# Chapter 13 - Graphical User Interface Components: Part 1



**Outline**





# Chapter 13 - Graphical User Interface Components: Part 1



**Outline**





# 13.1 Introduction

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



# Fig. 13.1 Netscape window with GUI components

# Fig. 13.2 Some basic GUI components

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



# 13.2 Overview of Swing Components

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

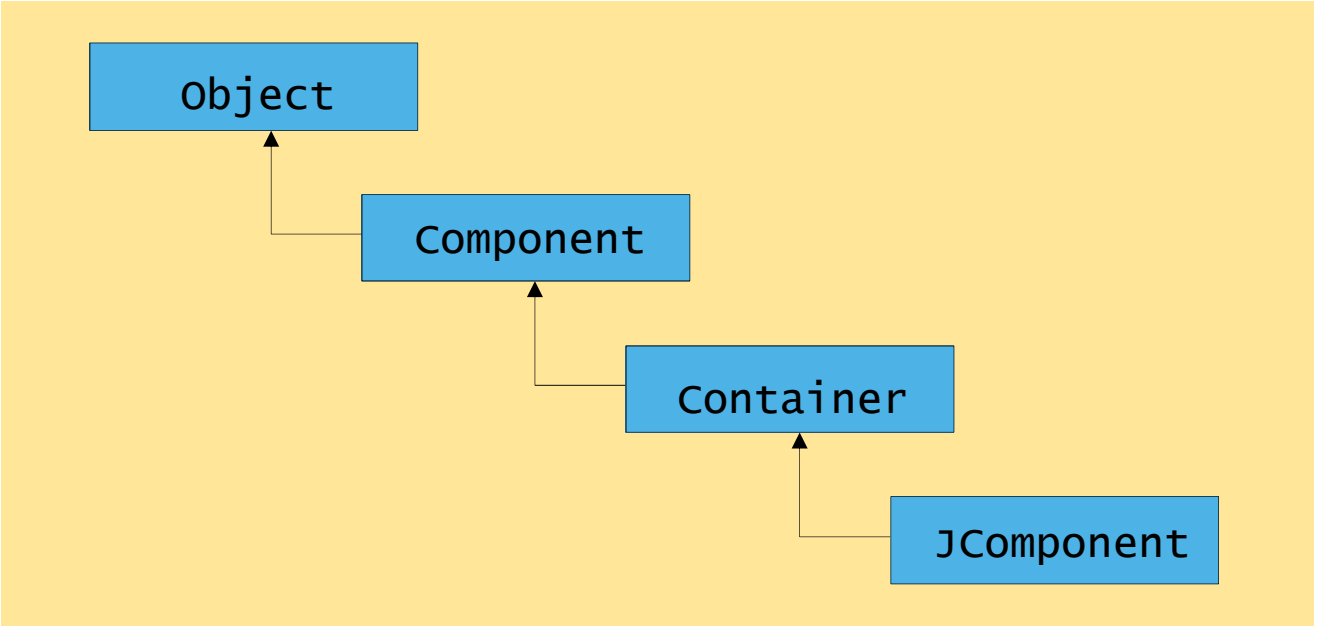


# 13.2 Overview of Swing Components

- Class `Component` Componenti, immagini e bottoni sono oggetti
  - Contains method `paint` for drawing `Component` onscreen
- Class `Container` è una lista, contiene i componenti
  - Collection of related components
  - Contains method `add` for adding components
- Class `JComponent` è un componente più elaborato
  - *Pluggable look and feel* for customizing look and feel è il tema
  - Shortcut keys (*mnemonics*) Ctrl + X, ...
  - Common event-handling capabilities fa da gestore di qualunque cosa accada nel programma, che sia fatta da un utente



# Fig. 13.3 Common superclasses of many of the Swing components



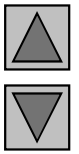



# 13.3 JLabel

- Label
  - Provide text on GUI
  - Defined with class `JLabel`
  - Can display:
    - Single line of read-only text
    - Image
    - Text and image

Genera una sola riga di testo non modificabile





Outline

LabelTest.java

Line 8

Line 20

Line 21

```
1  // Fig. 13.4: LabelTest.java
2  // Demonstrating the JLabel class.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class LabelTest extends JFrame {
8     private JLabel label1, label2, label3;
9      //8 istanzia dei riferimenti a label che sono null
10    // set up GUI
11    public LabelTest()
12    {
13       super( "Testing JLabel" );  //13 richiamo il costruttore della superclasse per dare un nome alla finestra
14
15       // get content pane and set its layout  //16 crea un container e recupera il pannello dei contenuti di JFrame
16       Container container = getContentPane();
17       container.setLayout( new FlowLayout() );
18
19       // JLabel constructor with a string argument
20       label1 = new JLabel( "Label with text" );
21       label1.setToolTipText( "This is label1" );
22       container.add( label1 );
23
```

Declare three `JLabel`s

Create first `JLabel` with text "`Label with text`"

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

Layout di base:
- Flow: ti mette gli oggetti dall'alto verso il basso dove trova spazio;
- Grid: ti mette gli oggetti come se fosse una griglia (Es. foto del telefono).

Il comando .setToolTipText(" "); crea una descrizione dell'oggetto richiamato
(Es. quando passi il cursore sopra un'icona esce scritto il nome dell'icona).

```
24        // JLabel constructor with string, Icon and alignment arguments
25        Icon bug = new ImageIcon( "bug1.gif" );
26        label2 = new JLabel( "Label with text and icon", bug,
27           SwingConstants.LEFT );
28        label2.setToolTipText( "This is label2" );
29        container.add( label2 );
30
31        // JLabel constructor no arguments
32        label3 = new JLabel();
33        label3.setText( "Label with icon and text at bottom" );
34        label3.setIcon( bug );
35        label3.setHorizontalTextPosition( SwingConstants.CENTER );
36        label3.setVerticalTextPosition( SwingConstants.BOTTOM );
37        label3.setToolTipText( "This is label3" );
38        container.add( label3 );
39
40        setSize( 275, 170 );    //40 crea una finestra di 275 px X 170 px
41        setVisible( true );
42
43     } // end constructor
44
45     public static void main( String args[] )
46     {
47        LabelTest application = new LabelTest();
48        application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE ); //48 quando premi il bottone con la X esce dal programma
49     }
```

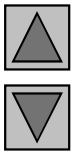
Create second `JLabel` with text to left of image

Create third `JLabel` with text below image



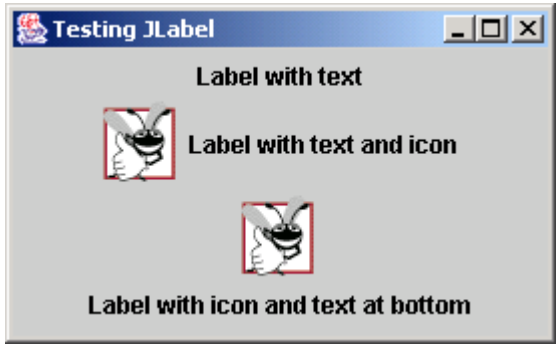
SwingConstants è una classe che contiene tutti i valori costanti che non cambiano nel tempo (le costanti sono tutte le variabili che non possono essere modificata), con .LEFT mette l'immagine a sinistra del testo

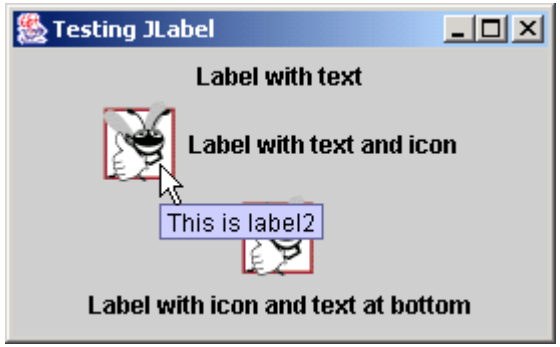
```
50
51  } // end class LabelTest
```



Outline

LabelTest.java



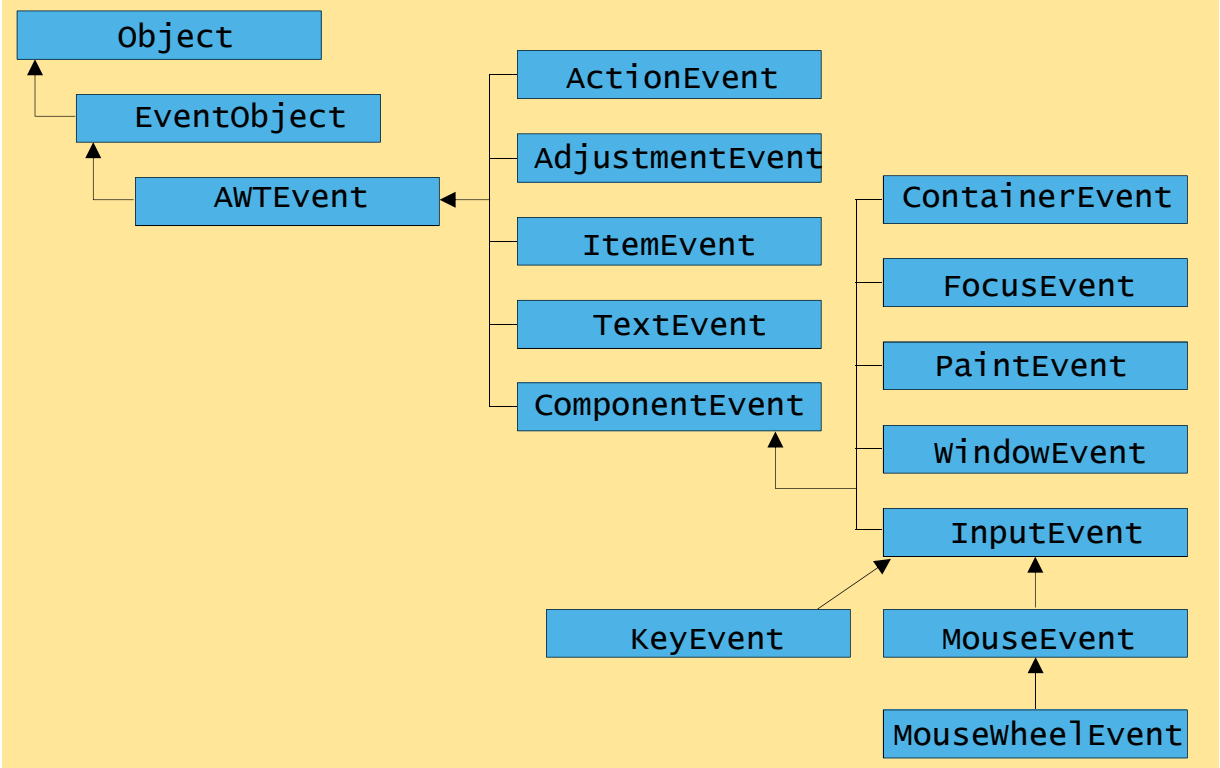



# 13.4 Event Handling

- GUIs are *event driven*
  - Generate *events* when user interacts with GUI
    - e.g., moving mouse, pressing button, typing in text field, etc.
    - Class `java.awt.AWTEvent`



