# Programação Orientada a Objetos

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## Planejamento

- Aula 1
  - Introdução
  - Conceitos Básicos
    - Classe, Objeto, Método,Herança, interfaces, polimorfismo, Encapsulamento
  - Introdução a linguagem Java
- **Aula 2**
  - Modelagem de Programas Orientada a Objetos
  - Introdução a Padrões de Projeto (Design Patterns)
  - Introdução a Ambientes Integrados de Desenvolvimento
- Aula 3
  - **Programando Interfaces Gráficas com Java I**
- Aula 4
  - Programando Interfaces Gráficas com Java - II



## Sumário de Hoje





## Introdução

- Graphical User Interface (GUI)
  - Swing permite diferentes “estilos” de programa (“look” and “feel”)
  - Provê componentes que fornecem funcionalides comuns em GUI: butões, menus, listas de seleção, janelas, diálogos, etc.
  - Construído a partir de GUI components (controls, widgets, etc.)
    - Interação via Mouse, teclado, etc.

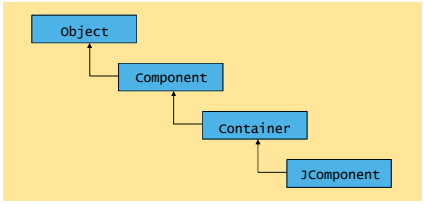


## Visão Geral dos Componentes Swing

- Componentes GUI Swing
  - Package `javax.swing`
  - Componentes originados do AWT (package `java.awt`)
  - Propriedades *look and feel*
    - Appearance and how users interact with program
  - *Lightweight components*
    - Written completely in Java



## Hierarquia de Classes de Compontes Swing



## Overview of Swing Components

- Class `Component`
  - Contains method `paint` for drawing `Component` onscreen
- Class `Container`
  - Collection of related components
  - Contains method `add` for adding components
- Class `JComponent`
  - *Pluggable look and feel* for customizing look and feel
  - Shortcut keys (*mnemonics*)
  - Common event-handling capabilities



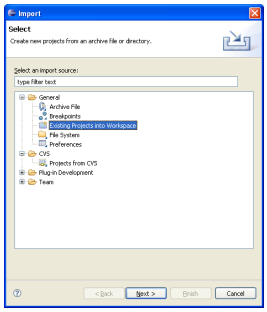
## Alguns Componentes Básicos

- `JFrame`
  - Janela onde podem ser colocados outros componentes visíveis
- `JLabel`
  - Controle para Exibição de Textos não editáveis
- `JTextField`, `JPasswordField`
  - Campos de Texto que podem ser editados pelo usuário (texto visível ou não)
- `JButton`
  - Componente que dispara um evento ao ser clicado
- `JCheckBox` and `JRadioButton`
  - Componentes que podem ser marcados como selecionados ou não selecionados
- `JComboBox`
  - Componente que permite a escolha de um elemento de uma lista
- `Jlist`
  - Componente que permite a escolha de um ou mais elementos de uma lista



## Importando Projetos Eclipse para seu Workspace

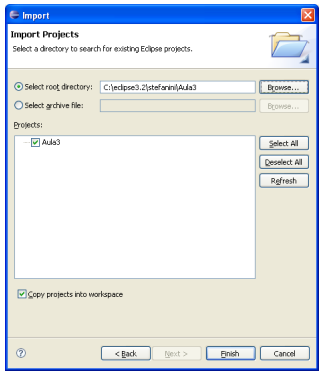
**Menu: File | Import**






## Copie o projeto para seu Workspace.

## Cuidado por Default é feita apenas linkagem



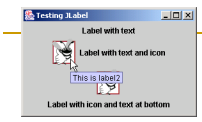



## `JLabel`

- Label (Rótulos)
  - Provê textos em GUI
  - Definido através da classe `Jlabel`
  - `Derivado de JComponent`
  - Pode apresentar:
    - Linha de texto simples
    - Imagens
    - Textos e imagens



## `LabelTest.java`

```
1  //  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
10    // set up GUI
11    public LabelTest()
12    {
13       super( "Testing JLabel" );
14
15       // get content pane and set its layout
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
```

LabelTest.java

Line 8

Line 20

Line 21

Declare three JLabels

Create first JLabel with text "Label with text"

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



```
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 );
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 );
49    }
50 }
```

