

Quiz 3 Review

Welcome back to CS 2100!

Prof. Rasika Bhalerao

Topics revisited from previous quizzes

- Classes (from Quiz 2)
 - Constructors, methods, attributes
 - `__str__()` and `__eq__()`
- Unit Testing (from Quiz 1)
 - `self.assertEqual()`, `self.assertTrue()`, and `self.assertRaises()`
 - Identifying test cases

New review topics

- Abstract methods
 - `@abstractmethod`
 - Rules for instantiation
- Inheritance
 - What subclasses inherit
 - Overwriting inherited methods
 - `super()`.
- Properties
 - `@property` and `*.setter`
 - Attributes with `_` and `__`
- UML diagrams
 - Name, attributes, methods
 - Abstract class / method
 - Public / private
 - Relationships between classes
- Privacy
 - What type of info is shared?
 - Who is the subject? Sender?
Potential recipients?
 - What principles govern the collection and transmission?
 - Determining tradeoffs

Abstract methods

We cannot instantiate a class that has an `@abstractmethod` (even inherited).

```
from abc import ABC, abstractmethod

class Shape(ABC):
    @abstractmethod
    def get_area(self) -> float:
        pass

    @abstractmethod
    def get_perimeter(self) -> float:
        pass

shape = Shape() # TypeError
```

- Doing so will raise a `TypeError`.
- To instantiate a class that inherits a `@abstractmethod`, overwrite it with a **concrete** (non-abstract) method.

Poll: What happens?

```
from abc import ABC, abstractmethod

class Animal(ABC):
    @abstractmethod
    def make_sound(self) -> None:
        pass

class Dog(Animal):
    pass

dog = Dog()
```

1. A `Dog` object is created successfully
2. A `TypeError` is raised because `Dog` doesn't implement `make_sound()`
3. `Dog.make_sound()` returns `None`
4. A warning is printed but `dog` is created

Poll: Which is TRUE?

1. A class can only have one abstract method
2. You can instantiate an ABC if it has no abstract methods
3. Abstract methods cannot have parameters
4. ABC classes cannot have concrete (non-abstract) methods

Poll: What is output?

```
from abc import ABC, abstractmethod

class Vehicle(ABC):
    @abstractmethod
    def start(self) -> str:
        return "Starting..."

class Car(Vehicle):
    def start(self) -> str:
        return super().start() + " car engine"

c = Car()
print(c.start())
```

- A) A TypeError is raised
- B) "Starting..."

- C) "Starting... car engine"
- D) "car engine"

Poll: How many abstract methods must a concrete (non-abstract) subclass overwrite?

1. At least one
2. Exactly one
3. All of them
4. None, they are optional

Inheritance

1. A *subclass* is a more specific version of a *superclass*.
2. The subclass *inherits* all methods and attributes from the superclass.
-> Except those named with two underscores
3. The subclass can overwrite any inherited methods / attributes.
4. The subclass can add more methods / attributes.

Calling a superclass's method (or constructor)

```
class Cat:  
    def __init__(self, name: str):  
        self.name = name  
        self.food = ['tuna', 'chicken']  
  
    def knead(self) -> None:  
        print('Kneading')  
  
    def eat(self, food: str) -> None:  
        if food in self.food:  
            print(f'Eating {food}')  
  
class Lion(Cat):  
    def __init__(self, name: str):  
        super().__init__(name)  
        self.food += ['zebra']  
  
    def roar(self) -> None:  
        print('Roaring')
```

- `eat()` method inherited from `Cat` works by default in `Lion`
- `self.food` is defined in `Cat`'s constructor, so we overwrite it with a new constructor in `Lion` ...
 - one that executes `Cat`'s constructor first, and then adds '`zebra`' to `self.food` (which is inherited)

Poll: What is output?

```
class Vehicle:  
    def __init__(self, brand: str):  
        self.brand = brand  
  
class Car(Vehicle):  
    def __init__()  
        self, brand: str, model: str):  
            self.model = model  
  
c = Car("Toyota", "Camry")  
print(c.brand)
```

1. Toyota
2. None
3. An AttributeError is raised
4. Camry

Poll: Which method call would return "Rex makes a sound" ?

```
class Animal:  
    def __init__(self, name: str):  
        self.name = name  
  
    def speak(self) -> str:  
        return f"{self.name} makes a sound"  
  
class Dog(Animal):  
    def __init__(self, name: str, breed: str):  
        super().__init__(name)  
        self.breed = breed  
  
    def speak(self) -> str:  
        return f"{self.name} barks"  
  
d = Dog("Rex", "Labrador")
```

A) d.speak()

B) super().speak()

C) Animal.speak(d)

D) d.Animal.speak()

Attribute visibility

It is impossible to block an attribute from being accessed externally.