# Fig. 13.5 Some event classes of package `java.awt.event`

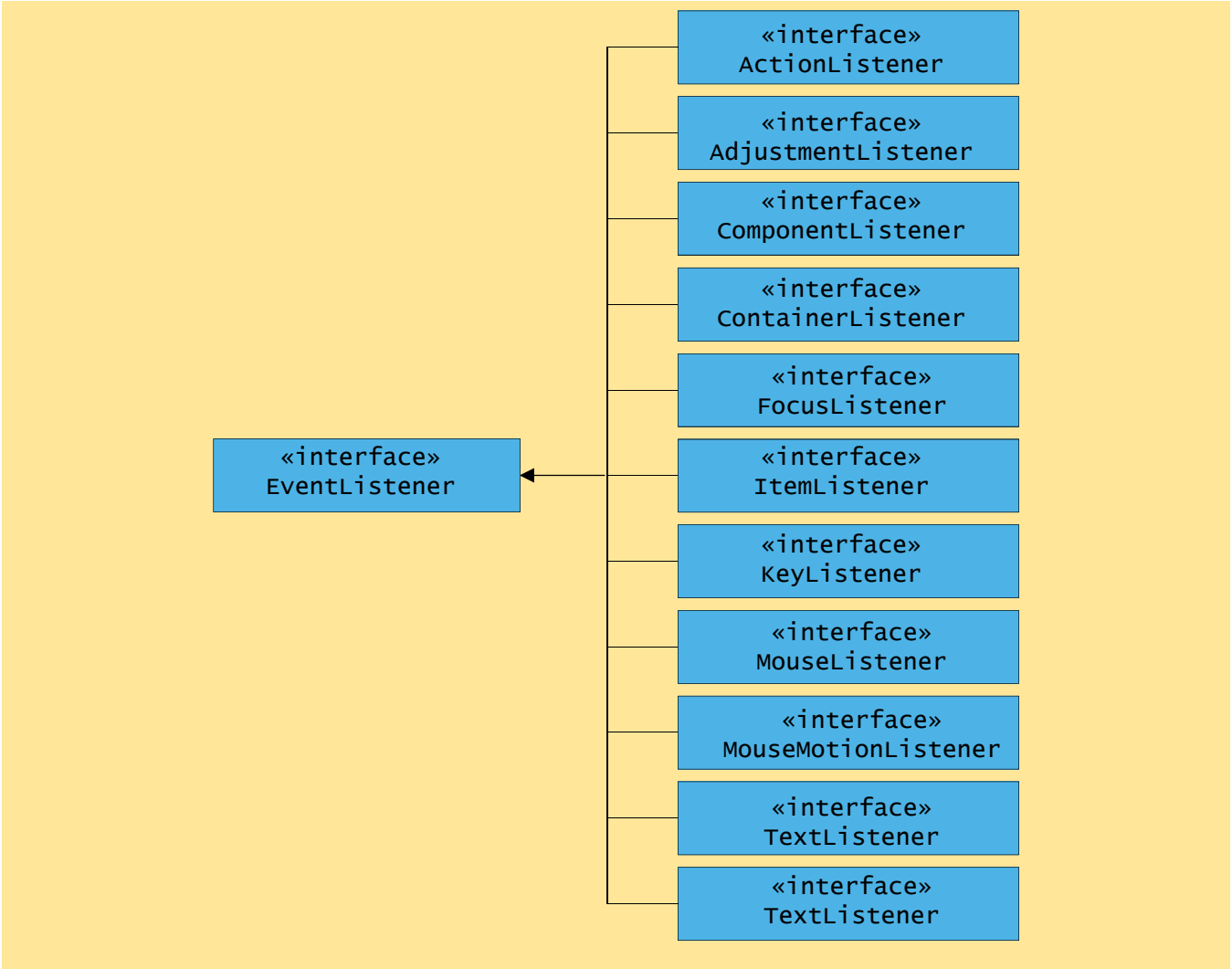


# 13.4 Event Handling

- Event-handling model Modello di gestione eventi
  - Three parts
    - Event source Sorgente di eventi, gli utenti interagiscono con la GUI; chi ha generato l'evento
      - GUI component with which user interacts
    - Event object Oggetti di eventi, è la classe che contiene le informazioni riguardanti gli eventi
      - Encapsulates information about event that occurred
    - Event listener Ascolto di eventi, è la classe che interpreta i segnali e risponde agli eventi
      - Receives event object when notified, then responds
  - Programmer must perform two tasks
    - Register event listener for event source
    - Implement event-handling method (event handler)



# Fig. 13.6 Event-listener interfaces of package `java.awt.event`



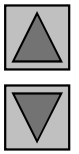
# 13.5 TextFields

- `JTextField`

Es. il riquadro dove devi inserire il nome utente o il riquadro dei commenti sotto un blog

  - Single-line area in which user can enter text
- `JPasswordField`
  - Extends `JTextField`
  - Hides characters that user enters





Outline

TextFieldTest.java

```
1  // Fig. 13.7: TextFieldTest.java
2  // Demonstrating the JTextField class.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class TextFieldTest extends JFrame {
8     private JTextField textField1, textField2, textField3;
9     private JPasswordField passwordField;
10
11    // set up GUI
12    public TextFieldTest()
13    {
14       super( "Testing JTextField and JPasswordField" );
15
16       Container container = getContentPane();
17       container.setLayout( new FlowLayout() );
18
19       // construct textfield with default sizing
20       textField1 = new JTextField( 10 );
21       container.add( textField1 );
22
23       // construct textfield with default text
24       textField2 = new JTextField( "Enter text here" );
25       container.add( textField2 );
26
```

Declare three JTextFields and one JPasswordField

Line 24

First JTextField contains empty string

Second JTextField contains text "Enter text here"

```
27        // construct textfield with default text,
28        // 20 visible elements and no event handler
29        textField3 = new JTextField( "Uneditable text field", 20 );
30        textField3.setEditable( false );
31        container.add( textField3 );
32
33        // construct passwordfield with default text
34        passwordField = new JPasswordField( "Hidden text" );
35        container.add( passwordField );
36
37        // register event handlers
38        TextFieldHandler handler = new TextFieldHandler();
39        textField1.addActionListener( handler );
40        textField2.addActionListener( handler );
41        textField3.addActionListener( handler );
42        passwordField.addActionListener( handler );
43
44        setSize( 325, 100 );
45        setVisible( true );
46
47     } // end constructor TextFieldTest
48
49     public static void main( String args[] )
50     {
51        TextFieldTest application = new TextFieldTest();
52        application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
53     }
```

Third `JTextField` contains uneditable text

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

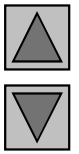
Register GUI components with `TextFieldHandler` (register for `ActionEvents`)

Outline

dTest.j
ava

Line 34

Lines 39-42



Outline

```
54
55    // private inner class for event handling
56    private class TextFieldHandler implements ActionListener {
57
58       // process textfield events
59       public void actionPerformed( ActionEvent event )
60       {
61          String string = "";
62
63          // user pressed Enter in JTextField textField1
64          if ( event.getSource() == textField1 )
65             string = "textField1: " + event.getActionCommand();
66
67          // user pressed Enter in JTextField textField2
68          else if ( event.getSource() == textField2 )
69             string = "textField2: " + event.getActionCommand();
70
71          // user pressed Enter in JTextField textField3
72          else if ( event.getSource() == textField3 )
73             string = "textField3: " + event.getActionCommand();
74
75          // user pressed Enter in JTextField passwordField
76          else if ( event.getSource() == passwordField ) {
77             string = "passwordField: " +
78                new String( passwordField.getPassword() );
79          }
```

Every `TextFieldHandler` instance is an `ActionListener`

Line 56

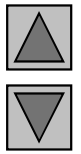
Method `actionPerformed` invoked when user presses Enter in GUI field

```
80
81          JOptionPane.showMessageDialog( null, string );
82
83       } // end method actionPerformed
84
85    } // end private inner class TextFieldHandler
86
87 } // end class TextFieldTest
```



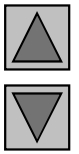






## Outline

TextFieldTest.java



## Outline

TextFieldTest.java

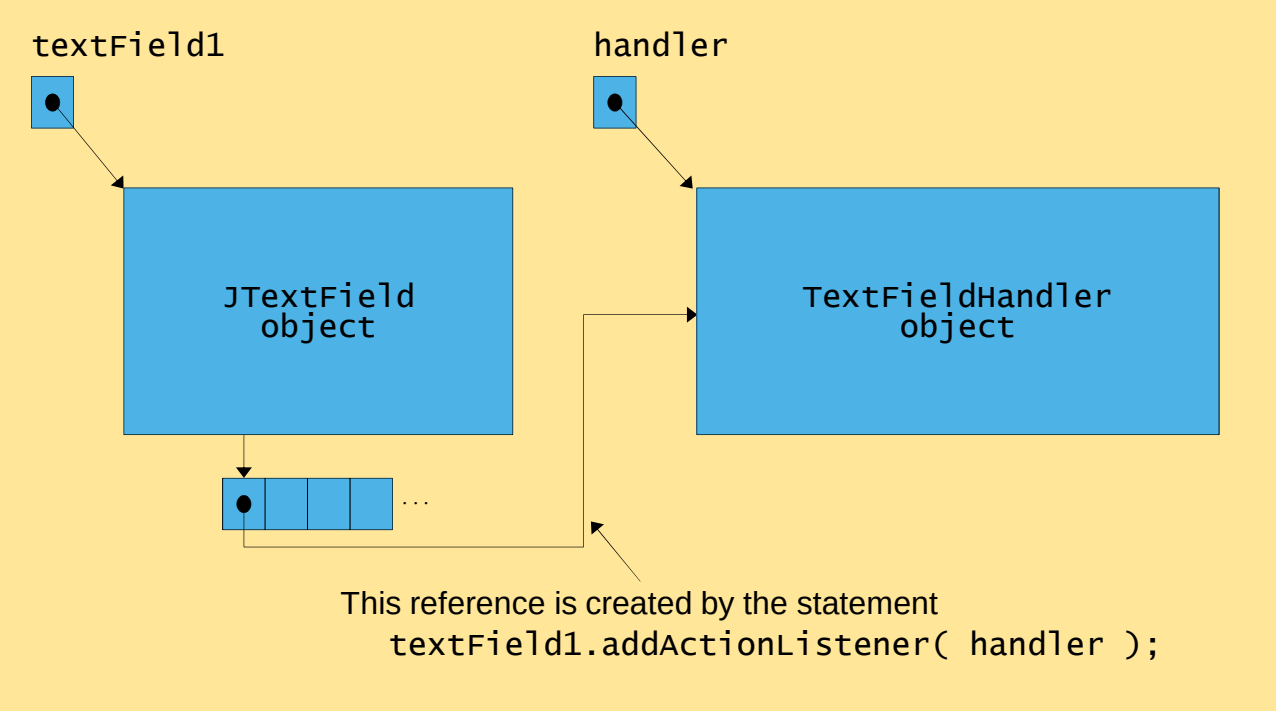


# 13.6 How Event Handling Works

- Two open questions from Section 13.4
  - How did event handler get registered?
    - Answer:
      - Through component's method `addActionListener`
      - Lines 39-42 of `TextFieldTest.java`
  - How does component know to call `actionPerformed`?
    - Answer:
      - Event is dispatched only to listeners of appropriate type
      - Each event type has corresponding event-listener interface
        - Event ID specifies event type that occurred



