# Fundamentals of Swing

In this tutorial you will:

- Find out about the need for Java™ Foundation Classes (JFC)-Swing and its advantages over the Abstract Window Toolkit (AWT)
- Learn about the JFC-Swing Controls
- Learn about the JFC-Swing Layout Managers

## Content

## JFC Overview

Sun Microsystems is leveraging the technology of Netscape™ Communications, IBM, and Lighthouse Design (now owned by Sun) to create a set of Graphical User Interface (GUI) classes that integrate with JDK™ 1.1.5+, are standard with the Java ® 2 platform (JDK 1.2) and provide a more polished look and feel than the standard AWT component set. The collection of APIs coming out of this effort, called the Java Foundation Classes (JFC), allows developers to build full-featured enterprise-ready applications.

JFC is composed of five APIs: AWT, Java™ 2D, Accessibility, Drag and Drop, and Swing. The AWT components refer to the AWT as it exists in JDK versions 1.1.2 and later. Java 2D is a graphics API based on technology licensed from IBM/Taligent. It is currently available with the Java® 2 Platform (and not usable with JDK 1.1). The Accessibility API provides assistive technologies, like screen magnifiers, for use with the various pieces of JFC. Drag and Drop support is part of the next JavaBean™ generation, "Glasgow," and is also available with the Java® 2 platform.

Swing includes a component set that is targeted at forms-based applications. Loosely based on Netscape's acclaimed Internet Foundation Classes (IFC), the Swing components have had the most immediate impact on Java development. They provide a set of well-groomed widgets and a framework to specify how GUIs are visually presented, independent of platform. At the time this was written, the Swing release is at 1.1 (FCS).

## IFC, AWT, and Swing: Sorting it all out

Though the Swing widgets were based heavily on IFC, the two APIs bear little resemblance to one another from the perspective of a developer. The look and feel of some Swing widgets and their rendering is primarily what descended from IFC, although you may notice some other commonalties.

The AWT 1.1 widgets and event model are still present for the Swing widgets. However, the 1.0 event model does not work with Swing widgets. The Swing widgets simply extend AWT by adding a new set of components, the *JComponents*, and a group of related support classes. As with AWT, Swing components are all JavaBeans and participate in the JavaBeans event model.

A subset of Swing widgets is analogous to the basic AWT widgets. In some cases, the Swing versions are simply lightweight components, rather than peer-based components. The lightweight component architecture was introduced in AWT 1.1. It allows components to exist without native operating system widgets. Swing also contains some new widgets such as trees, tabbed panes, and splitter panes that will greatly improve the look and functionality of GUIs.

## Swing Package Overview

Swing can expand and simplify your development of cross-platform applications. The Swing collection consists of seventeen packages, each of which has its own distinct purpose. As you'll learn in this short course, these packages make it relatively easy for you to put together a variety of applications that have a high degree of sophistication and user friendliness.

**`javax.swing`**
The high level swing package primarily consists of components, adapters, default component models, and interfaces for all the delegates and models.

**`javax.swing.border`**
The border package declares the `Border` interface and classes, which define specific border rendering styles.

**`javax.swing.colorchooser`**
The colorchooser package contains support classes for the color chooser component.

**`javax.swing.event`**
The event package is for the Swing-specific event types and listeners. In addition to the `java.awt.event` types, Swing components can generate their own event types.

**`javax.swing.filechooser`**
The filechooser package contains support classes for the file chooser component.

**`javax.swing.plaf.*`**
The pluggable look-and-feel (PLAF) packages contain the User Interface (UI) classes (delegates) which implement the different look-and-feel aspects for Swing components. There are also PLAF

packages under the `javax.swing.plaf` hierarchy.

**`javax.swing.table`**
The table package contains the support interfaces and classes the Swing table component.

**`javax.swing.text`**
The text package contains the support classes for the Swing document framework.

**`javax.swing.text.html.*`**
The text.html package contains the support classes for an HTML version 3.2 renderer and parser.

**`javax.swing.text.rtf`**
The text.rtf package contains the support classes for a basic Rich Text Format (RTF) renderer.

**`javax.swing.tree`**
The tree package contains the interfaces and classes which support the Swing tree component.

**`javax.swing.undo`**
The undo package provides the support classes for implementing undo/redo capabilities in a GUI.

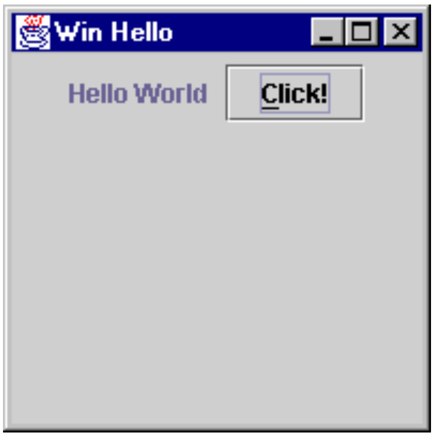
**`javax.accessibility`**
The JFC Accessibility package is included with the Swing classes. However, its usage is not discussed here.

## Writing a Swing Application

This section describes how to create a simple Swing application. Swing applications are somehow similar to usual AWT applications. Each app consist of a JFrame object which(unlike AWT) contains a JPanel containing all the components. Unlike AWT however the components cannot be placed directly into the frame, the components must be added to the content pane of the frame. The abstract class below can be extended to create any Swing application

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
public abstract class JWinApp extends JFrame{
        public JWinApp(String title, JPanel panel){
                super(title);// pass the title to JFrame
                // add the panel containing components to the content pane
                // of this JFrame
                getContentPane().add(panel, BorderLayout.CENTER);
                setSize(200,200);//set width and height of window
                // handle window closing event
                addWindowListener(new WindowAdapter(){
                        public void windowClosing(WindowEvent we){
                                exitApp();
                        }
                });
        }
        protected void exitApp(){
                setVisible(false);
                dispose();
                System.exit(0);
        }

        public static void main(String args[]){
        }
}
```

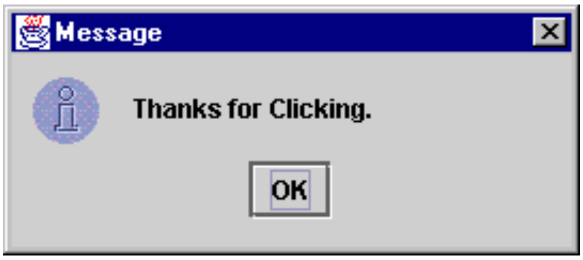
Next class JWinHello extends this class to create a complete application.



**A simple Swing application window**

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;

// the panel for main frame of this application
class WinHelloPanel extends JPanel implements ActionListener{
        JLabel label = new JLabel("Hello World "); // a label
        JButton button = new JButton("Click!"); // a button
        public WinHelloPanel(){
                add(label);
                button.setMnemonic('C'); // make C an accelerater key
                button.setToolTipText("Now"); // tool tip for button
                add(button);
                button.addActionListener(this);
        }
        public void actionPerformed(ActionEvent ae){
                // this shows a message box
                JOptionPane.showMessageDialog(this, "Thanks for Clicking.");
        }
}
// now the main frame
class JWinHello extends JWinApp{
        public JWinHello(){
                super("Win Hello",new WinHelloPanel());
                setVisible(true);
        }
        public static void main(String args[]){
                new JWinHello();
        }
}
```

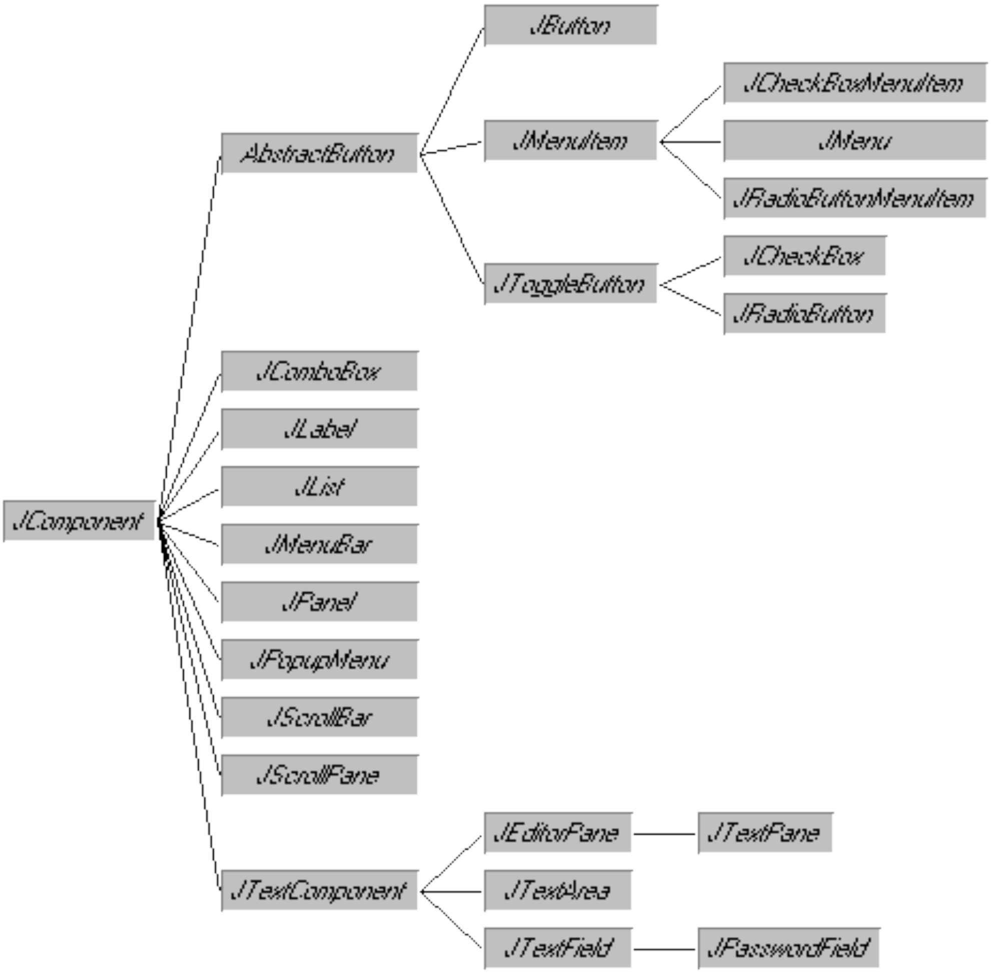
As you can see, first a panel containing the required components is created by extending JPanel, then an instance of this panel is passed to the constructor of JWinApp which adds it to the content pane of frame. When you click on Click! button a message box appears on screen