Create second JLabel with text to left of image

Lines 16-17

Lines 32-37

Create third JLabel with text below image

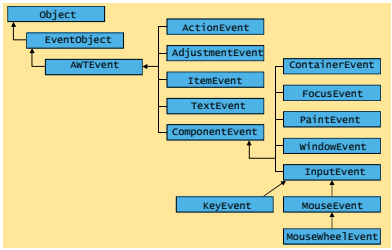


## 13.4 Event Handling

- Interfaces Gráficas são dirigidas a eventos
  - Generate *events* when user interacts with GUI
  - e.g., moving mouse, pressing button, typing in text field, etc.
  - Class `java.awt.AWTEvent`



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



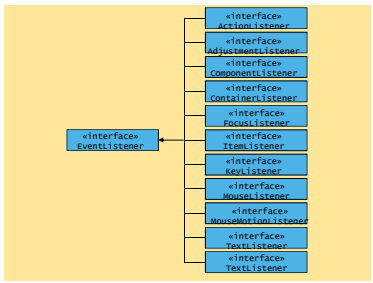



## Tratamento de Eventos

- Modelo de tratamento de eventos
  - Três partes
    - Origem do Evento - Event source
      - Componente GUI com o qual o usuário interage
    - Objeto de Evento - Event object
      - Encapsula informação sobre o evento que ocorreu
    - Objeto que deve receber o evento - Event listener
      - Recebe o objeto de evento e responde (faz tratamento)
  - O programador deve realizar duas tarefas
    - Registrar o "event listener" para cada "event source"
    - Implementar o método de tratamento (event handler)



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

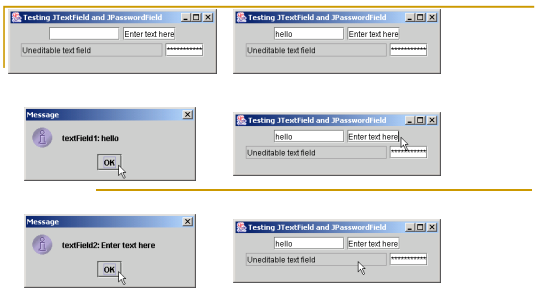


# TextFields

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

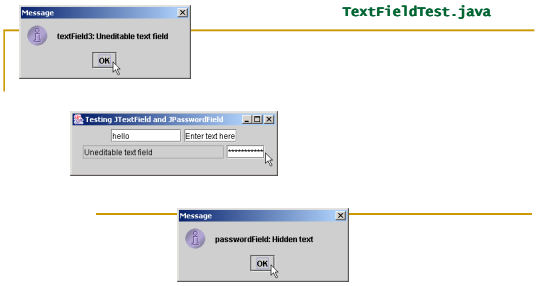


## TextFieldTest.java






## TextFieldTest.java






## TextFieldTest.java

```
1  // 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
```

Lines 8-9 — Declare three `JTextField`s and one `JPasswordField`

Line 20

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`)

TextFieldTest.java

Line 30

Line 34

Lines 39-42



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

Every `TextFieldHandler` instance is an `ActionListener`

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

TextFieldTest.java

Line 56

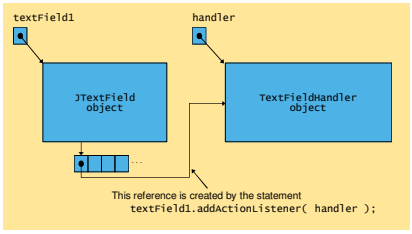
Line 59

## Como o tratamento de eventos funciona?

- Duas questões
  - Como o manipulador de eventos é registrado ?
    - Resposta:
      - Através do método de componente `addActionListener`
      - Linhas 39-42 de `TextFieldTest.java`
  - Como o componente sabe chamar o respectivo `actionPerformed`?
    - Resposta:
      - Evento é enviado apenas para os listeners do tipo apropriado
      - Cada tipo de evento tem uma interface event-listener correspondente
        - Um ID do evento ocorrido especifica seu tipo



## Registro de Eventos para `JTextField textField1`






## Exercício

- Altere o programa TextFieldTest para que seja alterado a barra de título da janela, para o valor do campo alterado, qualquer que seja tal campo
  - Dica: O 'handler' precisará de uma referência para a janela.

