Graphical User Interfaces

- AWT and Swing packages
- Frames and Panels
- Components
- Nested Panels
- Images
- Reading for this Lecture: L&L, 3.9 – 3.11

Graphical Applications

- The example programs we've explored thus far have been text-based *command-line applications*, which interact with the user using text prompts
- Let's examine some Java applications that have graphical components based on objects
- These components will serve as a foundation for programs with graphical user interfaces (GUIs)
- The important point to learn is that an object in your program corresponds with a real world object
- We will start by generating a frame with panels containing text “labels” or images

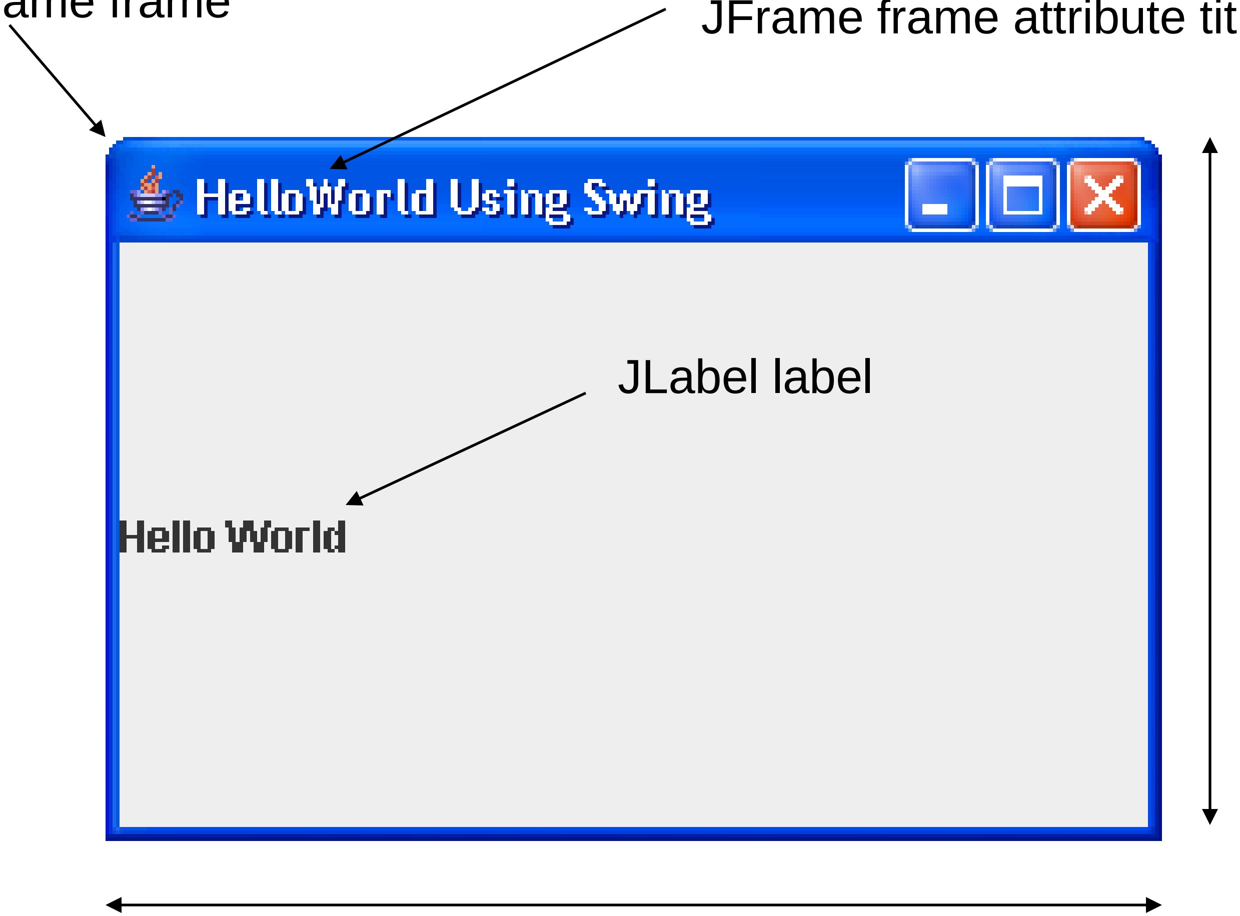
Graphical Applications

- GUI-related classes are defined primarily in `java.awt` and `javax.swing` packages
- The *Abstract Windowing Toolkit* (AWT) was the original Java GUI package
- The *Swing* package provides additional and more versatile components
- Sometimes called Java Foundation Classes (mimicking Microsoft Foundation Classes)

