

CSSE 220 Day 9

Details on class implementation,
Interfaces and Polymorphism

Check out *OnToInterfaces* and
EventBasedProgramming from SVN

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 myMethod() {  
    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);  
}
```

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 “class qualified names”
 - **Math.sqrt()**
 - **System.in**

Overlapping Scope and Shadowing

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

What does this
“temp” refer
to?

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

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

Packages

- ▶ 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

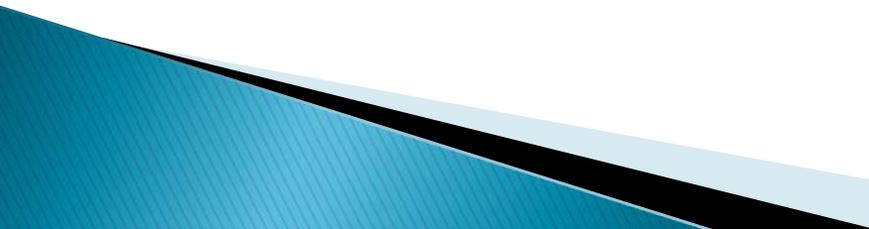


Groups related classes as company sees fit

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

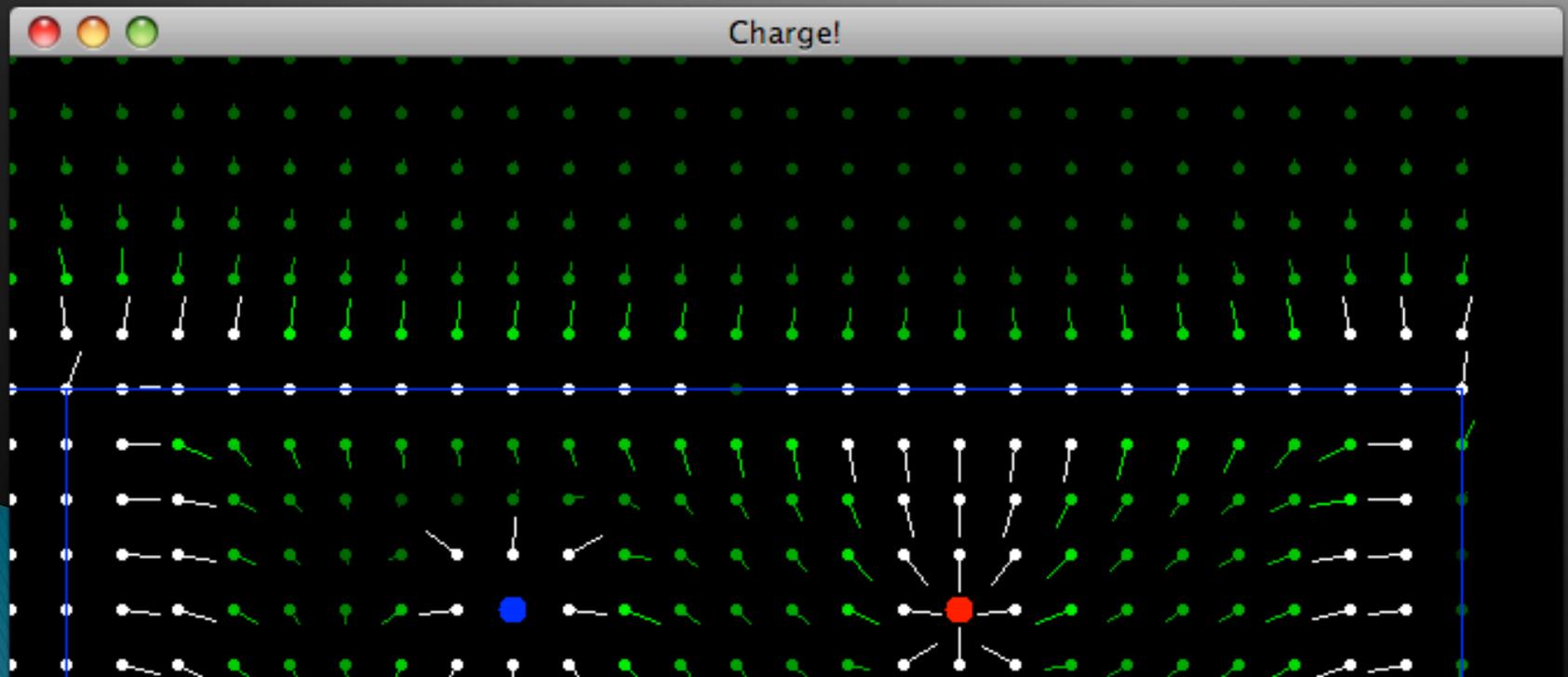
- ▶ Express common operations that multiple classes might have in common
 - ▶ Make “client” code more reusable
 - ▶ Provide method signatures and documentation
 - ▶ Do **not** provide method implementations or fields
- 

Interface Types: Key Idea

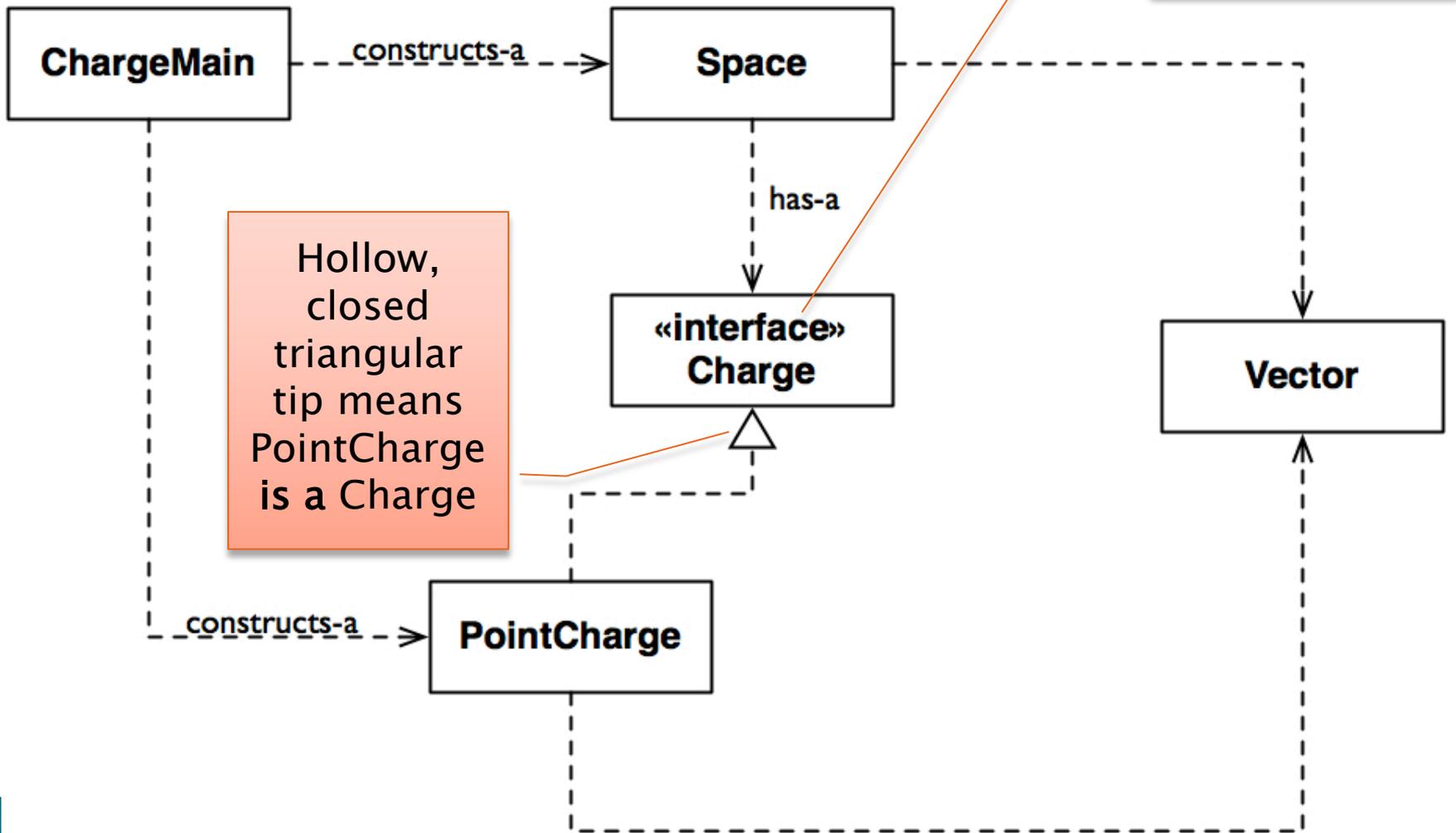
- ▶ Interface types are like **contracts**
 - A class can promise to **implement** an interface
 - That is, implement every method
 - Client code knows that the class will have those methods
 - Compiler verifies this
 - Any client code designed to use the interface type can automatically use the class!

