CSSE 220

Interfaces and Polymorphism

Check out *Interfaces* from SVN

Interfaces – What, When, Why, How?

- What:
  - Code Structure used to express operations that multiple class have in common
  - No method implementations
  - No fields
- When:
  - When abstracting an idea that has multiple, different implementations

Interfaces – What, When, Why, How?

- Why:
  - Provide method signatures and documentation
  - Create a **contract** that someone must follow
    - Client Code Reuse, for example, Java Event Handlers
- How:

```
public interface InterfaceName {
    //method definitions
    //We'll look more closely at the syntax in a later slide
}
```

Interface Types: Key Idea

- Interface types are like **contracts**
- A class can promise to **implement** an interface
  - MUST implement every method
  - Client code knows that the class will have those methods
    - Compiler verifies this
  - Any client code designed to use the interface type can automatically use the class!
- Interfaces help to reduce coupling by tying your design to the interface and not the class implementation.
  - A new interface implementation can be switched out for the original without changing the rest of the code

Q1

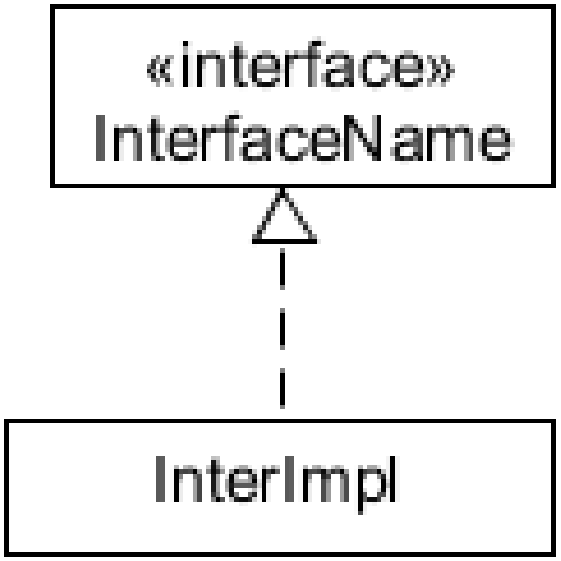
Using Interface Types

- Once an interface is defined, it can be used as a type.
- An interface type can be used anywhere that a class type is used:
  - Say we have an interface named Pet, and Dog and Cat implement this interface…
  - Variable Declaration:
    - Pet d = new Dog();
    - Pet c = new Cat();
  - Parameters:
    - public static void feedPet(Pet p) {…}
    - Can call with any object of type Pet:
      - feedPet(new Dog());
      - feedPet(new Cat());

Using Interface Types

- An interface type can be used anywhere that a class type is used (examples continued from last slide):
  - Fields:
    - private Pet pet;
  - Generic Type Parameters:
    - ArrayList<Pet> pets = new ArrayList<Pet>();
    - pets.Add(new Dog());
    - pets.Add(new Cat());

Notation: In UML



- Closed triangle with a dashed line in UML is an “is-a” relationship
- Read this as:

  InterImpl is-an InterfaceName

Q2

Why is this OK?

```
Pet p = new Dog();
p.feed();
p = new Cat();
p.feed();
```

- Any child type may be stored into a variable of a parent type, but not the other way around.
  - A Dog is a Pet, and a Cat is a Pet, but a Pet is not **required** to be a Dog or a Cat.
- But how does Java know which method implementation to use?

Q3

Polymorphism! (A quick intro)

- Origin:
  - Poly → many
  - Morphism → shape
- Classes implementing an interface give **many differently "shaped" objects for the interface type**

- Java knows what method implementation to use thanks to:
  - **Late Binding**:
    - choosing the right method based on the actual type of the implicit parameter (variable before the dot) **at run time**
  - For the p.feed() example:
    - Java decides at runtime which implementation to use based on the type of the object instance.
    - The Dog's feed method may specify dog food, and the Cat's may specify cat food.

Q4

Notation: In Code

```
public interface InterfaceName{
        /**
         *  regular javadocs
         */
        void methodName(int x, int y);

        /**
         *  regular javadocs here
         */
        int doSomething(Graphics2D g);
    }

public class InterImpl implements InterfaceName {

}
```

interface, not class

Automatically public, so we don't specify it

No method body, just a semi-colon

InterImpl promises to implement all the methods declared in the **InterfaceName** interface

Refactoring to an Interface

- stringTransforms package
  - Review the code in the stringTransforms package
  - Attempt to refactor the given code using an interface by thinking about what operation is performed repeatedly
  - There is a hint at the bottom if you're not quite sure where to start, but only use it if you need

How does all this help reuse?

- Can pass an **instance** of a class where an interface type is expected
  - But only *if the class* ***`implements`*** *the interface*
- We could add new functions to textCalculator's abilities without changing the calculator itself.
  - Sort of like application "plug-ins"
- We can use a new TransformInterface without changing the method that uses the TransformInterface instance
- **Use interface types** for field, method parameter, and return types whenever possible