GUI Containers - Frame

- A *GUI container* is a component that is used to hold and organize other components
- JFrame, JDialog, and JApplet are the three top level containers that are used to display graphics in GUI applications
- We will work only with JFrame for now
- A JFrame is displayed as a separate window with a title bar – it can be repositioned and resized on the screen as needed

Frame-based Hello World



JFrame frame

JFrame frame attribute title

JLabel label

JFrame frame
height = 200

JFrame frame width = 300

Frame-based Hello World

```
import javax.swing.*;       // Get JFrame and JLabel classes

public class HelloWorld {
  public static void main(String[] args) {
      //Create and set up the window with a frame object
      JFrame frame = new JFrame("HelloWorld Using Swing");
      frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

      //Add the ubiquitous "Hello World" label to the frame object
      JLabel label = new JLabel("Hello World");
      frame.add(label);

      //Display the window using frame methods
      frame.setSize(300,200);  // width and height
      frame.setVisible(true);
   }
}
```

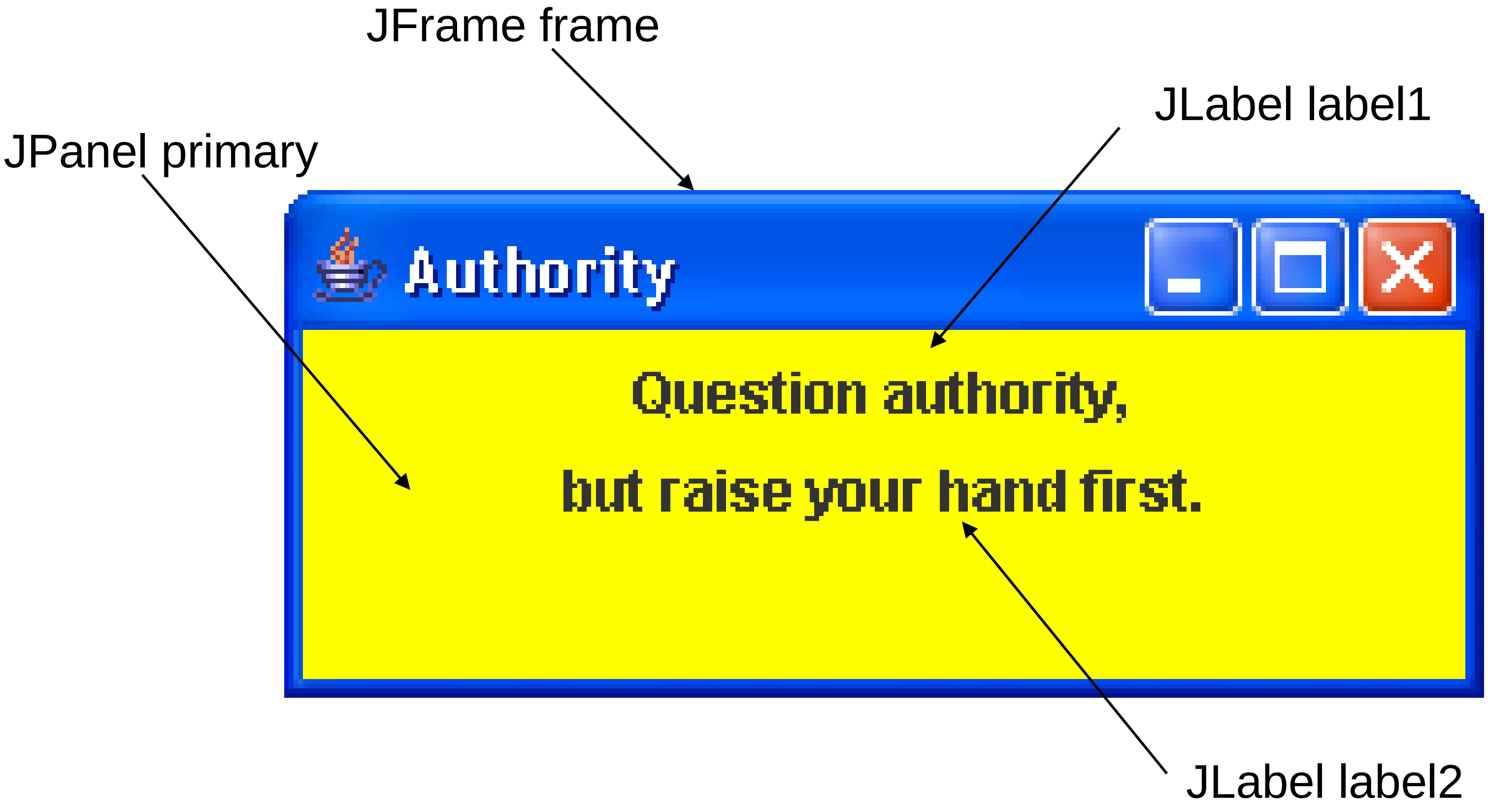
GUI Panels / Components

- A *panel* is a container that cannot be displayed on its own
- It must be added to a top level container or another panel to be displayed
- It is used to organize other components
- A *GUI component* is an object that represents a screen element such as a text field or an image
- A GUI component must be added to another container such as a frame or panel to be displayed

Labels

- A *label* is a GUI component that displays a line of text
- Labels are usually used to display information or identify other components in the display
- Let's look at a program that organizes two labels in a panel and displays that panel in a frame
- See Authority.java (page 145)
- This program is not interactive, but the frame can be repositioned and resized

Authority



Question authority,

but raise your hand first.

JFrame frame

JLabel label1

JPanel primary

JLabel label2

Authority.java

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

public class Authority
{
public static void main (String[] args)
 {
   JFrame frame = new JFrame ("Authority");
   frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

   JPanel primary = new JPanel();
   primary.setBackground (Color.YELLOW);
   primary.setPreferredSize (new Dimension(250, 75));
```

Authority.java

```
      JLabel label1 = new JLabel ("Question authority,");
      JLabel label2 = new JLabel ("but raise your hand first.");

      primary.add (label1);      // add the labels to the panel
      primary.add (label2);

