Module 1 Day 12

Polymorphism: Inheritance & Interfaces

Module 1 Day 12

Can you / Do You?

1. … explain what polymorphism is and how it is used with inheritance and interfaces
2. … understand where & how inheritance can help us write polymorphic code
3. … state the purpose of interfaces and how they are used
4. … implement polymorphism through inheritance (also see Day 11 Lecture Final Rich)
5. … implement polymorphism through interfaces

Three Main Inheritance Scenarios

Recall from the previous discussion that there are three main ways inheritance can be implemented.

- A **concrete class** (all the classes we have seen so far) inheriting from another concrete class. (Day 11)
- **A concrete class inheriting from an Interface. (Today!)**
- A concrete class inheriting from an **abstract class**. (Tomorrow)

Today we will be working with Java interfaces.

Java Interfaces

An interface is a contract of behavior that exists between the interface itself and a class that implements the interface.

Interface in the real world:

- **A fast food restaurant chain requires that each franchisee place a giant corporate logo in the front of the building.**
- *While a Logo is required to exist, the franchisee is free to choose the contractors & workers it needs to actually mount the logo.*

Here, the existence of the Corporate Logo is the interface, it is expected when management comes to inspect. The contractors and workers are the code in the implementing class.

Java Interfaces

A class that implements an interface must define its own specific implementation of whatever methods the interface requires it to implement.

- The methods that the class needs to implement are defined in the Interface through **abstract methods**.
- An interface itself is an example of a class that is “abstract in nature” though it *is not* an *Abstract Class* (They are covered in Day 13)
- An interface cannot be instantiated; they can only be “implemented” by other classes.

Java Interfaces: Declaration

- The declaration for an Interface is as follows:

  public **interface** **<<Name of the Interface>>** {...}

- A class implementing an Interface must have the following convention:

  public class **<<Name of Class>>** implements **<<Name of Interface>>** {...}

- The class implementing an interface is also called a **concrete class**.
- You cannot instantiate Interfaces, you can only instantiate the classes that implement an interface.

Java Interfaces: Abstract Methods

An abstract method is one that ***doesn't have an implementation***; the method has has no body. Here is an example from a Vehicle Interface:

```
package te.mobility;

public interface Vehicle {

        public void honkHorn();
        public void checkFuel();
}
```

- The Interface Vehicle has two abstract methods:
  honkHorn()
  and
  checkFuel()

- These abstract methods do not have method bodies. There are no {..//code blocks.}, and they each **end with a semicolon**.

Java Interfaces: Abstract Methods

A class implementing the Vehicle interface ***must*** provide a concrete implementation of the two abstract methods.

```
package te.mobility;

public interface Vehicle {

        public void honkHorn();
        public double checkFuel();
}
```

honkHorn has been implemented

checkFuel has been implemented

```
package te.mobility;

public class Car implements Vehicle {

        private double fuelLeft;
        private double tankCapacity;

        @Override
        public void honkHorn() {
                System.out.println("beeeep?");
        }
        @Override
        public double checkFuel() {
                return (fuelLeft / tankCapacity) * 100;
        }
}
```

Java Interfaces: Abstract Method Rules

When implementing the interface abstract methods in a concrete class, the following rules are in effect:

- To fulfill the Interface's contract, the concrete class must implement the method with the exact same return type, name, and number of arguments with matching data types.
- The access modifier on the implementation cannot be more restrictive than that of that parent Interface.
    - For example - the concrete class cannot implement the method as private if if the abstract class has marked it as public.
- All abstract methods in interfaces are assumed to be public.

Java Interfaces: Default Methods

Looking at our Vehicle interface, we could define the default method as follows:

```
package te.mobility;

public interface Vehicle {

        public double checkFuel(String units);

        default void honkHorn() {
                System.out.println("beeep");
        }
}
```

An instance of a concrete class that implements Vehicle can just call honkHorn now through the instantiated object, i.e. myCar.honkHorn();

Java Interfaces: Default Methods

A concrete class can override the default method by implementing its own version of the method:

```
package te.mobility;

public interface Vehicle {

        public double checkFuel(String units);

        default void honkHorn() {
                System.out.println("interface");
        }
}
```

For an instance of car, if honkHorn is invoked, this concrete method takes priority. The output from Car.honkHorn() will be “concrete.”

```
package te.mobility;

public class Car implements Vehicle {

        private double fuelLeft;
        private double tankCapacity;

        public void honkHorn() {
                System.out.println("concrete");
        }

        @Override
        public double checkFuel(String units) {
                return (fuelLeft / tankCapacity) * 100;
        }
}
```

Java Interfaces: Data Members

It is possible for interfaces to have data members, if they do, **they are assumed to be public, static, and final**.

Java Interfaces: Polymorphism

Polymorphic objects are those that can assume many forms. In other words, they can pass more than one “Is-A” test.

