Chapter 12 - GUI Components: Part 1

12.1 Introduction

- Graphical User Interface (GUI)
  - Gives program distinctive “look” and “feel”
  - Provides users with basic level of familiarity
  - Built from GUI components (controls, widgets, etc.)
    - User interacts with GUI component via mouse, keyboard, etc.

12.2 Swing Overview

- Swing GUI components
  - Package **`javax.swing`**
  - Components originate from AWT (package **`java.awt`**)
  - Contain ***look and feel***
    - Appearance and how users interact with program
  - ***Light-weight components***
    - Written completely in Java

JAVA Foundation Classes(JFC)

JAVA GUI元件包括:

- AWT(Abstract Window Toolkits)
  - Package ➔ java.awt.* ➔ JAVA 1.0 & 1.1 所提供之GUI
  - 與平台相關之程式
  - Heavy-weight component (tie into the “local platform GUI)
- Swing
  - Package ➔ javax.swing.* ➔ JAVA 2 所提供之GUI
  - 不受限於執行平台特性
  - Light-weight component (GUI components’ look and feel are the same on different Platform)
- Look-and-feel
- Drag-and-drop
- JAVA 2D 元件

12.14 Layout Managers

- Layout managers
  - Provided for arranging GUI components
  - Provide basic layout capabilities
  - Processes layout details
  - Programmer can concentrate on basic “look and feel”
  - Interface **`LayoutManager`**
    - **`FlowLayout`**
    - **`BorderLayout`**
    - **`GridLayout`**
    - **`CardLayout`**

Fig. 12.23 Layout managers.

Layout manager	Description
`FlowLayout`	Default for **`java.awt.Applet`**, **`java.awt.Panel`** and **`javax.swing.JPanel`**. Places components sequentially (left to right) in the order they were added. It is also possible to specify the order of the components using the **`Container`** method **`add`** that takes a **`Component`** and an integer index position as arguments.
`BorderLayout`	Default for the content panes of **`JFrame`**s (and other windows) and **`JApplet`**s. Arranges the components into five areas: North, South, East, West and Center.
`GridLayout`	Arranges the components into rows and columns.

Fig. 12.23 Layout managers.

12.14 FlowLayout, BorderLayout, GridLayout

- **`FlowLayout`**
  - Most basic layout manager
  - GUI components placed in container from left to right
- **`BorderLayout`**
  - Arranges components into five regions
    - **`NORTH`** (top of container)
    - **`SOUTH`** (bottom of container)
    - **`EAST`** (left of container)
    - **`WEST`** (right of container)
    - **`CENTER`** (center of container)
- **`GridLayout`**
  - Divides container into grid of specified row an columns
  - Components are added starting at top-left cell
    - Proceed left-to-fight until row is full

JAVA AWT show message

```
import java.awt.*;  import java.awt.event.*;
public class a030801 extends Frame {
  public a030801() {
     setLayout(new FlowLayout());   // chapter 13 layout manager
     add(new Label("Hello World!!!",0));
     setSize(450,140);  setVisible(true);
     addWindowListener(new MyWindowListener());
  }
  class MyWindowListener extends WindowAdapter {
    public void windowClosing(WindowEvent e) { System.exit(-1); }
  }
  public static void main(String args[]) {  new a030801();  }
}
```

JAVA Swing show message

```
import java.awt.*;  import java.awt.event.*;  import javax.swing.*;
public class a030802 extends JFrame {
  public a030802() {
    JFrame f=new JFrame();  Container c=f.getContentPane();
    c.add(new JLabel("Hello World!!!"), BorderLayout.CENTER);
    f.setSize(450,140); f.setVisible(true);
    f.addWindowListener(new MyWindowListener());
  }
  class MyWindowListener extends WindowAdapter {
    public void windowClosing(WindowEvent e) { System.exit(-1);  }
  }
  public static void main(String args[]) {  new a030802();  }
}
```

2.4 Displaying Text in a Dialog Box

12.2 Swing Overview (cont.)

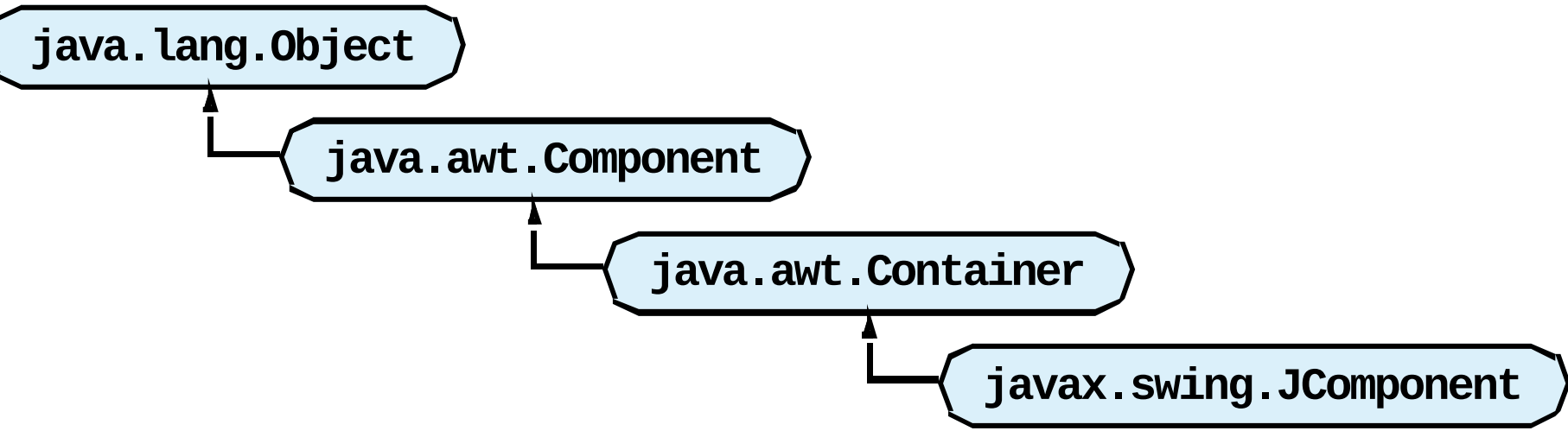
- Class **`Component inherits from Object`**
  - Contains method **`paint`** for drawing **`Component`** onscreen
- Class **`Container inherits from Component`**
  - Collection of related components
  - Contains method **`add`** for **adding components**
  - **setLayout** enables a program to specify the layout manager to put the **Container** and its **components ➔ default is FlowLayout in AWT**
- Class **`JComponent inherits from Container`**
  - *Pluggable look and feel* for customizing look and feel
  - Shortcut keys (*mnemonics*) ➔ direct access to GUI component through KB
  - Common event-handling capabilities
  - Breif description of a GUI component(Tool tips)

Fig. 12.2 Some basic GUI components.

Component	Description
`JLabel`	An area where uneditable text or icons can be displayed.
`JTextField`	An area in which the user inputs data from the keyboard. The area can also display information.
`JButton`	An area that triggers an event when clicked.
`JCheckBox`	A GUI component that is either selected or not selected.
`JComboBox`	A drop-down list of items from which the user can make a selection by clicking an item in the list or possibly by typing into the box.
`JList`	An area where a list of items is displayed from which the user can make a selection by clicking once on any element in the list. Double-clicking an element in the list generates an action event. Multiple elements can be selected.
`JPanel`	A container in which components can be placed.

Fig. 12.2 Some basic GUI components.

Fig. 12.3 Common superclasses of many of the Swing components.



12.3 `JLabel`

- Label
  - Provide text on GUI
  - Defined with class **`JLabel`**
  - Can display:
    - **Single line** of **read-only text**
    - Image for label icon (gif, jpeg, png)
    - Text and image for label icon (gif, jpeg, png)
      - Default is text appears to the right of the image
      - SetVerticalalignment, SetHorizontalAlignment

```
1  // Fig. 12.4: LabelTest.java
2  // Demonstrating the JLabel class.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class LabelTest extends JFrame {
12    private JLabel label1, label2, label3;
13
14    // set up GUI
15    public LabelTest()
16    {
17       super( "Testing JLabel" );
18
19       // get content pane and set its layout
20       Container container = getContentPane();
21       container.setLayout( new FlowLayout() );
22
23       // JLabel constructor with a string argument
24       label1 = new JLabel( "Label with text" );
25       label1.setToolTipText( "This is label1" );
26       container.add( label1 );
27
28       // JLabel constructor with string, Icon and
29       // alignment arguments
30       Icon bug = new ImageIcon( "bug1.gif" );
31       label2 = new JLabel( "Label with text and icon",
32          bug, SwingConstants.LEFT );
33       label2.setToolTipText( "This is label2" );
34       container.add( label2 );
35
```

Declare three **JLabel**s

Create first **JLabel** with text "**Label with text**"

Tool tip is text that appears when user moves cursor over **JLabel**

Create second **JLabel** with text to left of image

Outline

LabelTest.java

Line 12

Line 24

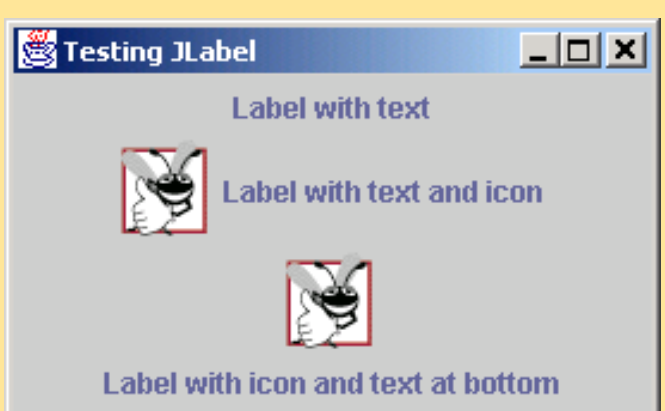
Line 25

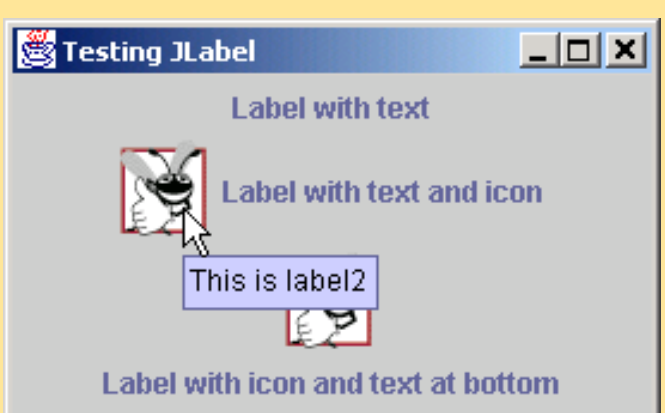
Lines 31-32

```
36       // JLabel constructor no arguments
37       label3 = new JLabel();
38       label3.setText( "Label with icon and text at bottom" );
39       label3.setIcon( bug );
40       label3.setHorizontalTextPosition( SwingConstants.CENTER );
41       label3.setVerticalTextPosition( SwingConstants.BOTTOM );
42       label3.setToolTipText( "This is label3" );
43       container.add( label3 );
44
45       setSize( 275, 170 );
46       setVisible( true );
47    }
48
49    // execute application
50    public static void main( String args[] )
51    {
52       LabelTest application = new LabelTest();
53
54       application.setDefaultCloseOperation(
55          JFrame.EXIT_ON_CLOSE );
56    }
57
58 }  // end class LabelTest
```

