

An Introduction To Graphical User Interfaces

You will learn about the event-driven model and how to create simple graphical user interfaces (GUI's) in Java

James Tam

Note: GUI Code Cannot Be Run Through A Text- Only Connection: SSH

- [csb exampleTwo 45]> ls
- Driver.class* Driver.java MyListener.class* MyListener.java

- [csb exampleTwo 46]> java Driver
- *Exception in thread "main" java.lang.InternalError: Can't connect to X11 window server using ':0.0' as the value of the DISPLAY variable.*
 - at sun.awt.X11GraphicsEnvironment.initDisplay(Native Method)
 - at sun.awt.X11GraphicsEnvironment.<clinit>(X11GraphicsEnvironment.java:125)
 - at java.lang.Class.forName0(Native Method)
 - at java.lang.Class.forName(Class.java:140)
 - at java.awt.GraphicsEnvironment.getLocalGraphicsEnvironment(GraphicsEnvironment.java:62)
 - at java.awt.Window.init(Window.java:223)
 - at java.awt.Window.<init>(Window.java:267)
 - at java.awt.Frame.<init>(Frame.java:398)
 - at java.awt.Frame.<init>(Frame.java:363)
 - at Driver.main(Driver.java:7)

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Components

- They are many types of graphical controls and displays available:
 - JButton, JFrame, JLabel, JList, JTextArea, Window
- Also known as “widgets”
- For Sun’s online documentation refer to the url:
 - <http://download.oracle.com/javase/7/docs/api/> (especially java.awt.event, javax.swing.event, and javax.swing).

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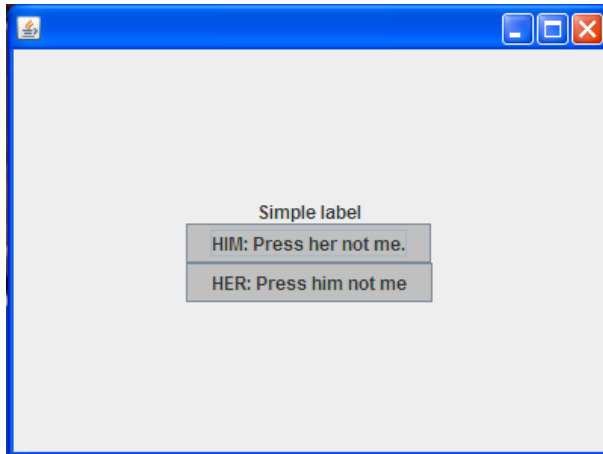
Containers

- A special type of component that is used to hold/contain the components (subclass of the basic component class)
- Can be used to group components on the screen (i.e., one container holds another container which in turn groups a number of controls).
- You must have at least one container object for your GUI:
 - JPanel, JWindow, JDialog, JFrame
- Components which have been added to a container will appear/disappear and be garbage collected along with the container.

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Containers

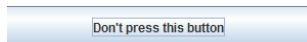
- You must have at least one container object for your GUI:
 - JPanel, JWindow, JDialog, **JFrame**



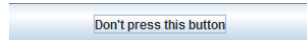
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Some Relevant Java GUI libraries

1. Java classes for the components and containers
 - e.g., JButton class
 - javax.swing (import javax.swing.* or import javax.swing.<class name>)



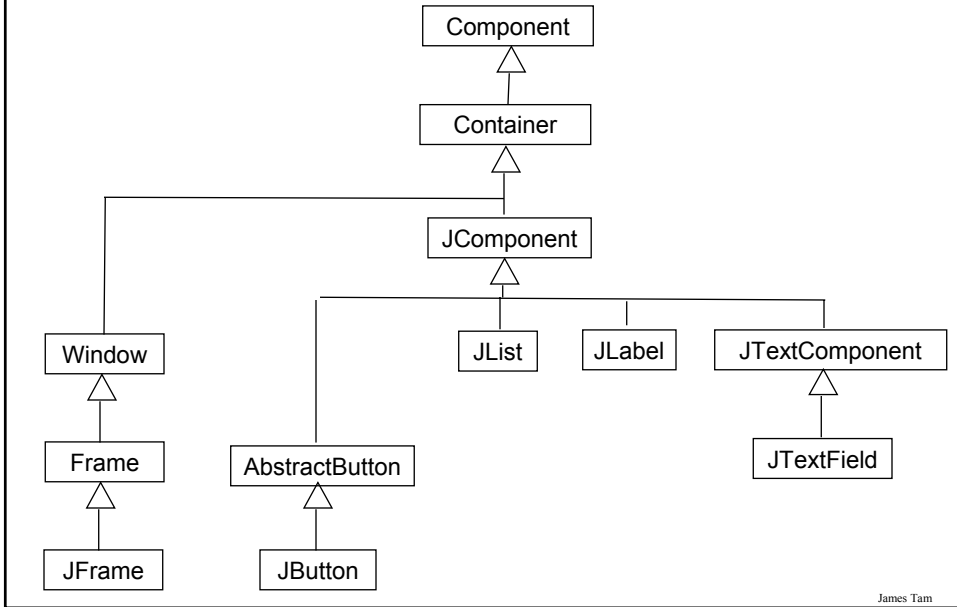
2. Java classes with the code to react to user-initiated events
 - e.g., code to react when a button is pressed
 - java.awt.event (import java.awt.event.*, import javax.swing.event.*)



