GUI Event Handling

Topics

- The Delegation Event Model
- Event Classes
- Event Listeners
  - *ActionListener* Method
  - *MouseListener* Methods
  - *MouseMotionListener* Methods
  - *WindowListener* Methods
- Steps for Creating GUI Applications with Event Handling

Delegation Event Model

What is Delegation Event Model?

- The Delegation Event Model
  - Model used by Java to handle user interaction with GUI components
  - Describes how your program can respond to user interaction
- Three important players
  - Event Source
  - Event Listener/Handler
  - Event Object

Event Source, Event Listener/Handler

- Event Source
  - GUI component that generates the event
  - Example: button

- Event Listener/Handler
  - Receives and handles events
  - Contains business logic
  - Example: displaying information useful to the user, computing a value

Event Object

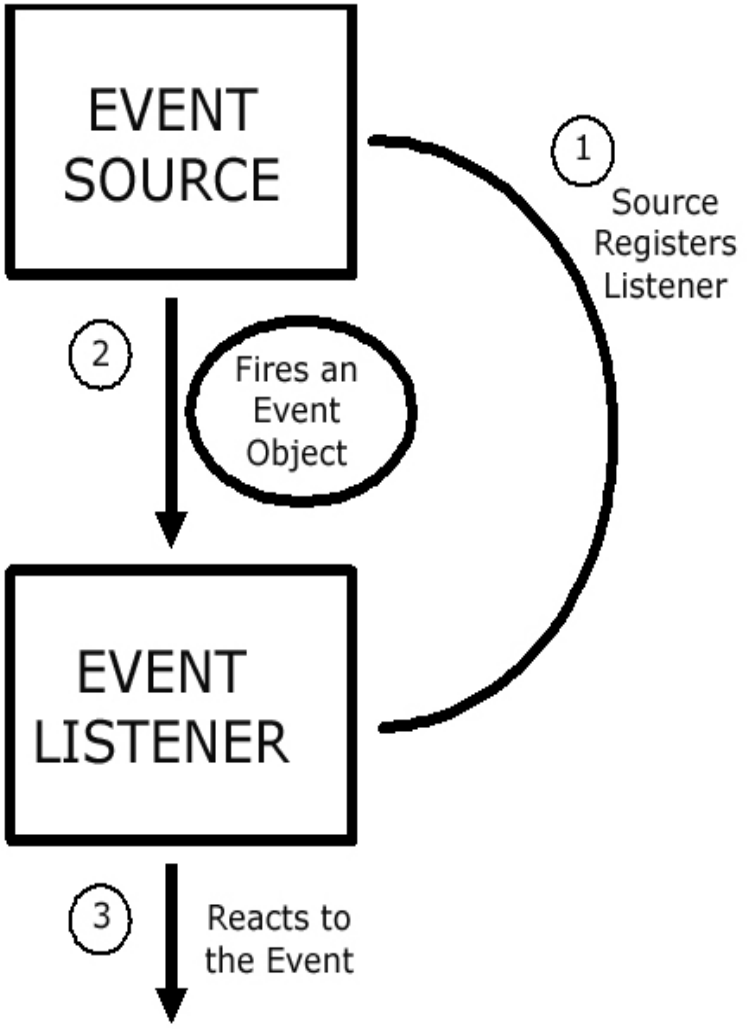
- Created when an event occurs (i.e., user interacts with a GUI component)
- Contains all necessary information about the event that has occurred
  - Type of event that has occurred
  - Source of the event
- Represented by an Event class

Event Listener Registration to Event Source in Delegation Event Model

Event Listener Registers to Event Source

- A listener should be registered with a source
- Once registered, listener waits until an event occurs
- When an event occurs
  - An event object created by the event source
  - Event object is fired by the event source to the registered listeners (method of event listener is called with an event object as a parameter)
- Once the listener receives an event object from the source
  - Deciphers the event
  - Processes the event that occurred.

Control Flow of Delegation Event Model



Methods of Event Source Used by Event Listeners for Registation

- Event source registering a listener:

```
void add<Type>Listener(<Type>Listener
  listenerObj)
```

  where,

  - <*Type*> depends on the type of event source
    - Can be *Key*, *Mouse*, *Focus*, *Component*, *Action* and others
  - One event source can register several listeners

- Registered listener being unregistered:

```
void remove<Type>Listener(<Type>Listener
  listenerObj)
```

Event Classes

Event Classes

- The *EventObject* class
  - Found in the *java.util* package
- The *AWTEvent* class
  - An immediate subclass of *EventObject*
  - Defined in *java.awt* package
  - Root of all AWT-based events
  - Subclasses follow this naming convention:

```
<Type>Event
```

Event Classes

Event Class	*Description*
ComponentEvent	Extends *AWTEvent*. Instantiated when a component is moved, resized, made visible or hidden.
InputEvent	Extends *ComponentEvent*. The abstract root event class for all component-level input event classes.
ActionEvent	Extends *AWTEvent*. Instantiated when a button is pressed, a list item is double-clicked, or a menu item is selected.
ItemEvent	Extends *AWTEvent*. Instantiated when an item is selected or deselected by the user, such as in a list or a checkbox.
KeyEvent	Extends *InputEvent*. Instantiated when a key is pressed, released or typed.
MouseEvent	Extends *InputEvent*. Instantiated when a mouse button is pressed, released, or clicked (pressed and released), or when a mouse cursor enteres or exits a visible part of a component.
TextEvent	Extends *AWTEvent*. Instantiated when the value of a text field or a text area is changed.
WindowEvent	Extends *ComponentEvent*. Instantiated when a *Window* object is opened, closed, activated, deactivated, iconified, deiconified, or when focus is transferred into or out of the window.

