Lecture 5

Subclasses & Inheritance

Announcements for This Lecture

Readings

- Section 1.6, 4.1 (today)
- Section 4.2 (next time)

Announcements

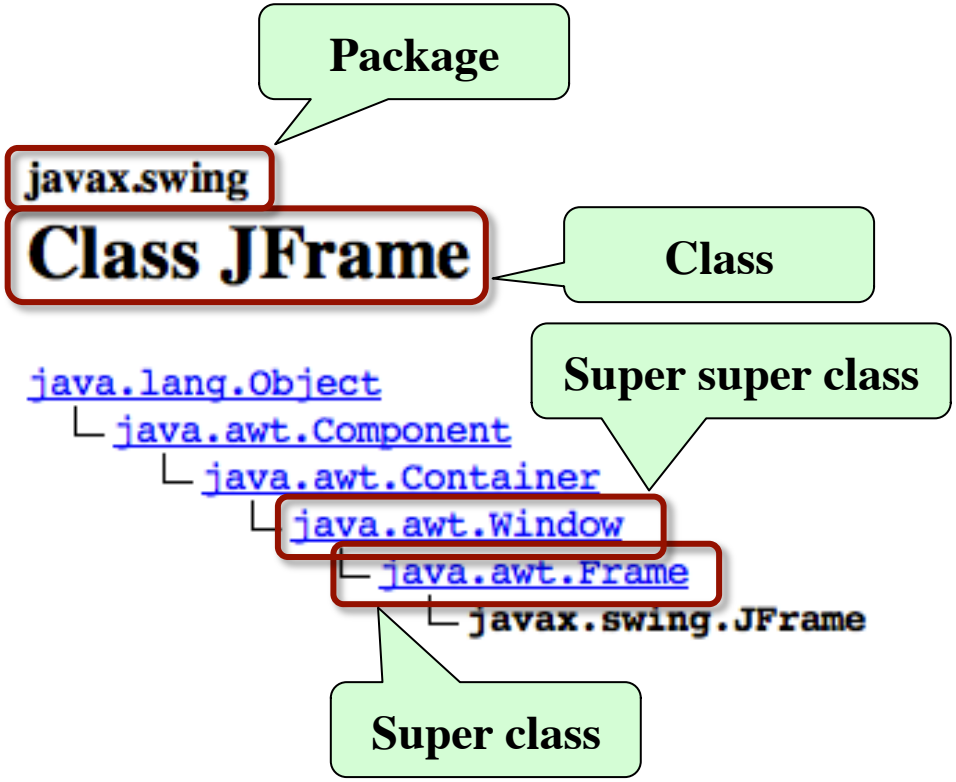
- Assignment 1 Resubmissions
  - Should have feedback now
  - Resubmit until correct
  - Note all deadlines
- Assignment 2 on Friday
  - Bring to class or
  - Scan and submit to CMS
  - Will grade/pass fail
  - Submit until pass

A Interesting Challenge

- How do we add new methods to **Rhino**?
  - Open up the .java file and add them!
- Java has a lot "built-in" classes
  - **Examples:** String, Vector, JFrame
- What if we want to add methods to these?
  - We cannot access the .java file (where is it???)
- But we can create a **subclass**
  - A new class with all fields, methods of the "parent"
  - Class also contains anything new we want to add

Subclasses in the Java API

- Subclassing creates a hierarchy of classes
  - Subclass has a super class or "parent" class
  - That parent may have a super class as well
- Explicit in the Java API
  - API does not respecify **inherited** methods
  - Often have to go to super class for specification