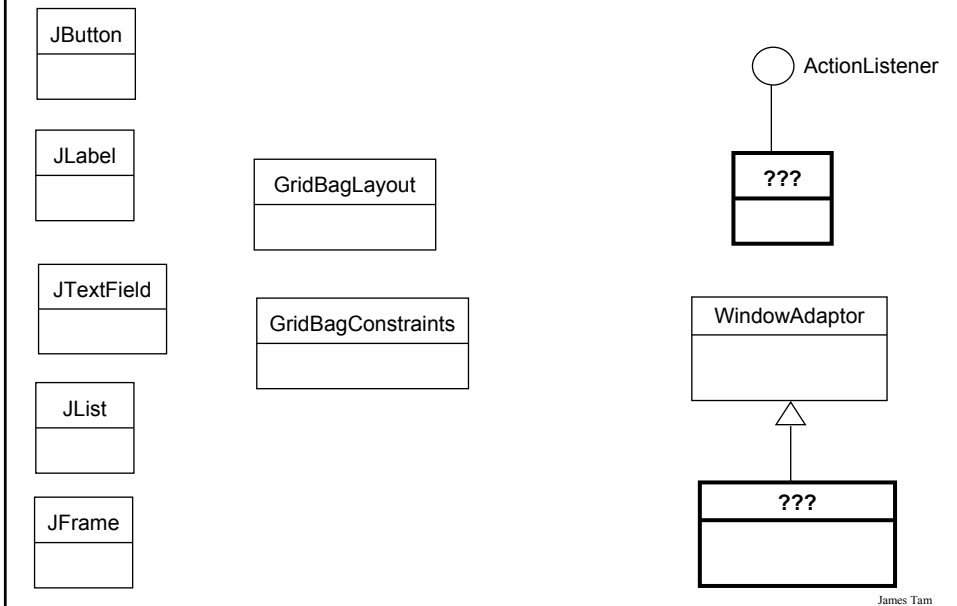
```
class ButtonListener implements ActionListener
{
    public void actionPerformed(ActionEvent e)
    {
        :       :       :
    }
}
```

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Hierarchy: Important Widget Classes



Some Relevant Java GUI Classes For This Section



Traditional Software

- Program control is largely determined by the program through a series of sequential statements.

Example

```

:
if (num >= 0)
{
    // Statements for the body of the if
}
else
{
    // Statements for the body of the else
}

```

When num is non-negative

Num is negative

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Traditional Software

- The user can only interact with the program at places that are specified by the program (e.g., when an input statement is encountered).

Example

```

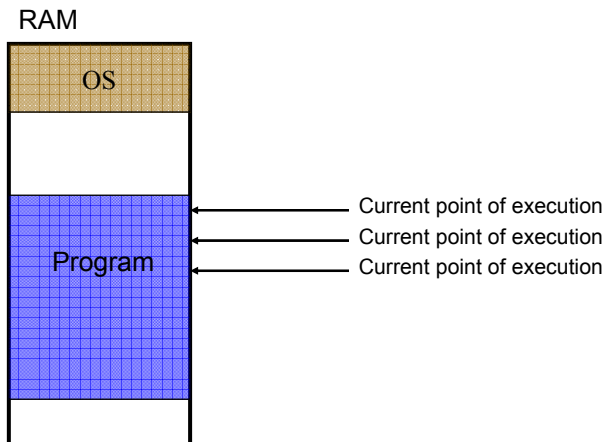
Scanner aScanner = new Scanner (System.in);
System.out.print("Enter student ID number: ");
id = aScanner.nextInt ();

```

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Event-Driven Software

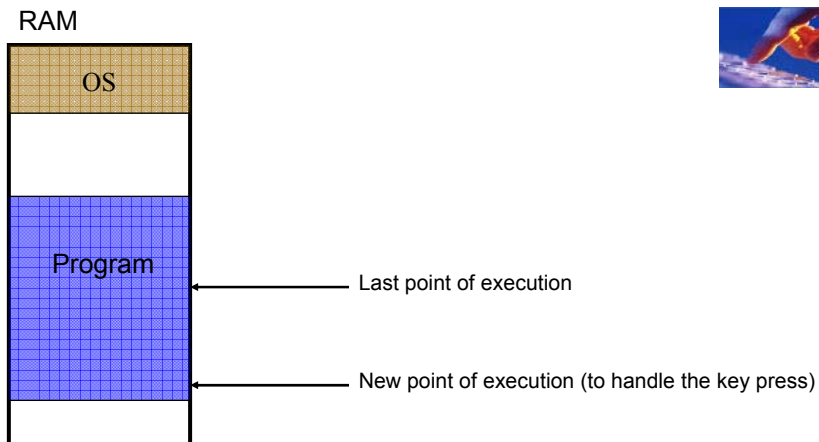
- Program control can also be sequential



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Event-Driven Software

- In addition program control *can also* be determined by events



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Characteristics Of Event Driven Software

- Program control can be determined by events as well as standard program control statements.
- A typical source of these events is the user.
- These events can occur at any time.

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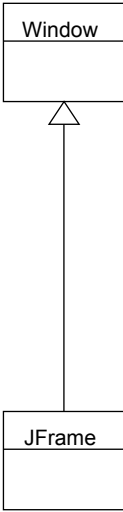
Most Components Can Trigger Events

- Graphical objects can be manipulated by the user to trigger events.
- Each graphical object can have 0, 1 or many events that can be triggered.



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Window Classes



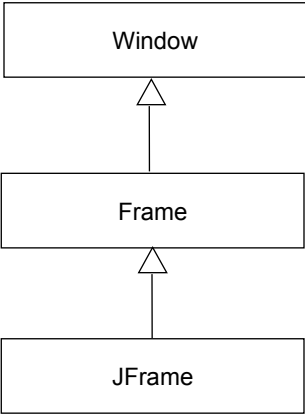
```
04/01/2004 09:00 PM (DIR) exampleSeven
04/01/2004 04:03 PM (DIR) exampleSix
03/31/2004 04:03 PM (DIR) exampleThree
11/19/2003 07:17 PM 737 FileIO.class
import java 11/20/2003 06:22 PM 1,186 FileIO.java
11/19/2003 06:00 PM 20F TextFieldListener.class
11/20/2003 03:18 PM 787 TextFieldListener.java
3 File(s) 13,378 bytes
7 Dir(s) 8,309,465,888 bytes free

location: class Driver
Window w = new Window ();
```



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The Window Class Hierarchy



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Class JFrame

- For full details look at the online API:
 - <http://download.oracle.com/javase/6/docs/api/javafx/swing/JFrame.html>
- Some of the more pertinent methods:
 - JFrame ("*<Text on the title bar>*")
 - setSize (<pixel width>, <pixel height>)
 - setVisible (<true/false>)
 - setDefaultCloseOperation (<class constants>¹)

¹ DISPOSE_ON_CLOSE, HIDE_ON_CLOSE, DO_NOTHING_ON_CLOSE

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Example: Creating A Frame That Can Close (And Cleanup Memory After Itself)

- The complete code for this example can be found in UNIX under the path:
/home/219/examples/gui/first_frame



```
import javax.swing.*;
public class Driver
{
    public static void main (String [] args)
    {
        JFrame mf = new JFrame ("Insert title here");
        mf.setSize (300,200);
        mf.setDefaultCloseOperation(JFrame.DISPOSE_ON_CLOSE);
        mf.setVisible(true);
    }
}
```

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Pitfall 1: Showing Too Early

- When a container holds a number of components the components must be added to the container (later examples).
- To be on the safe side the call to the “setVisible()” method should be done after the contents of the container have already been created and added.

