Agenda

03 February 2025 17:57

1. Why we need to study OOP (The problem and solution)
2. Class & Object
3. Four pillars of oops
   3.1 Inheritance
   3.2 Polymorphism
   3.2 Encapsulation
   3.4 Abstraction

Why we need to study OOP (The problem and solution)

03 February 2025 18:15

The Problem:

==========

What is Procedural Programming?

Procedural programming follows a step-by-step approach, where a program is structured as a sequence of procedures (functions) that operate on data. It focuses on writing functions that perform specific tasks.

Example:

Bank application

1. ATM functions(deposit, withdraw, check balance)
2. Loan Functions(interest calc, foreclosure)

Disadvantages:

1. As features grows it is not easy to maintain
2. Need to have mappings for each feature (mapping data & functions)

The Solution:

==========

OOP:

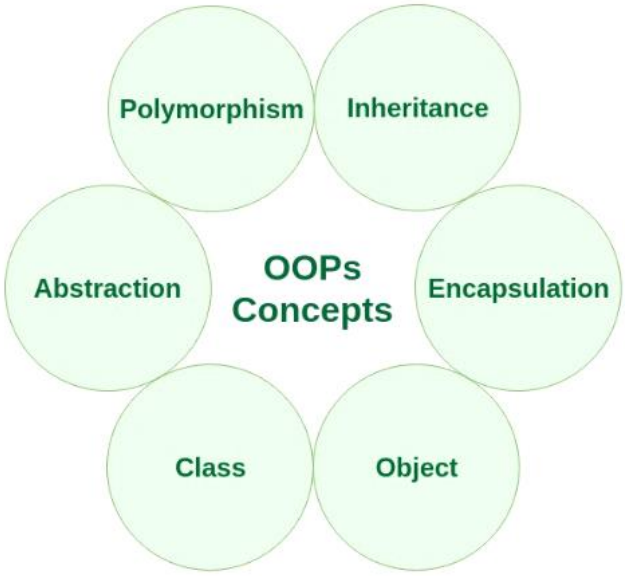
OOP organizes data(variables) and functions(behaviour) together into **objects** using **classes**.

Advantages:

Feature	**Procedural Programming**	**Object-Oriented Programming**
Structure	Uses functions and variables separately	Groups together (data and functions) into objects (classes)
Data Security	Data is global, risk of accidental modification	Data is encapsulated inside objects/class
Code Reusability	Difficult to reuse functions	Easy to reuse objects and classes
Scalability	Becomes complex handling in multiple features	Easy to extend with new features

Note: Using OOPS we can create our own data types(application specific).
In-built data types in python are nothing but classes

OOPS pillars/principles:


Polymorphism
Inheritance
Abstraction
OOPs Concepts
Encapsulation
Class
Object

Class & Object

03 February 2025 19:20

Class:

It is a blueprint and it is virtual(doesn't have memory), A class defines a set of rules/principles(attributes/data/variables and methods) that object can use them.

Object:

It is an instance of class and it has physical memory, Can access those class(attributes and methods)

Examples:

Class	Objects
Car	Toyota, Suzuki, Honda
Mobile	iPhone, Samsung
Television	Sony, BPL

Let us create a banking example with below functionalities:

- Change pin
- Check balance
- Withdraw
- Deposit

Functions (V) Methods

functions :- These are global and they can be applied on all other classes

Methods :- These are local to class. where these are defined, Any function defined inside a class are called methods.

Re-visit the example with granularity

06 February 2025 20:30

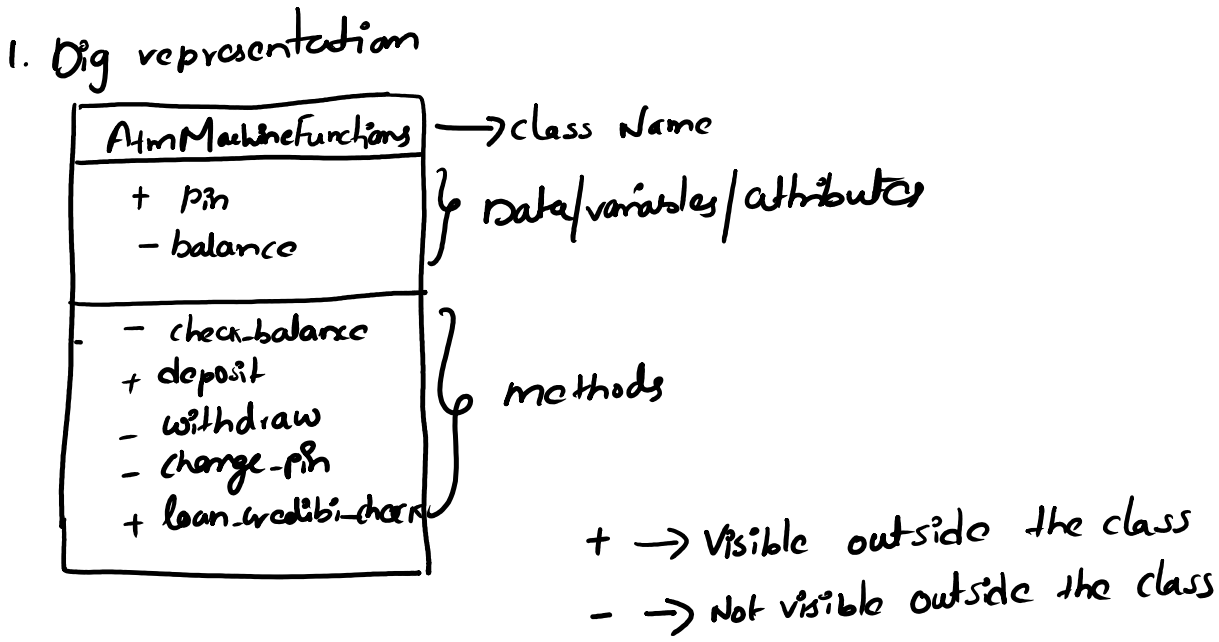
Let us create a banking example with below functionalities:

