Module 13

Handling GUI-Generated Events

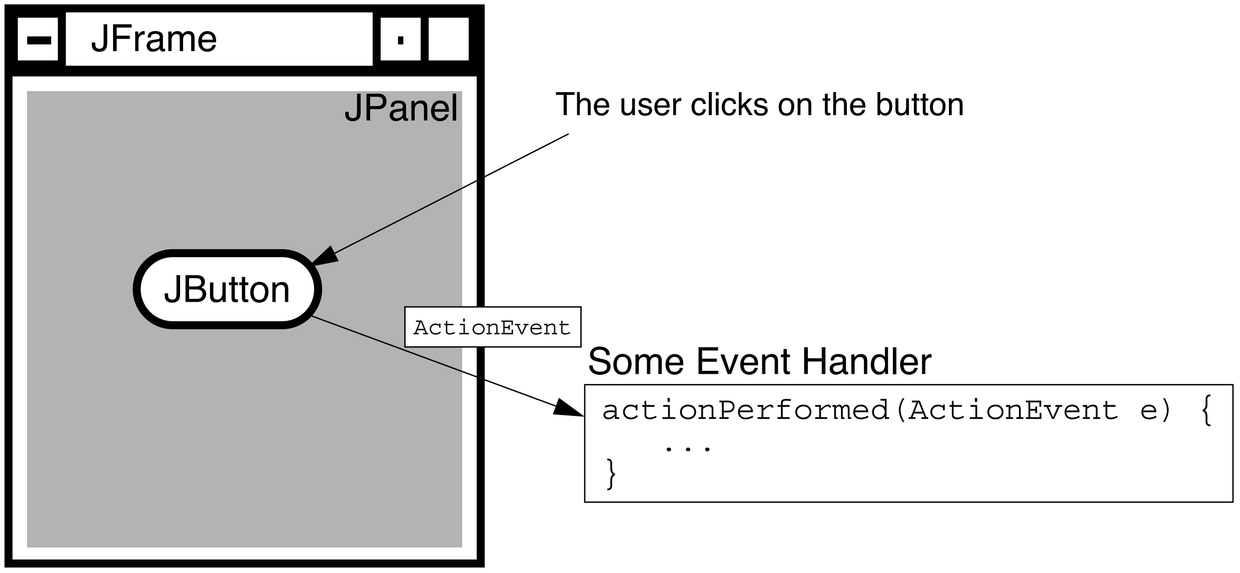
Objectives

- Define events and event handling
- Examine the Java SE event model
- Describe GUI behavior
- Determine the user action that originated an event
- Develop event listeners
- Describe concurrency in Swing-based GUIs and describe the features of the `SwingWorker` class

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

What Is an Event?

- Events – Objects that describe what happened
- Event sources – The generator of an event
- Event handlers – A method that receives an event object, deciphers it, and processes the user's interaction

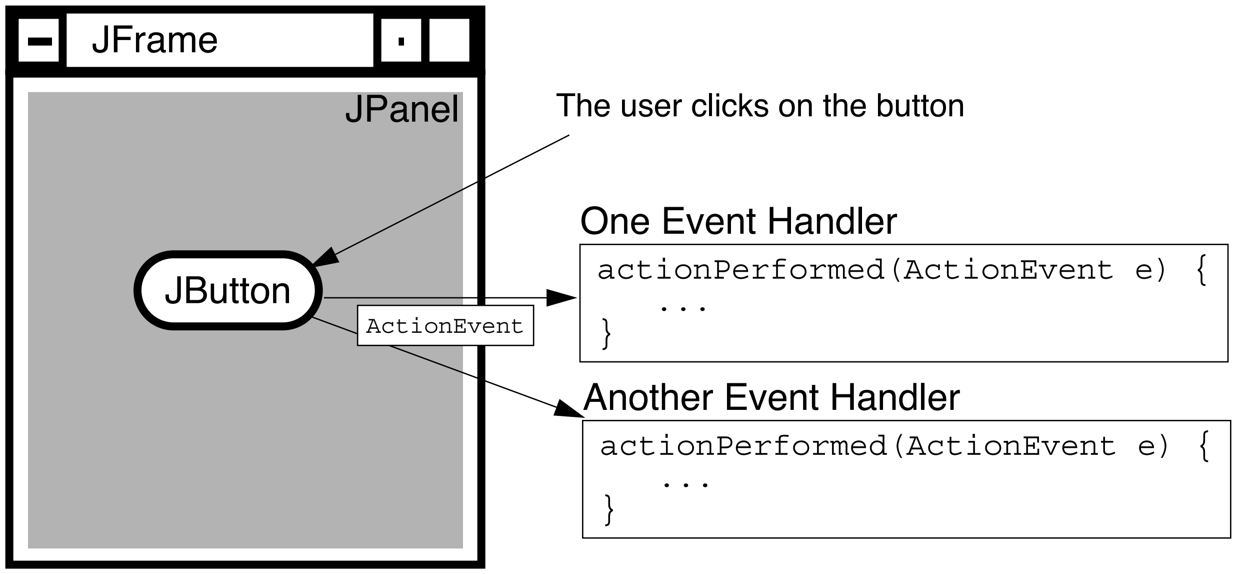


```
actionPerformed(ActionEvent e) {
   ...
}
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Delegation Model

- An event can be sent to many event handlers.