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Window Events

- The basic JFrame class provides basic capabilities for common windowing operations: minimize, maximize, resize, close.
- However if a program needs to perform other actions (i.e., your own custom code) when these events occur the built in approach won't be sufficient.
 - E.g., the program is to automatically save your work to a file when you close the window.

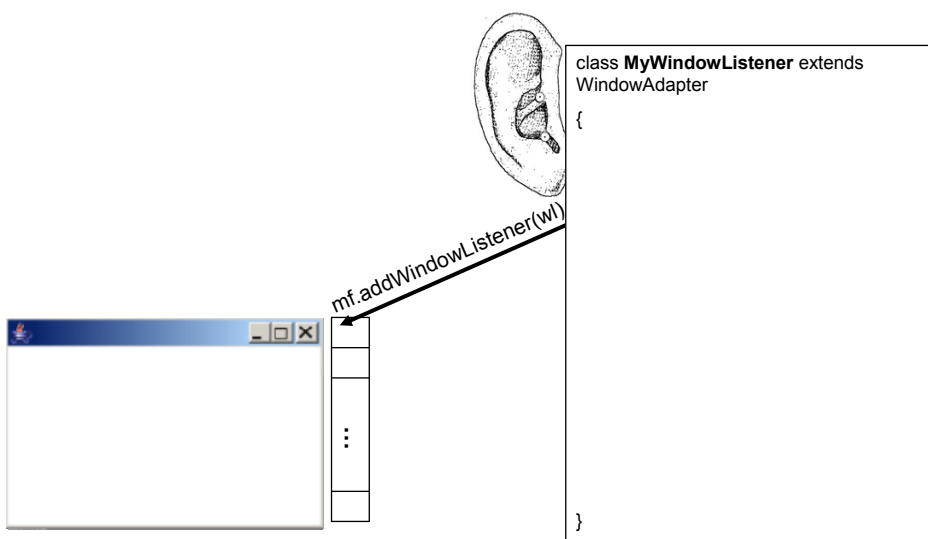
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Steps In The Event Model For Handling A Frame Event: Window Closing

- 1) The frame must register all interested event listeners.
- 2) The user triggers the event by closing the window
- 3) The window sends a message to all listeners of that event.
- 4) The window event listener runs the code to handle the event (e.g., save information to a file).

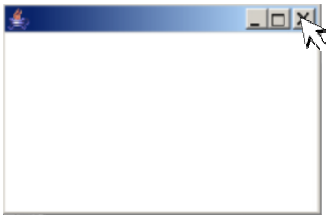
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1. The Frame Must Register All Interested Event Listeners.



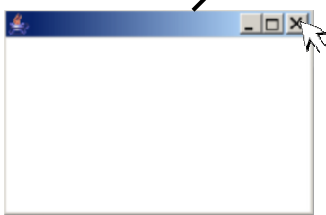
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2. The User Triggers The Event By Closing The Window



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3. The Window Sends A Message To All Listeners Of That Event.



```
public class MyWindowListener extends WindowAdapter
{
    public void windowClosing (WindowEvent e)
    {

    }

}
```

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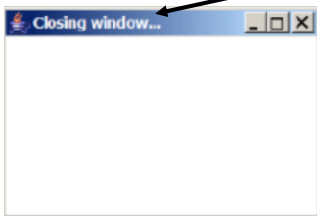
4. The Event Listener Runs The Code To Handle The Event.



```
public class MyWindowListener extends WindowAdapter
{
    public static final int DELAY_LENGTH = 500000000;
    public void windowClosing (WindowEvent e)
    {
        JFrame aFrame = (JFrame) e.getWindow();
        aFrame.setTitle("Closing window...");
        for (int i = 0; i < DELAY_LENGTH; i++);
        aFrame.setVisible(false);
        aFrame.dispose();
    }
}
```

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4. The Event Listener Runs The Code To Handle The Event.

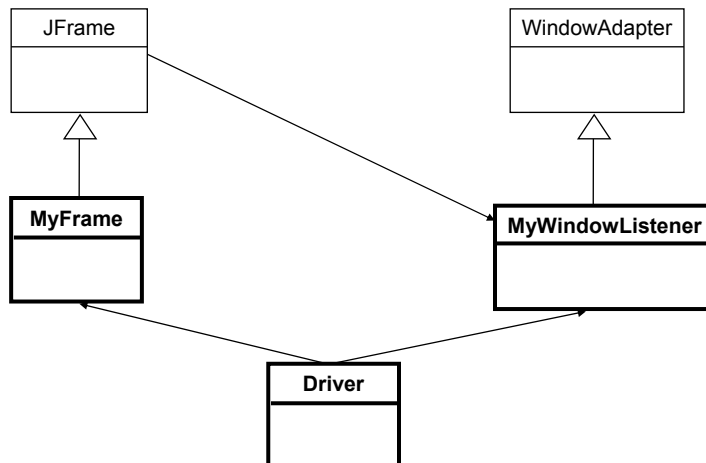


```
public class MyWindowListener extends WindowAdapter
{
    public static final int DELAY_LENGTH = 500000000;
    public void windowClosing (WindowEvent e)
    {
        JFrame aFrame = (JFrame) e.getWindow();
        aFrame.setTitle("Closing window...");
        for (int i = 0; i < DELAY_LENGTH; i++);
        aFrame.setVisible(false);
        aFrame.dispose();
    }
}
```

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An Example Of Handling A Frame Event

- The complete code for this example can be found in UNIX under the path: /home/219/examples/gui/second_window_events



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The Driver Class

```
import javax.swing.JFrame;

public class Driver
{
    public static final int WIDTH = 300;
    public static final int HEIGHT = 200;
    public static void main (String [] args)
    {
        MyFrame aFrame = new MyFrame ();
        MyWindowListener aListener = new MyWindowListener() ;
        aFrame.addWindowListener(aListener);
        aFrame.setSize (WIDTH,HEIGHT);
        aFrame.setVisible(true);
    }
}
```