- Change pin
- Check balance
- Withdraw
- Deposit
- loan credibility check

Class Diagram

06 February 2025 18:55

1. Diagrammatic representation of class
2. Public vs Private(visibility)



self keyword

06 February 2025 19:04

Definition: self is nothing but current object.

Why we need self?

A Python class does not allow methods or data to be accessed directly within other methods. To enable this interaction (calling methods interchangeably within the class), we use self

Note: We can use any word instead of self, such as shewag, honda, ram, etc.

self keyword

```
class Sample():

  def __init__(self):
    print(id(self))

  def func1(self):
    print("I am here in func1")
```

```
[2] s= Sample()
```

```
133365005766672
```

```
[3] print(id(s))
```

```
133365005766672
```

```
s1 = Sample()
```

```
133365004513296
```

```
[5] print(id(s1))
```

```
133365004513296
```

-> We can use any word instead of self

```
[28] class Sample():

       def __init__(vishnu):
```

will behave as self

```
[28] class Sample():

       def __init__(vishnu):
         print(id(vishnu))
         vishnu.a=1000

       def func1(vishnu):
         print("I am here in func1")
         print(vishnu.a)

       def func2(vishnu):
         print("I am here in func2")
         print(vishnu.a)
         vishnu.func1()
```

Will behave as self

```
[29] s= Sample()
```

```
133365005687952
```

```
s.func2()
```

```
I am here in func2
1000
I am here in func1
1000
```

Magic Methods

06 February 2025 19:52

1. __init__ - special method**(constructor)** will get called **implicitly** while **object creation time**
   Usage - writing configurations code
   Types : non-parameterized and parameterized

2. __str__ : It is special method in Python and gets executed when an object is **printed using print()**
   Usage: This method allows you to customize the output while printing the object, making it more readable and meaningful.

3. __add__: Performs **addition between 2 objects**, (python class doesn't know how to perform addition between 2 objects)
   Usage: when you want to perform **addition** between two objects of a custom class using the **+** operator

4. __sub__: Performs **subtraction between 2 objects**, (python class doesn't know how to perform addition between 2 objects)
   Usage: when you want to perform **subtraction** between two objects of a custom class using the **-** operator

5. __mul__: Performs **multiplication between 2 objects**, (python class doesn't know how to perform addition between 2 objects)
   Usage: when you want to perform **multiplication** between two objects of a custom class using the * operator

6. __truediv__: Performs **division between 2 objects**, (python class doesn't know how to perform addition between 2 objects)
   Usage: when you want to perform **division** between two objects of a custom class using the / operator

Constructor(- - init - -) :-

```
[32] class Sample():

       def __init__(self,b,c,d):
         print(id(self))
         self.a=b
         print(self.a)
         print(b)
         print(c,d)


       def func1(self):
         print("I am here in func1")
         print(self.a)

       def func2(self):
         print("I am here in func2")
         print(self.a)
         self.func1()
```

parametrized const

```
s= Sample(1,2,3)
```

This how you should call param const

```
133364824488656
1
1
2 3
```

```
class Sample():

  def __init__(self):
    print(id(self))


  def func1(self):
    print("I am here in func1")
    print(self.a)

  def func2(self):
    print("I am here in func2")
    print(self.a)
    self.func1()
```

Non-param const

```
[38] s= Sample()
```

This is how you should call non-param const

```
        self.func1()
```

This is how

```
[38] s= Sample()
```

```
133364824706128
```

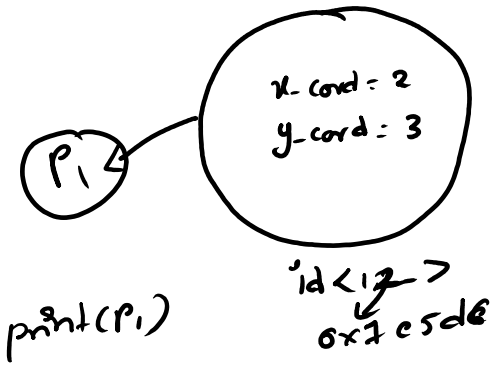
```
[19] class Point():

       def __init__(self,a,b):
         self.x_cord = a
         self.y_cord = b
```

```
p1 = Point(2,3)
```