# Fig. 13.8 Event registration for `JTextField` `textField1`

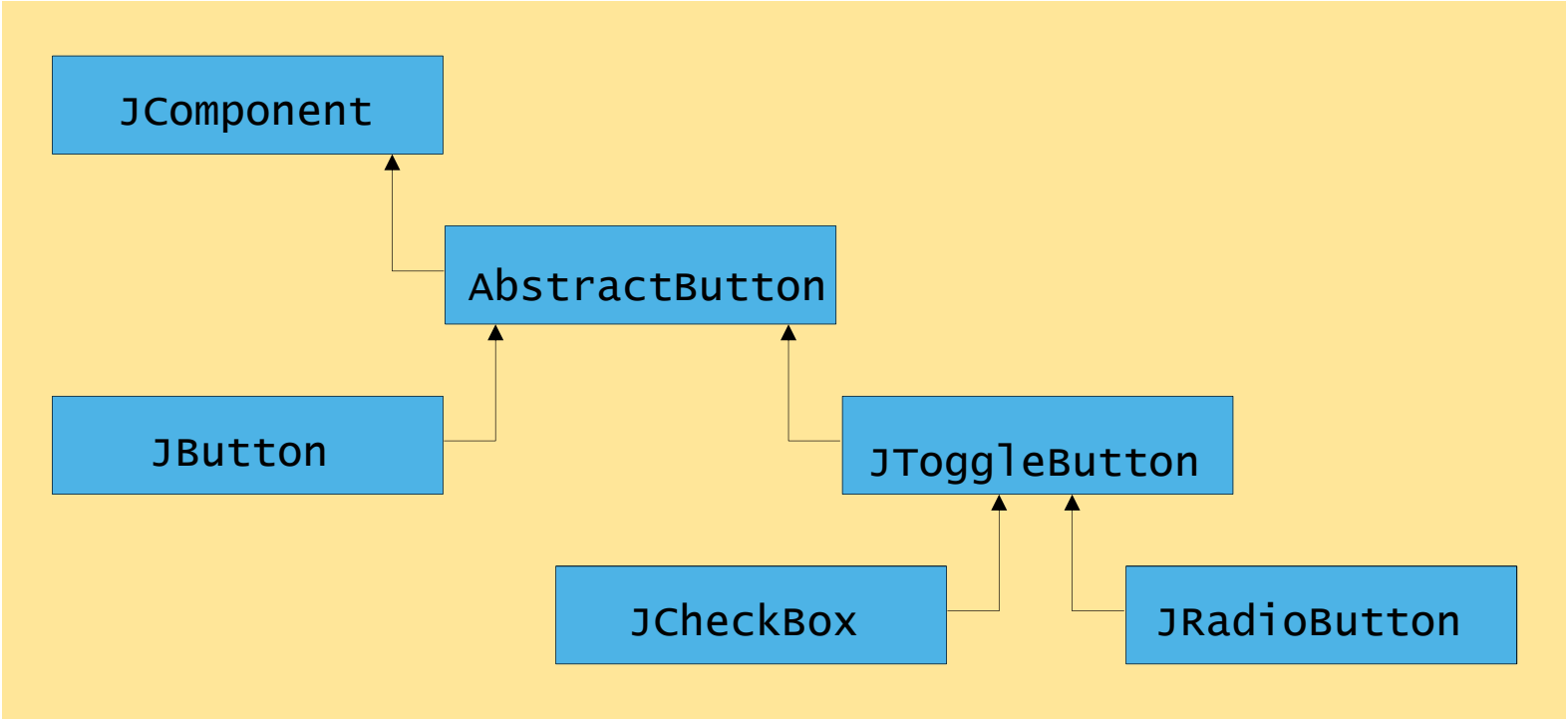


# 13.7 JButton

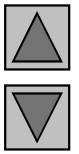
- Button
  - Component user clicks to trigger a specific action
  - Several different types
    - Command buttons
    - Check boxes
    - Toggle buttons
    - Radio buttons
  - `javax.swing.AbstractButton` subclasses
    - Command buttons are created with class `JButton`
      - Generate `ActionEvent`s when user clicks button



# Fig. 13.9 Swing button hierarchy





Outline

ButtonTest.java

Line 8

Line 20

Lines 24-26

```
1  // Fig. 13.10: ButtonTest.java
2  // Creating JButtons.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class ButtonTest extends JFrame {
8     private JButton plainButton, fancyButton;
9
10    // set up GUI
11    public ButtonTest()
12    {
13       super( "Testing Buttons" );
14
15       // get content pane and set its layout
16       Container container = getContentPane();
17       container.setLayout( new FlowLayout() );
18
19       // create buttons
20       plainButton = new JButton( "Plain Button" );
21       container.add( plainButton );
22
23       Icon bug1 = new ImageIcon( "bug1.gif" );
24       Icon bug2 = new ImageIcon( "bug2.gif" );
25       fancyButton = new JButton( "Fancy Button", bug1 );
26       fancyButton.setRolloverIcon( bug2 );
27       container.add( fancyButton );
```

Create two references to `JButton` instances

Instantiate `JButton` with text

Instantiate `JButton` with image and *rollover* image

Outline

```
28
29       // create an instance of inner class ButtonHandler
30       // to use for button event handling
31       ButtonHandler handler = new ButtonHandler();
32       fancyButton.addActionListener( handler );
33       plainButton.addActionListener( handler );
34
35       setSize( 275, 100 );
36       setVisible( true );
37
38    } // end ButtonTest constructor
39
40    public static void main( String args[] )
41    {
42       ButtonTest application = new ButtonTest();
43       application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
44    }
45
46    // inner class for button event handling
47    private class ButtonHandler implements ActionListener {
48
49       // handle button event
50       public void actionPerformed( ActionEvent event )
51       {
52          JOptionPane.showMessageDialog( ButtonTest.this,
53             "You pressed: " + event.getActionCommand() );
54       }
```

java

Instantiate `ButtonHandler` for `JButton` event handling

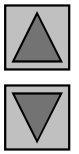
Register `JButton`s to receive events from `ButtonHandler`

Lines 32-33

Line 50

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

```
55
56     } // end private inner class ButtonHandler
57
58  } // end class ButtonTest
```



Outline

ButtonTest.java



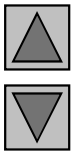



# 13.8 JCheckBox and JRadioButton

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

ToggleButton: Switch
CheckBox: Spunta a scelta multipla
RadioButton: Cerchio a scelta singola





Outline

CheckBoxTest.java

Line 9

Line 22

```
1  // Fig. 13.11: CheckBoxTest.java
2  // Creating JCheckBox buttons.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class CheckBoxTest extends JFrame {
8     private JTextField field;
9     private JCheckBox bold, italic;
10
11    // set up GUI
12    public CheckBoxTest()
13    {
14       super( "JCheckBox Test" );
15
16       // get content pane and set its layout
17       Container container = getContentPane();
18       container.setLayout( new FlowLayout() );
19
20       // set up JTextField and set its font
21       field = new JTextField( "Watch the font style change", 20 );
22       field.setFont( new Font( "Serif", Font.PLAIN, 14 ) );
23       container.add( field );
24
```

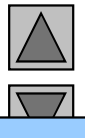
Declare two `JCheckBox` instances

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

```
25        // create checkbox objects
26        bold = new JCheckBox( "Bold" );
27        container.add( bold );
28
29        italic = new JCheckBox( "Italic" );
30        container.add( italic );
31
32        // register listeners for JCheckBoxes
33        CheckBoxHandler handler = new CheckBoxHandler();
34        bold.addItemListener( handler );
35        italic.addItemListener( handler );
36
37        setSize( 275, 100 );
38        setVisible( true );
39
40     } // end CheckBoxText constructor
41
42     public static void main( String args[] )
43     {
44        CheckBoxTest application = new CheckBoxTest();
45        application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
46     }
47
```

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

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



Outline

`t.ja`
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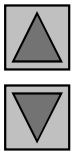
Lines 26 and 29



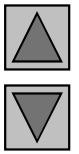
Outline

```
48    // private inner class for ItemListener event handling
49    private class CheckBoxHandler implements ItemListener {
50       private int valBold = Font.PLAIN;
51       private int valItalic = Font.PLAIN;
52
53       // respond to checkbox events
54       public void itemStateChanged( ItemEvent event )
55       {
56          // process bold checkbox events
57          if ( event.getSource() == bold )
58             valBold = bold.isSelected() ? Font.BOLD : Font.PLAIN;
59
60          // process italic checkbox events
61          if ( event.getSource() == italic )
62             valItalic = italic.isSelected() ? Font.ITAL
63
64          // set text field font
65          field.setFont( new Font( "Serif", valBold + valItalic, 14 ) );
66
67       } // end method itemStateChanged
68
69    } // end private inner class CheckBoxHandler
70
71 } // end class CheckBoxTest
```

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

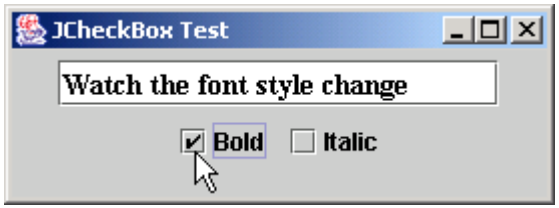
Change `JTextField` font, depending on which `JCheckBox` was selected

Line 65

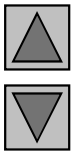


## Outline

CheckBoxTest.java





Outline

RadioButtonTest.java

```
1  // Fig. 13.12: RadioButtonTest.java
2  // Creating radio buttons using ButtonGroup and JRadioButton.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class RadioButtonTest extends JFrame {
8     private JTextField field;
9     private Font plainFont, boldFont, italicFont, boldItalicFont;
10    private JRadioButton plainButton, boldButton, italicButton,
11       boldItalicButton;
12    private ButtonGroup radioGroup;
13
14    // create GUI and fonts
15    public RadioButtonTest()
16    {
17       super( "RadioButton Test" );
18
19       // get content pane and set its layout
20       Container container = getContentPane();
21       container.setLayout( new FlowLayout() );
22
23       // set up JTextField
24       field = new JTextField( "Watch the font style change", 25 );
25       container.add( field );
26
```

