Lecture 10a

GUI Components: Part 1

OBJECTIVES

In this lecture you will learn:

- The design principles of graphical user interfaces (GUIs).
- To build GUIs and handle events generated by user interactions with GUIs.
- To understand the packages containing GUI components, event-handling classes and interfaces.
- To create and manipulate buttons, labels, lists, text fields and panels.
- To handle mouse events and keyboard events.
- To use layout managers to arrange GUI components

Outline

Outline

11.1 Introduction

- **Graphical user interface (GUI)**
  - **Presents a user-friendly mechanism for interacting with an application**
  - **Often contains title bar, menu bar containing menus, buttons and combo boxes**
  - **Built from GUI components**

Look-and-Feel Observation 11.1

Consistent user interfaces enable a user to learn new applications faster.

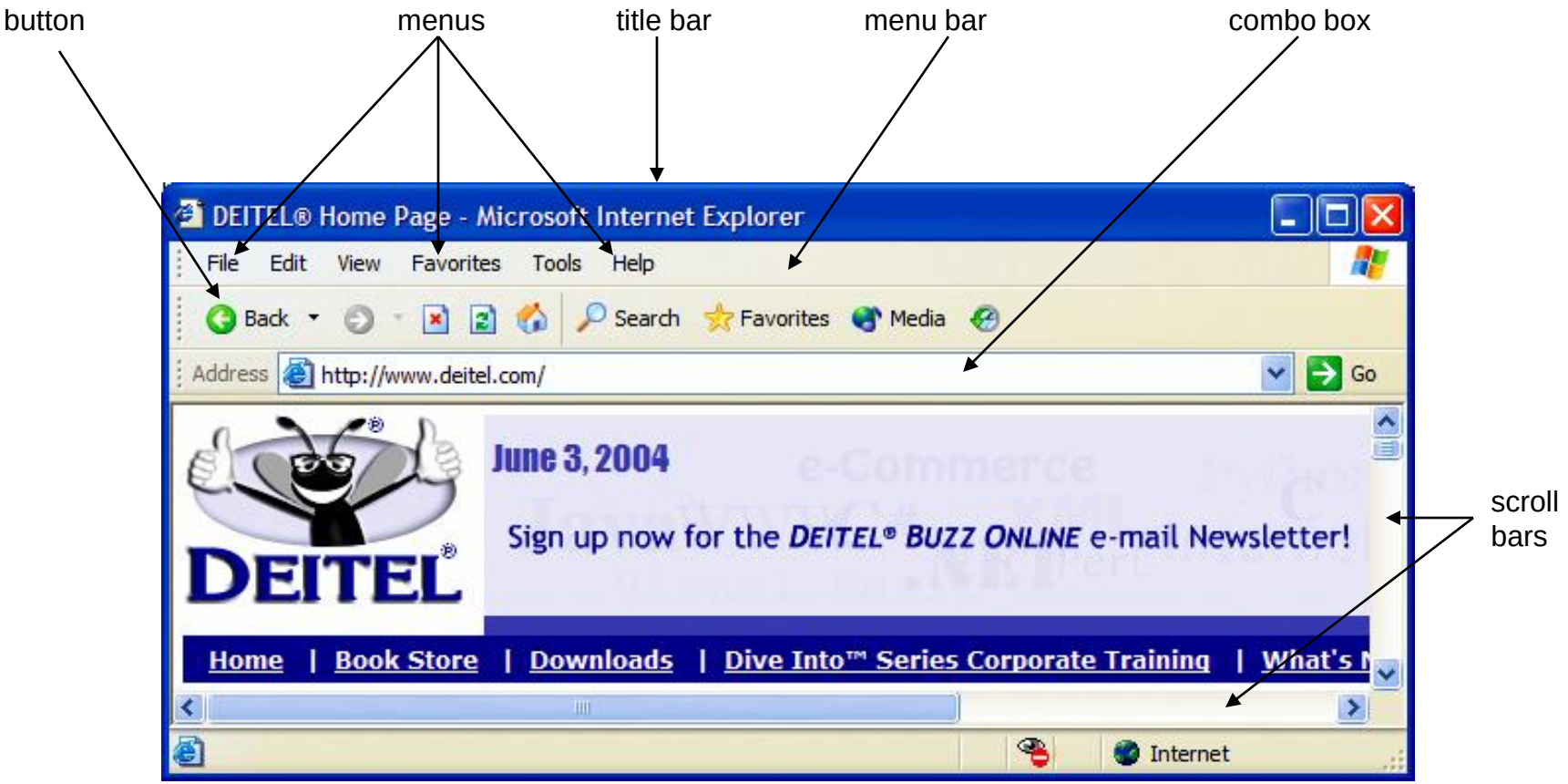


Fig. 11.1 | Internet Explorer window with GUI components.

11.2 Simple GUI-Based Input/Output with `JOptionPane`

- **Dialog boxes**
  - **Used by applications to interact with the user**
  - **Provided by Java's `JOptionPane` class**
    - **Contains input dialogs and message dialogs**

Outline

```java
// Fig. 11.2: Addition.java
// Addition program that uses JOptionPane for input and output.
import javax.swing.JOptionPane; // program uses JOptionPane

public class Addition
{
   public static void main( String args[] )
   {
      // obtain user input from JOptionPane input dialogs
      String firstNumber =
         JOptionPane.showInputDialog( "Enter first int
      String secondNumber =
          JOptionPane.showInputDialog( "Enter second integer" );

      // convert String inputs to int values for use in a calculation
      int number1 = Integer.parseInt( firstNumber );
      int number2 = Integer.parseInt( secondNumber );

      int sum = number1 + number2; // add numbers

      // display result in a JOptionPane message dialog
      JOptionPane.showMessageDialog( null, "The sum is " + sum,
         "Sum of Two Integers", JOptionPane.PLAIN_MESSAGE );
   } // end method main
} // end class Addition
```

Show input dialog to receive first integer

Show input dialog to receive second integer

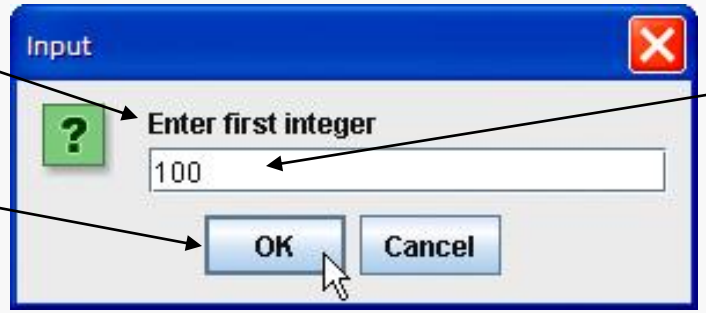
Show message dialog to output sum to user

Outline

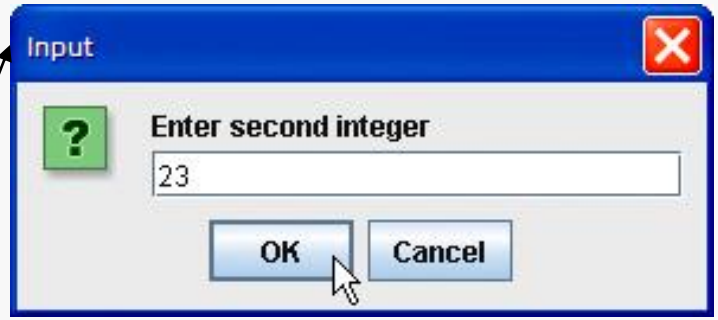
`Addition.java`

(2 of 2)

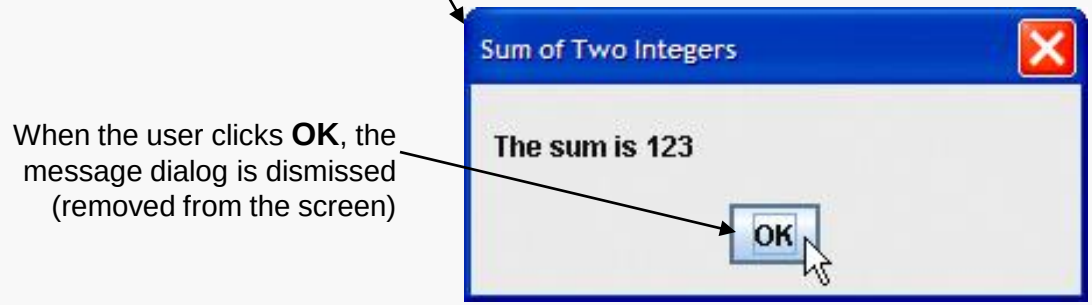
Input dialog displayed by lines 10–11



Input dialog displayed by lines 12–13



Message dialog displayed by lines 22–23



Look-and-Feel Observation 11.2

The prompt in an input dialog typically uses *sentence-style capitalization*—a style that capitalizes only the first letter of the first word in the text unless the word is a proper noun (for example, Deitel).

Look-and-Feel Observation 11.3

The title bar of a window typically uses *book-title capitalization*—a style that capitalizes the first letter of each significant word in the text and does not end with any punctuation (for example, Capitalization in a Book Title).

Message dialog type	Icon	Description
`ERROR_MESSAGE`		A dialog that indicates an error to the user.
`INFORMATION_MESSAGE`		A dialog with an informational message to the user.
`WARNING_MESSAGE`		A dialog warning the user of a potential problem.
`QUESTION_MESSAGE`		A dialog that poses a question to the user. This dialog normally requires a response, such as clicking a `Yes` or a `No` button.
`PLAIN_MESSAGE`	no icon	A dialog that contains a message, but no icon.

Fig. 11.3 | `JOptionPane` `static` constants for message dialogs.

11.3 Overview of Swing Components

- **Swing GUI components**
  - **Declared in package `javax.swing`**
  - **Most are pure Java components**
  - **Part of the Java Foundation Classes (JFC)**

Component	Description
`JLabel`	Displays uneditable text or icons.
`JTextField`	Enables user to enter data from the keyboard. Can also be used to display editable or uneditable text.
`JButton`	Triggers an event when clicked with the mouse.
`JCheckBox`	Specifies an option that can be selected or not selected.
`JComboBox`	Provides a drop-down list of items from which the user can make a selection by clicking an item or possibly by typing into the box.
`JList`	Provides a list of items from which the user can make a selection by clicking on any item in the list. Multiple elements can be selected.
`JPanel`	Provides an area in which components can be placed and organized. Can also be used as a drawing area for graphics.

Fig. 11.4 | Some basic GUI components.

Swing vs. AWT

- **Abstract Window Toolkit (AWT)**
  - **Precursor to Swing**
  - **Declared in package `java.awt`**
  - **Does not provide consistent, cross-platform look-and-feel**

Portability Tip 11.1

Swing components are implemented in Java, so they are more portable and flexible than the original Java GUI components from package `java.awt`, which were based on the GUI components of the underlying platform. For this reason, Swing GUI components are generally preferred.

Lightweight vs. Heavyweight GUI Components

- **Lightweight components**
  - **Not tied directly to GUI components supported by underlying platform**
- **Heavyweight components**
  - **Tied directly to the local platform**
  - **AWT components**
  - **Some Swing components**

Look-and-Feel Observation 11.4

The look and feel of a GUI defined with heavyweight GUI components from package `java.awt` may vary across platforms. Because heavyweight components are tied to the local-platform GUI, the look and feel varies from platform to platform.

Superclasses of Swing's Lightweight GUI Components

- **Class `Component` (package `java.awt`)**
  - **Subclass of `Object`**
  - **Declares many behaviors and attributes common to GUI components**
- **Class `Container` (package `java.awt`)**
  - **Subclass of `Component`**
  - **Organizes `Components`**
- **Class `JComponent` (package `javax.swing`)**
  - **Subclass of `Container`**
  - **Superclass of all lightweight Swing components**

Software Engineering Observation 11.1

Study the attributes and behaviors of the classes in the class hierarchy of Fig. 11.5. These classes declare the features that are common to most Swing components.

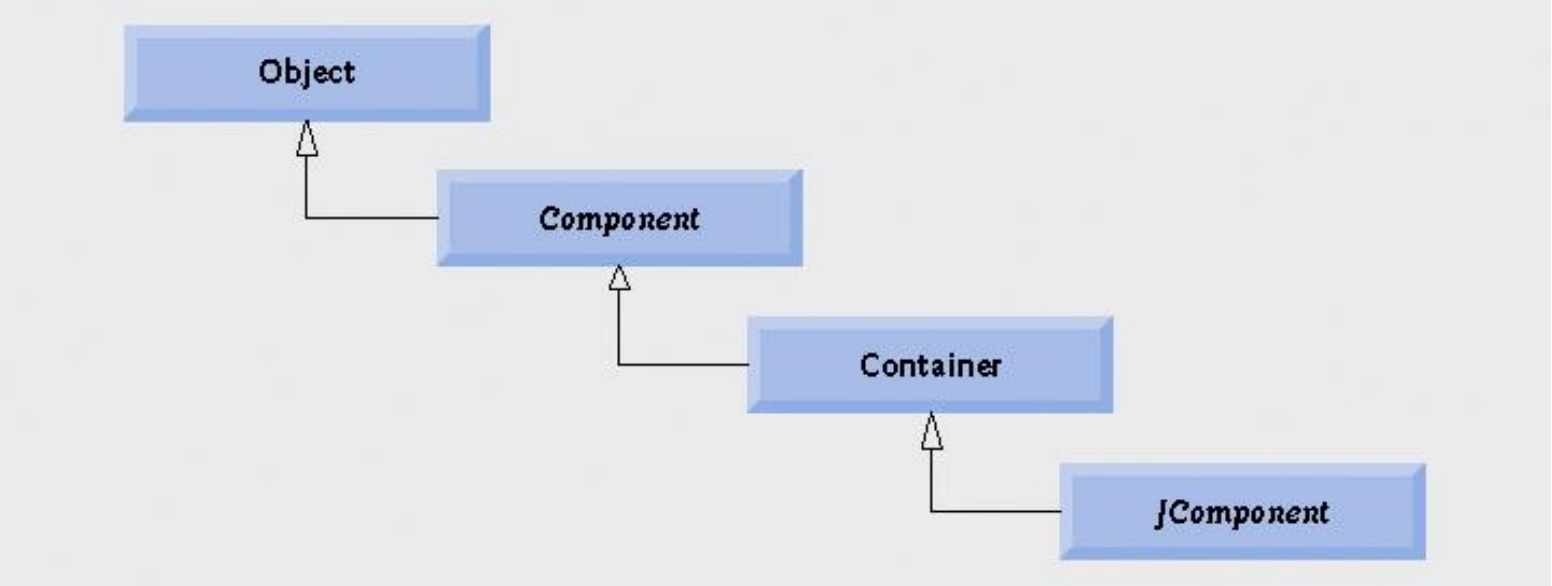


Fig. 11.5 | Common superclasses of many of the Swing components.

Superclasses of Swing's Lightweight GUI Components

- **Common lightweight component features**
  - **Pluggable look-and-feel to customize the appearance of components**
  - **Shortcut keys (called mnemonics)**
  - **Common event-handling capabilities**
  - **Brief description of component's purpose (called tool tips)**
  - **Support for localization**

11.4 Displaying Text and Images in a Window

- Class `JFrame`
  - Most windows are an instance or subclass of this class
  - Provides title bar
  - Provides buttons to minimize, maximize and close the application

Labeling GUI Components

- **Label**
  - **Text instructions or information stating the purpose of each component**
  - **Created with class `JLabel`**

Look-and-Feel Observation 11.5

Text in a `JLabel` normally uses sentence-style capitalization.

Specifying the Layout

- **Laying out containers**
  - **Determines where components are placed in the container**
  - **Done in Java with layout managers**
    - **One of which is class `FlowLayout`**
  - **Set with the `setLayout` method of class `JFrame`**

Outline

LabelFrame.java

(1 of 2)

```
1  // Fig. 11.6: LabelFrame.java
2  // Demonstrating the JLabel class.
3  import java.awt.FlowLayout; // specifies how components are arranged
4  import javax.swing.JFrame; // provides basic window features
5  import javax.swing.JLabel; // displays text and images
6  import javax.swing.SwingConstants; // common constants used with Swing
7  import javax.swing.Icon; // interface used to manipulate images
8  import javax.swing.ImageIcon; // loads images
9
10 public class LabelFrame extends JFrame
11 {
12    private JLabel label1; // JLabel with just text
13    private JLabel label2; // JLabel constructed with text and icon
14    private JLabel label3; // JLabel with added text and icon
15
16    // LabelFrame constructor adds JLabels to JFrame
17    public LabelFrame()
18    {
19       super( "Testing JLabel" );
20       setLayout( new FlowLayout() ); // set frame layout
21
22       // JLabel constructor with a string argument
23       label1 = new JLabel( "Label with text" );
24       label1.setToolTipText( "This is label1" );
25       add( label1 ); // add label1 to JFrame
26
```

Outline

LabelFrame.java

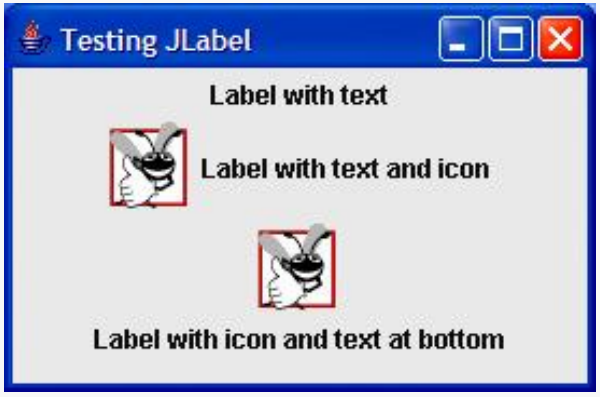
(2 of 2)

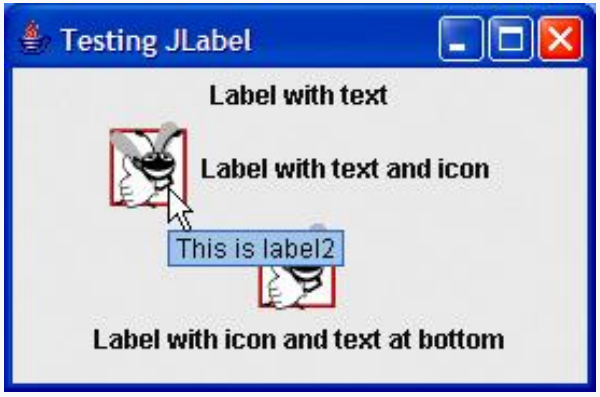
```
27       // JLabel constructor with string, Icon and alignment arguments
28       Icon bug = new ImageIcon( getClass().getResource(  "bug1.gif" ) );
29       label2 = new JLabel( "Label with text and icon", bug,
30          SwingConstants.LEFT );
31       label2.setToolTipText( "This is label2" );
32       add( label2 ); // add label2 to JFrame
33
34       label3 = new JLabel(); // JLabel constructor no arguments
35       label3.setText( "Label with icon and text at bottom" );
36       label3.setIcon( bug ); // add icon to JLabel
37       label3.setHorizontalTextPosition( SwingConstants.CENTER );
38       label3.setVerticalTextPosition( SwingConstants.BOTTOM );
39       label3.setToolTipText( "This is label3" );
40       add( label3 ); // add label3 to JFrame
41    } // end LabelFrame constructor
42 } // end class LabelFrame
```

Outline

LabelTest.java

```
1  // Fig. 11.7: LabelTest.java
2  // Testing LabelFrame.
3  import javax.swing.JFrame;
4
5  public class LabelTest
6  {
7     public static void main( String args[] )
8     {
9        LabelFrame labelFrame = new LabelFrame(); // create LabelFrame
10       labelFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       labelFrame.setSize( 275, 180 ); // set frame size
12       labelFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class LabelTest
```





Creating and Attaching `label1`

- **Method `setToolTipText` of class `JComponent`**
  - **Specifies the tool tip**
- **Method `add` of class `Container`**
  - **Adds a component to a container**

Common Programming Error 11.1

If you do not explicitly add a GUI component to a container, the GUI component will not be displayed when the container appears on the screen.

