LECTURE 11: GUI APPLICATION

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PLAN

- GUI
- GUI Components
- Event Handler

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Introduction

- A graphical user interface (GUI) presents a user-friendly mechanism for interacting with an application.
  - Pronounced “GOO-ee”
  - Gives an application a distinctive “look” and “feel.”
  - Consistent, intuitive user-interface components give users a sense of familiarity
  - Learn new applications more quickly and use them more productively.

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Introduction (cont.)

- Built from GUI components.
  - Sometimes called controls or widgets—short for window gadgets.
- User interacts via the mouse, the keyboard or another form of input, such as voice recognition.
- IDEs
  - Provide GUI design tools to specify a component's exact size and location in a visual manner by using the mouse.
  - Generates the GUI code for you.
  - Greatly simplifies creating GUIs, but each IDE has different capabilities and generates different code.

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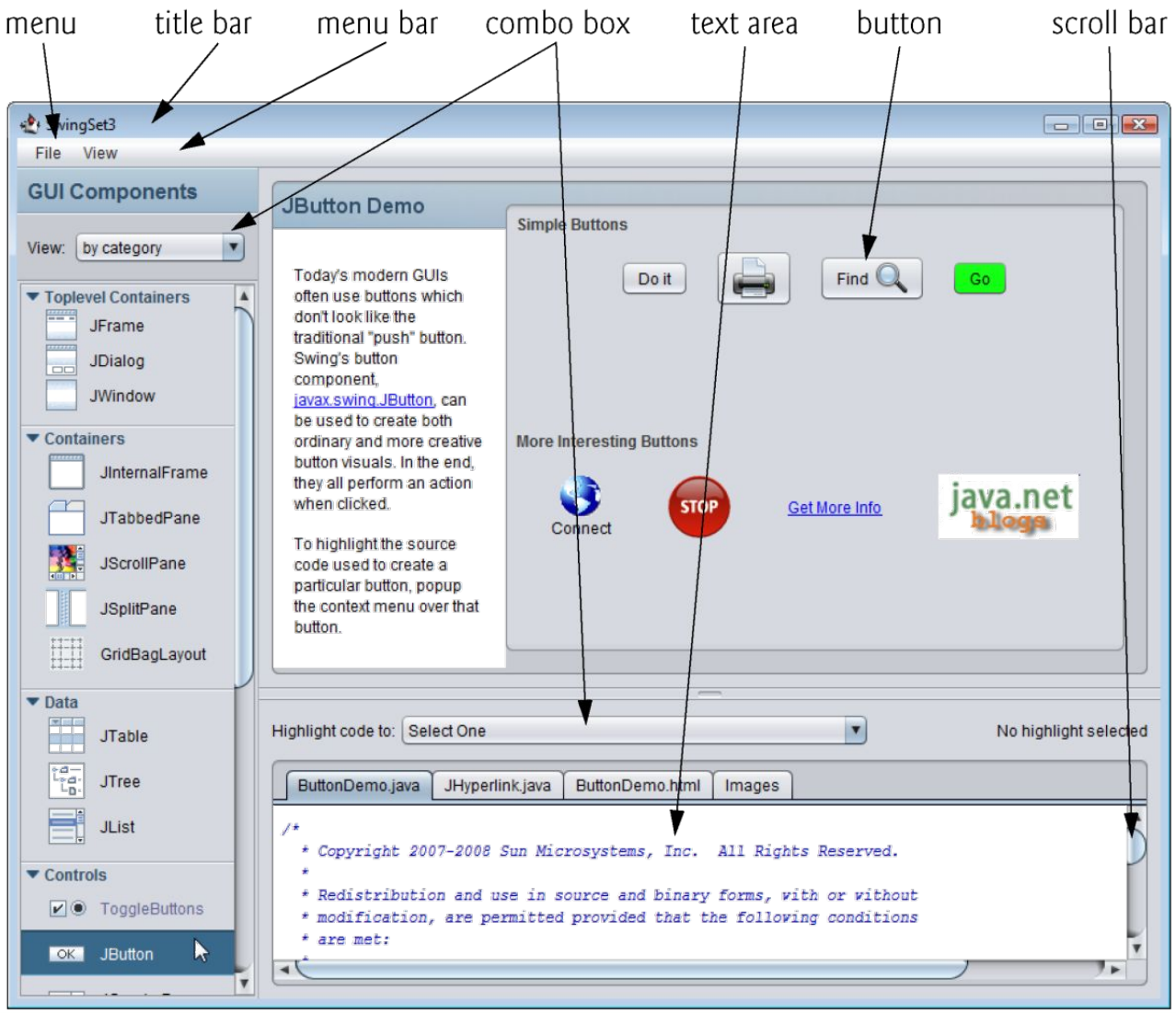
GUI Example



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Overview of Swing Components

- Swing GUI components located in package javax.swing.
- Abstract Window Toolkit (AWT) in package java.awt is another set of GUI components in Java.
  - When a Java application with an AWT GUI executes on different Java platforms, the application's GUI components display differently on each platform.
- Together, the appearance and the way in which the user interacts with the application are known as that application's look-and-feel.
- Swing GUI components allow you to specify a uniform look-and-feel for your application across all platforms or to use each platform's custom look-and-feel.

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Overview of Swing Components

- Most Swing components are not tied to actual GUI components of the underlying platform.
  - Known as lightweight components.
- AWT components are tied to the local platform and are called heavyweight components, because they rely on the local platform's windowing system to determine their functionality and their look-and-feel.
- Several Swing components are heavyweight components.