Declare four `JRadioButton` instances

Lines 10-11

Line 12

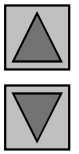
`JRadioButton`s normally appear as a `ButtonGroup`

```
27        // create radio buttons
28        plainButton = new JRadioButton( "Plain", true );
29        container.add( plainButton );
30
31        boldButton = new JRadioButton( "Bold", false );
32        container.add( boldButton );
33
34        italicButton = new JRadioButton( "Italic", false );
35        container.add( italicButton );
36
37        boldItalicButton = new JRadioButton( "Bold/Italic", false );
38        container.add( boldItalicButton );
39
40        // create logical relationship between JRadioButtons
41        radioGroup = new ButtonGroup();
42        radioGroup.add( plainButton );
43        radioGroup.add( boldButton );
44        radioGroup.add( italicButton );
45        radioGroup.add( boldItalicButton );
46
47        // create font objects
48        plainFont = new Font( "Serif", Font.PLAIN, 14 );
49        boldFont = new Font( "Serif", Font.BOLD, 14 );
50        italicFont = new Font( "Serif", Font.ITALIC, 14 );
51        boldItalicFont = new Font( "Serif", Font.BOLD + Font.ITALIC, 14 );
52        field.setFont( plainFont );  // set initial font
53
```

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

Lines 41-45

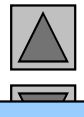
`JRadioButton`s belong to `ButtonGroup`



Outline

`RadioButtonTest.java`

```
54       // register events for JRadioButtons
55       plainButton.addItemListener( new RadioButtonHandler( plainFont ) );
56       boldButton.addItemListener( new RadioButtonHandler( boldFont ) );
57       italicButton.addItemListener(
58          new RadioButtonHandler( italicFont ) );
59       boldItalicButton.addItemListener(
60          new RadioButtonHandler( boldItalicFont ) );
61
62       setSize( 300, 100 );
63       setVisible( true );
64
65    } // end RadioButtonTest constructor
66
67    public static void main( String args[] )
68    {
69       RadioButtonTest application = new RadioButtonTest();
70       application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
71    }
72
73    // private inner class to handle radio button events
74    private class RadioButtonHandler implements ItemListener {
75       private Font font;
76
77       public RadioButtonHandler( Font f )
78       {
79          font = f;
80       }
```



## Outline

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

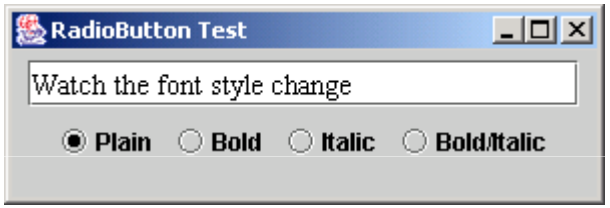
Lines 55-60

Outline

```
81
82       // handle radio button events
83       public void itemStateChanged( ItemEvent event )
84       {
85          field.setFont( font );
86       }
87
88    } // end private inner class RadioButtonHandler
89
90 } // end class RadioButtonTest
```

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

Set font corresponding to `JRadioButton` selected

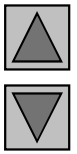





# 13.9 JComboBox

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





Outline

ComboBoxTest.java

```
1  // Fig. 13.13: ComboBoxTest.java
2  // Using a JComboBox to select an image to display.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class ComboBoxTest extends JFrame {
8     private JComboBox imagesComboBox;
9     private JLabel label;
10
11    private String names[] =
12       { "bug1.gif", "bug2.gif",  "travelbug.gif", "buganim.gif" };
13    private Icon icons[] = { new ImageIcon( names[ 0 ] ),
14       new ImageIcon( names[ 1 ] ), new ImageIcon( names[ 2 ] ),
15       new ImageIcon( names[ 3 ] ) };
16
17    // set up GUI
18    public ComboBoxTest()
19    {
20       super( "Testing JComboBox" );
21
22       // get content pane and set its layout
23       Container container = getContentPane();
24       container.setLayout( new FlowLayout() );
25
```

```
26       // set up JComboBox and register its event handler
27       imagesComboBox = new JComboBox( names );
28       imagesComboBox.setMaximumRowCount( 3 );
29       imagesComboBox.addItemListener(
30
31          new ItemListener() {  // anonymous inner class
32
33             // handle JComboBox event
34             public void itemStateChanged( ItemEvent event )
35             {
36                // determine whether check box selected
37                if ( event.getStateChange() == ItemEvent.SELECTED )
38                   label.setIcon( icons[
39                      imagesComboBox.getSelectedIndex() ] );
40             }
41
42          }  // end anonymous inner class
43
44       ); // end call to addItemListener
45
46       container.add( imagesComboBox );
47
48       // set up JLabel to display ImageIcons
49       label = new JLabel( icons[ 0 ] );
50       container.add( label );
51
```

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

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

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

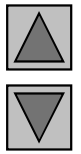
Set appropriate `Icon` depending on user selection

Outline

Line 29

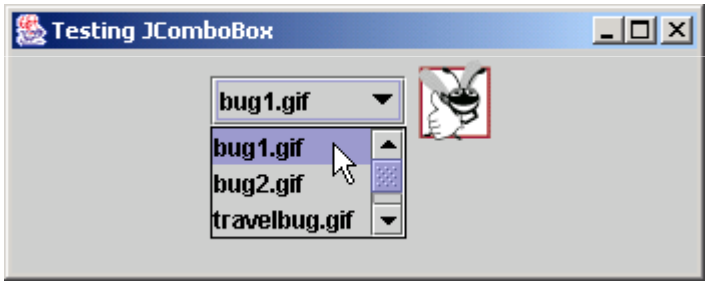
Line 34

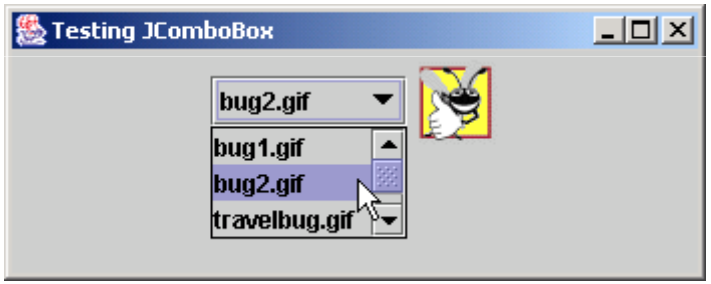
```
52         setSize( 350, 100 );
53         setVisible( true );
54
55      } // end ComboBoxTest constructor
56
57      public static void main( String args[] )
58      {
59         ComboBoxTest application = new ComboBoxTest();
60         application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
61      }
62
63   } // end class ComboBoxTest
```



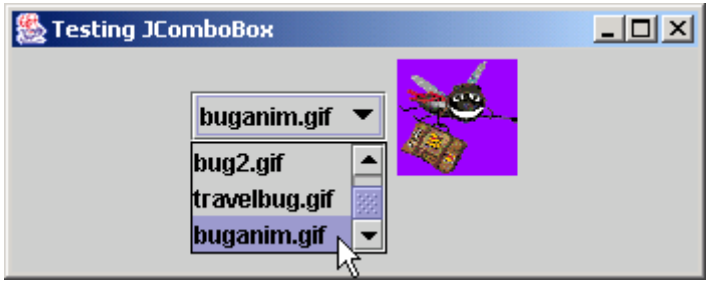
## Outline

ComboBoxTest.java



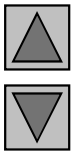




# 13.10 `JList`

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





Outline

ListTest.java

```
1  // Fig. 13.14: ListTest.java
2  // Selecting colors from a JList.
3  import java.awt.*;
4  import javax.swing.*;
5  import javax.swing.event.*;
6
7  public class ListTest extends JFrame {
8     private JList colorList;
9     private Container container;
10
11    private final String colorNames[] = { "Black", "Blue", "Cyan",
12       "Dark Gray", "Gray", "Green", "Light Gray", "Magenta",
13       "Orange", "Pink", "Red", "White", "Yellow" };
14
15    private final Color colors[] = { Color.BLACK, Color.BLUE, Color.CYAN,
16       Color.DARK_GRAY, Color.GRAY, Color.GREEN, Color.LIGHT_GRAY,
17       Color.MAGENTA, Color.ORANGE, Color.PINK, Color.RED, Color.WHITE,
18       Color.YELLOW };
19
20    // set up GUI
21    public ListTest()
22    {
23       super( "List Test" );
24
25       // get content pane and set its layout
26       container = getContentPane();
27       container.setLayout( new FlowLayout() );
```

Outline

```
28
29       // create a list with items in colorNames array
30       colorList = new JList( colorNames );
31       colorList.setVisibleRowCount( 5 );
32
33       // do not allow multiple selections
34       colorList.setSelectionMode( ListSelectionModel.SINGLE_SELECTION );
35
36       // add a JScrollPane containing JList to content pane
37       container.add( new JScrollPane( colorList ) );
38       colorList.addListSelectionListener(
39
40          new ListSelectionListener() {  // anonymous inn
41
42             // handle list selection events
43             public void valueChanged( ListSelectionEvent event )
44             {
45                container.setBackground(
46                   colors[ colorList.getSelectedIndex() ] );
47             }
48
49          } // end anonymous inner class
50
51       ); // end call to addListSelectionListener
52
```

Use `colorNames` array to populate `JList`

`JList` allows single selections

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

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

Set appropriate background depending on user selection

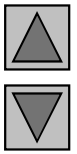
`ListTest.java`

Line 30

Line 34

Line 38

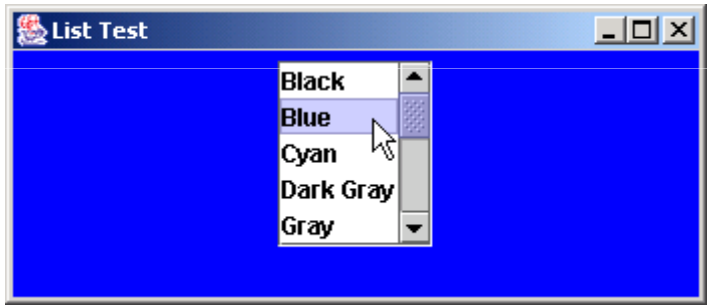
Lines 45-46

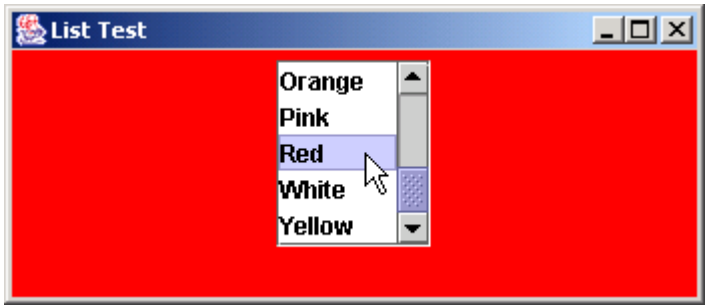


Outline

ListTest.java

```
53          setSize( 350, 150 );
54          setVisible( true );
55
56       } // end ListTest constructor
57
58       public static void main( String args[] )
59       {
60          ListTest application = new ListTest();
61          application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
62       }
63
64    } // end class ListTest
```