Class Definition REVISITED

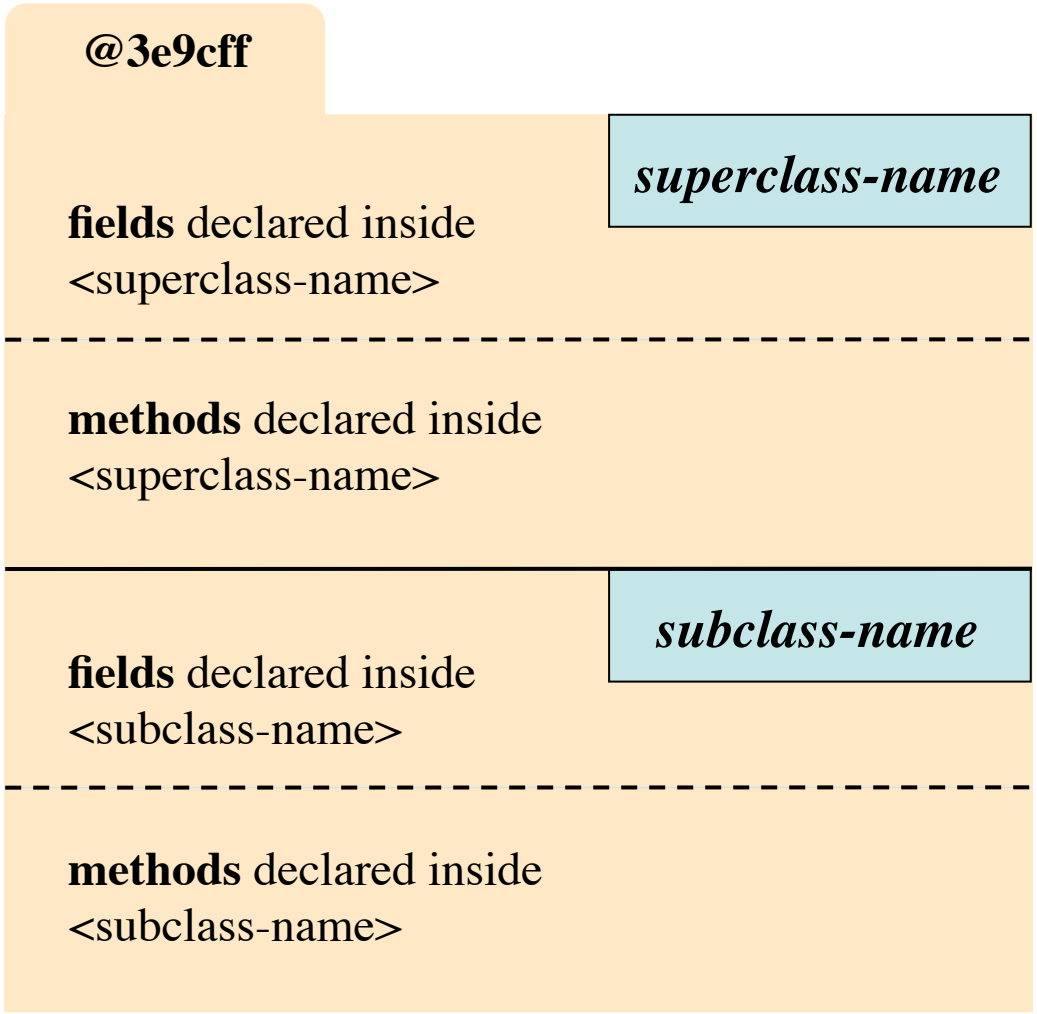
- Describes the format of a folder (instance, object) of the class.

```
/**
 * Description of what the class is for
 */
public class <class-name> extends <super-class> {

        declarations of fields and methods (in any order)
}
```

- Class <class-name> has all methods and fields of its parent
  - We say that it **inherits** them
- Also has any new fields or methods declared inside of it

Folder Analogy and Subclasses



folder (object) belongs in file drawer for class

subclass-name

Subclassing a JFrame

```
/** Description of what the class is for… */
public class SquareJFrame extends JFrame {
    /** Set the height of the window to the width */
    public void setHeightToWidth() {
        setSize(getWidth(),getWidth());
    }

    /** Yields: the area of the window */
    public int area() {
        return getWidth()*getHeight();
    }
    …
}
```

