Object Oriented Programming and Design in Java

Session 6

Instructor: Bert Huang

Announcements

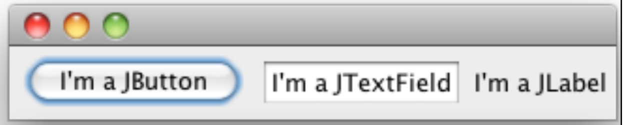
- Homework 1 due Wednesday Feb. 17th 11 AM
- Lauren's office hours moved to 8:30-10:30 PM (just this week)
- For fastest email queries, email all TAs and me
- `{bert@cs., jwg2116@, lep2128@, yh2315@}columbia.edu`

Review

- Introduction to Java graphics
  - Swing classes: JFrame, JComponent, JButton, JTextField, JPanel
  - ActionListener interface
  - Graphics: Graphics2D

Today’s Plan

- Named ActionListeners
- Timers
- Interfaces and polymorphism
    - Examples: List, Comparator, Collection, Iterator

1


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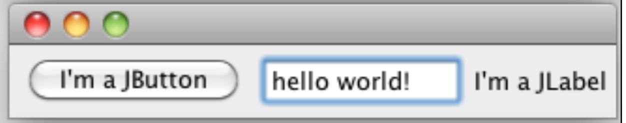

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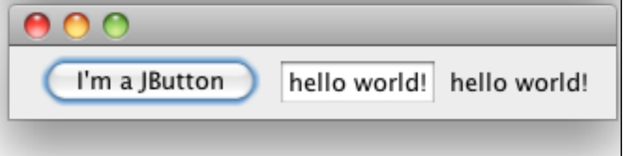


```
import javax.swing.*;
import java.awt.*;
import java.awt.event.*;

public class GraphicsTester2 {
    public static void main(String [] args)
    {
        JFrame frame = new JFrame();
        frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
        frame.setLayout(new FlowLayout());

        JButton myButton = new JButton("I'm a JButton");
        final JTextField myTextField = new JTextField("I'm a JTextField");
        final JLabel myLabel = new JLabel("I'm a JLabel");

        myButton.addActionListener(new ActionListener()
        {
            public void actionPerformed(ActionEvent event)
            {
                myLabel.setText(myTextField.getText());
            }
        });

        // continued in box ->
```

```
            //continued
        frame.add(myButton);
        frame.add(myTextField);
        frame.add(myLabel);

        frame.pack();
        frame.setVisible(true);
    }
}
```

```java
/**
 * This ActionListener object sets a JLabel to a textField's contents
 * @author bert
 */
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import javax.swing.*;

public class SetTextListener implements ActionListener {

   public SetTextListener(JTextField textField, JLabel label)
   {
      myLabel = label;
      myTextField = textField;
   }

   public void actionPerformed(ActionEvent event)
   {
      myLabel.setText(myTextField.getText());
   }

   private JLabel myLabel;
   private JTextField myTextField;
}
```

```
import javax.swing.*;
import java.awt.*;

public class GraphicsTester2 {
   public static void main(String [] args)
   {
     JFrame frame = new JFrame();
     frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
     frame.setLayout(new FlowLayout());

     JButton myButton = new JButton("I'm a JButton");
     JTextField myTextField = new JTextField("I'm a JTextField");
     JLabel myLabel = new JLabel("I'm a JLabel");

     myButton.addActionListener(
        new SetTextListener(myTextField, myLabel));

     frame.add(myButton);
     frame.add(myTextField);
     frame.add(myLabel);
     frame.pack();
     frame.setVisible(true);
   }
}
```