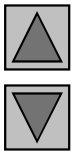


# 13.11 Multiple-Selection Lists

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





Outline

MultipleSelectionTest.java

Lines 10-12 and 24

Lines 26-27

```
1  // Fig. 13.15: MultipleSelectionTest.java
2  // Copying items from one List to another.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class MultipleSelectionTest extends JFrame {
8     private JList colorList, copyList;
9     private JButton copyButton;
10    private final String colorNames[] = { "Black", "Blue", "Cyan",
11       "Dark Gray", "Gray", "Green", "Light Gray", "Magenta", "Orange",
12       "Pink", "Red", "White", "Yellow" };
13
14    // set up GUI
15    public MultipleSelectionTest()
16    {
17       super( "Multiple Selection Lists" );
18
19       // get content pane and set its layout
20       Container container = getContentPane();
21       container.setLayout( new FlowLayout() );
22
23       // set up JList colorList
24       colorList = new JList( colorNames );
25       colorList.setVisibleRowCount( 5 );
26       colorList.setSelectionMode(
27          ListSelectionModel.MULTIPLE_INTERVAL_SELECTION );
28       container.add( new JScrollPane( colorList ) );
```

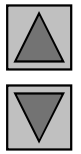
Use `colorNames` array to populate `JList`

`JList colorList` allows multiple selections

```
29
30       // create copy button and register its listener
31       copyButton = new JButton( "Copy >>>" );
32       copyButton.addActionListener(
33
34          new ActionListener() {  // anonymous inner class
35
36             // handle button event
37             public void actionPerformed( ActionEvent event )
38             {
39                // place selected values in copyList
40                copyList.setListData( colorList.getSelectedValues() );
41             }
42
43          } // end anonymous inner class
44
45       ); // end call to addActionListener
46
47       container.add( copyButton );
48
49       // set up JList copyList
50       copyList = new JList( );
51       copyList.setVisibleRowCount( 5 );
52       copyList.setFixedCellWidth( 100 );
53       copyList.setFixedCellHeight( 15 );
54       copyList.setSelectionMode(
55          ListSelectionModel.SINGLE_INTERVAL_SELECTION );
56       container.add( new JScrollPane( copyList ) );
```

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

`JList colorList` allows single selections



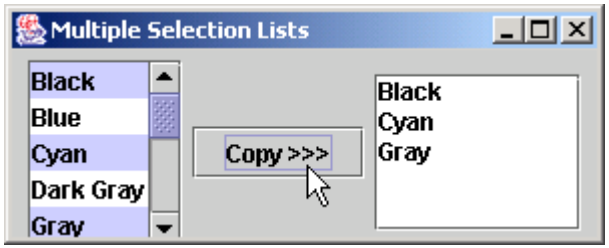
## Outline

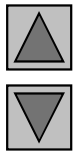
`MultipleSelectionTest.java`

Line 40

Lines 54-55

```
57
58          setSize( 300, 130 );
59          setVisible( true );
60
61       } // end constructor MultipleSelectionTest
62
63       public static void main( String args[] )
64       {
65          MultipleSelectionTest application = new MultipleSelectionTest();
66          application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
67       }
68
69    } // end class MultipleSelectionTest
```



## Outline

MultipleSelectionTest.java

# 13.12 Mouse Event Handling

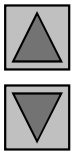
- Event-listener interfaces for mouse events
  - `MouseListener`
  - `MouseMotionListener`
  - Listen for `MouseEvent`s



# Fig. 13.16 `MouseListener` and `MouseMotionListener` interface methods

| **`MouseListener`** and **`MouseMotionListener`** interface methods | |
|---|---|
| *Methods of interface `MouseListener`* | |
| `public void mousePressed( MouseEvent event )` | |
| | Called when a mouse button is pressed 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. |
| `public void mouseReleased( MouseEvent event )` | |
| | Called when a mouse button is released after being pressed. This event is always preceded by a `mousePressed` event. |
| `public void mouseEntered( MouseEvent event )` | |
| | Called when the mouse cursor enters the bounds of a component. |
| `public void mouseExited( MouseEvent event )` | |
| | Called when the mouse cursor leaves the bounds of a component. |
| *Methods of interface `MouseMotionListener`* | |
| `public void mouseDragged( MouseEvent event )` | |
| | Called when the mouse button is pressed 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 drag began. |
| `public void mouseMoved( MouseEvent event )` | |
| | Called when the mouse is moved when the mouse cursor on a component. All move events are sent to the component over which the mouse is currently positioned. |





Outline

MouseTracker.java

Lines 20-21

```
1  // Fig. 13.17: MouseTracker.java
2  // Demonstrating mouse events.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class MouseTracker extends JFrame
8     implements MouseListener, MouseMotionListener {
9
10    private JLabel statusBar;
11
12    // set up GUI and register mouse event handlers
13    public MouseTracker()
14    {
15       super( "Demonstrating Mouse Events" );
16
17       statusBar = new JLabel();
18       getContentPane().add( statusBar, BorderLayout.SOUTH );
19
20       addMouseListener( this );       // listens for ow
21       addMouseMotionListener( this ); // mouse-motion e
22
23       setSize( 275, 100 );
24       setVisible( true );
25    }
26
```

Register `JFrame` to receive mouse events

Outline

```
27    // MouseListener event handlers
28    // handle event when mouse released immediately after press
29    public void mouseClicked( MouseEvent event )
30    {
31       statusBar.setText( "Clicked at [" + event.getX() +
32          ", " + event.getY() + "]" );
33    }
34
35    // handle event when mouse pressed
36    public void mousePressed( MouseEvent event )
37    {
38       statusBar.setText( "Pressed at [" + event.getX() +
39          ", " + event.getY() + "]" );
40    }
41
42    // handle event when mouse released after dragging
43    public void mouseReleased( MouseEvent event )
44    {
45       statusBar.setText( "Released at [" + event.getX() +
46          ", " + event.getY() + "]" );
47    }
48
49    // handle event when mouse enters area
50    public void mouseEntered( MouseEvent event )
51    {
```

Invoked when user presses and releases mouse button

Invoked when user presses mouse button

Invoked when user releases mouse button after dragging mouse

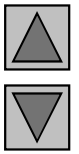
Invoked when mouse cursor enters `JFrame`

```
52          statusBar.setText( "Mouse entered at [" + event.getX() +
53             ", " + event.getY() + "]" );
54          getContentPane().setBackground( Color.GREEN );
55       }
56
57       // handle event when mouse exits area
58       public void mouseExited( MouseEvent event )
59       {
60          statusBar.setText( "Mouse outside window" );
61          getContentPane().setBackground( Color.WHITE );
62       }
63
64       // MouseMotionListener event handlers
65       // handle event when user drags mouse with button pressed
66       public void mouseDragged( MouseEvent event )
67       {
68          statusBar.setText( "Dragged at [" + event.getX() +
69             ", " + event.getY() + "]" );
70       }
71
72       // handle event when user moves mouse
73       public void mouseMoved( MouseEvent event )
74       {
75          statusBar.setText( "Moved at [" + event.getX() +
76             ", " + event.getY() + "]" );
77       }
78
```

Invoked when mouse cursor exits `JFrame`

Invoked when user drags mouse cursor

Invoked when user moves mouse cursor



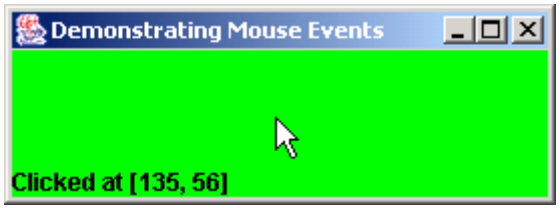
Outline

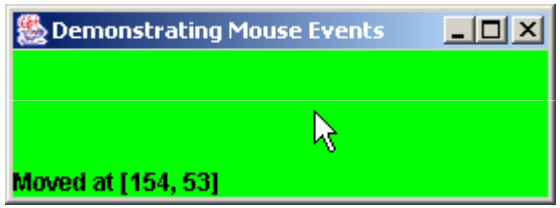
MouseTracker.ja

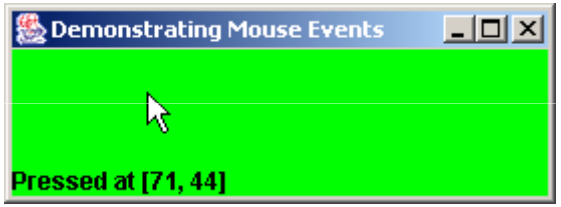
Line 66

Line 73

```
79     public static void main( String args[] )
80     {
81        MouseTracker application = new MouseTracker();
82        application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
83     }
84
85  } // end class MouseTracker
```

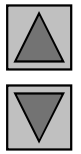









## Outline

MouseTracker.java

# 13.13 Adapter Classes

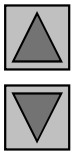
- Adapter class
  - Implements interface
  - Provides default implementation of each interface method
  - Used when all methods in interface is not needed



# Fig. 13.18 Event-adapter classes and the interfaces they implement in package `java.awt.event`

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





Outline

Painter.java

Line 22

```
1  // Fig. 13.19: Painter.java
2  // Using class MouseMotionAdapter.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class Painter extends JFrame {
8     private int pointCount = 0;
9
10    // array of 1000 java.awt.Point references
11    private Point points[] = new Point[ 1000 ];
12
13    // set up GUI and register mouse event handler
14    public Painter()
15    {
16       super( "A simple paint program" );
17
18       // create a label and place it in SOUTH of BorderLayout
19       getContentPane().add( new JLabel( "Drag the mouse to draw" ),
20          BorderLayout.SOUTH );
21
22       addMouseMotionListener(
23
24          new MouseMotionAdapter() {  // anonymous inner class
25
```