Inherited method which is used as a helper method

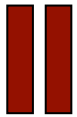
folder (object) belongs in file drawer for class

SquareJFrame

Object: The Superest Class of All

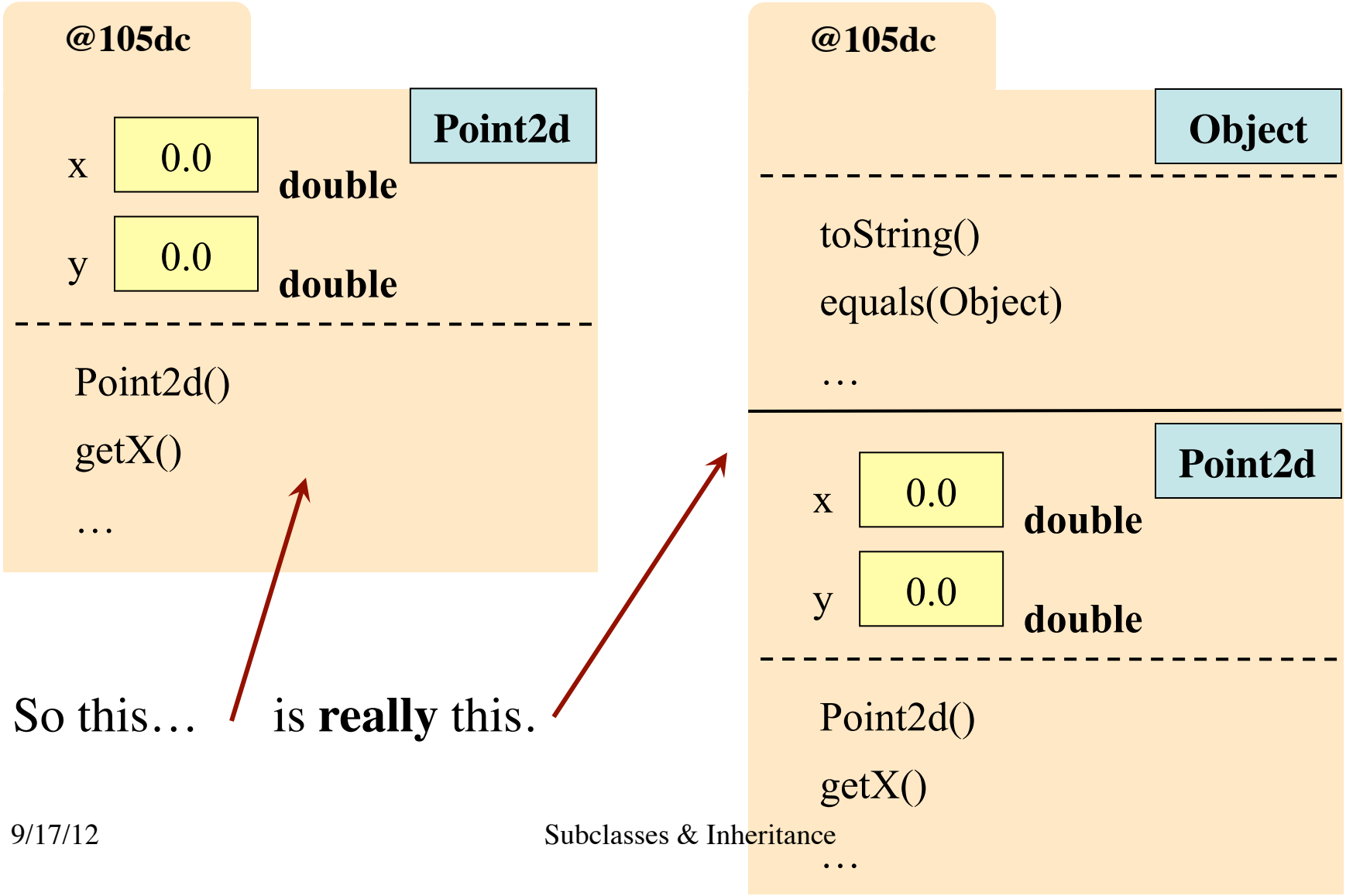
- How does toString() work?
  - All classes have a toString() by default
  - Default string is the folder name
  - Defining toString() in subclass **overrides** this method
- **Java Feature**: Every class that does not extend another class automatically extends class Object.

```
public class C { … }
```