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Using JOptionPane for Output

```
import javax.swing.*;
. . .

JOptionPane.showMessageDialog( null, "I Love Java" );
```

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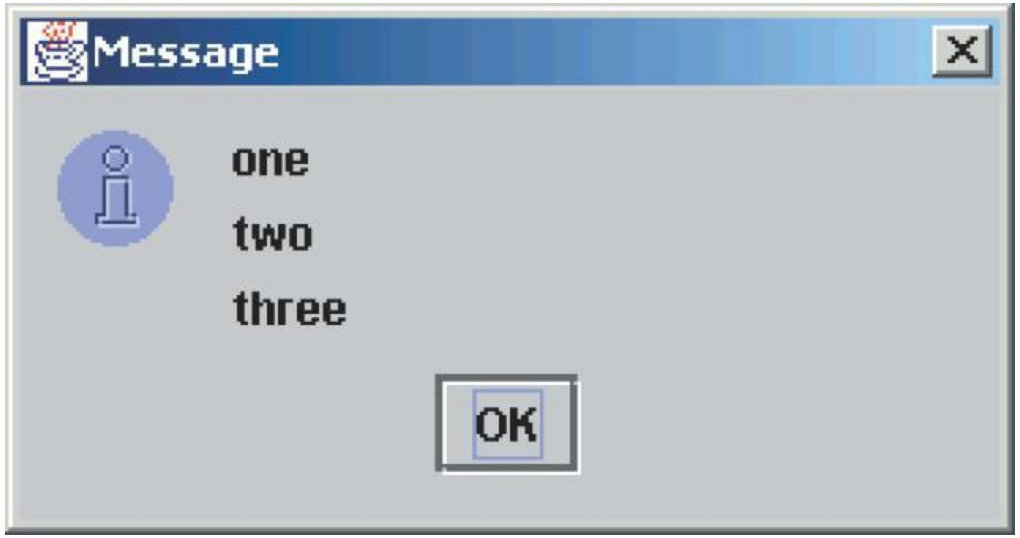
Using JOptionPane for Output - 2

```
import javax.swing.*;
. . .

JOptionPane.showMessageDialog( null, "one\ntwo\nthree"
);
//place newline \n to display multiple lines of output
```



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JOptionPane for Input

```
import javax.swing.*;
. . .

String inputstr =

JOptionPane.showInputDialog( null, "What is your name?" );
```

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JOptionPane static constants

Message dialog type	Icon	Description
`ERROR_MESSAGE`		Indicates an error.
`INFORMATION_MESSAGE`		Indicates an informational message.
`WARNING_MESSAGE`		Warns of a potential problem.
`QUESTION_MESSAGE`		Poses a question. This dialog normally requires a response, such as clicking a **Yes** or a **No** button.
`PLAIN_MESSAGE`	no icon	A dialog that contains a message, but no icon.

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Displaying Text and Images in a Window

- Most windows that can contain Swing GUI components are instances of class JFrame or a subclass of JFrame.
- JFrame is an indirect subclass of class java.awt.Window
- Provides the basic attributes and behaviors of a window
  - a title bar at the top
  - buttons to minimize, maximize and close the window
- Most of our examples will consist of two classes
  - a subclass of JFrame that demonstrates new GUI concepts
  - an application class in which main creates and displays the application's primary window.

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Subclassing JFrame

- To create a customized frame window, we define a subclass of the JFrame class.

- The JFrame class contains rudimentary functionalities to support features found in any frame window.

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Creating a Plain JFrame

```
import javax.swing.*;
class DefaultJFrame {
    public static void main( String[] args ) {
        JFrame defaultJFrame;
        defaultJFrame = new JFrame();
        defaultJFrame.setVisible(true);
    }
}
```

You may not notice this frame window on the screen at first because it is so small. Look carefully at the top left corner of the screen.

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Creating a Subclass of JFrame

- To define a subclass of another class, we declare the subclass with the reserved word extends.

```
import javax.swing.*;

class Ch7JFrameSubclass1 extends JFrame {
    . . .
}
```

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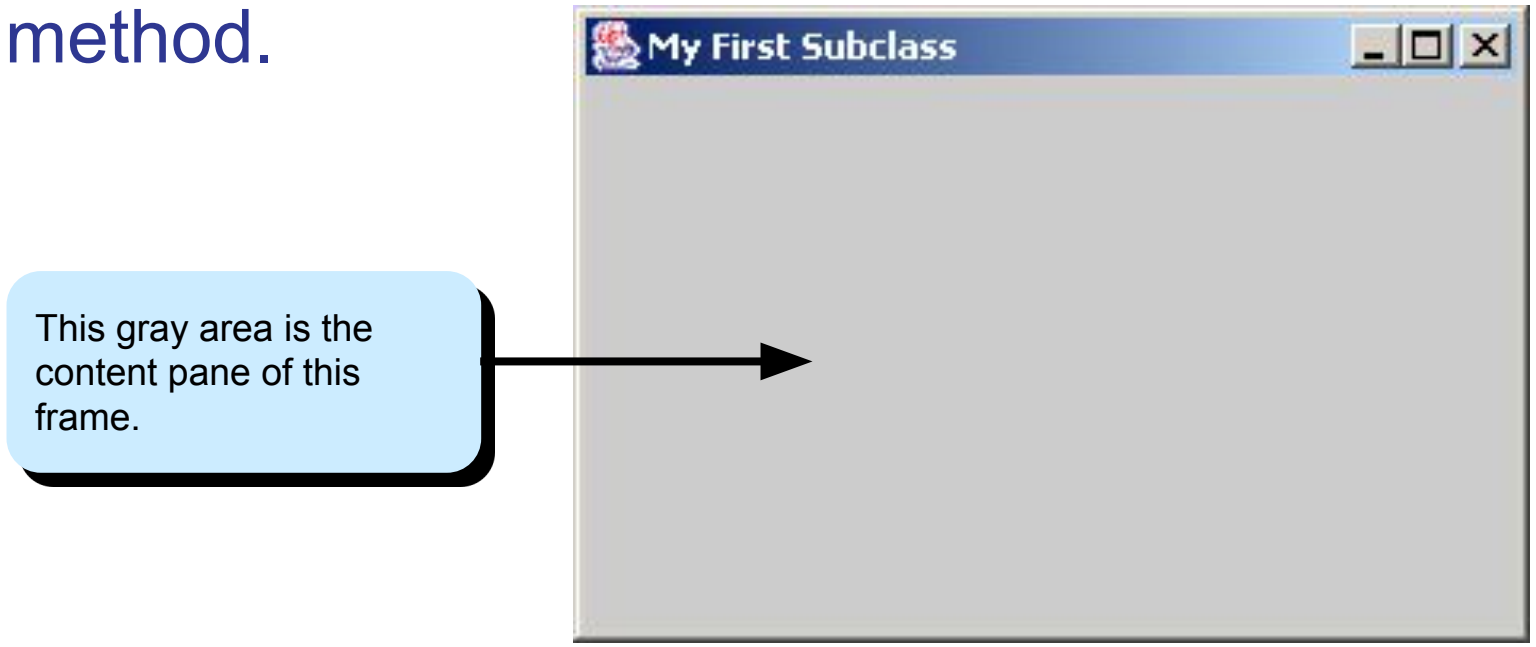
The Content Pane of a Frame