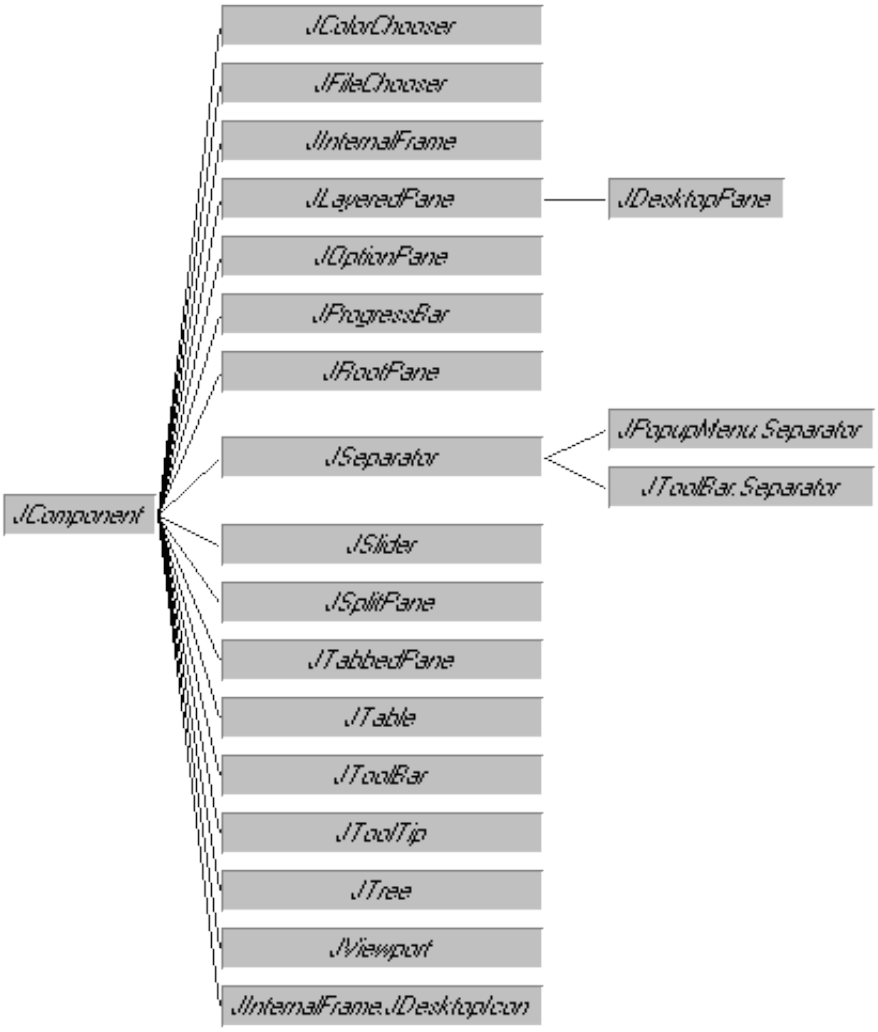
**A message box**

## Widgets, Widgets, Widgets

This section describes how to use the various Swing widgets. The Swing component hierarchy is shown in two parts for comparison with AWT. Part 1 of the component hierarchy is similar to that of AWT. However, there are over twice as many components in Swing as in AWT. Part 2 shows the expanded Swing component set. This group of components appeals most to developers, as it provides a much richer set of widgets to use.



**Component Hierarchy: Part 1--AWT Similar**



**Component Hierarchy: Part 2--New And Expanded Components**

## JPanel

The first widget to discuss is `JPanel`. It is a lightweight `Panel` object offering built-in support for double buffering. When buffering is enabled, through the constructor, all the drawing operations of components within the panel will be drawn to an off-screen drawing area prior to being drawn to the screen. The `JPanel` class is used in most of the examples in this section.

## Icons

The second component, `Icon`, isn't really a component at all. However, you can use it *with* almost all Swing components.

An `Icon` is used to describe fixed-size pictures, or glyphs. Typically, you embed icons in a `JButton` or other `JComponent`. Objects that can act as icons implement the `Icon` interface, shown below. It contains a `paintIcon()` method that specifies a drawing origin. You render the picture specified in the `paintIcon()` method in a rectangle whose size cannot exceed a rectangle with an origin at (`x`, `y`), a width of `getIconWidth()`, and a height of `getIconHeight()`. The `Component` parameter to `paintIcon()` is not usually used, unless you need to specify additional information, such as a font or color.

```
public interface Icon {

  void paintIcon(Component c, Graphics g, int x, int y);

  int getIconWidth();

  int getIconHeight();

}
```

The `ImageIcon` class is an implementation of `Icon` that creates an `Icon` from an `Image`.

```
Icon tinyPicture = new ImageIcon("TinyPicture.gif");
```

Alternatively, the `ImageIcon` constructor can take an `Image` or `URL` object or byte array as its parameter, with an optional `String` description parameter. One nice thing about `ImageIcon` is it checks a cache before retrieving the image file.

Swing uses `ImageIcon` rather than `Image` for two reasons:

1. An `Image` loads asynchronously, creating the need to monitor the loading process (with `MediaTracker`).
2. An `Image` is not serializable.

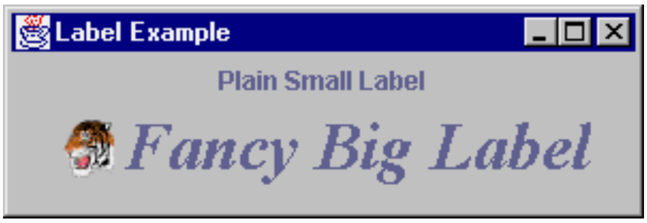
In addition to using `ImageIcon`, you can implement the interface yourself to create your own icons:

```
public class RedOval implements Icon {
  public void paintIcon (Component c, Graphics g,
                         int x, int y) {
    g.setColor(Color.red);
    g.drawOval (x, y, getIconWidth(), getIconHeight());
  }
  public int getIconWidth() {
    return 10;
  }
  public int getIconHeight() {
    return 10;
  }
}
```

### JLabel

A `JLabel` is a single line label similar to `java.awt.Label`. Additional functionality that a `JLabel` has is the ability to:

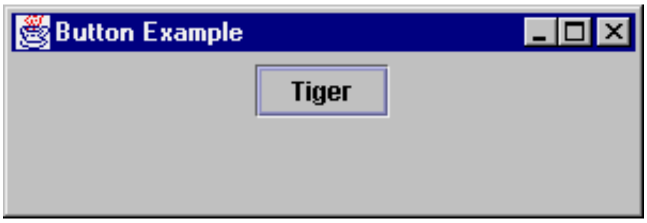
1. Add an `Icon`
2. Set the vertical and horizontal position of text relative to the `Icon`
3. Set the relative position of contents within component



```
public class LabelPanel extends JPanel {
  public LabelPanel() {
    // Create and add a JLabel
    JLabel plainLabel = new JLabel("Plain Small Label");

    add(plainLabel);

    // Create a 2nd JLabel

    JLabel fancyLabel = new JLabel("Fancy Big Label");

    // Instantiate a Font object to use for the label

    Font fancyFont =

      new Font("Serif", Font.BOLD | Font.ITALIC, 32);

    // Associate the font with the label

    fancyLabel.setFont(fancyFont);

    // Create an Icon

    Icon tigerIcon = new ImageIcon("SmallTiger.gif");

    // Place the Icon in the label

    fancyLabel.setIcon(tigerIcon);

    // Align the text to the right of the Icon

    fancyLabel.setHorizontalAlignment(JLabel.RIGHT);

    // Add to panel

    add(fancyLabel);

  }

}
```

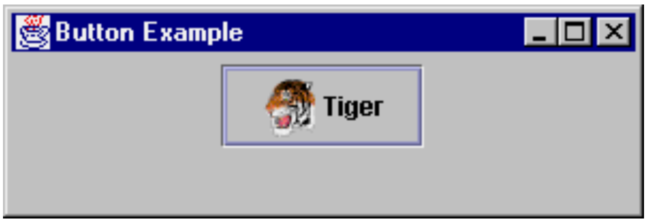
### JButton

A JButton can be instantiated and used in a GUI just like a java.awt.Button. It behaves like an AWT 1.1 Button, notifying ActionListener list elements when pushed.



```
public class ButtonPanel extends JPanel {

  public ButtonPanel () {

    JButton myButton = new JButton("Tiger");

    add(myButton);

  }

}
```

Also, the JButton has support for an embedded Icon, specified in the constructor, or via the setIcon() method. This creates an image button; here, with the label *Tiger*:



```
public class ButtonPanel extends JPanel {

  public ButtonPanel() {

    Icon tigerIcon = new ImageIcon("SmallTiger.gif");

    JButton myButton = new JButton("Tiger", tigerIcon);

    add(myButton);

  }

}
```

### AbstractButton

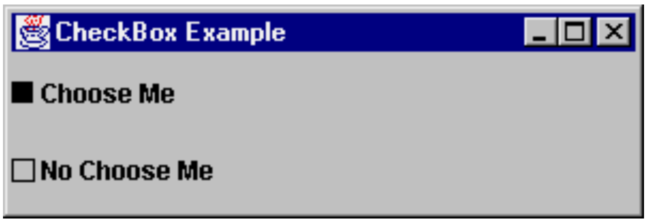
While the `AbstractButton` isn't a class you use directly, several of the more common `JComponent` classes inherit much of their shared behavior from this object. For instance, the icon usage methods `getIcon()` and `setIcon()` come from `AbstractButton`. (The methods are also available elsewhere.) Some of the other common features are listed below:

- `setMnemonic()` - Add a keyboard accelerator to a text label, use the `VK_*` constants from `KeyEvent` to specify the key
- `doClick()` - Programmatically, select the button
- `setDisabledIcon()`, `setDisabledSelectedIcon()`, `setPressedIcon()`, `setRolloverIcon()`, `setRolloverSelectedIcon()`, `setSelectedIcon()` - Change the displayed `Icon`, based on the button state (in addition to `setIcon()`)
- `setVerticalAlignment()`, `setHorizontalAlignemnt()` - Anchors icon/text in different areas of button
- `setVerticalTextPosition()`, `setHorizontalTextPosition()` - Positions text in different areas around icon. Both `set`*`XXX`*`Alignment()` and `set`*`YYY`*`TextPosition()` rely on the `SwingConstants` interface for the area placement settings.

> **Note:** The upcoming Swing 1.1.1 release includes the ability to specify label text in HTML by preceding the content with <html>. This will allow you to have multi-line button labels without having to customize the user interface.

### JCheckBox

A `JCheckBox` is similar to an AWT `Checkbox` that is not in a `CheckboxGroup`. Although Swing provides a default graphic to signify `JCheckBox` selection, you also can specify your own `Icon` objects for both the checked and unchecked state.



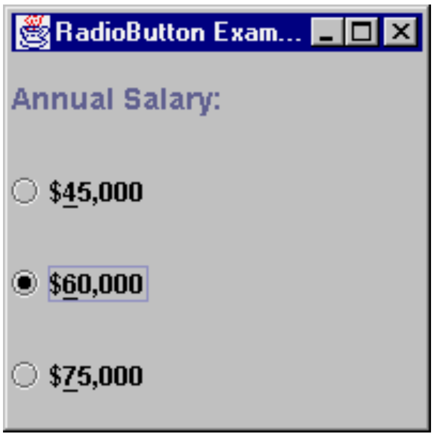
```
public class CheckboxPanel extends JPanel {
```

```
Icon unchecked = new ToggleIcon (false);

Icon checked = new ToggleIcon (true);


public CheckboxPanel() {


  // Set the layout for the JPanel

  setLayout(new GridLayout(2, 1));

  // Create checkbox with its state initialized to true

  JCheckBox cb1 = new JCheckBox("Choose Me", true);

  cb1.setIcon(unchecked);

  cb1.setSelectedIcon(checked);

  // Create checkbox with its state initialized to false

  JCheckBox cb2 = new JCheckBox("No Choose Me", false);

  cb2.setIcon(unchecked);

  cb2.setSelectedIcon(checked);

  add(cb1);

  add(cb2);

}

class ToggleIcon implements Icon {

  boolean state;

  public ToggleIcon (boolean s) {

    state = s;

  }

  public void paintIcon (Component c, Graphics g,

                         int x, int y) {

    int width = getIconWidth();

    int height = getIconHeight();

    g.setColor (Color.black);

    if (state)

      g.fillRect (x, y, width, height);

    else

      g.drawRect (x, y, width, height);

  }
```

```
    public int getIconWidth() {
      return 10;
    }
    public int getIconHeight() {
      return 10;
    }
  }
}
```

### JRadioButton

In AWT, radio buttons are checkboxes that belong to the same `CheckboxGroup`; which ensures that only one checkbox is selected at a time. Swing has a separate widget called a `JRadioButton`. Each `JRadioButton` is added to a `ButtonGroup` so the group behaves as a set of radio buttons. Like `CheckboxGroup`, `ButtonGroup` is a functional object that has no visual representation.