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

```
26             // store drag coordinates and repaint
27             public void mouseDragged( MouseEvent event )
28             {
29                if ( pointCount < points.length ) {
30                   points[ pointCount ] = event.getPoint();
31                   ++pointCount;
32                   repaint();
33                }
34             }
35
36          } // end anonymous inner class
37
38       ); // end call to addMouseMotionListener
39
40       setSize( 300, 150 );
41       setVisible( true );
42
43    } // end Painter constructor
44
45    // draw oval in a 4-by-4 bounding box at specified location on window
46    public void paint( Graphics g )
47    {
48       super.paint( g ); // clears drawing area
49
50       for ( int i = 0; i < points.length && points[ i ] != null; i++ )
51          g.fillOval( points[ i ].x, points[ i ].y, 4, 4 );
52    }
```

Override method `mouseDragged`, but not method `mouseMoved`

`Painter.java`

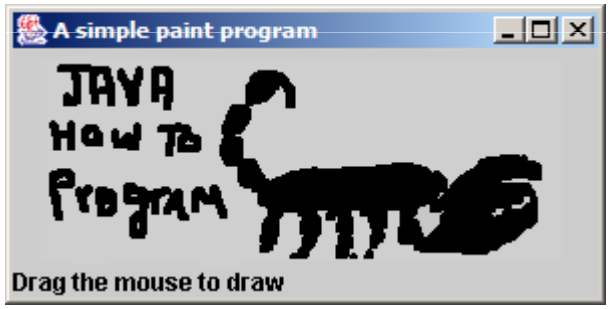
Store coordinates where mouse was dragged, then repaint `JFrame`

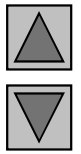
Line 30

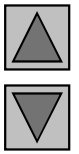
Line 51

Draw circle of diameter 4 where user dragged cursor

```
53
54    public static void main( String args[] )
55    {
56       Painter application = new Painter();
57       application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
58    }
59
60 } // end class Painter
```





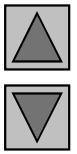
Outline

MouseDetails.java

Line 15

```
1  // Fig. 13.20: MouseDetails.java
2  // Demonstrating mouse clicks and distinguishing between mouse buttons.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class MouseDetails extends JFrame {
8     private int xPos, yPos;
9
10    // set title bar String; register mouse listener; size and show window
11    public MouseDetails()
12    {
13       super( "Mouse clicks and buttons" );
14
15       addMouseListener( new MouseClickHandler() );
16
17       setSize( 350, 150 );
18       setVisible( true );
19    }
20
21    // draw String at location where mouse was clicked
22    public void paint( Graphics g )
23    {
24       // call superclass paint method
25       super.paint( g );
26
```

Register mouse listener



## Outline

MouseDetails.java

Line 41

```
27        g.drawString( "Clicked @ [" + xPos + ", " + yPos + "]",
28           xPos, yPos );
29     }
30
31     public static void main( String args[] )
32     {
33        MouseDetails application = new MouseDetails();
34        application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
35     }
36
37     // inner class to handle mouse events
38     private class MouseClickHandler extends MouseAdapter {
39
40        // handle mouse click event and determine which button was pressed
41        public void mouseClicked( MouseEvent event )
42        {
43           xPos = event.getX();
44           yPos = event.getY();
45
46           String title = "Clicked " + event.getClickCount() + " time(s)";
47
48           if ( event.isMetaDown() ) // right mouse button
49              title += " with right mouse button";
50
51           else if ( event.isAltDown() ) // middle mouse button
52              title += " with center mouse button";
```

Invoke method `mouseClicked` when user clicks mouse

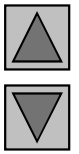
Store mouse-cursor coordinates where mouse was clicked

Determine number of times user has clicked mouse

Determine if user clicked right mouse button

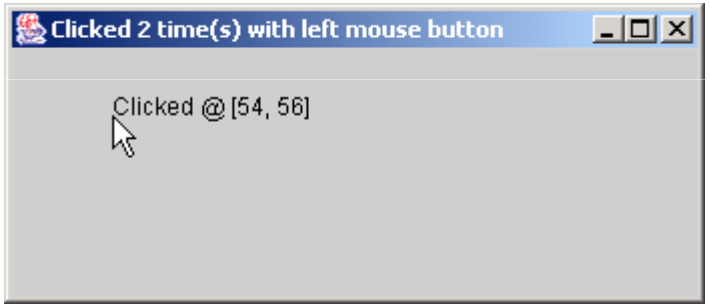
Determine if user clicked middle mouse button

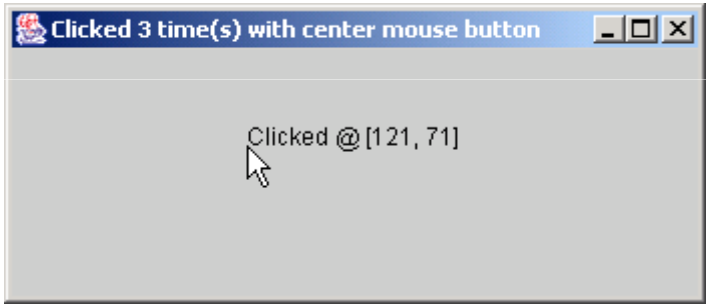
```
53
54          else  // left mouse button
55             title += " with left mouse button";
56
57          setTitle( title );  // set title bar of window
58          repaint();
59
60       } // end method mouseClicked
61
62    } // end private inner class MouseClickHandler
63
64 } // end class MouseDetails
```

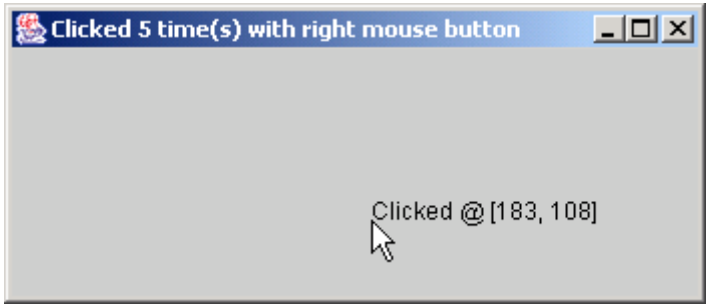


## Outline

MouseDetails.java



# Fig. 13.21 `InputEvent` methods that help distinguish among left-, center- and right-mouse-button clicks

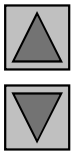
| **`InputEvent`** method | Description |
|---|---|
| `isMetaDown()` | Returns `true` when the user clicks the right mouse button on a mouse with two or three buttons. To simulate a right-mouse-button click on a one-button mouse, the user can hold down the *Meta* key on the keyboard and click the mouse 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. |



# 13.14 Key Event Handling

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





Outline

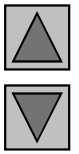
KeyDemo.java

Line 23

```
1  // Fig. 13.22: KeyDemo.java
2  // Demonstrating keystroke events.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class KeyDemo extends JFrame implements KeyListener {
8     private String line1 = "", line2 = "", line3 = "";
9     private JTextArea textArea;
10
11    // set up GUI
12    public KeyDemo()
13    {
14       super( "Demonstrating Keystroke Events" );
15
16       // set up JTextArea
17       textArea = new JTextArea( 10, 15 );
18       textArea.setText( "Press any key on the keyboard..." );
19       textArea.setEnabled( false );
20       textArea.setDisabledTextColor( Color.BLACK );
21       getContentPane().add( textArea );
22
23       addKeyListener( this );  //allow frame to proce
24
25       setSize( 350, 100 );
26       setVisible( true );
```

Register `JFrame` for key events

```
27
28    } // end KeyDemo constructor
29
30    // handle press of any key
31    public void keyPressed( KeyEvent event )
32    {
33       line1 = "Key pressed: " + event.getKeyText( event.getKeyCode() );
34       setLines2and3( event );
35    }
36
37    // handle release of any key
38    public void keyReleased( KeyEvent event )
39    {
40       line1 = "Key released: " + event.getKeyText( event.getKeyCode() );
41       setLines2and3( event );
42    }
43
44    // handle press of an action key
45    public void keyTyped( KeyEvent event )
46    {
47       line1 = "Key typed: " + event.getKeyChar();
48       setLines2and3( event );
49    }
50
51    // set second and third lines of output
52    private void setLines2and3( KeyEvent event )
53    {
```



Outline

KeyDemo.java

Line 31

Line 33 and 40

Line 45

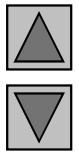
Called when user presses key

Return virtual key code

Called when user releases key

Called when user types key

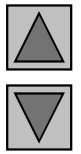
```
54          line2 = "This key is " + ( event.isActionKey() ? "" : "not " ) +
55             "an action key";
56
57          String temp = event.getKeyModifiersText( event.getModifiers() );
58
59          line3 = "Modifier keys pressed: " +
60             ( temp.equals( "" ) ? "none" : temp );
61
62          textArea.setText( line1 + "\n" + line2 + "\n" + line3
63       }
64
65       public static void main( String args[] )
66       {
67          KeyDemo application = new KeyDemo();
68          application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
69       }
70
71    } // end class KeyDemo
```



## Outline

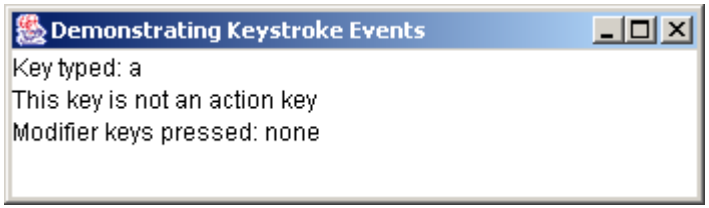
KeyDemo.java

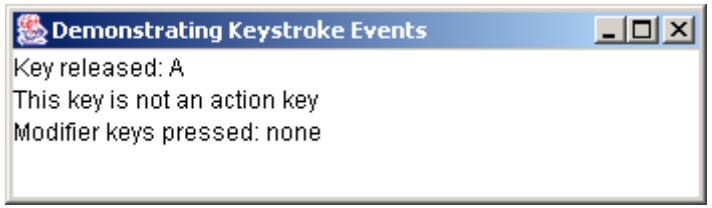
Determine if *modifier keys* (e.g., *Alt*, *Ctrl*, *Meta* and *Shift*) were used