- `self.size` (attribute with no underscores): anyone can access
- `self._contents` (single underscore): nicely ask others to avoid using it
 - Externally accessible (`dataframe._contents`)
- `self.__password` (two underscores): even stronger suggestion to keep away
 - External name is mangled (`my_diary._Diary__password`)

Poll: Which are true?

```
class BankAccount:  
    def __init__(self, account_id: int, pin: str):  
        self.balance = 0  
        self._account_id = account_id  
        self.__pin = pin
```

1. All three attributes are truly private and cannot be accessed from outside the class
2. `balance` and `_account_id` are publicly accessible
3. `_account_id` and `__pin` are not accessible from outside the class
4. Accessing `_account_id` from outside `BankAccount` is avoided by convention
5. Externally, `__pin` is name-mangled to `_BankAccount__pin`

Properties: `@property` and `*.setter`

- Create a property by putting the `@property` decorator above a method with the name for the property
 - Returns the value of the property (likely using `_` or `__` attributes)
- Give the property a "setter" using another method with the same name, with the decorator `@age.setter`
 - Takes the property's new value as an arg
 - Updates any internal attributes

```
class Person:  
    def __init__(self, age: int):  
        self._age = age  
  
    @property  
    def age(self) -> int:  
        return self._age  
  
    @age.setter  
    def age(self, new_age: int) -> None:  
        if new_age >= 0:  
            self._age = new_age  
  
mini: Person = Person(10)  
mini.age = 11  
print(mini.age) # 11
```

Poll: Which code snippet will work?

```
class Temperature:  
    def __init__(self, celsius: float):  
        self._celsius = celsius  
  
    @property  
    def fahrenheit(self) -> float:  
        return self._celsius * 9/5 + 32  
  
    @fahrenheit.setter  
    def fahrenheit(  
        self, value: float) -> None:  
        self._celsius = (value - 32) * 5/9
```

1.

```
temp = Temperature(0)  
print(temp.fahrenheit(0))  
temp.fahrenheit(32)
```

2.

```
temp = Temperature(0)  
print(temp.fahrenheit)  
temp.fahrenheit = 32
```

3.

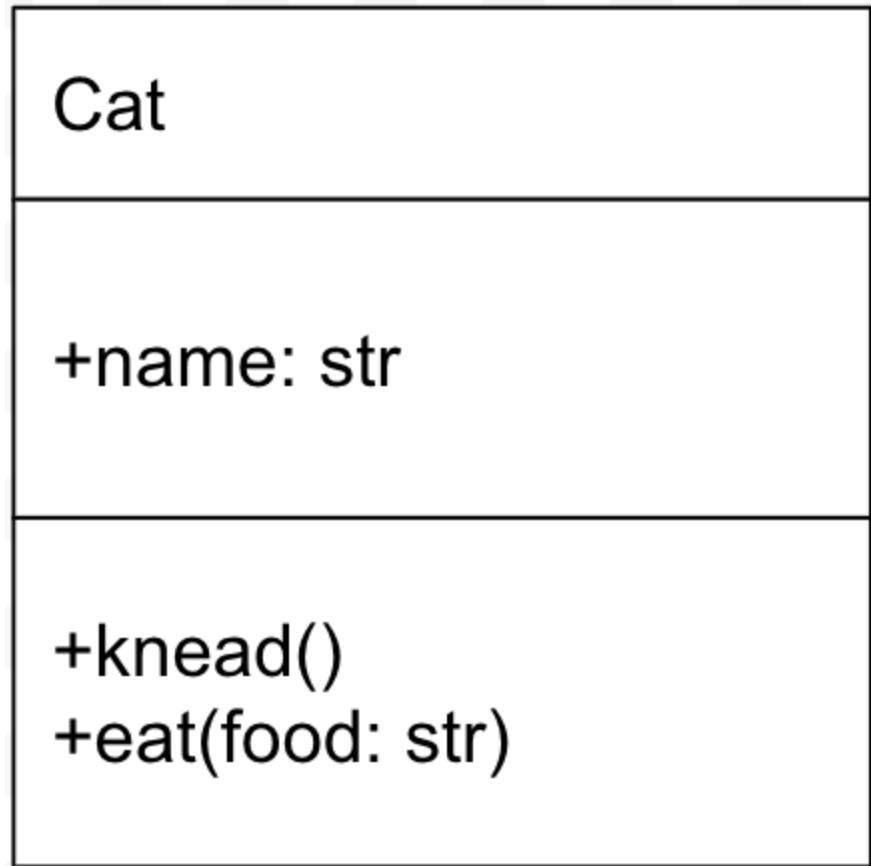
```
temp = Temperature(0)  
print(temp.get_fahrenheit())  
temp.set_fahrenheit(32)
```

4.

```
temp = Temperature(0)  
print(temp._fahrenheit)  
temp._fahrenheit = 32
```

UML (Unified Modeling Language) Diagrams

A UML diagram visually shows us the classes and their relationships in a program.