Look-and-Feel Observation 11.6

Use tool tips to add descriptive text to your GUI components. This text helps the user determine the GUI component's purpose in the user interface.

Creating and Attaching `label2`

- **Interface `Icon`**
  - **Can be added to a `JLabel` with the `setIcon` method**
  - **Implemented by class `ImageIcon`**
- **Interface `SwingConstants`**
  - **Declares a set of common integer constants such as those used to set the alignment of components**
  - **Can be used with methods `setHorizontalAlignment` and `setVerticalAlignment`**

Creating and Attaching `label3`

- **Other `JLabel` methods**
  - `getText` **and** `setText`
    - **For setting and retrieving the text of a label**
  - `getIcon` **and** `setIcon`
    - **For setting and retrieving the icon displayed in the label**
  - `getHorizontalTextPosition` **and** `setHorizontalTextPosition`
    - **For setting and retrieving the horizontal position of the text displayed in the label**

Constant	Description
Horizontal-position constants	
`SwingConstants.LEFT`	**Place text on the left.**
`SwingConstants.CENTER`	**Place text in the center.**
`SwingConstants.RIGHT`	**Place text on the right.**
Vertical-position constants	
`SwingConstants.TOP`	**Place text at the top.**
`SwingConstants.CENTER`	**Place text in the center.**
`SwingConstants.BOTTOM`	**Place text at the bottom.**

Fig. 11.8 | **Some basic GUI components.**

Creating and Displaying a `LabelFrame` Window

- **Other `JFrame` methods**
  - `setDefaultCloseOperation`
    - **Dictates how the application reacts when the user clicks the close button**
  - `setSize`
    - **Specifies the width and height of the window**
  - `setVisible`
    - **Determines whether the window is displayed (`true`) or not (`false`)**

11.5 Text Fields and an Introduction to Event Handling with Nested Classes

- **GUIs are event-driven**
  - **A user interaction creates an event**
    - **Common events are clicking a button, typing in a text field, selecting an item from a menu, closing and window and moving the mouse**
  - **The event causes a call to a method called an event handler**

11.5 Text Fields and an Introduction to Event Handling with Nested Classes

- Class `JTextComponent`
  - Superclass of `JTextField`
    - Superclass of `JPasswordField`
      - Adds echo character to hide text input in component
  - Allows user to enter text in the component when component has the application's focus

Outline

TextFieldFrame.java

(1 of 3)

```
1  // Fig. 11.9: TextFieldFrame.java
2  // Demonstrating the JTextField class.
3  import java.awt.FlowLayout;
4  import java.awt.event.ActionListener;
5  import java.awt.event.ActionEvent;
6  import javax.swing.JFrame;
7  import javax.swing.JTextField;
8  import javax.swing.JPasswordField;
9  import javax.swing.JOptionPane;
10
11 public class TextFieldFrame extends JFrame
12 {
13    private JTextField textField1; // text field with set size
14    private JTextField textField2; // text field constructed with text
15    private JTextField textField3; // text field with text and size
16    private JPasswordField passwordField; // password field with text
17
18    // TextFieldFrame constructor adds JTextFields to JFrame
19    public TextFieldFrame()
20    {
21       super( "Testing JTextField and JPasswordField" );
22       setLayout( new FlowLayout() ); // set frame layout
23
24       // construct textfield with 10 columns
25       textField1 = new JTextField( 10 );
26       add( textField1 ); // add textField1 to JFrame
27
```

Create a new `JTextField`

Outline

TextFieldFrame.java
(2 of 3)

```
28       // construct textfield with default text
29       textField2 = new JTextField( "Enter text here" );
30       add( textField2 ); // add textField2 to JFrame
31
32       // construct textfield with default text and 21 columns
33       textField3 = new JTextField( "Uneditable text field", 21 );
34       textField3.setEditable( false ); // disable editing
35       add( textField3 ); // add textField3 to JFrame
36
37       // construct passwordfield with default text
38       passwordField = new JPasswordField( "Hidden text" );
39       add( passwordField ); // add passwordField to JF
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    } // end TextFieldFrame constructor
48
49    // private inner class for event handling
50    private class TextFieldHandler implements ActionList
51    {
52       // process text field events
53       public void actionPerformed( ActionEvent event )
54       {
55          String string = ""; // declare string to displ
56
```

Create a new `JTextField`

Make this `JTextField` uneditable

Create a new `JPasswordField`

Create event handler

Register event handler

Create event handler class by implementing the `ActionListener` interface

Declare `actionPerformed` method

```
57          // user pressed Enter in JTextField textField1
58          if ( event.getSource() == textField1 )
59             string = String.format( "textField1: %s",
60                event.getActionCommand() );
61
62          // user pressed Enter in JTextField textField2
63          else if ( event.getSource() == textField2 )
64             string = String.format( "textField2: %s",
65                event.getActionCommand() );
66
67          // user pressed Enter in JTextField textField3
68          else if ( event.getSource() == textField3 )
69             string = String.format( "textField3: %s",
70                event.getActionCommand() );
71
72          // user pressed Enter in JTextField passwordF
73          else if ( event.getSource() == passwordField )
74             string = String.format( "passwordField: %s
75                new String( passwordField.getPassword()
76
77          // display JTextField content
78          JOptionPane.showMessageDialog( null, string );
79       } // end method actionPerformed
80    } // end private inner class TextFieldHandler
81 } // end class TextFieldFrame
```

Test if the source of the event is the first text field

Get text from text field

dFrame

Test if the source of the event is the second text field

(3 of 3)

Get text from text field

Test if the source of the event is the third text field

Get text from text field

Test if the source of the event is the password field

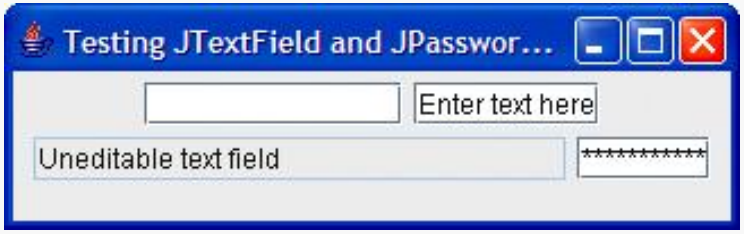
Get password from password field

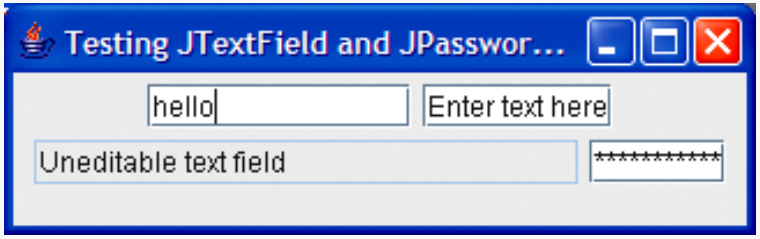
Outline

TextFieldTest.java

(1 of 2)

```
1  // Fig. 11.10: TextFieldTest.java
2  // Testing TextFieldFrame.
3  import javax.swing.JFrame;
4
5  public class TextFieldTest
6  {
7     public static void main( String args[] )
8     {
9        TextFieldFrame textFieldFrame = new TextFieldFrame();
10       textFieldFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       textFieldFrame.setSize( 325, 100 ); // set frame size
12       textFieldFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class TextFieldTest
```

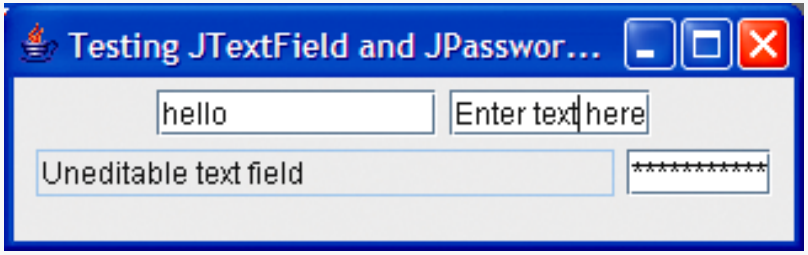


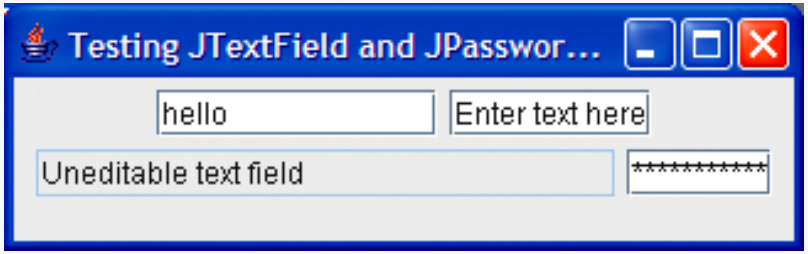


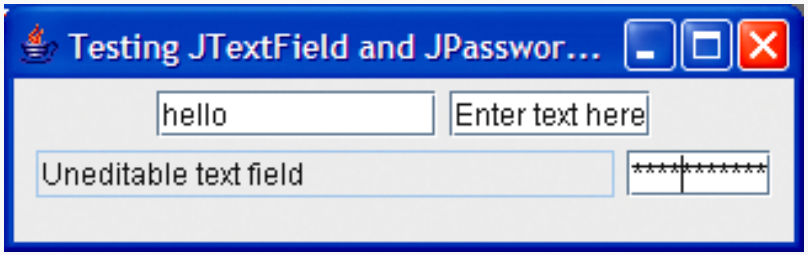
Outline

`TextFieldTest.java`

(2 of 2)







Steps Required to Set Up Event Handling for a GUI Component

- **Several coding steps are required for an application to respond to events**
  - **Create a class for the event handler**
  - **Implement an appropriate event-listener interface**
  - **Register the event handler**

Using a Nested Class to Implement an Event Handler

- **Top-level classes**
  - **Not declared within another class**
- **Nested classes**
  - **Declared within another class**
  - **Non-`static` nested classes are called inner classes**
    - **Frequently used for event handling**

Software Engineering Observation 11.2

An inner class is allowed to directly access its top-level class's variables and methods, even if they are `private`.

Using a Nested Class to Implement an Event Handler

- `JTextFields` **and** `JPasswordFields`
  - **Pressing enter within either of these fields causes an** `ActionEvent`
    - **Processed by objects that implement the** `ActionListener` **interface**

Registering the Event Handler for Each Text Field

- **Registering an event handler**
  - **Call method** `addActionListener` **to register an** `ActionListener` **object**
  - `ActionListener` **listens for events on the object**

Software Engineering Observation 11.3

The event listener for an event must implement the appropriate event-listener interface.

Common Programming Error 11.2

Forgetting to register an event-handler object for a particular GUI component's event type causes events of that type to be ignored.

Details of Class `TextFieldHandler`'s `actionPerformed` Method

- **Event source**
  - **Component from which event originates**
  - **Can be determined using method `getSource`**
  - **Text from a `JTextField` can be acquired using `getActionCommand`**
  - **Text from a `JPasswordField` can be acquired using `getPassword`**

11.6 Common GUI Event Types and Listener Interfaces

- **Event types**
  - **All are subclasses of `AWTEvent`**
  - **Some declared in package `java.awt.event`**
  - **Those specific to Swing components declared in `javax.swing.event`**

11.6 Common GUI Event Types and Listener Interfaces

- **Delegation event model**
  - **Event source is the component with which user interacts**
  - **Event object is created and contains information about the event that happened**
  - **Event listener is notified when an event happens**

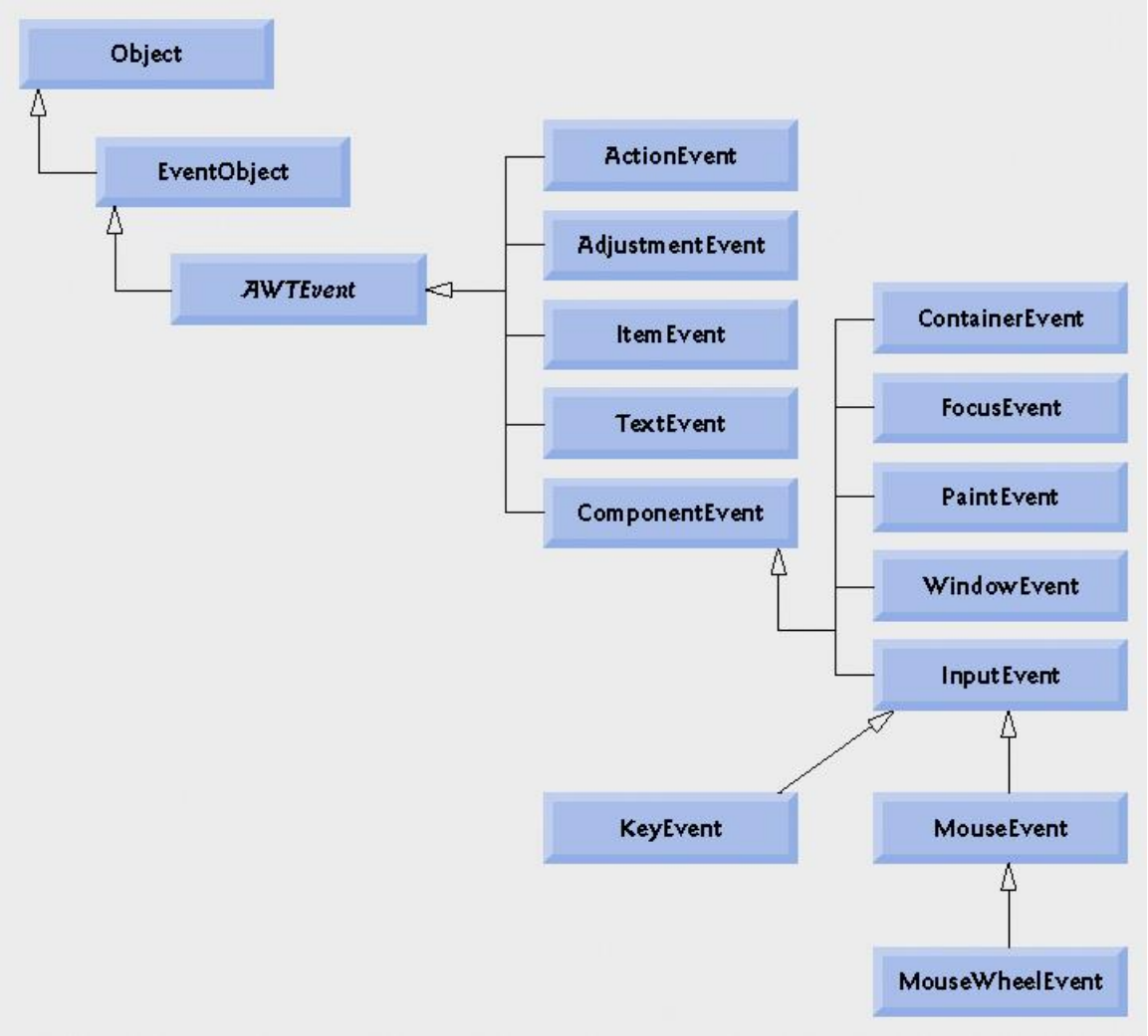


Fig. 11.11 | Some event classes of package `java.awt.event`.

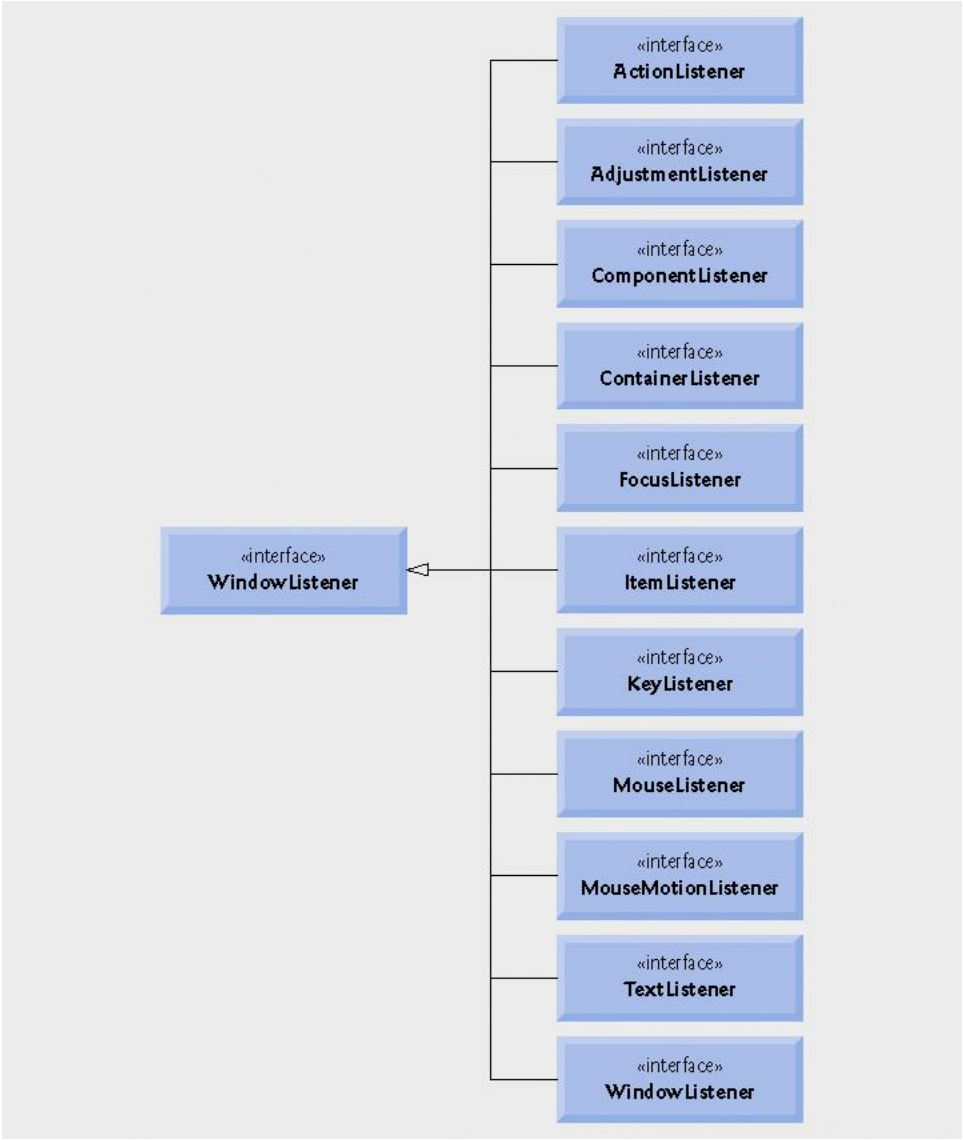


Fig. 11.12 | Some common event-listener interfaces of package `java.awt.event`.

