

Interface Polymorphism

Ch 4.1-4.5



Topics

- 1) How can we **reduce coupling** between classes?
- 2) How can one piece of code work on **different types of objects**?

Interface

- An Interface specifies a set of ***public*** methods, but..

- It's a contract for providing methods.

```
public interface LetterGrader {  
    String getGrade(double percent);  
    double getMinPercentForGrade(String grade);  
}
```

- "Interface" can refer to two things:
 - An interface in Java
(such as "The LetterGrader interface")
 - The..
(such as "The class's public interface")

Interface Usage

- To implement an interface, a class must both:

- Say it "implements" the interface

-

```
public class EasyLetterGrader implements LetterGrader {  
    private static final double BREAK_POINT = 70;
```

```
    @Override
```

```
    public String getGrade(double percent) {  
        if (percent >= BREAK_POINT) {  
            return "A+";  
        } else {  
            return "B";  
        }  
    }
```

```
    // Code seems incomplete :)
```

```
}
```

```
    @Override
```

```
    public double getMinPercentForGrade(String grade) {  
        if (grade.compareToIgnoreCase("A+") == 0) {  
            return BREAK_POINT;  
        } else {  
            return 0;  
        }  
    }
```

```
}
```

```
}
```

@Override is an..

Tells Java that this method..

..

Concrete Types

- Concrete Type

-

- (not a more general interface or base class).

- Example

- LetterGrader is an Interface (not instantiatable), so *not* a concrete type.

- BAD: LetterGrader oops = new LetterGrader();

- Example

- EasyLetterGrader is an instantiatable class, so..

- GOOD: LetterGrader good = new EasyLetterGrader();

Polymorphism

- **Polymorphism Example:**

- A variable of type **LetterGrade** can reference any object of class type which..

```
LetterGrader g = new EasyLetterGrader();  
computeClassGrades(g);  
LetterGrader g = new HardLetterGrader();  
computeClassGrades(g);
```

- **Polymorphism definition:**

- The exact method to execute is selected at runtime.
- **Ex:** Does `g.getGrade()` call **`EasyLetterGrader.getGrade()`**, or **`HardLetterGrader.getGrade()`** ?

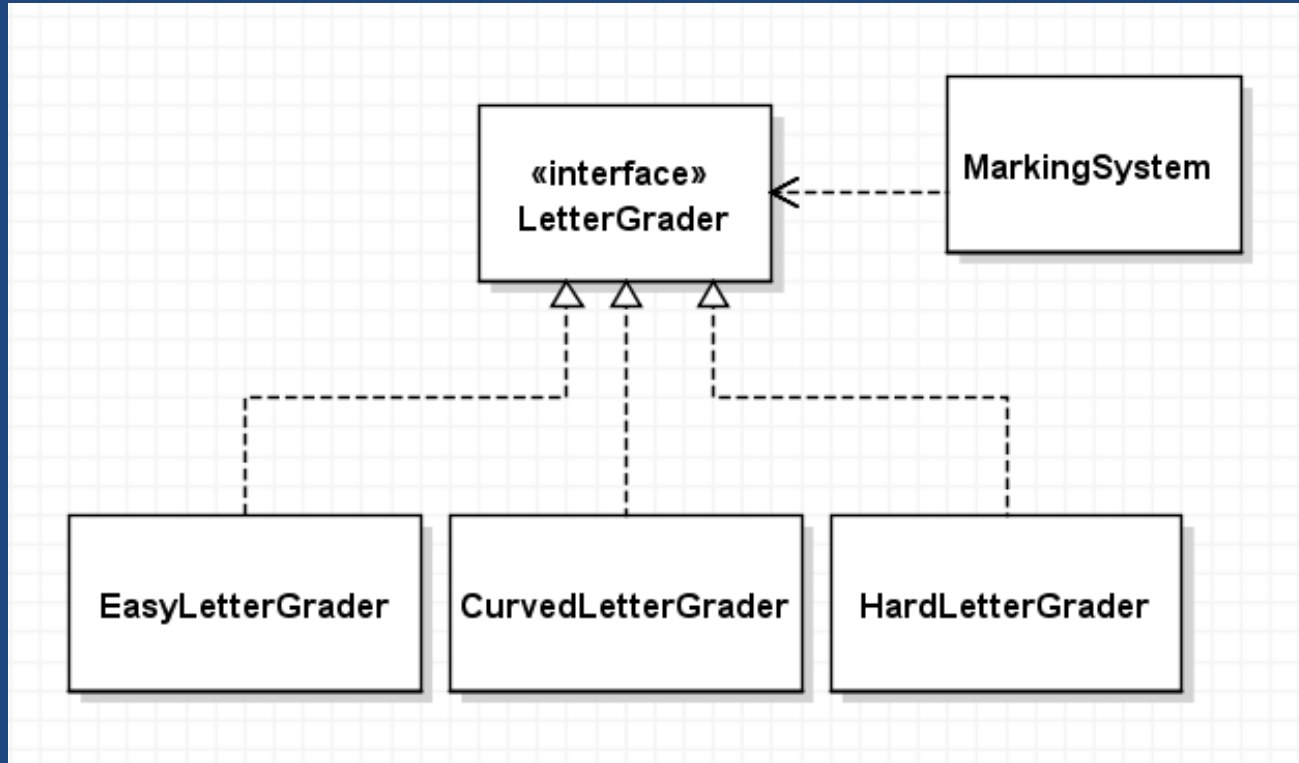
Polymorphism Example

```
class MarkingSystem {  
    double[ ] marks = {74, 85, 25, 55, 93, 1};  
  
    void printLetterGrades() {  
        LetterGrader grader = new EasyLetterGrader();  
        String[] grades = gradeEachStudent(grader);  
  
        for (String grade : grades) {  
            System.out.println("Grade: " + grade);  
        }  
    }  
  
    String[ ] gradeEachStudent(LetterGrader grader) {  
        String[ ] letterGrades = new String[marks.length];  
        for (int i = 0; i < marks.length; i++) {  
            letterGrades[i] = grader.getGrade(marks[i]);  
        }  
        return letterGrades;  
    }  
}
```