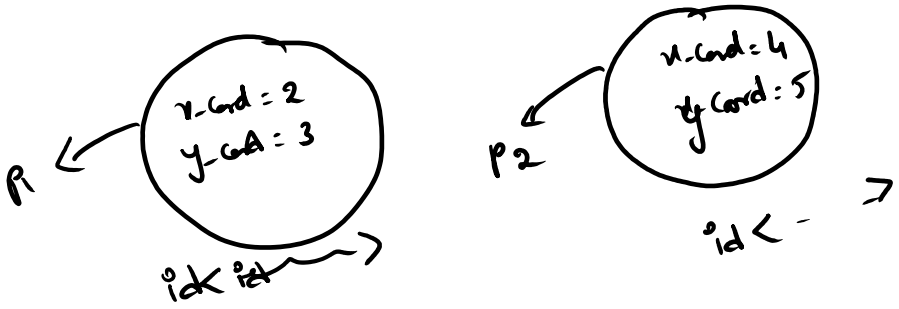
```
print(p1)
```

```
<__main__.Point object at 0x7e5d6ca67f10>
```

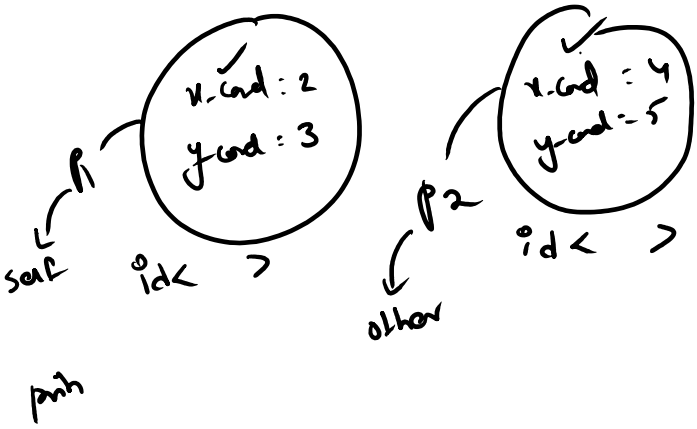
(2,3) <2,3>




```
p1 = Point(2,3)
p2=Point(4,5)
```




```
class Point():

  def __init__(self,a,b):
    self.x_cord = a
    self.y_cord = b

  def __str__(self):
    return "({},{})".format(self.x_cord,self.y_cord)


  def __add__(self,other):
    x = self.x_cord + other.x_cord
    y = self.y_cord + other.y_cord
    return "({},{})".format(x,y)
```



p1 = Point(2,3) ✓

p2 = Point(4,5) ✓

print(p1) ✓ (2,3)

print(p2) ✓ (4,5)