Example

»» Charges Demo



Charges UML



Hollow, closed triangular tip means PointCharge is a Charge

Distinguishes interfaces from classes

Notation: In Code

interface, not class

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

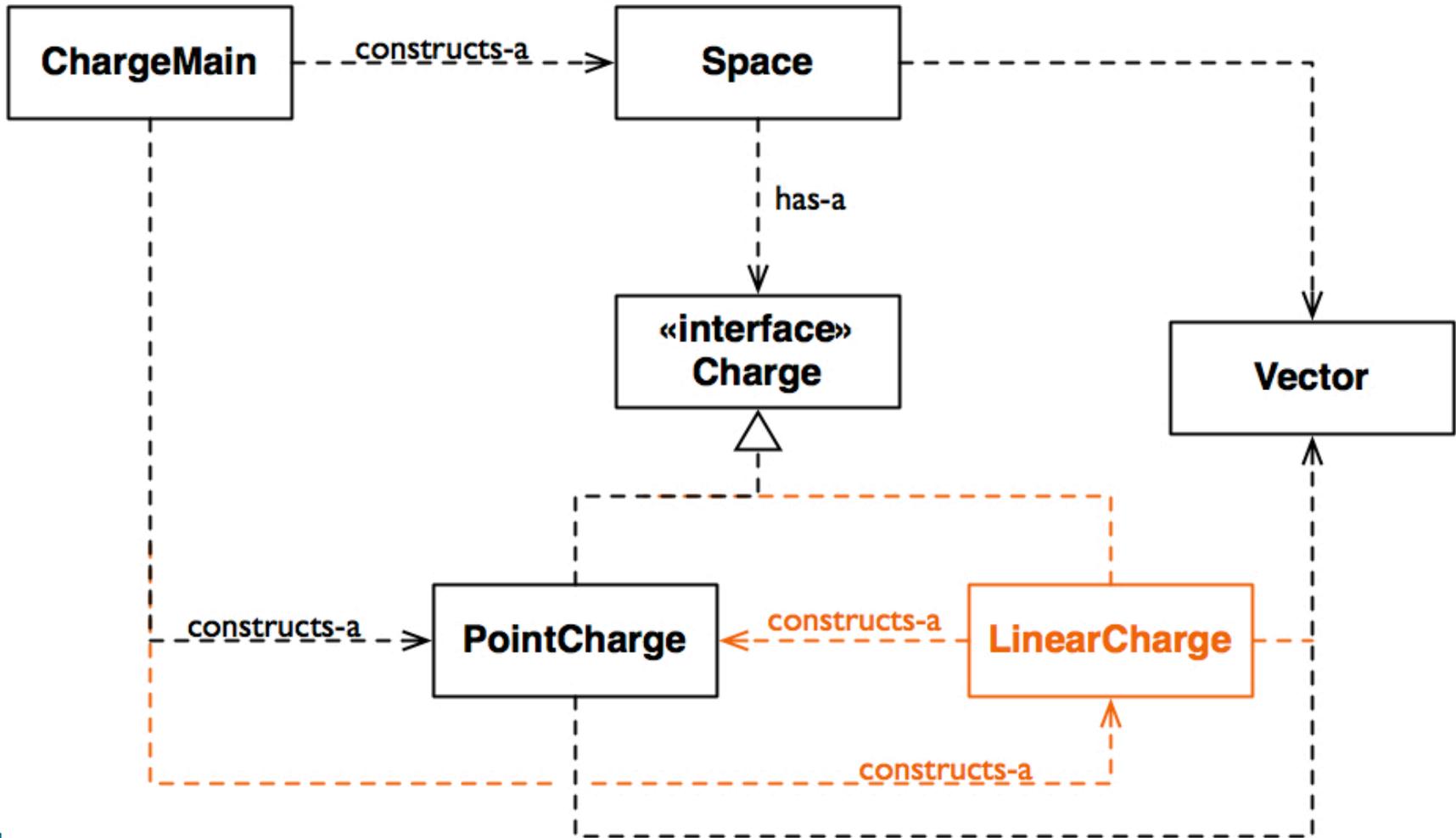
No "public",
automatically
are so

No method
body, just a
semi-colon

```
public class PointCharge implements Charge {  
}
```

PointCharge promises to implement all the
methods declared in the Charge interface

Updated Charges UML



Interfaces reduce coupling!