No idea what type of `LetterGrader` is passed; just that the object..

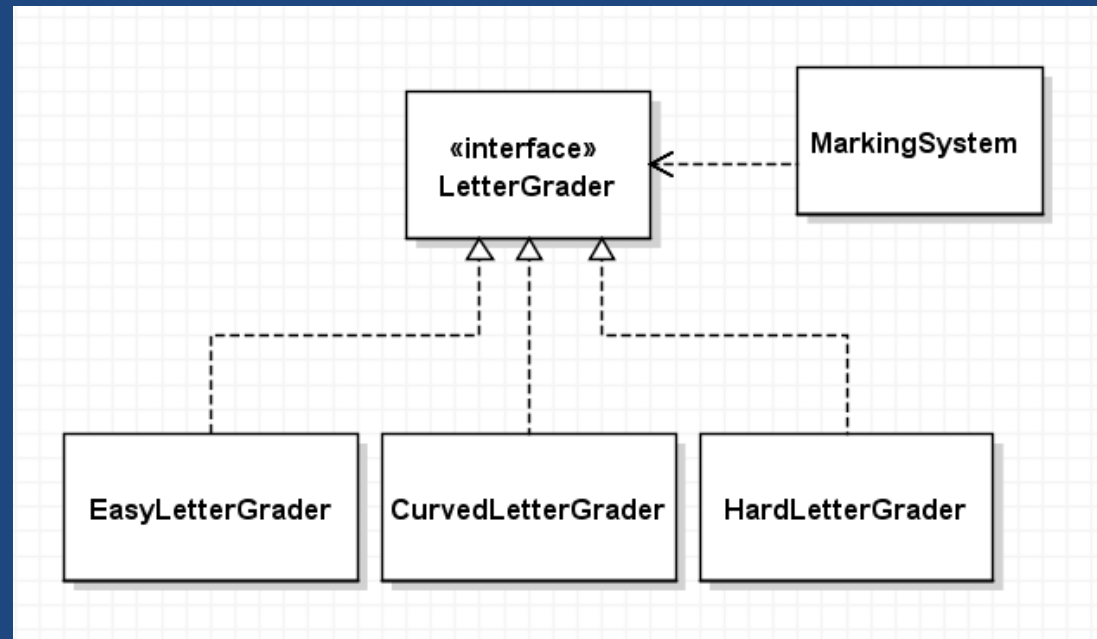
It can only use..

Terminology



Why Use Polymorphism?

- ..
Exact method (concrete type) determined at runtime.
- ..
works with any object implementing the Interface so independent of object's concrete type.
- **Design Heuristic:**
 - **Extensible:**
Reuse code without re-write to support new classes.



Interface Details

- Interface methods are ..
 - can provide “default” implementation of function.
- Can declare.. (automatically **public static final**)

```
public interface CardDeck {  
    int NUM_CARDS = 52;  
    // ...  
}
```

Interface Details

- An Interface can..