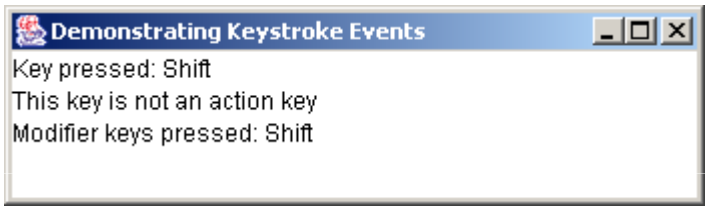


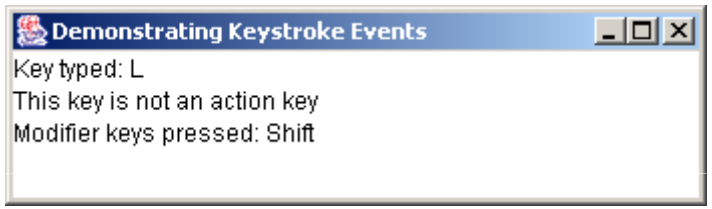
## Outline

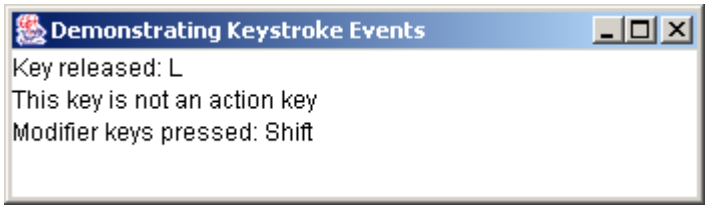
KeyDemo.java

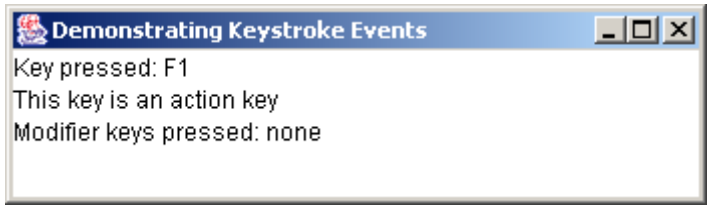


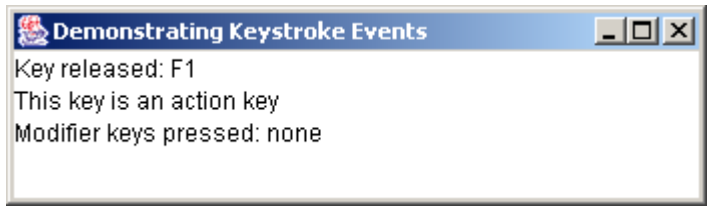



# 13.15 Layout Managers

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



# Fig. 13.23 Layout managers

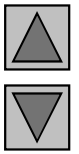
| Layout manager | Description |
|---|---|
| `FlowLayout` | Default for `java.awt.Applet`, `java.awt.Panel` and `javax.swing.JPanel`. Places components sequentially (left to right) in the order they were added. It is also possible to specify the order of the components by using the `Container` method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



# 13.15.1 FlowLayout

- FlowLayout
  - Most basic layout manager
  - GUI components placed in container from left to right





Outline

FlowLayoutDemo.java

Lines 17 and 21

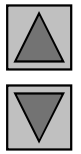
```
1  // Fig. 13.24: FlowLayoutDemo.java
2  // Demonstrating FlowLayout alignments.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class FlowLayoutDemo extends JFrame {
8     private JButton leftButton, centerButton, rightButton;
9     private Container container;
10    private FlowLayout layout;
11
12    // set up GUI and register button listeners
13    public FlowLayoutDemo()
14    {
15       super( "FlowLayout Demo" );
16
17       layout = new FlowLayout();
18
19       // get content pane and set its layout
20       container = getContentPane();
21       container.setLayout( layout );
22
23       // set up leftButton and register listener
24       leftButton = new JButton( "Left" );
25       container.add( leftButton );
```

Set layout as `FlowLayout`

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

When user presses left `JButton`, left align components

When user presses center `JButton`, center components



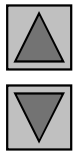
## Outline

`FlowLayoutDemo.java`

Line 33

```
55                // realign attached components
56                layout.layoutContainer( container );
57             }
58          }
59       );
60
61       // set up rightButton and register listener
62       rightButton = new JButton( "Right" );
63       container.add( rightButton );
64       rightButton.addActionListener(
65
66          new ActionListener() {  // anonymous inner class
67
68             // process rightButton event
69             public void actionPerformed( ActionEvent event )
70             {
71                layout.setAlignment( FlowLayout.RIGHT );
72
73                // realign attached components
74                layout.layoutContainer( container );
75             }
76          }
77       );
78
79       setSize( 300, 75 );
80       setVisible( true );
```

When user presses right `JButton`, right components



Outline

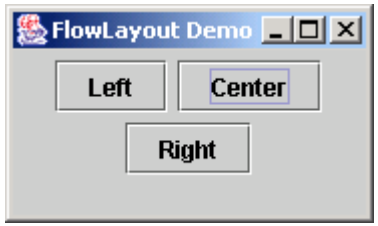
`FlowLayoutDemo.java`

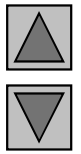
Line 71

```
81
82     } // end constructor FlowLayoutDemo
83
84     public static void main( String args[] )
85     {
86        FlowLayoutDemo application = new FlowLayoutDemo();
87        application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
88     }
89
90  } // end class FlowLayoutDemo
```







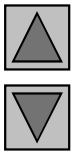
## Outline

FlowLayoutDemo.java

# 13.15.2 BorderLayout

- BorderLayout
  - Arranges components into five regions
    - NORTH (top of container)
    - SOUTH (bottom of container)
    - EAST (left of container)
    - WEST (right of container)
    - CENTER (center of container)





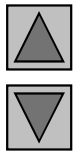
Outline

BorderLayoutDemo.java

Lines 18 and 22

```
1  // Fig. 13.25: BorderLayoutDemo.java
2  // Demonstrating BorderLayout.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class BorderLayoutDemo extends JFrame implements ActionListener {
8     private JButton buttons[];
9     private final String names[] = { "Hide North", "Hide South",
10       "Hide East", "Hide West", "Hide Center" };
11    private BorderLayout layout;
12
13    // set up GUI and event handling
14    public BorderLayoutDemo()
15    {
16       super( "BorderLayout Demo" );
17
18       layout = new BorderLayout( 5, 5 ); // 5 pixel gaps
19
20       // get content pane and set its layout
21       Container container = getContentPane();
22       container.setLayout( layout );
23
24       // instantiate button objects
25       buttons = new JButton[ names.length ];
26
```

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



## Outline

BorderLayoutDemo.java

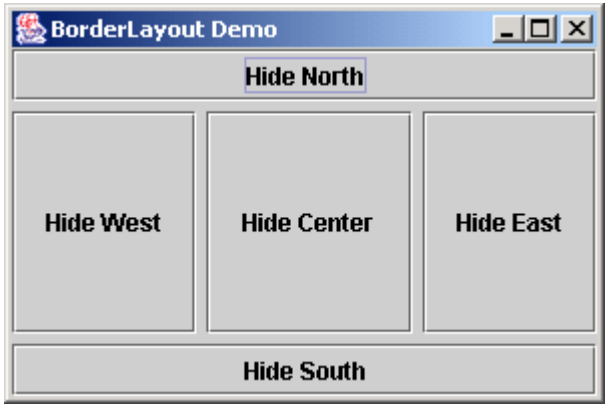
```
27       for ( int count = 0; count < names.length; count++ ) {
28          buttons[ count ] = new JButton( names[ count ] );
29          buttons[ count ].addActionListener( this );
30       }
31
32       // place buttons in BorderLayout; order not important
33       container.add( buttons[ 0 ], BorderLayout.NORTH );
34       container.add( buttons[ 1 ], BorderLayout.SOUTH );
35       container.add( buttons[ 2 ], BorderLayout.EAST );
36       container.add( buttons[ 3 ], BorderLayout.WEST );
37       container.add( buttons[ 4 ], BorderLayout.CENTER );
38
39       setSize( 300, 200 );
40       setVisible( true );
41
42    } // end constructor BorderLayoutDemo
43
44    // handle button events
45    public void actionPerformed( ActionEvent event )
46    {
47       for ( int count = 0; count < buttons.length; count++ )
48
49          if ( event.getSource() == buttons[ count ] )
50             buttons[ count ].setVisible( false );
51          else
52             buttons[ count ].setVisible( true );
```

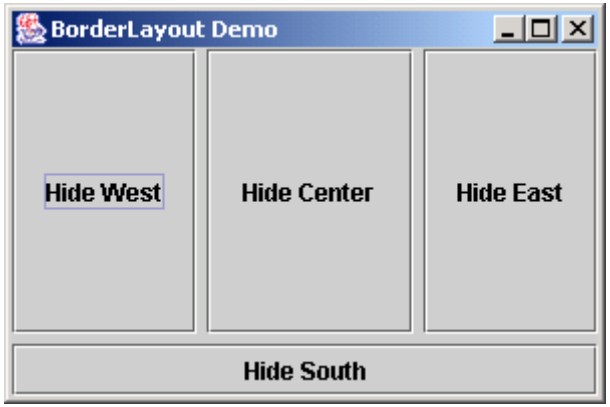
Place `JButton`s in regions specified by `BorderLayout`

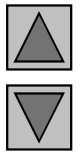
Lines 50 and 52

When `JButton`s are "invisible," they are not displayed on screen, and `BorderLayout` rearranges

```
53
54          // re-layout the content pane
55          layout.layoutContainer( getContentPane() );
56       }
57
58       public static void main( String args[] )
59       {
60          BorderLayoutDemo application = new BorderLayoutDemo();
61          application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
62       }
63
64    } // end class BorderLayoutDemo
```