11.7 How Event Handling Works

- **Remaining questions**
  - **How did the event handler get registered?**
  - **How does the GUI component know to call `actionPerformed` rather than some other event-handling method?**

Registering Events

- **Every `JComponent` has instance variable `listenerList`**
  - **Object of type `EventListenerList`**
  - **Maintains references to all its registered listeners**

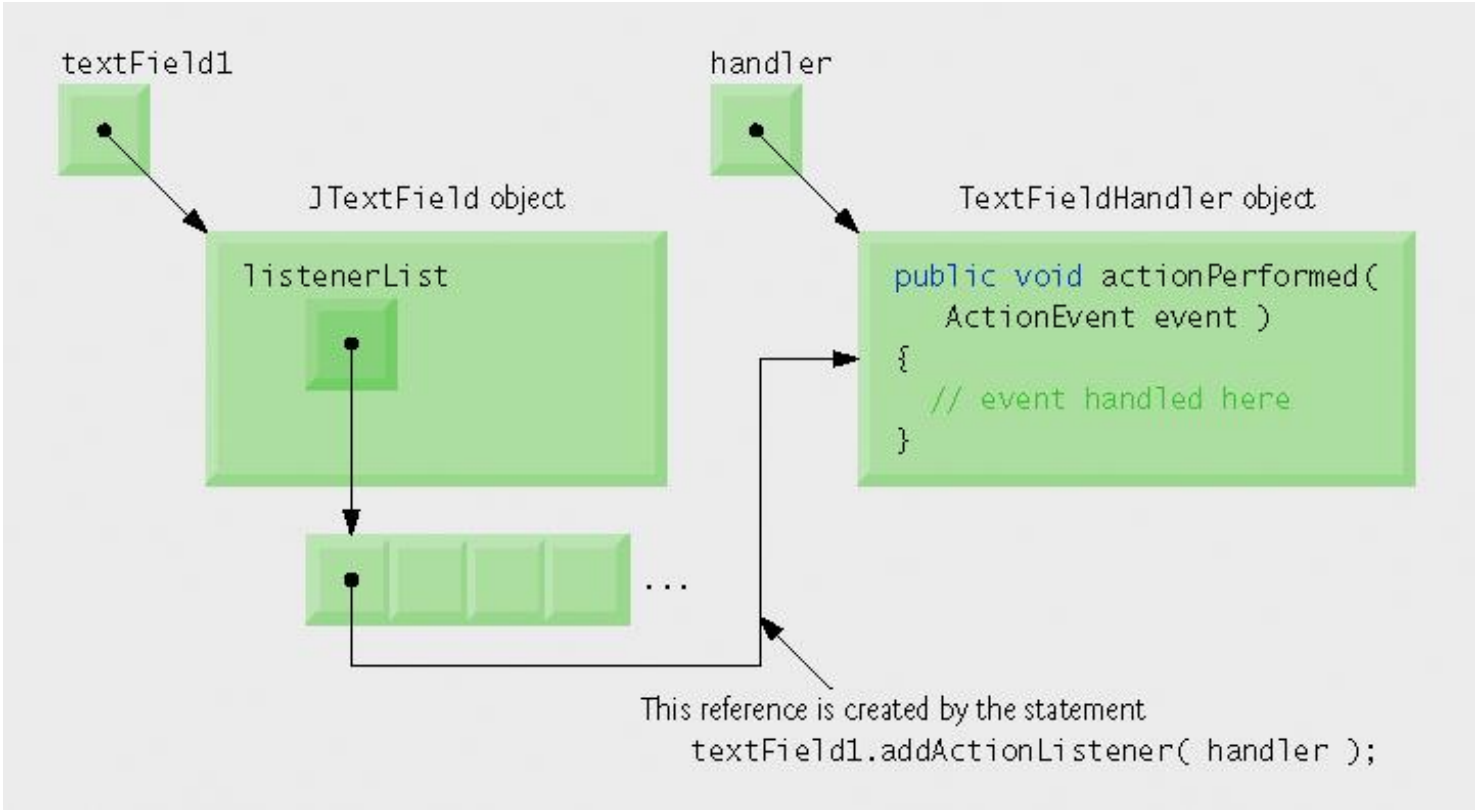


Fig. 11.13 | Event registration for `JTextField textField1`.

Event-Handler Invocation

- **Events are dispatched to only the event listeners that match the event type**
  - **Events have a unique event ID specifying the event type**
- **`MouseEvents` are handled by `MouseListeners` and `MouseMotionsListeners`**
- **`KeyEvents` are handled by `KeyListeners`**

11.8 JButton

- **Button**
  - **Component user clicks to trigger a specific action**
  - **Can be command button, check box, toggle button or radio button**
  - **Button types are subclasses of class `AbstractButton`**

Look-and-Feel Observation 11.7

Buttons typically use book-title capitalization.

11.8 JButton

- **Command button**
  - **Generates an `ActionEvent` when it is clicked**
  - **Created with class `JButton`**
  - **Text on the face of the button is called button label**

Look-and-Feel Observation 11.8

Having more than one `JButton` with the same label makes the `JButton`s ambiguous to the user. Provide a unique label for each button.

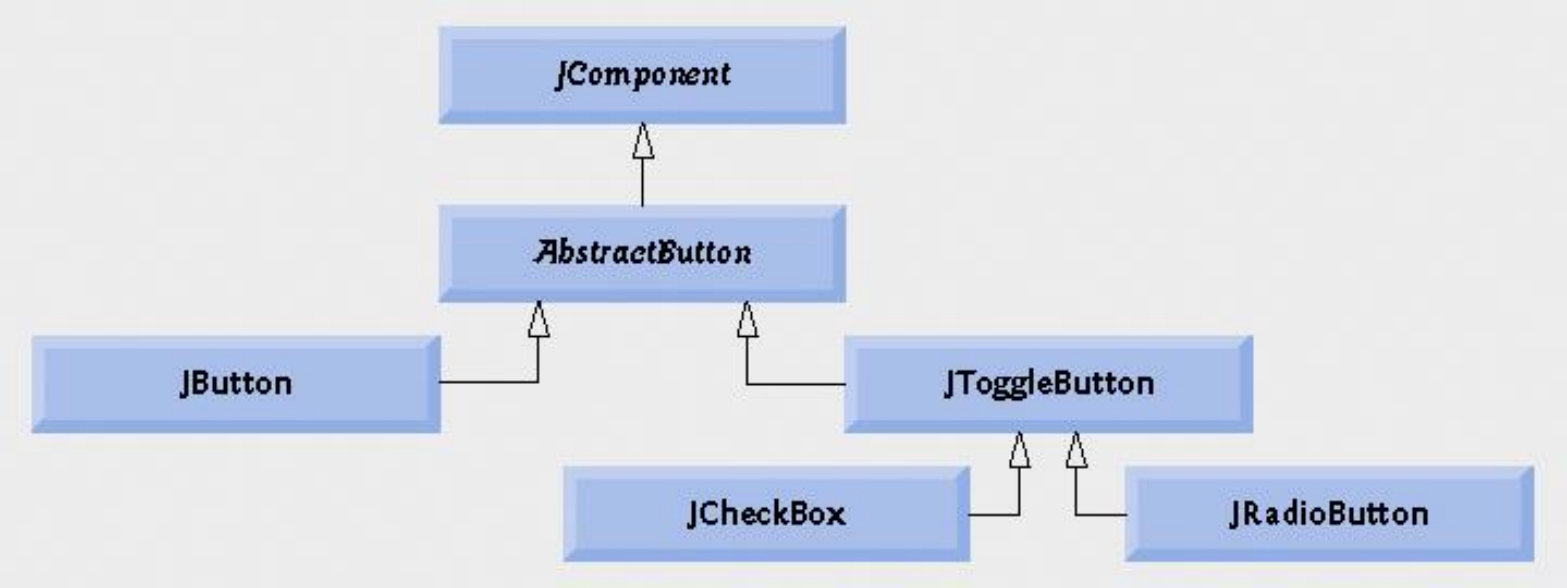


Fig. 11.14 | Swing button hierarchy.

Outline

ButtonFrame.java

(1 of 2)

```
1  // Fig. 11.15: ButtonFrame.java
2  // Creating JButtons.
3  import java.awt.FlowLayout;
4  import java.awt.event.ActionListener;
5  import java.awt.event.ActionEvent;
6  import javax.swing.JFrame;
7  import javax.swing.JButton;
8  import javax.swing.Icon;
9  import javax.swing.ImageIcon;
10 import javax.swing.JOptionPane;
11
12 public class ButtonFrame extends JFrame
13 {
14    private JButton plainJButton; // button with just text
15    private JButton fancyJButton; // button with icons
16
17    // ButtonFrame adds JButtons to JFrame
18    public ButtonFrame()
19    {
20       super( "Testing Buttons" );
21       setLayout( new FlowLayout() ); // set frame layout
22
23       plainJButton = new JButton( "Plain Button" ); //
24       add( plainJButton ); // add plainJButton to JFrame
25
26       Icon bug1 = new ImageIcon( getClass().getResource( "bug1.gif" ) );
27       Icon bug2 = new ImageIcon( getClass().getResourc
28       fancyJButton = new JButton( "Fancy Button", bug
29       fancyJButton.setRolloverIcon( bug2 ); // set rollover image
30       add( fancyJButton ); // add fancyJButton to JFrame
```

Declare two `JButton` instance variables

Create new `JButton`

Create two `ImageIcon`s

Create new `JButton`

Set rollover icon for `JButton`

Outline

```
31
32       // create new ButtonHandler for button event handling
33       ButtonHandler handler = new ButtonHandler();
34       fancyJButton.addActionListener( handler );
35       plainJButton.addActionListener( handler );
36    } // end ButtonFrame constructor
37
38    // inner class for button event handling
39    private class ButtonHandler implements ActionListener
40    {
41       // handle button event
42       public void actionPerformed( ActionEvent event )
43       {
44          JOptionPane.showMessageDialog( ButtonFrame.this, String.format(
45             "You pressed: %s", event.getActionCommand() ) );
46       } // end method actionPerformed
47    } // end private inner class ButtonHandler
48 } // end class ButtonFrame
```

Create handler for buttons

Register event handlers

Inner class implements `ActionListener`

Access outer class's instance using `this` reference

Get text of `JButton` pressed

`ButtonFrame.java`

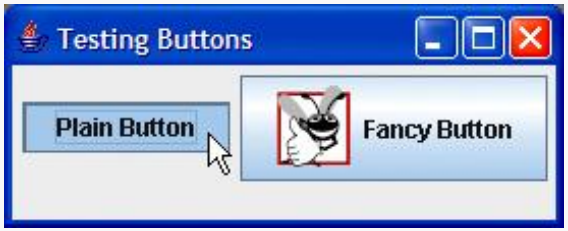
(2 of 2)

Outline

ButtonTest.java

(1 of 2)

```
1  // Fig. 11.16: ButtonTest.java
2  // Testing ButtonFrame.
3  import javax.swing.JFrame;
4
5  public class ButtonTest
6  {
7     public static void main( String args[] )
8     {
9        ButtonFrame buttonFrame = new ButtonFrame(); // create ButtonFrame
10       buttonFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       buttonFrame.setSize( 275, 110 ); // set frame size
12       buttonFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class ButtonTest
```



Outline

`ButtonTest.java`

(2 of 2)

11.8 JButton

- JButtons can have a rollover icon
  - Appears when mouse is positioned over a button
  - Added to a JButton with method setRolloverIcon

Look-and-Feel Observation 11.9

Because class `AbstractButton` supports displaying text and images on a button, all subclasses of `AbstractButton` also support displaying text and images.

Look-and-Feel Observation 11.10

Using rollover icons for `JButton`s provides users with visual feedback indicating that when they click the mouse while the cursor is positioned over the button, an action will occur.

Software Engineering Observation 11.4

When used in an inner class, keyword `this` refers to the current inner-class object being manipulated. An inner-class method can use its outer-class object's `this` by preceding `this` with the outer-class name and a dot, as in `ButtonFrame.this`.

11.9 Buttons That Maintain State

- **State buttons**
  - **Swing contains three types of state buttons**
  - `JToggleButton`, `JCheckBox` **and** `JRadioButton`
  - `JCheckBox` **and** `JRadioButton` **are subclasses of** `JToggleButton`

11.9.1 JCheckBox

- JCheckBox
  - **Contains a check box label that appears to right of check box by default**
  - **Generates an `ItemEvent` when it is clicked**
    - `ItemEvents` **are handled by an** `ItemListener`
    - **Passed to method** `itemStateChanged`
  - **Method** `isSelected` **returns whether check box is selected (**`true`**) or not (**`false`**)**

Outline

CheckBoxFrame.java

(1 of 3)

```
1  // Fig. 11.17: CheckBoxFrame.java
2  // Creating JCheckBox buttons.
3  import java.awt.FlowLayout;
4  import java.awt.Font;
5  import java.awt.event.ItemListener;
6  import java.awt.event.ItemEvent;
7  import javax.swing.JFrame;
8  import javax.swing.JTextField;
9  import javax.swing.JCheckBox;
10
11 public class CheckBoxFrame extends JFrame
12 {
13    private JTextField textField; // displays text in changing fonts
14    private JCheckBox boldJCheckBox; // to select/deselect bold
15    private JCheckBox italicJCheckBox; // to select/deselect italic
16
17    // CheckBoxFrame constructor adds JCheckBoxes to JFrame
18    public CheckBoxFrame()
19    {
20       super( "JCheckBox Test" );
21       setLayout( new FlowLayout() ); // set frame layout
22
23       // set up JTextField and set its font
24       textField = new JTextField( "Watch the font style change", 20 );
25       textField.setFont( new Font( "Serif", Font.PLAIN, 14 ) );
26       add( textField ); // add textField to JFrame
27
```

Declare two `JCheckBox` instance variables

Set font of text field

Outline

```
28       boldJCheckBox = new JCheckBox( "Bold" ); // create bold checkbox
29       italicJCheckBox = new JCheckBox( "Italic" ); // create italic
30       add( boldJCheckBox ); // add bold checkbox to JFrame
31       add( italicJCheckBox ); // add italic checkbox t
32
33       // register listeners for JCheckBoxes
34       CheckBoxHandler handler = new CheckBoxHandler();
35       boldJCheckBox.addItemListener( handler );
36       italicJCheckBox.addItemListener( handler );
37    } // end CheckBoxFrame constructor
38
39    // private inner class for ItemListener event handl
40    private class CheckBoxHandler implements ItemListener
41    {
42       private int valBold = Font.PLAIN; // controls bo
43       private int valItalic = Font.PLAIN; // controls
44
45       // respond to checkbox events
46       public void itemStateChanged( ItemEvent event )
47       {
48          // process bold checkbox events
49          if ( event.getSource() == boldJCheckBox )
50             valBold =
51                boldJCheckBox.isSelected() ? Font.BOLD : Font.PLAIN;
52
```

Create two `JCheckBox`es

`CheckBoxFrame`
.java
(2 of 2)

Create event handler

Register event handler with `JCheckBox`es

Inner class implements `ItemListener`

`itemStateChanged` method is called when a `JCheckBox` is clicked

Test whether `JCheckBox` is selected

```
53          // process italic checkbox events
54          if ( event.getSource() == italicJCheckBox )
55             valItalic =
56                italicJCheckBox.isSelected() ? Font.ITALIC : Font.PLAIN;
57
58          // set text field font
59          textField.setFont(
60             new Font( "Serif", valBold + valItalic, 14 ) );
61       } // end method itemStateChanged
62    } // end private inner class CheckBoxHandler
63 } // end class CheckBoxFrame
```

Test source of the event

`isSelected` method returns whether `JCheckBox` is selected

Outline

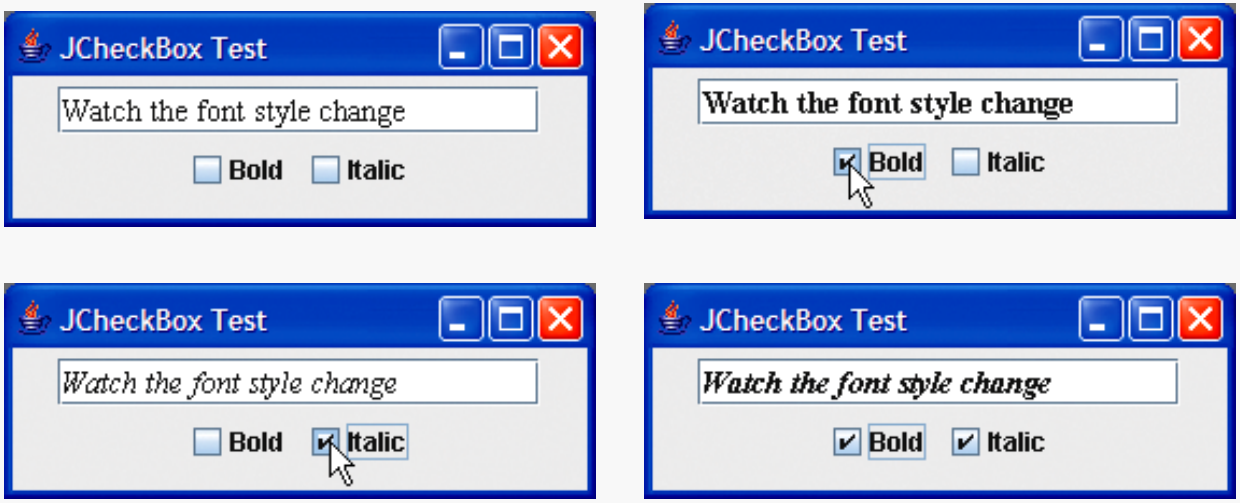
`oxFrame`

(3 of 3)

Outline

CheckBoxTest.java

```
1  // Fig. 11.18: CheckBoxTest.java
2  // Testing CheckBoxFrame.
3  import javax.swing.JFrame;
4
5  public class CheckBoxTest
6  {
7     public static void main( String args[] )
8     {
9        CheckBoxFrame checkBoxFrame = new CheckBoxFrame();
10       checkBoxFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       checkBoxFrame.setSize( 275, 100 ); // set frame size
12       checkBoxFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class CheckBoxTest
```



11.9.2 JRadioButton

- JRadioButton
  - **Has two states – selected and unselected**
  - **Normally appear in a group in which only one radio button can be selected at once**
    - **Group maintained by a ButtonGroup object**
      - **Declares method add to add a JRadioButton to group**
  - **Usually represents mutually exclusive options**

Common Programming Error 11.3

Adding a `ButtonGroup` object (or an object of any other class that does not derive from `Component`) to a container results in a compilation error.