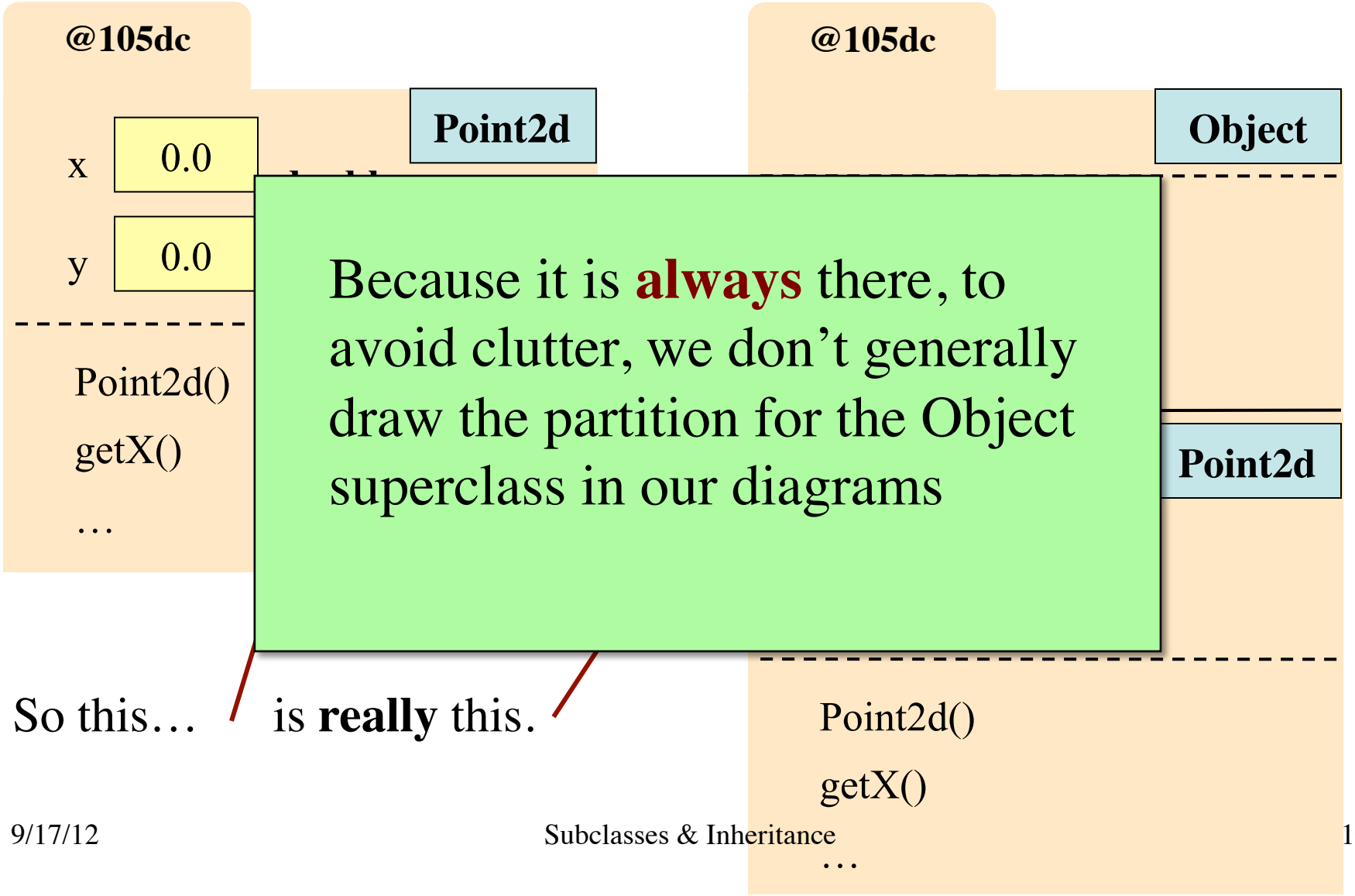


```
public class C extends Object { …}
```