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

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.

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**

Package Tracking

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

ONLINE PACKAGE TRACKING:

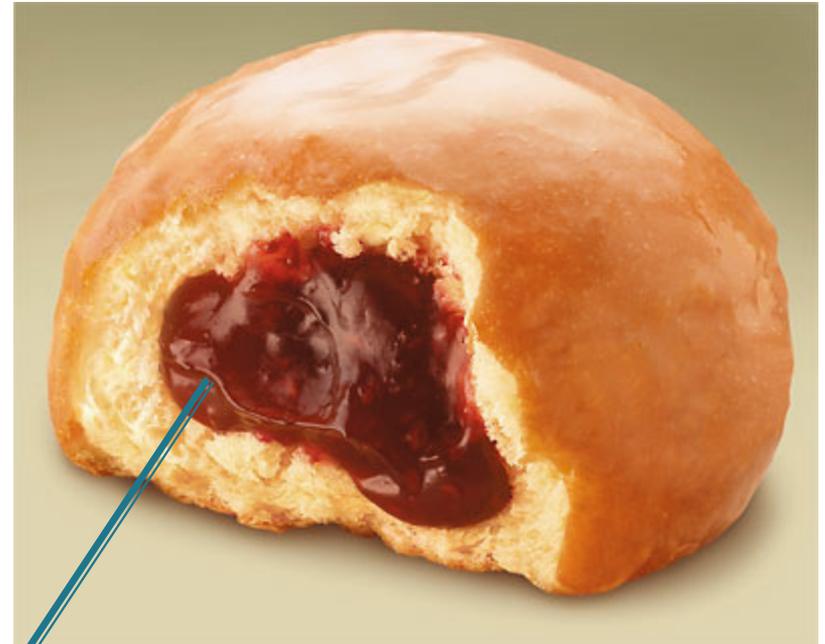
PROs:
CONVENIENT
USEFUL

CONS:
MAKES YOU
CRAZY



Graphical User Interfaces in Java

- ▶ We say what to draw
- ▶ Java windowing library:
 - Draws it
 - Gets user input
 - **Calls back** to us with events
- ▶ We **handle** events



Hmm, donuts

Goody

Handling Events

- ▶ Many kinds of events:
 - Mouse pressed, mouse released, mouse moved, mouse clicked, button clicked, key pressed, menu item selected, ...
- ▶ We create **event listener objects**
 - that implement the right **interface**
 - that handle the event as we wish
- ▶ We **register** our listener with an **event source**
 - Sources: buttons, menu items, graphics area, ...

Using Inner Classes

- ▶ Classes can be defined **inside** other classes or methods
- ▶ Used for “smallish” helper classes
- ▶ Example: **Ellipse2D.Double**



- ▶ Often used for **ActionListeners...**

Anonymous Classes

- ▶ Sometimes very small helper classes are only used once
 - This is a job for an anonymous class!
- ▶ **Anonymous** → no name
- ▶ A special case of inner classes
- ▶ Used for the simplest **ActionListeners...**

Inner Classes and Scope

- ▶ Inner classes can access any variables in surrounding scope
- ▶ Caveats:
 - Local variables must be **final**
 - Can only use instance fields of surrounding scope if we're inside an instance method
- ▶ Example:
 - Prompt user for what porridge tastes like

Work Time

»» Homework 9: Board Games