```
actionPerformed(ActionEvent e) {
    ...
}
```

```
actionPerformed(ActionEvent e) {
    ...
}
```

- Event handlers register with components when they are interested in events generated by that component.

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Delegation Model

- Client objects (handlers) register with a GUI component that they want to observe.
- GUI components trigger only the handlers for the type of event that has occurred.
- Most components can trigger more than one type of event.
- The delegation model distributes the work among multiple classes.

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

A Listener Example

```
import java.awt.*;
import javax.swing.*;
public class TestButton {
  private JFrame f;
  private JButton b;

  public TestButton() {
    f = new JFrame("Test");
    b = new JButton("Press Me!");
    b.setActionCommand("ButtonPressed");
  }

  public void launchFrame() {
    b.addActionListener(new ButtonHandler());
    f.add(b,BorderLayout.CENTER);
    f.pack();
    f.setVisible(true);
  }
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

A Listener Example

```

  public static void main(String args[]) {
    TestButton guiApp = new TestButton();
    guiApp.launchFrame();
  }
}
```

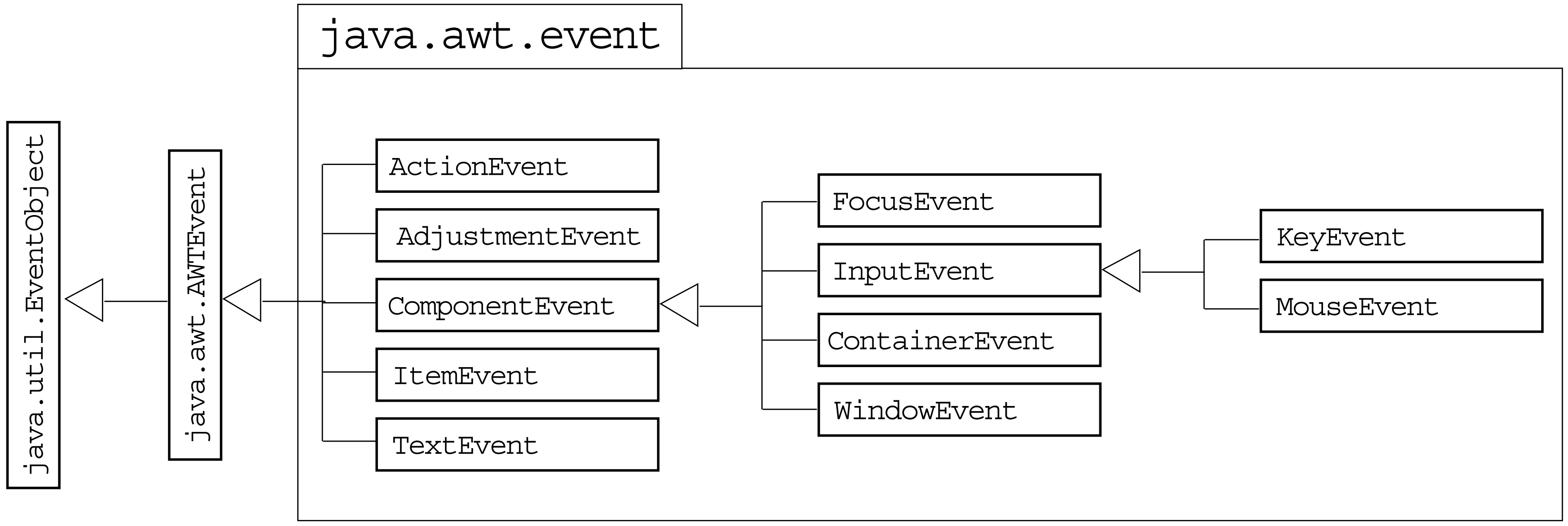
Code for the event listener looks like the following:

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

public class ButtonHandler implements ActionListener {
  public void actionPerformed(ActionEvent e) {
    System.out.println("Action occurred");
    System.out.println("Button’s command is: "
                       + e.getActionCommand());
  }
}
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Event Categories



Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Method Categories and Interfaces

Category	Interface Name	Methods
Action	`ActionListener`	`actionPerformed(ActionEvent)`
Item	`ItemListener`	`itemStateChanged(ItemEvent)`

Mouse	`MouseListener`	`mousePressed(MouseEvent)`
		`mouseReleased(MouseEvent)`
		`mouseEntered(MouseEvent)`
		`mouseExited(MouseEvent)`
		`mouseClicked(MouseEvent)`

Mouse motion	`MouseMotionListener`	`mouseDragged(MouseEvent)`
		`mouseMoved(MouseEvent)`

Key	`KeyListener`	`keyPressed(KeyEvent)`
		`keyReleased(KeyEvent)`
		`keyTyped(KeyEvent)`

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Method Categories and Interfaces

Category	Interface Name	Methods

Focus	`FocusListener`	`focusGained(FocusEvent)`
		`focusLost(FocusEvent)`

Adjustment	`AdjustmentListener`	`adjustmentValueChanged`
		`(AdjustmentEvent)`

Component	`ComponentListener`	`componentMoved(ComponentEvent)`
		`componentHidden(ComponentEvent)`
		`componentResized(ComponentEvent)`
		`componentShown(ComponentEvent)`

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Method Categories and Interfaces

Category	Interface Name	Methods

Window	`WindowListener`	`windowClosing(WindowEvent)`
		`windowOpened(WindowEvent)`
		`windowIconified(WindowEvent)`
		`windowDeiconified(WindowEvent)`
		`windowClosed(WindowEvent)`
		`windowActivated(WindowEvent)`
		`windowDeactivated(WindowEvent)`

Container	`ContainerListener`	`componentAdded(ContainerEvent)`
		`componentRemoved`
		`(ContainerEvent)`

Window state	`WindowStateListener`	`windowStateChanged(WindowEvent e)`

Window focus	`WindowFocusListener`	`windowGainedFocus(WindowEvent e)`
		`windowLostFocus(WindowEvent e)`

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Method Categories and Interfaces

Category	Interface Name	Methods
Mouse wheel	`MouseWheelListener`	`mouseWheelMoved (MouseWheelEvent e)`
Input methods	`InputMethodListener`	`caretPositionChanged (InputMethodEvent e)` `inputMethodTextChnaged (InputMethodEvent e)`
Hierarchy	`HierarchyListener`	`hierarchyChanged (HierarchyEvent e)`
Hierarchy bounds	`HierarchyBoundsList ener`	`ancestorMoved(HierarchyEvent e)` `ancestorResized(HierarchyEvent e)`
AWT	`AWTEventListener`	`eventDispatched(AWTEvent e)`
Text	`TextListener`	`textValueChanged(TextEvent)`

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Complex Example

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
public class TwoListener
       implements MouseMotionListener, MouseListener {
  private JFrame f;
  private JTextField tf;

  public TwoListener() {
    f = new JFrame("Two listeners example");
    tf = new JTextField(30);
  }
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Complex Example

```

  public void launchFrame() {
    JLabel label = new JLabel("Click and drag the mouse");
    // Add components to the frame
    f.add(label, BorderLayout.NORTH);
    f.add(tf, BorderLayout.SOUTH);
    // Add this object as a listener
    f.addMouseMotionListener(this);
    f.addMouseListener(this);
    // Size the frame and make it visible
    f.setSize(300, 200);
    f.setVisible(true);
  }
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Complex Example