Create third **JLabel** with text below image

Lines 37-41

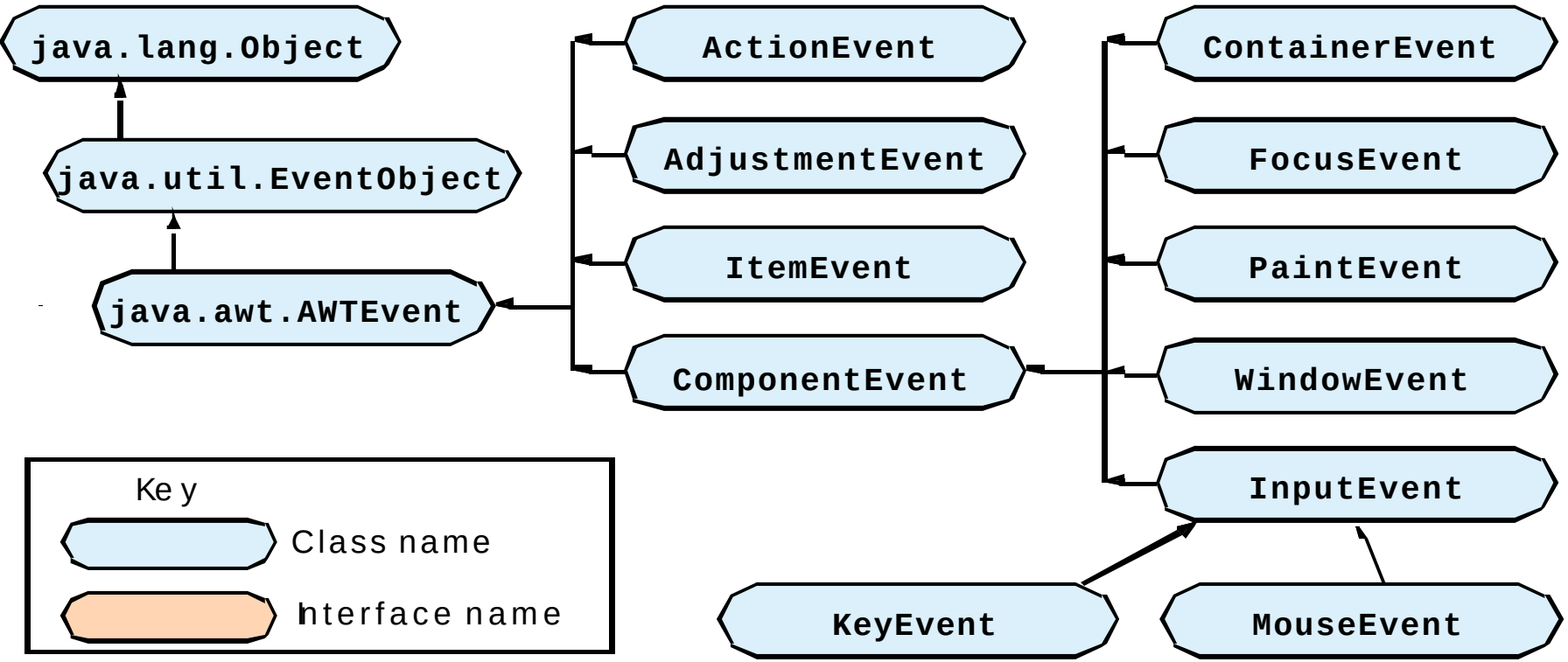




12.4 Event-Handling Model

- GUIs are *event driven*
  - Generate *events* when user interacts with GUI
    - e.g., moving mouse, click the mouse, click the button, typing in text field, select an item from a menu, close a window … etc.
    - Class **`java.awt.AWTEvent`**

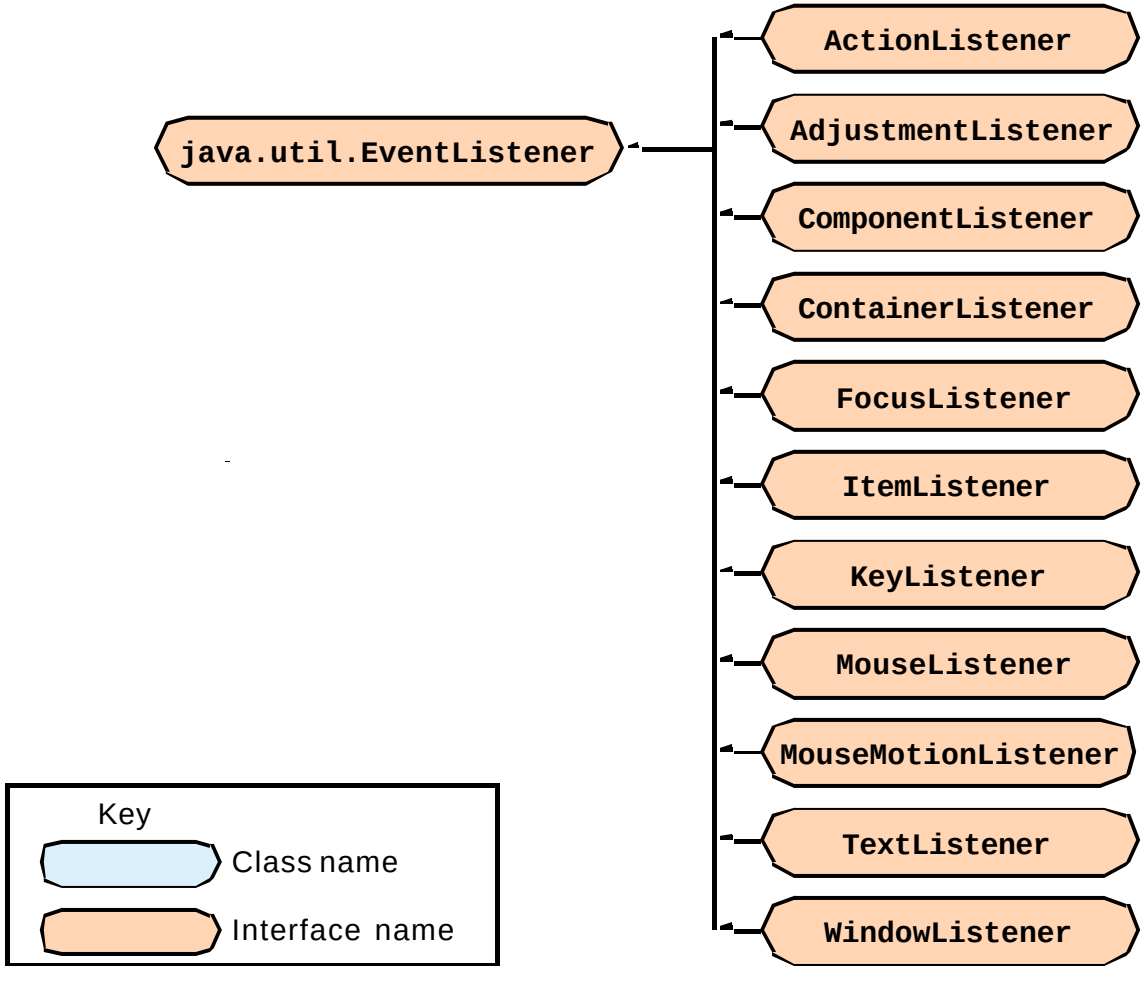
Fig. 12.5 Some event classes of package `java.awt.event`



12.4 Event-Handling Model (cont.)

- Event-handling model
  - Three parts
    - Event source(**what kinds of events**)
      - GUI component with which user interacts
    - Event object(**what event happen to this object**)
      - Encapsulates information about event that occurred
    - Event listener(**what to do when the event happen**)
      - Receives event object when notified, then responds
  - Programmer must perform two tasks
    - Register event listener for event source
    - Implement event-handling method (event handler)

Fig. 12.6 Event-listener interfaces of package `java.awt.event`



12.5 `JTextField` and `JPasswordField`

- **`JTextField`**
  - Single-line area in which user can enter text
- **`JPasswordField`**
  - Extends **`JTextField`**
  - Hides characters that user enters
  - Use as a password input control

Outline

TextFieldTest.jav

Lines 12-13

Line 24

```
1  // Fig. 12.7: TextFieldTest.java
2  // Demonstrating the JTextField class.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class TextFieldTest extends JFrame {
12    private JTextField textField1, textField2, textField3;
13    private JPasswordField passwordField;
14
15    // set up GUI
16    public TextFieldTest()
17    {
18       super( "Testing JTextField and JPasswordField" );
19
20       Container container = getContentPane();
21       container.setLayout( new FlowLayout() );
22
23       // construct textfield with default sizing
24       textField1 = new JTextField( 10 );
25       container.add( textField1 );
26
27       // construct textfield with default text
28       textField2 = new JTextField( "Enter text here" );
29       container.add( textField2 );
30
31       // construct textfield with default text and
32       // 20 visible elements and no event handler
33       textField3 = new JTextField( "Uneditable text field",
34       textField3.setEditable( false );
35       container.add( textField3 );
```

Declare three **JTextField**s and one **JPasswordField**

First **JTextField** contains empty string

Second **JTextField** contains text "**Enter text here**"

Third **JTextField** contains uneditable text

```
36
37       // construct textfield with default text
38       passwordField = new JPasswordField( "Hidden text" );
39       container.add( passwordField );
40
41       // register event handlers
42       TextFieldHandler handler = new TextFieldHandler();
43       textField1.addActionListener( handler );
44       textField2.addActionListener( handler );
45       textField3.addActionListener( handler );
46       passwordField.addActionListener( handler );
47
48       setSize( 325, 100 );
49       setVisible( true );
50    }
51
52    // execute application
53    public static void main( String args[] )
54    {
55       TextFieldTest application = new TextFieldTest();
56
57       application.setDefaultCloseOperation(
58          JFrame.EXIT_ON_CLOSE );
59    }
60
61    // private inner class for event handling
62    private class TextFieldHandler implements ActionListener {
63
64       // process text field events
65       public void actionPerformed( ActionEvent event )
66       {
67          String string = "";
68
69          // user pressed Enter in JTextField textField1
70          if ( event.getSource() == textField1 )
```

`JPasswordField` contains text "**`Hidden text`**," but tex appears as series of asterisks (*

Line 38

Register GUI components with **`TextFieldHandler`** (register for **`ActionEvent`**s)

Line 65

Every **`TextFieldHandler`** instance is an **`ActionListener`**

Method **`actionPerformed`** invoked when user presses Enter in GUI field

```
71             string = "textField1: " + event.getActionCommand();
72
73          // user pressed Enter in JTextField textField2
74          else if ( event.getSource() == textField2 )
75             string = "textField2: " + event.getActionCommand();
76
77          // user pressed Enter in JTextField textField3
78          else if ( event.getSource() == textField3 )
79             string = "textField3: " + event.getActionCommand();
80
81          // user pressed Enter in JTextField passwordField
82          else if ( event.getSource() == passwordField ) {
83             JPasswordField pwd =
84                ( JPasswordField ) event.getSource();
85             string = "passwordField: " +
86                 new String( passwordField.getPassword() );
87          }
88
89          JOptionPane.showMessageDialog( null, string );
90       }
91
92    }  // end private inner class TextFieldHandler
93
94 }  // end class TextFieldTest
```

TextFieldTest.jav

12.5.1 How Event Handling Works

- Two open questions from Section 12.4
  - How did **event handler get registered**?
    - Through component's method **`addActionListener`**
    - Lines 43-46 of **`TextFieldTest.java`**
  - How does component know to call **`actionPerformed`**?
    - Event is dispatched only to listeners of appropriate type
    - Each event type has corresponding event-listener interface
      - Event ID specifies event type that occurred

      Ex. ActionEvent is handled by ActionListener

      MouseEvent is handled by MouseListener

      KeyEvent is handled by KeyListener

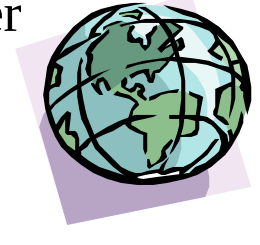
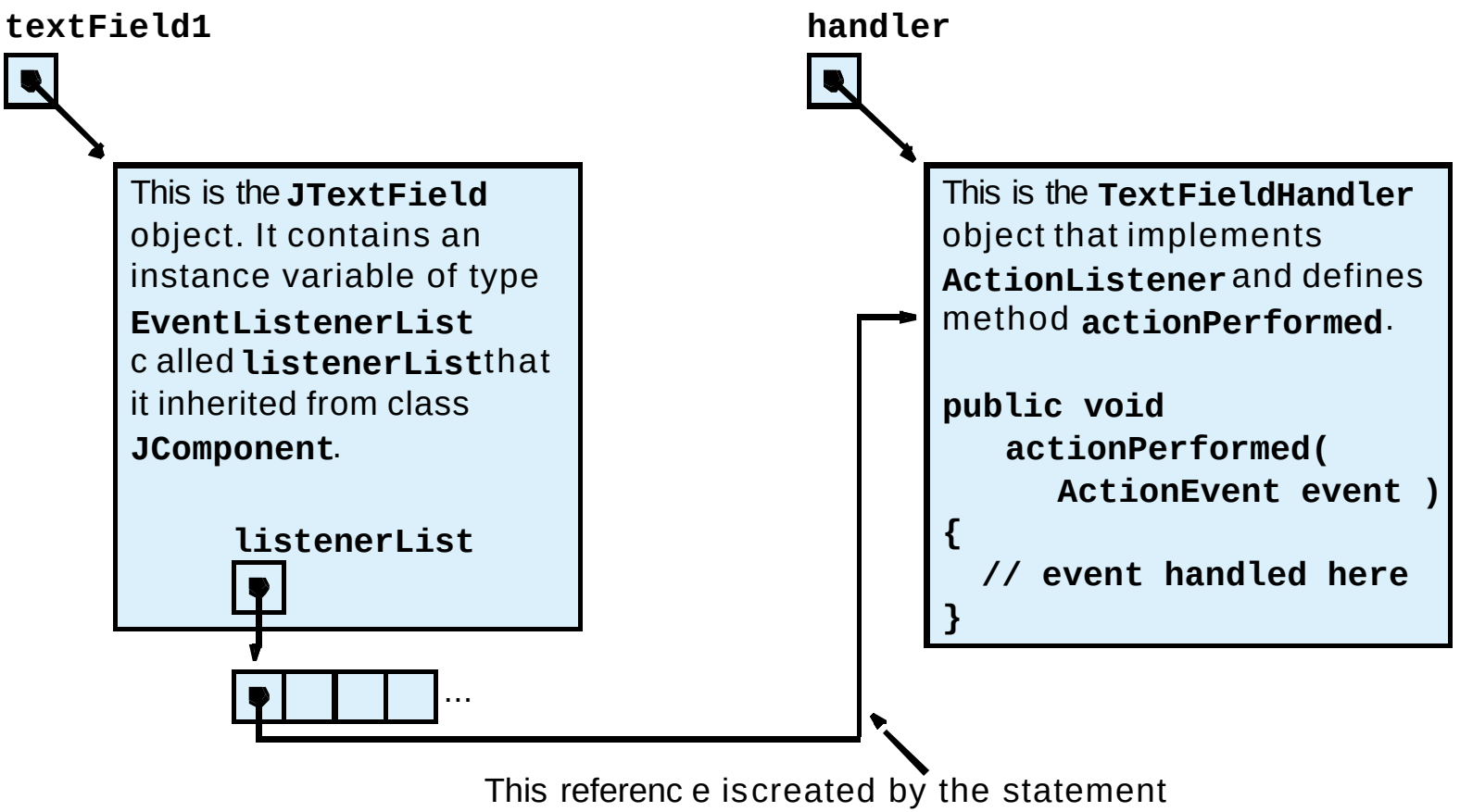