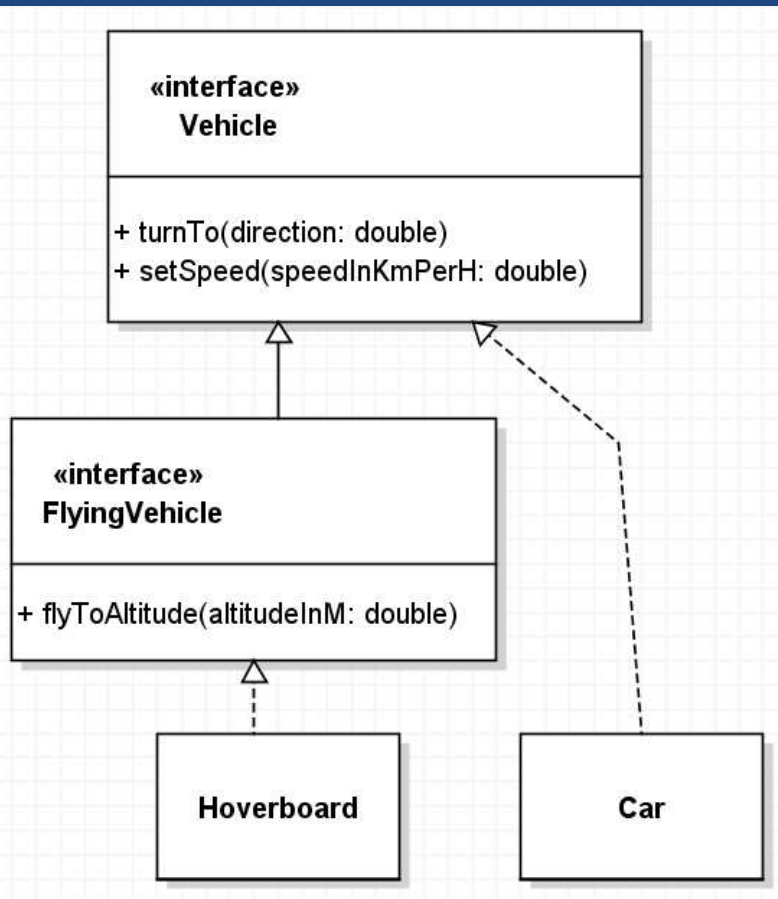
```
public interface Vehicle {  
    void turnTo(double direction);  
    void setSpeed(double speedInKmPerH);  
}
```

```
public interface FlyingVehicle extends Vehicle {  
    void flyToAltitude(double altitudeInM);  
}
```

- A class implementing **FlyingVehicle** must also implement all of **Vehicle's** methods too.

Exercise

- Which of the following statements work?



```
public static void main(String[] args) {
```

```
    Vehicle v1;
```

```
    v1 = new Vehicle();
```

```
    v1 = new Car();
```

```
    v1 = new Hoverboard();
```

```
    FlyingVehicle v2;
```

```
    v2 = new Vehicle();
```

```
    v2 = new Car();
```

```
    v2 = new Hoverboard();
```

```
    Car v3;
```

```
    v3 = new Vehicle();
```

```
    v3 = new Car();
```

```
    v3 = new Hoverboard();
```

```
}
```

Comparable Review

- Can write algorithms for interface types.

```
interface Comparable<Type> {  
    int compareTo(Type obj);  
}
```

This is not quite perfect.
`Comparable` is a generic type, so `isAscending()` should have the heading
`public static <T extends Comparable<T>> boolean isAscending(T[] array) {`

```
public class InOrder {  
    public static void main(String[] args) {  
        Long[] data = new Long[5];  
        for (int i = 0; i < data.length; i++) {  
            data[i] = i;  
        }  
  
        System.out.println("In order? "  
            + isAscending(data));  
    }  
  
    public static boolean  
    isAscending(Comparable[] array) {  
        for(int i = 0; i < array.length - 1; i++) {  
            Comparable first = array[i];  
            Comparable second = array[i+1];  
            if (first.compareTo(second) > 0) {  
                return false;  
            }  
        }  
        return true;  
    }  
}
```

Comparator Review

- An **idiom** is..
- For creating anonymous classes make a function which creates it.

```
public interface FileFilter {  
    boolean accept(File path);  
}
```

```
private void addFolder(File directory) {  
    FileFilter filter = createExtensionFilter();  
    File[] files = directory.listFiles(filter);  
    //..  
}  
  
private FileFilter createExtensionFilter() {  
    return new FileFilter() {  
        @Override  
        public boolean accept(File path) {  
            return path.isDirectory()  
                || hasAcceptedExtension(path);  
        }  
    };  
}
```

Review Questions

- Can the full type of an object be just an Interface type?
 - No: An object's concrete type cannot be an Interface. An Interface cannot be instantiated, only implemented by other classes.
- Are the following two ideas identical?
 - A class which has the same methods as an Interface
 - A class which implements the interface?
 -

Summary

- **Interface**: A set of methods & constants.
 - How to define, implement, and use an interface.
- **Concrete Type**: the instantiated type of an object.
- Example uses for **polymorphism**.