- The content pane is where we put GUI objects such as buttons, labels, scroll bars, and others.
- We access the content pane by calling the frame's getContentPane method.



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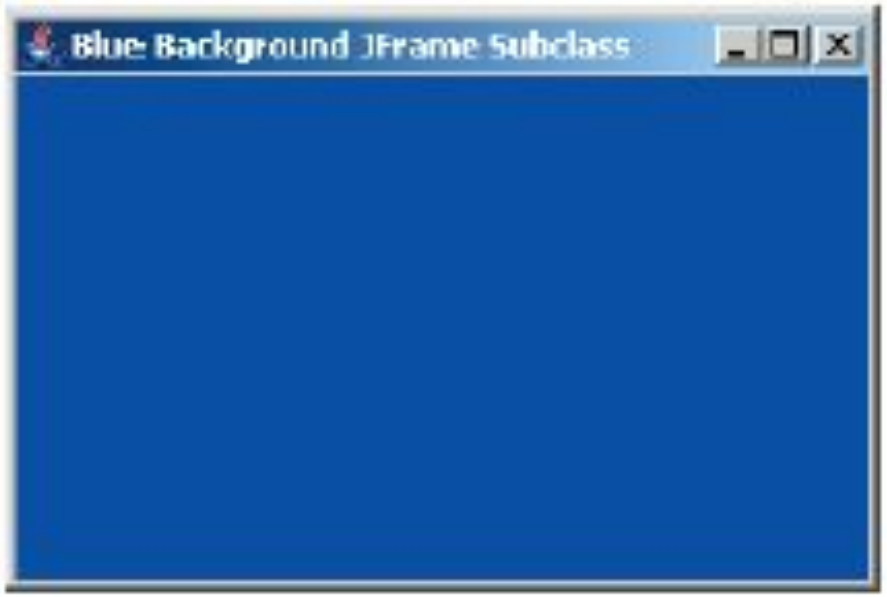
Changing the Background Color

- Here's how we can change the background color of a content pane to blue:

```
Container contentPane = getContentPane();
contentPane.setBackground(Color.BLUE);
```



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Placing GUI Objects on a Frame

- There are two ways to put GUI objects on the content pane of a frame:
  - Use a *layout manager*
    - FlowLayout
    - BorderLayout
    - GridLayout
  - Use *absolute positioning*
    - null layout manager

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Placing a Button

- A JButton object a GUI component that represents a pushbutton.
- Here's an example of how we place a button with FlowLayout.

```
contentPane.setLayout( new FlowLayout());
okButton = new JButton("OK");
cancelButton = new JButton("CANCEL");
contentPane.add(okButton);
contentPane.add(cancelButton);
```

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IDE Help for GUI Desgin

- Many IDEs provide GUI design tools in which you can specify the exact size and location of a component
- IDE generates the GUI code for you
- Greatly simplifies GUI creation
- To ensure that this book's examples can be used with any IDE, we did not use an IDE to create the GUI code
- We use Java's layout managers in our GUI examples

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Layout Managers

- The layout manager determines how the GUI components are added to the container (such as the content pane of a frame)
- Among the many different layout managers, the common ones are
  - FlowLayout
  - BorderLayout
  - GridLayout

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FlowLayout

- In using this layout, GUI componentsare placed in left-to-right order.
  - When the component does not fit on the same line, left-to-right placement continues on the next line.
- As a default, components on each line are centered.
- When the frame containing the component is resized, the placement of components is adjusted accordingly.

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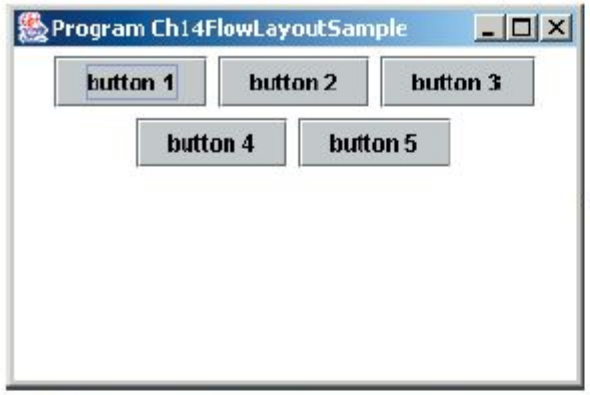
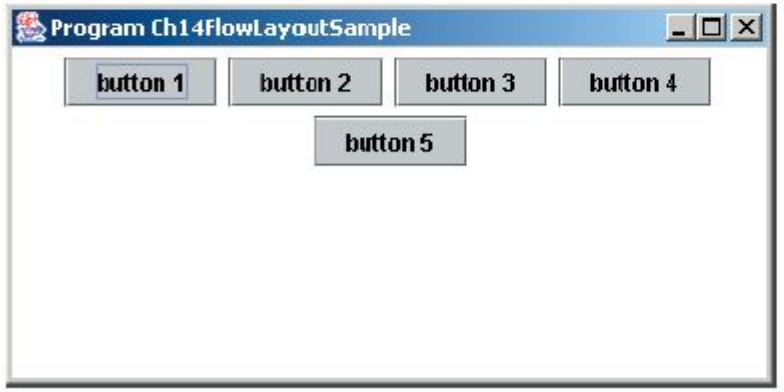
FlowLayout Sample

- This shows the placement of five buttons by using FlowLayout.