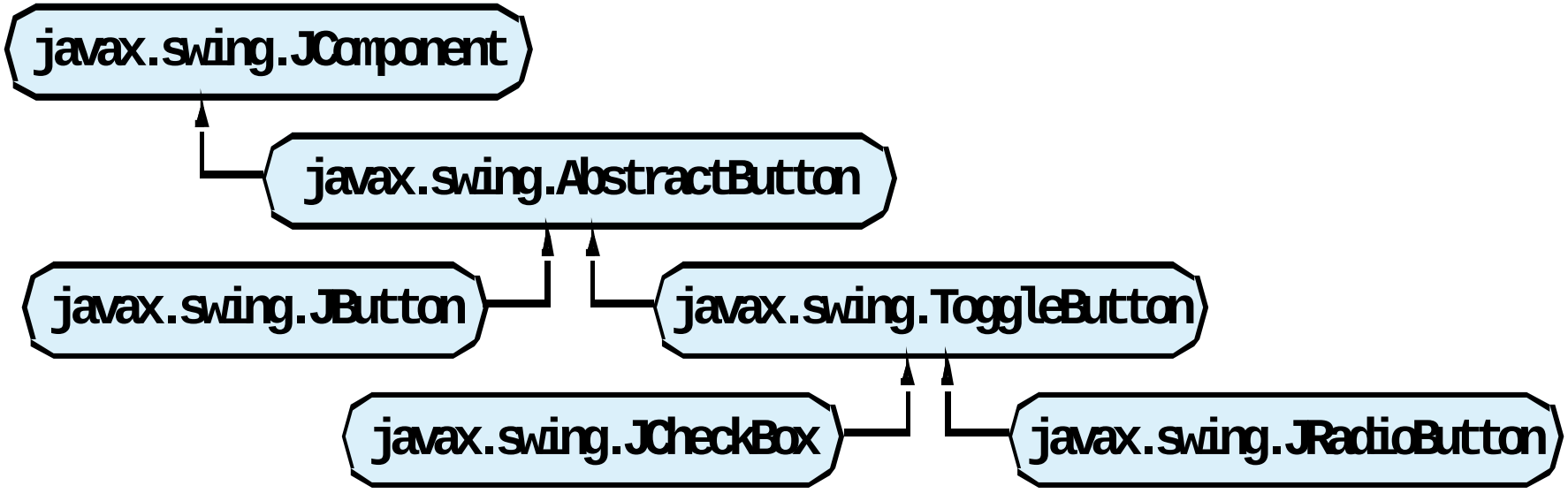
Fig 12.8 Event registration for `JTextField textField1`.



12.6 JButton

- Button
  - Component user clicks to trigger a specific action
  - Several different types
    - Command buttons
    - Check boxes (**multiple choices**)
    - Toggle buttons
    - Radio buttons(grouped to be **Single choice**)
  - **`javax.swing.AbstractButton`** subclasses
    - Command buttons are created with class **`JButton`**
      - Generate **`ActionEvent`**s when user clicks button

Fig. 12.9 The button heirarchy.



```
1  // Fig. 12.10: ButtonTest.java
2  // Creating JButtons.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class ButtonTest extends JFrame {
12    private JButton plainButton, fancyButton;
13
14    // set up GUI
15    public ButtonTest()
16    {
17       super( "Testing Buttons" );
18
19       // get content pane and set its layout
20       Container container = getContentPane();
21       container.setLayout( new FlowLayout() );
22
23       // create buttons
24       plainButton = new JButton( "Plain Button" );
25       container.add( plainButton );
26
27       Icon bug1 = new ImageIcon( "bug1.gif" );
28       Icon bug2 = new ImageIcon( "bug2.gif" );
29       fancyButton = new JButton( "Fancy Button", bug1 );
30       fancyButton.setRolloverIcon( bug2 );
31       container.add( fancyButton );
32
33       // create an instance of inner class ButtonHandler
34       // to use for button event handling
35       ButtonHandler handler = new ButtonHandler();
```

Create two references to **JButton** instances

Instantiate **JButton** with text

Instantiate **JButton** with image and *rollover* image

Instantiate **ButtonHandler** for **JButton** event handling

Outline

ButtonTest.java

Line 12

Line 24

Lines 27-30

Line 35

```
36       fancyButton.addActionListener( handler );
37       plainButton.addActionListener( handler );
38
39       setSize( 275, 100 );
40       setVisible( true );
41    }
42
43    // execute application
44    public static void main( String args[] )
45    {
46       ButtonTest application = new ButtonTest();
47
48       application.setDefaultCloseOperation(
49          JFrame.EXIT_ON_CLOSE );
50    }
51
52    // inner class for button event handling
53    private class ButtonHandler implements ActionListener {
54
55       // handle button event
56       public void actionPerformed( ActionEvent event )
57       {
58          JOptionPane.showMessageDialog( null,
59             "You pressed: " + event.getActionCommand() );
60       }
61
62    }  // end private inner class ButtonHandler
63
64 }  // end class ButtonTest
```

Register **JButton**s to receive events from **ButtonHandler**

ButtonTest.java

Lines 36-37

Lines 56-60

When user clicks **JButton**, **ButtonHandler** invokes method **actionPerformed** of all registered listeners

ButtonTest.java

12.15 Panels

- Panel
  - Helps organize components place in an exact location
  - Class **`JPanel`** is **`JComponent`** subclass
  - May have components (and other panels) added to them

12.7 `JCheckBox` and `JRadioButton`

- State buttons
  - On/Off or **`true`**/**`false`** values
  - Java provides three types
    - **`JToggleButton`**
    - **`JCheckBox`**
    - **`JRadioButton`**

```
1  // Fig. 12.11: CheckBoxTest.java
2  // Creating Checkbox buttons.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class CheckBoxTest extends JFrame {
12    private JTextField field;
13    private JCheckBox bold, italic;
14
15    // set up GUI
16    public CheckBoxTest()
17    {
18       super( "JCheckBox Test" );
19
20       // get content pane and set its layout
21       Container container = getContentPane();
22       container.setLayout( new FlowLayout() );
23
24       // set up JTextField and set its font
25       field =
26          new JTextField( "Watch the font style change", 20 );
27       field.setFont( new Font( "Serif", Font.PLAIN, 14 ) );
28       container.add( field );
29
30       // create checkbox objects
31       bold = new JCheckBox( "Bold" );
32       container.add( bold );
33
34       italic = new JCheckBox( "Italic" );
35       container.add( italic );
```

Declare two **JCheckBox** instances

Set **JTextField** font to Serif, 14-point plain

Instantiate **JCheckBox**s for bolding and italicizing **JTextField** text, respectively

Outline

CheckBoxTest.java

Line 13

Line 27

31-35

```
36
37       // register listeners for JCheckBoxes
38       CheckBoxHandler handler = new CheckBoxHandler();
39       bold.addItemListener( handler );
40       italic.addItemListener( handler );
41
42       setSize( 275, 100 );
43       setVisible( true );
44    }
45
46    // execute application
47    public static void main( String args[] )
48    {
49       CheckBoxTest application = new CheckBoxTest();
50
51       application.setDefaultCloseOperation(
52          JFrame.EXIT_ON_CLOSE );
53    }
54
55    // private inner class for ItemListener event handling
56    private class CheckBoxHandler implements ItemListener {
57       private int valBold = Font.PLAIN;
58       private int valItalic = Font.PLAIN;
59
60       // respond to checkbox events
61       public void itemStateChanged( ItemEvent event )
62       {
63          // process bold checkbox events
64          if ( event.getSource() == bold )
65
66             if ( event.getStateChange() == ItemEvent.SELECTED )
67                valBold = Font.BOLD;
68             else
69                valBold = Font.PLAIN;
70
```

Register **JCheckBox**s to receive events from **CheckBoxHandler**

When user selects **JCheckBox**, **CheckBoxHandler** invokes method **itemStateChanges** of all registered listeners

Outline

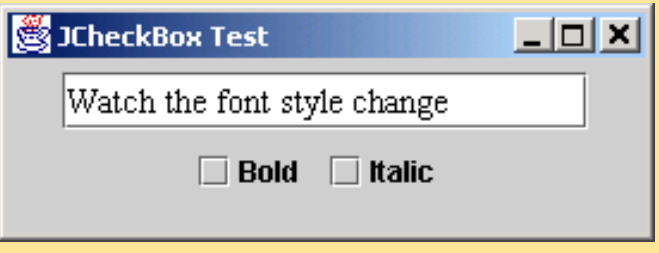
Lines 38-40

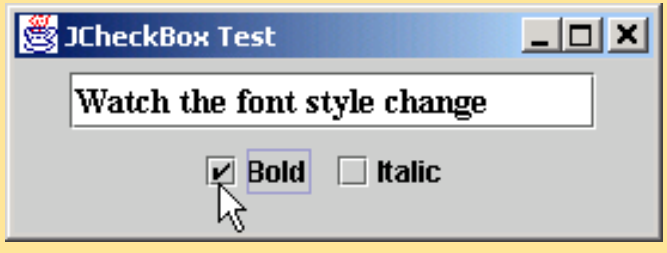
Line 61

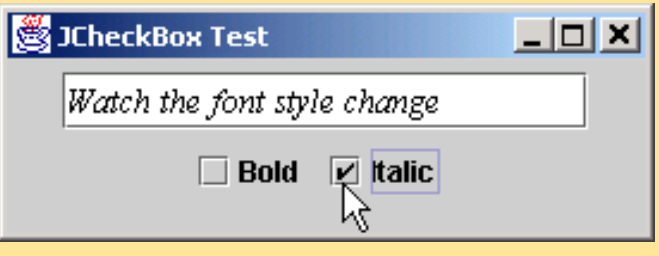
CheckBoxTest.java

```
71          // process italic checkbox events
72          if ( event.getSource() == italic )
73
74             if ( event.getStateChange() == ItemEvent.SELECTED )
75                valItalic = Font.ITALIC;
76             else
77                valItalic = Font.PLAIN;
78
79          // set text field font
80          field.setFont(
81             new Font( "Serif", valBold + valItalic, 14 ) );
82       }
83
84    }  // end private inner class CheckBoxHandler
85
86 }  // end class CheckBoxTest
```

Change **JTextField** font, depending on which **JCheckBox** was selected







Outline

RadioButtonTest.java

Lines 14-15

Line 16

```
1  // Fig. 12.12: RadioButtonTest.java
2  // Creating radio buttons using ButtonGroup and JRadioButton.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class RadioButtonTest extends JFrame {
12    private JTextField field;
13    private Font plainFont, boldFont, italicFont, boldItalicFont;
14    private JRadioButton plainButton, boldButton, italicButton,
15       boldItalicButton;
16    private ButtonGroup radioGroup;
17
18    // create GUI and fonts
19    public RadioButtonTest()
20    {
21       super( "RadioButton Test" );
22
23       // get content pane and set its layout
24       Container container = getContentPane();
25       container.setLayout( new FlowLayout() );
26
27       // set up JTextField
28       field =
29          new JTextField( "Watch the font style change", 25 );
30       container.add( field );
31
32       // create radio buttons
33       plainButton = new JRadioButton( "Plain", true );
34       container.add( plainButton );
35
```

Declare four **JRadioButton** instances

JRadioButtons normally appear as a **ButtonGroup**

```
36       boldButton = new JRadioButton( "Bold", false);
37       container.add( boldButton );
38
39       italicButton = new JRadioButton( "Italic", false );
40       container.add( italicButton );
41
42       boldItalicButton = new JRadioButton(
43          "Bold/Italic", false );
44       container.add( boldItalicButton );
45
46       // register events for JRadioButtons
47       RadioButtonHandler handler = new RadioButtonHandler();
48       plainButton.addItemListener( handler );
49       boldButton.addItemListener( handler );
50       italicButton.addItemListener( handler );
51       boldItalicButton.addItemListener( handler );
52
53       // create logical relationship between JRadioButtons
54       radioGroup = new ButtonGroup();
55       radioGroup.add( plainButton );
56       radioGroup.add( boldButton );
57       radioGroup.add( italicButton );
58       radioGroup.add( boldItalicButton );
59
60       // create font objects
61       plainFont = new Font( "Serif", Font.PLAIN, 14 );
62       boldFont = new Font( "Serif", Font.BOLD, 14 );
63       italicFont = new Font( "Serif", Font.ITALIC, 14 );
64       boldItalicFont =
65          new Font( "Serif", Font.BOLD + Font.ITALIC, 14 );
66       field.setFont( plainFont );
67
68       setSize( 300, 100 );
69       setVisible( true );
70    }
```