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Class MyFrame

```
import javax.swing.JFrame;

public class MyFrame extends JFrame
{
    // More code will be added in later examples.
}
```

James Tam

Class MyWindowListener

```
import java.awt.event.WindowAdapter;
import java.awt.event.WindowEvent;
import javax.swing.JFrame;

public class MyWindowListener extends WindowAdapter
{
    public static final int DELAY_LENGTH = 500000000;
    public void windowClosing (WindowEvent e)
    {
        JFrame aFrame = (JFrame) e.getWindow();
        aFrame.setTitle("Closing window...");
        for (int i = 0; i < DELAY_LENGTH; i++);
            aFrame.setVisible(false);
        aFrame.dispose();
    }
}
```

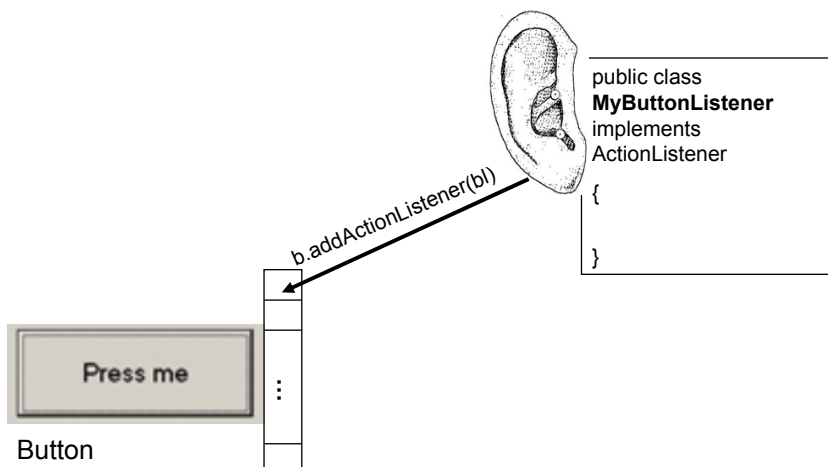
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Steps In The Event Model For Handling A Button Event

- 1) The button must register all interested event listeners.
- 2) The user triggers an event by pressing a button.
- 3) The button sends a message to all listeners of the button press event.
- 4) The button listener runs the code to handle the button press event.

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1. The Graphical Component Must Register All Interested Event Listeners.



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2. The User Triggers An Event By Pressing The Button



James Tam

3. The Component Sends A Message To All Registered Listeners For That Event



```
public class MyButtonListener implements  
ActionListener  
{  
    public void actionPerformed (ActionEvent e)  
    {  
    }  
}
```

James Tam

3. The Component Sends A Message To All Registered Listeners For That Event

```
public class MyButtonListener implements  
ActionListener  
{  
    public void actionPerformed (ActionEvent e)  
    {  
        JButton b = (JButton) e.getSource();  
        b.setLabel("Stop pressing me!");  
    }  
}
```



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4. The Event Listener Runs The Code To Handle The Event

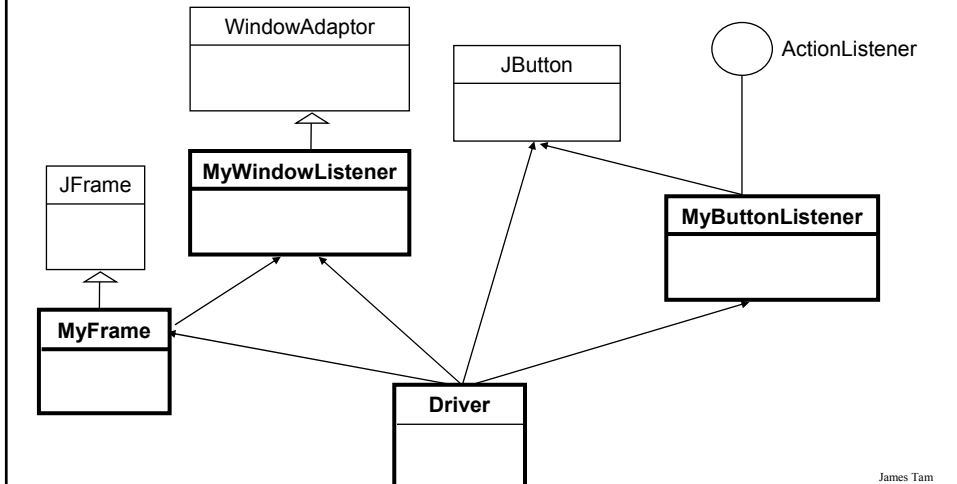
```
public class MyButtonListener implements  
ActionListener  
{  
    public void actionPerformed (ActionEvent e)  
    {  
        JButton b = (JButton) e.getSource();  
        b.setLabel("Stop pressing me!");  
    }  
}
```



James Tam

An Example Of Handling A Button Event

- The complete code for this example can be found in UNIX under the path: /home/219/examples/gui/three_button_events



An Example Of Handling A Button Event: The Driver Class

```
import javax.swing.JButton;
```

```
public class Driver
```

```
{
```

```
    public static final int WIDTH = 300;
```

```
    public static final int HEIGHT = 200;
```

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

```
    {
```

```
        MyFrame aFrame = new MyFrame ();
```

```
        MyWindowListener aWindowListener = new MyWindowListener();
```

```
        aFrame.addWindowListener(aWindowListener);
```

```
        aFrame.setSize (WIDTH,HEIGHT);
```

An Example Of Handling A Button Event: The Driver Class (2)

```
    JButton aButton = new JButton("Press me.");
    MyButtonListener aButtonListener = new
    MyButtonListener();
    aButton.addActionListener(aButtonListener);
    aFrame.add (aButton);
    aFrame.setVisible(true);
}
}
```

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An Example Of Handling A Button Event: The ButtonListener Class

```
import javax.swing.JButton;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;

public class MyButtonListener implements ActionListener
{
    public void actionPerformed (ActionEvent e)
    {
        JButton aButton = (JButton) e.getSource();
        aButton.setText("Stop pressing me!");
    }
}
```

James Tam

Anonymous Objects/Anonymous Inner Class

- If an object needs to be created but never directly referenced then it may be candidate for being created as an anonymous object.
- An example of where an anonymous object may be created is an event listener.

```
    JButton aButton = new JButton("Press me.");  
    aButton.addActionListener (new ActionListener() {  
        public void actionPerformed(ActionEvent e) {  
            JButton aButton = (JButton) e.getSource();  
            aButton.setText("Stop pressing me!");  
        }  
    });
```

Awkward if complex programming is required.