Event Listeners

Event Listeners

- Classes that implement the <*Type*>*Listener* interfaces

Event Listeners	***Description***
ActionListener	Receives action events.
MouseListener	Receives mouse events.
MouseMotionListener	Receives mouse motion events, which include dragging and moving the mouse.
WindowListener	Receives window events.

ActionListener Method

- Contains exactly one method

ActionListener Method
`public void actionPerformed(ActionEvent e)`
Contains the handler for the *ActionEvent e* that occurred.

MouseListener Methods

MouseListener Methods
`public void mouseClicked(MouseEvent e)`
Contains the handler for the event when the mouse is clicked (i.e., pressed and released).
`public void mouseEntered(MouseEvent e)`
Contains the code for handling the case wherein the mouse enters a component.
`public void mouseExited(MouseEvent e)`
Contains the code for handling the case wherein the mouse exits a component.
`public void mousePressed(MouseEvent e)`
Invoked when the mouse button is pressed on a component.
`public void mouseReleased(MouseEvent e)`
Invoked when the mouse button is released on a component.

MouseMotionListener Methods

MouseListener Methods
`public void mouseDragged(MouseEvent e)`
Contains the code for handling the case wherein the mouse button is pressed on a component and dragged. Called several times as the mouse is dragged.
`public void mouseMoved(MouseEvent e)`
Contains the code for handling the case wherein the mouse cursor is moved onto a component, without the mouse button being pressed. Called multiple times as the mouse is moved.

WindowListener Methods

WindowListener Methods
`public void windowOpened(WindowEvent e)`
Contains the code for handling the case when the *Window* object is opened (i.e., made visible for the first time).
`public void windowClosing(WindowEvent e)`
Contains the code for handling the case when the user attempts to close *Window* object from the object's system menu.
`public void windowClosed(WindowEvent e)`
Contains the code for handling the case when the *Window* object was closed after calling dispose (i.e., release of resources used by the source) on the object.
`public void windowActivated(WindowEvent e)`
Invoked when a *Window* object is the active window (i.e., the window in use).
`public void windowDeactivated(WindowEvent e)`
Invoked when a *Window* object is no longer the active window.
`public void windowIconified(WindowEvent e)`
Called when a *Window* object is minimized.
`public void windowDeiconified(WindowEvent e)`
Called when a *Window* object reverts from a minimized to a normal state.

Steps for Creating GUI Application with Event Handling

Steps for Creating GUI Applications with Event Handling

1. Create a GUI class
   - Describes and displays the appearance of your GUI application
2. Create Event Listener class (a class implementing the appropriate listener interface)
   - Override all methods of the appropriate listener interface
   - Describe in each method how you would like the event to be handled
   - May give empty implementations for methods you don't need

Steps for Creating GUI Applications with Event Handling (Continued)

3. Register the listener object with the event source
   - The object is an instantiation of the listener class in step 2
   - Use the *add<Type>Listener* method of the event source

Mouse Events Example (page #1)

```
1  import java.awt.*;
2  import java.awt.event.*;
3  public class MouseEventsDemo extends Frame implements
                    MouseListener, MouseMotionListener {
4      TextField tf;
5      public MouseEventsDemo(String title){
6          super(title);
7          tf = new TextField(60);
8          // Register event listener to the event source
9          addMouseListener(this);
10     }
11     //continued...
```

Mouse Events Example (page #2)

```
11      // Displays GUI
12      public void launchFrame() {
13          /* Add components to the frame */
14          add(tf, BorderLayout.SOUTH);
15          setSize(300,300);
16          setVisible(true);
17      }
18
19      // Implement methods of event listener interface
20      public void mouseClicked(MouseEvent me) {
21          String msg = "Mouse clicked.";
22          tf.setText(msg);
23      }
24      //continued...
```

Mouse Events Example (page #3)

```
22      public void mouseEntered(MouseEvent me) {
23          String msg = "Mouse entered component.";
24          tf.setText(msg);
25      }
26      public void mouseExited(MouseEvent me) {
27          String msg = "Mouse exited component.";
28          tf.setText(msg);
29      }
30      public void mousePressed(MouseEvent me) {
31          String msg = "Mouse pressed.";
32          tf.setText(msg);
33      }
34  //continued...
```

Mouse Events Example (page #4)

```
35     public void mouseReleased(MouseEvent me) {
36         String msg = "Mouse released.";
37         tf.setText(msg);
38     }
39     public void mouseDragged(MouseEvent me) {
40         String msg = "Mouse dragged at " + me.getX()
41                           + "," + me.getY();
42         tf.setText(msg);
43     }
44 //continued...
```