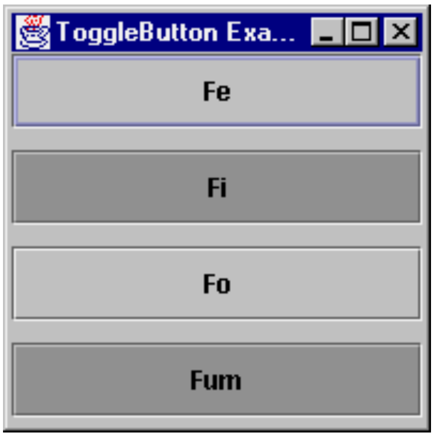


```
public class RadioButtonPanel extends JPanel {

  public RadioButtonPanel() {
    // Set the layout to a GridLayout
    setLayout(new GridLayout(4,1));

    // Declare a radio button
    JRadioButton radioButton;

    // Instantiate a ButtonGroup for functional
    // association among radio buttons
    ButtonGroup rbg = new ButtonGroup();

    // Create a label for the group
    JLabel label = new JLabel("Annual Salary: ");
    label.setFont(new Font("SansSerif", Font.BOLD, 14));
    add(label);

    // Add a new radio button to the pane
    radioButton = new JRadioButton("$45,000");
    add (radioButton);
    // set key accelerator
    radioButton.setMnemonic (KeyEvent.VK_4);

    // Add the button to the ButtonGroup
    rbg.add (radioButton);

    // Set this radio button to be the default
    radioButton.setSelected(true);

    // Set up two more radio buttons
    radioButton = new JRadioButton("$60,000");
    radioButton.setMnemonic (KeyEvent.VK_6);
    add (radioButton);
    rbg.add (radioButton);
    radioButton = new JRadioButton("$75,000");
    radioButton.setMnemonic (KeyEvent.VK_7);
    add (radioButton);
    rbg.add (radioButton);
  }
}
```

Technically speaking, you can add `JCheckBox` or `JToggleButton` (described next) components to a `CheckboxGroup`. At most, one will be selected while in the group.

### JToggleButton

The `JToggleButton` class is the parent to both `JCheckBox` and `JRadioButton`. It doesn't have an AWT equivalent. The `JToggleButton` works like a `Button` that stays pressed in when toggled on. When a `JToggleButton` is toggled off, you cannot tell it from a regular `Button` or `JButton` class.



```
public class ToggleButtonPanel extends JPanel {

  public ToggleButtonPanel() {

    // Set the layout to a GridLayout

    setLayout(new GridLayout(4,1, 10, 10));

    add (new JToggleButton ("Fe"));

    add (new JToggleButton ("Fi"));

    add (new JToggleButton ("Fo"));

    add (new JToggleButton ("Fum"));

  }

}
```

### JScrollPane

Like the AWT 1.1 `ScrollPane`, `JScrollPane` handles automatic horizontal and vertical scrolling of content. It lays out components using a `ScrollPaneLayout`, described in more detail under Swing Layouts. The key thing to know when using a `JScrollPane` is that Swing provides a `JViewport` for adding the object to scroll.

To get a handle to the viewport, `JScrollPane` has a `getViewport()` method. Then, to add a component to the viewport, the `JViewport` class has an `add` method.

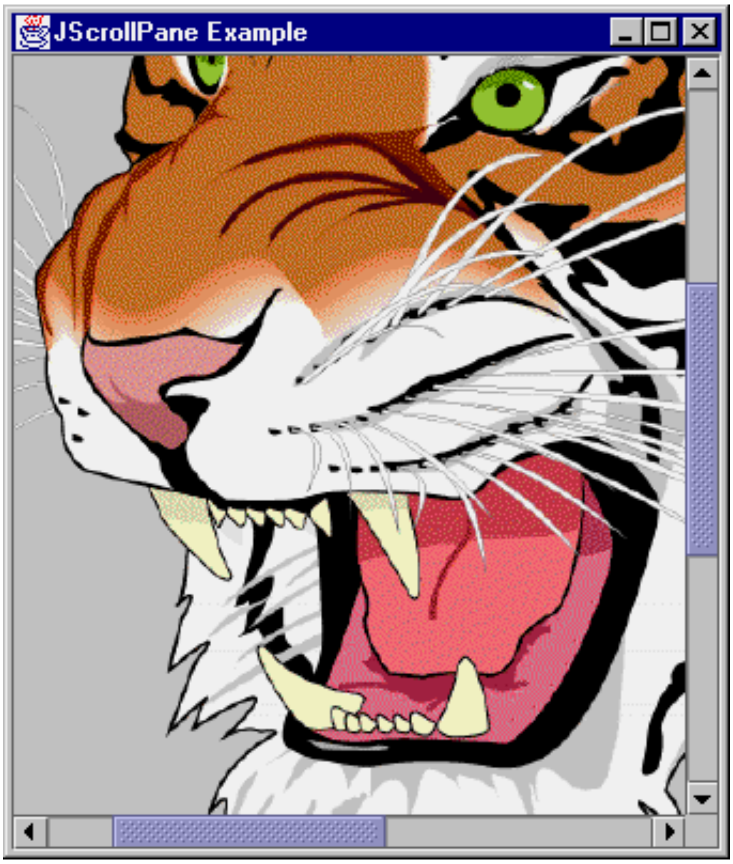
```
JViewport vport = someScrollPane.getViewport();

vport.add(someComponent);
```

Or, more commonly, the two lines are combined:

```
someScrollPane.getViewport().add(someComponent);
```

Another option is to provide the component to scroll to the constructor:

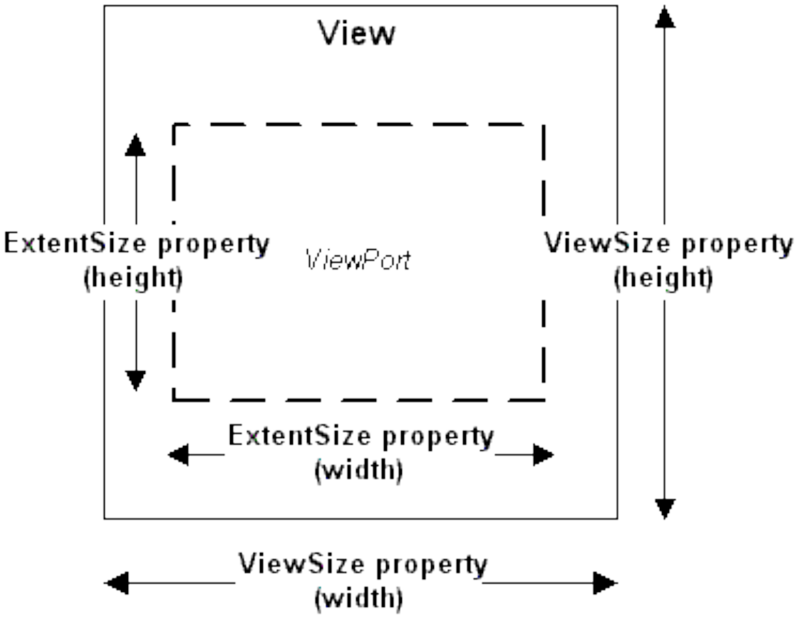
```
JScrollPane pane = new JScrollPane(someComponent);
```



```
public class ScrollPanel extends JPanel {


  public ScrollPanel() {

    setLayout(new BorderLayout());

    Icon bigTiger = new ImageIcon("BigTiger.gif");

    JLabel tigerLabel = new JLabel(bigTiger);

    JScrollPane scrollPane = new JScrollPane(tigerLabel);

    add(scrollPane, BorderLayout.CENTER);

  }

}
```

### Viewports

The `JViewport` offers a view into a much larger area then can be seen without it. It can be either used within the `JScrollPane` component or as a standalone widget, where you control all the scrolling functionality yourself. Normally, you wouldn't want to do all the scrolling functionality yourself, but the capability is available. (Besides `JScrollPane`, `JViewport` is used internally within the Swing text components to handle scrolling of text.)


View
ExtentSize property (height)
ViewPort
ViewSize property (height)
ExtentSize property (width)
ViewSize property (width)

### JTextComponents

`JTextComponent` is a generalized text class that contains all the features you would expect from a simple editor. Some of its methods include:

`copy()`

`cut()`

`paste()`

`getSelectedText()`

`setSelectionStart()`

`setSelectionEnd()`

`selectAll()`

`replaceSelection()`

`getText()`

`setText()`

`setEditable()`

`setCaretPosition()`

Although you won't instantiate a `JTextComponent` object directly, you will often use these methods, many of which are not available in AWT text widgets.

`JTextComponent` objects in Swing can be placed in a panel in a fashion nearly identical to AWT text widgets.

There are three basic subclasses of `JTextComponent`: `JTextField`, `JTextArea`, and `JEditorPane`. `JPasswordField` and `JTextPane` are sub-subclasses that are also of interest.

If you want your users to be able to see content that exceeds the screen display area, you must place the component inside of a `JScrollPane` to support scrolling to the extra content.

#### *JTextField & JTextArea*

Other than having to add a `JTextArea` to a `JScrollPane` for scrolling, `JTextField` and `JTextArea` behave very similarly to their AWT counterparts: `java.awt.TextField` and `java.awt.TextArea`:

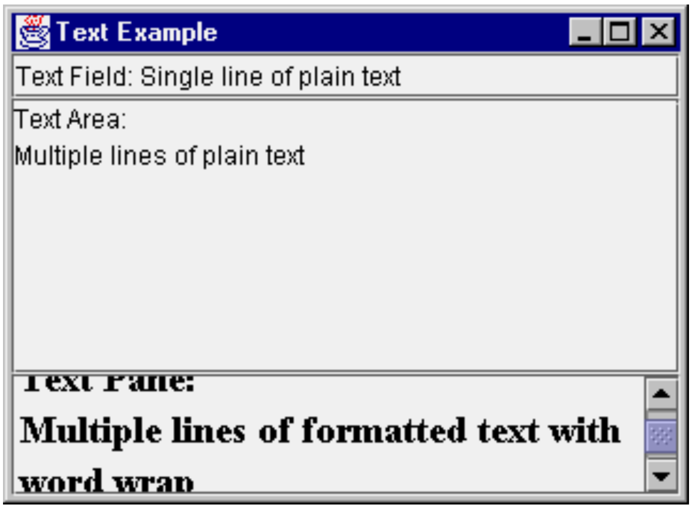
```
// Instantiate a new TextField

JTextField tf = new JTextField();

// Instantiate a new TextArea

JTextArea ta = new JTextArea();

// Initialize the text of each

tf.setText("TextField");

ta.setText("JTextArea\n Allows Multiple Lines");

add(tf);

add(new JScrollPane(ta));
```

The `JTextField` also supports setting of text justification with `setHorizontalAlignment()`. The three available settings are `LEFT`, `CENTER`, and `RIGHT`, where `LEFT` is the default.