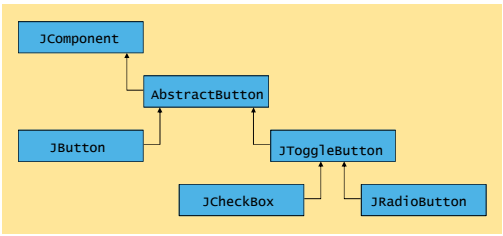


## `JButton`

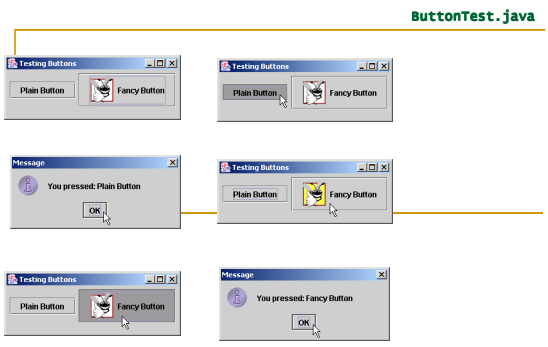
- Button
  - Component user clicks to trigger a specific action
  - Several different types
    - Command buttons
    - Check boxes
    - Toggle buttons
    - Radio buttons
  - `javax.swing.AbstractButton` subclasses
    - Command buttons are created with class `JButton`
      - Generate `ActionEvents`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



## Swing button hierarchy





```
1  // 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 );
```

ButtonTest.java

Line 8

Line 20

Lines 24-26

Create two references to `JButton` instances

Instantiate `JButton` with text

Instantiate `JButton` with image and *rollover* image



```
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       }
55    }
56 }
```

Instantiate `ButtonHandler` for `JButton` event handling

Register `JButtons` to receive events from `ButtonHandler`

ButtonTest.java

Line 31

Lines 32-33

Line 50

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

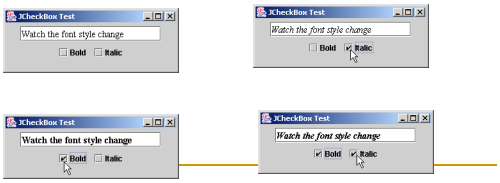


# `JCheckBox` and `JRadioButton`

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



CheckBoxTest.java






```
1  // 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
```

CheckBoxTest.java

Line 9

Line 22

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 `JCheckBoxs` for bolding and italicizing `JTextField` text, respectively

Register `JCheckBoxs` to receive events from `CheckBoxHandler`

CheckBoxTest.java

Lines 26 and 29

Lines 34-35

```
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.
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

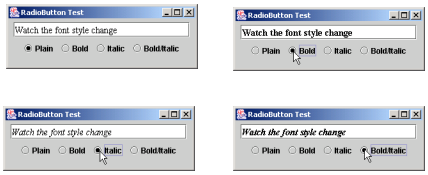
CheckBoxTest.java

Line 54

Line 65



# Exemplo com Radio Button






```
1    //  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

`JRadioButton`s normally appear as a `ButtonGroup`

RadioButtonTest.java

Lines 10-11



```
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", fals
35      container.add( italicButton );
36
37      boldItalicButton = new JRadioButton( "Bold/Italic", false );
38      container.add( boldItalicButton );
39
40      // create logical relationship between JRadioBut
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

`JRadioButton`s belong to `ButtonGroup`

RadioButtonTest.java

Lines 28-35



```
54      // register events for JRadioButtons
55      plainButton.addItemListener( new RadioButtonHandler( plainF
56      boldButton.addItemListener( new RadioButtonHandler( boldFon
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      }
```

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

RadioButtonTest.java

Lines 55-60



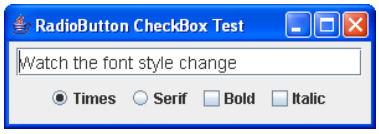
```
81
82      // handle radio button events
83      public void itemStateChanged( ItemEvent event )
84      {
85         field.setFont( font );
86      }
87
88   } // end private inner class RadioButtonHandler
89
90 } // end class RadioButtonTest
```

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

Set font corresponding to `JRadioButton` selected

## Exercício

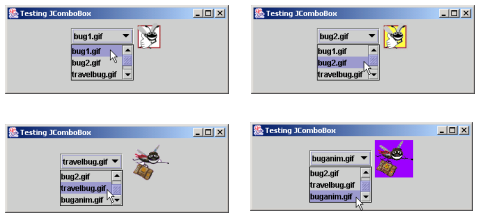
- Criar um programa RadioButton CheckBox Test, com dois "radio buttons" com tipos de fontes: "Serif" e "Times" e dois "check box": "Bold" e "Italic"
  - Dica: Crie um único handler como uma inner class e utilize a referência this para acessar as informações necessárias para contruir o objeto fonte






## 13.9 JComboBox

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





ComboBoxTest.java

