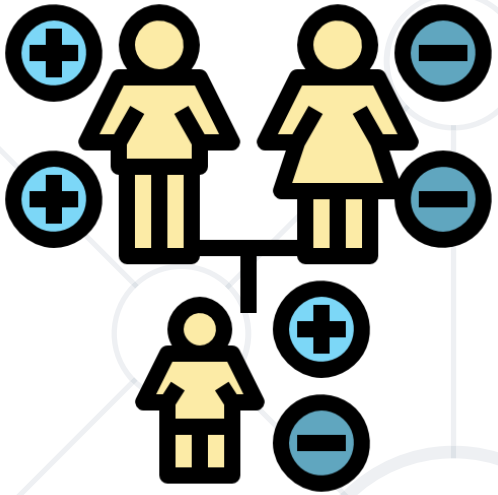
Inheritance

Capability to Inherit Other Properties



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Capability to Inherit Other Properties

The Four Basics Concepts of OOP

- **Inheritance** - extend the functionality of the code's existing classes to eliminate repetitive code
- **Encapsulation** - stop objects from interacting with each other so classes cannot change or interact with the specific variables and functions of an object
- **Abstraction** - isolate the impact of changes made to the code so the change will only affect the variables shown and not the outside code
- **Polymorphism** - allows different classes to have methods with the same name

Inheritance

- Inheritance is the capability of one class to **inherit** the methods and properties from another class
- Benefits of inheritance:
  - Code **reusability**
  - Add features to a class without modifying it
  - It is **transitive** in nature

Example: Inheritance

```
class Person:
    def __init__(self, first_name,
last_name):
        self.first_name =
first_name
        self.last_name = last_name

    def get_full_name(self):
        return f'{self.first_name}
{self.last_name}'
```

Subclassing

```
class Student(Person):
    pass
```

```
# An Object of class Student
student = Student("John", "Smith")
print(student.get_full_name())
# John Smith
```

The super() Method

- Built-in method which **returns a temporary object** of the superclass
- Allows you to call methods of the **superclass** in your **subclass**
- The primary use case of this is to **extend** the functionality of the inherited method

Example: super() Method

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

    def get_info(self):
        return f'{self.name} is {self.age} years old.'

class Student(Person):
    def __init__(self, name, age, student_id):
        super().__init__(name, age)
        self.student_id = student_id

    def get_id(self):
        return self.student_id
```

```
# Create an object of the
superclass
person = Person("John", 25)
print(person.get_info())
# returns 'John is 25 years
old.'

# Create an object of the
subclass
student = Student("Leo", 20,
10035464)
print(student.get_info())
# returns 'Leo is 20 years old.'
print(student.get_id())
# returns 10035464
```

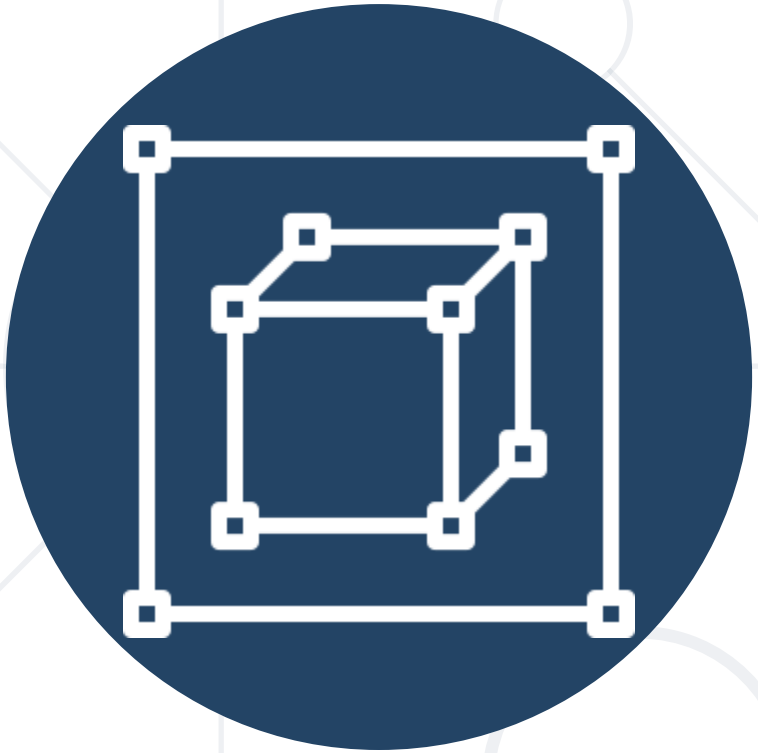
Problem: Food

- Create two classes named **Food** and **Fruit**
  - **Food** will receive **`expiration_date`** upon initialization
  - **Fruit** will receive **`name`** and **`expiration_date`** upon initialization
- **Fruit** should inherit from **Food**

Solution: Food