### *JTextPane*

`JTextPane` is a full-featured text editor that supports formatted text, word wrap, and image display. It uses a linked list of objects that implement the `Style` interface to specify formatting and supplies some convenience methods for formatting text.

```
JTextPane tp = new JTextPane();

MutableAttributeSet attr = new SimpleAttributeSet();

StyleConstants.setFontFamily(attr, "Serif");

StyleConstants.setFontSize(attr, 18);

StyleConstants.setBold(attr, true);

tp.setCharacterAttributes(attr, false);

add(new JScrollPane(tp));
```



Text Field: Single line of plain text

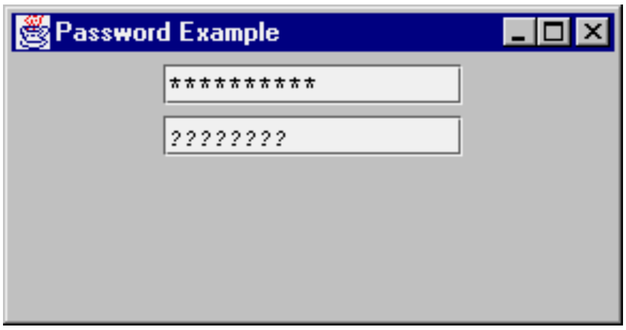
Text Area:
Multiple lines of plain text

**Text Pane:**
**Multiple lines of formatted text with**
**word wrap**

```
public class TextPanel extends JPanel {

  public TextPanel() {

    // Set the layout to a BorderLayout
    setLayout(new BorderLayout());

    // Create the three basic text components
    JTextField textField = new JTextField();
    JTextArea textArea = new JTextArea();
    JTextPane textPane = new JTextPane();

    //Set the textpane's font properties
    MutableAttributeSet attr = new SimpleAttributeSet();
    StyleConstants.setFontFamily(attr, "Serif");
    StyleConstants.setFontSize(attr, 18);
    StyleConstants.setBold(attr, true);
    textPane.setCharacterAttributes(attr, false);

    add(textField, BorderLayout.NORTH);
    add(new JScrollPane(textArea), BorderLayout.CENTER);
    add(new JScrollPane(textPane), BorderLayout.SOUTH);
  }
}
```

### *JPasswordField*

The `JPasswordField` is a `JTextField` that refuses to display its contents openly. By default, the mask character is the asterisk ('*'). However, you can change this with the `setEchoChar()` method. Unlike `java.awt.TextField`, an echo character of `(char)0` does not unset the mask.



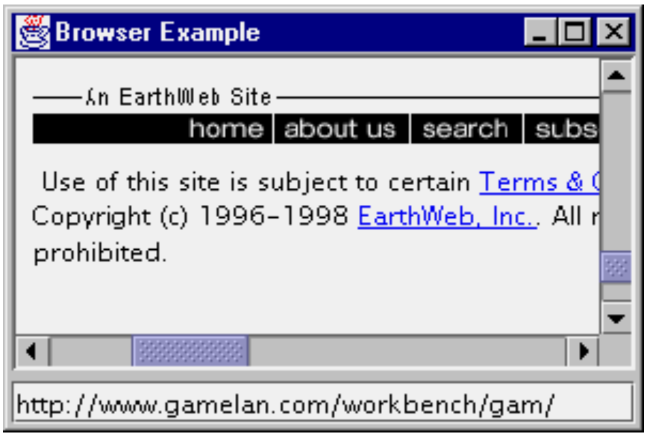
**********

????????

```
class PasswordPanel extends JPanel {
  PasswordPanel() {
    JPasswordField pass1 = new JPasswordField(20);
    JPasswordField pass2 = new JPasswordField(20);
    pass2.setEchoChar ('?');
    add(pass1);
    add(pass2);
  }
}
```

### *JEditorPane*

The `JEditorPane` class is a specialized `JTextComponent` for displaying and editing HTML 3.2 tags or some other format like RTF (rich text format), as determined by the input. It is not meant to provide a full-fledged browser, but a lightweight HTML viewer, usually for the purpose of displaying help text. You either construct the pane with a URL parameter (via a `String` or `URL`), or change pages with the `setPage()` method. For HTML content, links within the HTML page are traversable with the help of a `HyperlinkListener`.



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http://www.gamelan.com/workbench/gam/

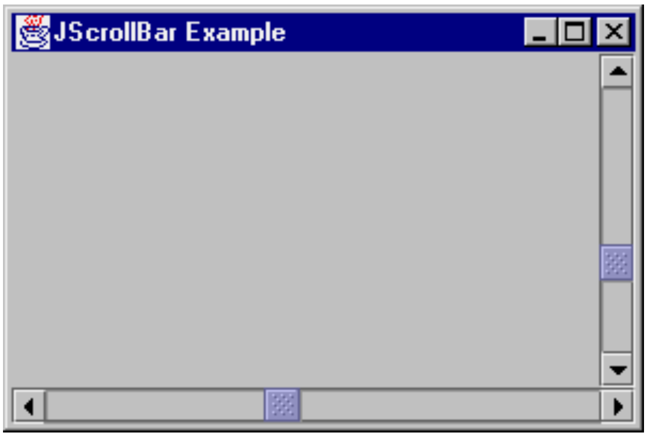
```
public class Browser extends JPanel {
  Browser() {
    setLayout (new BorderLayout (5, 5));
    final JEditorPane jt = new JEditorPane();
    final JTextField input =
      new JTextField("http://java.sun.com");
    // make read-only
    jt.setEditable(false);
    // follow links
    jt.addHyperlinkListener(new HyperlinkListener () {
      public void hyperlinkUpdate(final HyperlinkEvent e) {
        if (e.getEventType() ==
            HyperlinkEvent.EventType.ACTIVATED) {
          SwingUtilities.invokeLater(new Runnable() {
            public void run() {
              // Save original
              Document doc = jt.getDocument();
              try {
                URL url = e.getURL();
                jt.setPage(url);
                input.setText (url.toString());
              } catch (IOException io) {
                JOptionPane.showMessageDialog (
                  Browser.this, "Can't follow link",
                  "Invalid Input",
                   JOptionPane.ERROR_MESSAGE);
                jt.setDocument (doc);
              }
            }
          });
        }
      }
    });
    JScrollPane pane = new JScrollPane();
    pane.setBorder (
      BorderFactory.createLoweredBevelBorder());
    pane.getViewport().add(jt);
    add(pane, BorderLayout.CENTER);

    input.addActionListener (new ActionListener() {
      public void actionPerformed (ActionEvent e) {
        try {
          jt.setPage (input.getText());
        } catch (IOException ex) {
          JOptionPane.showMessageDialog (
            Browser.this, "Invalid URL",
            "Invalid Input",
            JOptionPane.ERROR_MESSAGE);
        }
      }
    });
    add (input, BorderLayout.SOUTH);
  }
```

```
}
```

To activate the hyperlinks within the `JEditorPane`, event handling code is provided. Also, if you only want to display HTML, remember to `setEditable(false)` to make the editor read-only.

### JScrollBar

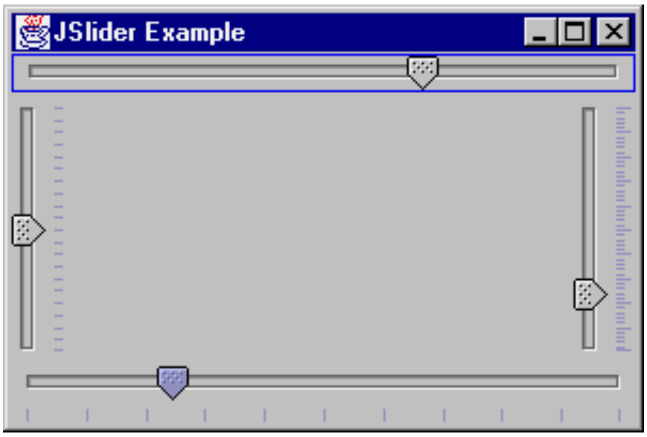
`JScrollBar` offers a lightweight version of the `java.awt.Scrollbar` component.



```
public class ScrollbarPanel extends JPanel {


  public ScrollbarPanel() {

    setLayout(new BorderLayout());

    JScrollBar scrollBar1 =

      new JScrollBar (JScrollBar.VERTICAL, 0, 5, 0, 100);

    add(scrollBar1, BorderLayout.EAST);

    JScrollBar scrollBar2 =

      new JScrollBar (JScrollBar.HORIZONTAL, 0, 5, 0, 100);

    add(scrollBar2, BorderLayout.SOUTH);

  }

}
```

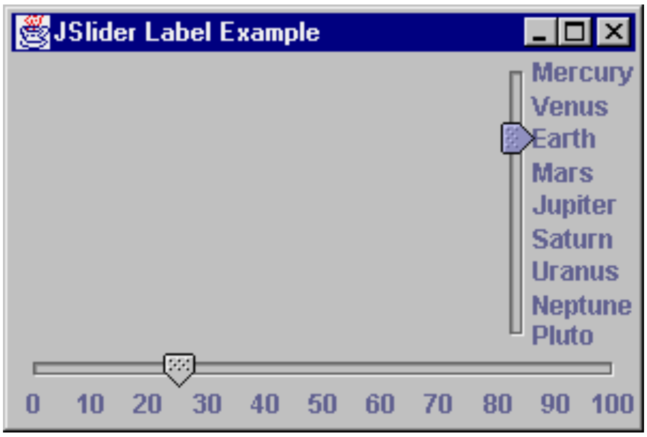
### JSlider

`JSlider` functions like a `JScrollBar`; however, it adds the ability to display major and minor tick marks, as well as display a `Border` around the slider.



```
public class SliderPanel extends JPanel {

  public SliderPanel() {

    setLayout(new BorderLayout());

    JSlider slider1 =

      new JSlider (JSlider.VERTICAL, 0, 100, 50);

    slider1.setPaintTicks(true);

    slider1.setMajorTickSpacing(10);

    slider1.setMinorTickSpacing(2);

    add(slider1, BorderLayout.EAST);

    JSlider slider2 =

      new JSlider (JSlider.VERTICAL, 0, 100, 50);

    slider2.setPaintTicks(true);

    slider2.setMinorTickSpacing(5);

    add(slider2, BorderLayout.WEST);

    JSlider slider3 =

      new JSlider (JSlider.HORIZONTAL, 0, 100, 50);

    slider3.setPaintTicks(true);

    slider3.setMajorTickSpacing(10);

    add(slider3, BorderLayout.SOUTH);

    JSlider slider4 =

      new JSlider (JSlider.HORIZONTAL, 0, 100, 50);

    slider4.setBorder(

      BorderFactory.createLineBorder(Color.blue));

    add(slider4, BorderLayout.NORTH);

  }

}
```

In addition to plain tick marks, with `JSlider` you can place labels along the axis as either a serious of numbers or components. For numeric labels, by just calling `setPaintLabels (true)`, the slider will generate and use a series of labels based on the major tick spacing. So, if the slider range is 0 to 100 with tick spacing of 10, the slider would then have labels of 0, 10, 20, ... 100. On the other hand, if you want to generate the labels yourself, you can provide a `Hashtable` of labels. The hashtable key would be the `Integer` value of the position. The hashtable value would be a `Component` to use for display of the label. The following demonstrates both:



```
public class SliderPanel2 extends JPanel {

  public SliderPanel2() {

    setLayout(new BorderLayout());

    JSlider right, bottom;

    right = new JSlider(JSlider.VERTICAL, 1, 9, 3);

    Hashtable h = new Hashtable();

    h.put (new Integer (1), new JLabel("Mercury"));

    h.put (new Integer (2), new JLabel("Venus"));

    h.put (new Integer (3), new JLabel("Earth"));

    h.put (new Integer (4), new JLabel("Mars"));

    h.put (new Integer (5), new JLabel("Jupiter"));

    h.put (new Integer (6), new JLabel("Saturn"));

    h.put (new Integer (7), new JLabel("Uranus"));

    h.put (new Integer (8), new JLabel("Neptune"));

    h.put (new Integer (9), new JLabel("Pluto"));

    right.setLabelTable (h);

    right.setPaintLabels (true);

    right.setInverted (true);

    bottom = new JSlider(JSlider.HORIZONTAL, 0, 100, 25);

    bottom.setMajorTickSpacing (10);

    bottom.setPaintLabels (true);

    add(right, BorderLayout.EAST);

    add(bottom, BorderLayout.SOUTH);
  }
}
```