Object: The Superest Class of All

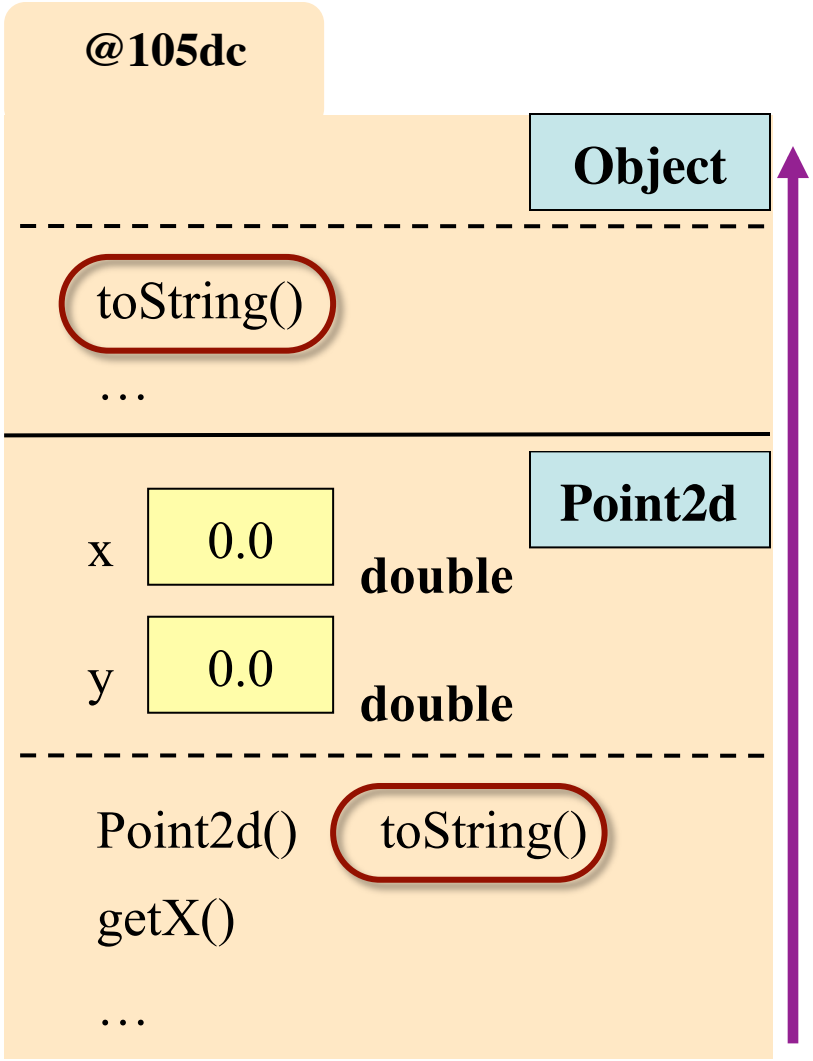


Object: The Superest Class of All



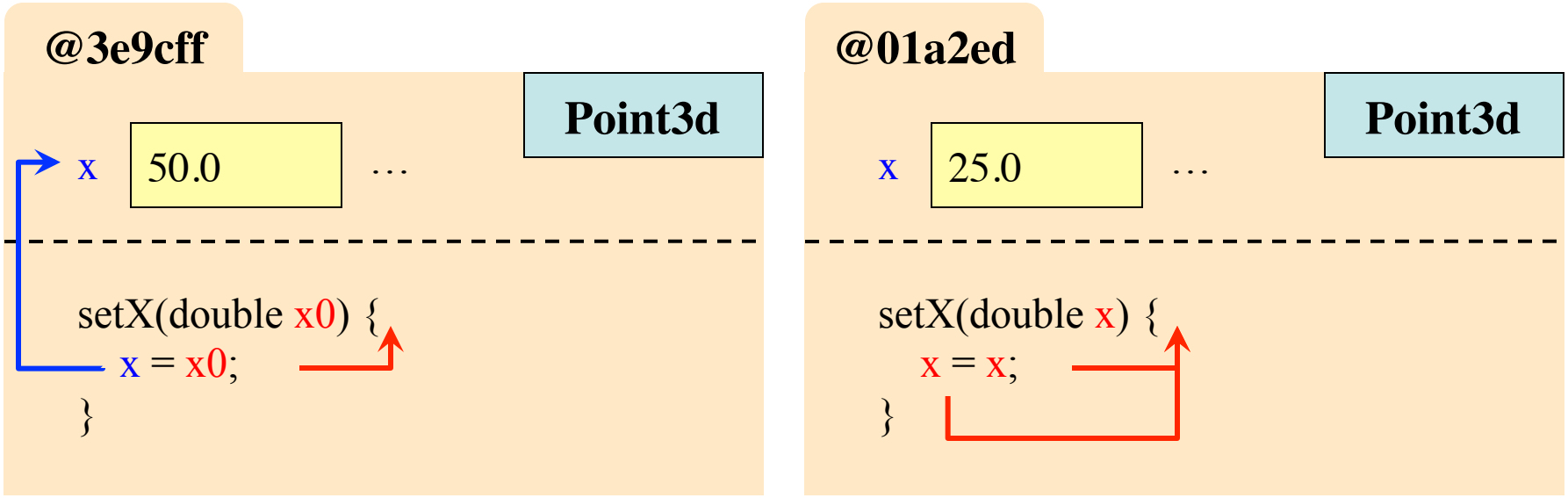
The Bottom-Up Rule

- Which toString() is called?
  - Work the way up from the bottom of the folder.