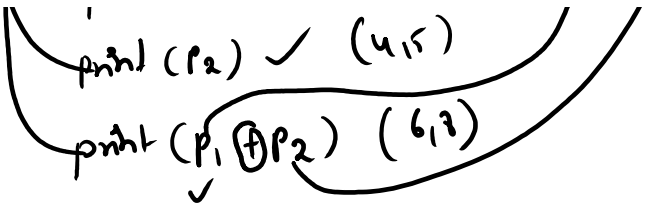
print

x = 6

y = 18

a = 3

b = a

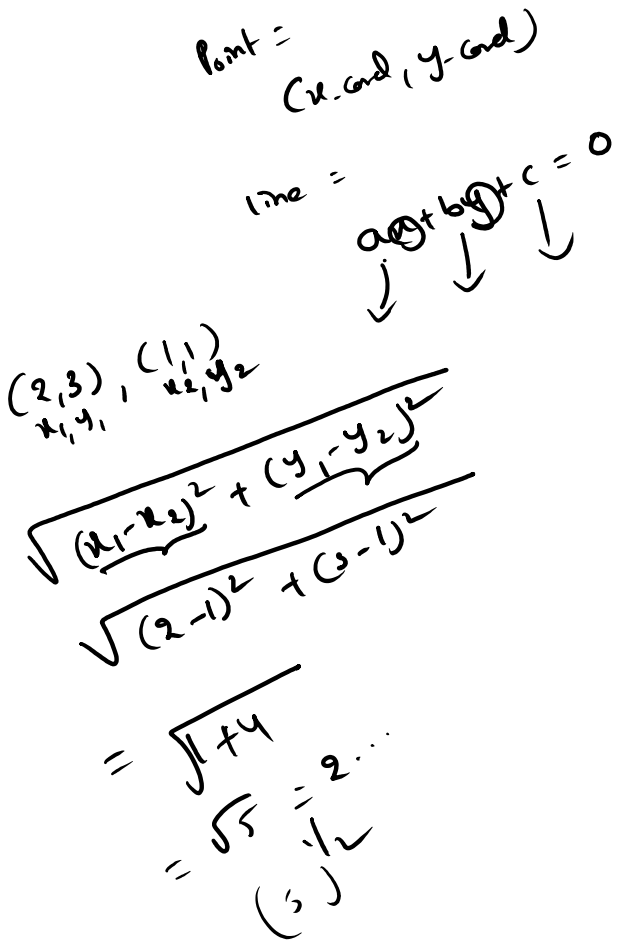

print (p2) ✓ (4,5)
print (p1 + p2) (6,7)
y=18

Sample Question

10 February 2025 19:13

Let us create own data type called Geometry which performs operations on point and line

1. Find the distance between 2 points?
2. Find the distance between point and line?
3. Check whether the point exists on line or not?
4. Find the distance from a point to an origin?
5. Find the mid point between 2 given points?



Find the distance between 2 points?

```
class Point():
  def __init__(self,a,b):
    self.x_cord = a
    self.y_cord = b
  def __str__(self):
    return "<{},{}>".format(self.x_cord,self.y_cord)

  def distance_between_points(self,other):
    return ((self.x_cord - other.x_cord)**2 + (self.y_cord - other.y_cord)**2)**0.5
```

```
p1=Point(2,3)
print(p1)
```

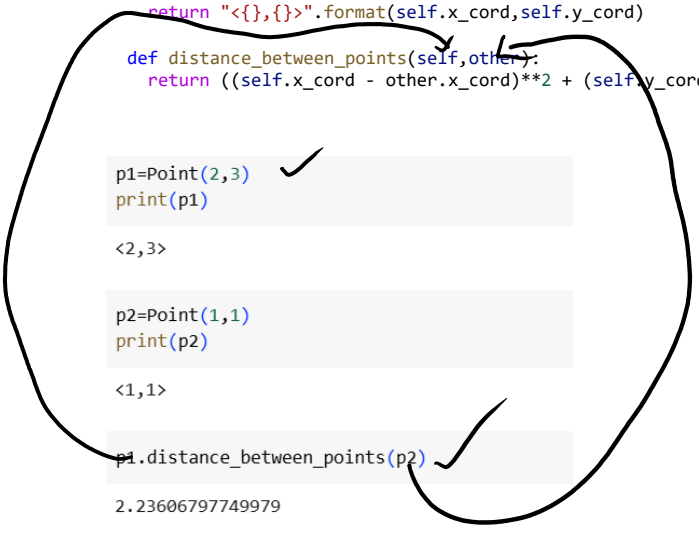
```
<2,3>
```

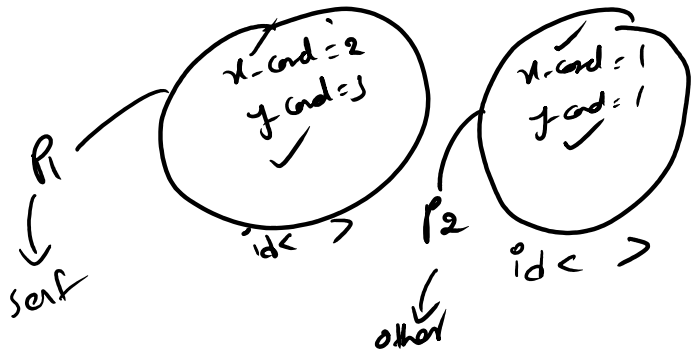
```
p2=Point(1,1)
print(p2)
```

```
<1,1>
```

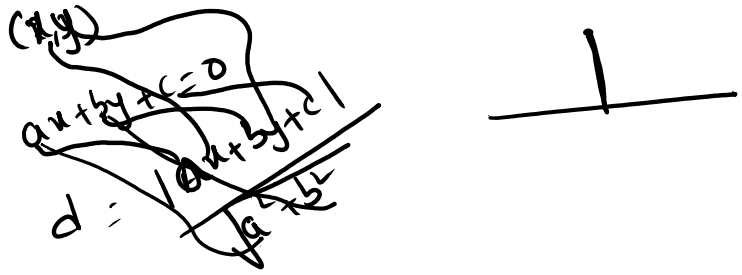
```
p1.distance_between_points(p2)
```

```
2.23606797749979
```