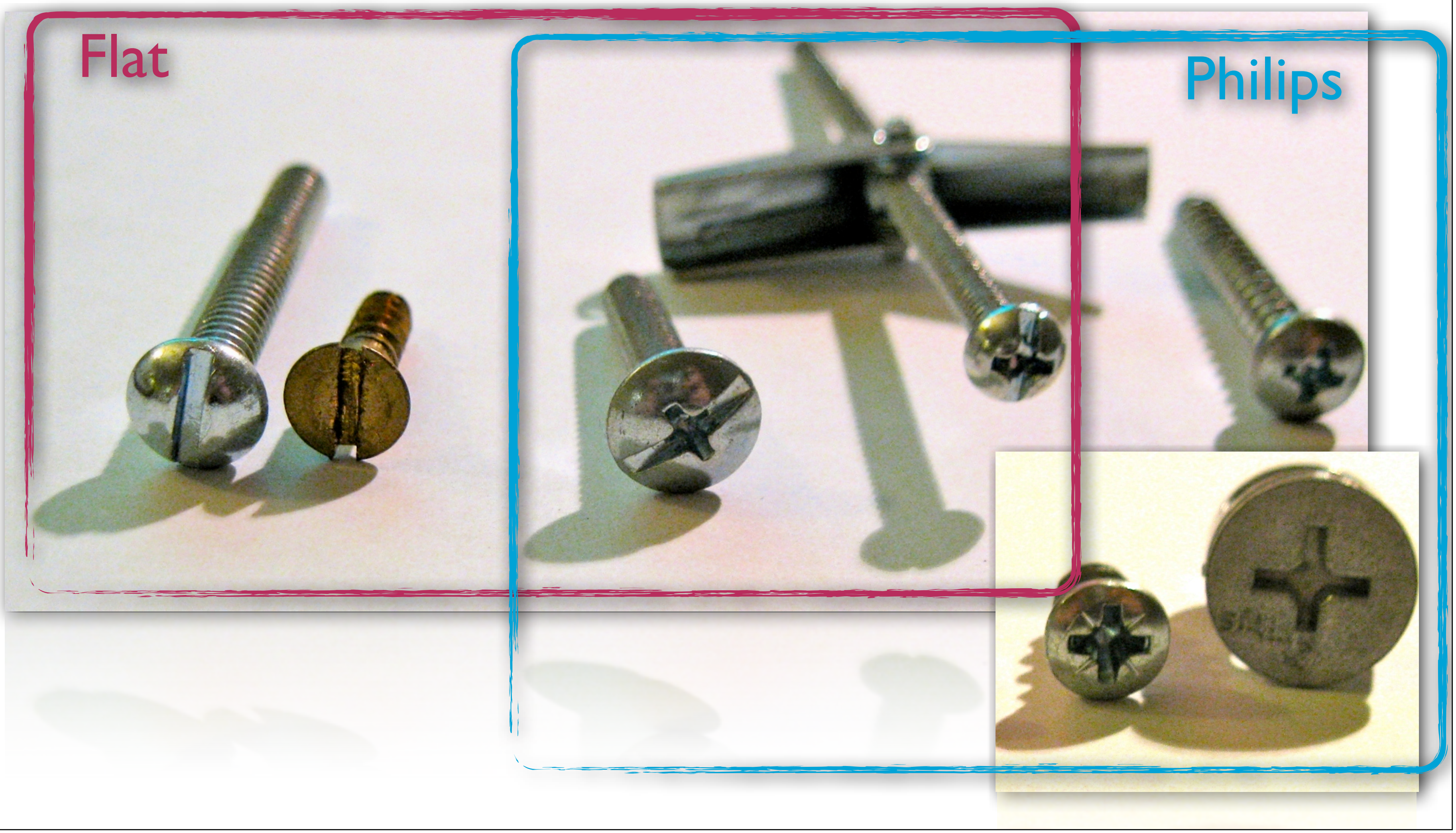
Timer

- Invisible Swing component that can call ActionListeners based on time
- `new Timer(int delay, ActionListener listener)`
- `addActionListener(ActionListener listener)`
- `start()`
- `setRepeats(boolean b) // default true`
- `setDelay(int delay) // milliseconds`

Why Interfaces?