```
// ComboBoxTest.java
// Using a JComboBox to select an image to display.
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;

public class ComboBoxTest extends JFrame {
   private JComboBox imagesComboBox;
   private JLabel label;

   private String names[] =
      { "bug1.gif", "bug2.gif", "travelbug.gif", "buganim.gif" };
   private Icon icons[] = { new ImageIcon( names[ 0 ] ),
      new ImageIcon( names[ 1 ] ), new ImageIcon( names[ 2 ] ),
      new ImageIcon( names[ 3 ] ) };

   // set up GUI
   public ComboBoxTest()
   {
      super( "Testing JComboBox" );

      // get content pane and set its layout
      Container container = getContentPane();
      container.setLayout( new FlowLayout() );
```



```
      // set up JComboBox and register its event handler
      imagesComboBox = new JComboBox( names );
      imagesComboBox.setMaximumRowCount( 3 );
      imagesComboBox.addItemListener(

         new ItemListener() {  // anonymous inner class

            // handle JComboBox event
            public void itemStateChanged( ItemEvent event )
            {
               // determine whether check box selected
               if ( event.getStateChange() == ItemEvent.SELECTED )
                  label.setIcon( icons[
                     imagesComboBox.getSelectedIndex() ] );
            }

         } // end anonymous inner class

      ); // end call to addItemListener

      container.add( imagesComboBox );

      // set up JLabel to display ImageIcons
      label = new JLabel( icons[ 0 ] );
      container.add( label );
```

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

ComboBoxTest.java



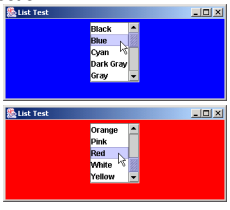
ComboBoxTest.java

```
      setSize( 350, 100 );
      setVisible( true );

   } // end ComboBoxTest constructor

   public static void main( String args[] )
   {
      ComboBoxTest application = new ComboBoxTest();
      application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
   }

} // end class ComboBoxTest
```



## JList

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



```
1  // 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() );
```

ListTest.java



```
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
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
```

ListTest.java

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



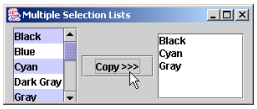
```
53          setSize( 350, 150 );
54          setVisible( true );
55
56       } // end ListTest constructor
57
58       public static void main( String args[] )
59       {
60          ListTest application = new ListTest();
61          application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
62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

ListTest.java



## 13.11 Multiple-Selection Lists

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






```
1  // 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 ) );
```

MultipleSelectionTest.java

Lines 10-12 and 24

Lines 26-27

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 ) );
```

MultipleSelectionTest.java

Line 40

Lines 54-55

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

`JList colorList` allows single selections

```
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
```

MultipleSelectionTest.java



## 13.12 Mouse Event Handling

- Event-listener interfaces for mouse events
  - `MouseListener`
  - `MouseMotionListener`
  - Listen for `MouseEvents`

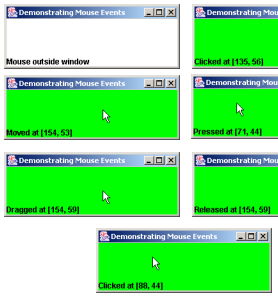


## `MouseListener` and `MouseMotionListener` interface methods

| `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. |



## Programa de Exemplo para Tratamento de Eventos de Mouse






```
1  // 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
21       addMouseMotionListener( this ); // mouse-moti
22
23       setSize( 275, 100 );
24       setVisible( true );
25    }
26
```

MouseTracker.java

Lines 20-21

Register `JFrame` to receive mouse events



```
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

MouseTracker.java

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
```

MouseTracker.java

Invoked when mouse cursor exits JFrame

Invoked when user drags mouse cursor

Invoked when user moves mouse cursor