Instantiate **JRadioButton**s for manipulating **JTextField** text font

Register **JRadioButton**s to receive events from **RadioButtonHandler**

JRadioButtons belong to **ButtonGroup**

```
72    // execute application
73    public static void main( String args[] )
74    {
75       RadioButtonTest application = new RadioButtonTest();
76
77       application.setDefaultCloseOperation(
78          JFrame.EXIT_ON_CLOSE );
79    }
80
81    // private inner class to handle radio button events
82    private class RadioButtonHandler implements ItemListener {
83
84       // handle radio button events
85       public void itemStateChanged( ItemEvent event )
86       {
87          // user clicked plainButton
88          if ( event.getSource() == plainButton )
89             field.setFont( plainFont );
90
91          // user clicked boldButton
92          else if ( event.getSource() == boldButton )
93             field.setFont( boldFont );
94
95          // user clicked italicButton
96          else if ( event.getSource() == italicButton )
97             field.setFont( italicFont );
98
99          // user clicked boldItalicButton
100         else if ( event.getSource() == boldItalicButton )
101            field.setFont( boldItalicFont );
102      }
103
104   }  // end private inner class RadioButtonHandler
105
106 }  // end class RadioButtonTest
```

When user selects **JRadioButton**, **RadioButtonHandler** invokes method **itemStateChanged** of all registered listeners

Set font corresponding to **JRadioButton** selected

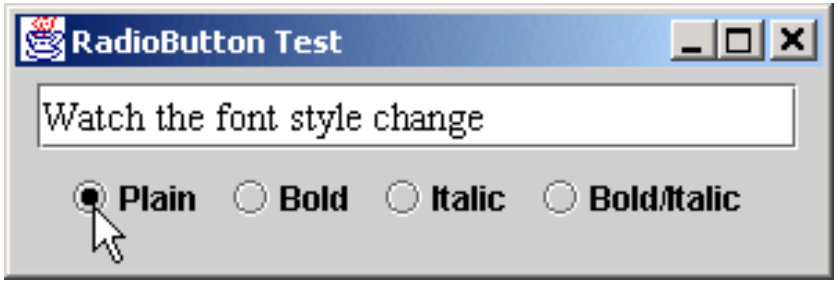
Outline

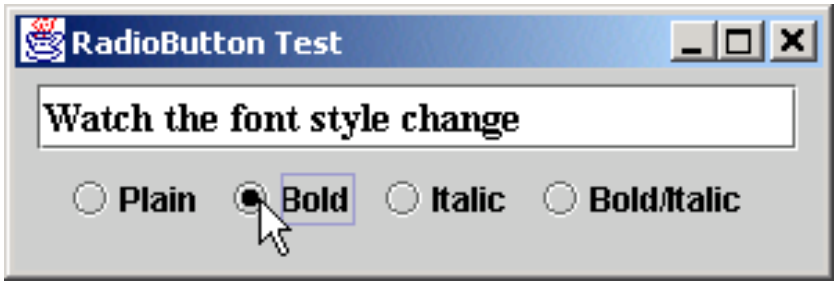
RadioButtonTest.java

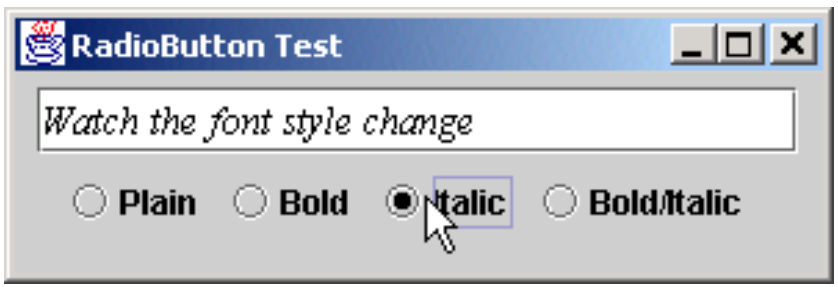
Lines 85-104

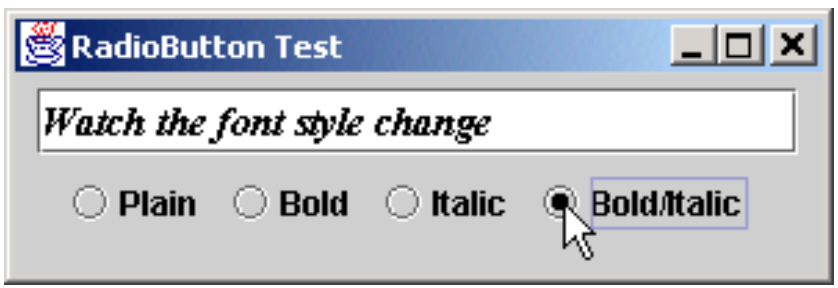
Lines 88-102

RadioButtonTest.java









12.8 JComboBox

- **JComboBox**
  - List of items from which user can select
  - Also called a ***drop-down list***

```
1  // Fig. 12.13: ComboBoxTest.java
2  // Using a JComboBox to select an image to display.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class ComboBoxTest extends JFrame {
12    private JComboBox imagesComboBox;
13    private JLabel label;
14
15    private String names[] =
16       { "bug1.gif", "bug2.gif",  "travelbug.gif", "buganim.gif" };
17    private Icon icons[] = { new ImageIcon( names[ 0 ] ),
18       new ImageIcon( names[ 1 ] ), new ImageIcon( names[ 2 ] ),
19       new ImageIcon( names[ 3 ] ) };
20
21    // set up GUI
22    public ComboBoxTest()
23    {
24       super( "Testing JComboBox" );
25
26       // get content pane and set its layout
27       Container container = getContentPane();
28       container.setLayout( new FlowLayout() );
29
30       // set up JComboBox and register its event handler
31       imagesComboBox = new JComboBox( names );
32       imagesComboBox.setMaximumRowCount( 3 );
33
34       imagesComboBox.addItemListener(
35
```

Instantiate **JComboBox** to show three **String**s from **names** array at a time

Register **JComboBox** to receive events from anonymous **ItemListener**

Outline

ComboBoxTest.java

Lines 31-32

Line 34

```
37          new ItemListener() {
38
39             // handle JComboBox event
40             public void itemStateChanged( ItemEvent event )
41             {
42                // determine whether check box selected
43                if ( event.getStateChange() == ItemEvent.SELECTED )
44                   label.setIcon( icons[
45                      imagesComboBox.getSelectedIndex() ] );
46             }
47
48          }  // end anonymous inner class
49
50       ); // end call to addItemListener
51
52       container.add( imagesComboBox );
53
54       // set up JLabel to display ImageIcons
55       label = new JLabel( icons[ 0 ] );
56       container.add( label );
57
58       setSize( 350, 100 );
59       setVisible( true );
60    }
61
62    // execute application
63    public static void main( String args[] )
64    {
65       ComboBoxTest application = new ComboBoxTest();
66
67       application.setDefaultCloseOperation(
68          JFrame.EXIT_ON_CLOSE );
69    }
70
71 }  // end class ComboBoxTest
```

When user selects item in **JComboBox**, **ItemListener** invokes method **itemStateChanged** of all registered listeners

Set appropriate **Icon** depending on user selection

Outline

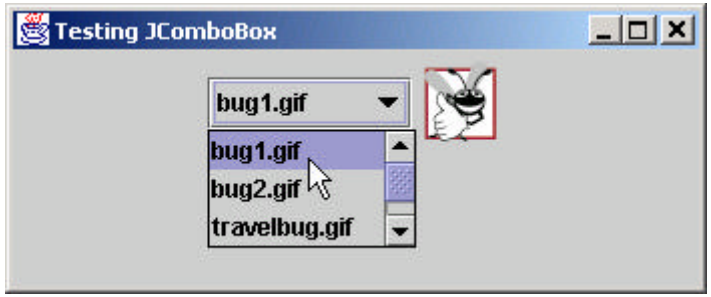
ComboBoxTest.java

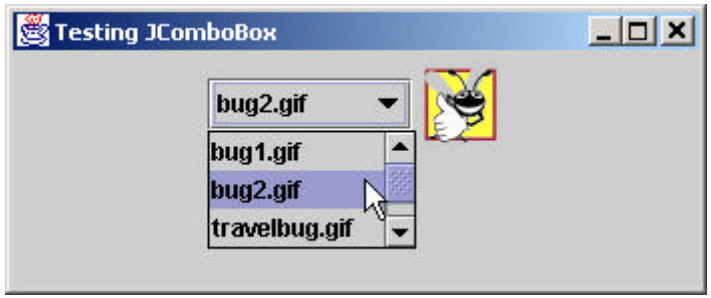
Lines 40-46

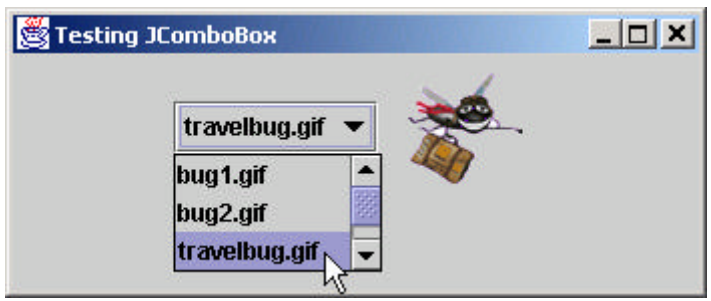
Lines 43-45

Outline

`ComboBoxTest.java`







12.9 JList

- List
  - Series of items
  - user can select one or more items
  - Single-selection vs. multiple-selection
  - **JList**

Outline

ListTest.java

Line 34

```
1  // Fig. 12.14: ListTest.java
2  // Selecting colors from a JList.
3
4  // Java core packages
5  import java.awt.*;
6
7  // Java extension packages
8  import javax.swing.*;
9  import javax.swing.event.*;
10
11 public class ListTest extends JFrame {
12    private JList colorList;
13    private Container container;
14
15    private String colorNames[] = { "Black", "Blue", "Cyan",
16       "Dark Gray", "Gray", "Green", "Light Gray", "Magenta",
17       "Orange", "Pink", "Red", "White", "Yellow" };
18
19    private Color colors[] = { Color.black, Color.blue,
20       Color.cyan, Color.darkGray, Color.gray, Color.green,
21       Color.lightGray, Color.magenta, Color.orange, Color.pink,
22       Color.red, Color.white, Color.yellow };
23
24    // set up GUI
25    public ListTest()
26    {
27       super( "List Test" );
28
29       // get content pane and set its layout
30       container = getContentPane();
31       container.setLayout( new FlowLayout() );
32
33       // create a list with items in colorNames array
34       colorList = new JList( colorNames );
35       colorList.setVisibleRowCount( 5 );
```

Use **colorNames** array to populate **JList**

```
36
37       // do not allow multiple selections
38       colorList.setSelectionMode(
39          ListSelectionModel.SINGLE_SELECTION );
40
41       // add a JScrollPane containing JList to content pane
42       container.add( new JScrollPane( colorList ) );
43
44       // set up event handler
45       colorList.addListSelectionListener(
46
47          // anonymous inner class for list selection events
48          new ListSelectionListener() {
49
50             // handle list selection events
51             public void valueChanged( ListSelectionEvent event )
52             {
53                container.setBackground(
54                   colors[ colorList.getSelectedIndex() ] );
55             }
56
57          }  // end anonymous inner class
58
59       ); // end call to addListSelectionListener
60
61       setSize( 350, 150 );
62       setVisible( true );
63    }
64
65    // execute application
66    public static void main( String args[] )
67    {
68       ListTest application = new ListTest();
69
```

Outline

`JList` allows single selections

Lines 38-39

Register **`JList`** to receive events from anonymous **`ListSelectionListener`**

