# Exercise: Polymorphism and Abstraction

Problems for exercise and homework for the [Python OOP Course @SoftUni](https://softuni.bg/courses/python-oop).

Submit your solutions in the SoftUni judge system at <https://judge.softuni.org/Contests/1943>.

## Vehicle

Create an **abstract class called** Vehicle that should have abstract methods drive and refuel. Create **2 vehicles** that **inherit the** Vehicle class (a Car and a Truck) and simulates **driving** and **refueling** them. Car and Truck both receive fuel\_quantity and fuel\_consumption in liters per **km** upon initialization. They both can be driven a given **distance**: drive(distance) and refueled with a given amount of fuel: refuel(fuel). It is summer, so both vehicles use air conditioners, and their fuel consumption per **km** when **driving** is **increased by 0.9 liters** for the **car** and **1.6 liters** for the **truck**. Also, the Truck has a tiny hole in its tank, and when it is refueled, it keeps only **95% of the given fuel**. The car has no problems and adds all the given fuel to its tank. If a vehicle **cannot travel** the given distance, its fuel **does not change**.

***Note: Submit all your classes and imports in the judge system***

### Examples

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| **Test Code** | **Output** |
| car = Car(20, 5)  car.drive(3)  print(car.fuel\_quantity)  car.refuel(10)  print(car.fuel\_quantity) | 2.299999999999997  12.299999999999997 |
| truck = Truck(100, 15)  truck.drive(5)  print(truck.fuel\_quantity)  truck.refuel(50)  print(truck.fuel\_quantity) | 17.0  64.5 |

## Groups

Create a class called **Person**. Upon initialization, it will receive a **name** (str) and a **surname** (str). Implement the needed **magic methods** so that:

* Each person could be represented by their **names, separated by a single space**.
* When you concatenate two people, you should return a **new instance** of a person who will take **the first name from the first person and the surname from the second person**.

Create another class called **Group**. Upon initialization, it should receive a **name** (str) and **people** (list of Person instances). Implement the needed **magic methods** so that:

* When you access the **length of a group instance**, you should receive the **total number of people** in the group.
* When you **concatenate two groups**, you should return a **new instance** of a group which will have a name -string in the format **"{first\_name} {second\_name}"** and **all the people** in the two groups will participate in the new one too.
* Each group should be represented in the format **"Group {name} with members {members' names separated by comma and space}"**
* You could **iterate over a group**, and **each person** (element of the group) should be represented in the format **"Person {index}: {person's name}"**

### Examples

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| **Test Code** | **Output** |
| p0 = Person('Aliko', 'Dangote')  p1 = Person('Bill', 'Gates')  p2 = Person('Warren', 'Buffet')  p3 = Person('Elon', 'Musk')  p4 = p2 + p3  first\_group = Group('\_\_VIP\_\_', [p0, p1, p2])  second\_group = Group('Special', [p3, p4])  third\_group = first\_group + second\_group  print(len(first\_group))  print(second\_group)  print(third\_group[0])  for person in third\_group:  print(person) | 3  Group Special with members Elon Musk, Warren Musk  Person 0: Aliko Dangote  Person 0: Aliko Dangote  Person 1: Bill Gates  Person 2: Warren Buffet  Person 3: Elon Musk  Person 4: Warren Musk |

## Account

Create a single class called **Account**. Upon initialization, it should receive an **owner** (str) and a starting **amount** (int, **optional**, 0 by default). It should also have an attribute called **\_transactions** (**empty list**). Create the following **methods**:

* **add\_transaction(amount)** - if the amount is **not an integer**, raise **ValueError** with the message **"please use int for amount"**. Otherwise, **add the amount** to the transactions
* **balance()** - a property that returns the **sum** between the **amount** and all the **transactions**
* **validate\_transaction(account: Account, amount\_to\_add)**
  + If the balance becomes **less than zero**, raise **ValueError** with the message **"sorry cannot go in debt!"** and **break the transaction**.
  + Otherwise, **complete it** and **return** a message **"New balance: {account\_balance}"**

Implement the correct **magic methods** so the code in the example below works properly:

* When you **print** an account instance, the output should be in the format **"Account of {owner} with starting amount: {amount}"**.
* When you print a **representational string** of an account instance, the output should be in the format **"Account({owner}, {amount})"**.
* When you access the **length of an account instance**, you should receive the **total number of transactions** made.
* You should **iterate over** an account instance and **receive each transaction** as a result.
* You should be able to **reverse the order of transactions** by reversing an account instance.
* You should be able to **compare** **(>, <, >=, <=, ==, !=)** two account instances **by their** **balance amount**.
* When you **concatenate two accounts**, you should return a **new account** with a **name** - string in the format **"{first\_owner}&{second\_owner}"** and **starting amount** - the sum between their two. Both their transactions should be added to the new account.