  - Find the first method header that matches
  - Use the definition from the .java file for that class
- New method definitions **override** those of super class



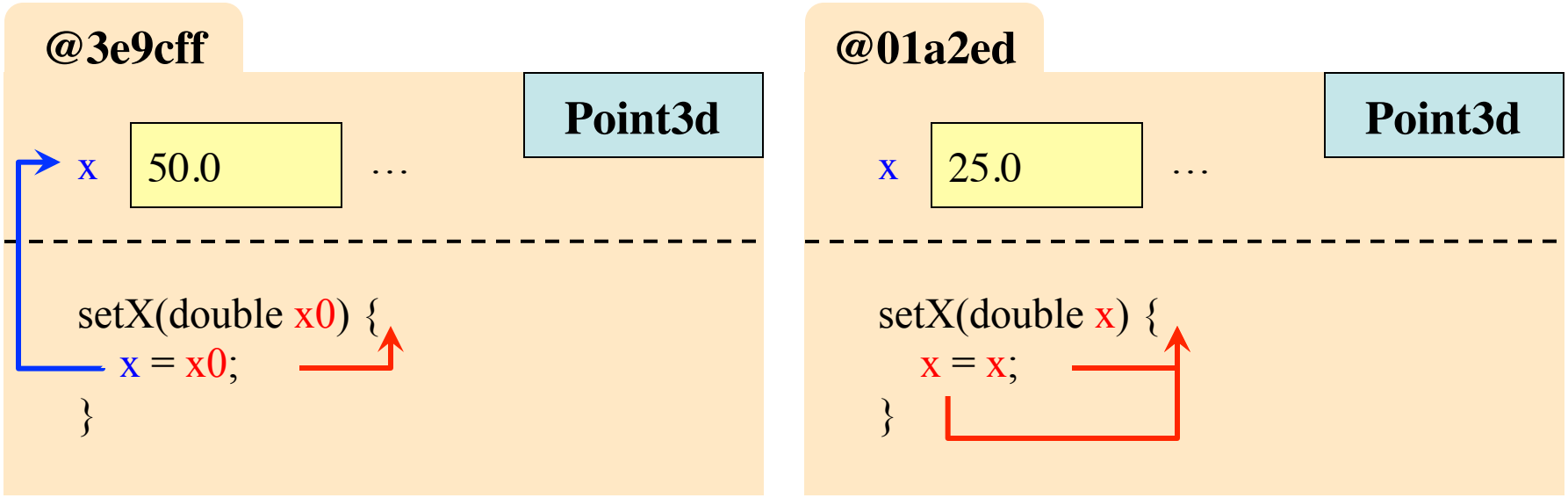
Inside-Out Rule (See p. 83)