Mouse Events Example (page #5)

```
45      public void mouseMoved(MouseEvent me) {
46          String msg = "Mouse moved at " + me.getX()
47                       + "," + me.getY();
48          tf.setText(msg);
49      }
50
51      // Main method
52      public static void main(String args[]) {
53          MouseEventsDemo med =
54                  new MouseEventsDemo("Mouse Events Demo");
55          med.launchFrame();
56       }
57  }
```

Close Window Example (page #1)

```
1  import java.awt.*;
2  import java.awt.event.*;
3
4  class CloseFrame extends Frame
5                    implements WindowListener {
6      Label label;
7      CloseFrame(String title) {
8          super(title);
9          label = new Label("Close the frame.");
10         this.addWindowListener(this);
11     }
12     //continued...
```

Close Window Example (page #2)

```
13    void launchFrame() {
14        setSize(300,300);
15        setVisible(true);
16    }
17    // Implement methods of listener interface
18    public void windowActivated(WindowEvent e) {
19    }
20    public void windowClosed(WindowEvent e) {
21    }
22    public void windowClosing(WindowEvent e) {
23        setVisible(false);
24        System.exit(0);
25    }
26    //continued...
```

Close Window Example (page #3)

```
26      public void windowDeactivated(WindowEvent e) {
27      }
28      public void windowDeiconified(WindowEvent e) {
29      }
30      public void windowIconified(WindowEvent e) {
31      }
32      public void windowOpened(WindowEvent e) {
33      }
34
35      // Main method
36      public static void main(String args[]) {
37         CloseFrame cf =
38                  new CloseFrame("Close Window Example");
39         cf.launchFrame();
40       }
41  }
```

Adaptor Classes

Adapter Classes

- Why use Adapter classes?
  - Implementing all methods of an interface takes a lot of work
  - Interested in implementing some methods of the interface only
- Adapter classes
  - Built-in in Java
  - Implement all methods of each listener interface with more than one method
  - Implementations of the methods are all empty

Adapter Classes: Close Window Example

```
1  import java.awt.*;
2  import java.awt.event.*;
3
4  class CloseFrame extends Frame{
5     Label label;
6     CFListener w = new CFListener(this);
7
8     CloseFrame(String title) {
9        super(title);
10       label = new Label("Close the frame.");
11       this.addWindowListener(w);
12    }
13 //continued...
```

Adapter Classes: Close Window Example

```
14      void launchFrame() {
15          setSize(300,300);
16          setVisible(true);
17      }
18
19      public static void main(String args[]) {
20          CloseFrame cf =
21                  new CloseFrame("Close Window Example");
22          cf.launchFrame();
23       }
24  }
25  //continued...
```

Adapter Classes: Close Window Example

```
25 class CFListener extends WindowAdapter {
26      CloseFrame ref;
27      CFListener( CloseFrame ref ){
28          this.ref = ref;
29      }
30
31      public void windowClosing(WindowEvent e) {
32            ref.dispose();
33            System.exit(1);
34     }
35 }
```

Inner Classes

- Class declared within another class

- Why use inner classes?
  - > Help simplify your programs
  - > Especially in event handling

Inner Classes: Close Window Example

```
1  import java.awt.*;
2  import java.awt.event.*;
3
4  class CloseFrame extends Frame{
5     Label label;
6
7     CloseFrame(String title) {
8        super(title);
9        label = new Label("Close the frame.");
10       this.addWindowListener(new CFListener());
11    }
12 //continued...
```

Inner Classes: Close Window Example

```
13     void launchFrame() {
14         setSize(300,300);
15         setVisible(true);
16     }
17
18     class CFListener extends WindowAdapter {
19         public void windowClosing(WindowEvent e) {
20             dispose();
21             System.exit(1);
22         }
23     }
24 //continued...
```

Inner Classes: Close Window Example

```
25      public static void main(String args[]) {
26          CloseFrame cf =
27                  new CloseFrame("Close Window  Example");
28          cf.launchFrame();
29      }
30  }
```

Anonymous Inner Classes

- Unnamed inner classes

- Why use anonymous inner classes?
  - > Further simplify your codes
  - > Especially in event handling

Anonymous Inner Classes: Close Window Example

```
1  import java.awt.*;   import java.awt.event.*;
2  class CloseFrame extends Frame{
3     Label label;
4     CloseFrame(String title) {
5        super(title);
6        label = new Label("Close the frame.");
7        this.addWindowListener(new WindowAdapter(){
8           public void windowClosing(WindowEvent e){
9              dispose();
10             System.exit(1);
11          }
12       });
13    }
```

Anonymous Inner Classes: Close Window Example

```
14      void launchFrame() {
15          setSize(300,300);
16          setVisible(true);
17      }
18
19      public static void main(String args[]) {
20          CloseFrame cf =
21                  new CloseFrame("Close Window Example");
22          cf.launchFrame();
23       }
24  }
```

Thank You!