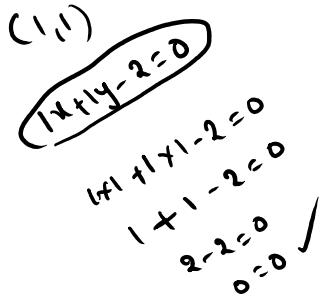




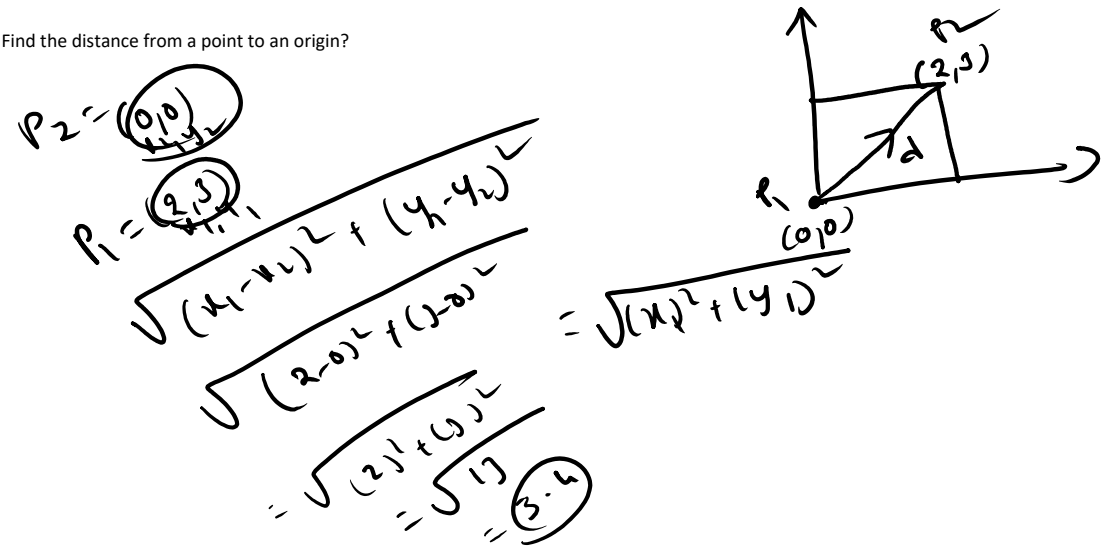
Find the distance between point and line?



Check whether the point exists on line or not?



Find the distance from a point to an origin?



Find the mid point between 2 given points?

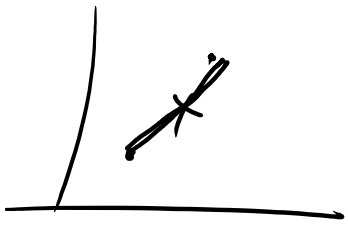
$P_1 = (x_1, y_1)$

$P_2 = (x_2, y_2)$

$\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

$= \left(\frac{3}{2}, \frac{4}{2}\right)$

mid p $= (1.5, 2)$



Encapsulation

10 February 2025 21:08

Encapsulation:

Encapsulation is the process of bundling data (variables) and methods (functions) together into a single unit (class) while restricting direct access outside the class

This ensures that sensitive information is **hidden** from direct modification and can only be accessed through controlled mechanisms like **getter and setter methods**.

{ bundling (data & methods)
restriction (accessing & modifying)
getter & setter methods

Recap:-

1) Why we require oops?
   (i) procedural programming
   (ii) oops based
      -> Custom datatypes
         (app specific)

2) class & object

3) self keyword

4) Magic Methods

5) Built custom geometry datatype

6) Encapsulation

Ex:1

5,00,000 [Enter amount] × 5 [Enter tenure] = ?

personal loan calculation

principle : amount
T = tenure
r = self.rate-of-interest

$$S.I = \frac{PTR}{100}$$

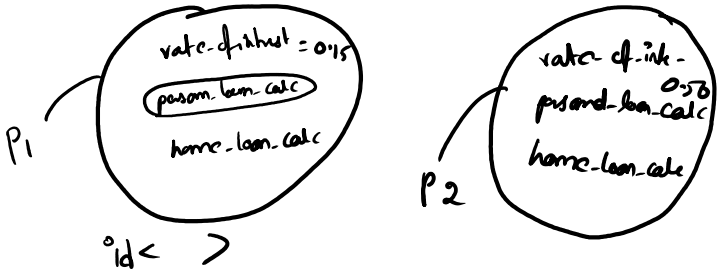
$$= \frac{5,00,000 \times 5 \times 0.15}{100} = \frac{5,00,000 \times 5 \times 15}{100 \times 100}$$