### JProgressBar

The `JProgressBar` component allows you to display a progress bar to reflect the status of an operation. The general format of using a `JProgressBar` is as follows:

- Initialize the `JProgressBar`:

  ```
  JProgressBar progressBar = new JProgressBar();
  progressBar.setMinimum(0);
  progressBar.setMaximum(numberSubOperations);
  ```

- Repeat each time you want to perform an operation:

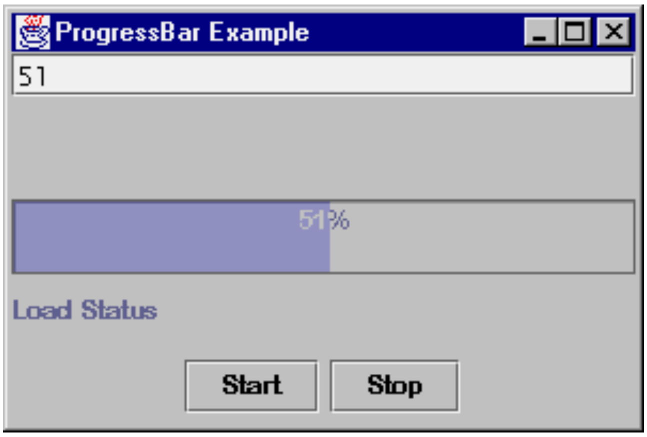
  ```
  progressBar.setValue(progressBar.getMinimum());
  for (int i = 0; i < numberSubOperations; i++) {
    // Perform sub-operation i
    // Update bar value in event thread
    // Where runner is created outside for loop
    SwingUtilities.invokeAndWait(runner);
  }
  ```

- Outside the for-loop, create the `Runnable` object

  ```
  Runnable runner = new Runnable() {
    public void run() {
      int value = progressBar.getValue();
      progressBar.setValue(value+1);
    }
  };
  ```

Often, you will want to set up an operation to execute in a thread and have the operation monitored by a progress bar. This allows the user to cancel the operation if it is taking too long. (The `ProgressMonitorInputStream` class provides this type of behavior for reading input streams.)

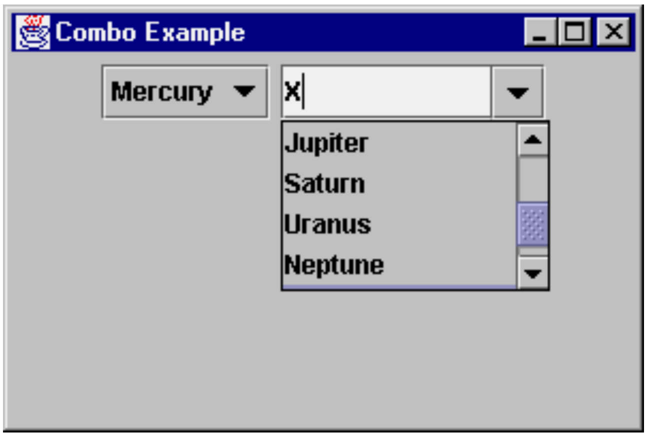
To demonstrate `JProgressBar`, an example follows. The stepping thread simply counts up, displaying the current count in a `JTextField`. In addition, the bar displays the current value by setting its stringPainted property to `true` with `progressBar.setStringPainted(true)`.



```
public class ProgressBarPanel extends JPanel {

  Thread loadThread;

  Object lock = new Object();

  boolean shouldStop=false;

  JTextField progressTextField;

  JProgressBar progressBar;

  public ProgressBarPanel() {

    setLayout(new BorderLayout());


    progressTextField = new JTextField();

    add(progressTextField, BorderLayout.NORTH);


    JPanel bottomPanel = new JPanel();

    progressBar = new JProgressBar();

    progressBar.setStringPainted(true);

    bottomPanel.setLayout(new GridLayout(0,1));

    bottomPanel.add(progressBar);

    bottomPanel.add(new JLabel("Load Status"));

    JPanel buttonPanel = new JPanel();

    JButton startButton = new JButton("Start");

    buttonPanel.add(startButton);

    startButton.addActionListener(new ActionListener() {

      public void actionPerformed(ActionEvent e) {

        startLoading();

      }

    });

    JButton stopButton = new JButton("Stop");
    buttonPanel.add(stopButton);
    stopButton.addActionListener(new ActionListener() {
      public void actionPerformed(ActionEvent e) {
        stopLoading();
      }
    });
    bottomPanel.add(buttonPanel);
    add(bottomPanel, BorderLayout.SOUTH);
  }
  public void startLoading() {
    if(loadThread == null) {
      loadThread = new LoadThread();
      shouldStop = false;
      loadThread.start();
    }
  }
  public void stopLoading() {
    synchronized(lock) {
      shouldStop = true;
      lock.notify();
    }
  }
  class LoadThread extends Thread {
    public void run () {
      int min = 0;
      int max = 100;
      progressBar.setValue(min);
      progressBar.setMinimum(min);
      progressBar.setMaximum(max);
      Runnable runner = new Runnable() {
        public void run() {
          int value = progressBar.getValue();
          value++;
          progressBar.setValue(value);
          progressTextField.setText (""+value);
        }
      };
      for (int i=min;i<=max;i++) {
        try {
          SwingUtilities.invokeAndWait(runner);
        } catch (InvocationTargetException e) {
          break;
        } catch (InterruptedException e) {
            // Ignore Exception
        }
        synchronized(lock) {
          if(shouldStop)
            break;
          try {
            lock.wait(100);
          } catch (InterruptedException e) {
            // Ignore Exception
          }
        }
      }
      loadThread = null;
    }
  }
}
```

## JComboBox

The JComboBox works like AWT's Choice component, but renames some methods and offers an editable option. For times when a fixed-list of choices isn't enough, you can offer a JComboBox with a list of default choices, but still permit the entry of another value. The nicest part about this control is that when the user presses the key for the first letter of an entry, it changes the highlighted selection. You can enhance this behavior by providing your own KeySelectionManager, a public inner class of JComboBox.



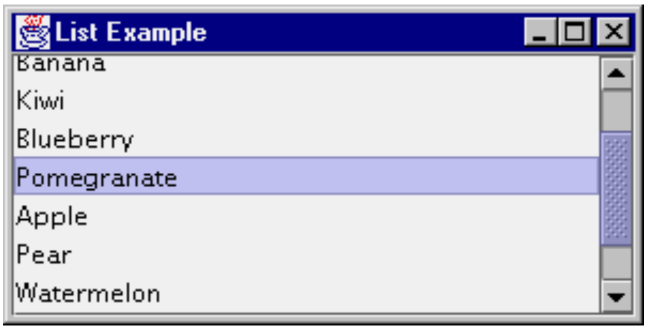
```
public class ComboPanel extends JPanel {

  String choices[] = {
    "Mercury", "Venus", "Earth",
    "Mars", "Jupiter", "Saturn",
    "Uranus","Neptune", "Pluto"};

  public ComboPanel() {

    JComboBox combo1 = new JComboBox();

    JComboBox combo2 = new JComboBox();

    for (int i=0;i<choices.length;i++) {

      combo1.addItem (choices[i]);

      combo2.addItem (choices[i]);

    }

    combo2.setEditable(true);

    combo2.setSelectedItem("X");

    combo2.setMaximumRowCount(4);

    add(combo1);

    add(combo2);

  }

}
```

There is more to `JComboBox` than just a few new methods and editability.

## JList

The `JList` component has both an easy (non-MVC) implementation and a more complicated view. Now, you'll see how to display a list of `String` objects, just like an AWT `List` component. Thankfully, it has gotten much easier. To add a `String[]` (or `Vector`) of elements to a `JList`, just tell the constructor or use the `setListData()` method.

There is one major difference between `List` and `JList`. `JList` doesn't directly support scrolling. You need to place the `JList` within a `JScrollPane` object, and let it deal with the scrolling.



```
public class ListPanel extends JPanel {

  String label [] = {"Cranberry", "Orange",

    "Banana", "Kiwi", "Blueberry",
    "Pomegranate", "Apple", "Pear",
    "Watermelon", "Raspberry", "Snozberry"

  };

  public ListPanel() {

    setLayout (new BorderLayout());

    JList list = new JList(label);

    JScrollPane pane = new JScrollPane(list);

    add(pane, BorderLayout.CENTER);

  }

}
```

### Borders

The `javax.swing.border` package consists of several objects to draw borders around components. They all implement the `Border` interface, which consists of three methods:

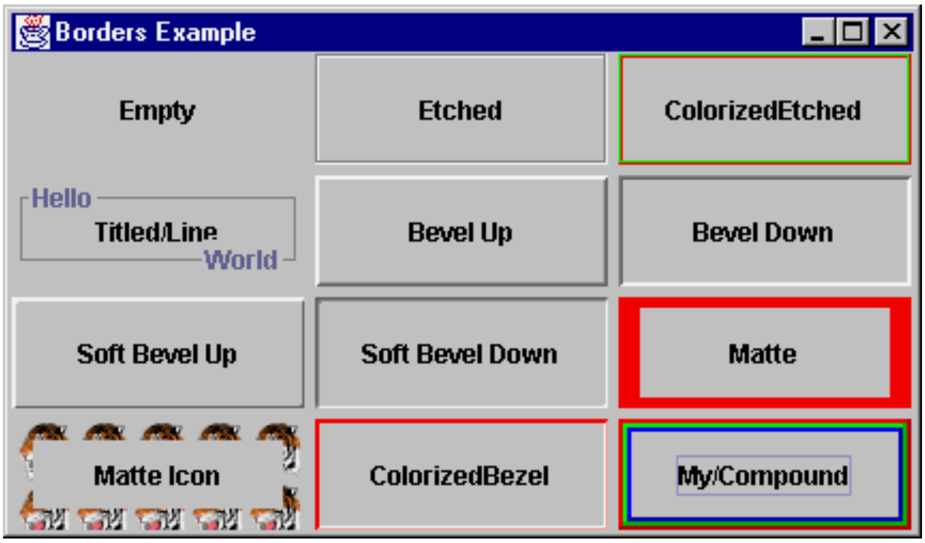
- `public Insets getBorderInsets(Component c)`
  Defines the drawable area necessary to draw the border
- `public boolean isBorderOpaque()`
  Defines if the border area is opaque or transparent
- `public void paintBorder (Component c, Graphics g, int x, int y, int width, int height)`
  Defines how to draw the border within the specified area. The routine should only draw into the area requested with `getBorderInsets()`.

The border behavior is defined for `JComponent`, so all subclasses inherit the behavior.

