Programming Languages and Techniques (CIS120)

Lecture 34

April 10, 2013

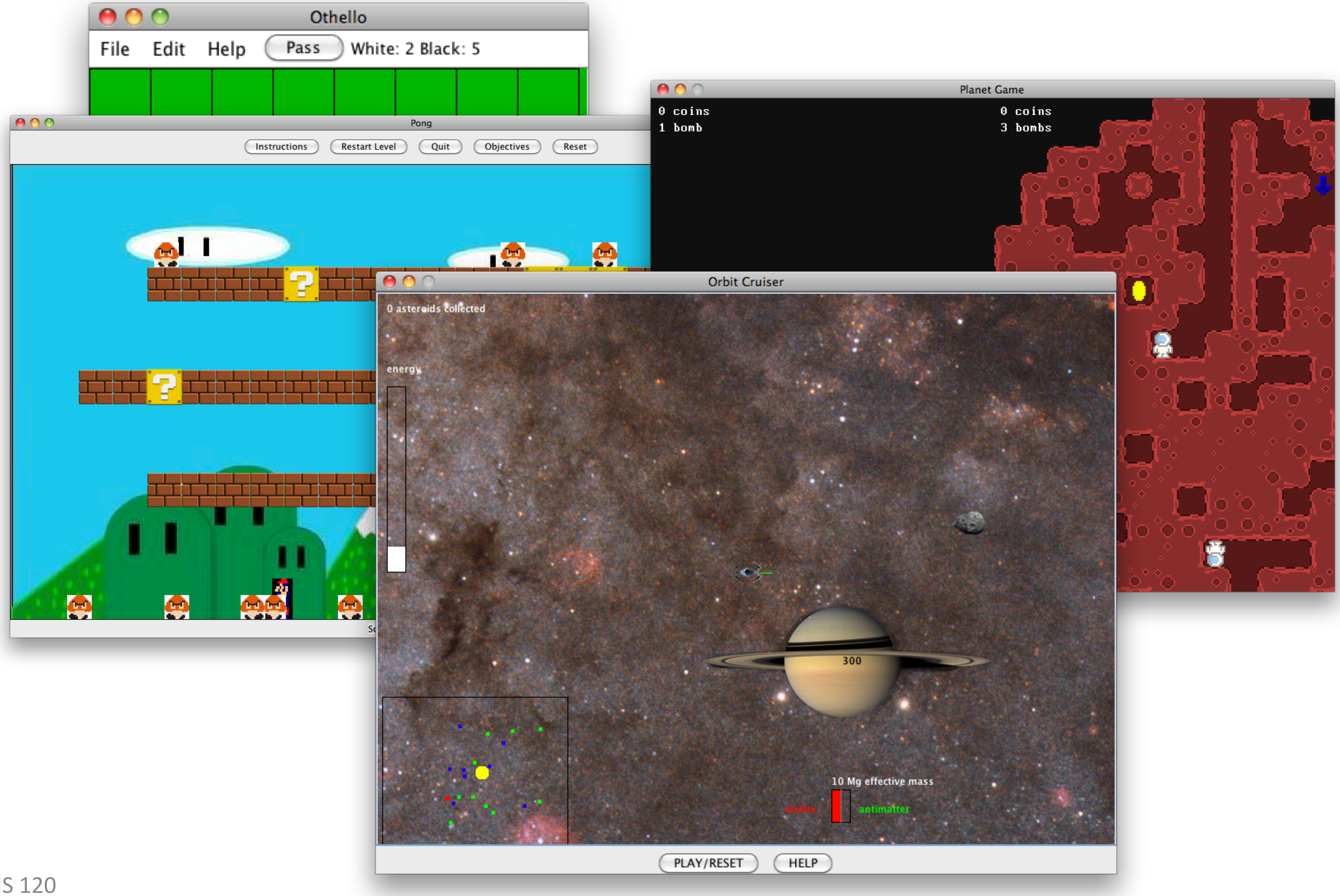
Swing II: Layout and Inner Classes

Announcements

- Friday is the BONUS lecture

- HW10 is available:
  - due Tuesday, April 23rd at 11:59:59pm

HW 10: Game projects



Swing Programming Demo

Layout & Wiring

Inner Classes

Inner Classes

- Useful in situations where two objects require "deep access" to each other's internals
- Replaces tangled workarounds like "owner object" (as in the drawing example)
  - Solution with inner classes is easier to read
  - No need to allow public access to instance variables of outer class
- Also called "dynamic nested classes"

Basic Example

Key idea: Classes can be *members* of other classes…

```
public class Outer {
  private int outerVar;
  public Outer () {
    outerVar = 6;
  }
  public class Inner {
    private int innerVar;
    public Inner(int z) {
      innerVar = outerVar + z;
    }
  }
}
```

Name of this class is Outer.Inner (which is also the static type of objects that this class creates)