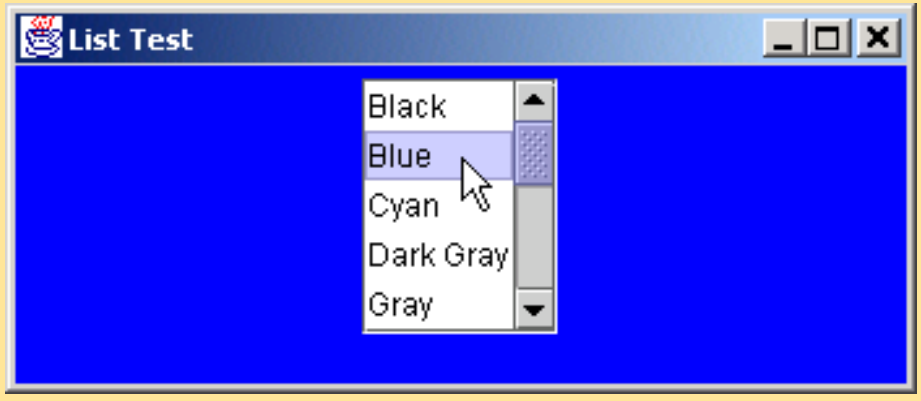
Lines 51-55

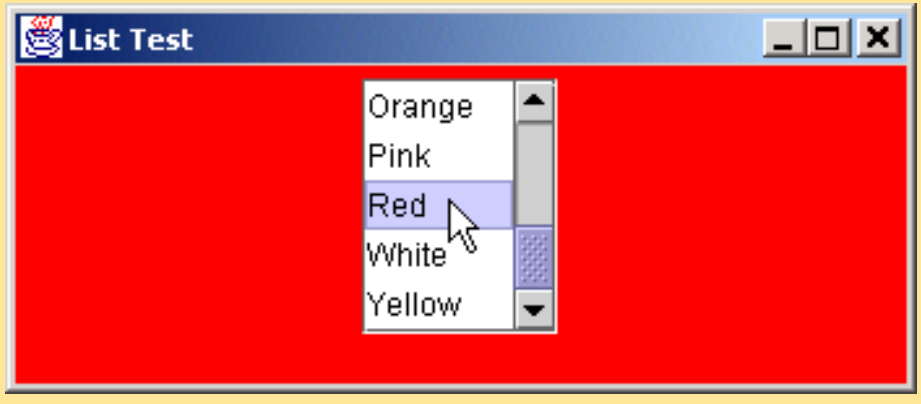
Lines 53-54

When user selects item in **`JList`**, **`ListSelectionListener`** invokes method **`valueChanged`** of all registered listeners

Set appropriate background depending on user selection

```
70          application.setDefaultCloseOperation(
71             JFrame.EXIT_ON_CLOSE );
72       }
73
74    }  // end class ListTest
```





Outline

ListTest.java

12.10 Multiple-Selection Lists

- Multiple-selection list
  - Select many items from **`Jlist`**
  - Allows continuous range selection

Outline

MultipleSelection.java

Line 29

Lines 32-33

```
1  // Fig. 12.15: MultipleSelection.java
2  // Copying items from one List to another.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class MultipleSelection extends JFrame {
12    private JList colorList, copyList;
13    private JButton copyButton;
14
15    private String colorNames[] = { "Black", "Blue", "Cyan",
16       "Dark Gray", "Gray", "Green", "Light Gray",
17       "Magenta", "Orange", "Pink", "Red", "White", "Yellow" };
18
19    // set up GUI
20    public MultipleSelection()
21    {
22       super( "Multiple Selection Lists" );
23
24       // get content pane and set its layout
25       Container container = getContentPane();
26       container.setLayout( new FlowLayout() );
27
28       // set up JList colorList
29       colorList = new JList( colorNames );
30       colorList.setVisibleRowCount( 5 );
31       colorList.setFixedCellHeight( 15 );
32       colorList.setSelectionMode(
33          ListSelectionModel.MULTIPLE_INTERVAL_SELECTION );
34       container.add( new JScrollPane( colorList ) );
35
```

Use **colorNames** array to populate **JList**

JList colorList allows multiple selections

```
36       // create copy button and register its listener
37       copyButton = new JButton( "Copy >>>" );
38
39       copyButton.addActionListener(
40
41          // anonymous inner class for button event
42          new ActionListener() {
43
44             // handle button event
45             public void actionPerformed( ActionEvent event )
46             {
47                // place selected values in copyList
48                copyList.setListData(
49                   colorList.getSelectedValues() );
50             }
51
52          }  // end anonymous inner class
53
54       ); // end call to addActionListener
55
56       container.add( copyButton );
57
58       // set up JList copyList
59       copyList = new JList();
60       copyList.setVisibleRowCount( 5 );
61       copyList.setFixedCellWidth( 100 );
62       copyList.setFixedCellHeight( 15 );
63       copyList.setSelectionMode(
64          ListSelectionModel.SINGLE_INTERVAL_SELECTION );
65       container.add( new JScrollPane( copyList ) );
66
67       setSize( 300, 120 );
68       setVisible( true );
69    }
70
```

When user presses **JButton**, **JList** **copyList** adds items that user selected from **JList** **colorList**

JList **colorList** allows single selections

Outline

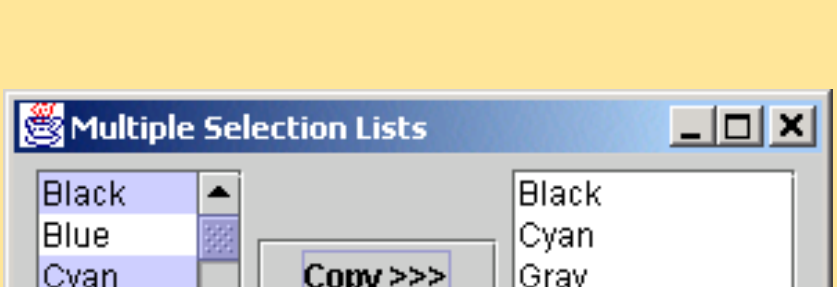
MultipleSelection.java

Lines 48-49

Outline

MultipleSelection.java

```
71    // execute application
72    public static void main( String args[] )
73    {
74       MultipleSelection application = new MultipleSelection();
75
76       application.setDefaultCloseOperation(
77          JFrame.EXIT_ON_CLOSE );
78    }
79
80 }  // end class MultipleSelection
```



12.11 Mouse Event Handling

- Event-listener interfaces for mouse events
  - **`MouseListener`**
  - **`MouseMotionListener`**
  - Listen for **`MouseEvent`**s

Fig. 12.16 `MouseListener` and `MouseMotionListener` interface methods

`MouseListener` and `MouseMotionListener` interface methods	
Methods of interface ***`MouseListener`***	
`public void mousePressed( MouseEvent event )`	Called when a mouse button is pressed with the mouse cursor on a component.
`public void mouseClicked( MouseEvent event )`	Called when a mouse button is pressed and released on a component without moving the mouse cursor.
`public void mouseReleased( MouseEvent event )`	Called when a mouse button is released after being pressed. This event is always preceded by a **`mousePressed`** event.
`public void mouseEntered( MouseEvent event )`	Called when the mouse cursor enters the bounds of a component.
`public void mouseExited( MouseEvent event )`	Called when the mouse cursor leaves the bounds of a component.
Methods of interface ***`MouseMotionListener`***	
`public void mouseDragged( MouseEvent event )`	Called when the mouse button is pressed with the mouse cursor on a component and the mouse is moved. This event is always preceded by a call to **`mousePressed`**.
`public void mouseMoved( MouseEvent event )`	Called when the mouse is moved with the mouse cursor on a component.

Fig. 12.16 **`MouseListener`** and **`MouseMotionListener`** interface methods.

```
1  // Fig. 12.17: MouseTracker.java
2  // Demonstrating mouse events.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class MouseTracker extends JFrame
12    implements MouseListener, MouseMotionListener {
13
14    private JLabel statusBar;
15
16    // set up GUI and register mouse event handlers
17    public MouseTracker()
18    {
19       super( "Demonstrating Mouse Events" );
20
21       statusBar = new JLabel();
22       getContentPane().add( statusBar, BorderLayout.SOUTH );
23
24       // application listens to its own mouse events
25       addMouseListener( this );
26       addMouseMotionListener( this );
27
28       setSize( 275, 100 );
29       setVisible( true );
30    }
31
32    // MouseListener event handlers
33
34    // handle event when mouse released immediately after press
35    public void mouseClicked( MouseEvent event )
```

Register **`JFrame`** to receive mouse events

Invoked when user presses and releases mouse button

Outline

`MouseTracker.java`

Lines 25-26

Line 35

```
36    {
37       statusBar.setText( "Clicked at [" + event.getX() +
38          ", " + event.getY() + "]" );
39    }
40
41    // handle event when mouse pressed
42    public void mousePressed( MouseEvent event )
43    {
44       statusBar.setText( "Pressed at [" + event.getX() +
45          ", " + event.getY() + "]" );
46    }
47
48    // handle event when mouse released after dragging
49    public void mouseReleased( MouseEvent event )
50    {
51       statusBar.setText( "Released at [" + event.getX() +
52          ", " + event.getY() + "]" );
53    }
54
55    // handle event when mouse enters area
56    public void mouseEntered( MouseEvent event )
57    {
58       JOptionPane.showMessageDialog( null, "Mouse in window" );
59    }
60
61    // handle event when mouse exits area
62    public void mouseExited( MouseEvent event )
63    {
64       statusBar.setText( "Mouse outside window" );
65    }
66
67    // MouseMotionListener event handlers
68
69    // handle event when user drags mouse with button pressed
70    public void mouseDragged( MouseEvent event )
```

Outline

MouseTracker.java

Invoked when user presses mouse button

Line 49

Invoked when user releases mouse button after dragging mouse

Line 62

Line 70

Invoked when mouse cursor enters **JFrame**

Invoked when mouse cursor exits **JFrame**

Invoked when user drags mouse cursor

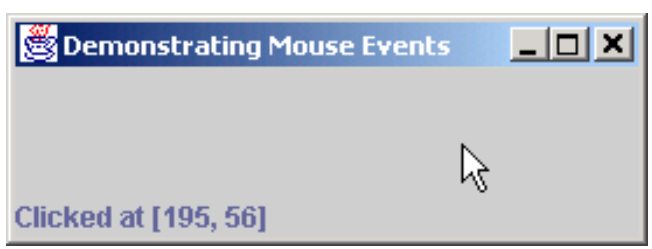
MouseTracker.java

```
71    {
72       statusBar.setText( "Dragged at [" + event.getX() +
73          ", " + event.getY() + "]" );
74    }
75
76    // handle event when user moves mouse
77    public void mouseMoved( MouseEvent event )
78    {
79       statusBar.setText( "Moved at [" + event.getX() +
80          ", " + event.getY() + "]" );
81    }
82
83    // execute application
84    public static void main( String args[] )
85    {
86       MouseTracker application = new MouseTracker();
87
88       application.setDefaultCloseOperation(
89          JFrame.EXIT_ON_CLOSE );
90    }
91
92 }  // end class MouseTracker
```

Invoked when user moves mouse cursor

Outline

`MouseTracker.java`



12.12 Adapter Classes

- Adapter class
  - Implements interface
  - Provides default implementation of each interface method
  - Used when all methods in interface is not needed

Fig. 12.18 Event adapter classes and the interfaces they implement.

Event adapter class	Implements interface
`ComponentAdapter`	`ComponentListener`
`ContainerAdapter`	`ContainerListener`
`FocusAdapter`	`FocusListener`
`KeyAdapter`	`KeyListener`
`MouseAdapter`	`MouseListener`
`MouseMotionAdapter`	`MouseMotionListener`
`WindowAdapter`	`WindowListener`

Fig. 12.18 Event adapter classes and the interfaces they implement.

Outline

Painter.java

Line 24

Lines 30-35

Lines 32-34

```
1  // Fig. 12.19: Painter.java
2  // Using class MouseMotionAdapter.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class Painter extends JFrame {
12    private int xValue = -10, yValue = -10;
13
14    // set up GUI and register mouse event handler
15    public Painter()
16    {
17       super( "A simple paint program" );
18
19       // create a label and place it in SOUTH of BorderLayout
20       getContentPane().add(
21          new Label( "Drag the mouse to draw" ),
22          BorderLayout.SOUTH );
23
24       addMouseMotionListener(
25
26          // anonymous inner class
27          new MouseMotionAdapter() {
28
29             // store drag coordinates and repaint
30             public void mouseDragged( MouseEvent event )
31             {
32                xValue = event.getX();
33                yValue = event.getY();
34                repaint();
35             }
```

Register **MouseMotionListener** to listen for window's mouse-motion events

Override method **mouseDragged**, but not method **mouseMoved**

Store coordinates where mouse was dragged, then repaint **JFrame**

```
36
37          }  // end anonymous inner class
38
39       ); // end call to addMouseMotionListener
40
41       setSize( 300, 150 );
42       setVisible( true );
43    }
44
45    // draw oval in a 4-by-4 bounding box at the specified
46    // location on the window
47    public void paint( Graphics g )
48    {
49       // we purposely did not call super.paint( g ) here to
50       // prevent repainting
51
52       g.fillOval( xValue, yValue, 4, 4 );
53    }
54
55    // execute application
56    public static void main( String args[] )
57    {
58       Painter application = new Painter();
59
60       application.addWindowListener(
61
62          // adapter to handle only windowClosing event
63          new WindowAdapter() {
64
65             public void windowClosing( WindowEvent event )
66             {
67                System.exit( 0 );
68             }
69
```

Draw circle of diameter **4** where user dragged cursor

Painter.java

```
70          }  // end anonymous inner class
71
72       ); // end call to addWindowListener
73    }
74
75 }  // end class Painter
```

Outline

MouseDetails.java

Line 21

```
1  // Fig. 12.20: MouseDetails.java
2  // Demonstrating mouse clicks and
3  // distinguishing between mouse buttons.
4
5  // Java core packages
6  import java.awt.*;
7  import java.awt.event.*;
8
9  // Java extension packages
10 import javax.swing.*;
11
12 public class MouseDetails extends JFrame {
13    private int xPos, yPos;
14
15    // set title bar String, register mouse listener and size
16    // and show window
17    public MouseDetails()
18    {
19       super( "Mouse clicks and buttons" );
20
21       addMouseListener( new MouseClickHandler() );
22
23       setSize( 350, 150 );
24       setVisible( true );
25    }
26
27    // draw String at location where mouse was clicked
28    public void paint( Graphics g )
29    {
30       // call superclass's paint method
31       super.paint( g );
32
33       g.drawString( "Clicked @ [" + xPos + ", " + yPos + "]",
34          xPos, yPos );
35    }
```