### Examples

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| **Test Code** | **Output** |
| acc = Account('bob', 10)  acc2 = Account('john')  print(acc)  print(repr(acc))  acc.add\_transaction(20)  acc.add\_transaction(-20)  acc.add\_transaction(30)  print(acc.balance)  print(len(acc))  for transaction in acc:  print(transaction)  print(acc[1])  print(list(reversed(acc)))  acc2.add\_transaction(10)  acc2.add\_transaction(60)  print(acc > acc2)  print(acc >= acc2)  print(acc < acc2)  print(acc <= acc2)  print(acc == acc2)  print(acc != acc2)  acc3 = acc + acc2  print(acc3)  print(acc3.\_transactions) | Account of bob with starting amount: 10  Account(bob, 10)  40  3  20  -20  30  -20  [30, -20, 20]  False  False  True  True  False  True  Account of bob&john with starting amount: 10  [20, -20, 30, 10, 60] |

## Wild Farm

Create the following project structure:



Your task is to create a class **hierarchy** like the one described below. The Animal,Bird,Mammal, and Food classes should be abstract:

In the **food.py** file, implement the following classes:

* Food - the class should be **abstract** and should receive quantity (int) upon **initialization**
* Vegetable, Fruit, Meat and Seed classes should **inherit** from the Food class

In the **animal.py** file, implement the following classes:

* Animal - the class should be **abstract** and should have the following attributes:
  + name (string) - passed upon **initialization**
  + weight (float) - passed upon **initialization**
  + food\_eaten - 0 by default
* Bird - should **inherit** from the **Animal** class. The class should be **abstract** and should have wing\_size (float) as an additional attribute passed upon initialization.
* Mammal - should **inherit** from the **Animal** class. The class should be **abstract** and should have living\_region (str) as an additional attribute passed upon initialization.

In the **birds.py** file, implement the following classes:

* Owl
* Hen

In the **mammals.py** file, implement the following classes:

* Mouse
* Dog
* Cat
* Tiger

All **animals** also can ask for food by producing a sound. Create a make\_sound() method that returns the sound:

* Owl - **"Hoot Hoot"**
* Hen - **"Cluck"**
* Mouse - **"Squeak"**
* Dog - **"Woof!"**
* Cat - **"Meow"**
* Tiger - **"ROAR!!!"**

Now use the classes that you have created to instantiate some animals and feed them. Add method feed(food) where the food will be an instance of some food classes.

**Animals** will only eat a specific type of food, as follows:

* Hens eat **everything**
* Mice eat **vegetables** and **fruits**
* Cats eat **vegetables** and **meat**
* Tigers, Dogs, and Owls eat only **meat**

If you try to give an animal a **different type** of food, it will not eat it, and you should return:

* **"{AnimalType} does not eat {FoodType}!"**

The weight of an animal will increase with every piece of food it eats, as follows:

* Hen - **0.35**
* Owl - **0.25**
* Mouse - **0.10**
* Cat - **0.30**
* Dog - **0.40**
* Tiger - **1.00**

Override the \_\_repr\_\_() method to print the information about an animal in the formats:

* Birds - "{AnimalType} [{AnimalName}, {WingSize}, {AnimalWeight}, {FoodEaten}]"
* Mammals - "{AnimalType} [{AnimalName}, {AnimalWeight}, {AnimalLivingRegion}, {FoodEaten}]"

***Note: Submit all your classes and your imports in the judge system***

### Examples

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| **Test Code** | **Output** |
| owl = Owl("Pip", 10, 10)  print(owl)  meat = Meat(4)  print(owl.make\_sound())  owl.feed(meat)  veg = Vegetable(1)  print(owl.feed(veg))  print(owl) | Owl [Pip, 10, 10, 0]  Hoot Hoot  Owl does not eat Vegetable!  Owl [Pip, 10, 11.0, 4] |
| hen = Hen("Harry", 10, 10)  veg = Vegetable(3)  fruit = Fruit(5)  meat = Meat(1)  print(hen)  print(hen.make\_sound())  hen.feed(veg)  hen.feed(fruit)  hen.feed(meat)  print(hen) | Hen [Harry, 10, 10, 0]  Cluck  Hen [Harry, 10, 13.15, 9] |

## Animals

Your task is to create a class **hierarchy** like the one described below. Submit in judge a **zip file** named **project**, containing a **separate file for each of the classes**.

The **Animal** class (**abstract**) should take, as attributes, a **name**, an **age**, and a **gender**. It should **have 2 methods**: **repr()** and **make\_sound()**.

The **Dog** class should **inherit** and **implement** the **Animal** class. Its **repr()** method should return **"This is {name}. {name} is a {age} year old {gender} {class}"**. The dog sound is **"Woof!"**.

The **Cat** class should **inherit** and **implement** the **Animal** class. Its **repr()** method should **return "This is {name}. {name} is a {age} year old {gender} {class}"**. The cat sound, **"Meow meow!"**.

The **Kitten** class should **inherit** and **implement** the **Cat** class. Its gender is **"Female"**, and its sound is **"Meow"**.

The **Tomcat** class should **inherit** and **implement** the **Cat** class. Its gender is **"Male"**, and its sound is **"Hiss"**.

### Examples

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| **Test Code** | **Output** |
| dog = Dog("Rocky", 3, "Male")  print(dog.make\_sound())  print(dog)  tomcat = Tomcat("Tom", 6)  print(tomcat.make\_sound())  print(tomcat) | Woof!  This is Rocky. Rocky is a 3 year old Male Dog  Hiss  This is Tom. Tom is a 6 year old Male Tomcat |
| kitten = Kitten("Kiki", 1)  print(kitten.make\_sound())  print(kitten)  cat = Cat("Johnny", 7, "Male")  print(cat.make\_sound())  print(cat) | Meow  This is Kiki. Kiki is a 1 year old Female Kitten  Meow meow!  This is Johnny. Johnny is a 7 year old Male Cat |