$$\frac{75 \times 5}{2} = \frac{375}{2}$$

principle + S.I = Total = 3,75,00

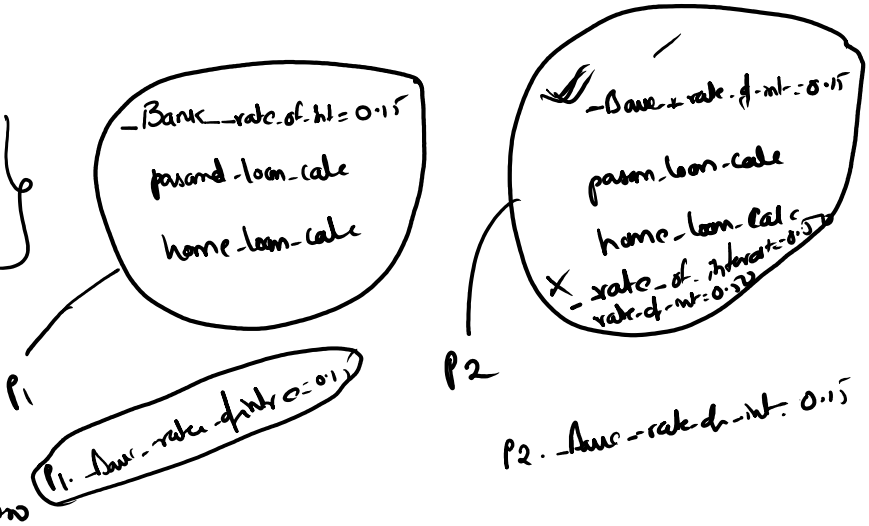
5,00,000 + 37,500 = 5,37,500 ✓

```
class Bank():
  def __init__(self):
    self.rate_of_intrest = 0.15
  def personal_loan_calc(self,amount,tenure):
    p = amount
    t = tenure
    r = self.rate_of_intrest
    total_amount = p+(p*r*t)/100
    return total_amount

  def home_loan_calc(self,amount,tenure):
    p = amount
    t = tenure
    r = self.rate_of_intrest
    total_amount = p+(p*r*t)/100
    return total_amount
```




```
p1= Bank()
p1.personal_loan_calc(500000,5)
p2 = Bank()
p2.home_loan_calc(500000,5)
p2.rate_of_intrest = 0.50
p2.personal_loan_calc(500000,5)
p1.home_loan_calc(500000,5)
```

```
class Bank():
  def __init__(self):
    self.__rate_of_intrest = 0.15
  def personal_loan_calc(self,amount,tenure):
    p = amount
    t = tenure
    r = self.__rate_of_intrest
    total_amount = p+(p*r*t)/100
    return total_amount

  def home_loan_calc(self,amount,tenure):
    p = amount
    t = tenure
    r = self.__rate_of_intrest
    total_amount = p+(p*r*t)/100
    return total_amount
```




```
p1=Bank()
p1.personal_loan_calc(500000,5)
p1.home_loan_calc(500000,5)
p2=Bank()
p2.rate_of_intrest = 0.50
p2.personal_loan_calc(500000,5)
p2.home_loan_calc(500000,5)
```

Imp points:-

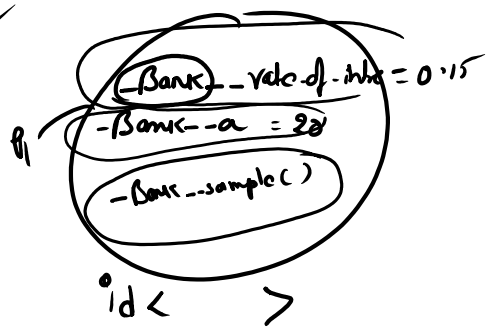
→ If no Encapsulation (Junior prog can access and modify the data & methods)

If no encapsulation (Junior prog can access or modify the data & methods)

→ If Encapsulation is used (direct access / modification is not possible outside the class)

→ But, still we can access / modify using getter & setter methods outside the class. (indirect access)

Ex:-
```
class Bank():
    def __init__(self):
        self.__rate_of_int = 0.15
        self.__a = 20
    def __sample(self):
        pass
```




```
P1 = Bank()
P1.__a = 25 ×
P1._Bank__a = 25 ✓
P1._Bank__sample() ✓
```

→ Python still provides an opportunity to access / modify the private variable / methods directly using their class Names

Ex:-
```
P1._Bank__a ✓
P1._Bank__rate_of_int ✓
P1._Bank__sample() ✓
```

```
P1.__a ×
P1.a ×
P1._rate_of_int ×
P1.rate_of_int ×
P1.sample() ✓
P1.__sample() ×
```

Inheritance

13 February 2025 07:22

Inheritance is one of the key concepts of **Object-Oriented Programming (OOP)** in Python. It allows one class (child class) to inherit the properties and behaviours (methods and attributes) of another class (parent class).

Why Use Inheritance?

1. **Code Reusability** – Avoids writing the same code multiple times.
2. **Improved Maintainability** – Changes in the parent class automatically reflect in child classes.
3. **Modularity** – Helps organize code in a structured way.
4. **Extensibility** – Allows adding new features to an existing class without modifying it.

What can be inherited from Parent to Child?