- A child object from a parent class that implements an interface:
  - is a member of the child class
  - and a member of the parent class
  - And a member of interface “class”.
- Yesterday we instantiated a ReserveAuction with

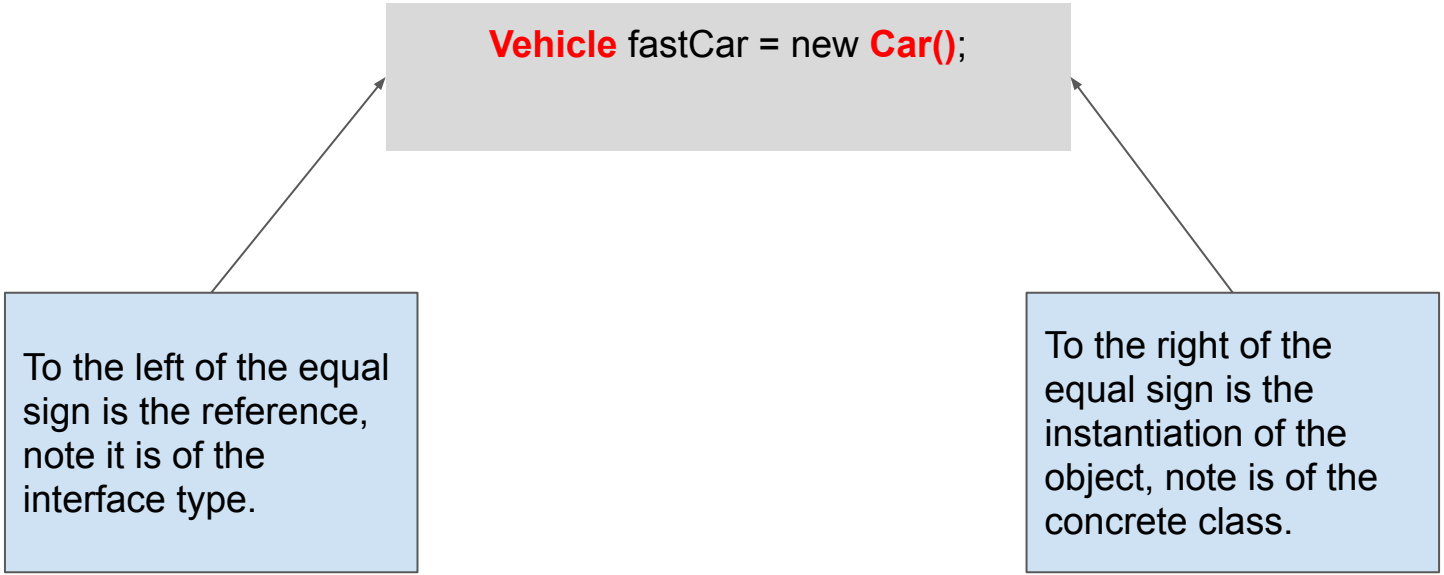
  ```
  ReserveAuction lowReserve = new ReserveAuction ()
  ```

  lowReserve Is-A ReserveAuction ***and*** Auction.

Polymorphism is the ability to leverage these relationships in order to write more compact and reusable code.

Java Interfaces: Polymorphism References

Interfaces allow us to create references based on the interface, but instantiate an instance of the concrete class instead.



Java Interfaces: Polymorphism Example

Assuming that Car and Truck implements vehicle, consider a new class called RepairShop. In the real world, it is very likely that a car repair shop is able to handle more than one type of vehicle.

```
package te.main;

import te.mobility.Car;

public class RepairShop {

        public void repairVehicle(Car damagedCar) {
                System.out.println("repairing");
        }
}
```

Here is an issue, the RepairShop only accepts objects of class Car! Hmm...

We can bypass this issue by creating yet another method that accepts Trucks.

Java Interfaces: Polymorphism Example

We can leverage interfaces to make the repairVehicle method much more flexible, allowing it to take in any Vehicle.

```
package te.main;

import te.mobility.Car;

public class RepairShop {

        public void repairVehicle(Vehicle damagedVehicle) {
                System.out.println("repairing");
        }
}
```

The method will now accept objects of class Car, and objects of class Truck.

Java Interfaces: Polymorphism Example

We can leverage interfaces to make the repairVehicle method much more flexible, allowing it to take in any Vehicle.

```
package te.main;
import te.mobility.Car;
import te.mobility.Truck;
import te.mobility.Vehicle;

public class Garage {

        public static void main(String[] args) {

                Vehicle fastCar = new Car();
                Vehicle bigTruck = new Truck();
                RepairShop repairShop = new RepairShop();

                repairShop.repairVehicle(fastCar);
                repairShop.repairVehicle(bigTruck);

}}
```

Both of these calls are ok to make because both Cars and Trucks are concrete classes implementing Vehicle.