```
class Food:
    def __init__(self, expiration_date):
        self.expiration_date = expiration_date

class Fruit(Food):
    def __init__(self, name, expiration_date):
        super().__init__(expiration_date)
        self.name = name
```



Forms of Inheritance

Single, Multiple and Multilevel

Forms of Inheritance

- There are four types of inheritance
  - **Single**
  - **Multiple**
  - **Multilevel**
  - **Hierarchical**
- **Hybrid Inheritance** - consists of multiple types of inheritance

Single Inheritance

- When a child class inherits properties from a **single parent** class only

```
class Parent:
  def say_hi(self):
      return "Hello!"

class Child(Parent):
    def go_school(self):
        return "I go to school."

child = Child()
print(child.say_hi())    # Hello!
print(child.go_school()) # I go to school.
```

Problem: Single Inheritance

- Create two classes named **Animal** and **Dog**
  - **Animal** with a single method **`eat()`** that returns: "eating..."
  - **Dog** with a single method **`bark()`** that returns: "barking..."
- **Dog** should inherit from **Animal**

Solution: Single Inheritance

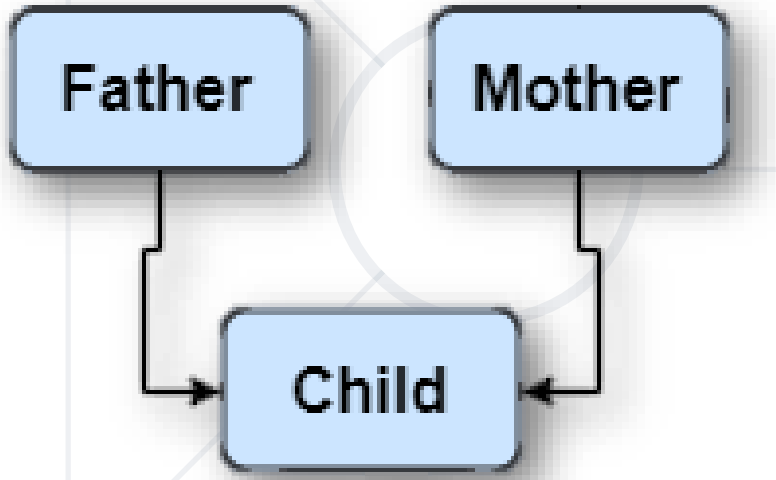
```
class Animal:
    def eat(self):
        return "eating..."

class Dog(Animal):
    def bark(self):
        return "barking..."

# dog = Dog()
# print(dog.eat())
# print(dog.bark())
```

Multiple Inheritance

- When a child inherits from **more than one parent** class
- Allows modeling of **complex** relationships



Example: Multiple Inheritance

```
class Father:
    def __init__(self):
        self.father_name = 'Taylor Evans'


class Mother:
    def __init__(self):
        self.mother_name = 'Bet Williams'


class Daughter(Father, Mother):
    def __init__(self):
        Father.__init__(self)
        Mother.__init__(self)

    def get_parent_info(self):
        return f'Father: {self.father_name},
Mother: {self.mother_name}'
```

```
child = Daughter()
print(child.get_parent_info())
# Father: Taylor Evans, Mother: Bet
Williams
```

Calling constructors of both parent classes

Problem: Multiple Inheritance

- Create three classes named **Person**, **Employee**, and **Teacher**
  - **Person** with a single method `sleep()` that returns: "sleeping..."
  - **Employee** with a single method `get_fired()` that returns: "fired..."
  - **Teacher** with a single method `teach()` that returns: "teaching..."
- **Teacher** should inherit from **Person** and **Employee**

Solution: Multiple Inheritance

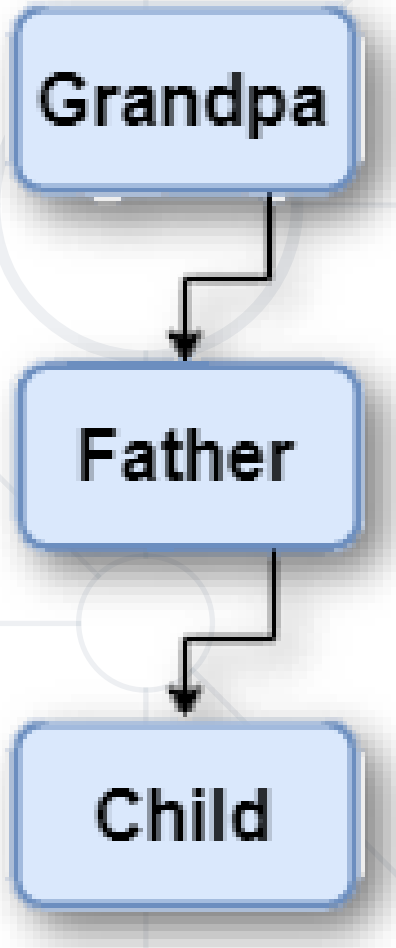
```
class Person:
    def sleep(self):
        return "sleeping..."