- Methods reference fields or static variables (of same class)
  - Can reference parameters of that method
  - Can reference local variables inside same braces {}
- If two of the same name, use the **closest** declaration



Inside-Out Rule (See p. 83)

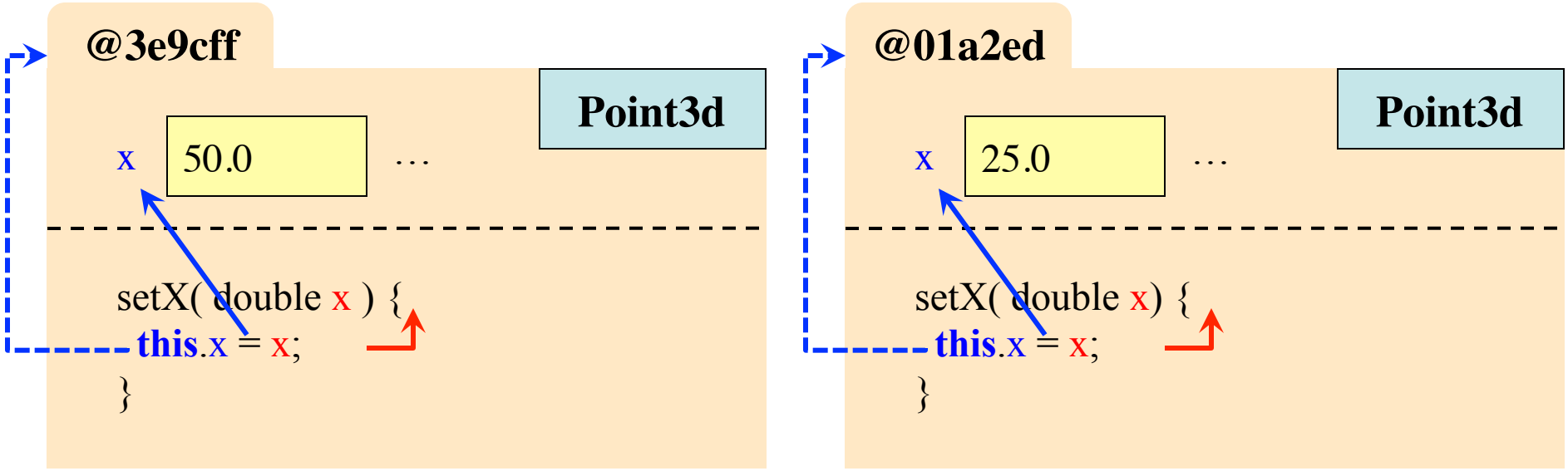
- Parameter x0 is found in the frame for the method call. Exists temporarily
- Parameter x "blocks" (or **shadows**) the reference to the field x.



