

CSSE 220 Day 17

Details on class implementation,
Interfaces and Polymorphism

Check out *OnToInterfaces* from SVN

HW 16 and 17 now due Wednesday at 5 PM. This overrides the schedule page. Reading quiz in HW 17 due Tuesday at 8 AM.

Questions?

Today

- ▶ Variable scope
- ▶ Packages recap
- ▶ Interfaces and polymorphism

Variable Scope

- ▶ **Scope**: the region of a program in which a variable can be accessed
 - **Parameter scope**: the whole method body
 - **Local variable scope**: from declaration to block end:

```
• public double area() {  
    double sum = 0.0;  
    Point2D prev =  
        this.pts.get(this.pts.size() - 1);  
    for (Point2D p : this.pts) {  
        sum += prev.getX() * p.getY();  
        sum -= prev.getY() * p.getX();  
        prev = p;  
    }  
    return Math.abs(sum / 2.0);  
}
```

Q1

Member (Field or Method) Scope

- ▶ *Member scope*: anywhere in the class, including *before* its declaration
 - This lets methods call other methods later in the class.
- ▶ `public static` class members can be accessed from outside with “qualified names”
 - `Math.sqrt()`
 - `System.in`

Q2

Overlapping Scope and Shadowing

```
public class TempReading {
    private double temp;

    public void setTemp(double temp) {
        this.temp = temp;
    }
    // ...
}
```

Always qualify field references with `this`. It prevents accidental shadowing.

What does this “temp” refer to?

Q3

Last Bit of Static

- ▶ Static imports let us use unqualified names:
 - `import static java.lang.Math.PI;`
 - `import static java.lang.Math.cos;`
 - `import static java.lang.Math.sin;`
- ▶ See the `polygon.drawOn()` method in the `DesigningClasses` project

Review: Packages

- ▶ Let us group related classes
- ▶ We've been using them:
 - `javax.swing`
 - `java.awt`
 - `java.lang`



Avoiding Package Name Clashes

- ▶ Java built-in Timer class?
 - `java.util.Timer`, `javax.swing.Timer`
 - Packages allow us to specify which we want to use.
- ▶ Package naming convention: reverse URLs
 - Examples:
 - `edu.roseHulman.csse.courseware.scheduling`
 - `com.xkcd.comicSearch`

Specifies the company or organization

Groups related classes as company sees fit

Q4

Qualified Names and Imports

- ▶ Can use `import` to get classes from other packages:
 - `import java.awt.Rectangle;`
- ▶ Suppose we have our own `Rectangle` class and we want to use ours and Java's?
 - Can use "fully qualified names":
 - `java.awt.Rectangle rect = new java.awt.Rectangle(10, 20, 30, 40);`
 - U-G-L-Y, but sometimes needed.

Interface Types

- ▶ Express common operations that multiple classes might have in common
- ▶ Make “client” code more reusable
- ▶ Provide method signatures and docs.
- ▶ Do **not** provide implementation or fields

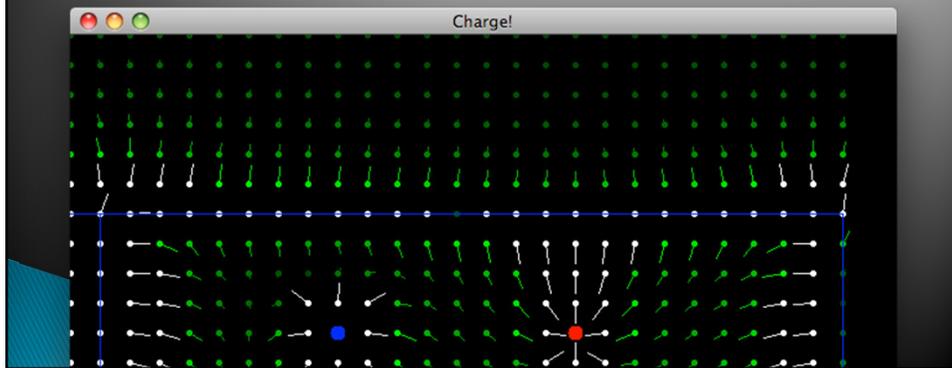
Q5

Interface Types: Key Idea

- ▶ Interface types are like **contracts**
 - A class can promise to **implement** an interface
 - That is, implement every method
 - Client code knows that the class will have those methods
 - Any client code designed to use the interface type can automatically use the class!

Example

Charges Demo



Package Tracking

ONLINE PACKAGE TRACKING:

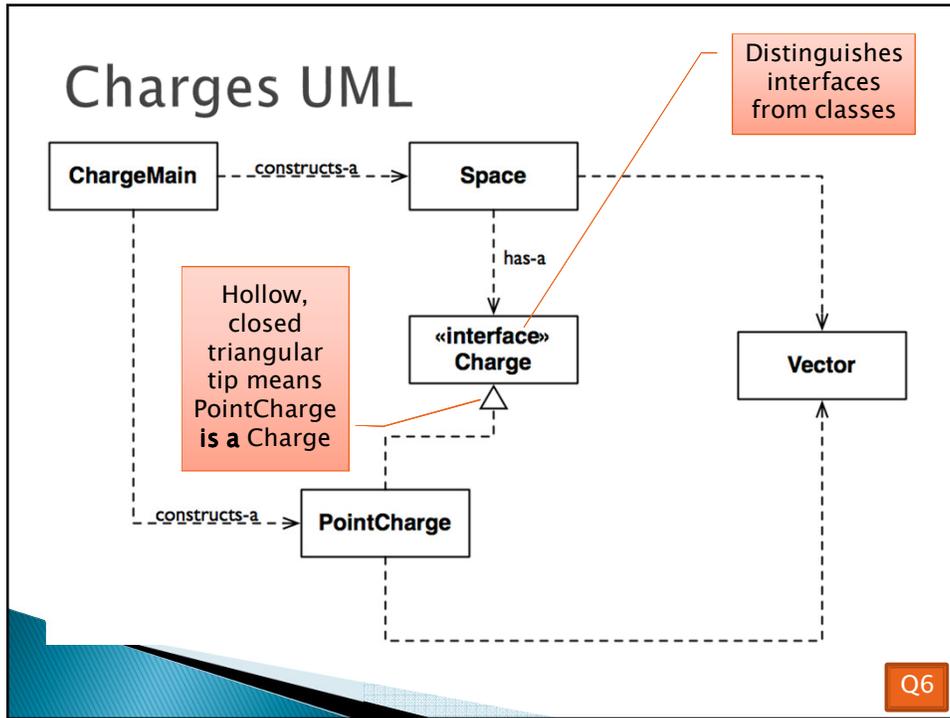
PROS:
CONVENIENT
USEFUL

CONS:
MAKES YOU
CRAZY

REFRESH
| AWW, STILL IN MEMPHIS.
REFRESH
| AWW, STILL IN MEMPHIS.
REFRESH
| AWW, STILL IN MEMPHIS.



I don't even want this package. Why did I sign up for the stinging insect of the month club anyway?



Notation: In Code

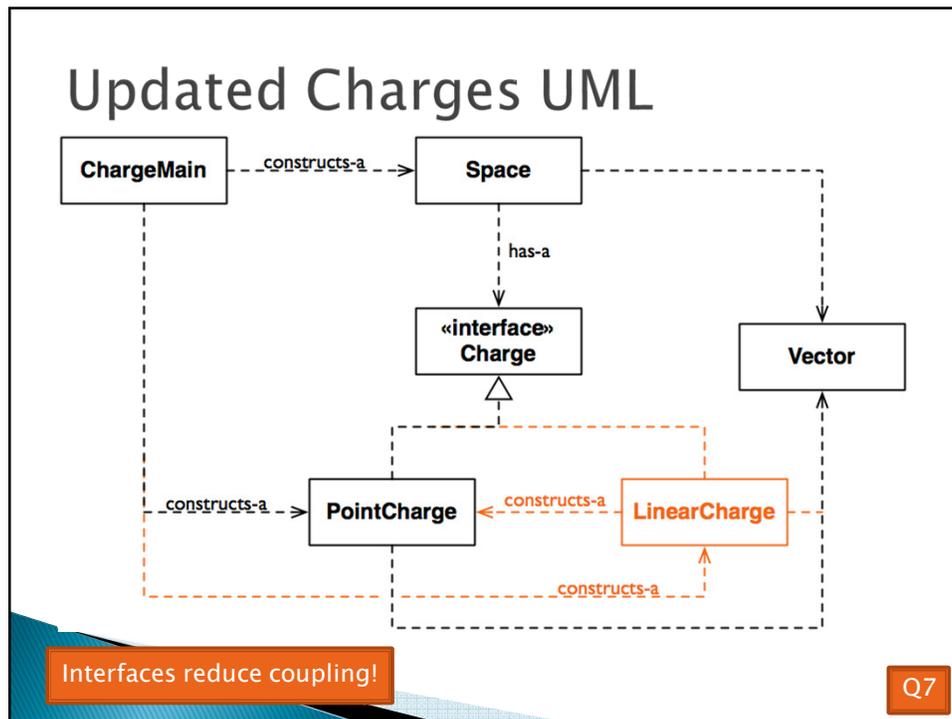
```

public interface Charge {
    /**
     * regular javadocs here
     */
    Vector forceAt(int x, int y);
    /**
     * regular javadocs here
     */
    void drawOn(Graphics2D g);
}

public class PointCharge implements Charge {
}
    
```

Annotations:

- interface, not class
- No "public", automatically are so
- No method body, just a semi-colon
- PointCharge promises to implement all the methods declared in the Charge interface



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 passed **LinearCharges** to **Space's** `addCharge(Charge c)` method without changing **Space**!
- ▶ **Use interface types** for field, method parameter, and return types whenever possible

Q8

Why is this OK?

- ▶ Charge `c = new PointCharge(...);`
`Vector v1 = c.forceAt(...);`
`c = new LinearCharge(...);`
`Vector v2 = c.forceAt(...);`
- ▶ The type of the **actual object** determines the method used.

Q9

Polymorphism

- ▶ Origin:
 - Poly → many
 - Morphism → shape
- ▶ Classes implementing an interface give **many differently “shaped” objects for the interface type**
- ▶ **Late Binding**: choosing the right method based on the actual type of the implicit parameter **at run time**

Q10-Q11

Work Time

- » Homework 16: Polygon
- » Homework 17: Board Games
- » Homework 17-18: BigRational