When the frame first appears on the screen.

Center alignment is used as a default. It can be set to a different align-ment at the time a FlowLayout is created.



After the frame's width is widened and shortened.

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BorderLayout

- This layout manager divides the container into five regions: center, north, south, east, and west.
- The north and south regions expand or shrink in height only
- The east and west regions expand or shrink in width only
- The center region expands or shrinks on both height and width.
- Not all regions have to be occupied.

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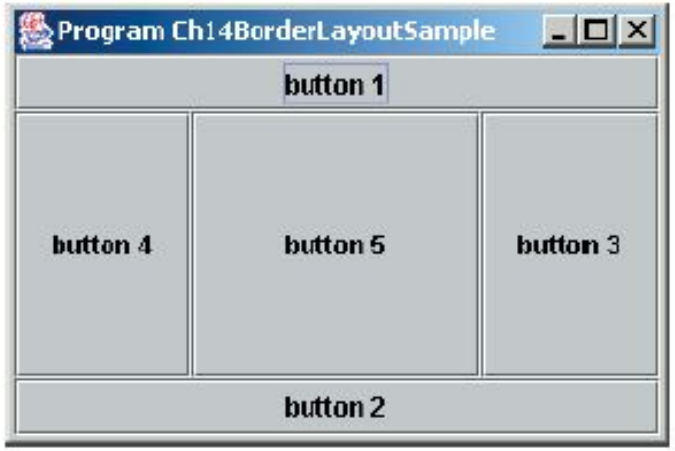
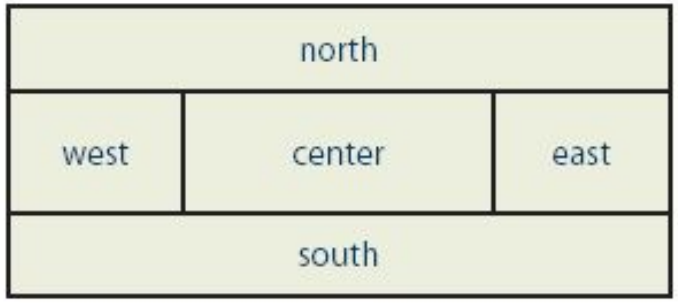
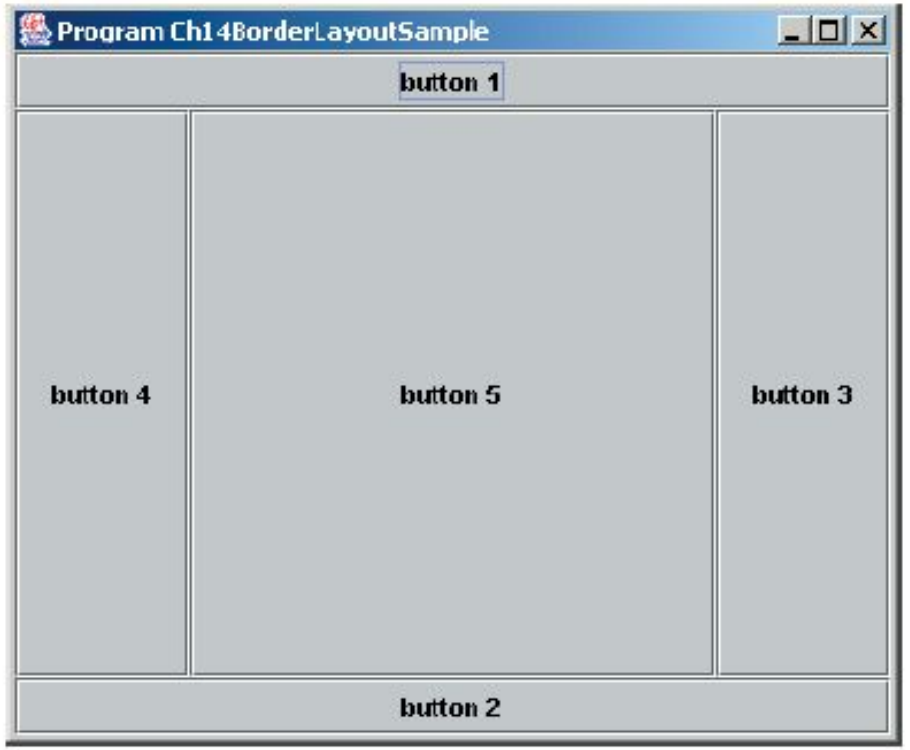
BorderLayout Sample

When the frame first appears on the screen.





After the frame is resized.



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GridLayout

- This layout manager placesGUI components on equal-size N by M grids.
- Components are placed in top-to-bottom, left-to-right order.
- The number of rows and columns remains the same after the frame is resized, but the width and height of each region will change.