A Solution: `this`

`this` is a built-in "variable" that gives an object name

- In object (folder) **@3e9cff**, **this** refers to **@3e9cff**
- In object (folder) **@01a2ed**, **this** refers to **@01a2ed**



Keywords `this` and `super`

`this`

- Refers to the object name in scope box of the method call
- this.<field> is field in object
  - Example: this.x
- this.<method-call> calls a method in this object
  - Example: this.getX()
- this(<parameters>) calls a constructor
  - Example: this(0.0,0.0,0.0)

`super`

- Functions mostly the same as this (refers to object in scope)
- super.<method-call> calls a method in the superclass or even higher up!
- super(<parameters>) calls constructor of super class
  - Useful for initialization
  - Necessary if fields private

Using `this` as a Constructor

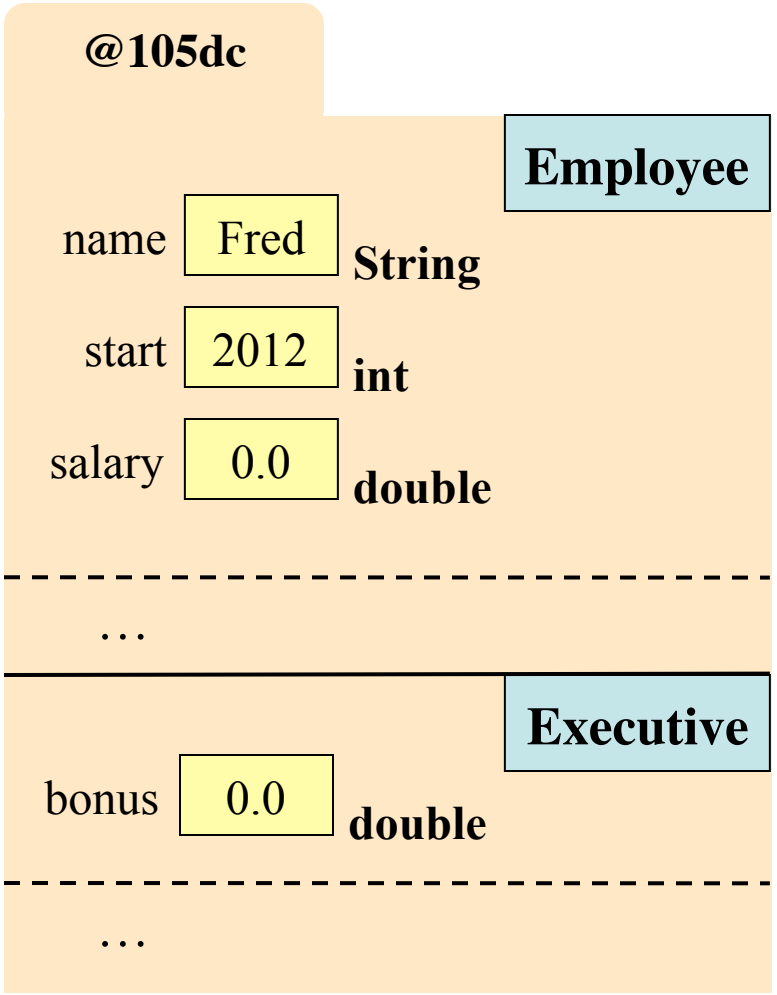
- Usage: `this(<params>)`
  - Looks for constructor with parameters of that type
  - Calls that constructor as a helper method
  - Can only do this inside another constructor
- This is why object name must be in the scope box
  - Else what is `this`?
  - `this` = name in scope box

```
public Point3d(double x0,
               double y0,
               double z0) {
    x = x0;
    y = y0;
    z = z0;
}

public Point3d() {
    // Uses other constructor.
    this(0.0,0.0,0.0)
}
```

Using `super` in a Constructor

- Subclasses inherit fields of the superclass
- How do we initialize them?
  - Could initialize in subclass
  - Or could use constructor from the parent class
- Usage: super(<params>)
  - Calls superclass constructor with matching parameters
  - It must be first line in the constructor!



Using `super` in a Constructor

```
public Employee(String n, int d) {
    name= n;
    start= d;
    salary= 50000;
}
```

```
public Executive(String n, int d,
                 double b) {
    super(n,d);
    bonus = b;
}
```