This UML diagram says:

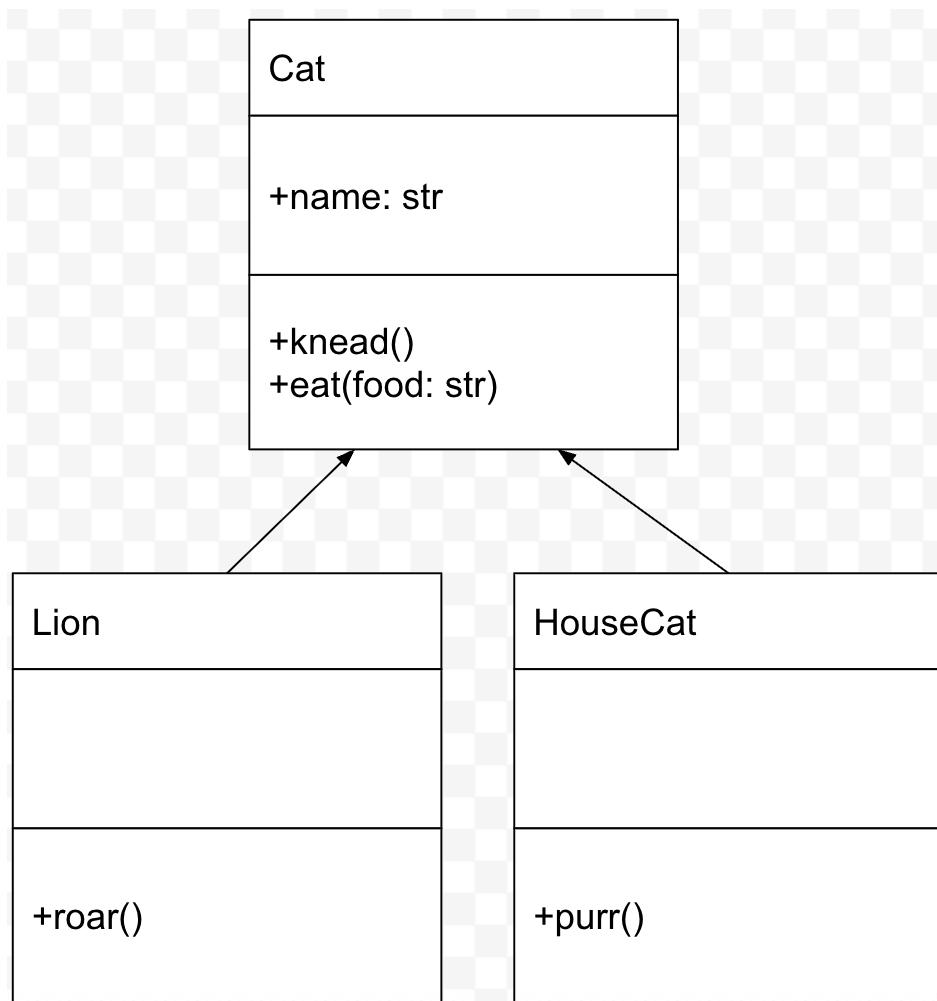
- class name: Cat
- str attribute called name
- method called knead()
- method called eat(food: str)

+ : intended to be publicly available

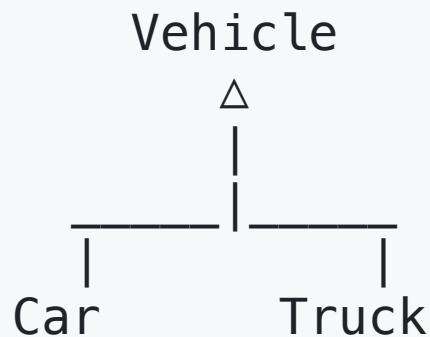
- : not public (two underscores __)

UML Diagram: Subclass / Superclass Relationship

Arrow from subclass to superclass:

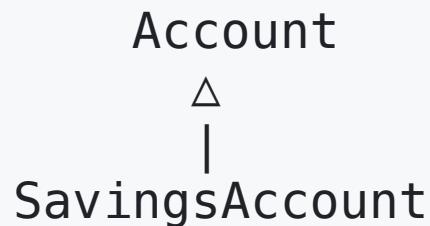


Poll: Which statement is TRUE?



1. Vehicle inherits from both Car and Truck
2. Car and Truck are superclasses of Vehicle
3. Car and Truck are subclasses of Vehicle
4. Car and Truck are sibling classes with no relationship

Poll: If `Account` has a method `deposit()`, what can you infer about `SavingsAccount`?



1. `SavingsAccount` must override the `deposit()` method
2. `SavingsAccount` inherits the `deposit()` method
3. `SavingsAccount` cannot use the `deposit()` method
4. `SavingsAccount` must implement `deposit()` from scratch

(Privacy) Polls: Algorithmic hiring

“Shamazon” (a fictitious company) is looking to hire software engineers, and you have been tasked with designing a tool to filter the submitted resumes and select the ideal candidates for hire.

| Question | Answer |
|---|--------|
| What type of information is shared? | |
| Who is the subject of the information? | |
| Who is the sender of the information? | |
| Who are the potential recipients of the information? | |
| What principles govern the collection and transmission of this information? | |

Let's go through Practice Quiz 3!

Poll:

- 1. What is your main takeaway from today?**

- 2. What would you like to revisit next time?**