

CSSE 220

Interfaces and Polymorphism

Check out *Interfaces* from SVN

Object-Oriented Programming

- The **three pillars of Object-Oriented Programming**
 - Encapsulation (already covered)
 - Inheritance (we will partly cover it today)
 - Polymorphism (also covered today)

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

Interface Types can be used anywhere that a class type is used.

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

Interface Types can be used anywhere that a class type is used.

(...continued from last slide)

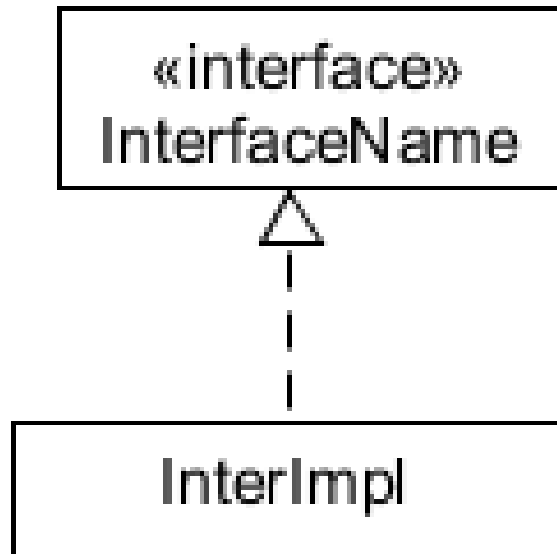
3. Fields:

- `private Pet pet;`

4. 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

Why is this OK?

```
Pet p = new Dog();  
p.feed();  
p = new Cat();  
p.feed();  
p = new Pet(); // NO!
```

- 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.
 - And how could you *construct* a Pet?
- But how does Java know which method implementation to use?

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.

Notation: In Code

```
public interface InterfaceName{  
    /**  
     * regular javadocs  
     */  
    void methodName(int x, int y);  
    /**  
     * regular javadocs here  
     */  
    int doSomething(Graphics2D g);  
}
```

interface, not class

Automatically
public, so we
don't specify it

No method
body, just a
semi-colon

```
public class InterImpl implements InterfaceName {  
}
```

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 a NumberSequence's abilities without changing the runner 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. Like Pet instead of Dog, and List for ArrayList.
 - **List**<Pet> pets= new ArrayList<Pet>();