Outline

RadioButtonFrame.java

(1 of 3)

```
1  // Fig. 11.19: RadioButtonFrame.java
2  // Creating radio buttons using ButtonGroup and JRadioButton.
3  import java.awt.FlowLayout;
4  import java.awt.Font;
5  import java.awt.event.ItemListener;
6  import java.awt.event.ItemEvent;
7  import javax.swing.JFrame;
8  import javax.swing.JTextField;
9  import javax.swing.JRadioButton;
10 import javax.swing.ButtonGroup;
11
12 public class RadioButtonFrame extends JFrame
13 {
14    private JTextField textField; // used to display fo
15    private Font plainFont; // font for plain text
16    private Font boldFont; // font for bold text
17    private Font italicFont; // font for italic text
18    private Font boldItalicFont; // font for bold and italic text
19    private JRadioButton plainJRadioButton; // selects plain text
20    private JRadioButton boldJRadioButton; // selects bold text
21    private JRadioButton italicJRadioButton; // selects italic text
22    private JRadioButton boldItalicJRadioButton; // bold and italic
23    private ButtonGroup radioGroup; // buttongroup to hold radio buttons
24
25    // RadioButtonFrame constructor adds JRadioButtons to JFrame
26    public RadioButtonFrame()
27    {
28       super( "RadioButton Test" );
29       setLayout( new FlowLayout() ); // set frame layout
30
```

Declare four `JRadioButton`s and a `ButtonGroup` to manage them

Outline

RadioButtonFrame.java

(2 of 3)

```
31      textField = new JTextField( "Watch the font style change", 25 );
32      add( textField ); // add textField to JFrame
33
34      // create radio buttons
35      plainJRadioButton = new JRadioButton( "Plain", true );
36      boldJRadioButton = new JRadioButton( "Bold", false );
37      italicJRadioButton = new JRadioButton( "Italic", false );
38      boldItalicJRadioButton = new JRadioButton( "Bold/Italic", false );
39      add( plainJRadioButton ); // add plain button to JFrame
40      add( boldJRadioButton ); // add bold button to JFrame
41      add( italicJRadioButton ); // add italic button
42      add( boldItalicJRadioButton ); // add bold and italic button
43
44      // create logical relationship between JRadioButtons
45      radioGroup = new ButtonGroup(); // create ButtonGroup
46      radioGroup.add( plainJRadioButton ); // add pla
47      radioGroup.add( boldJRadioButton ); // add bold
48      radioGroup.add( italicJRadioButton ); // add italic to group
49      radioGroup.add( boldItalicJRadioButton ); // add bold and italic
50
51      // create font objects
52      plainFont = new Font( "Serif", Font.PLAIN, 14 );
53      boldFont = new Font( "Serif", Font.BOLD, 14 );
54      italicFont = new Font( "Serif", Font.ITALIC, 14 );
55      boldItalicFont = new Font( "Serif", Font.BOLD + Font.ITALIC, 14 );
56      textField.setFont( plainFont ); // set initial font to plain
57
```

Create the four `JRadioButton`s

Create the `ButtonGroup`

Add each `JRadioButton` to the `ButtonGroup`

Outline

```
58       // register events for JRadioButtons
59       plainJRadioButton.addItemListener(
60          new RadioButtonHandler( plainFont ) );
61       boldJRadioButton.addItemListener(
62          new RadioButtonHandler( boldFont ) );
63       italicJRadioButton.addItemListener(
64          new RadioButtonHandler( italicFont ) );
65       boldItalicJRadioButton.addItemListener(
66          new RadioButtonHandler( boldItalicFont ) );
67    } // end RadioButtonFrame constructor
68
69    // private inner class to handle radio button events
70    private class RadioButtonHandler implements ItemListener
71    {
72       private Font font; // font associated with this
73
74       public RadioButtonHandler( Font f )
75       {
76          font = f; // set the font of this listener
77       } // end constructor RadioButtonHandler
78
79       // handle radio button events
80       public void itemStateChanged( ItemEvent event )
81       {
82          textField.setFont( font ); // set font of textField
83       } // end method itemStateChanged
84    } // end private inner class RadioButtonHandler
85 } // end class RadioButtonFrame
```

Register an event handler with each `JRadioButton`

Event handler inner class implements `ItemListener`

When radio button is selected, the text field's font will be set to the value passed to the constructor

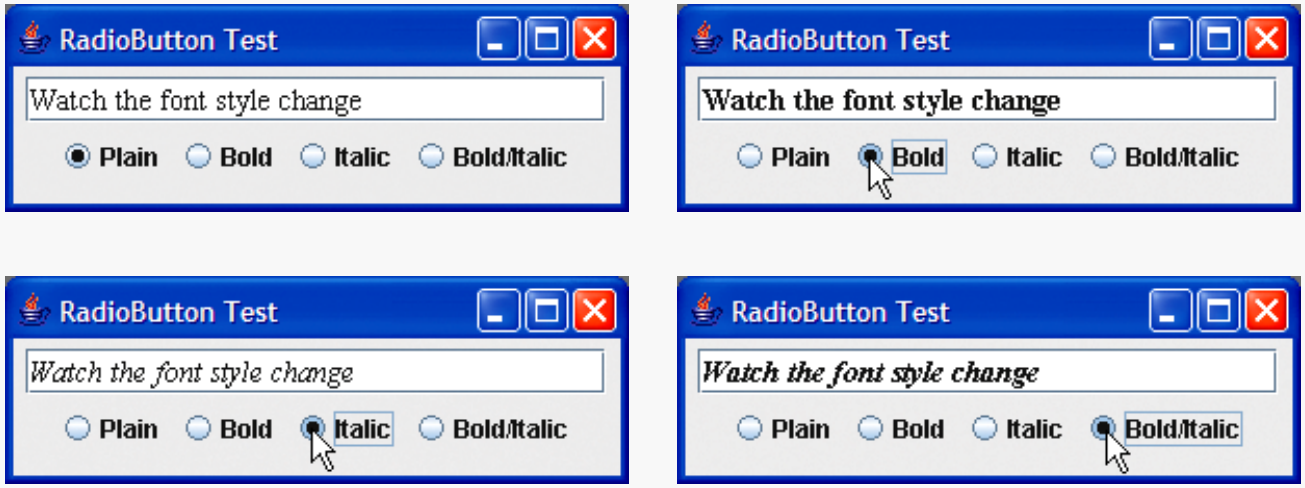
RadioButtonFrame.java

(3 of 3)

Outline

RadioButtonTest.java

```
1  // Fig. 11.20: RadioButtonTest.java
2  // Testing RadioButtonFrame.
3  import javax.swing.JFrame;
4
5  public class RadioButtonTest
6  {
7     public static void main( String args[] )
8     {
9        RadioButtonFrame radioButtonFrame = new RadioButtonFrame();
10       radioButtonFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       radioButtonFrame.setSize( 300, 100 ); // set frame size
12       radioButtonFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class RadioButtonTest
```



11.10 JComboBox and Using an Anonymous Inner Class for Event Handling

- **Combo box**
  - **Also called a drop-down list**
  - **Implemented by class `JComboBox`**
  - **Each item in the list has an index**
  - **`setMaximumRowCount` sets the maximum number of rows shown at once**
  - **`JComboBox` provides a scrollbar and up and down arrows to traverse list**

Look-and-Feel Observation 11.11

Set the maximum row count for a `JComboBox` to a number of rows that prevents the list from expanding outside the bounds of the window in which it is used. This configuration will ensure that the list displays correctly when it is expanded by the user.

Using an Anonymous Inner Class for Event Handling

- **Anonymous inner class**
  - **Special form of inner class**
  - **Declared without a name**
  - **Typically appears inside a method call**
  - **Has limited access to local variables**

Outline

ComboBoxFrame.java

(1 of 2)

```
1  // Fig. 11.21: ComboBoxFrame.java
2  // Using a JComboBox to select an image to display.
3  import java.awt.FlowLayout;
4  import java.awt.event.ItemListener;
5  import java.awt.event.ItemEvent;
6  import javax.swing.JFrame;
7  import javax.swing.JLabel;
8  import javax.swing.JComboBox;
9  import javax.swing.Icon;
10 import javax.swing.ImageIcon;
11
12 public class ComboBoxFrame extends JFrame
13 {
14    private JComboBox imagesJComboBox; // combobox to hold names of icons
15    private JLabel label; // label to display selected icon
16
17    private String names[] =
18       { "bug1.gif", "bug2.gif",  "travelbug.gif", "bug
19    private Icon icons[] = {
20       new ImageIcon( getClass().getResource( names[ 0 ] ) ),
21       new ImageIcon( getClass().getResource( names[ 1 ] ) ),
22       new ImageIcon( getClass().getResource( names[ 2 ] ) ),
23       new ImageIcon( getClass().getResource( names[ 3 ] ) ) };
24
25    // ComboBoxFrame constructor adds JComboBox to JFrame
26    public ComboBoxFrame()
27    {
28       super( "Testing JComboBox" );
29       setLayout( new FlowLayout() ); // set frame layout
30
```

Declare `JComboBox` instance variable

```
31       imagesJComboBox = new JComboBox( names ); // set up JComboBox
32       imagesJComboBox.setMaximumRowCount( 3 ); // disp
33
34       imagesJComboBox.addItemListener(
35          new ItemListener() // anonymous inner class
36          {
37             // handle JComboBox event
38             public void itemStateChanged( ItemEvent event )
39             {
40                // determine whether check box selected
41                if ( event.getStateChange() == ItemEvent.SELECTED )
42                   label.setIcon( icons[
43                      imagesJComboBox.getSelectedIndex(
44             } // end method itemStateChanged
45          } // end anonymous inner class
46       ); // end call to addItemListener
47
48       add( imagesJComboBox ); // add combobox to JFrame
49       label = new JLabel( icons[ 0 ] ); // display first icon
50       add( label ); // add label to JFrame
51    } // end ComboBoxFrame constructor
52 } // end class ComboBoxFrame
```

Create `JComboBox` and set maximum row count

Create anonymous inner class as the event handler

Declare method `itemStateChanged`

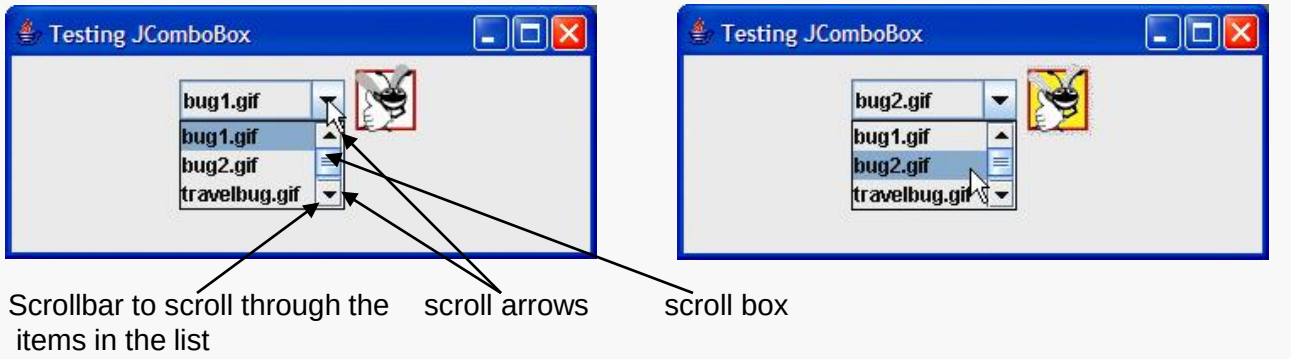
Test state change of `JComboBox`

Method `getSelectedIndex` locates selected item

Outline

ComboBoxTest.java

```
1  // Fig. 11.22: ComboBoxTest.java
2  // Testing ComboBoxFrame.
3  import javax.swing.JFrame;
4
5  public class ComboBoxTest
6  {
7     public static void main( String args[] )
8     {
9        ComboBoxFrame comboBoxFrame = new ComboBoxFrame();
10       comboBoxFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       comboBoxFrame.setSize( 350, 150 ); // set frame size
12       comboBoxFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class ComboBoxTest
```



Software Engineering Observation 11.5

An anonymous inner class declared in a method can access the instance variables and methods of the top-level class object that declared it, as well as the method's `final` local variables, but cannot access the method's non-`final` variables.

Software Engineering Observation 11.6

Like any other class, when an anonymous inner class implements an interface, the class must implement every method in the interface.

11.11 JList

- **List**
  - **Displays a series of items from which the user may select one or more items**
  - **Implemented by class `JList`**
  - **Allows for single-selection lists or multiple-selection lists**
  - **A `ListSelectionEvent` occurs when an item is selected**
    - **Handled by a `ListSelectionListener` and passed to method `valueChanged`**

Outline

ListFrame.java

(1 of 2)

```
1  // Fig. 11.23: ListFrame.java
2  // Selecting colors from a JList.
3  import java.awt.FlowLayout;
4  import java.awt.Color;
5  import javax.swing.JFrame;
6  import javax.swing.JList;
7  import javax.swing.JScrollPane;
8  import javax.swing.event.ListSelectionListener;
9  import javax.swing.event.ListSelectionEvent;
10 import javax.swing.ListSelectionModel;
11
12 public class ListFrame extends JFrame
13 {
14    private JList colorJList; // list to display colors
15    private final String colorNames[] = { "Black", "Blue", "Cyan",
16       "Dark Gray", "Gray", "Green", "Light Gray", "Magenta",
17       "Orange", "Pink", "Red", "White", "Yellow" };
18    private final Color colors[] = { Color.BLACK, Color.BLUE, Color.CYAN,
19       Color.DARK_GRAY, Color.GRAY, Color.GREEN, Color.LIGHT_GRAY,
20       Color.MAGENTA, Color.ORANGE, Color.PINK, Color.RED, Color.WHITE,
21       Color.YELLOW };
22
23    // ListFrame constructor add JScrollPane containing JList to JFrame
24    public ListFrame()
25    {
26       super( "List Test" );
27       setLayout( new FlowLayout() ); // set frame layout
28
```

Declare `JList` instance variable

```
29       colorJList = new JList( colorNames ); // create with colorNames
30       colorJList.setVisibleRowCount( 5 ); // display f
31
32       // do not allow multiple selections
33       colorJList.setSelectionMode( ListSelectionModel.SINGLE_SELECTION );
34
35       // add a JScrollPane containing JList to frame
36       add( new JScrollPane( colorJList ) );
37
38       colorJList.addListSelectionListener(
39          new ListSelectionListener() // anonymous inne
40          {
41             // handle list selection events
42             public void valueChanged( ListSelectionEvent event )
43             {
44                getContentPane().setBackground(
45                   colors[ colorJList.getSelectedIndex() ] );
46             } // end method valueChanged
47          } // end anonymous inner class
48       ); // end call to addListSelectionListener
49    } // end ListFrame constructor
50 } // end class ListFrame
```

Create `JList`

Set selection mode of `JList`

Add `JList` to `ScrollPane` and add to application

Get index of selected item

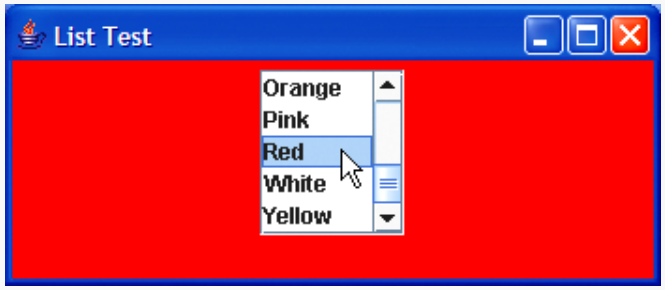
me.java

(2 of 2)

Outline

ListTest.java

```
1  // Fig. 11.24: ListTest.java
2  // Selecting colors from a JList.
3  import javax.swing.JFrame;
4
5  public class ListTest
6  {
7     public static void main( String args[] )
8     {
9        ListFrame listFrame = new ListFrame(); // create ListFrame
10       listFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       listFrame.setSize( 350, 150 ); // set frame size
12       listFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class ListTest
```



11.12 Multiple-Selection Lists

- **Multiple-selection list**
  - **Enables users to select many items**
  - **Single interval selection allows only a continuous range of items**
  - **Multiple interval selection allows any set of elements to be selected**

Outline

MultipleSelectionFrame.java

(1 of 3)

```
1  // Fig. 11.25: MultipleSelectionFrame.java
2  // Copying items from one List to another.
3  import java.awt.FlowLayout;
4  import java.awt.event.ActionListener;
5  import java.awt.event.ActionEvent;
6  import javax.swing.JFrame;
7  import javax.swing.JList;
8  import javax.swing.JButton;
9  import javax.swing.JScrollPane;
10 import javax.swing.ListSelectionModel;
11
12 public class MultipleSelectionFrame extends JFrame
13 {
14    private JList colorJList; // list to hold color names
15    private JList copyJList; // list to copy color names into
16    private JButton copyJButton; // button to copy selected names
17    private final String colorNames[] = { "Black", "Blue", "Cyan",
18       "Dark Gray", "Gray", "Green", "Light Gray", "Magenta", "Orange",
19       "Pink", "Red", "White", "Yellow" };
20
21    // MultipleSelectionFrame constructor
22    public MultipleSelectionFrame()
23    {
24       super( "Multiple Selection Lists" );
25       setLayout( new FlowLayout() ); // set frame layout
26
```

Outline

```
27       colorJList = new JList( colorNames ); // holds names of all colors
28       colorJList.setVisibleRowCount( 5 ); // show five rows
29       colorJList.setSelectionMode(
30          ListSelectionModel.MULTIPLE_INTERVAL_SELECTION );
31       add( new JScrollPane( colorJList ) ); // add lis
32
33       copyJButton = new JButton( "Copy >>>" ); // create copy button
34       copyJButton.addActionListener(
35
36          new ActionListener() // anonymous inner class
37          {
38             // handle button event
39             public void actionPerformed( ActionEvent event )
40             {
41                // place selected values in copyJList
42                copyJList.setListData( colorJList.getSelectedValues() );
43             } // end method actionPerformed
44          } // end anonymous inner class
45       ); // end call to addActionListener
46
```

Use a multiple interval selection list

Use methods `setListData` and `getSelectedValues` to copy values from one `JList` to the other

`e SelectionFrame .java`

(2 of 3)

```
47       add( copyJButton ); // add copy button to JFrame
48
49       copyJList = new JList(); // create list to hold
50       copyJList.setVisibleRowCount( 5 ); // show 5 rows
51       copyJList.setFixedCellWidth( 100 ); // set width
52       copyJList.setFixedCellHeight( 15 ); // set height
53       copyJList.setSelectionMode(
54          ListSelectionModel.SINGLE_INTERVAL_SELECTION );
55       add( new JScrollPane( copyJList ) ); // add list with scrollpane
56    } // end MultipleSelectionFrame constructor
57 } // end class MultipleSelectionFrame
```

Set cell width for presentation

Set cell height for presentation

Set selection model to single interval selection

Multiple

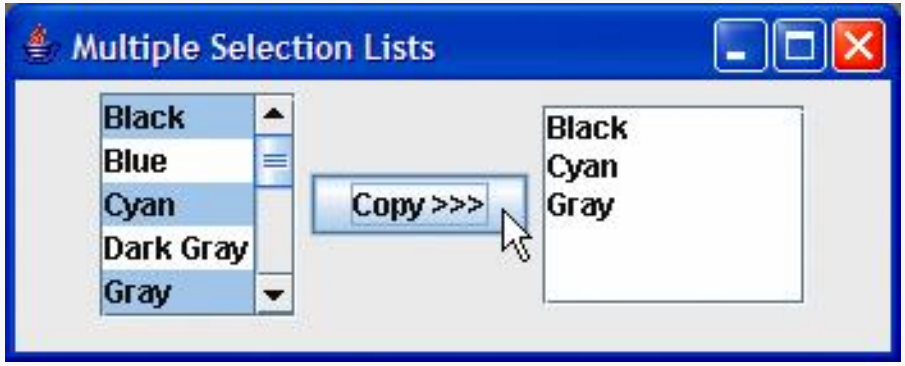
onFrame

.java

Outline

Multiple SelectionTest .java

```
1  // Fig. 11.26: MultipleSelectionTest.java
2  // Testing MultipleSelectionFrame.
3  import javax.swing.JFrame;
4
5  public class MultipleSelectionTest
6  {
7     public static void main( String args[] )
8     {
9        MultipleSelectionFrame multipleSelectionFrame =
10          new MultipleSelectionFrame();
11       multipleSelectionFrame.setDefaultCloseOperation(
12          JFrame.EXIT_ON_CLOSE );
13       multipleSelectionFrame.setSize( 350, 140 ); // set frame size
14       multipleSelectionFrame.setVisible( true ); // display frame
15    } // end main
16 } // end class MultipleSelectionTest
```



11.13 Mouse Event Handling

- **Mouse events**
  - **Create a** `MouseEvent` **object**
  - **Handled by** `MouseListeners` **and** `MouseMotionListeners`
  - `MouseInputListener` **combines the two interfaces**
  - **Interface** `MouseWheelListener` **declares method** `mouseWheelMoved` **to handle** `MouseWheelEvents`

MouseListener and MouseMotionListener interface methods

Methods of interface `MouseListener`

`public void mousePressed( MouseEvent event )`

Called when a mouse button is pressed while the mouse cursor is on a component.

`public void mouseClicked( MouseEvent event )`

Called when a mouse button is pressed and released while the mouse cursor remains stationary on a component. This event is always preceded by a call to `mousePressed`.

`public void mouseReleased( MouseEvent event )`

Called when a mouse button is released after being pressed. This event is always preceded by a call to `mousePressed` and one or more calls to `mouseDragged`.