Register mouse listener

```
36
37    // execute application
38    public static void main( String args[] )
39    {
40       MouseDetails application = new MouseDetails();
41
42       application.setDefaultCloseOperation(
43          JFrame.EXIT_ON_CLOSE );
44    }
45
46    // inner class to handle mouse events
47    private class MouseClickHandler extends MouseAdapter {
48
49       // handle mouse click event and determine which mouse
50       // button was pressed
51       public void mouseClicked( MouseEvent event )
52       {
53          xPos = event.getX();
54          yPos = event.getY();
55
56          String title =
57             "Clicked " + event.getClickCount() + " time(s)";
58
59          // right mouse button
60          if ( event.isMetaDown() )
61             title += " with right mouse button";
62
63          // middle mouse button
64          else if ( event.isAltDown() )
65             title += " with center mouse button";
66
67          // left mouse button
68          else
69             title += " with left mouse button";
```

Outline

MouseDetails.java

Line 51

Lines 53-54

Invoke method **mouseClicked** when user clicks mouse

Lines 60-61

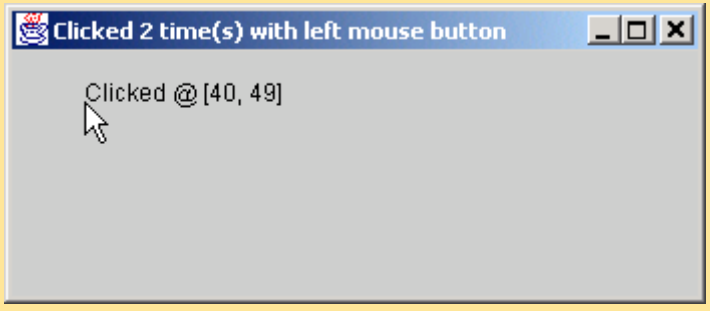
Store mouse-cursor coordinates where mouse was clicked

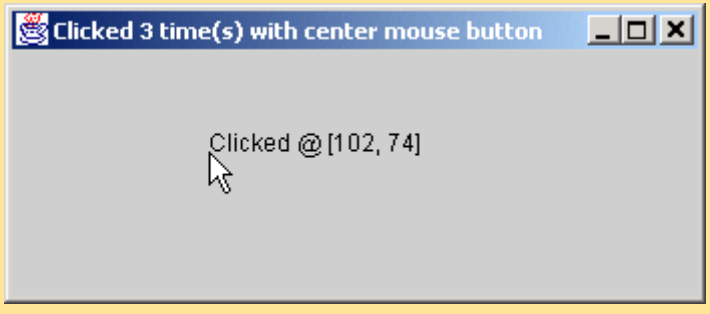
Determine number of times user has clicked mouse

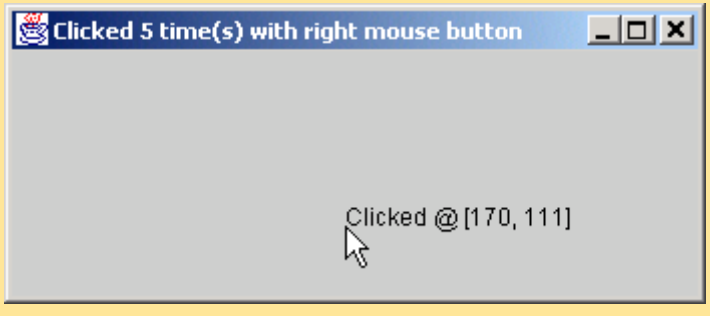
Determine if user clicked right mouse button

Determine if user clicked middle mouse button

```
70
71          setTitle( title );  // set title bar of window
72          repaint();
73       }
74
75    }  // end private inner class MouseClickHandler
76
77 }  // end class MouseDetails
```







Outline

MouseDetails.java

Fig. 12.21 `InputEvent` methods that help distinguish among left-, center- and right-mouse-button clicks.

`InputEvent` method	Description
`isMetaDown()`	This method returns **`true`** when the user clicks the right mouse button on a mouse with two or three buttons. To simulate a right-mouse-button click on a one-button mouse, the user can press the *Meta* key on the keyboard and click the mouse button.
`isAltDown()`	This method returns **`true`** when the user clicks the middle mouse button on a mouse with three buttons. To simulate a middle-mouse-button click on a one- or two-button mouse, the user can press the *Alt* key on the keyboard and click the mouse button.

Fig. 12.21 **`InputEvent`** methods that help distinguish among left-, center- and right-mouse-button clicks.

12.22 Keyboard Event Handling

- Interface **`KeyListener`**
  - Handles *key events*
    - Generated when keys on keyboard are pressed and released
    - **`KeyEvent`**
      - Contains *virtual key code* that represents key

```
1  // Fig. 12.22: KeyDemo.java
2  // Demonstrating keystroke events.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class KeyDemo extends JFrame implements KeyListener {
12    private String line1 = "", line2 = "";
13    private String line3 = "";
14    private JTextArea textArea;
15
16    // set up GUI
17    public KeyDemo()
18    {
19       super( "Demonstrating Keystroke Events" );
20
21       // set up JTextArea
22       textArea = new JTextArea( 10, 15 );
23       textArea.setText( "Press any key on the keyboard..." );
24       textArea.setEnabled( false );
25       getContentPane().add( textArea );
26
27       // allow frame to process Key events
28       addKeyListener( this );
29
30       setSize( 350, 100 );
31       setVisible( true );
32    }
33
34    // handle press of any key
35    public void keyPressed( KeyEvent event )
```

Register **`JFrame`** for key events

Called when user presses key

```
36    {
37       line1 = "Key pressed: " +
38          event.getKeyText( event.getKeyCode() );
39       setLines2and3( event );
40    }
41
42    // handle release of any key
43    public void keyReleased( KeyEvent event )
44    {
45       line1 = "Key released: " +
46          event.getKeyText( event.getKeyCode() );
47       setLines2and3( event );
48    }
49
50    // handle press of an action key
51    public void keyTyped( KeyEvent event )
52    {
53       line1 = "Key typed: " + event.getKeyChar();
54       setLines2and3( event );
55    }
56
57    // set second and third lines of output
58    private void setLines2and3( KeyEvent event )
59    {
60       line2 = "This key is " +
61          ( event.isActionKey() ? "" : "not " ) +
62          "an action key";
63
64       String temp =
65          event.getKeyModifiersText( event.getModifiers() );
66
67       line3 = "Modifier keys pressed: " +
68          ( temp.equals( "" ) ? "none" : temp );
69
```

Called when user releases key

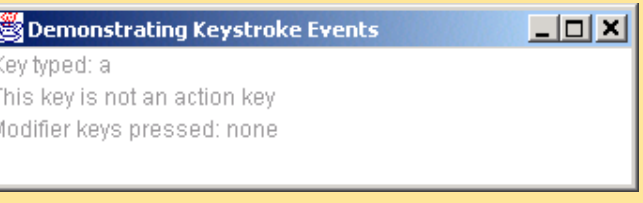
Return virtual key code

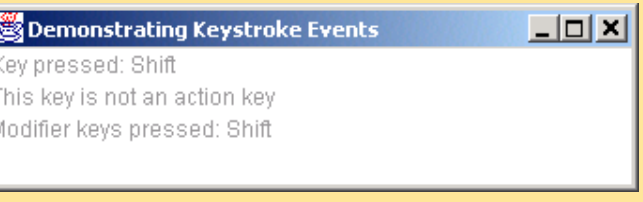
Called when user types key

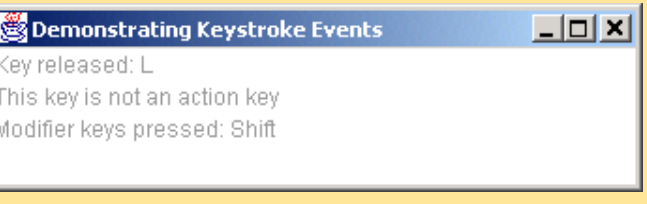
Determine if *modifier keys* (e.g., *Alt*, *Ctrl*, *Meta* and *Shift*) were used

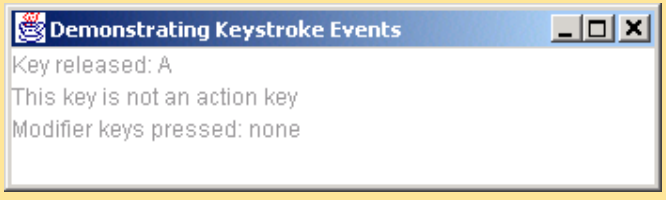
KeyDemo.java

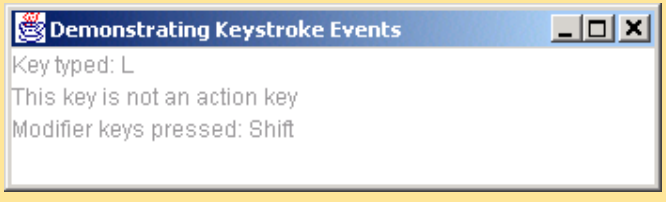
```
70        textArea.setText(
71           line1 + "\n" + line2 + "\n" + line3 + "\n" );
72     }
73
74     // execute application
75     public static void main( String args[] )
76     {
77        KeyDemo application = new KeyDemo();
78
79        application.setDefaultCloseOperation(
80           JFrame.EXIT_ON_CLOSE );
81     }
82
83  }  // end class KeyDemo
```

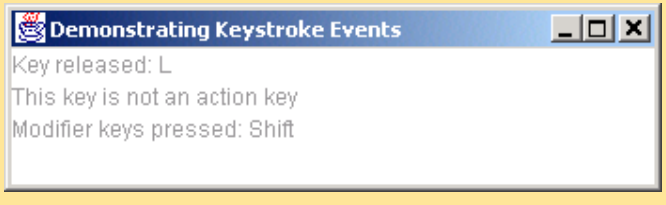


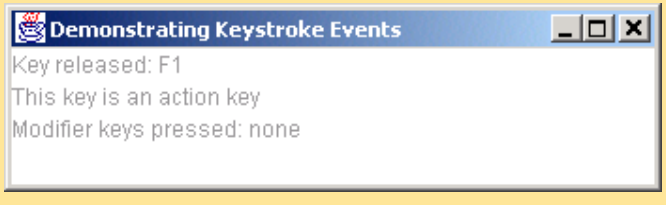












Outline

FlowLayoutDemo.java

Lines 21-25

```
1  // Fig. 12.24: FlowLayoutDemo.java
2  // Demonstrating FlowLayout alignments.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class FlowLayoutDemo extends JFrame {
12    private JButton leftButton, centerButton, rightButton;
13    private Container container;
14    private FlowLayout layout;
15
16    // set up GUI and register button listeners
17    public FlowLayoutDemo()
18    {
19       super( "FlowLayout Demo" );
20
21       layout = new FlowLayout();
22
23       // get content pane and set its layout
24       container = getContentPane();
25       container.setLayout( layout );
26
27       // set up leftButton and register listener
28       leftButton = new JButton( "Left" );
29
30       leftButton.addActionListener(
31
32          // anonymous inner class
33          new ActionListener() {
34
35             // process leftButton event
```

Set layout as **FlowLayout**

FlowLayoutDemo.java

```
36          public void actionPerformed( ActionEvent event )
37          {
38             layout.setAlignment( FlowLayout.LEFT );
39
40             // re-align attached components
41             layout.layoutContainer( container );
42          }
43
44       }  // end anonymous inner class
45
46    ); // end call to addActionListener
47
48    container.add( leftButton );
49
50    // set up centerButton and register listener
51    centerButton = new JButton( "Center" );
52
53    centerButton.addActionListener(
54
55       // anonymous inner class
56       new ActionListener() {
57
58          // process centerButton event
59          public void actionPerformed( ActionEvent event )
60          {
61             layout.setAlignment( FlowLayout.CENTER );
62
63             // re-align attached components
64             layout.layoutContainer( container );
65          }
66       }
67    );
68
69    container.add( centerButton );
70
```

When user presses left **JButton**, left align components

When user presses center **JButton**, center components

```
71       // set up rightButton and register listener
72       rightButton = new JButton( "Right" );
73
74       rightButton.addActionListener(
75
76          // anonymous inner class
77          new ActionListener() {
78
79             // process rightButton event
80             public void actionPerformed( ActionEvent event )
81             {
82                layout.setAlignment( FlowLayout.RIGHT );
83
84                // re-align attached components
85                layout.layoutContainer( container );
86             }
87          }
88       );
89
90       container.add( rightButton );
91
92       setSize( 300, 75 );
93       setVisible( true );
94    }
95
96    // execute application
97    public static void main( String args[] )
98    {
99       FlowLayoutDemo application = new FlowLayoutDemo();
100
101       application.setDefaultCloseOperation(
102          JFrame.EXIT_ON_CLOSE );
103    }
104
105 }  // end class FlowLayoutDemo
```