No reference name

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Nested/Inner Classes

- Occurs when one class is defined inside of another class:

```
public class X  
{  
    private class Y  
    {  
    }  
}
```

Outer class

Inner class

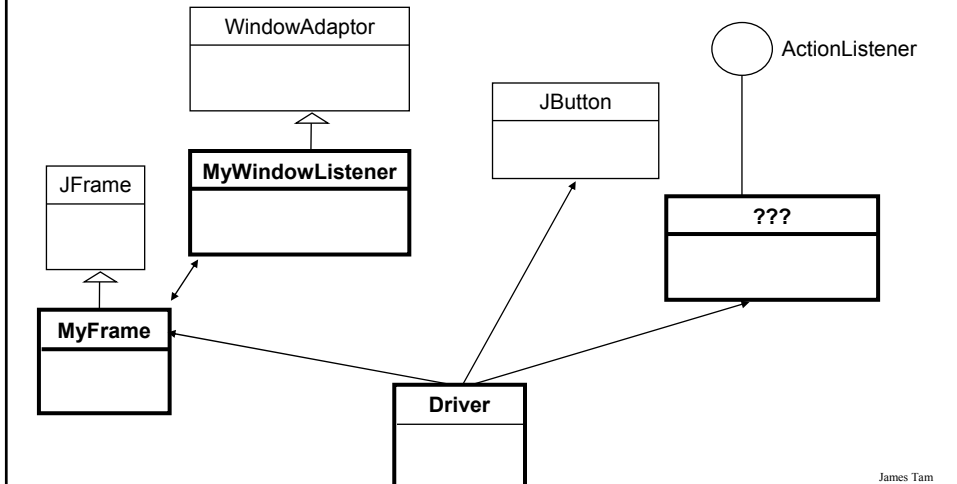
- Why nest class definitions¹:
 - It is a way of logically grouping classes that are only used in one place.
 - Nested classes can lead to more readable and maintainable code.
 - It increases encapsulation.
- Similar to declaring anonymous objects, nesting classes may be used when creating event listeners.

¹ For more information: <http://download.oracle.com/javase/tutorial/java/javaOO/nested.html>

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Alternate Example For Handling Events (Better)

- The complete code for this example can be found in UNIX under the path: /home/219/examples/gui/four_button_alternate



The Driver Class

```
import javax.swing.JButton;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;

public class Driver
{
    public static final int WIDTH = 300;
    public static final int HEIGHT = 200;
    public static void main (String [] args)
    {
        MyFrame aFrame = new MyFrame ();
        aFrame.setSize (WIDTH,HEIGHT);
        JButton aButton = new JButton("Press me.");
    }
}
```

The Driver Class (2)

```
// Anonymous object/class
aButton.addActionListener(new ActionListener() {
    public void actionPerformed(ActionEvent e) {
        JButton aButton = (JButton) e.getSource();
        aButton.setText("Stop pressing me!");
    }
});
aFrame.add(aButton);
aFrame.setVisible(true);
}
```

James Tam

Class MyFrame

```
import javax.swing.JFrame;
import java.awt.event.WindowAdapter;
import java.awt.event.WindowEvent;

public class MyFrame extends JFrame
{
    public MyFrame ()
    {
        MyWindowListener aWindowListener = new MyWindowListener();
        this.addWindowListener(aWindowListener);
    }
}
```

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Class MyFrame (2)

```
// Inner class defined within the MyFrame class.  
// Private because it's only used by the MyFrame class.  
private class MyWindowListener extends WindowAdapter  
{  
    public static final int DELAY_LENGTH = 500000000;  
    public void windowClosing (WindowEvent e)  
    {  
        JFrame aFrame = (JFrame) e.getWindow();  
        aFrame.setTitle("Closing window...");  
        for (int i = 0; i < DELAY_LENGTH; i++);  
            aFrame.setVisible(false);  
            aFrame.dispose();  
        }  
    }  
}
```

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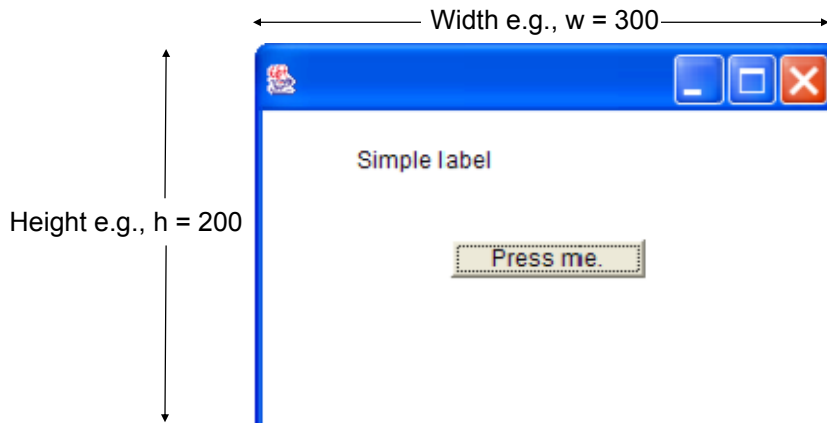
How To Handle The Layout Of Components

1. Manually set the coordinates yourself
2. Use one of Java's built-in layout manager classes

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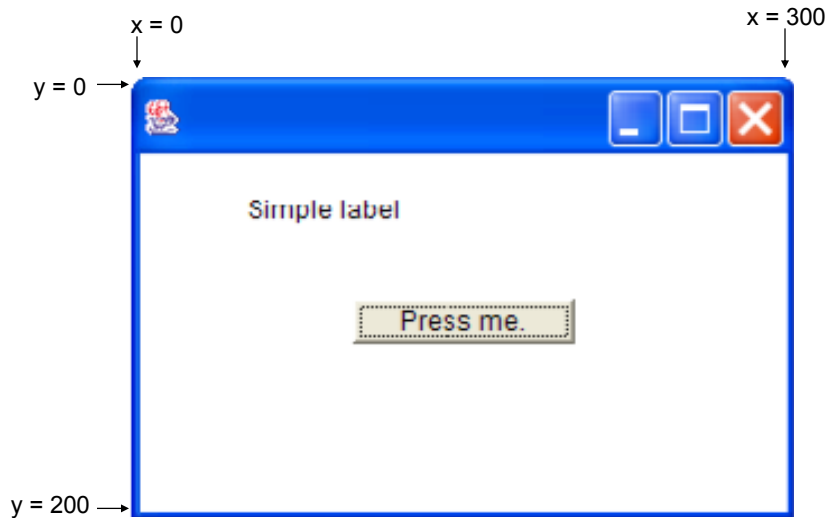
Layout Is Based On Spatial Coordinates