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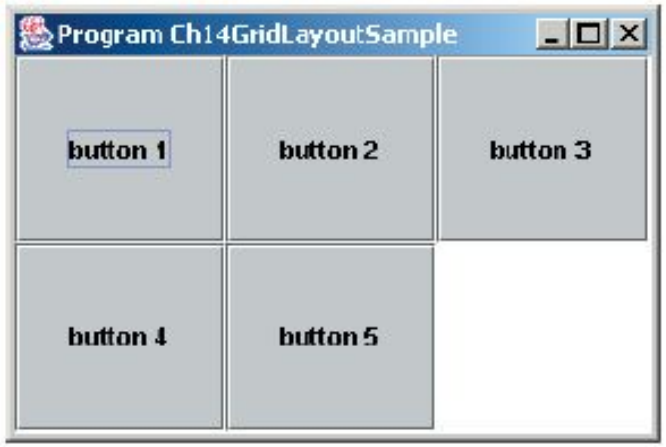
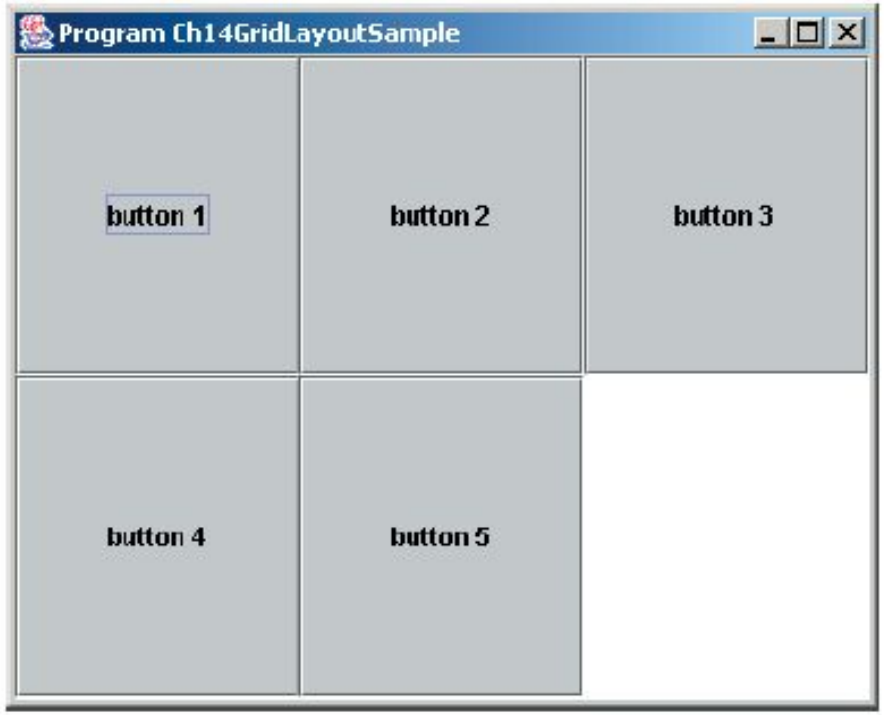
GridLayout Sample

When the frame first appears on the screen.



After the frame is resized.



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Event Handling

- An action involving a GUI object, such as clicking a button, is called an event.
- The mechanism to process events is called event handling.
- The event-handling model of Java is based on the concept known as the delegation-based event model.
- With this model, event handling is implemented by two types of objects:
  - event source objects
  - event listener objects

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Event Source Objects

- An event source is a GUI object where an event occurs. We say an event source generates events.
- Buttons, text boxes, list boxes, and menus are common event sources in GUI-based applications.
- Although possible, we do not, under normal circumstances, define our own event sources when writing GUI-based applications.

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Event Listener Objects

- An event listener object is an object that includes a method that gets executed in response to the generated events.
- A listener must be associated, or registered, to a source, so it can be notified when the source generates events.

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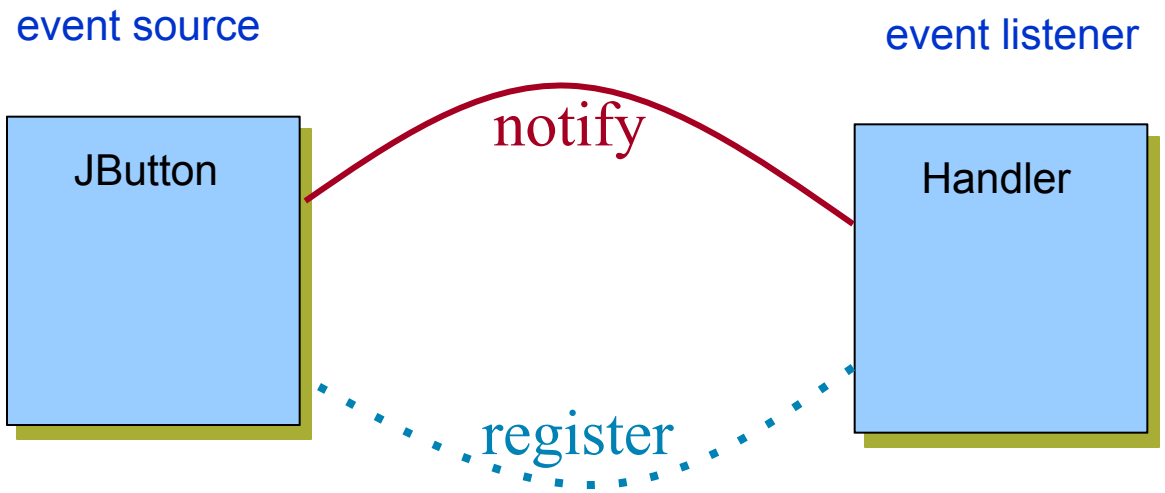
Connecting Source and Listener



A listener must be registered to a event source. Once registered, it will get notified when the event source generates events.

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Event Types

- Registration and notification are specific to event types
  - Mouse listener handles mouse events
  - Item listener handles item selection events
  - and so forth
- Among the different types of events, the action event is the most common.
  - Clicking on a button generates an action event
  - Selecting a menu item generates an action event
  - and so forth
- Action events are generated by action event sources and handled by action event listeners.