`public void mouseEntered( MouseEvent event )`

Called when the mouse cursor enters the bounds of a component.

Fig. 11.27 | `MouseListener` and `MouseMotionListener` interface methods. (Part 1 of 2.)

MouseListener and MouseMotionListener interface methods

`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 while the mouse cursor is on a component and the mouse is moved while the mouse button remains pressed. This event is always preceded by a call to `mousePressed`. All drag events are sent to the component on which the user began to drag the mouse.

`public void mouseMoved( MouseEvent event )`

Called when the mouse is moved when the mouse cursor is on a component. All move events are sent to the component over which the mouse is currently positioned.

Fig. 11.27 | `MouseListener` and `MouseMotionListener` interface methods. (Part 2 of 2.)

Look-and-Feel Observation 11.12

Method calls to `mouseDragged` and `mouseReleased` are sent to the `MouseMotionListener` for the `Component` on which a mouse drag operation started. Similarly, the `mouseReleased` method call at the end of a drag operation is sent to the `MouseListener` for the `Component` on which the drag operation started.

Outline

MouseTracker Frame.java

(1 of 4)

```
1  // Fig. 11.28: MouseTrackerFrame.java
2  // Demonstrating mouse events.
3  import java.awt.Color;
4  import java.awt.BorderLayout;
5  import java.awt.event.MouseListener;
6  import java.awt.event.MouseMotionListener;
7  import java.awt.event.MouseEvent;
8  import javax.swing.JFrame;
9  import javax.swing.JLabel;
10 import javax.swing.JPanel;
11
12 public class MouseTrackerFrame extends JFrame
13 {
14    private JPanel mousePanel; // panel in which mouse events will occur
15    private JLabel statusBar; // label that displays event information
16
17    // MouseTrackerFrame constructor sets up GUI and
18    // registers mouse event handlers
19    public MouseTrackerFrame()
20    {
21       super( "Demonstrating Mouse Events" );
22
23       mousePanel = new JPanel(); // create panel
24       mousePanel.setBackground( Color.WHITE ); // set
25       add( mousePanel, BorderLayout.CENTER ); // add
26
27       statusBar = new JLabel( "Mouse outside JPanel" );
28       add( statusBar, BorderLayout.SOUTH ); // add label to JFrame
29
```

Create `JPanel` to capture mouse events

Set background to white

Create `JLabel` and add to application

```
30       // create and register listener for mouse and mouse motion events
31       MouseHandler handler = new MouseHandler();
32       mousePanel.addMouseListener( handler );
33       mousePanel.addMouseMotionListener( handler );
34    } // end MouseTrackerFrame constructor
35
36    private class MouseHandler implements MouseListener,
37       MouseMotionListener
38    {
39       // MouseListener event handlers
40       // handle event when mouse released immediately after press
41       public void mouseClicked( MouseEvent event )
42       {
43          statusBar.setText( String.format( "Clicked at [%d, %d]",
44             event.getX(), event.getY() ) );
45       } // end method mouseClicked
46
47       // handle event when mouse pressed
48       public void mousePressed( MouseEvent event )
49       {
50          statusBar.setText( String.format( "Pressed at [%d, %d]",
51             event.getX(), event.getY() ) );
52       } // end method mousePressed
53
54       // handle event when mouse released after dragging
55       public void mouseReleased( MouseEvent event )
56       {
57          statusBar.setText( String.format( "Released a
58             event.getX(), event.getY() ) );
59       } // end method mouseReleased
```

Create event handler for mouse events

Register event handler

Implement mouse listener interfaces

Declare `mouseClicked` method

Find location of mouse click

Declare `mousePressed` method

Declare `mouseReleased` method

Outline

```
60
61       // handle event when mouse enters area
62       public void mouseEntered( MouseEvent event )
63       {
64          statusBar.setText( String.format( "Mouse entered at [%d, %d]",
65             event.getX(), event.getY() ) );
66          mousePanel.setBackground( Color.GREEN );
67       } // end method mouseEntered
68
69       // handle event when mouse exits area
70       public void mouseExited( MouseEvent event )
71       {
72          statusBar.setText( "Mouse outside JPanel" );
73          mousePanel.setBackground( Color.WHITE );
74       } // end method mouseExited
75
```

Declare `mouseEntered` method

Set background of `JPanel`

`MouseTracker` `ava`

(3 of 4)

Declare `mouseExited` method

Set background of `JPanel`

```
76       // MouseMotionListener event handlers
77       // handle event when user drags mouse with button pressed
78       public void mouseDragged( MouseEvent event )
79       {
80          statusBar.setText( String.format( "Dragged at [%d, %d]",
81             event.getX(), event.getY() ) );
82       } // end method mouseDragged
83
84       // handle event when user moves mouse
85       public void mouseMoved( MouseEvent event )
86       {
87          statusBar.setText( String.format( "Moved at [%d, %d]",
88             event.getX(), event.getY() ) );
89       } // end method mouseMoved
90    } // end inner class MouseHandler
91 } // end class MouseTrackerFrame
```

Declare `mouseDragged` method

Declare `mouseMoved` method

Outline

MouseTracker Frame.java

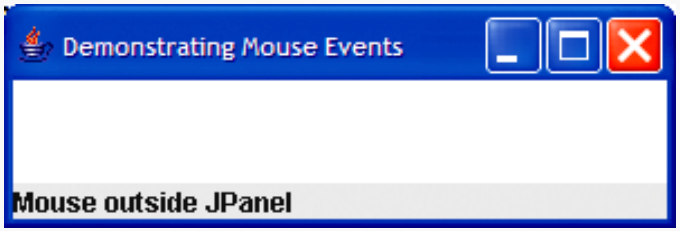
(4 of 4)

Outline

MouseTracker Frame.java

(1 of 2)

```
1  // Fig. 11.29: MouseTrackerFrame.java
2  // Testing MouseTrackerFrame.
3  import javax.swing.JFrame;
4
5  public class MouseTracker
6  {
7     public static void main( String args[] )
8     {
9        MouseTrackerFrame mouseTrackerFrame = new MouseTrackerFrame();
10       mouseTrackerFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       mouseTrackerFrame.setSize( 300, 100 ); // set frame size
12       mouseTrackerFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class MouseTracker
```



Outline

`MouseTracker Frame.java`

(2 of 2)

11.14 Adapter Classes

- **Adapter class**
  - **Implements event listener interface**
  - **Provides default implementation for all event-handling methods**

Software Engineering Observation 11.7

When a class implements an interface, the class has an "*is a*" relationship with that interface. All direct and indirect subclasses of that class inherit this interface. Thus, an object of a class that extends an event-adapter class *is an* object of the corresponding event-listener type (e.g., an object of a subclass of `MouseAdapter` *is a* `MouseListener`).

Extending `MouseAdapter`

- `MouseAdapter`
  - **Adapter class for `MouseListener` and `MouseMotionListener` interfaces**
  - **Extending class allows you to override only the methods you wish to use**

Common Programming Error 11.4

If you extend an adapter class and misspell the name of the method you are overriding, your method simply becomes another method in the class. This is a logic error that is difficult to detect, since the program will call the empty version of the method inherited from the adapter class.

Event-adapter class in `java.awt.event`	Implements interface
`ComponentAdapter`	`ComponentListener`
`ContainerAdapter`	`ContainerListener`
`FocusAdapter`	`FocusListener`
`KeyAdapter`	`KeyListener`
`MouseAdapter`	`MouseListener`
`MouseMotionAdapter`	`MouseMotionListener`
`WindowAdapter`	`WindowListener`

Fig. 11.30 | Event-adapter classes and the interfaces they implement in package `java.awt.event`.

Outline

MouseDetailsFrame.java

(1 of 2)

```
1  // Fig. 11.31: MouseDetailsFrame.java
2  // Demonstrating mouse clicks and distinguishing between mouse buttons.
3  import java.awt.BorderLayout;
4  import java.awt.Graphics;
5  import java.awt.event.MouseAdapter;
6  import java.awt.event.MouseEvent;
7  import javax.swing.JFrame;
8  import javax.swing.JLabel;
9
10 public class MouseDetailsFrame extends JFrame
11 {
12    private String details; // String representing
13    private JLabel statusBar; // JLabel that appears at bottom of window
14
15    // constructor sets title bar String and register mouse listener
16    public MouseDetailsFrame()
17    {
18       super( "Mouse clicks and buttons" );
19
20       statusBar = new JLabel( "Click the mouse" );
21       add( statusBar, BorderLayout.SOUTH );
22       addMouseListener( new MouseClickHandler() ); // add handler
23    } // end MouseDetailsFrame constructor
24
```

Register event handler

Outline

MouseDetails Frame.java

(2 of 2)

```
25    // inner class to handle mouse events
26    private class MouseClickHandler extends MouseAdapter
27    {
28       // handle mouse click event and determine which button was pressed
29       public void mouseClicked( MouseEvent event )
30       {
31          int xPos = event.getX(); // get x position of mouse
32          int yPos = event.getY(); // get y position of mouse
33
34          details = String.format( "Clicked %d time(s)",
35             event.getClickCount() );
36
37          if ( event.isMetaDown() ) // right mouse button
38             details += " with right mouse button";
39          else if ( event.isAltDown() ) // middle mouse button
40             details += " with center mouse button";
41          else // left mouse button
42             details += " with left mouse button";
43
44          statusBar.setText( details ); // display message in statusBar
45       } // end method mouseClicked
46    } // end private inner class MouseClickHandler
47 } // end class MouseDetailsFrame
```

Get number of times mouse button was clicked

Test for right mouse button

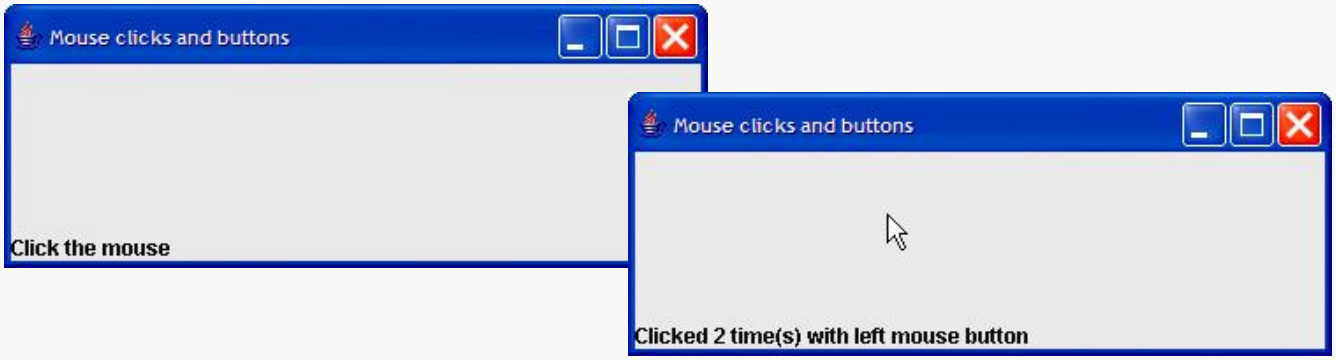
Test for middle mouse button

Outline

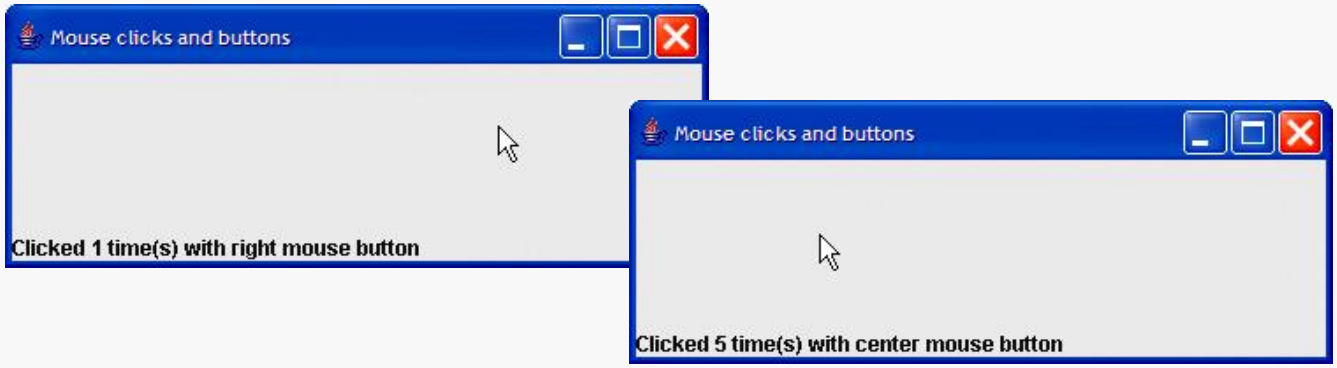
MouseDetails.java

(1 of 2)

```
1  // Fig. 11.32: MouseDetails.java
2  // Testing MouseDetailsFrame.
3  import javax.swing.JFrame;
4
5  public class MouseDetails
6  {
7     public static void main( String args[] )
8     {
9        MouseDetailsFrame mouseDetailsFrame = new MouseDetailsFrame();
10       mouseDetailsFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       mouseDetailsFrame.setSize( 400, 150 ); // set frame size
12       mouseDetailsFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class MouseDetails
```



Outline



`MouseDetails.java`

(2 of 2)

11.15 `JPanel` Subclass for Drawing with the Mouse

- **Overriding class `JPanel`**
  - **Provides a dedicated drawing area**

InputEvent method	Description
`isMetaDown()`	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 hold down the *Meta* key on the keyboard and click the mouse button.
`isAltDown()`	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 only- or left-mouse button, respectively.

Fig. 11.33 | `InputEvent` methods that help distinguish among left-, center- and right-mouse-button clicks.

Method `paintComponent`

- **Method `paintComponent`**
  - **Draws on a Swing component**
  - **Overriding method allows you to create custom drawings**
  - **Must call superclass method first when overridden**

Look-and-Feel Observation 11.13

Most Swing GUI components can be transparent or opaque. If a Swing GUI component is opaque, its background will be cleared when its `paintComponent` method is called. Only opaque components can display a customized background color. `JPanel` objects are opaque by default.

Error-Prevention Tip 11.1

In a `JComponent` subclass's `paintComponent` method, the first statement should always be a call to the superclass's `paintComponent` method to ensure that an object of the subclass displays correctly.

Common Programming Error 11.5

If an overridden `paintComponent` method does not call the superclass's version, the subclass component may not display properly. If an overridden `paintComponent` method calls the superclass's version after other drawing is performed, the drawing will be erased.

Defining the Custom Drawing Area

- **Customized subclass of `JPanel`**
  - **Provides custom drawing area**
  - **Class `Graphics` is used to draw on Swing components**
  - **Class `Point` represents an *x*-*y* coordinate**

Outline

PaintPanel.java

(1 of 2)

```
1  // Fig. 11.34: PaintPanel.java
2  // Using class MouseMotionAdapter.
3  import java.awt.Point;
4  import java.awt.Graphics;
5  import java.awt.event.MouseEvent;
6  import java.awt.event.MouseMotionAdapter;
7  import javax.swing.JPanel;
8
9  public class PaintPanel extends JPanel
10 {
11    private int pointCount = 0; // count number of points
12
13    // array of 10000 java.awt.Point references
14    private Point points[] = new Point[ 10000 ];
15
16    // set up GUI and register mouse event handler
17    public PaintPanel()
18    {
19       // handle frame mouse motion event
20       addMouseMotionListener(
21
```

Create array of `Point`s

```
22          new MouseMotionAdapter() // anonymous inner
23          {
24             // store drag coordinates and repaint
25             public void mouseDragged( MouseEvent event )
26             {
27                if ( pointCount < points.length )
28                {
29                   points[ pointCount ] = event.getPoint(); // find point
30                   pointCount++; // increment number of points in array
31                   repaint(); // repaint JFrame
32                } // end if
33             } // end method mouseDragged
34          } // end anonymous inner class
35       ); // end call to addMouseMotionListener
36    } // end PaintPanel constructor
37
38    // draw oval in a 4-by-4 bounding box at specified location on window
39    public void paintComponent( Graphics g )
40    {
41       super.paintComponent( g ); // clears drawing area
42
43       // draw all points in array
44       for ( int i = 0; i < pointCount; i++ )
45          g.fillOval( points[ i ].x, points[ i ].y, 4, 4 );
46    } // end method paintComponent
47 } // end class PaintPanel
```

Anonymous inner class for event handling

Override `mouseDragged` method

Get location of mouse cursor

Repaint the `JFrame`

Get the *x* and *y*-coordinates of the `Point`

e

PaintPanel.java

(2 of 2)

Look-and-Feel Observation 11.14

Calling `repaint` for a Swing GUI component indicates that the component should be refreshed on the screen as soon as possible. The background of the GUI component is cleared only if the component is opaque. `JComponent` method `setOpaque` can be passed a `boolean` argument indicating whether the component is opaque (`true`) or transparent (`false`).

Look-and-Feel Observation 11.15

Drawing on any GUI component is performed with coordinates that are measured from the upper-left corner (0, 0) of that GUI component, not the upper-left corner of the screen.