Reference from inner class to instance variable bound in outer class

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Object Creation

- Inner classes can refer to the instance variables and methods of the outer class
- Inner class instances usually created by the methods/constructors of the outer class

```
public Outer () {
   Inner b = new Inner ();
}
```

Actually this.new

- Inner class instances *cannot* be created independently of a containing class instance.

```
Outer.Inner b = new Outer.Inner() ✗

Outer a = new Outer();
Outer.Inner b = a.new Inner(); ✓

Outer.Inner b = (new Outer()).new Inner(); ✓
```

Inner classes

DrawingExample Constructor

```
b1.addActionListener(new DrawingButtonListener(b1));
b2.addActionListener(new DrawingButtonListener(b2));
```

Inner Class

```
class DrawingButtonListener implemen
    JButton button;
    DrawingButtonListener(JButton b)

    public void actionPerformed(ActionEvent e) {
        // Find out which button generated the event
        if (button.equals(b1)) {
            shapes.add(new Line());
        } else if (button.equals(b2)) {
            shapes.add(new Square());
        …
}
```

Button action code far from button creation

Awkward logic to avoid one class per button

Anonymous Inner Classes

- Define a class and create an object from it all at once, inside a method

```
b1.addActionListener(new ActionListener() {
    public void actionPerformed(ActionEvent e) {
        shapes.add(new Line());
        drawingCanvas.repaint();
    }
});
```

Can access fields and methods of outer class

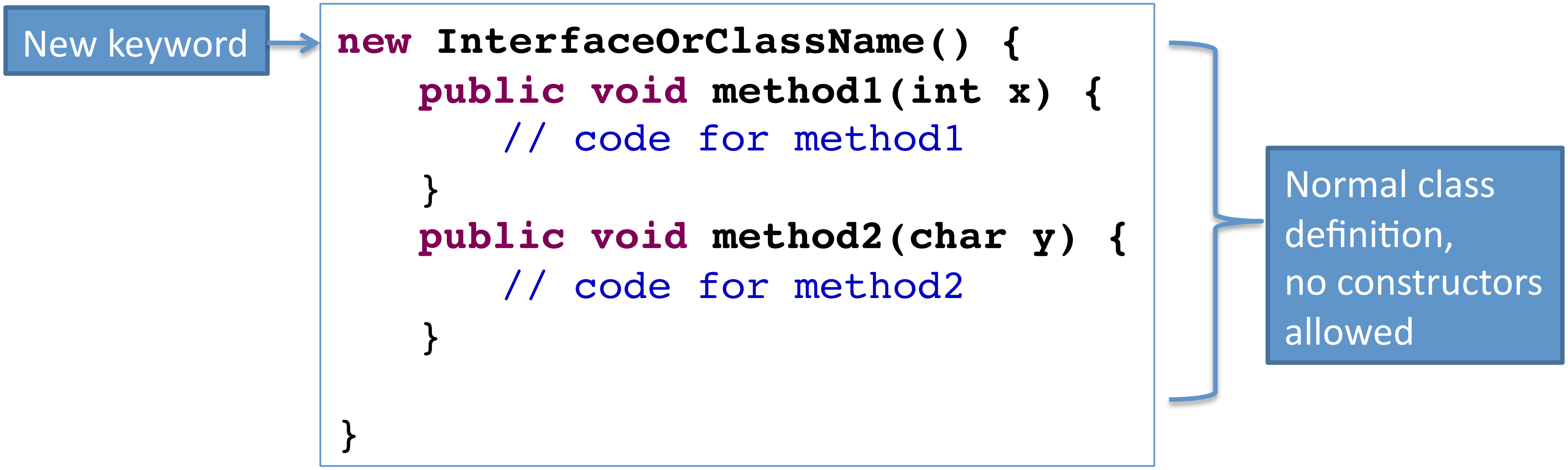
```
b2.addActionListener(new ActionListener() {
    public void actionPerformed(ActionEvent e) {
        shapes.add(new Square());
        drawingCanvas.repaint();
    }
});
```

Puts button action right with button definition

Each button gets its own inner class

Anonymous Inner class

- New *expression* form: define a class and create an object from it all at once



New keyword

```
new InterfaceOrClassName() {
    public void method1(int x) {
        // code for method1
    }
    public void method2(char y) {
        // code for method2
    }

}
```

Normal class definition, no constructors allowed

Static type of the expression is the Interface/superclass used to create it

Dynamic class of the created object is anonymous! Can't really refer to it.

Like first-class functions

- Anonymous inner classes are the Java equivalent of Ocaml first-class functions

- Both create "delayed computation" that can be stored in a data structure and run later
  - Code stored by the event / action listener
  - Code only runs when the button is pressed
  - Could run once, many times, or not at all
- Both sorts of computation can refer to variables in the current scope
  - OCaml: Any available variable
  - Java: only instance variables (fields) and variables marked final