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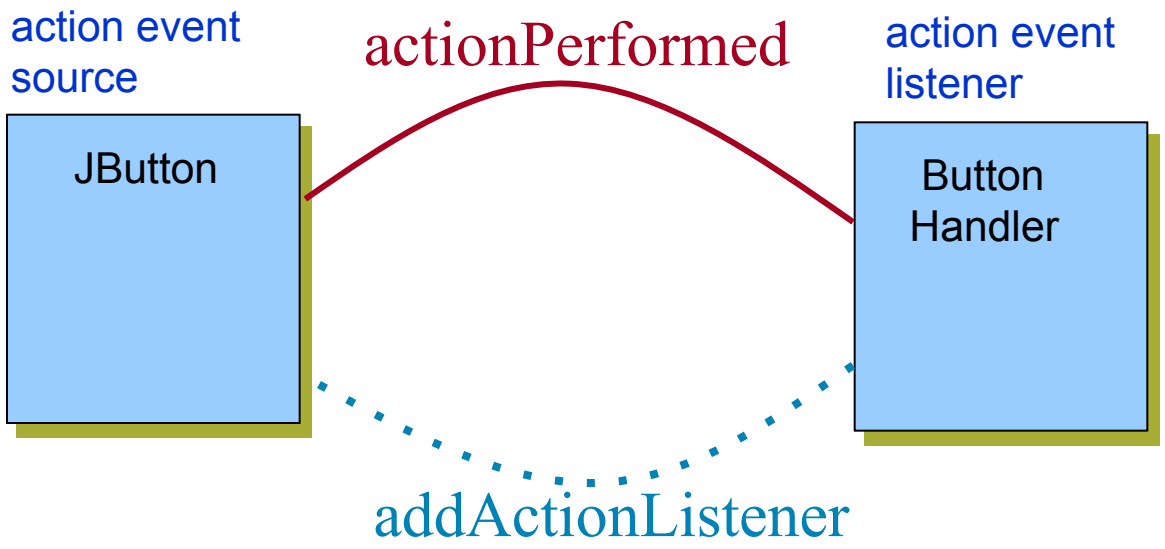
Handling Action Events




```
JButton button = new JButton("OK");
ButtonHandler handler = new ButtonHandler( );

button.addActionListener(handler);
```

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The Java Interface

- A Java interface includes only constants and abstract methods.
- An abstract method has only the method header, or prototype. There is no method body. You cannot create an instance of a Java interface.
- A Java interface specifies a behavior.
- A class implements an interface by providing the method body to the abstract methods stated in the interface.
- Any class can implement the interface.

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ActionListener Interface

- When we call the addActionListener method of an event source, we must pass an instance of a class that implements the ActionListener interface.
- The ActionListener interface includes one method named actionPerformed.
- A class that implements the ActionListener interface must therefore provide the method body of actionPerformed.
- Since actionPerformed is the method that will be called when an action event is generated, this is the place where we put a code we want to be executed in response to the generated events.

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The ButtonHandler Class

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

class ButtonHandler implements ActionListener {
    . . .
    public void actionPerformed(ActionEvent event) {
        JButton clickedButton = (JButton) event.getSource();

        JRootPane rootPane = clickedButton.getRootPane( );
        Frame     frame    = (JFrame) rootPane.getParent();

        frame.setTitle("You clicked " + clickedButton.getText());
    }
}
```

Container as Event Listener

- Instead of defining a separate event listener such as ButtonHandler, it is much more common to have an object that contains the event sources be a listener.
  - Example: We make this frame a listener of the action events of the buttons it contains.

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ButtonFrameHandlerDemo

```
. . .
class JButtonFrameHandlerDemo extends JFrame implements ActionListener {
    . . .
    public void actionPerformed(ActionEvent event) {
        JButton clickedButton    = (JButton) event.getSource();

        String  buttonText = clickedButton.getText();

        setTitle("You clicked " + buttonText);
    }
}
```

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GUI Classes for Handling Text

- The Swing GUI classes JLabel, JTextField, and JTextArea deal with text.
- A JLabel object displays uneditable text (or image).
- A JTextField object allows the user to enter a single line of text.
- A JTextArea object allows the user to enter multiple lines of text. It can also be used for displaying multiple lines of uneditable text.

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JTextField

- We use a JTextField object to accept a single line to text from a user. An action event is generated when the user presses the ENTER key.
- The getText method of JTextField is used to retrieve the text that the user entered.

```
JTextField input = new JTextField( );
input.addActionListener(eventListener);
contentPane.add(input);
```

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JLabel

- We use a JLabel object to display a label.
- A label can be a text or an image.
- When creating an image label, we pass ImageIcon object instead of a string.

```
JLabel textLabel = new JLabel("Please enter your name");
contentPane.add(textLabel);

JLabel imgLabel = new JLabel(new ImageIcon("cat.gif"));
contentPane.add(imgLabel);
```

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Ch14TextFrame2

JLabel
(with an image)

JLabel
(with a text)

JTextField

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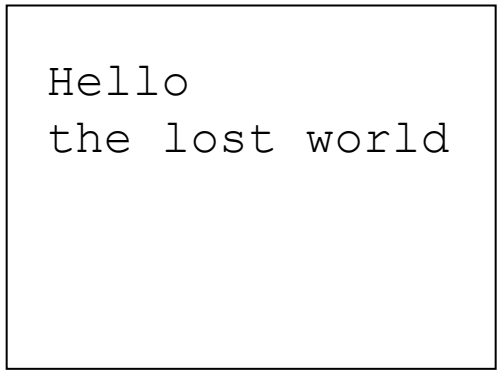
JTextArea

- We use a JTextArea object to display or allow the user to enter multiple lines of text.
- The setText method assigns the text to a JTextArea, replacing the current content.
- The append method appends the text to the current text.