Swing provides nine borders, and you can create your own if none of them meets your needs:

- `AbstractBorder` - An abstract class that implements the `Border` interface, but does nothing
- `BevelBorder` - A 3D border that may be raised or lowered
- `CompoundBorder` - A border that can nest multiple borders
- `EmptyBorder` - A border where you specify the *reserved* space for an undrawn border
- `EtchedBorder` - A border that appears as a groove, instead of raised or lowered
- `LineBorder` - A border for single color borders, with arbitrary thickness
- `MatteBorder` - A border that permits tiling of an icon or color
- `SoftBevelBorder` - A 3D border with softened corners
- `TitledBorder` - A border that permits title strings in arbitrary locations

You can create a border object directly from the appropriate class constructor or ask a `BorderFactory` to create the border for you, with methods like `createBevelBorder(type)` and `createTitledBorder("TItle")`. When using `BorderFactory`, multiple requests to create the same border return the same object.



```
public class BorderPanel extends JPanel {


  class MyBorder implements Border {
    Color color;
    public MyBorder (Color c) {
      color = c;
    }
    public void paintBorder (Component c, Graphics g,
        int x, int y, int width, int height) {
      Insets insets = getBorderInsets(c);
      g.setColor (color);
      g.fillRect (x, y, 2, height);
      g.fillRect (x, y, width, 2);
      g.setColor (color.darker());
      g.fillRect (x+width-insets.right, y, 2, height);
      g.fillRect (x, y+height-insets.bottom, width, 2);
    }
    public boolean isBorderOpaque() {
      return false;
    }
    public Insets getBorderInsets(Component c) {
      return new Insets (2, 2, 2, 2);
    }
```

```
}

public BorderPanel() {
  setLayout (new GridLayout (4, 3, 5, 5));
  JButton b = new JButton("Empty");
  b.setBorder (new EmptyBorder (1,1,1,1));
  add(b);
  b = new JButton ("Etched");
  b.setBorder (new EtchedBorder ());
  add(b);
  b = new JButton ("ColorizedEtched");
  b.setBorder (new EtchedBorder (Color.red,
                                Color.green));
  add(b);
  b = new JButton ("Titled/Line");
  b.setBorder(new TitledBorder (
    new TitledBorder(
      LineBorder.createGrayLineBorder(),
      "Hello"),
    "World",
    TitledBorder.RIGHT,
    TitledBorder.BOTTOM));
  add(b);
  b = new JButton ("Bevel Up");
  b.setBorder(new BevelBorder(BevelBorder.RAISED));
  add(b);
  b = new JButton ("Bevel Down");
  b.setBorder(new BevelBorder(BevelBorder.LOWERED));
  add(b);
  b = new JButton ("Soft Bevel Up");
  b.setBorder(new SoftBevelBorder(SoftBevelBorder.RAISED));
  add(b);
  b = new JButton ("Soft Bevel Down");
  b.setBorder(new SoftBevelBorder(SoftBevelBorder.LOWERED));
```

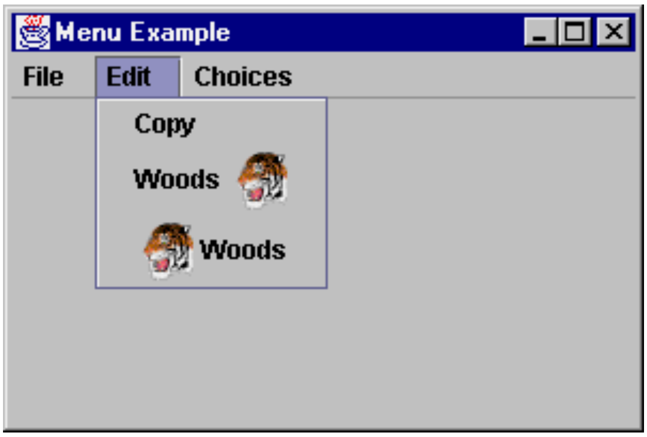
```
    add(b);

    b = new JButton ("Matte");

    b.setBorder(new MatteBorder(5, 10, 5, 10, Color.red));

    add(b);

    b = new JButton ("Matte Icon");

    Icon icon = new ImageIcon ("SmallTiger.gif");

    b.setBorder(new MatteBorder(10, 10, 10, 10, icon));

    add(b);


    b = new JButton ("ColorizedBezel");

    b.setBorder(new BevelBorder(BevelBorder.RAISED,

                                Color.red, Color.pink));

    add(b);

    b = new JButton ("My/Compound");

    b.setBorder(new CompoundBorder(

      new MyBorder(Color.red),

      new CompoundBorder (new MyBorder(Color.green),

                          new MyBorder(Color.blue))));

    add(b);

  }

}
```

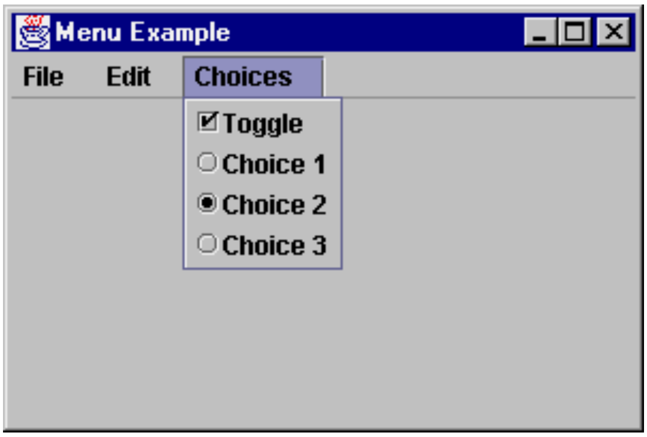
You can change the border of any `JComponent` object with the `setBorder()` method.

### Menus

The menuing model used in Swing is nearly identical to that used in AWT. There are three key exceptions:

- The menu classes (`JMenuItem`, `JCheckBoxMenuItem`, `JMenu`, and `JMenuBar`) are all subclasses of `JComponent`. They are not off in their own independent class hierarchy. As a result of this, you can place a `JMenuBar` within any `Container`, including `Applet`. [The `JApplet` class has a `setJMenuBar()` method to add a `JMenuBar`.]
- There is a new menu class, `JRadioButtonMenuItem`, to provide a set of mutually exclusive checkboxes on a menu, when placed within a `ButtonGroup`.
- Also, you can associate an `Icon` object with any `JMenuItem`.





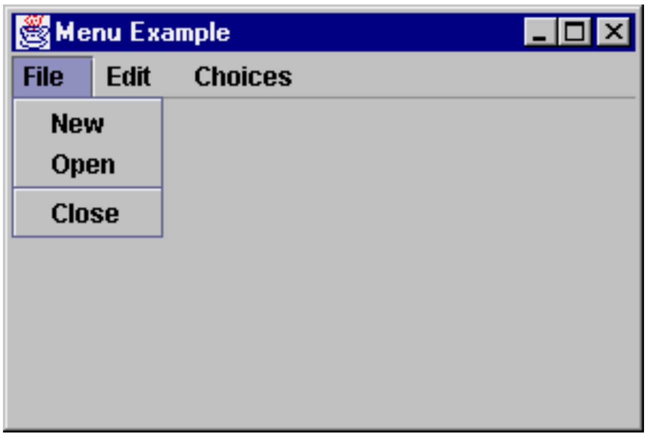
```
public class MenuTester extends JFrame

    implements ActionListener {


  public void actionPerformed (ActionEvent e) {

    System.out.println (e.getActionCommand());

  }


  public MenuTester() {

    super ("Menu Example");


    JMenuBar jmb = new JMenuBar();

    JMenu file = new JMenu ("File");

    JMenuItem item;

    file.add (item = new JMenuItem ("New"));

    item.addActionListener (this);

    file.add (item = new JMenuItem ("Open"));

    item.addActionListener (this);

    file.addSeparator();

    file.add (item = new JMenuItem ("Close"));

    item.addActionListener (this);
```

```
jmb.add (file);

JMenu edit = new JMenu ("Edit");
edit.add (item = new JMenuItem ("Copy"));
item.addActionListener (this);
Icon tigerIcon = new ImageIcon("SmallTiger.gif");
edit.add (item = new JMenuItem ("Woods", tigerIcon));
item.setHorizontalTextPosition (JMenuItem.LEFT);
item.addActionListener (this);
edit.add (item = new JMenuItem ("Woods", tigerIcon));
item.addActionListener (this);
jmb.add (edit);

JMenu choice = new JMenu ("Choices");
JCheckBoxMenuItem check =
  new JCheckBoxMenuItem ("Toggle");
check.addActionListener (this);
choice.add (check);
ButtonGroup rbg = new ButtonGroup();
JRadioButtonMenuItem rad =
  new JRadioButtonMenuItem ("Choice 1");
choice.add (rad);
rbg.add (rad);
rad.addActionListener (this);
rad = new JRadioButtonMenuItem ("Choice 2");
choice.add (rad);
rbg.add (rad);
rad.addActionListener (this);
rad = new JRadioButtonMenuItem ("Choice 3");
choice.add (rad);
rbg.add (rad);
rad.addActionListener (this);

jmb.add (choice);
```

```
    setJMenuBar (jmb);
  }
}
```

### JSeparator

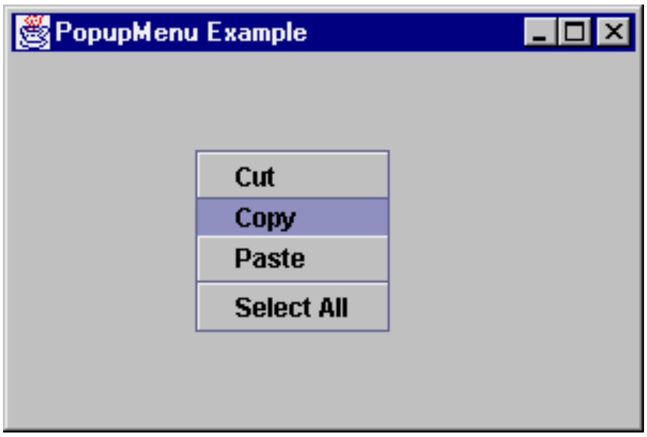
The `JSeparator` object is the menu separator control. The image below shows the separator under the File menu from the example above.



Because Swing menu objects are truly components, you can use `JSeparator` outside of menus, too. However, normally you just add them to a `JMenu` with `addSeparator()`.

### JPopupMenu

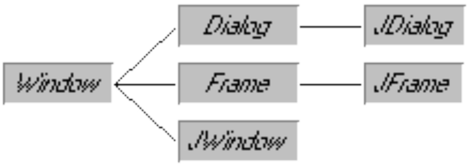
The `JPopupMenu` component allows you to associate context-sensitive menus with any `JComponent`. They work similarly to the AWT `PopupMenu` class, with an `addSeparator()` method to add a separator bar.



```
public class PopupPanel extends JPanel {
  JPopupMenu popup = new JPopupMenu ();
  public PopupPanel() {
    JMenuItem item;
    popup.add (item = new JMenuItem ("Cut"));
    popup.add (item = new JMenuItem ("Copy"));
    popup.add (item = new JMenuItem ("Paste"));
    popup.addSeparator();
    popup.add (item = new JMenuItem ("Select All"));
    popup.setInvoker (this);
    addMouseListener (new MouseAdapter() {
      public void mousePressed (MouseEvent e) {
        if (e.isPopupTrigger()) {
          popup.show (e.getComponent(),
            e.getX(), e.getY());
        }
      }
      public void mouseReleased (MouseEvent e) {
        if (e.isPopupTrigger()) {
          popup.show (e.getComponent(),
            e.getX(), e.getY());
        }
      }
    });
  }
}
```

## JFrame and Windows

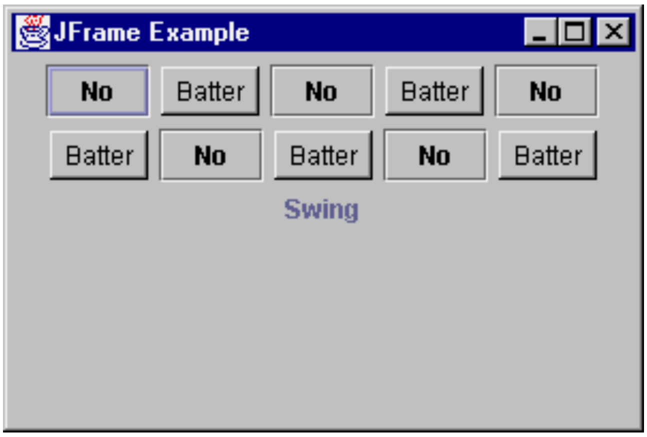
The `Window` class hierarchy is a little different when the Swing window classes are added.