      frame.add(primary);        // add the panel to the frame
      frame.pack();         // set frame size based on contents
      frame.setVisible(true);
   }
}
```

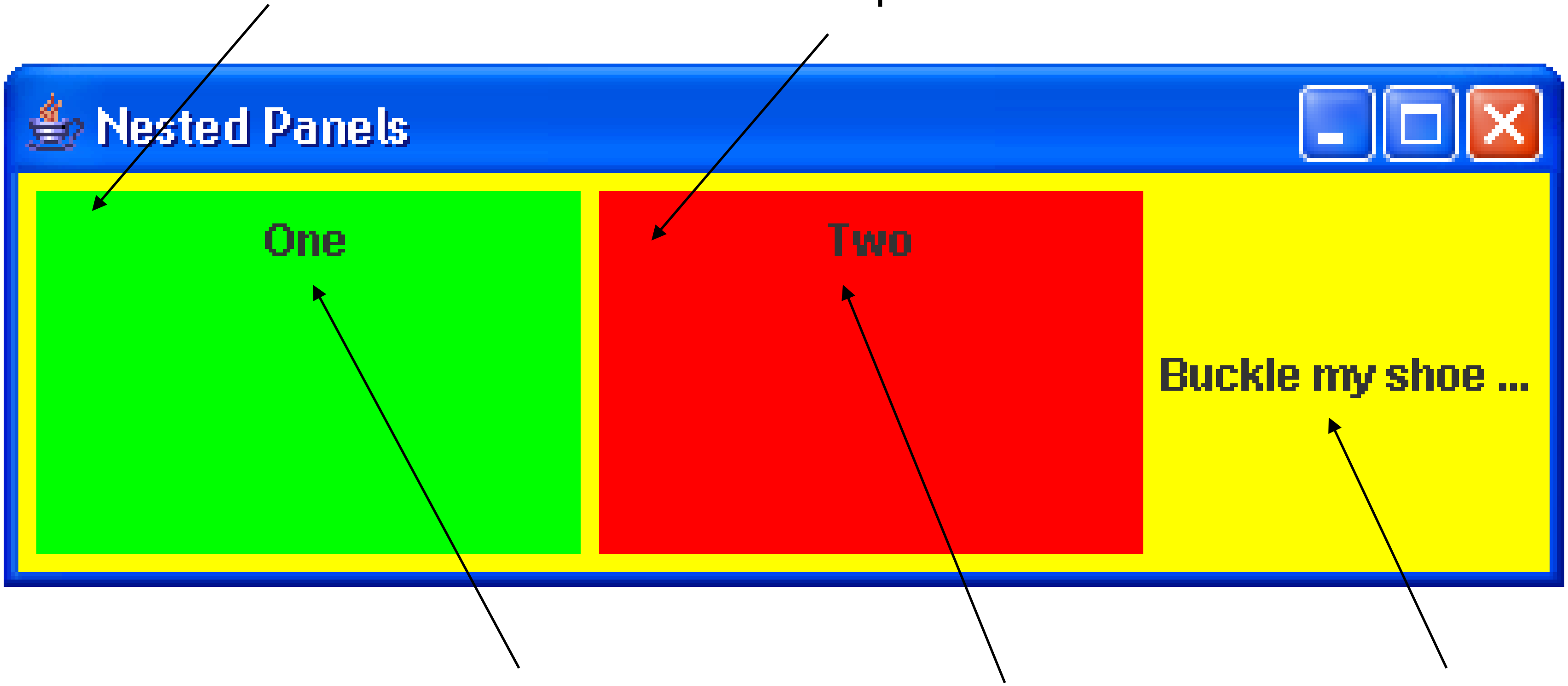
Nested Panels

- Containers that contain other components make up the *containment hierarchy* of an interface
- This hierarchy can be as intricate as needed to create the visual effect desired
- The following example nests two panels inside a third panel – note the effect this has as the frame is resized
- See NestedPanels.java (page 148-149)

Nested Panels

JPanel panel1

JPanel panel1



JLabel label1

JLabel label2

JLabel label3

NestedPanels.java

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

public class NestedPanels
{
public static void main (String[] args)
  {
     JFrame frame = new JFrame ("Nested Panels");
     frame.setDefaultCloseOperation (JFrame.EXIT_ON_CLOSE);

     // Set up first subpanel
     JPanel subPanel1 = new JPanel();
     subPanel1.setPreferredSize (new Dimension(150, 100));
     subPanel1.setBackground (Color.GREEN);
     JLabel label1 = new JLabel ("One");
     subPanel1.add (label1);
```

NestedPanels.java

```
    // Set up second subpanel
    JPanel subPanel2 = new JPanel();
    subPanel2.setPreferredSize (new Dimension(150, 100));
    subPanel2.setBackground (Color.RED);
    JLabel label2 = new JLabel ("Two");
    subPanel2.add (label2);

    // Set up primary panel
    JPanel primary = new JPanel();
    primary.setBackground (Color.YELLOW);
    primary.add (subPanel1);
    primary.add (subPanel2);
    JLabel label3 = new JLabel ("Buckle my shoe ...");
    primary.add (label3);

    frame.add(primary);
    frame.pack();
    frame.setVisible(true);
  }
}
```