```
JTextArea textArea
        = new JTextArea( );
. . .
textArea.setText("Hello\n");
textArea.append("the lost ");
textArea.append("world");
```



JTextArea

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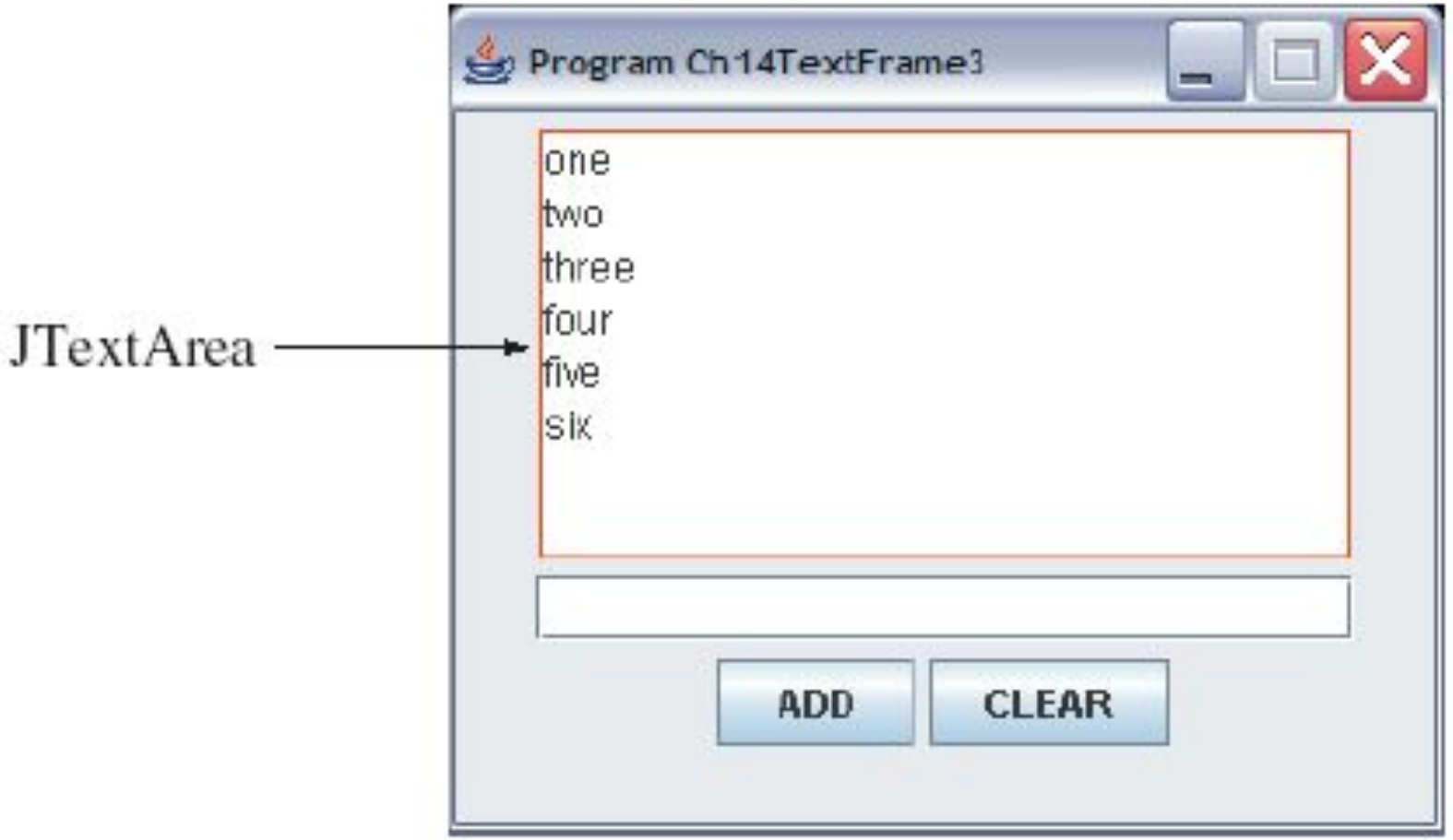
Demo



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Adding Scroll Bars to JTextArea

- By default a JTextArea does not have any scroll bars. To add scroll bars, we place a JTextArea in a JScrollPane object.