As the diagram shows, they all subclass `Window`, not `JComponent`. This means they are not *lightweight*, have a peer, and cannot be transparent.

The `JFrame` class is the replacement for AWT's `Frame` class. In addition to the ability to add a `java.awt.MenuBar` via `setMenuBar()`, you can add a `JMenuBar` to a `JFrame` via `setJMenuBar()`.

The other difference of the `JFrame` class is shared with the `JWindow` and `JDialog` classes. No longer do you just `add()` components to each directly or `setLayout()` to change the `LayoutManager`. Now, you must get what's called a *content pane*, then add components to that or change its layout.



```
public class FrameTester {

  public static void main (String args[]) {

    JFrame f = new JFrame ("JFrame Example");

    Container c = f.getContentPane();

    c.setLayout (new FlowLayout());

    for (int i = 0; i < 5; i++) {

      c.add (new JButton ("No"));

      c.add (new Button ("Batter"));

    }

    c.add (new JLabel ("Swing"));

    f.setSize (300, 200);

    f.show();

  }

}
```

The reason you have to get a content pane is because the inside of a window is now composed of a `JRootPane`, which no longer shields you from the inner workings of the `Window`, as AWT did.

One other difference between `JFrame` and `Frame` is `JFrame` has a property that defines the default close operation. With `Frame`, nothing happens, by default, if you try to close the frame. On the other hand, `JFrame` will hide itself when you try to close it. The `setDefaultCloseOperation()` method lets you define three operations that can happen when the user tries to close a `JFrame`:

- `DO_NOTHING_ON_CLOSE`: The AWT `Frame` behavior
- `HIDE_ON_CLOSE`: The default behavior. When user tries to close the window, the window will be hidden. You can then `setVisible(true)` to reshow it.
- `DISPOSE_ON_CLOSE`: When user tries to close window, it will be disposed.

Both `HIDE_ON_CLOSE` and `DISPOSE_ON_CLOSE` perform their operations last, in case an event listener needs to use the information from the closing event.

### *JRootPane*

A `JRootPane` is a container that consists of two objects, a glass pane and a layered pane. The glass pane is initially invisible, so all you see is the layered pane. The layered pane also consists of two objects, an optional menu bar and a content pane. You work with the content pane just like you would the inside of a `Window`, Dialog, or Frame in AWT. The way the glass pane works is if you place a component in it, this component will always display in front of the content pane. This allows things like popup menus and tool tip text to work properly. The layering effect is done with the help of the new JLayeredPane component, explained next.

Normally, the only difference in coding is changing all lines like:

```
aFrame.setLayout (new FlowLayout());

aFrame.add(aComponent);
```

to new lines accessing the content pane:

```
aFrame.getContentPane().setLayout (new FlowLayout());

aFrame.getContentPane().add(aComponent);
```

The rest of the panes are accessed with similar methods, though are rarely accessed directly. The layout management of all these panes is done through a custom layout manager.

```
  Container getContentPane();

  setContentPane (Container);

  Component getGlassPane();

  setGlassPane (Component);

  JLayeredPane getLayeredPane();

  setLayeredPane (JLayeredPane);

  JMenuBar getMenuBar();

  setMenuBar (JMenuBar);
```

### *JLayeredPane*

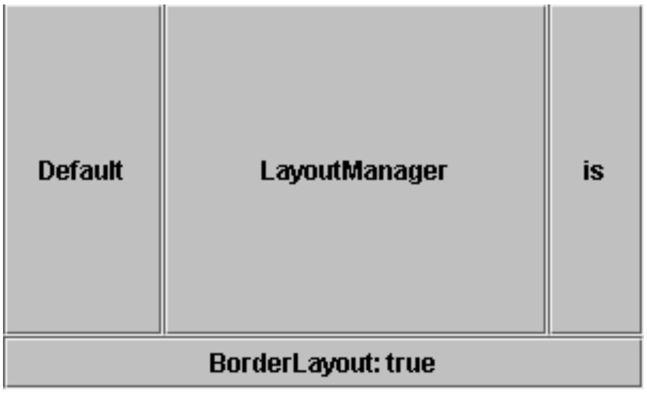
The JLayeredPane container keeps its children in layers to define an order to paint its components. When you add a component to the pane, you specify which layer you want it in:

```
  layeredPane.add (component, new Integer(5));
```

The default layer is the value JLayeredPane.DEFAULT_LAYER. You can add or subtract values from this value to have things appear above or below, layerwise. The LayoutManager of the pane determines what happens with the layers. Using FlowLayout or GridLayout as the layout only reorders the components as they are added; they will not be drawn on top of each other. For an example of actually drawing overlaid components, see the examples subdirectory that comes with the Swing release.

## Swing in Applets

For applets to properly handle the Swing component set, your applets need to subclass JApplet instead of Applet. JApplet is a special subclass of Applet that adds support for JMenuBar and handles the painting support required by Swing child components (along with any other necessary tasks like accessibility support). Also, like JFrame, JApplet has a JContentPane to add components into, instead of directly to the applet. Another difference is the default LayoutManager: in JApplet it is BorderLayout, while in Applet it has always been FlowLayout.

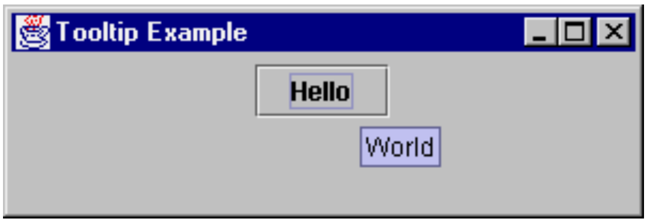


```
public class AppTester extends JApplet {

  public void init () {

    Container c = getContentPane();

    JButton jb = new JButton ("Default");

    c.add (jb, BorderLayout.WEST);

    jb = new JButton ("LayoutManager");

    c.add (jb, BorderLayout.CENTER);

    jb = new JButton ("is");

    c.add (jb, BorderLayout.EAST);

    jb = new JButton ("BorderLayout: " +

      (c.getLayout() instanceof BorderLayout));

    c.add (jb, BorderLayout.SOUTH);

  }

}
```

The `LayoutManager` is actually a custom subclass of `BorderLayout`. This subclassing ensures that when a component with no constraints is added, the subclass maps the component to the `CENTER` area.

## Tooltips

A *tooltip* is a context-sensitive text string that is displayed in a popup window when the mouse rests over a particular object on the screen. Swing provides the `JToolTip` class to support this; however, you will rarely use it directly. To create a tooltip, you only need to call the `setToolTipText()` method of `JComponent`.



```
public class TooltipPanel extends JPanel {

  public TooltipPanel() {

    JButton myButton = new JButton("Hello");

    myButton.setToolTipText ("World");

    add(myButton);
  }
}
```

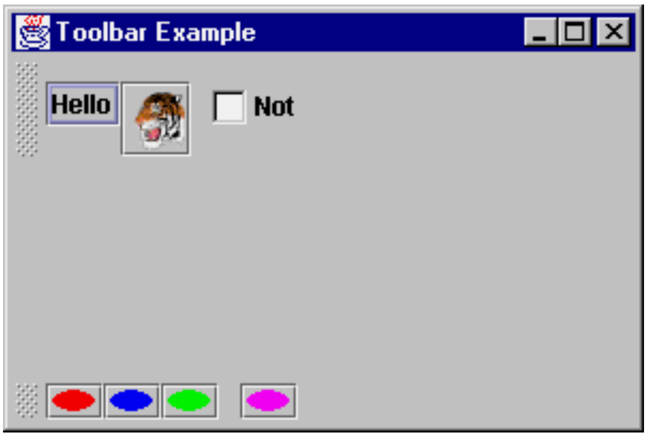
### Toolbars

The `JToolBar` control offers a container that displays its components in a toolbar fashion, across or down, in one row or column, depending upon the area of the screen it is placed in. Certain user-interface models permit *floatable* toolbars; the default user-interface is one that supports floating. In order to disable the floatable capability, just call the `setFloatable()` method. It is possible that a particular user interface may ignore this setting.

```
// Disabling floating
aToolBar.setFloatable (false);
```

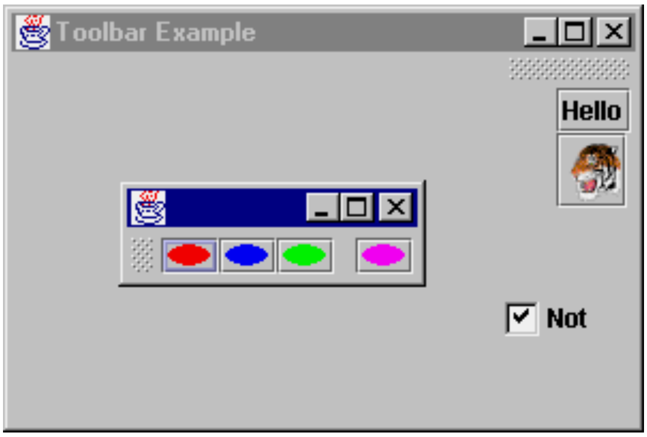
When `JToolBar` is considered floatable, this means a user can drag it to another area of the screen, or place it in a window external from the original container.

To demonstrate a `JToolBar`, take a look at the following example. As it demonstrates, there are no restrictions on what components appear within the toolbar. However, it works best if they are all the same type and size.



```
public class ToolbarPanel extends JPanel {
  ToolbarPanel() {
    setLayout (new BorderLayout());
    JToolBar toolbar = new JToolBar();
    JButton myButton = new JButton("Hello");
    toolbar.add(myButton);
    Icon tigerIcon = new ImageIcon("SmallTiger.gif");
    myButton = new JButton(tigerIcon);
    toolbar.add(myButton);
    toolbar.addSeparator();
    toolbar.add (new Checkbox ("Not"));
    add (toolbar, BorderLayout.NORTH);
    toolbar = new JToolBar();
    Icon icon = new AnOvalIcon(Color.red);
    myButton = new JButton(icon);
    toolbar.add(myButton);
    icon = new AnOvalIcon(Color.blue);
    myButton = new JButton(icon);
    toolbar.add(myButton);
    icon = new AnOvalIcon(Color.green);
    myButton = new JButton(icon);
    toolbar.add(myButton);
    toolbar.addSeparator();
    icon = new AnOvalIcon(Color.magenta);
    myButton = new JButton(icon);
    toolbar.add(myButton);
    add (toolbar, BorderLayout.SOUTH);
  }
  class AnOvalIcon implements Icon {
    Color color;
    public AnOvalIcon (Color c) {
      color = c;
    }
    public void paintIcon (Component c, Graphics g,
                          int x, int y) {
      g.setColor(color);
      g.fillOval (x, y, getIconWidth(), getIconHeight());
    }
    public int getIconWidth() {
      return 20;
    }
    public int getIconHeight() {
      return 10;
    }
  }
}
```

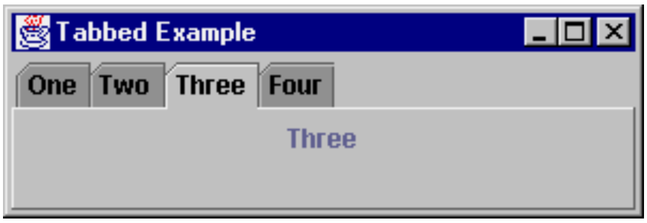
After dragging around the toolbar, the user may just leave it looking a little different than you originally planned:



## JTabbedPane

The `JTabbedPane` component offers a tabbed control for quick accessibility to multiple panels. If you ever tried to use `CardLayout` in JDK 1.0/1.1, you'll appreciate this: `JTabbedPane` adds the necessary support for changing from one card to the next. After creating the control, you add cards to it with the `addTab()` method. There are three forms for the `addTab()` method. One offers a quick way to associate a `JToolTip` to a tab, while the others only permit text, an `Icon`, or both. Any `Component` subclass can be the object added to each card.