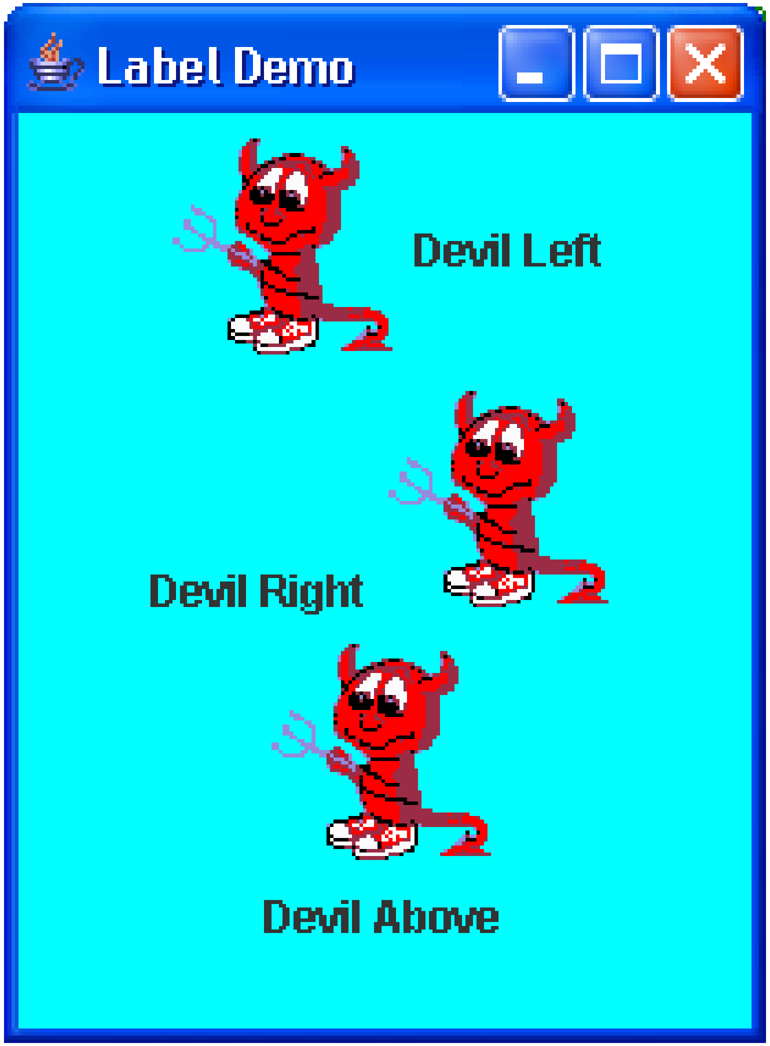
Images

- Images are often used in a programs with a graphical interface
- Java can manage images in both JPEG and GIF formats
- As we've seen, a `JLabel` object can be used to display a line of text
- It can also be used to display an image
- That is, a label can be composed of text, and image, or both at the same time

Images

- The `ImageIcon` class is used to represent an image that is stored in a label
- The position of the text relative to the image can be set explicitly
- The alignment of the text and image within the label can be set as well
- See LabelDemo.java (page 151)

LabelDemo



LabelDemo.java

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

public class LabelDemo
{
public static void main (String[] args)
  {
    JFrame frame = new JFrame ("Label Demo");
    frame.setDefaultCloseOperation (JFrame.EXIT_ON_CLOSE);

    ImageIcon icon = new ImageIcon ("devil.gif");

    JLabel label1, label2, label3;

    label1 = new JLabel ("Devil Left", icon, SwingConstants.CENTER);

    label2 = new JLabel ("Devil Right", icon, SwingConstants.CENTER);
    label2.setHorizontalTextPosition (SwingConstants.LEFT);
    label2.setVerticalTextPosition (SwingConstants.BOTTOM);
```

LabelDemo.java

```
    label3 = new JLabel ("Devil Above", icon, SwingConstants.CENTER);
    label3.setHorizontalTextPosition (SwingConstants.CENTER);
    label3.setVerticalTextPosition (SwingConstants.BOTTOM);

    JPanel panel = new JPanel();
    panel.setBackground (Color.CYAN);
    panel.setPreferredSize (new Dimension (200, 250));
    panel.add (label1);
    panel.add (label2);
    panel.add (label3);

    frame.add(panel);
    frame.pack();
    frame.setVisible(true);
  }
}
```