Outline

Painter.java

(1 of 2)

```
1  // Fig. 11.35: Painter.java
2  // Testing PaintPanel.
3  import java.awt.BorderLayout;
4  import javax.swing.JFrame;
5  import javax.swing.JLabel;
6
7  public class Painter
8  {
9     public static void main( String args[] )
10    {
11       // create JFrame
12       JFrame application = new JFrame( "A simple paint program" );
13
14       PaintPanel paintPanel = new PaintPanel(); // create paint panel
15       application.add( paintPanel, BorderLayout.CENTER ); // in center
16
17       // create a label and place it in SOUTH of Bor
18       application.add( new JLabel( "Drag the mouse to draw" ),
19          BorderLayout.SOUTH );
20
21       application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
22       application.setSize( 400, 200 ); // set frame size
23       application.setVisible( true ); // display frame
24    } // end main
25 } // end class Painter
```

Create instance of custom drawing panel

Outline

`Painter.java`

(2 of 2)

11.16 Key-Event Handling

- `KeyListener` **interface**
  - **For handling** `KeyEvents`
  - **Declares methods** `keyPressed`**,** `keyReleased` **and** `keyTyped`

Outline

KeyDemoFrame.java

(1 of 3)

```
1  // Fig. 11.36: KeyDemoFrame.java
2  // Demonstrating keystroke events.
3  import java.awt.Color;
4  import java.awt.event.KeyListener;
5  import java.awt.event.KeyEvent;
6  import javax.swing.JFrame;
7  import javax.swing.JTextArea;
8
9  public class KeyDemoFrame extends JFrame implements KeyListener
10 {
11    private String line1 = ""; // first line of textar
12    private String line2 = ""; // second line of texta
13    private String line3 = ""; // third line of textar
14    private JTextArea textArea; // textarea to display output
15
16    // KeyDemoFrame constructor
17    public KeyDemoFrame()
18    {
19       super( "Demonstrating Keystroke Events" );
20
21       textArea = new JTextArea( 10, 15 ); // set up JTextArea
22       textArea.setText( "Press any key on the keyboard..." );
23       textArea.setEnabled( false ); // disable textar
24       textArea.setDisabledTextColor( Color.BLACK );
25       add( textArea ); // add textarea to JFrame
26
27       addKeyListener( this ); // allow frame to process key events
28    } // end KeyDemoFrame constructor
29
```

Implement `KeyListener` interface

Set background color

Register application as event handler for itself

Outline

```
30    // handle press of any key
31    public void keyPressed( KeyEvent event )
32    {
33       line1 = String.format( "Key pressed: %s",
34          event.getKeyText( event.getKeyCode() ) ); // output pressed key
35       setLines2and3( event ); // set output lines two
36    } // end method keyPressed
37
38    // handle release of any key
39    public void keyReleased( KeyEvent event )
40    {
41       line1 = String.format( "Key released: %s",
42          event.getKeyText( event.getKeyCode() ) ); // output released key
43       setLines2and3( event ); // set output lines two
44    } // end method keyReleased
45
46    // handle press of an action key
47    public void keyTyped( KeyEvent event )
48    {
49       line1 = String.format( "Key typed: %s", event.getKeyChar() );
50       setLines2and3( event ); // set output lines two and three
51    } // end method keyTyped
52
```

Declare `keyPressed` method

Get code of pressed key

oFrame

.java

(2 of 3)

Declare `keyReleased` method

Get code of released key

Declare `keyTyped` method

Get character typed

Outline

```
53    // set second and third lines of output
54    private void setLines2and3( KeyEvent event )
55    {
56       line2 = String.format( "This key is %san action key",
57          ( event.isActionKey() ? "" : "not " ) );
58
59       String temp = event.getKeyModifiersText( event.getModifiers() );
60
61       line3 = String.format( "Modifier keys pressed:
62          ( temp.equals( "" ) ? "none" : temp ) ); // output modifiers
63
64       textArea.setText( String.format( "%s\n%s\n%s\n",
65          line1, line2, line3 ) ); // output three lines of text
66    } // end method setLines2and3
67 } // end class KeyDemoFrame
```

Test if it was an action key

Determine any modifiers pressed

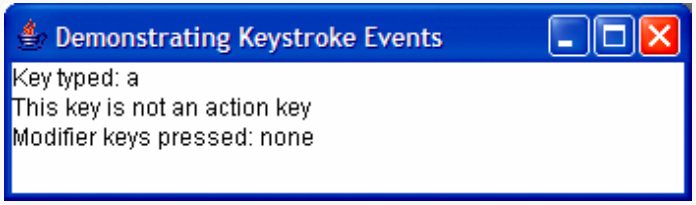
KeyDemoFrame.java

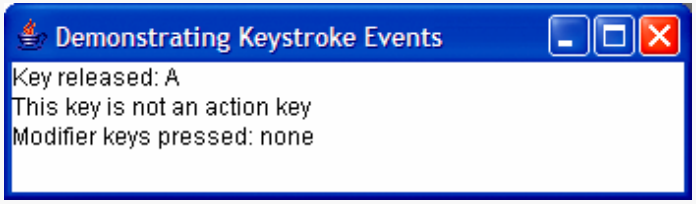
Outline

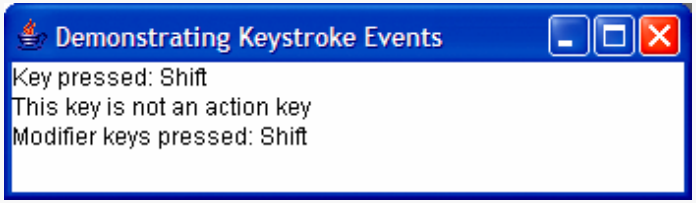
KeyDemo.java

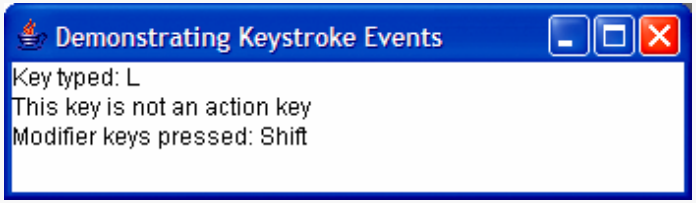
(1 of 2)

```
1  // Fig. 11.37: KeyDemo.java
2  // Testing KeyDemoFrame.
3  import javax.swing.JFrame;
4
5  public class KeyDemo
6  {
7     public static void main( String args[] )
8     {
9        KeyDemoFrame keyDemoFrame = new KeyDemoFrame();
10       keyDemoFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       keyDemoFrame.setSize( 350, 100 ); // set frame size
12       keyDemoFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class KeyDemo
```





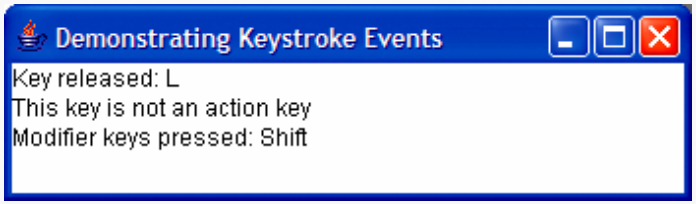


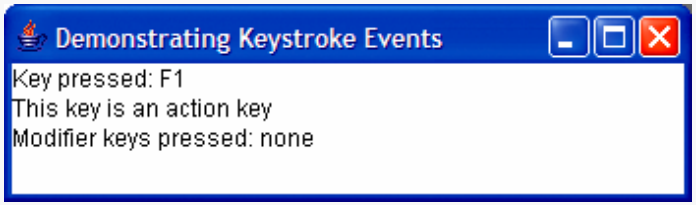


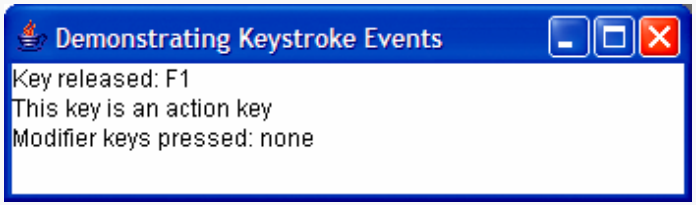
Outline

KeyDemo.java

(1 of 2)







12 Групиране на GUI компоненти и реализация на функционалност в JPanel

Всяка `JComponent-а` е контейнер

- **Съдържа в себе си други компоненти**
- **Реализира желана за изпълнение фунционалност**

Позволява създаване на библиотеки от готови компоненти и "вмъкване" на компонети при нужда

За групиране и компонети най- често се използва `JPanel` като контейнер за други компоненти или реализация на желано поведение ("функционалност") на компонента

12 Групиране на GUI компоненти и реализация на функционалност в JPanel

Пример:

Създаваме група от компоненти за пресмятане обща стойност на покупка по въведени на цена и количество на стока

Целта е да използваме тези компоненти в други приложения, включително аплети.

Започваме със *създаването на Java приложение, което ще създаде необходимата библиотека* от графични компоненти

12 Групиране на GUI компоненти и реализация на функционалност в JPanel

Създаване на библиотека от графични компоненти:

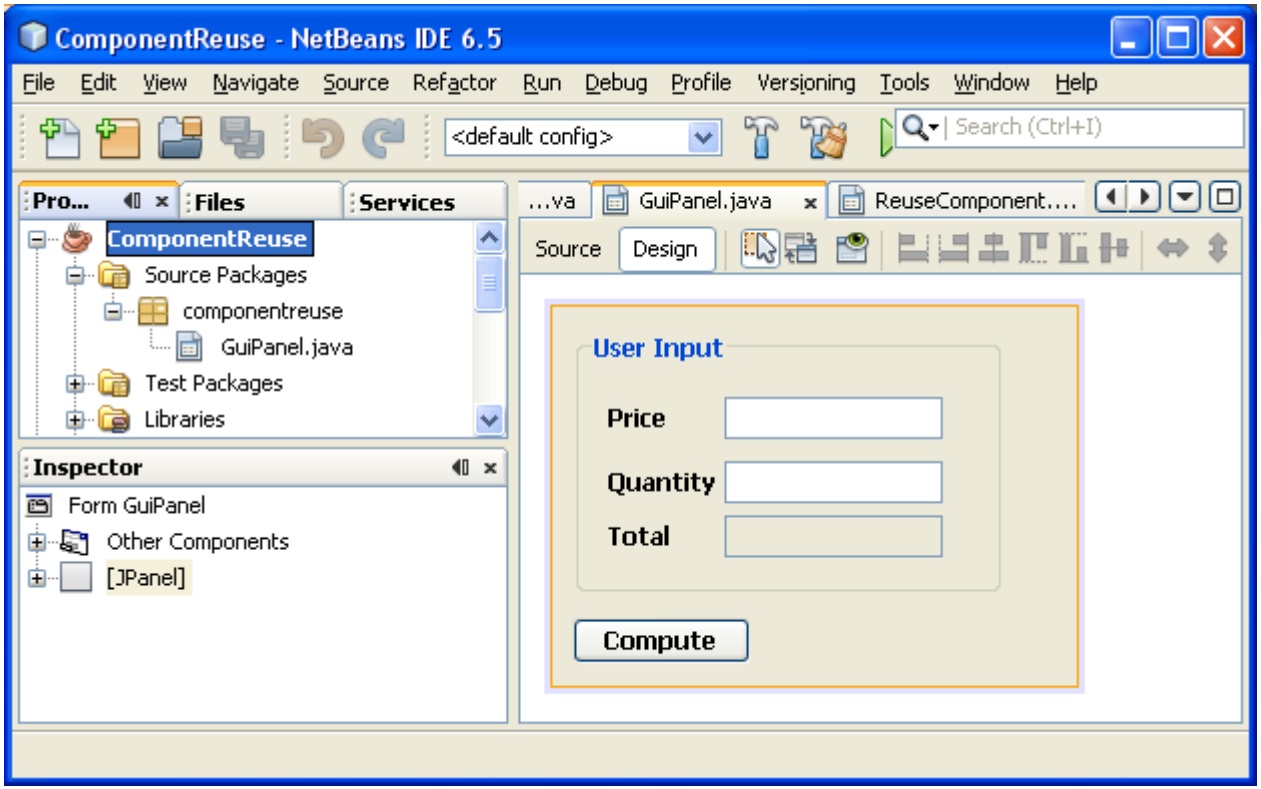
- същата последователност от действия, както създаване на всяка друга библиотека (виж лекция 11.1)

- разликата е, че вместо обикновен Java файл използваме `JPanel Form` за визуално редактиране на графичния контекст

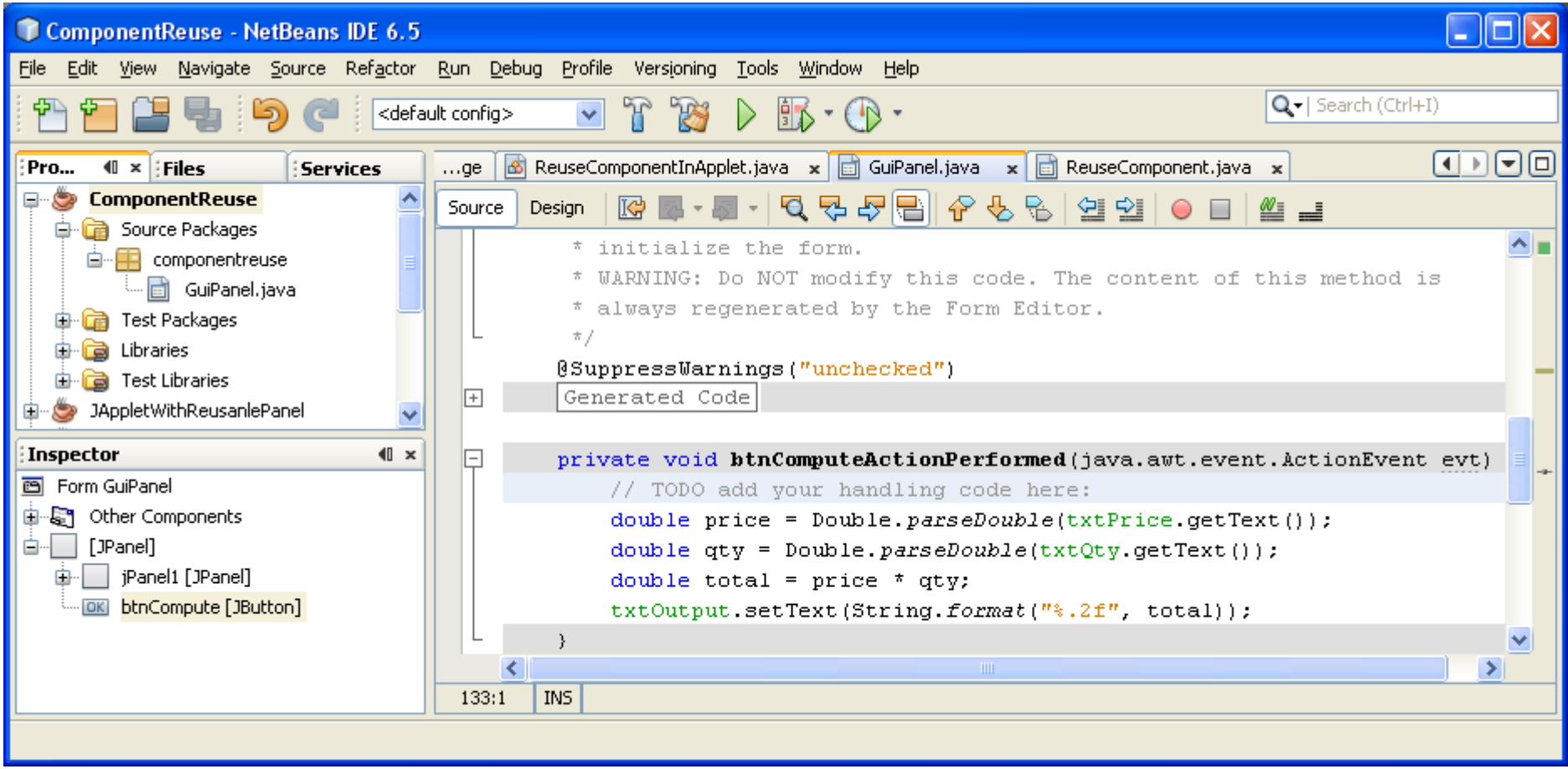
Пример:

Нека е създаден Java Application проект, съдържащ `JPanel Form` , показан на следващия слайд

JPanel Form с графични компонетнти и реализирано събитие Action за бутона Compute

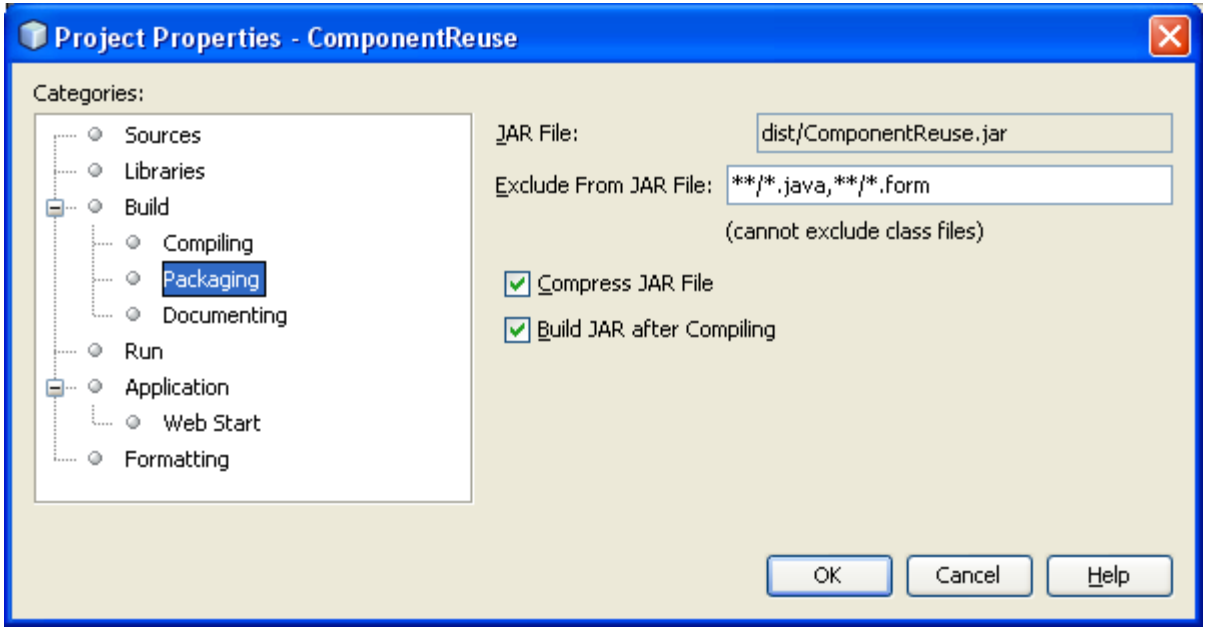


JPanel Form с графични компонетнти и реализирано събитие Action за бутона Compute



1 Групиране на GUI компоненти и реализация на функционалност в `JPanel`

Настройваме свойствата по създаване на пакет (библиотека на Java), както обикновено (лекция 11.1)



12 Групиране на GUI компоненти и реализация на функционалност в `JPanel`

Изпълнявате **`Build`**, за да се създаде нужния JAR файл, съдържащ така дефинираната графична компонента (**`JPanel Form`** в случая)

Остава да се добави тази компонента към **`Palette`** с другите Swing графични компоненти

12 Групиране на GUI компоненти и реализация на функционалност в `JPanel`

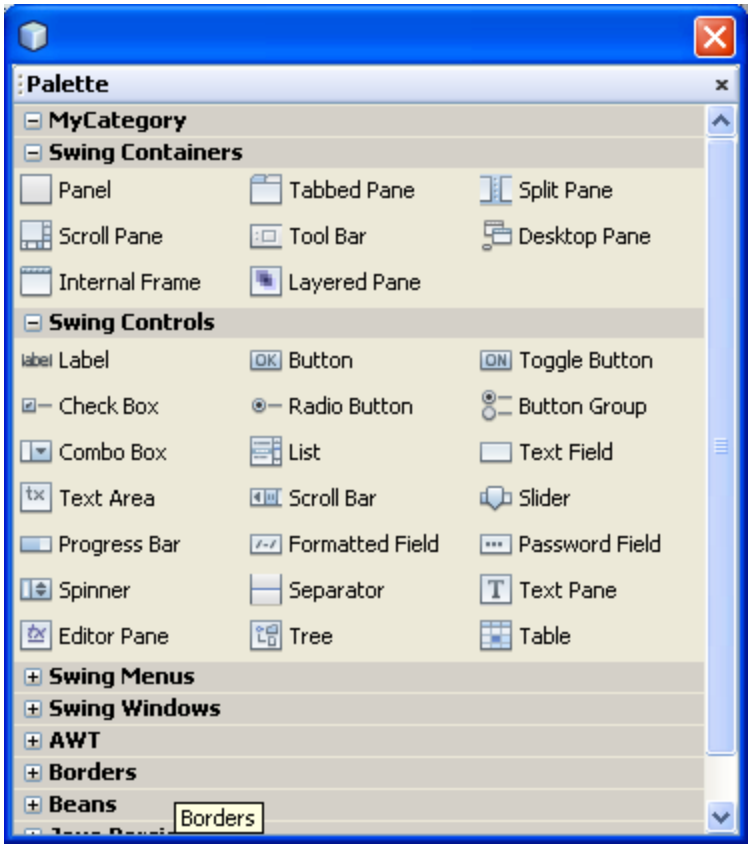
За целта:

- отваряте създадената графична компонента (`JPanel Form` в случая) в Design

- кликнете с десния бутон на мишката върху `Palette` (ако не се вижда, Ctrl-Shift- 8) и изберете `Palette Manager`

- използвайте `Palette Manager` за създаване на нова категория (бутон `New Category`) от компоненти, примерно, `My Category`

12 Групиране на GUI компоненти и реализация на функционалност в `JPanel`



12 Групиране на GUI компоненти и реализация на функционалност в `JPanel`

Остава да добавите вашата GUI компонента в тази нова категория

- кликнете с десния бутон на мишката върху `java файла` (в случая, `GuiPanel.java`) и изберете `Tools->Add To Palette` от менюто

- изберете желаната категория, от `Swing` компоненти от диалоговия прозорец, примерно, `My Category` и потвърдете с бутона `OK`