```

  // These are MouseMotionListener events
  public void mouseDragged(MouseEvent e) {
    String s =  "Mouse dragging:  X = " + e.getX()
                + " Y = " + e.getY();
    tf.setText(s);
  }

  public void mouseEntered(MouseEvent e) {
    String s = "The mouse entered";
    tf.setText(s);
  }

  public void mouseExited(MouseEvent e) {
    String s = "The mouse has left the building";
    tf.setText(s);
  }
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Complex Example

```

  // Unused MouseMotionListener method.
  // All methods of a listener must be present in the
  // class even if they are not used.
  public void mouseMoved(MouseEvent e) { }

  // Unused MouseListener methods.
  public void mousePressed(MouseEvent e) { }
  public void mouseClicked(MouseEvent e) { }
  public void mouseReleased(MouseEvent e) { }

  public static void main(String args[]) {
    TwoListener two = new TwoListener();
    two.launchFrame();
  }
}
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Multiple Listeners

- Multiple listeners cause unrelated parts of a program to react to the same event.
- The handlers of all registered listeners are called when the event occurs.

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Event Adapters

- The listener classes that you define can extend adapter classes and override only the methods that you need.
- An example is:

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

public class MouseClickHandler extends MouseAdapter {

  // We just need the mouseClick handler, so we use
  // an adapter to avoid having to write all the
  // event handler methods

  public void mouseClicked(MouseEvent e) {
    // Do stuff with the mouse click...
  }
}
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Event Handling Using Inner Classes

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
public class TestInner {
  private JFrame f;
  private JTextField tf; // used by inner class

  public TestInner() {
    f = new JFrame("Inner classes example");
    tf = new JTextField(30);
  }

  class MyMouseMotionListener extends MouseMotionAdapter {
      public void mouseDragged(MouseEvent e) {
        String s = "Mouse dragging:  X = "+ e.getX()
                    + " Y = " + e.getY();
        tf.setText(s);
      }
  }
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Event Handling Using Inner Classes

```

  public void launchFrame() {
    JLabel label = new JLabel("Click and drag the mouse");
    // Add components to the frame
    f.add(label, BorderLayout.NORTH);
    f.add(tf, BorderLayout.SOUTH);
    // Add a listener that uses an Inner class
    f.addMouseMotionListener(new MyMouseMotionListener());
    f.addMouseListener(new MouseClickHandler());
    // Size the frame and make it visible
    f.setSize(300, 200);
    f.setVisible(true);
  }

  public static void main(String args[]) {
    TestInner obj = new TestInner();
    obj.launchFrame();
  }
}
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Event Handling Using Anonymous Classes

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

public class TestAnonymous {
  private JFrame f;
  private JTextField tf;

  public TestAnonymous() {
    f = new JFrame("Anonymous classes example");
    tf = new JTextField(30);
  }

  public static void main(String args[]) {
    TestAnonymous obj = new TestAnonymous();
    obj.launchFrame();
  }

```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Event Handling Using Anonymous Classes

```
    public void launchFrame() {
      JLabel label = new JLabel("Click and drag the mouse");
      // Add components to the frame
      f.add(label, BorderLayout.NORTH);
      f.add(tf, BorderLayout.SOUTH);
      // Add a listener that uses an anonymous class
      f.addMouseMotionListener(new MouseMotionAdapter() {
        public void mouseDragged(MouseEvent e) {
          String s = "Mouse dragging:  X = "+ e.getX()
                      + " Y = " + e.getY();
          tf.setText(s);
        }
      }); // <- note the closing parenthesis
      f.addMouseListener(new MouseClickHandler()); // Not shown
      // Size the frame and make it visible
      f.setSize(300, 200);
      f.setVisible(true);
    }
  }
```

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

Concurrency In Swing

To handle a GUI efficiently, the Swing program needs different threads to:

- Execute the application code (current threads)
- Handle the events that arise from the GUI (event dispatch threads)
- Handle background tasks that might be time consuming (worker threads)

Each task in a worker thread is represented by an instance of `javax.swing.SwingWorker`.

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2

The `SwingWorker` Class

The `SwingWorker` class has methods to service the following requirements:

- To provide communication and coordination between worker thread tasks and the tasks on other threads:
  - Properties: `state` and `progress`
- To execute simple background tasks:
  - `doInBackground` method
- To execute tasks that have intermediate results:
  - `publish` method
- To cancel the background threads:
  - `cancel` method

Copyright Copyright 2008 Sun Microsystems, Inc. All Rights Reserved. Sun Services, Revision G.2