```
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
```

MouseTracker.java



## Classes Adaptadoras - Adapter Classes

- Adapter class
  - Implementam uma interface
  - Provê implementação default para cada método de interface method
  - Úteis principalmente quando nem todos os métodos de uma interface são necessários

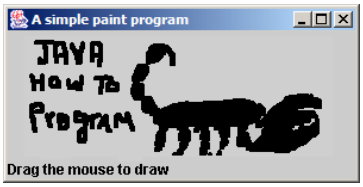


## Event-adapter classes and the interfaces they implement in package `java.awt.event`

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



## Exemplo de Uso de Classes Adaptadoras






```
1     // 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
```

Painter.java

Line 22

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

```
            // store drag coordinates and repaint
            public void mouseDragged( MouseEvent event )
            {
               if ( pointCount < points.length ) {
                  points[ pointCount ] = event.getPoint();
                  ++pointCount;
                  repaint();
               }
            }

         } // end anonymous inner class

      ); // end call to addMouseMotionListener

      setSize( 300, 150 );
      setVisible( true );

   } // end Painter constructor

   // draw oval in a 4-by-4 bounding box at specified location on window
   public void paint( Graphics g )
   {
      super.paint( g ); // clears drawing area

      for ( int i = 0; i < points.length && points[ i ] != null; i++ )
         g.fillOval( points[ i ].x, points[ i ].y, 4, 4 );
   }
```

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

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

Draw circle of diameter 4 where user dragged cursor

**Painter.java**

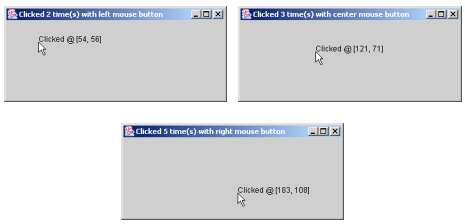


```
public static void main( String args[] )
   {
      Painter application = new Painter();
      application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
   }

} // end class Painter
```

**Painter.java**



# Herdando de uma classe adaptadora – Exemplo






```
// MouseDetails.java
// Demonstrating mouse clicks and distinguishing between mouse buttons.
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;

public class MouseDetails extends JFrame {
   private int xPos, yPos;

   // set title bar String; register mouse listener; size and show window
   public MouseDetails()
   {
      super( "Mouse clicks and buttons" );

      addMouseListener( new MouseClickHandler() );

      setSize( 350, 150 );
      setVisible( true );
   }

   // draw String at location where mouse was clicked
   public void paint( Graphics g )
   {
      // call superclass paint method
      super.paint( g );
```

**MouseDetails.java**

Line 15

Register mouse listener



```
      g.drawString( "Clicked @ [" + xPos + ", " + yPos + "]",
         xPos, yPos );
   }

   public static void main( String args[] )
   {
      MouseDetails application = new MouseDetails();
      application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
   }

   // inner class to handle mouse events
   private class MouseClickHandler extends MouseAdapter {

      // handle mouse click event and determine which button was pressed
      public void mouseClicked( MouseEvent event )
      {
         xPos = event.getX();
         yPos = event.getY();

         String title = "Clicked " + event.getClickCount() + " time(s)";

         if ( event.isMetaDown() ) // right mouse button
            title += " with right mouse button";

         else if ( event.isAltDown() ) // middle mouse button
            title += " with center mouse button";
```

**MouseDetails.java**

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



```
         else  // left mouse button
            title += " with left mouse button";

         setTitle( title );  // set title bar of window
         repaint();

      } // end method mouseClicked

   } // end private inner class MouseClickHandler

} // end class MouseDetails
```

**MouseDetails.java**

## Métodos Úteis de Eventos de Entrada de Mouse – 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. |
| | |

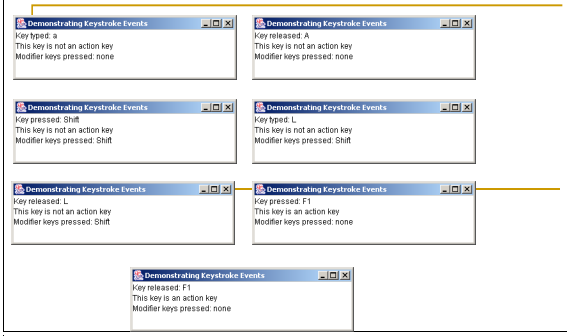


## Tratamento de Eventos de Teclado

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



## Tratamento de Eventos de Teclado: KeyDemo.java






```
1  // 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 p
24
25       setSize( 350, 100 );
26       setVisible( true );
```

KeyDemo.java

Line 23

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    {
```