```
JTextArea   textArea   = new JTextArea();
. . .
JScrollPane scrollText = new JScrollPane(textArea);
. . .
contentPane.add(scrollText);
```

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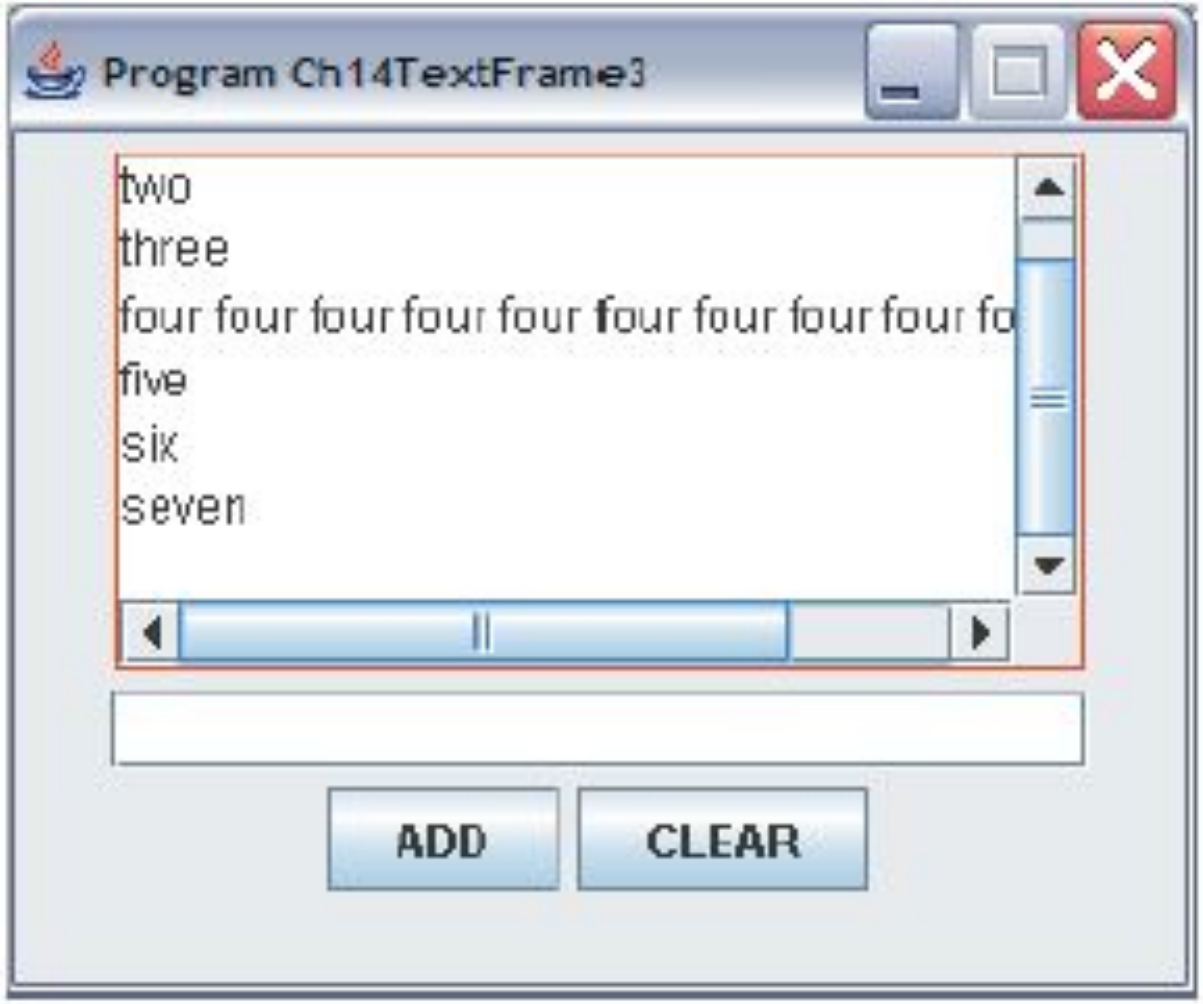
Demo



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Other Common GUI Components

- JCheckBox
- JRadioButton
- JComboBox
- JList
- JSlider

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Menus

- The javax.swing package contains three menu-related classes: JMenuBar, JMenu, and JMenuItem.
- JMenuBar is a bar where the menus are placed. There is one menu bar per frame.
- JMenu (such as File or Edit) is a group of menu choices. JMenuBar may include many JMenu objects.
- JMenuItem (such as Copy, Cut, or Paste) is an individual menu choice in a JMenu object.
- Only the JMenuItem objects generate events.

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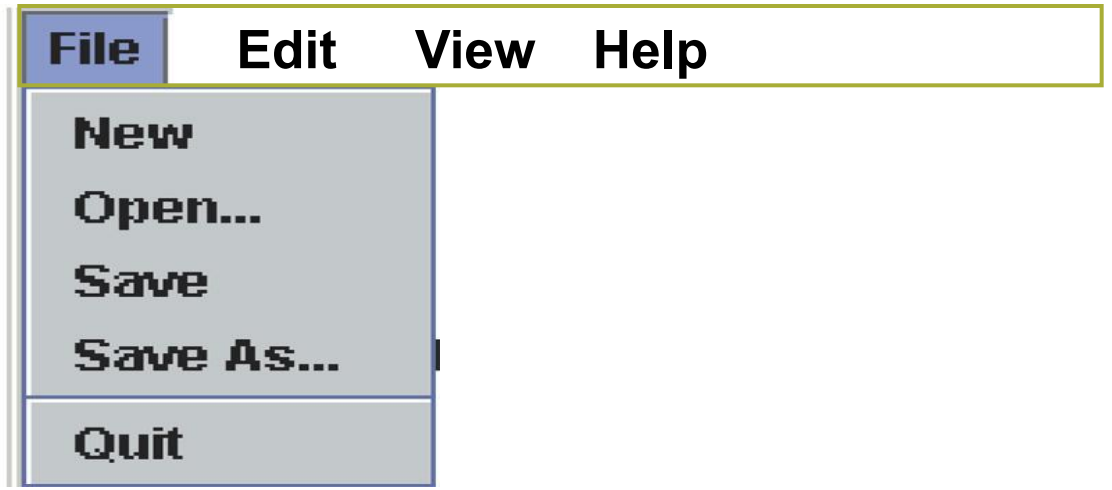
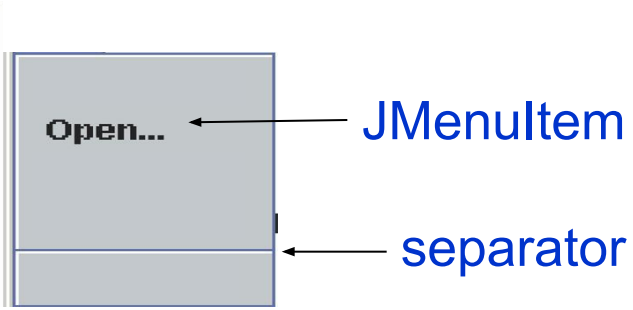
Menu Components



JMenuBar

JMenu



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Sequence for Creating Menus

- Create a JMenuBar object and attach it to a frame.
- Create a JMenu object.
- Create JMenuItem objects and add them to the JMenu object.
- Attach the JMenu object to the JMenuBar object.

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Demo

- Demo a GUI application with several components working together, loading data from file to manage