e.g. `MyFrame my = new MyFrame ();`
`my.setSize(300,200);`



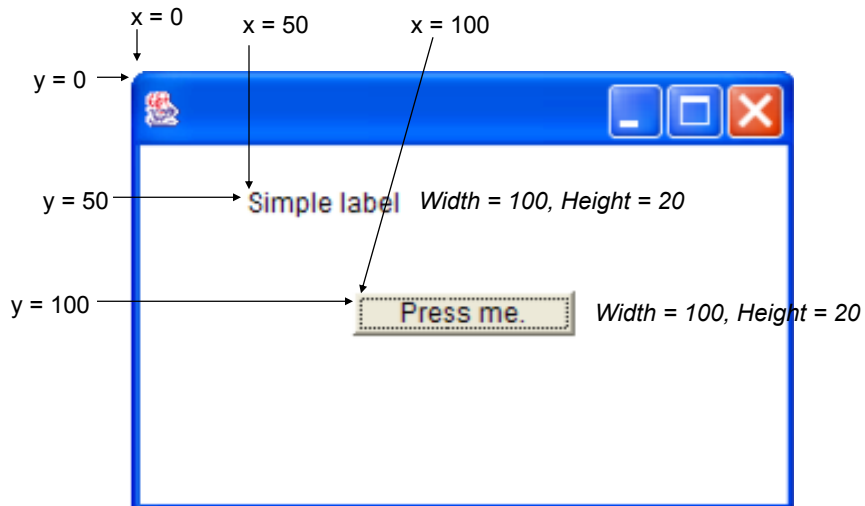
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Layout Is Based On Spatial Coordinates



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Coordinates Of Components: Relative To The Container



Pitfall 2: Invisible Component

- Don't forget that coordinates $(0,0)$ are covered by the title bar of the frame.
- Components added at this location may be partially or totally hidden by the title bar.

A Example Showing Manual Layout

- The complete code for this example can be found in UNIX under the path:
- /home/219/examples/gui/fifth_manual_layout

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An Example Showing Manual Layout: The Driver Class

```
import javax.swing.JButton;  
import javax.swing.JLabel;  
import javax.swing.JFrame;  
  
public class Driver  
{  
    public static final int WIDTH_FRAME = 300;  
    public static final int HEIGHT_FRAME = 300;  
    public static final int X_COORD_BUTTON = 100;  
    public static final int Y_COORD_BUTTON = 100;  
    public static final int WIDTH_BUTTON = 100;  
    public static final int HEIGHT_BUTTON = 20;  
    public static final int X_COORD_LABEL = 50;  
    public static final int Y_COORD_LABEL = 50;  
    public static final int WIDTH_LABEL = 100;  
    public static final int HEIGHT_LABEL = 20;
```

James Tam

An Example Showing Manual Layout: The Driver Class (2)

```
public static void main (String [] args) {  
    JFrame aFrame = new JFrame ();  
    aFrame.setLayout(null);  
    aFrame.setSize (WIDTH_FRAME,HEIGHT_FRAME);  
    JButton aButton = new JButton("Press me.");  
    aButton.setBounds(X_COORD_BUTTON,  
                    Y_COORD_BUTTON,  
                    WIDTH_BUTTON,  
                    HEIGHT_BUTTON);  
    JLabel aLabel = new JLabel ("Simple label");  
    aLabel.setBounds(X_COORD_LABEL,  
                   Y_COORD_LABEL,  
                   WIDTH_LABEL,  
                   HEIGHT_LABEL);  
    aFrame.add(aButton);  
    aFrame.add(aLabel);  
    aFrame.setVisible(true);  
    }  
}
```

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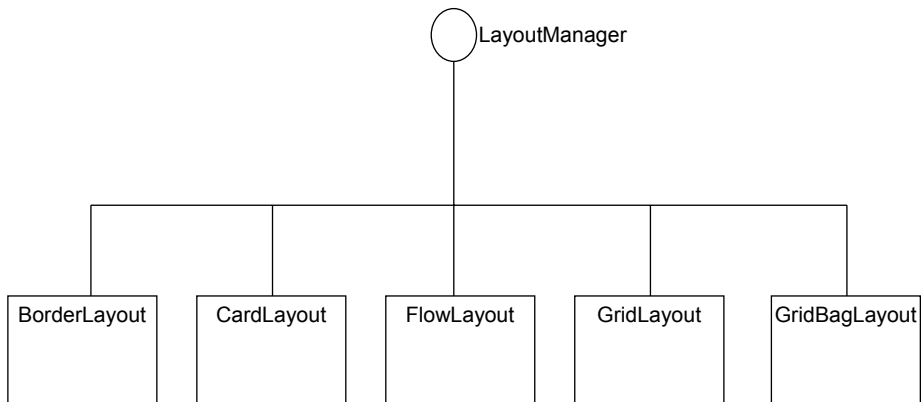
How To Handle The Layout Of Components

1. Manually set the coordinates yourself
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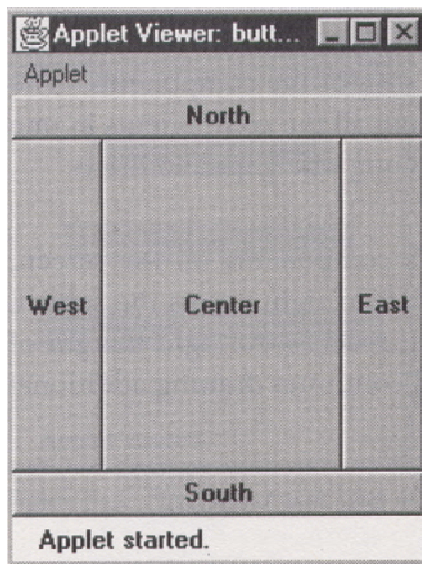
Java Layout Classes

- There are many implementations (this diagram only includes the original classes that were implemented by Sun).



