    →distance(another_point)"""
    def __init__(self, x,y):
        self.x = x

```

```

        self.y = y
    def __repr__(self):
        return "{},{ {}".format(self.x,self.y)
    def distanceFromOrigin(self):
        print (math.sqrt((self.x)**2+(self.y)**2))
class Point3D(Point2D):
    def __init__(self,x,y,z):
        Point2D.__init__(self,x,y)
        self.z=z
    def __repr__(self):
        return "{},{ {},{ {}".format(self.x,self.y,self.z)
    def distanceFromOrigin(self):
        print (math.sqrt((self.x)**2+(self.y)**2+(self.z)**2))
        #To maximize the potentiality of polymorphism we could do
        #distance=math.sqrt(Point2D(self.x,self.y).distanceFromOrigin()**2+self.
        →z**2)
if __name__=="__main__":
    a=Point2D(1,1)
    a.distanceFromOrigin()
    b=Point3D(1,1,1)
    b.distanceFromOrigin()

```

1.4142135623730951

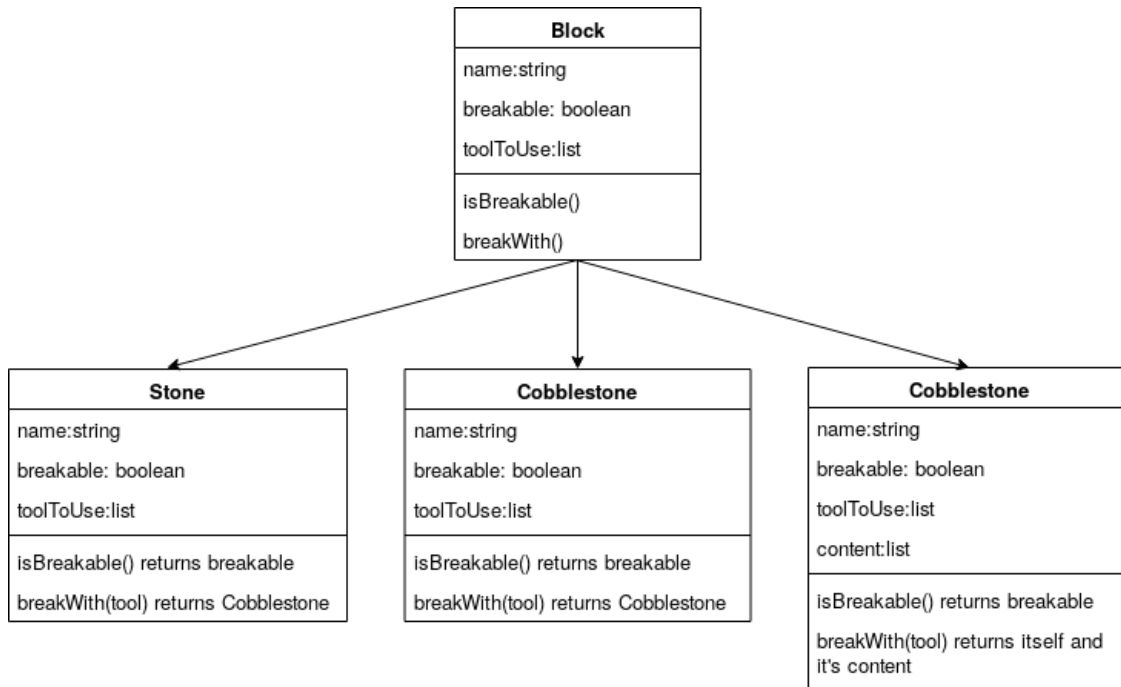
1.7320508075688772

11 Exercise 7

As exercise on polymorphism and inheritance you can create the parent-class "Circle" and the child-class "Cylinder". The Circle class must have the methods to calculate area and perimeter while the Cylinder class must have the method to calculate area and volume

12 Exercise 8

I imagine everyone knows the popular sandbox game Minecraft. In that game almost everything is a block with a set of properties that define the block and his behaviour. Some blocks have common characteristics others are completely different among each other. We want to try to create the classes to represent some of these pieces of the game. As exercise we want to create to represent 3 blocks using inheritance and polymorphism, their description is shown in the picture below



13 Encapsulation

When programmin using classes we sometimes want to avoid the final user to execute some method or access some attributes to avoid possible mistakes and problems. We can doing this using encapsulation. Let's make an example considering the class "*Student*" defined below

```
[3]: class Student(object):
    def __init__(self,name,surname,birthday):
        self.name=name
        self.surname=surname
        self.birthday=birthday
if __name__=="__main__":
    #Create a student
    s=Student("Mickey","Mouse","16/01/1928")
    #Print his full name
    print(s.name+" "+s.surname)
    #Change the student's surname and print it again
    s.surname="Duck"
    print(s.name+" "+s.surname)
```

Mickey Mouse

Mickey Duck

As you see we can access to the attributes of the class without any restriction. If we want instead to restrict the access to the attribute `name` and `surname` to avoid the possibility to modify these after the object creation, the attribute `birthday` instead well have the same behaviour. To achieve this we would do as follows

```
[7]: class Student(object):
      def __init__(self,name,surname,birthday):
          self.__name=name
          self.__surname=surname
          self.birthday=birthday
      def getFullName(self):
          return self.__name+" "+self.__surname
```

If in this case we try to access the attributes `__name` or `__surname` we would get an error. The only way to obtain the complete name would be to use the method `getFullName()`. So to use encapsulation in Python and hide some attributes to the final user we must simply put `__` before the name its name (the same can be done to hide methods)

14 Exercise 9

As exercise to exploit encapsulation let's create a class `"Car"`, the class must have the attributes for name, speed and gear with the following properties

1. the *name* can't be changed after the creation of the object, but it can be retrieved
2. the *speed* can be set to any value less than 250 (if greater it will be changed to 250) and can be retrieved
3. the *gear* can go from 1 to 6 and can be changed only up and down by one (it's set to 1 when the object is created) and can be retrieved

```
[ ]:
```