Така създадохме графична компонента и я добавихме към `Palette` от `Swing` компоненти

12.1 Използване на GUI компоненти в `JFrame Form` приложение

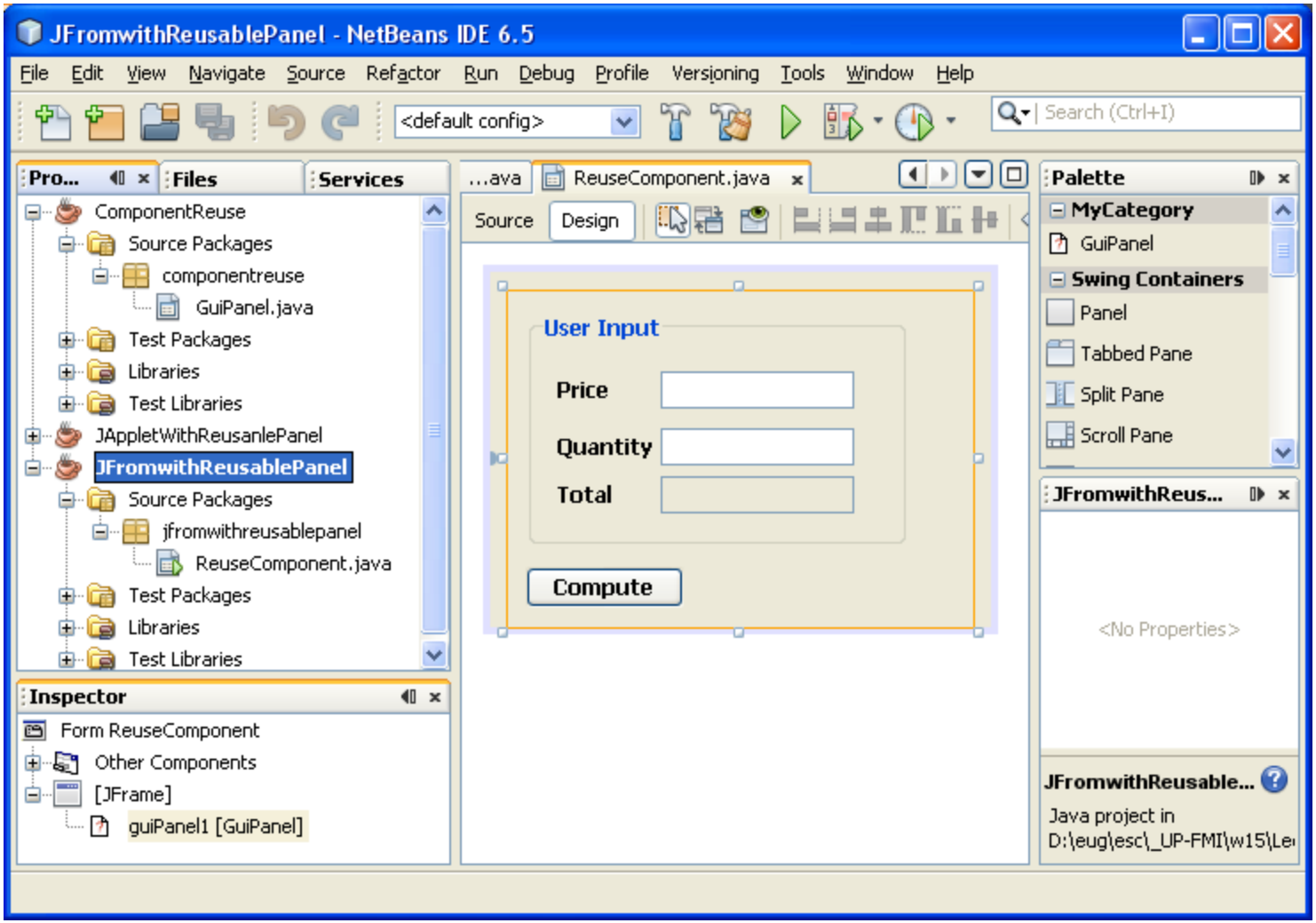
За целта:

1. Създайте Java приложение и добавете `JFrame Form` клас , например ReuseComponent.java (виж лекция 14.1)

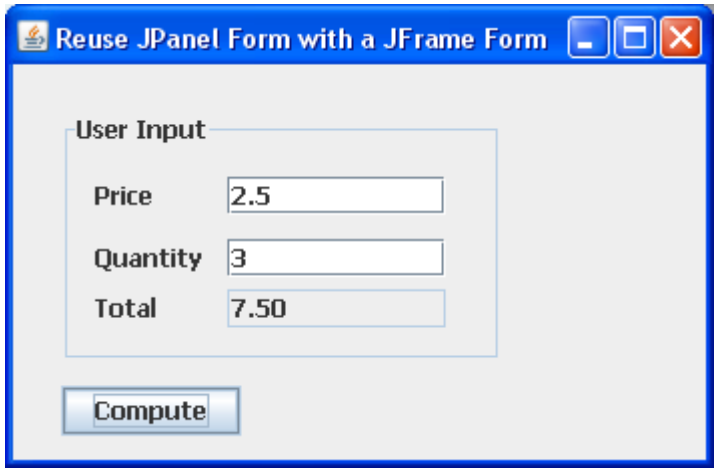
2. Изберете потребителската компонента от Palette, както всяка друга компонента и я добавете към `JFrame` Form

3. `Build` и `Run` Java приложението с така създадената JFrame Form

12.1 Използване на GUI компоненти в `Jframe Form` приложение



12.1 Използване на GUI компоненти в `Jframe Form` приложение

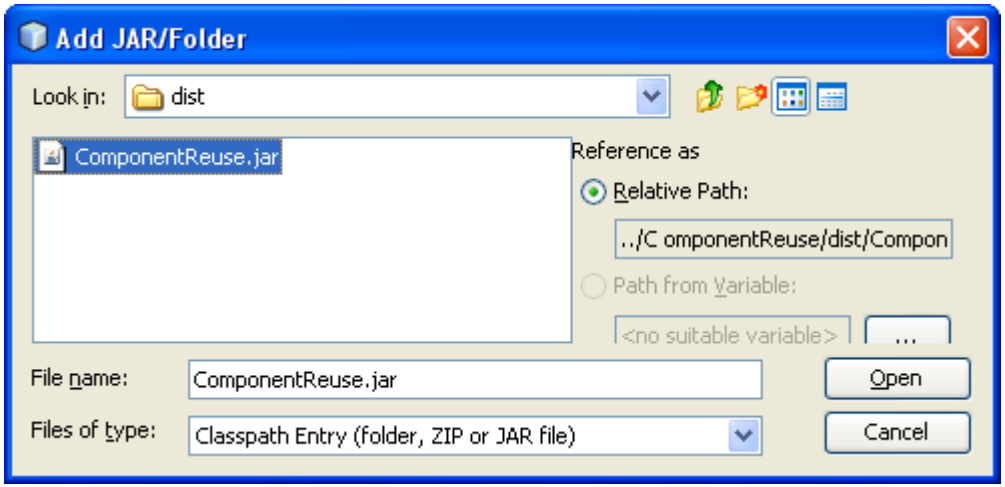


12.2 Използване на GUI компоненти в `JApplet` приложение

За целта:

1. **Създайте Java приложение и добавете `JApplet Form` клас, например `ReuseComponentInApplet.java`**

2. **Настройте Java приложение да използва JAR файла от приложението, в което създадохме `JPanel` компонентата (виж лекция 11.1)**



12.2 Използване на GUI компоненти в JApplet приложение

3. Добавете в JApplet-а `import` към съответния пакет, например,

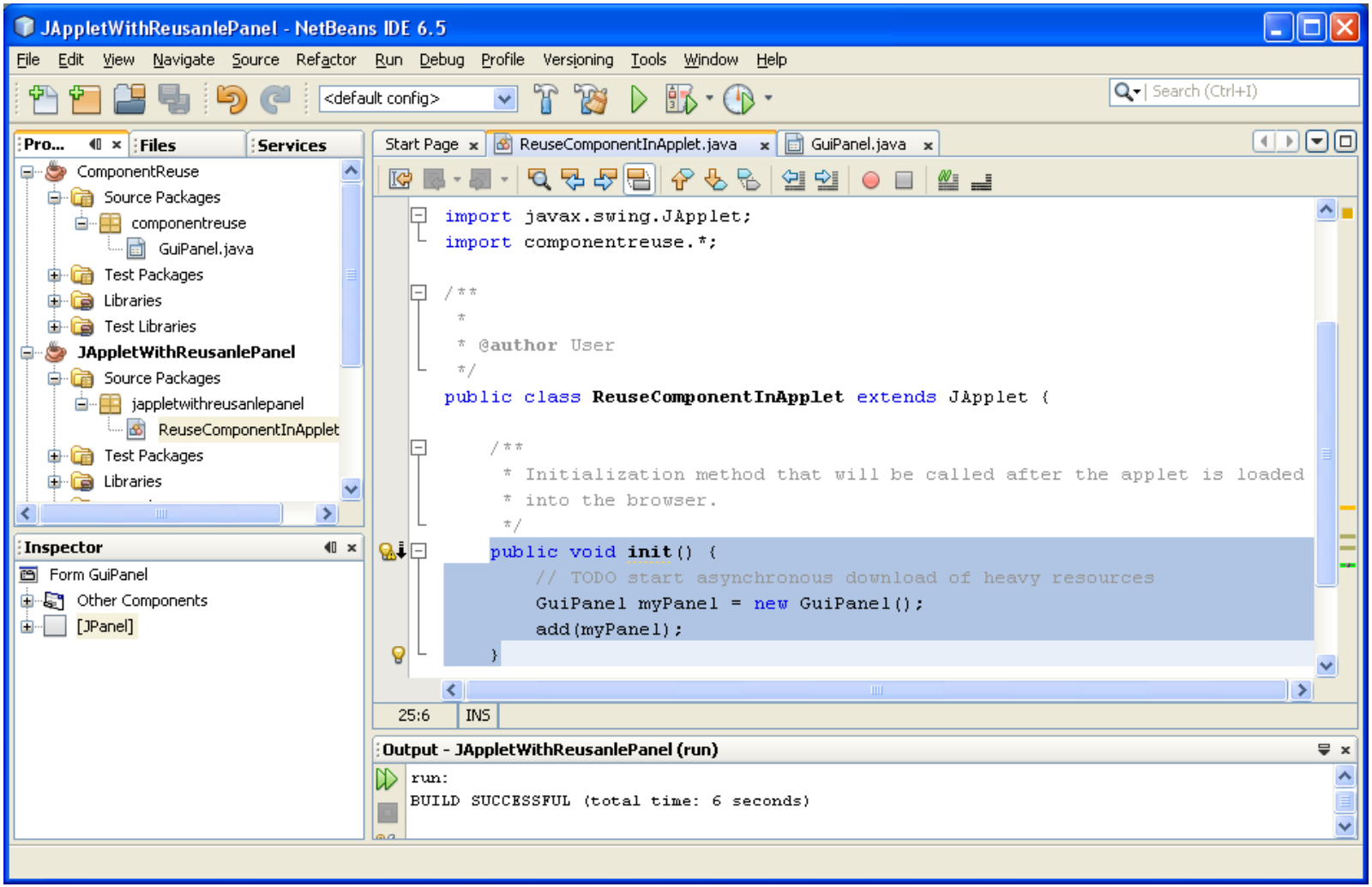
```
import componentreuse.*;
```

4. Дръпнете потребителската компонента от Palette, както всяка друга компонента и я добавете към `JApplet Form` или създайте инстанция от графичната компопента и я добавете към JApplet-а, `public void init() {`

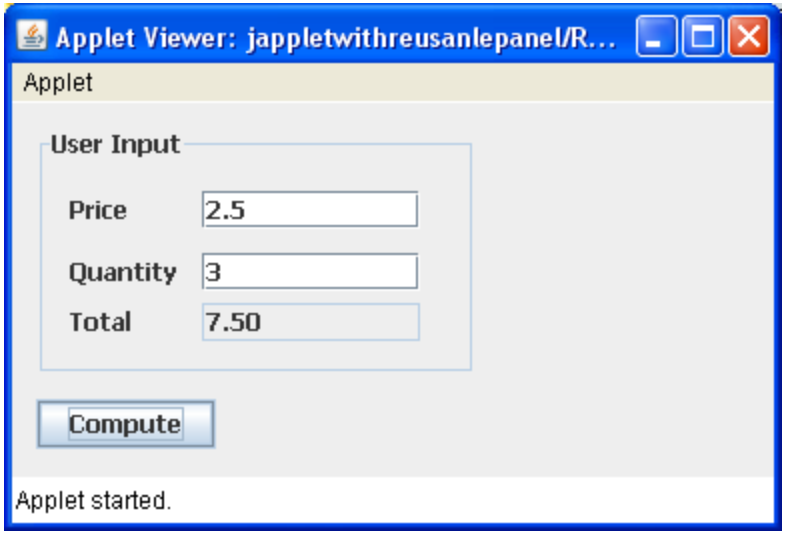
```
// TODO start asynchronous download of heavy resources
        GuiPanel myPanel = new GuiPanel();
        add(myPanel);
    }
```

5. Изпълнете аплета

12.2 Използване на GUI компоненти в `JApplet` приложение



12.2 Използване на GUI компоненти в `JApplet` приложение



11.17 Layout Managers

- **Layout managers**
  - **Provided to arrange GUI components in a container**
  - **Provide basic layout capabilities**
  - **Implement the interface `LayoutManager`**

Look-and-Feel Observation 11.16

Most Java programming environments provide GUI design tools that help a programmer graphically design a GUI; the design tools then write the Java code to create the GUI. Such tools often provide greater control over the size, position and alignment of GUI components than do the built-in layout managers.

Look-and-Feel Observation 11.17

It is possible to set a `Container`'s layout to `null`, which indicates that no layout manager should be used. In a `Container` without a layout manager, the programmer must position and size the components in the given container and take care that, on resize events, all components are repositioned as necessary. A component's resize events can be processed by a `ComponentListener`.

11.17.1 FlowLayout

- FlowLayout
  - **Simplest layout manager**
  - **Components are placed left to right in the order they are added**
  - **Components can be left aligned, centered or right aligned**

Layout manager	Description
`FlowLayout`	Default for `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 by using the `Container` method `add`, which takes a `Component` and an integer index position as arguments.
`BorderLayout`	Default for `JFrame`s (and other windows). Arranges the components into five areas: `NORTH`, `SOUTH`, `EAST`, `WEST` and `CENTER`.
`GridLayout`	Arranges the components into rows and columns.

Fig. 11.38 | Layout managers.

Outline

FlowLayoutFrame.java

(1 of 3)

```
1  // Fig. 11.39: FlowLayoutFrame.java
2  // Demonstrating FlowLayout alignments.
3  import java.awt.FlowLayout;
4  import java.awt.Container;
5  import java.awt.event.ActionListener;
6  import java.awt.event.ActionEvent;
7  import javax.swing.JFrame;
8  import javax.swing.JButton;
9
10 public class FlowLayoutFrame extends JFrame
11 {
12    private JButton leftJButton; // button to set alignment left
13    private JButton centerJButton; // button to set alignment center
14    private JButton rightJButton; // button to set alignment right
15    private FlowLayout layout; // layout object
16    private Container container; // container to set layout
17
18    // set up GUI and register button listeners
19    public FlowLayoutFrame()
20    {
21       super( "FlowLayout Demo" );
22
23       layout = new FlowLayout(); // create FlowLayout
24       container = getContentPane(); // get container to layout
25       setLayout( layout ); // set frame layout
26
```

Create FlowLayout

Set layout of application

Outline

```
27       // set up leftJButton and register listener
28       leftJButton = new JButton( "Left" ); // create Left button
29       add( leftJButton ); // add Left button to frame
30       leftJButton.addActionListener(
31
32          new ActionListener() // anonymous inner clas
33          {
34             // process leftJButton event
35             public void actionPerformed( ActionEvent event )
36             {
37                layout.setAlignment( FlowLayout.LEFT );
38
39                // realign attached components
40                layout.layoutContainer( container );
41             } // end method actionPerformed
42          } // end anonymous inner class
43       ); // end call to addActionListener
44
45       // set up centerJButton and register listener
46       centerJButton = new JButton( "Center" ); // create Center button
47       add( centerJButton ); // add Center button to frame
48       centerJButton.addActionListener(
49
50          new ActionListener() // anonymous inner clas
51          {
52             // process centerJButton event
53             public void actionPerformed( ActionEvent
54             {
55                layout.setAlignment( FlowLayout.CENTER );
56
```

Add `JButton`; `FlowLayout` will handle placement

Set alignment to left

Adjust layout

Add `JButton`; `FlowLayout` will handle placement

Set alignment to center

`FlowLayoutFrame.java`

(2 of 3)

Outline

FlowLayoutFrame.java

(3 of 3)

```
57                // realign attached components
58                layout.layoutContainer( container );
59             } // end method actionPerformed
60          } // end anonymous inner class
61       ); // end call to addActionListener
62
63       // set up rightJButton and register listener
64       rightJButton = new JButton( "Right" ); // create Right button
65       add( rightJButton ); // add Right button to frame
66       rightJButton.addActionListener(
67
68          new ActionListener() // anonymous inner clas
69          {
70             // process rightJButton event
71             public void actionPerformed( ActionEvent event )
72             {
73                layout.setAlignment( FlowLayout.RIGHT );
74
75                // realign attached components
76                layout.layoutContainer( container );
77             } // end method actionPerformed
78          } // end anonymous inner class
79       ); // end call to addActionListener
80    } // end FlowLayoutFrame constructor
81 } // end class FlowLayoutFrame
```

Adjust layout

Add `JButton`; `FlowLayout` will handle placement

Set alignment to right

Adjust layout

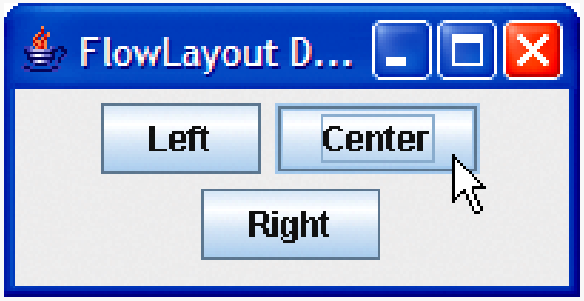
Outline

FlowLayoutDemo.java

(1 of 2)

```
1  // Fig. 11.40: FlowLayoutDemo.java
2  // Testing FlowLayoutFrame.
3  import javax.swing.JFrame;
4
5  public class FlowLayoutDemo
6  {
7     public static void main( String args[] )
8     {
9        FlowLayoutFrame flowLayoutFrame = new FlowLayoutFrame();
10       flowLayoutFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       flowLayoutFrame.setSize( 300, 75 ); // set frame size
12       flowLayoutFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class FlowLayoutDemo
```

Outline



`FlowLayoutDemo.java`

(2 of 2)

11.17.2 BorderLayout

- BorderLayout
  - **Arranges components into five regions – north, south, east, west and center**
  - **Implements interface** LayoutManager2
  - **Provides horizontal gap spacing and vertical gap spacing**

Look-and-Feel Observation 11.18

Each container can have only one layout manager. Separate containers in the same application can use different layout managers.

Look-and-Feel Observation 11.19

If no region is specified when adding a `Component` to a `BorderLayout`, the layout manager assumes that the `Component` should be added to region `BorderLayout.CENTER`.

Common Programming Error 11.6

When more than one component is added to a region in a `BorderLayout`, only the last component added to that region will be displayed. There is no error that indicates this problem.

