

# Python OOP

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# Object-Oriented Programming in Python

- **What is OOP?**
  - A programming paradigm based on "objects"
  - Combines **data** and **methods** into single entities
  - Focuses on **modularity** and **reusability**
- **Key Features:**
  - Encapsulation
  - Inheritance
  - Polymorphism
  - Abstraction

# Classes

**Classes** are software programming models - abstractions of the real world or system entities.

**Classes** define methods that operate on their object instances

**Object  
instances**

**Class**



# Classes vs Objects (2)

## House Class

- Data
  - House color ( `String` )
  - Number of windows ( `Number` )
  - Is for sale ( `Boolean` )
- Behavior
  - `updateColor()`
  - `putOnSale()`

## Object Instances



# Key Concepts in Python OOP

## 1. Classes and Objects

- **Class:** A blueprint for creating objects.
- **Object:** An instance of a class.

```
class Dog:
    def __init__(self, name, breed):
        self.name = name
        self.breed = breed

my_dog = Dog("Alfski", "Norwegian Elkhound") # Object creation
```

- **self**: Refers to the instance of the class.

## 2. Encapsulation

- **Definition:** Bundling data and methods into a single unit (class) and restricting direct access to some components.
- Example:

```
class BankAccount:  
    def __init__(self, balance):  
        self.__balance = balance    # Private attribute  
  
    def deposit(self, amount):  
        self.__balance += amount  
  
    def get_balance(self):  
        return self.__balance
```

- Use **getter and setter methods** to access private attributes.

# 3. Inheritance

- **Definition:** A mechanism to derive a class from another class.
- Python supports single and multiple inheritance.
- Example:

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

    def eat(self):
        print("I can eat!")

    def sleep(self):
        print("I can sleep")

class Dog(Animal):
    def __init__(self, name, breed):
        # Call the parent class's __init__
        super().__init__(name)
        self.breed = breed

    def bark(self):
        print("Woof!")

dog = Dog("Alfski", "Norwegian Elkhound")
print(dog.name)    # Alfski
print(dog.breed)   # Norwegian Elkhound
```

## 4. Polymorphism

- **Definition:** The ability of objects to take many forms.
- Example:

```
class Bird:
    def fly(self):
        print("Bird flies")

class Penguin(Bird):
    def fly(self):
        print("Penguins cannot fly")

def test_fly(bird):
    bird.fly()

test_fly(Bird())      # Bird flies
test_fly(Penguin())  # Penguins cannot fly
```



## 5. Abstraction

- **Definition:** Hiding implementation details while showing essential features.
- Achieved using abstract base classes.

```
from abc import ABC, abstractmethod

class Shape(ABC):
    @abstractmethod
    def area(self):
        pass ## keyword for placeholder

class Circle(Shape):
    def __init__(self, radius):
        self.radius = radius

    def area(self):
        return 3.14 * self.radius ** 2

circle = Circle(5)
print(circle.area()) # 78.5
```

# Special Methods in Python

- **Magic/Dunder Methods:** Special methods with double underscores.
- Examples:
  - `__init__`: Initialize an object.
  - `__str__`: String representation of an object.
  - `__add__`: Define addition behavior for objects.

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

    def __add__(self, other):
        return Vector(self.x + other.x, self.y + other.y)

    def __str__(self):
        return f"Vector({self.x}, {self.y})"

v1 = Vector(2, 3)
v2 = Vector(5, 6)
print(v1 + v2)  # Vector(7, 9)
```

# Why Use OOP?

- **Benefits:**
  - Code reusability through inheritance.
  - Modularity for easier debugging and maintenance.
  - Encapsulation enhances data security.
  - Polymorphism makes systems more flexible.
- **Real-World Use Cases:**
  - GUI applications
  - Games
  - Web frameworks

# Summary

- OOP provides a structured and modular way of programming.
- Key concepts:
  - Classes and Objects
  - Encapsulation
  - Inheritance
  - Polymorphism
  - Abstraction
  - `super()` for parent class method calls
- Use OOP for scalable and maintainable code.