class Employee:
    def get_fired(self):
        return "fired..."

class Teacher(Person, Employee):
    def teach(self):
        return "teaching..."
```

Multilevel Inheritance

- When a child class becomes a parent class for another child class
- In Python, multilevel inheritance can be done at any depth



Example: Multilevel Inheritance

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

    def get_name(self):
        return self.name

class Child(Parent):
    def __init__(self, name, age):
        super().__init__(name)
        self.age = age

    def get_age(self):
        return self.age
```

Example: Multilevel Inheritance

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```
class GrandChild(Child):
    def __init__(self, name, age, address):
        super().__init__(name, age)
        self.address = address

    def get_address(self):
        return self.address

grand_child = GrandChild("Grand Name", 19, "Address 15-
17")
print(grand_child.name)      # Grand Name
print(grand_child.age)       # 19
print(grand_child.address)   # Address 15-17
```

Problem: Multilevel Inheritance

- Create three classes named **Vehicle**, **Car**, and **SportsCar**
  - **Vehicle** with a single method **`move()`** that returns: "moving..."
  - **Car** with a single method **`drive()`** that returns: "driving..."
  - **SportsCar** with a single-method **`race()`** that returns: "racing..."
- **SportsCar** should inherit from **Car** and **Car** should inherit from **Vehicle**

Solution: Multilevel Inheritance

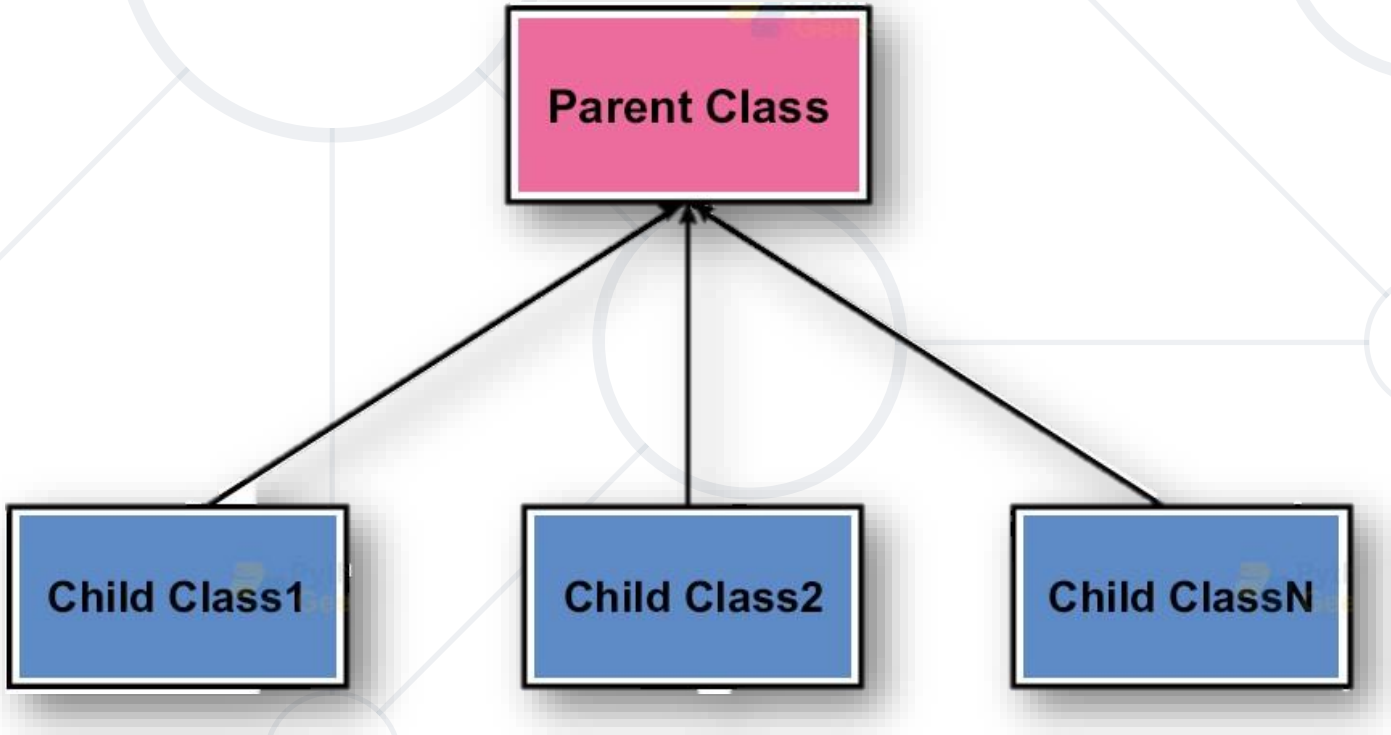
```
class Vehicle:
    def move(self):
        return "moving..."