KeyDemo.java

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" + li
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
```

KeyDemo.java

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

## Gerenciamento de Layout

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



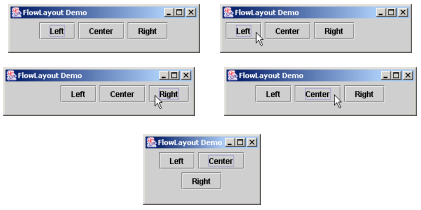
## Alguns Exemplos de Layout managers

| 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






```
1  // 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 );
```

FlowLayoutDemo.java

Lines 17 and 21

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
```

FlowLayoutDemo.java

When user presses left `JButton`, left align components

When user presses center `JButton`, center components



```
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 );
```

FlowLayoutDemo.java

When user presses right `JButton`, right components

```
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
```

FlowLayoutDemo.java

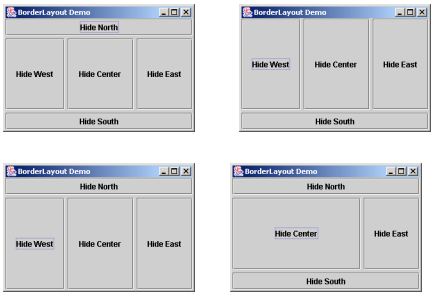


## 13.15.2 BorderLayout

- 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)

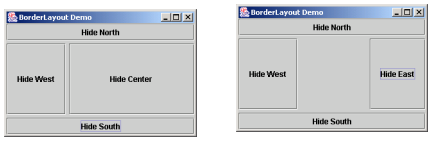


## Exemplo - BorderLayout






## Exemplo - BorderLayout






```
1  // 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
```

BorderLayoutDemo.java

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



```
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 );
```

BorderLayoutDemo.java

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

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

BorderLayoutDemo.java

```
      // re-layout the content pane
      layout.layoutContainer( getContentPane() );
   }

   public static void main( String args[] )
   {
      BorderLayoutDemo application = new BorderLayoutDemo();
      application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
   }

} // end class BorderLayoutDemo
```



# 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





GridLayoutDemo.java

```
// GridLayoutDemo.java
// Demonstrating GridLayout.
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;

public class GridLayoutDemo extends JFrame implements ActionListener {
   private JButton buttons[];
   private final String names[] =
      { "one", "two", "three", "four", "five", "six" };
   private boolean toggle = true;
   private Container container;
   private GridLayout grid1, grid2;

   // set up GUI
   public GridLayoutDemo()
   {
      super( "GridLayout Demo" );

      // set up layouts
      grid1 = new GridLayout( 2, 3, 5, 5 );
      grid2 = new GridLayout( 3, 2 );

      // get content pane and set its layout
      container = getContentPane();
      container.setLayout( grid1 );
```

Create GridLayout grid1 with 2 rows and 3 columns

Create GridLayout grid2 with 3 rows and 2 columns



GridLayoutDemo.java

```
      // create and add buttons
      buttons = new JButton[ names.length ];

      for ( int count = 0; count < names.length; count++ ) {
         buttons[ count ] = new JButton( names[ count ] );
         buttons[ count ].addActionListener( this );
         container.add( buttons[ count ] );
      }

      setSize( 300, 150 );
      setVisible( true );

   } // end constructor GridLayoutDemo

   // handle button events by toggling between layouts
   public void actionPerformed( ActionEvent event )
   {
      if ( toggle )
         container.setLayout( grid2 );
      else
         container.setLayout( grid1 );

      toggle = !toggle;  // set toggle to opposite value
      container.validate();
   }
```

Toggle current GridLayout when user presses JButton



GridLayoutDemo.java

```
   public static void main( String args[] )
   {
      GridLayoutDemo application = new GridLayoutDemo();
      application.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
   }

} // end class GridLayoutDemo
```



# Panels

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

```
1  // 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
```

PanelDemo.java

Line 23

Create JPanel to hold JButtons



```
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 JButtons to JPanel

Line 29

Add JPanel to SOUTH region of Container



## Exercício

- Crie uma calculadora simples usando dois “panels” (1 panel com BorderLayout, outro com GridLayout 4x 4)
- Crie dois handlers um para números e ponto(insere no campo de texto), outro para comandos (+, - ,*,/,=)
- Use as classes wrapper para transformar texto em número e vice-versa