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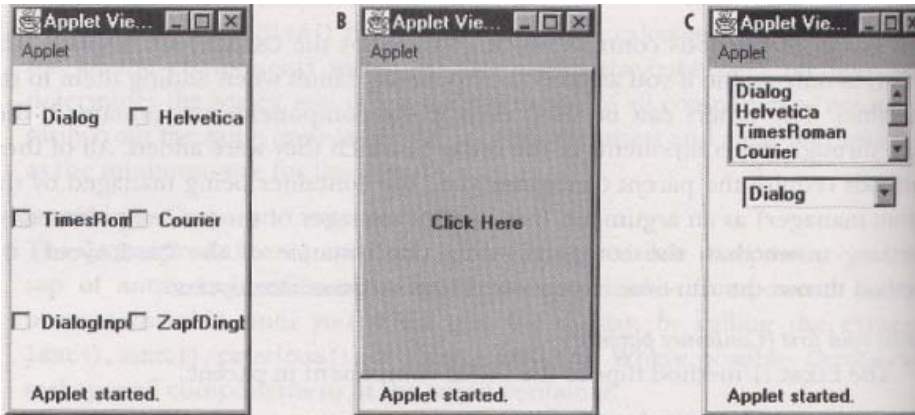
BorderLayout



From Java: AWT Reference p. 256

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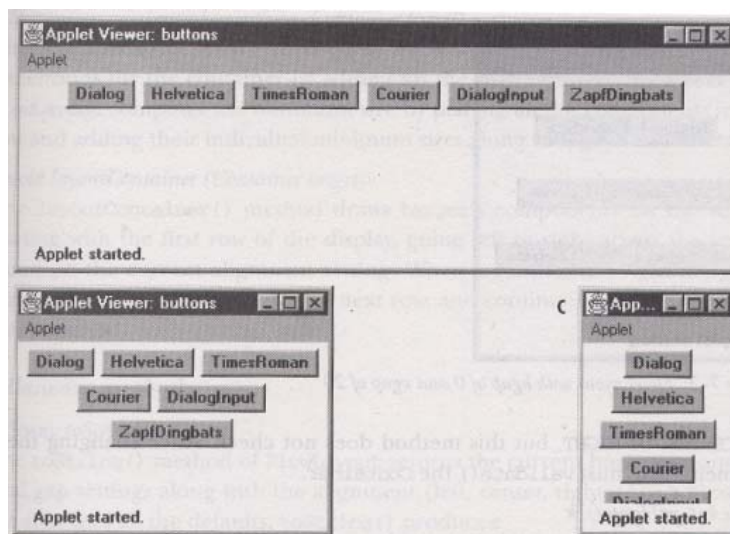
CardLayout



From Java: AWT Reference p. 264

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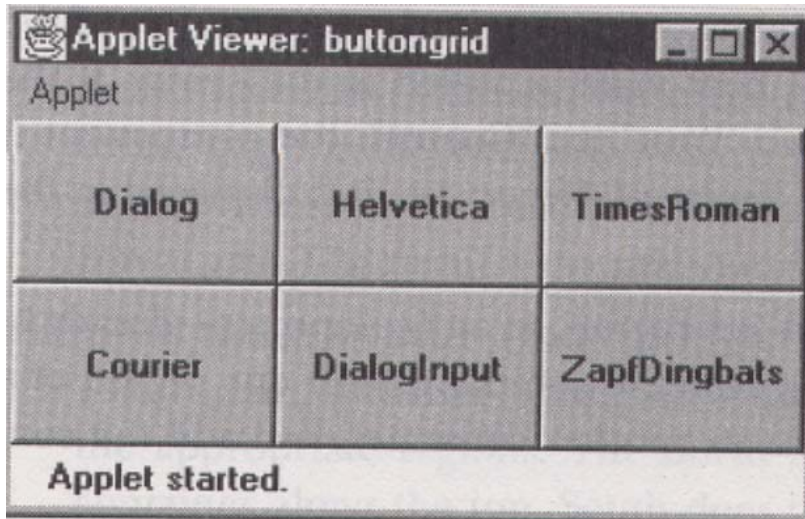
FlowLayout



From Java: AWT Reference p. 253

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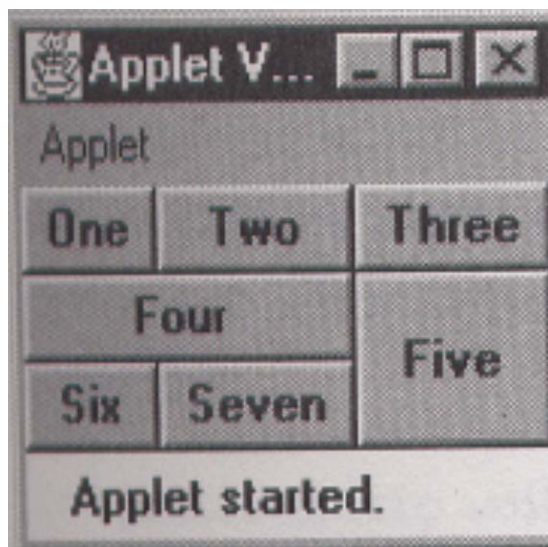
GridLayout



From Java: AWT Reference p. 260

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GridBagLayout

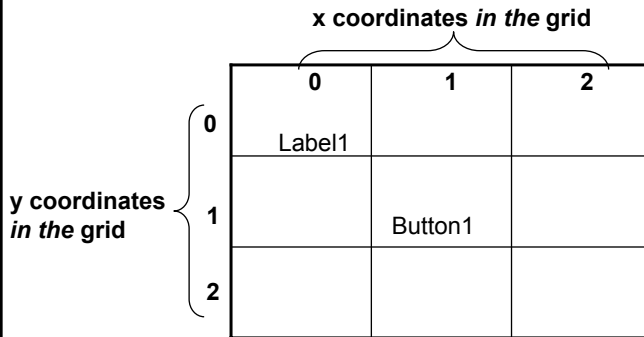


From Java: AWT Reference p. 269

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Designing A GUI When Using The GridBagLayout

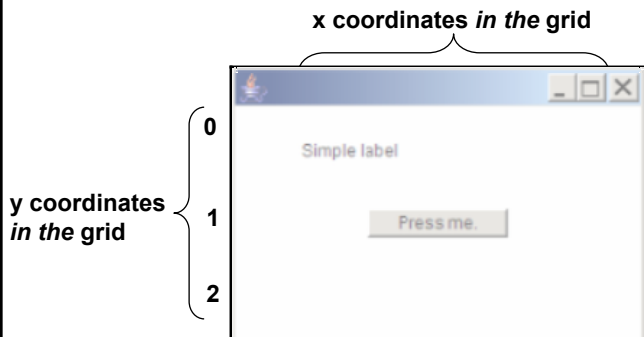
- Use graph paper or draw out a table.