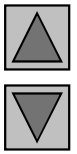


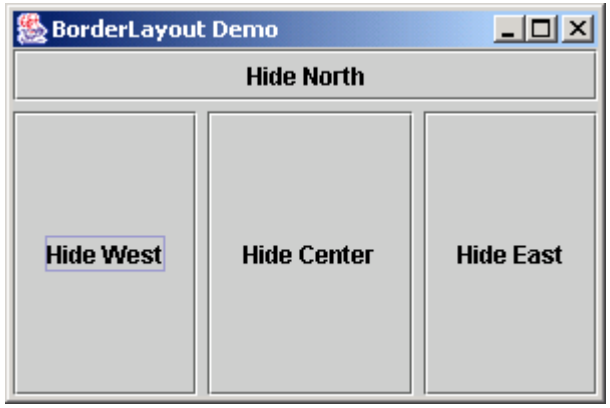
## Outline

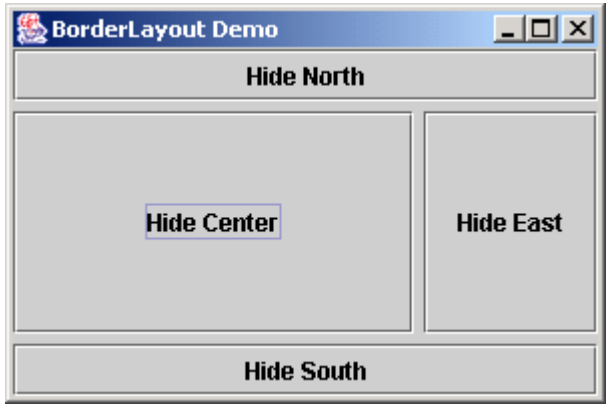
BorderLayoutDemo.java

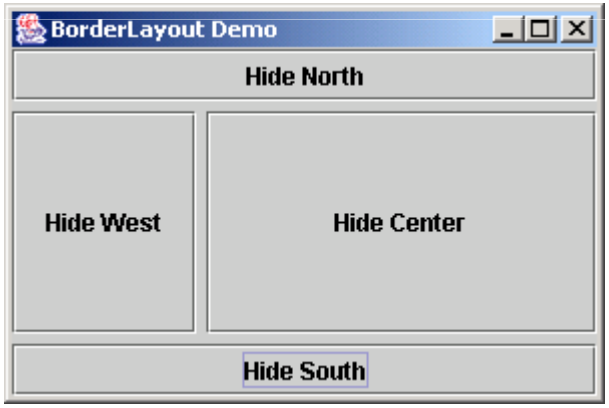


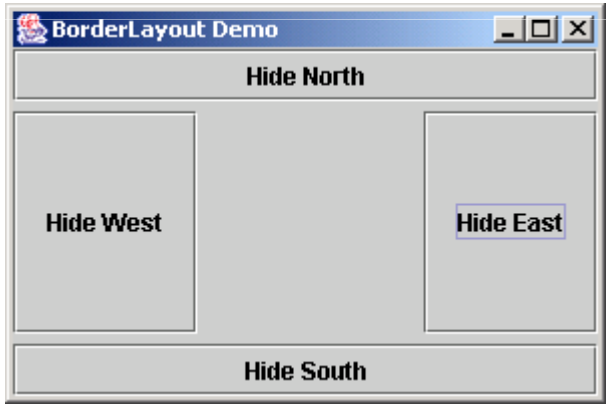
## Outline

BorderLayoutDemo.java



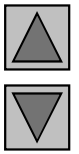



# 13.15.3 GridLayout

- GridLayout
  - Divides container into grid of specified row an columns
  - Components are added starting at top-left cell
    - Proceed left-to-fight until row is full





Outline

GridLayoutDemo.java

Line 21

Line 22

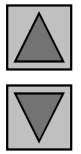
```
1  // Fig. 13.26: GridLayoutDemo.java
2  // Demonstrating GridLayout.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class GridLayoutDemo extends JFrame implements ActionListener {
8     private JButton buttons[];
9     private final String names[] =
10       { "one", "two", "three", "four", "five", "six" };
11    private boolean toggle = true;
12    private Container container;
13    private GridLayout grid1, grid2;
14
15    // set up GUI
16    public GridLayoutDemo()
17    {
18       super( "GridLayout Demo" );
19
20       // set up layouts
21       grid1 = new GridLayout( 2, 3, 5, 5 );
22       grid2 = new GridLayout( 3, 2 );
23
24       // get content pane and set its layout
25       container = getContentPane();
26       container.setLayout( grid1 );
```

Create `GridLayout grid1` with 2 rows and 3 columns

Create `GridLayout grid2` with 3 rows and 2 columns

```
27
28       // create and add buttons
29       buttons = new JButton[ names.length ];
30
31       for ( int count = 0; count < names.length; count++ ) {
32          buttons[ count ] = new JButton( names[ count ] );
33          buttons[ count ].addActionListener( this );
34          container.add( buttons[ count ] );
35       }
36
37       setSize( 300, 150 );
38       setVisible( true );
39
40    } // end constructor GridLayoutDemo
41
42    // handle button events by toggling between layouts
43    public void actionPerformed( ActionEvent event )
44    {
45       if ( toggle )
46          container.setLayout( grid2 );
47       else
48          container.setLayout( grid1 );
49
50       toggle = !toggle;   // set toggle to opposite value
51       container.validate();
52    }
```

Toggle current `GridLayout` when user presses `JButton`

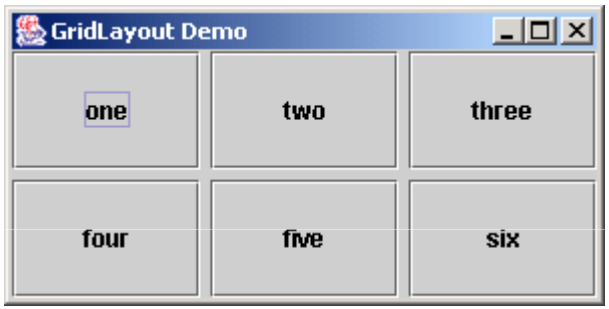


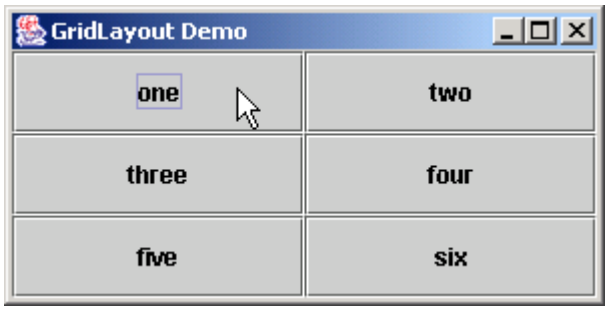
## Outline

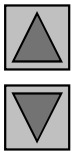
`GridLayoutDemo.java`

Lines 46 and 48

```
53
54    public static void main( String args[] )
55    {
56       GridLayoutDemo application = new GridLayoutDemo();
57       application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
58    }
59
60 } // end class GridLayoutDemo
```



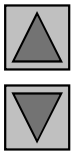
## Outline

GridLayoutDemo.java

# 13.16 Panels

- Panel
  - Helps organize components
  - Class `JPanel` is `JComponent` subclass
  - May have components (and other panels) added to them





Outline

PanelDemo.java

Line 23

```
1  // Fig. 13.27: PanelDemo.java
2  // Using a JPanel to help lay out components.
3  import java.awt.*;
4  import java.awt.event.*;
5  import javax.swing.*;
6
7  public class PanelDemo extends JFrame {
8     private JPanel buttonPanel;
9     private JButton buttons[];
10
11    // set up GUI
12    public PanelDemo()
13    {
14       super( "Panel Demo" );
15
16       // get content pane
17       Container container = getContentPane();
18
19       // create buttons array
20       buttons = new JButton[ 5 ];
21
22       // set up panel and set its layout
23       buttonPanel = new JPanel();
24       buttonPanel.setLayout( new GridLayout( 1, buttons.length ) );
25
```

Create `JPanel` to hold `JButton`s

```
26        // create and add buttons
27        for ( int count = 0; count < buttons.length; count++ ) {
28           buttons[ count ] = new JButton( "Button " + ( count + 1 ) );
29           buttonPanel.add( buttons[ count ] );
30        }
31
32        container.add( buttonPanel, BorderLayout.SOUTH );
33
34        setSize( 425, 150 );
35        setVisible( true );
36
37     } // end constructor PanelDemo
38
39     public static void main( String args[] )
40     {
41        PanelDemo application = new PanelDemo();
42        application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
43     }
44
45  } // end class PanelDemo
```

Add `JButton`s to `JPanel`

Add `JPanel` to `SOUTH` region of `Container`

# 13.17 (Optional Case Study) Thinking About Objects: Use Cases

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



# 13.17 (Optional Case Study) Thinking About Objects: Use Cases

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

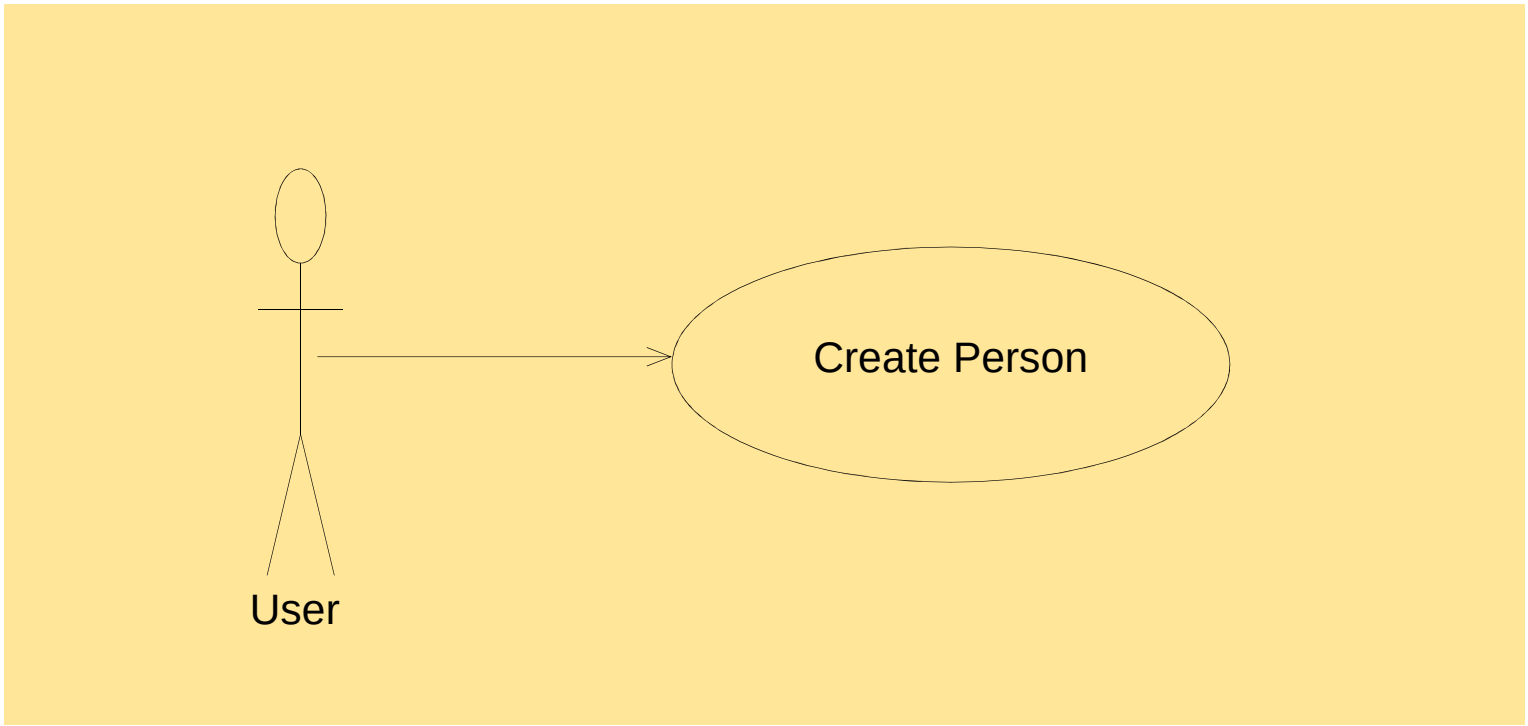


# 13.17 (Optional Case Study) Thinking About Objects: Use Cases

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



# Fig. 13.28 Use case diagram for elevator simulation from user's perspective






# Fig. 13.29 Use case diagram from the perspective of a `Person`