Parent constructor
Non- Private/public data attributes
Non-Private/public methods

Super() keyword:

Points to remember:

1. Cannot be used outside the class
2. Using super keyword only parent public class methods can be accessed but **not data attributes**
3. Super keyword used only inside the class (child)

Types of Inheritance:

1. **Single inheritance**
2. **Multilevel Inheritance**
3. **Hierarchical**
4. **Multiple**
5. **Hybrid**

Recap:-

-> you can inherit all the properties (data attributes & methods) of parent to a child

Note:- you can only inherit public properties

-> super() -> can directly access the parent public properties
-> super() inside the class (child)
-> super() a can access only parent public methods
-> super() cannot outside the class

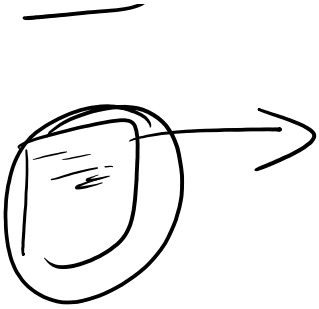
Method overriding:-

Parent
-> property - method

Parent
→ property-method
→ amount 10,000000

child (Parent)
→ property-method super()
→ a
→ amount 1,00,0000

c = child()
c.property method
c.amount
c.a



Types of inheritence :-

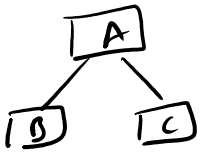
1) single inheritance

class A():
=
class B(A):
=

2) multilave inheritance

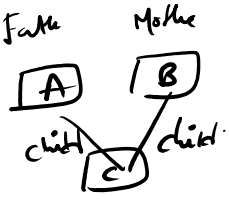
class A():
=
class B(A):
=
class C(B):
=

3) hierarchical inheritance



class A()
=
class B(A):
=
class C(A):
=

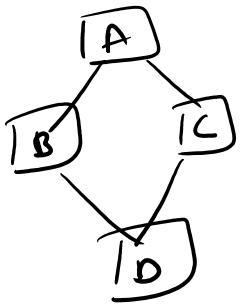
4) multiple



class A()
= X
class B()
= X
class C(A,B)
=

5) hybrid

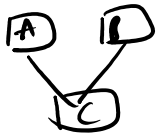
5) Hybrid

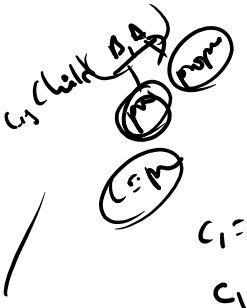



```
class A:
class B(A):
class C(A):
class D(B,C):
```

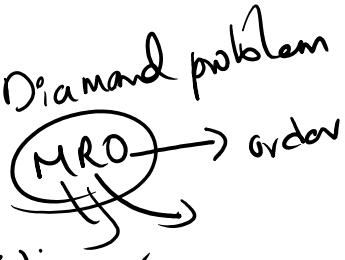
1) MRO (Method Resolution Order):

```
class A():
    property():
class B():
    property():
class C(B,A):
```





Diamond problem




```
c1 = C():
c1.property():
```

Polymorphism

14 February 2025 07:21

Polymorphism means **"many forms"** and allows the same function or operator to work differently for different objects.

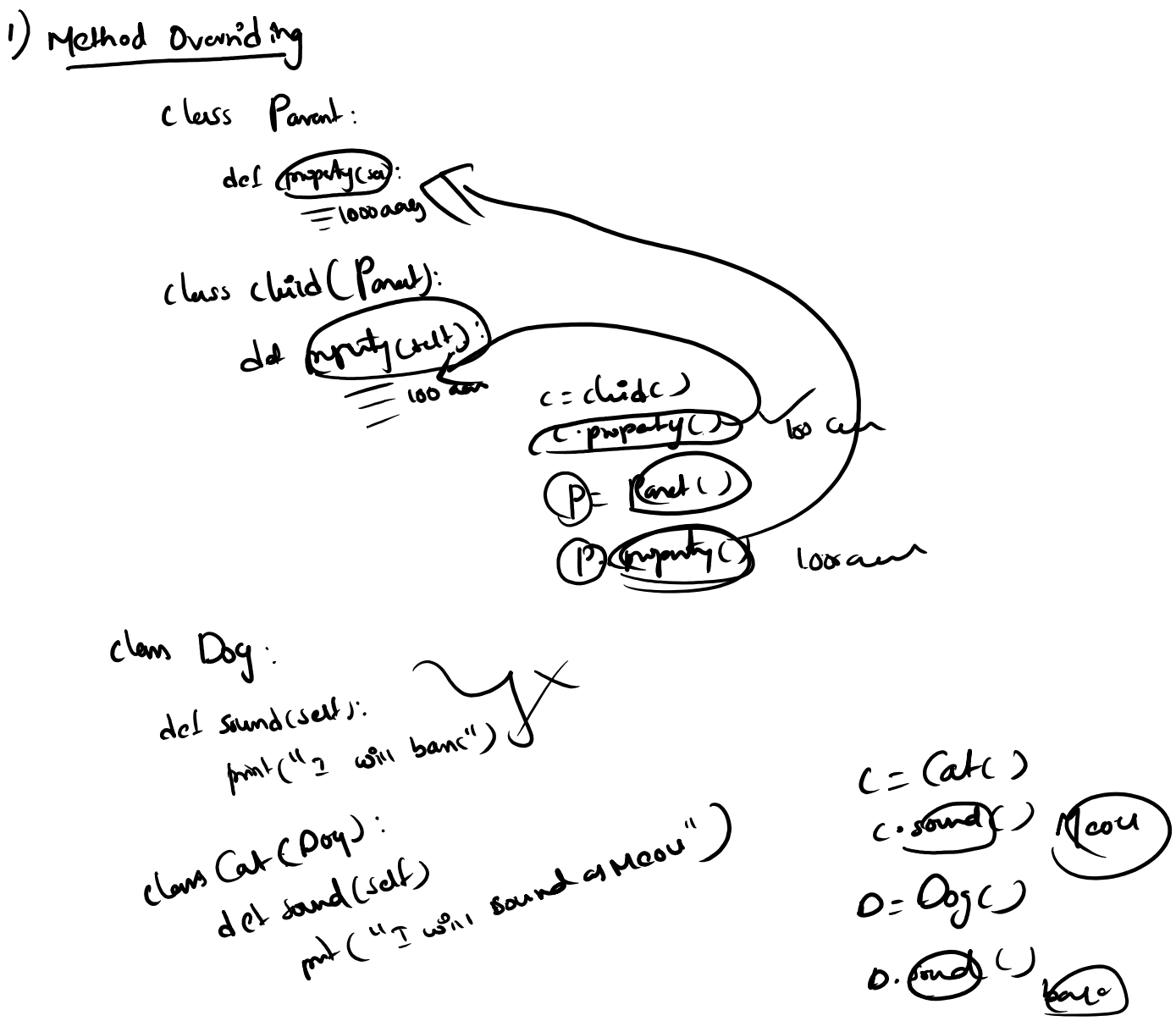
In General **one thing behaving in different ways** depending on the situation.