Outline

BorderLayoutFrame.java

(1 of 2)

```
1  // Fig. 11.41: BorderLayoutFrame.java
2  // Demonstrating BorderLayout.
3  import java.awt.BorderLayout;
4  import java.awt.event.ActionListener;
5  import java.awt.event.ActionEvent;
6  import javax.swing.JFrame;
7  import javax.swing.JButton;
8
9  public class BorderLayoutFrame extends JFrame implements ActionListener
10 {
11    private JButton buttons[]; // array of buttons to hide portions
12    private final String names[] = { "Hide North", "Hide South",
13       "Hide East", "Hide West", "Hide Center" };
14    private BorderLayout layout; // borderlayout object
15
16    // set up GUI and event handling
17    public BorderLayoutFrame()
18    {
19       super( "BorderLayout Demo" );
20
21       layout = new BorderLayout( 5, 5 ); // 5 pixel g
22       setLayout( layout ); // set frame layout
23       buttons = new JButton[ names.length ]; // set size of array
24
25       // create JButtons and register listeners for them
26       for ( int count = 0; count < names.length; count++ )
27       {
28          buttons[ count ] = new JButton( names[ count ] );
29          buttons[ count ].addActionListener( this );
30       } // end for
```

Declare `BorderLayout` instance variable

Create `BorderLayout`

Set layout

Register event handler

Outline

BorderLayout.java

(2 of 2)

```
31
32       add( buttons[ 0 ], BorderLayout.NORTH ); // add button to north
33       add( buttons[ 1 ], BorderLayout.SOUTH ); // add button to south
34       add( buttons[ 2 ], BorderLayout.EAST ); // add button to east
35       add( buttons[ 3 ], BorderLayout.WEST ); // add button to west
36       add( buttons[ 4 ], BorderLayout.CENTER ); // add button to center
37    } // end BorderLayoutFrame constructor
38
39    // handle button events
40    public void actionPerformed( ActionEvent event )
41    {
42       // check event source and layout content pane correspondingly
43       for ( JButton button : buttons )
44       {
45          if ( event.getSource() == button )
46             button.setVisible( false ); // hide butte
47          else
48             button.setVisible( true ); // show other buttons
49       } // end for
50
51       layout.layoutContainer( getContentPane() ); // layout content pane
52    } // end method actionPerformed
53 } // end class BorderLayoutFrame
```

Add buttons to application using layout manager constants

Make button invisible

Make button visible

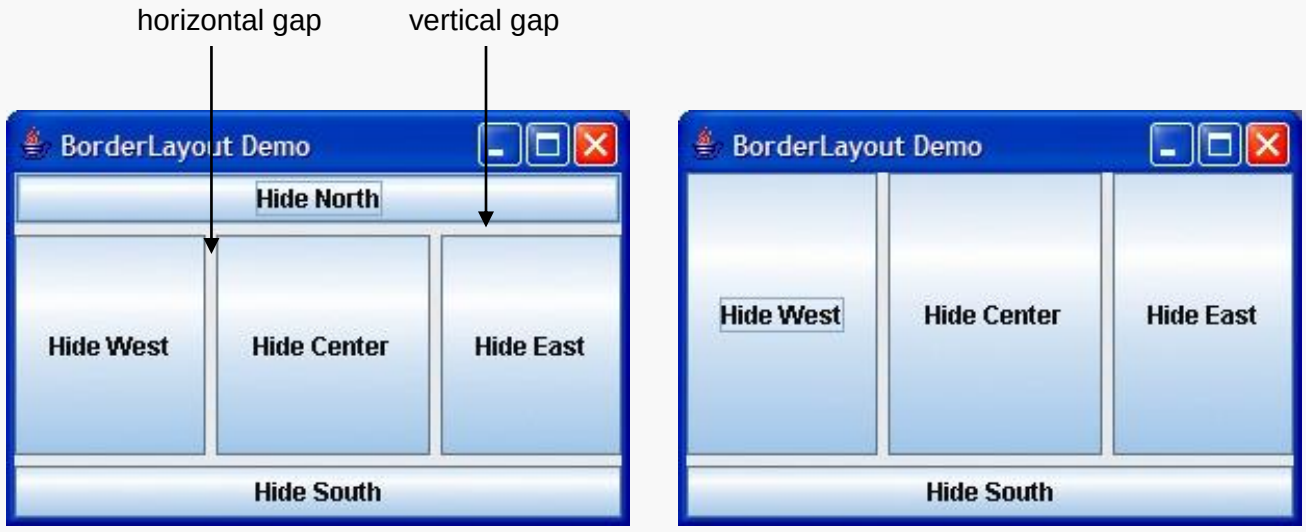
Update layout

Outline

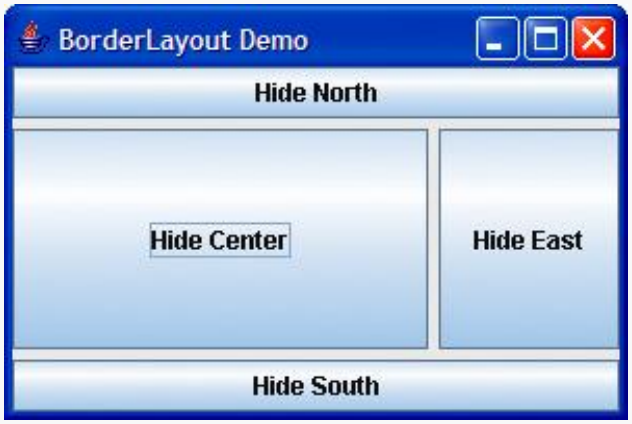
BorderLayout Demo.java

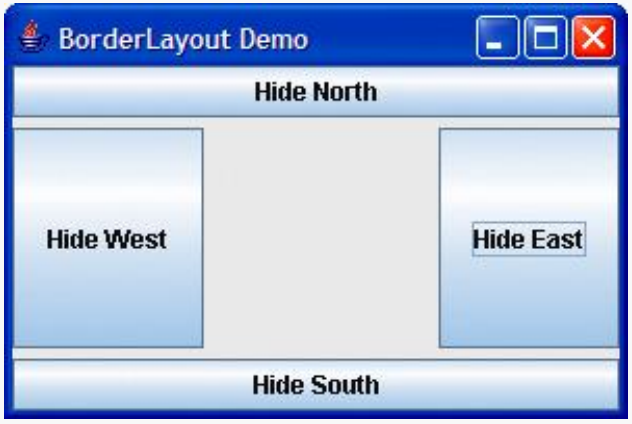
(1 of 2)

```
1  // Fig. 11.42: BorderLayoutDemo.java
2  // Testing BorderLayoutFrame.
3  import javax.swing.JFrame;
4
5  public class BorderLayoutDemo
6  {
7     public static void main( String args[] )
8     {
9        BorderLayoutFrame borderLayoutFrame = new BorderLayoutFrame();
10       borderLayoutFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       borderLayoutFrame.setSize( 300, 200 ); // set frame size
12       borderLayoutFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class BorderLayoutDemo
```



Outline





`BorderLayoutDemo.java`

(2 of 2)

11.17.3 GridLayout

- GridLayout
  - **Divides container into a grid**
  - **Every component has the same width and height**

Outline

GridLayout Frame.java

(1 of 2)

```
1  // Fig. 11.43: GridLayoutFrame.java
2  // Demonstrating GridLayout.
3  import java.awt.GridLayout;
4  import java.awt.Container;
5  import java.awt.event.ActionListener;
6  import java.awt.event.ActionEvent;
7  import javax.swing.JFrame;
8  import javax.swing.JButton;
9
10 public class GridLayoutFrame extends JFrame implements ActionListener
11 {
12    private JButton buttons[]; // array of buttons
13    private final String names[] =
14       { "one", "two", "three", "four", "five", "six"
15    private boolean toggle = true; // toggle between t
16    private Container container; // frame container
17    private GridLayout gridLayout1; // first gridlayout
18    private GridLayout gridLayout2; // second gridlayout
19
20    // no-argument constructor
21    public GridLayoutFrame()
22    {
23       super( "GridLayout Demo" );
24       gridLayout1 = new GridLayout( 2, 3, 5, 5 ); // 2 by 3; gaps of 5
25       gridLayout2 = new GridLayout( 3, 2 ); // 3 by 2; no gaps
26       container = getContentPane(); // get content pane
27       setLayout( gridLayout1 ); // set JFrame layout
28       buttons = new JButton[ names.length ]; // creat
29
```

Declare two `GridLayout` instance variables

Create `GridLayout`

Set layout

Outline

```
30       for ( int count = 0; count < names.length; count++ )
31       {
32          buttons[ count ] = new JButton( names[ count ] );
33          buttons[ count ].addActionListener( this ); // register listener
34          add( buttons[ count ] ); // add button to JFrame
35       } // end for
36    } // end GridLayoutFrame constructor
37
38    // handle button events by toggling between layouts
39    public void actionPerformed( ActionEvent event )
40    {
41       if ( toggle )
42          container.setLayout( gridLayout2 ); // set l
43       else
44          container.setLayout( gridLayout1 ); // set layout to first
45
46       toggle = !toggle; // set toggle to opposite value
47       container.validate(); // re-layout container
48    } // end method actionPerformed
49 } // end class GridLayoutFrame
```

Add button to `JFrame`

Use second layout

Use first layout

Update layout

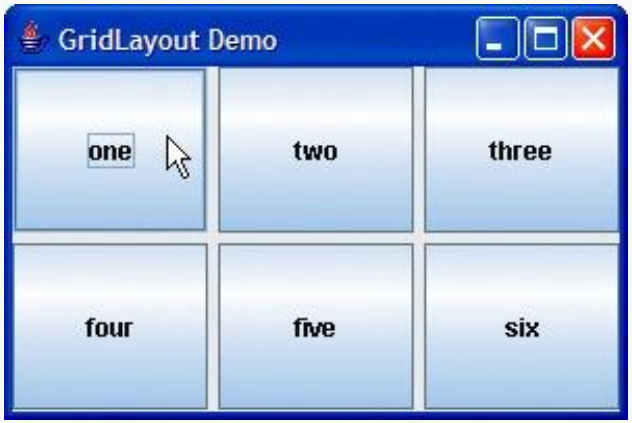
yout
java

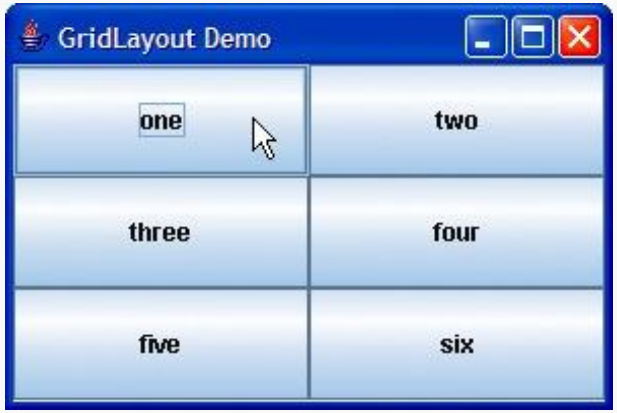
(2 of 2)

Outline

GridLayoutDemo.java

```
1  // Fig. 11.44: GridLayoutDemo.java
2  // Testing GridLayoutFrame.
3  import javax.swing.JFrame;
4
5  public class GridLayoutDemo
6  {
7     public static void main( String args[] )
8     {
9        GridLayoutFrame gridLayoutFrame = new GridLayoutFrame();
10       gridLayoutFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       gridLayoutFrame.setSize( 300, 200 ); // set frame size
12       gridLayoutFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class GridLayoutDemo
```





11.18 Using Panels to Manage More Complex Layouts

- **Complex GUIs often require multiple panels to arrange their components properly**

Outline

PanelFrame.java

(1 of 2)

```
1  // Fig. 11.45: PanelFrame.java
2  // Using a JPanel to help lay out components.
3  import java.awt.GridLayout;
4  import java.awt.BorderLayout;
5  import javax.swing.JFrame;
6  import javax.swing.JPanel;
7  import javax.swing.JButton;
8
9  public class PanelFrame extends JFrame
10 {
11    private JPanel buttonJPanel; // panel to hold buttons
12    private JButton buttons[]; // array of buttons
13
14    // no-argument constructor
15    public PanelFrame()
16    {
17       super( "Panel Demo" );
18       buttons = new JButton[ 5 ]; // create buttons array
19       buttonJPanel = new JPanel(); // set up panel
20       buttonJPanel.setLayout( new GridLayout( 1, buttons.length ) );
21
```

Declare a `JPanel` to hold buttons

Create `JPanel`

Set layout

Outline

```
22       // create and add buttons
23       for ( int count = 0; count < buttons.length; count++ )
24       {
25          buttons[ count ] = new JButton( "Button " + ( count + 1 ) );
26          buttonJPanel.add( buttons[ count ] ); // add button to panel
27       } // end for
28
29       add( buttonJPanel, BorderLayout.SOUTH ); // add panel to JFrame
30    } // end PanelFrame constructor
31 } // end class PanelFrame
```

rame.java

(2 of 2)

Add button to panel

Add panel to application

Outline

PanelDemo.java

```
1  // Fig. 11.46: PanelDemo.java
2  // Testing PanelFrame.
3  import javax.swing.JFrame;
4
5  public class PanelDemo extends JFrame
6  {
7     public static void main( String args[] )
8     {
9        PanelFrame panelFrame = new PanelFrame();
10       panelFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       panelFrame.setSize( 450, 200 ); // set frame size
12       panelFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class PanelDemo
```

11.19 JTextArea

- JTextArea
  - **Provides an area for manipulating multiple lines of text**
- Box **container**
  - **Subclass of** Container
  - **Uses a** BoxLayout **layout manager**

Look-and-Feel Observation 11.20

To provide line-wrapping functionality for a `JTextArea`, invoke `JTextArea` method `setLineWrap` with a `true` argument.

Outline

TextAreaFrame.java

(1 of 2)

```
1  // Fig. 11.47: TextAreaFrame.java
2  // Copying selected text from one textarea to another.
3  import java.awt.event.ActionListener;
4  import java.awt.event.ActionEvent;
5  import javax.swing.Box;
6  import javax.swing.JFrame;
7  import javax.swing.JTextArea;
8  import javax.swing.JButton;
9  import javax.swing.JScrollPane;
10
11 public class TextAreaFrame extends JFrame
12 {
13    private JTextArea textArea1; // displays demo string
14    private JTextArea textArea2; // highlighted text is copied here
15    private JButton copyJButton; // initiates copying of text
16
17    // no-argument constructor
18    public TextAreaFrame()
19    {
20       super( "TextArea Demo" );
21       Box box = Box.createHorizontalBox(); // create box
22       String demo = "This is a demo string to\n" +
23          "illustrate copying text\nfrom one textarea
24          "another textarea using an\nexternal event\n";
25
26       textArea1 = new JTextArea( demo, 10, 15 ); // create textarea1
27       box.add( new JScrollPane( textArea1 ) ); // add scrollpane
28
```

Declare `JTextArea` instance variables

Create a `Box` container

Create text area and add to box

Outline

TextAreaFrame.java

(2 of 2)

```
29       copyJButton = new JButton( "Copy >>>" ); // create copy button
30       box.add( copyJButton ); // add copy button to box
31       copyJButton.addActionListener(
32
33          new ActionListener() // anonymous inner class
34          {
35             // set text in textArea2 to selected text from textArea1
36             public void actionPerformed( ActionEvent event )
37             {
38                textArea2.setText( textArea1.getSelectedText() );
39             } // end method actionPerformed
40          } // end anonymous inner class
41       ); // end call to addActionListener
42
43       textArea2 = new JTextArea( 10, 15 ); // create second textarea
44       textArea2.setEditable( false ); // disable editing
45       box.add( new JScrollPane( textArea2 ) ); // add scrollpane
46
47       add( box ); // add box to frame
48    } // end TextAreaFrame constructor
49 } // end class TextAreaFrame
```

Add button to box

Copy selected text from one text area to the other

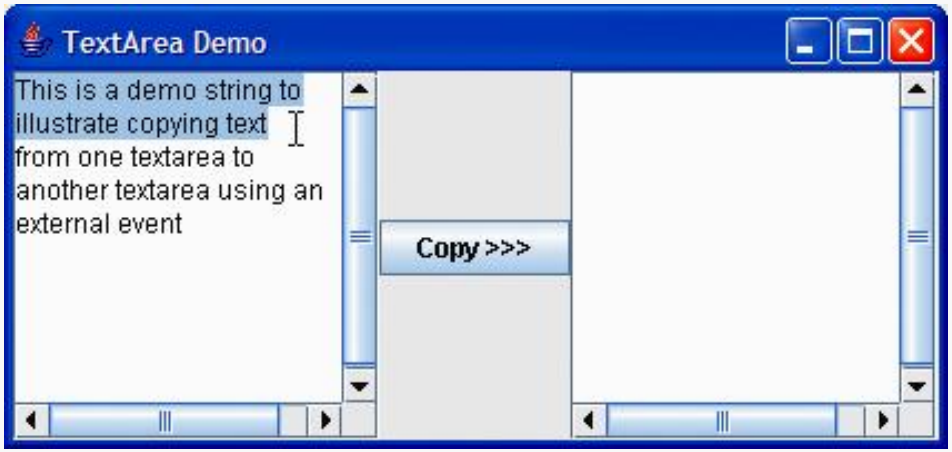
Create second text area and add it to box

Outline

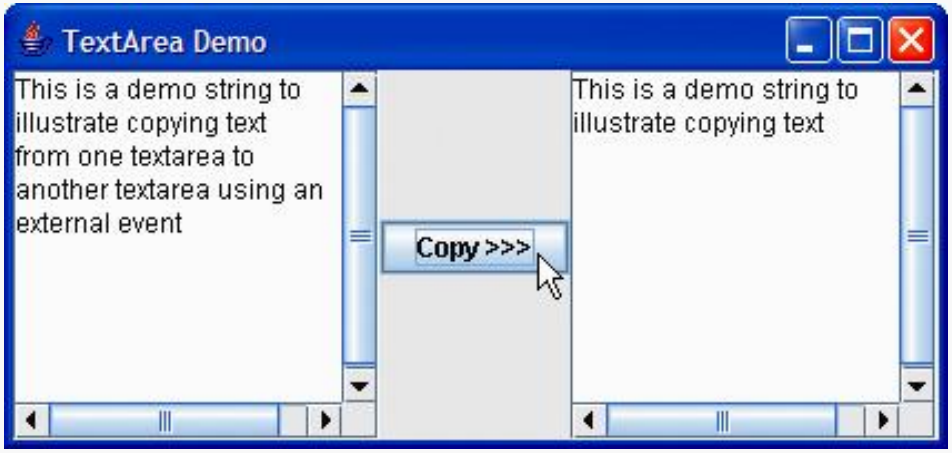
TextAreaDemo.java

(1 of 2)

```
1  // Fig. 11.48: TextAreaDemo.java
2  // Copying selected text from one textarea to another.
3  import javax.swing.JFrame;
4
5  public class TextAreaDemo
6  {
7     public static void main( String args[] )
8     {
9        TextAreaFrame textAreaFrame = new TextAreaFrame();
10       textAreaFrame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
11       textAreaFrame.setSize( 425, 200 ); // set frame size
12       textAreaFrame.setVisible( true ); // display frame
13    } // end main
14 } // end class TextAreaDemo
```



Outline



`TextAreaDemo.java`

(2 of 2)

JScrollPane Scrollbar Policies

- JScrollPane has scrollbar policies
  - Horizontal policies
    - Always (HORIZONTAL_SCROLLBAR_ALWAYS)
    - As needed (HORIZONTAL_SCROLLBAR_AS_NEEDED)
    - Never (HORIZONTAL_SCROLLBAR_NEVER)
  - Vertical policies
    - Always (VERTICAL_SCROLLBAR_ALWAYS)
    - As needed (VERTICAL_SCROLLBAR_AS_NEEDED)
    - Never (VERTICAL_SCROLLBAR_NEVER)