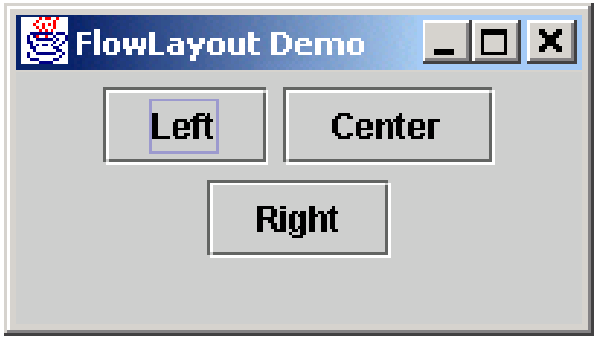
When user presses right **`JButton`**, right components

Outline

`FlowLayoutDemo.java`

Line 82

FlowLayoutDemo.java



```
1  // Fig. 12.25: BorderLayoutDemo.java
2  // Demonstrating BorderLayout.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class BorderLayoutDemo extends JFrame
12    implements ActionListener {
13
14    private JButton buttons[];
15    private String names[] = { "Hide North", "Hide South",
16       "Hide East", "Hide West", "Hide Center" };
17    private BorderLayout layout;
18
19    // set up GUI and event handling
20    public BorderLayoutDemo()
21    {
22       super( "BorderLayout Demo" );
23
24       layout = new BorderLayout( 5, 5 );
25
26       // get content pane and set its layout
27       Container container = getContentPane();
28       container.setLayout( layout );
29
30       // instantiate button objects
31       buttons = new JButton[ names.length ];
32
33       for ( int count = 0; count < names.length; count++ ) {
34          buttons[ count ] = new JButton( names[ count ] );
35          buttons[ count ].addActionListener( this );
```

Set layout as **`BorderLayout`** with 5-pixel horizontal and vertical gaps

Outline

`BorderLayoutDemo.jav`

Lines 24-28

Outline

```
36       }
37
38       // place buttons in BorderLayout; order not important
39       container.add( buttons[ 0 ], BorderLayout.NORTH );
40       container.add( buttons[ 1 ], BorderLayout.SOUTH );
41       container.add( buttons[ 2 ], BorderLayout.EAST );
42       container.add( buttons[ 3 ], BorderLayout.WEST );
43       container.add( buttons[ 4 ], BorderLayout.CENTER );
44
45       setSize( 300, 200 );
46       setVisible( true );
47    }
48
49    // handle button events
50    public void actionPerformed( ActionEvent event )
51    {
52       for ( int count = 0; count < buttons.length; count++ )
53
54          if ( event.getSource() == buttons[ count ] )
55             buttons[ count ].setVisible( false );
56          else
57             buttons[ count ].setVisible( true );
58
59       // re-layout the content pane
60       layout.layoutContainer( getContentPane() );
61    }
62
63    // execute application
64    public static void main( String args[] )
65    {
66       BorderLayoutDemo application = new BorderLayoutDemo();
```

BorderLayoutDemo.jav

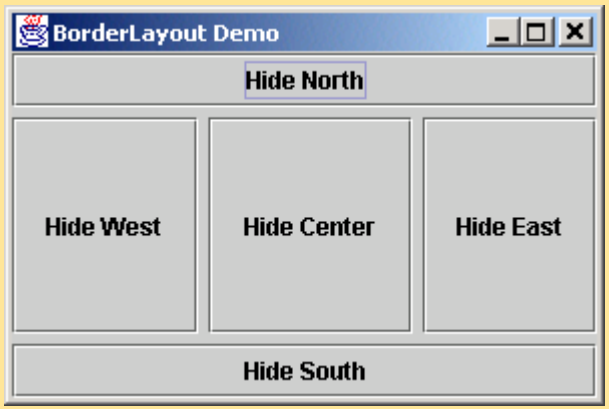
Place **JButton**s in regions specified by **BorderLayout**

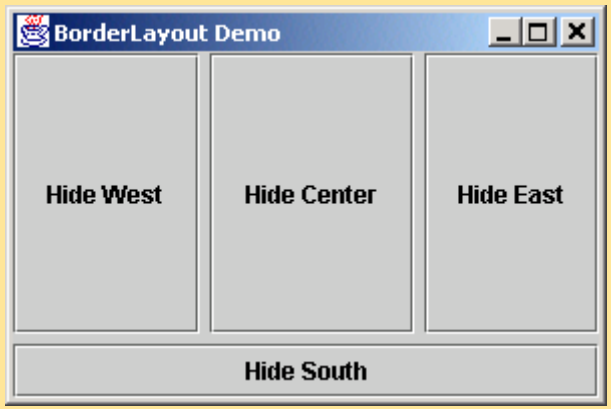
Lines 54-57

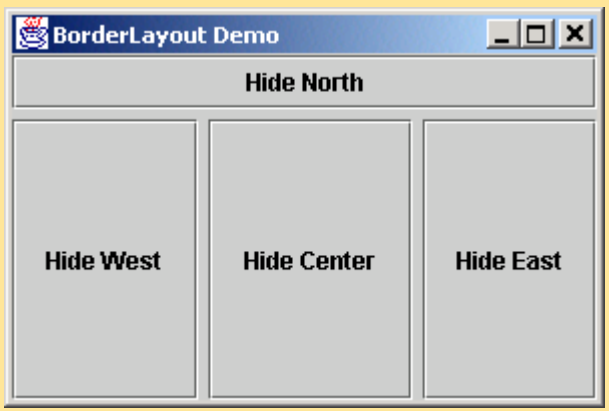
When **JButton**s are “invisible,” they are not displayed on screen, and **BorderLayout** rearranges

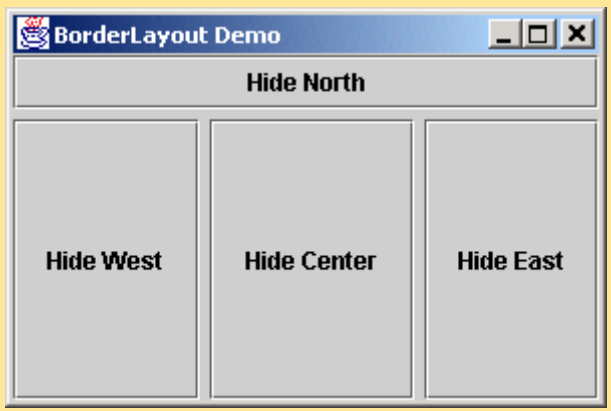
BorderLayoutDemo.jav

```
67
68          application.setDefaultCloseOperation(
69             JFrame.EXIT_ON_CLOSE );
70       }
71
72    }  // end class BorderLayoutDemo
```

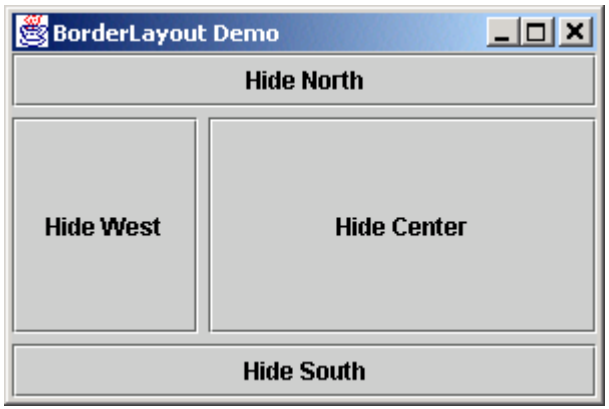


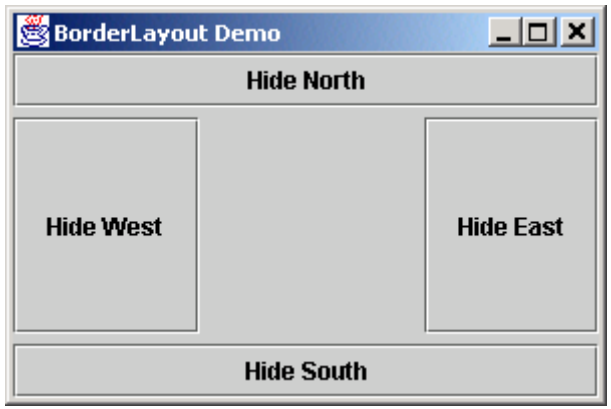






BorderLayoutDemo.jav





Outline

GridLayoutDemo.java

Line 27

Line 28

```
1  // Fig. 12.26: GridLayoutDemo.java
2  // Demonstrating GridLayout.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class GridLayoutDemo extends JFrame
12    implements ActionListener {
13
14    private JButton buttons[];
15    private String names[] =
16       { "one", "two", "three", "four", "five", "six" };
17    private boolean toggle = true;
18    private Container container;
19    private GridLayout grid1, grid2;
20
21    // set up GUI
22    public GridLayoutDemo()
23    {
24       super( "GridLayout Demo" );
25
26       // set up layouts
27       grid1 = new GridLayout( 2, 3, 5, 5 );
28       grid2 = new GridLayout( 3, 2 );
29
30       // get content pane and set its layout
31       container = getContentPane();
32       container.setLayout( grid1 );
33
34       // create and add buttons
35       buttons = new JButton[ names.length ];
```

Create **GridLayout grid1** with 2 rows and 3 columns

Create **GridLayout grid2** with 3 rows and 2 columns

Outline

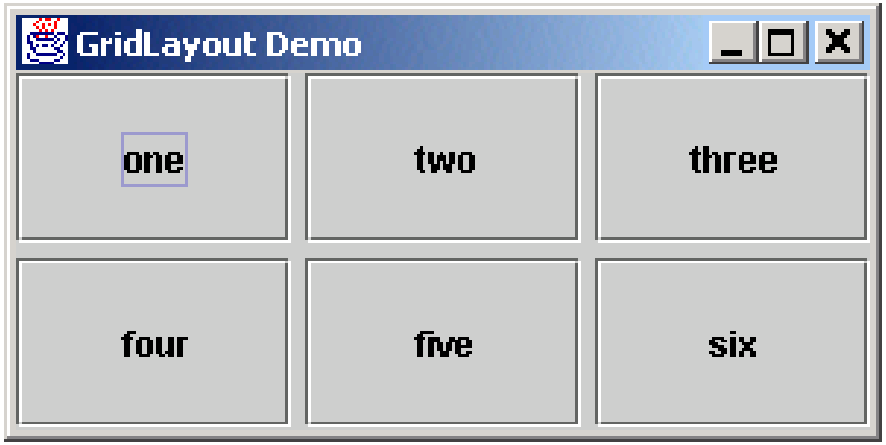
GridLayoutDemo.java

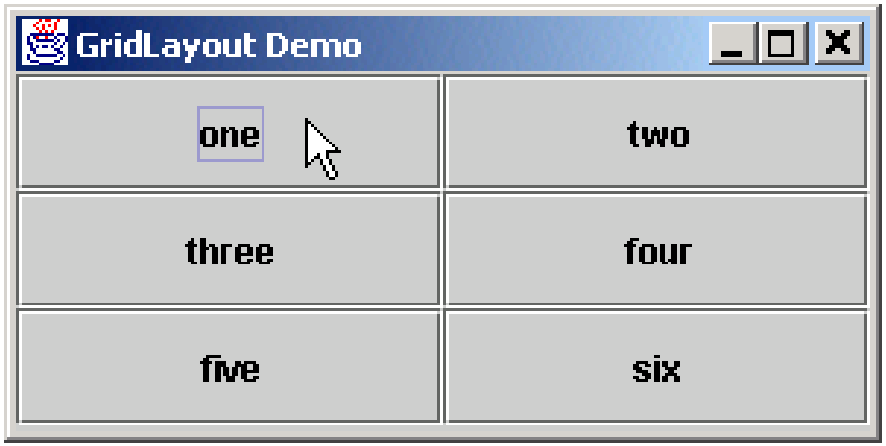
Lines 50-53

```
36
37       for ( int count = 0; count < names.length; count++ ) {
38          buttons[ count ] = new JButton( names[ count ] );
39          buttons[ count ].addActionListener( this );
40          container.add( buttons[ count ] );
41       }
42
43       setSize( 300, 150 );
44       setVisible( true );
45    }
46
47    // handle button events by toggling between layouts
48    public void actionPerformed( ActionEvent event )
49    {
50       if ( toggle )
51          container.setLayout( grid2 );
52       else
53          container.setLayout( grid1 );
54
55       toggle = !toggle;   // set toggle to opposite value
56       container.validate();
57    }
58
59    // execute application
60    public static void main( String args[] )
61    {
62       GridLayoutDemo application = new GridLayoutDemo();
63
64       application.setDefaultCloseOperation(
65          JFrame.EXIT_ON_CLOSE );
66    }
67
68 }  // end class GridLayoutDemo
```