- `addTab(String title, Component component)` - Create new tab with *title* as tab label and *component* shown within tab when selected.
- `addTab(String title, Icon icon, Component component)` - Adds an options *icon* to be associated with the *title* for the tab. Either may be `null`.
- `addTab(String title, Icon icon, Component component, String tip)` - Adds *tip* as the tooltip for the tab.



```
public class TabbedPanel extends JPanel {

  String tabs[] = {"One", "Two", "Three", "Four"};

  public JTabbedPane tabbedPane = new JTabbedPane();

  public TabbedPanel() {

    setLayout (new BorderLayout());

    for (int i=0;i<tabs.length;i++)

      tabbedPane.addTab (tabs[i], null,

                         createPane (tabs[i]));

    tabbedPane.setSelectedIndex(0);

    add (tabbedPane, BorderLayout.CENTER);

  }

  JPanel createPane(String s) {

    JPanel p = new JPanel();

    p.add(new JLabel(s));
    return p;
  }
}
```

## JSplitPane

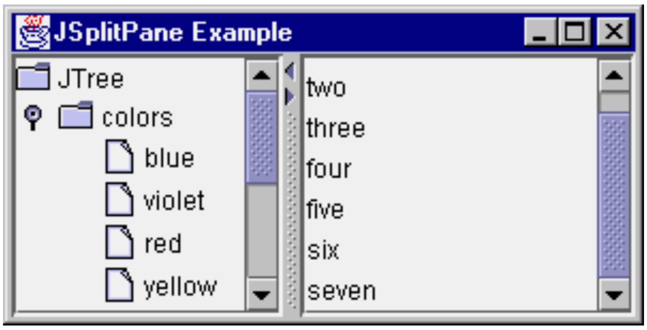
The JSplitPane control offers user-controlled resizing of two components within a container.

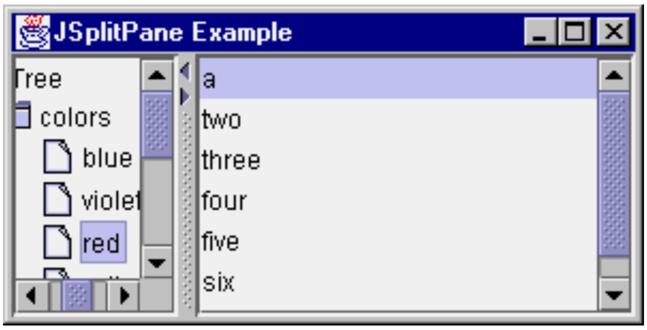
You can place a JSplitPane within a JSplitPane for control of more then two components, and, you can control whether the splitting happens vertically or horizontally.

The setContinuousLayout property causes each pane to be updated continuously as the splitter is dragged, when set to true.

You can move the divider programmatically by setting the dividerLocation property to a floating point value between 0.0 and 1.0 to indicate a percentage of the screen or to an integer value for an absolute position.

The following screenshots demonstrate a JSplitPane between a JTree and a JList. (Note that the scrollbars in the pictures are there because the components are included in a JScrollPane; it is not a result of the JSplitPane.





The arrows on the splitter bar are obtained by setting the oneTouchExpandable property of the JSplitPane to true. Pressing them will fully push the splitter in the direction of the arrow, or return it to its previous position.

Note that the splitter bar will not move past the minimumSize of either component if it can avoid it. In many cases it is desirable to call the following:

```
comp.setMinimumSize(new Dimension(0,0));
```

on each component to allow full movement of the splitter bar.

```
public class JSplitPanel extends JPanel {


  public JSplitPanel() {
    setLayout(new BorderLayout());

    JTree tree = new JTree();

    String[] items = {"a", "two", "three",

      "four", "five", "six", "seven"};

    JList list = new JList(items);

    JScrollPane left = new JScrollPane(tree);

    JScrollPane right = new JScrollPane(list);

    left.setMinimumSize(new Dimension(0,0));

    right.setMinimumSize(new Dimension(0,0));

    JSplitPane pane = new JSplitPane(

      JSplitPane.HORIZONTAL_SPLIT, left, right);

    pane.setDividerLocation(0.5);

    pane.setOneTouchExpandable(true);

    add(pane, BorderLayout.CENTER);

  }

}
```

## Swing Layouts

There are four primary Swing layout managers, two are built into components (ScrollPaneLayout and ViewportLayout) and the remaining two (BoxLayout and OverlayLayout) are used like the ones from java.awt. The BoxLayout also happens to be built into the Box component.

### BoxLayout

The BoxLayout layout manager allows you to arrange components along either an x-axis or y-axis. For instance, in a y-axis BoxLayout, components are arranged from top to bottom in the order in which they are added.

Unlike GridLayout, BoxLayout allows components to occupy different amounts of space along the primary axis. A JTextField in a top-to-bottom BoxLayout can take much less space than a JTextArea.

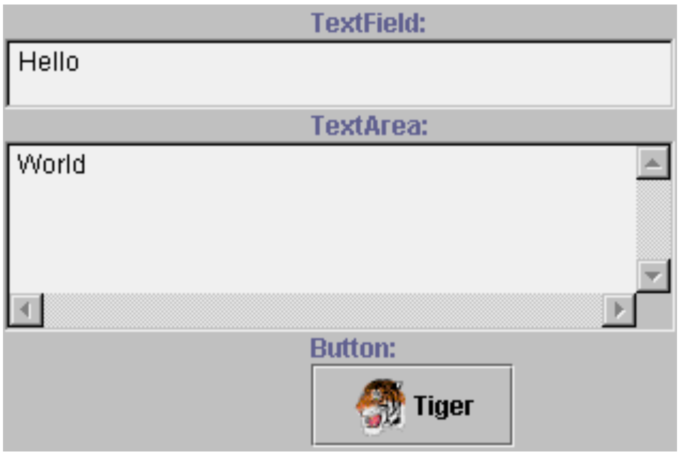
Along the non-primary axis, BoxLayout attempts to make all components as tall as the tallest component (for left-to-right BoxLayouts) or as wide as the widest component (for top-to-bottom BoxLayouts). If a component cannot increase to this size, BoxLayout looks at its Y-alignment property or X-alignment property to determine how to place it within the available space. By default, JComponent objects inherit an alignment of 0.5 indicating that they will be centered. You can override the getAlignmentX() and getAlignmentY() methods of Container to specify a different default alignment. JButton for instance specifies left alignment.

To create a BoxLayout, you must specify two parameters:

```
setLayout(new BoxLayout(this, BoxLayout.Y_AXIS));
```

The first parameter specifies the container and the second the major axis of the BoxLayout. Components can then be added as they are in a GridLayout or FlowLayout:

```
  add(myComponent);
```



Hello

World

```
class BoxLayoutTest extends JPanel {

  BoxLayoutTest() {
    // Set the layout to a y-axis BoxLayout
    setLayout(new BoxLayout(this, BoxLayout.Y_AXIS));

    // Create three components
    TextField textField = new TextField();
    TextArea textArea = new TextArea(4, 20);
    JButton button = new JButton(
      "Tiger", new ImageIcon("SmallTiger.gif"));

    // Add the three components to the BoxLayout
    add(new JLabel("TextField:"));
    add(textField);
    add(new JLabel("TextArea:"));
    add(textArea);
    add(new JLabel("Button:"));
    add(button);
  }}
```

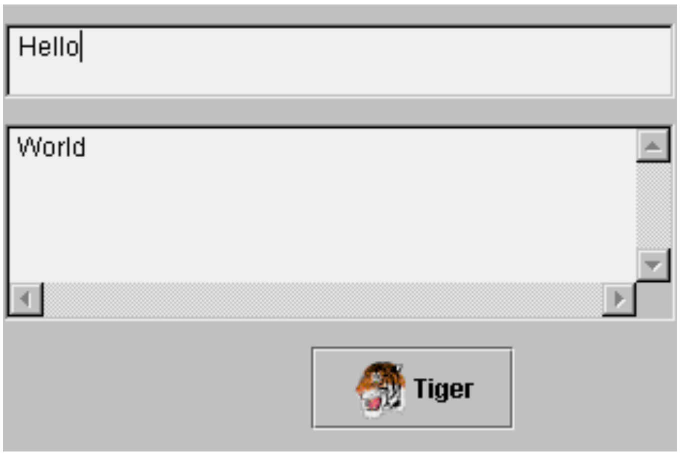
### *Box*

The `Box` class is a convenience container whose default layout manager is a `BoxLayout`. Rather than subclassing `JPanel` as above, the previous example could have subclassed the `Box` class. In addition to being a `BoxLayout` container, `Box` has some very useful static methods for arranging components in a `BoxLayout`. These methods create non-visual components that act as fillers and spacers.

| | |
|---|---|
| `createVerticalStrut(int)` | Returns a fixed height component used for spacing |

| | |
|---|---|
| `createHorizontalStrut(int)` | Returns a fixed width component used for spacing |
| `createVerticalGlue()` | Returns a component whose height expands to absorb excess space between components |
| `createHorizontalGlue()` | Returns a component whose width expands to absorb excess space between components |
| `createGlue()` | Returns a component whose height will expand for a y-axis box and whose width will expand for an x-axis Box |
| `createRigidArea(Dimension)` | Returns a fixed height, fixed width component used for spacing |

Now, rather than using labels to space components out as above, you could use struts and glue:



Hello

World

```
public class TestBox extends Box {
  TestBox() {
    super(BoxLayout.Y_AXIS);

    // Create the three basic text components
    TextField textField = new TextField();
    TextArea textArea = new TextArea(4, 20);
    JButton button = new JButton("Tiger", new
      ImageIcon("SmallTiger.gif"));

    // Separate the three components
    // by struts for spacing
    add(createVerticalStrut(8));
    add(textField);
    add(createVerticalGlue());
    add(textArea);
    add(createVerticalGlue());
    add(button);
    add(createVerticalStrut(8));
  }
}
```

The struts will appear as top and bottom margins and the glue will expand to fill space when the `Box` is heightened.

### ScrollPaneLayout

The `ScrollPaneLayout` is the layout manager used by a `JScrollPane`. You do not need to create one, nor associate it to the `JScrollPane`. That is done for you automatically. The layout defines nine different areas for the `JScrollPane`:

- one `JViewport` - in the center for the content
- two `JScrollBar` objects - one each for horizontal and vertical scrolling
- two `JViewport` objects - one for a column headers, the other row
- four `Component` objects - one for each of the corners
  The `JScrollPane` constants to specify the corners are: `LOWER_LEFT_CORNER`, `LOWER_RIGHT_CORNER`, `UPPER_LEFT_CORNER`, `UPPER_RIGHT_CORNER`.

The center viewport portion of this layout is of primary interest for simple layouts. A `JViewport` is itself a container object that can hold components. This allows for some very flexible arrangements. `JViewport` contains its own layout manager, `ViewportLayout`.

### ViewportLayout

`ViewportLayout` is the layout manager used by a `JViewport`. You should never need to use the layout directly, as it is automatically associated with a `JViewport` object, and positions the internal component for you based upon the `JViewport` properties.

**Move to Part II**