class Car(Vehicle):
    def drive(self):
        return "driving..."

class SportsCar(Car):
    def race(self):
        return "racing..."
```

Hierarchical Inheritance

- When more than one child classes are created from a single parent class



Example: Hierarchical Inheritance

```
class Parent:
  def init(self, name):
    self.name = name

  def say_hi(self):
    return f"Hi! I am {self.name}"
```

```
class Daughter(Parent):
  def __init__(self, name):
    super().__init__(name)

  def relation(self):
    return "I am my parent's daughter"

class Son(Parent):
 def __init__(self, name):
     super().__init__(name)

 def relation(self):
    return "I am my parent's son"
```

Both child classes reuse the same code

Problem: Hierarchical Inheritance

- Create three classes named **Animal**, **Dog**, and **Cat**
  - **Animal** with a single method `eat()` that returns: "eating..."
  - **Dog** with a single method `bark()` that returns: "barking..."
  - **Cat** with a single method `meow()` that returns: "meowing..."
- Both **Dog** and **Cat** should inherit from **Animal**

Solution: Hierarchical Inheritance

```
class Animal:
    def eat(self):
        return "eating..."

class Dog(Animal):
    def bark(self):
        return "barking..."

class Cat(Animal):
    def meow(self):
        return "meowing..."
```

Method Resolution Order

In Python 3

MRO in Python 3

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- It is the order in which **methods should be inherited** in the presence of multiple inheritance
- Python 3 uses the **C3 linearization** algorithm for MRO
- It is possible to see the MRO of a class using `mro()` method of the class

Example: MRO

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```
class Parent:
    pass

class FirstChild(Parent):
    pass

class SecondChild(Parent):
    pass

class GrandChild(SecondChild, FirstChild):
    pass

print(GrandChild.mro())
# [<class '__main__.GrandChild'>, <class '__main__.SecondChild'>, <class
'__main__.FirstChild'>, <class '__main__.Parent'>, <class 'object'>]
```

The Diamond Problem

Mixins

"mix in" extra properties and methods

Mixins

- A **mixin** is a class that is implementing a specific set of features that is needed in **many different classes**
- A mixin is a class that **has no data**, only methods
- Mixins **cannot be instantiated** by themselves
- We use mixins to **extend the functionality**

Mixins Advantages

- Provides **non-complex** mechanisms of **multiple inheritance**
- Provides **code reusability**
- Allow inheritance and use of only **desired features** from the parent class, **not all of them**

Example: Mixins

```
class Vehicle:
    def __init__(self, position):
        self.position = position

    def travel(self, destination):
        pass

class Car(Vehicle):
    pass

class Clock():
    pass
```

```
class RadioMixin():
   def play_song_on_station(self,
station_frequency):
        return f'playing song on radio frequency
{station_frequency}'

class Car(Vehicle, RadioMixin):
    pass

class Clock(RadioMixin):
    pass
```

```
car = Car('Sofia')
clock = Clock()
print(car.play_song_on_station(95.0))      # playing song on radio frequency 95.0
print(clock.play_song_on_station(100.3))   # playing song on radio frequency 100.3
```

Summary

- **Inheritance** is the capability to inherit the properties from some another class
- `super()` method allows us to call methods of the superclass in your subclass
- **Mixins** implement a set of features that are needed in many different classes

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