- Interchangeable parts are essential in modern engineering
- Allows tools and parts to be used for various applications
- Without establishing standard interfaces, every part must be custom-built for each application

Interfaces of Screws



Designing Interfaces

- Parts of your code do the same thing to objects of similar classes
    - but don't want to combine the classes
- The similar classes can implement an interface, then consolidate redundant code to work with the interface type

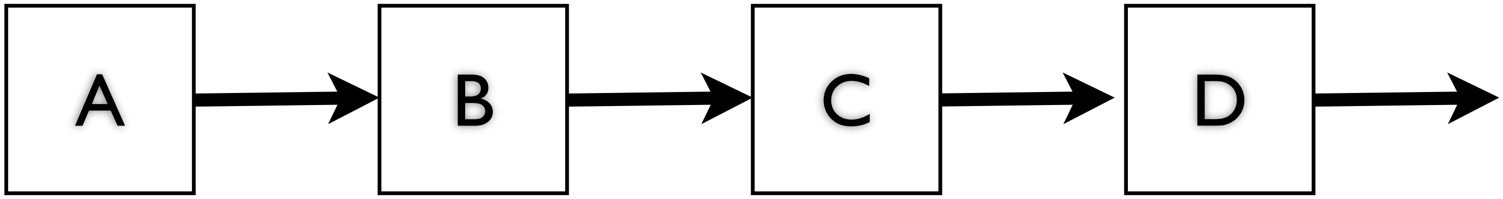
Interface Syntax

```
public interface FlatHeadScrew
{
    public void turnClockWise(FlatHeadScrewDriver driver);

    public void turnCounterClockWise(FlatHeadScrewDriver driver);
}
```

```
public class WoodScrew implements FlatHeadScrew
{
    public void turnClockWise(FlatHeadScrewDriver driver)
    { /* ... */  }

    public void turnCounterClockWise(FlatHeadScrewDriver driver)
    { /* ... */  }
}
```

ArrayLists and LinkedLists

0	1	2	3	4	5
A	B	C	D	0	0



Review: Generics

- Classes with <SomeType> in their definition are **generic**
- Keyword inside the brackets is a placeholder for a type
- Objects are instantiated with a particular type, e.g., ArrayList<Integer>

List<T> Interface

- Includes methods:
  - boolean add(int index, T o)
  - Object get(int index)
  - boolean remove(int index)
  - int size()
- Implemented by ArrayList<T>, LinkedList<T>

Collections.sort()

- `Collections.sort(List<T> list,`
  ```
                     Comparator<T> c);
  ```
- Sorts list according to Comparator c
- Comparator<T> objects define comparison metrics for types
- e.g., sort Rectangle2D.Double by:
  - Left edge, top edge, distance to (0,0)

Comparator<T> Interface

- int compare(T object1, T object2)
  - returns positive int if object1 > object2
  - returns negative if   object1 < object2
  - returns zero if equal

Reusable Code

- Using the same code, we can sort a combination of

Sort a	according to
LinkedList ArrayList	LeftEdgeComparator TopEdgeComparator DistFromOriginComparator

Polymorphism in Collections.sort()

- Polymorphism - ability to work with multiple shapes
- Collections.sort treats LinkedLists and ArrayLists as List objects
- If it did not, code would have to be specifically written for each kind of list

Collection Interface

- More general than List: a Collection stores a set of objects, but does not have to be **ordered**
- LinkedList, ArrayList, Stack, Queue
- Methods include: add(Object o), remove (Object o), boolean contains(Object o)
- Iterator iterator();

Iterator Interface

- An Iterator<T> lets you look at one element at a time from a Collection<T>
- boolean hasNext(), T next()
- Using Iterators, you can write code that doesn't know what kind of Collection you have

Iterators Preserve Encapsulation

- Iterator user doesn't know how the items are stored
- Iterating through linked list:
  - Do work on current node
  - Go to current.next()
- Need to know linked list structure, and private next() links

Interface Relationships

- Collections.sort() sorts object implementing List
  - using an object that implements Comparator
- List extends Collection
- Collection includes iterator(), returns an object that implements Iterator

Anonymous Classes

- Anonymous ActionListener objects are of some class
    - but that class is only used once
- Anonymous classes can lead to shorter code in these cases
- Can use final variables in local scope

Reading

- Horstmann Ch. 4
- Next class, Horstmann Ch. 5