Toggle current **GridLayout** when user presses **JButton**

GridLayoutDemo.java





```
1  // Fig. 12.27: PanelDemo.java
2  // Using a JPanel to help lay out components.
3
4  // Java core packages
5  import java.awt.*;
6  import java.awt.event.*;
7
8  // Java extension packages
9  import javax.swing.*;
10
11 public class PanelDemo extends JFrame {
12    private JPanel buttonPanel;
13    private JButton buttons[];
14
15    // set up GUI
16    public PanelDemo()
17    {
18       super( "Panel Demo" );
19
20       // get content pane
21       Container container = getContentPane();
22
23       // create buttons array
24       buttons = new JButton[ 5 ];
25
26       // set up panel and set its layout
27       buttonPanel = new JPanel();
28       buttonPanel.setLayout(
29          new GridLayout( 1, buttons.length ) );
30
31       // create and add buttons
32       for ( int count = 0; count < buttons.length; count++ ) {
33          buttons[ count ] =
34             new JButton( "Button " + ( count + 1 ) );
35          buttonPanel.add( buttons[ count ] );
```

Create **JPanel** to hold **JButton**s

Add **JButton**s to **JPanel**

Outline

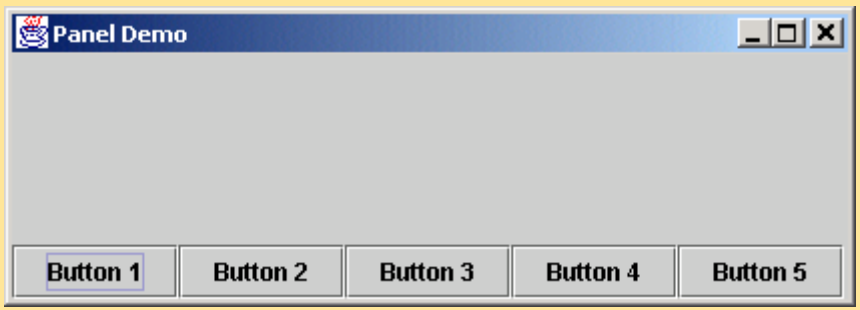
PanelDemo.java

Line 27

Line 35

```
36       }
37
38       container.add( buttonPanel, BorderLayout.SOUTH );
39
40       setSize( 425, 150 );
41       setVisible( true );
42    }
43
44    // execute application
45    public static void main( String args[] )
46    {
47       PanelDemo application = new PanelDemo();
48
49       application.setDefaultCloseOperation(
50          JFrame.EXIT_ON_CLOSE );
51    }
52
53 }  // end class PanelDemo
```

Add **JPanel** to **SOUTH** region of **Container**



Outline

PanelDemo.java

Line 38

12.12 (Optional Case Study) Thinking About Objects: Use Cases

- Use case
  - Represents capabilities that systems provide to clients
    - Automated-teller-machine use cases
      - “Deposit Money,” “Withdraw Money,” “Transfer Funds”

12.12 Thinking About Objects (cont.)

- Use-case diagram
  - Models use cases in system
  - Facilitates system-requirements gathering
  - Notation
    - Stick figure represents *actor*
      - Actor represents set of roles that *external entity* can play
    - *System box* (rectangle) contains system use cases
    - Ovals represent use cases

12.12 Thinking About Objects (cont.)

- Elevator-simulation use cases
  - "Create Person"
    - From user's perspective
  - "Relocate Person" (move to other floor)
    - From **`Person`**'s perspective
- Constructing GUI
  - Use "Create Person" use case

Fig. 12.28 Use-case diagram for elevator simulation from user's perspective

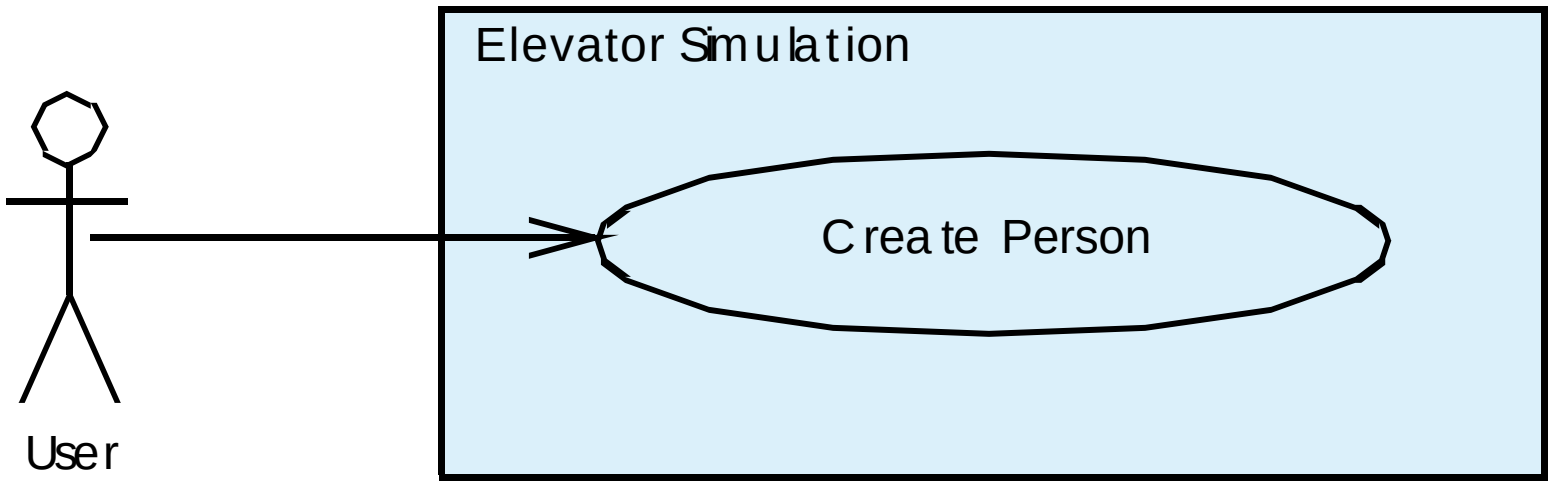
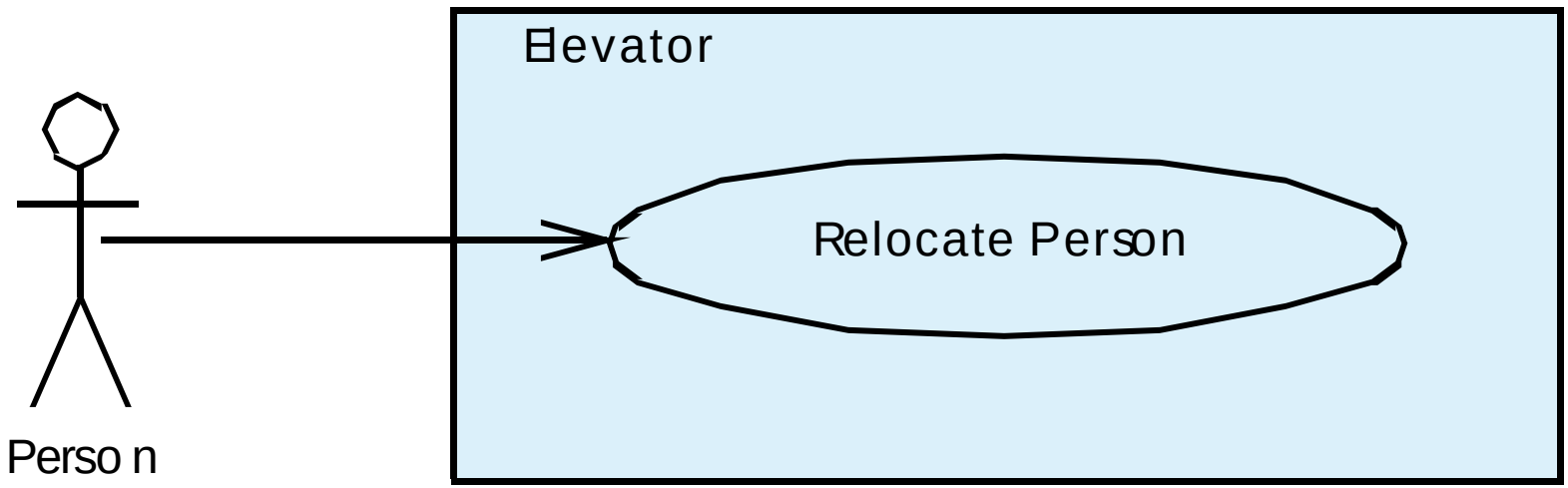


Fig. 12.28 Use-case diagram from the perspective of a Person



Outline

ElevatorControlle
.java

Line 17

Lines 21-22

```
1  // ElevatorController.java
2  // Controller for Elevator Simulation
3  package com.deitel.jhtp4.elevator.controller;
4
5  // Java core packages
6  import java.awt.*;
7  import java.awt.event.*;
8
9   // Java extension packages
10 import javax.swing.*;
11
12 // Deitel packages
13 import com.deitel.jhtp4.elevator.model.*;
14 import com.deitel.jhtp4.elevator.event.*;
15 import com.deitel.jhtp4.elevator.ElevatorConstants;
16
17 public class ElevatorController extends JPanel
18    implements ElevatorConstants {
19
20    // controller contains two JButtons
21    private JButton firstControllerButton;
22    private JButton secondControllerButton;
23
24    // reference to model
25    private ElevatorModel elevatorModel;
26
27    public ElevatorController( ElevatorModel model )
28    {
29       elevatorModel = model;
30       setBackground( Color.white );
31
32       // add first button to controller
33       firstControllerButton = new JButton( "First Floor" );
34       add( firstControllerButton );
35
```

ElevatorController
GUI for elevator simulation

JButtons for creating **Person**s on **Floor**

```
36    // add second button to controller
37    secondControllerButton = new JButton( "Second Floor" );
38    add( secondControllerButton );
39
40    // anonymous inner class registers to receive ActionEvents
41    // from first Controller JButton
42    firstControllerButton.addActionListener(
43       new ActionListener() {
44
45          // invoked when a JButton has been pressed
46          public void actionPerformed( ActionEvent event )
47          {
48             // place Person on first Floor
49             elevatorModel.addPerson(
50                FIRST_FLOOR_NAME );
51
52             // disable user input
53             firstControllerButton.setEnabled( false );
54          }
55       } // end anonymous inner class
56    );
57
58    // anonymous inner class registers to receive ActionEvents
59    // from second Controller JButton
60    secondControllerButton.addActionListener(
61       new ActionListener() {
62
63          // invoked when a JButton has been pressed
64          public void actionPerformed( ActionEvent event )
65          {
66             // place Person on second Floor
67             elevatorModel.addPerson(
68                SECOND_FLOOR_NAME );
69
70             // disable user input
```

Outline

ElevatorControlle
.java

Lines 42-43 and 60-6

Lines 49-50 and 67-6

Register **JButton**s with separate anonymous **ActionListener**s

Add **Person** to respective **Floor**, depending on **JButton** that user pressed

Disable **JButton** after **Person** is created (so user cannot create more than one **Person** on **Floor**)

```
71             secondControllerButton.setEnabled( false );
72          }
73       } // end anonymous inner class
74    );
75
76    // anonymous inner class enables user input on Floor if
77    // Person enters Elevator on that Floor
78    elevatorModel.addPersonMoveListener(
79       new PersonMoveListener() {
80
81          // invoked when Person has entered Elevator
82          public void personEntered(
83             PersonMoveEvent event )
84          {
85             // get Floor of departure
86             String location =
87                event.getLocation().getLocationName();
88
89             // enable first JButton if first Floor departure
90             if ( location.equals( FIRST_FLOOR_NAME ) )
91                firstControllerButton.setEnabled( true );
92
93             // enable second JButton if second Floor
94             else
95                secondControllerButton.setEnabled( true );
96
97          } // end method personEntered
98
99          // other methods implementing PersonMoveListener
100         public void personCreated(
101            PersonMoveEvent event ) {}
102
103         public void personArrived(
104            PersonMoveEvent event ) {}
105
```

Outline

ElevatorControlle
.java

Lines 78-79

Enable **ElevatorModel** to listener for **PersonMoveEvent**s

Enable **JButton** after **Person** enters **Elevator** (so user can create another **Person**)

```
106             public void personExited(
107                PersonMoveEvent event ) {}
108
109             public void personDeparted(
110                PersonMoveEvent event ) {}
111
112             public void personPressedButton(
113                PersonMoveEvent event ) {}
114
115          } // end anonymous inner class
116       );
117    } // end ElevatorController constructor
118 }
```

Outline

ElevatorControlle
.java

Outline

ElevatorConstants.java

Lines 7-9

```
1  // ElevatorConstants.java
2  // Constants used between ElevatorModel and ElevatorView
3  package com.deitel.jhtp4.elevator;
4
5  public interface ElevatorConstants {
6
7     public static final String FIRST_FLOOR_NAME = "firstFloor";
8     public static final String SECOND_FLOOR_NAME = "secondFloor";
9     public static final String ELEVATOR_NAME = "elevator";
10 }
```

Classes use these constants to refer to **`Location`**s

12.12 Thinking About Objects (cont.)

- Classes **`Location`**
  - Subclasses **`Elevator`** and **`Floor`**
    - Attribute **`capacity`** no longer needed

Fig. 12.32 Modfied class diagram showing generalization of superclass `Location` and subclasses `Elevator` and `Floor`.