Example in Real Life:

- A **person** can be a **teacher at school**, a **parent at home**, and a **friend outside**—same person, different roles

Polymorphism can be achieved by:

1. Method Overriding
2. Method Overloading → There is not direct overloady, but though default args, # args, ## always
3. Operator Overloading → +, -, *, /



2) class Parent:

```
def sample(self, a, b=5):
    self.a = a
    self.b = b
```

default arguments

#args, *+ kwargs

```
p = Parent()
p.sample(2)
p.sample(2,10)
```

method overloading

3) class Parent

```
def sample(*args):
    self.numbers = args
    print(self.num)
```

variable length non keywords

```
p = Parent()
p.sample(2)
p.sample(2,3)
p.sample(1,2,3,4,5,6)
p.sample(1,2,3,4,5,6,7,8...)
```

tuple(2)

tuple(2,3)

tuple(1,2,3...5,6)

Abstraction

17 February 2025 07:04

Abstraction is the process of **hiding the implementation details** and **showing only the essential features** of an object.

Why is Abstraction Important?

1. **Hides unnecessary details** – Users only need to know what a function does, not how it does it.
2. **Improves maintainability** – Code changes do not affect other parts of the program.
3. **Enhances security** – Prevents users from accessing sensitive parts of the code.
4. **Promotes modularity** – Easier to Extend & Modify

How Abstraction is different from inheritance?

– Abstraction :- Enforces to implement the parent class abstract methods, otherwise it throw Error

– Inheritance :- Will not force to implement the parent class methods.

Recap :-

1) Inheritance
   - -> const
   - -> public data
   - -> public methods
2) super()
   - -> Call only public methods
   - -> declare inside the class
3) Types of inh :-
   1) single
   2) multilevel
   3) hierarchial
   4) multiple
   5) hybrid
4) MRO (Method Resolution Ord)

Polymorphism

1) Method overriding
2) Method overloading (def, *args, **kwargs)
3) Operator overloading

Example:

from abc import ABC, abstractmethod

```
class Mobile(ABC):
  @abstractmethod
  def call(self):
    pass

  @abstractmethod
  def wifi_connection(self):
    pass
  def fm_radio(self):
    self.freq_hz = 93.2
    self.antenna = "radio antenna"
    print("tunning with {} and {}".format(self.freq_hz,self.antenna))
```

(1st abs; 2nd abs; Concrete method)

Note:- Abstract class has 2 methods

-> abst method (abs imp logic)

-> conc method (imp logic)

-> It should inherit from class ABC

-> It should have atleast one abstract method.

```python
class Vehicle(ABC):

  @abstractmethod
  def start(self):
    pass
  @abstractmethod
  def stop(self):
    pass
  @abstractmethod
  def drive(self):
    pass

class Honda(Vehicle):
  def start(self):
    print("I am starting Honda")
  def stop(self):
    print("I am stopping Honda")

class Honda_City(Honda):
  def drive(self):
    print("I am driving Honda City")
```