James Tam

Designing A GUI When Using The GridBagLayout

- Use graph paper or draw out a table.



James Tam

GridBagConstraints

- Goes with the GridBagLayout class.
- Because the GridBagLayout doesn't know how to display components you also need GridBagConstraints to constrain things (determine the layout).
- GridBagConstraints indicates how components should be displayed within the GridBag.
- For more complete information see:
- <http://java.sun.com/javase/7/docs/api/java/awt/GridBagConstraints.html>

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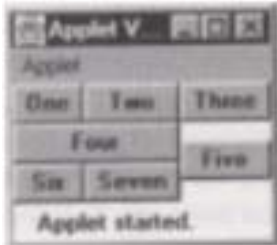
Some Important Parts Of The GridBagConstraints Class

```
public class GridBagConstraints
{
    // Used in conjunction with the constants below to determine the resize policy
    // of the component
    public int fill;

    // Apply only if there is available space.
    // Determine in which direction (if any) that the component expands to fill the
    // space.
    public final static int NONE;
    public final static int BOTH;
    public final static int HORIZONTAL;
    public final static int VERTICAL;
```

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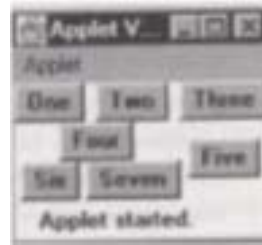
GridBagConstraints: Fill Values



Horizontal



Vertical



None

James Tam

Some Important Parts Of The GridBagConstraints Class (2)

// Position within the grid

```
public int gridx;
```

```
public int gridy;
```

// Number of grid squares occupied by a component

```
public int gridwidth;
```

```
public int gridheight;
```

James Tam

Some Important Parts Of The GridBagConstraints Class (3)

```
// Used in conjunction with the constants below to determine that the
// component drift if the space available is larger than the component.
public int anchor;

// Apply only if the component is smaller than the available space.
// Determine in which direction that the component will be anchored there
public final static int CENTER; █
public final static int EAST; █
public final static int NORTH; █
public final static int NORTHEAST; █
public final static int NORTHWEST; █
public final static int SOUTH; █
public final static int SOUTHEAST; █
public final static int SOUTHWEST; █
public final static int WEST; █
```

James Tam

An Example Using The GridBagLayout

- The complete code for this example can be found in UNIX under the path: /home/219/examples/gui/sixth_gridbaglayout

James Tam

An Example Using The GridBagLayout: The Driver Class

```
public class Driver
{
    public static final int WIDTH = 400;
    public static final int HEIGHT = 300;
    public static void main (String [] args)
    {
        MyFrame aFrame = new MyFrame ();
        aFrame.setSize(WIDTH,HEIGHT);
        aFrame.setVisible(true);
    }
}
```

James Tam

An Example Using The GridBagLayout: Class MyFrame

```
public class MyFrame extends JFrame
{
    private JButton aButton;
    private JLabel aLabel;
    private GridBagLayout aLayout;
    GridBagConstraints aConstraint;

    public MyFrame ()
    {
        MyWindowListener aWindowListener = new MyWindowListener ();
        addWindowListener(aWindowListener); // Calling method of super class.

        aConstraint = new GridBagConstraints();
        aButton = new JButton("Press me");
    }
}
```

James Tam

An Example Using The GridBagLayout: Class MyFrame (2)

```
// Anonymous object.
aButton.addActionListener (new ActionListener ()
{
    public void actionPerformed (ActionEvent e)
    {
        JButton aButton = (JButton) e.getSource();
        aButton.setText("Stop pressing me!");
    }
});
aLabel = new JLabel("Simple label");
aLayout = new GridBagLayout();
setLayout(aLayout); // Calling method of super class.
addWidget(aLabel, 0, 0, 1, 1);
addWidget(aButton, 2, 2, 1, 1);
} // End constructor
```

James Tam

An Example Using The GridBagLayout: Class MyFrame (3)

```
public void addWidget (Component widget, int x, int y, int w, int h)
{
    aConstraint.gridx = x;
    aConstraint.gridy = y;
    aConstraint.gridwidth = w;
    aConstraint.gridheight = h;
    aLayout.setConstraints (widget, aConstraint);
    addWidget(); // Calling method of super class.
}
```

James Tam

An Example Using The GridBagLayout: Class MyFrame (3)

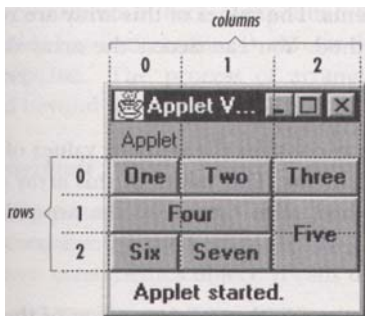
```

// Inner class
private class MyWindowListener extends WindowAdapter
{
    public void windowClosing (WindowEvent e)
    {
        JFrame f = (JFrame) e.getWindow();
        f.setTitle("Closing window...");
        for (int i = 0; i < 500000000; i++);
        f.setVisible(false);
        f.dispose();
    }
} // End of inner class definition
} // End of definition for class MyFrame

```

James Tam

Advanced Uses Of GridBagLayout



Button	gridx (col)	gridy (row)	grid-width	grid-height
One	0	0	1	1
Two	1	0	1	1
Three	2	0	1	1
Four	0	1	2	1
Five	2	1	1	2
Six	0	2	1	1
Seven	1	2	1	1

From Java: AWT Reference p. 269

James Tam

Components Effecting The State Of Other Components

- The complete code for this example can be found in UNIX under the path:
/home/courses/219/examples/gui/seventh_controls_affect_controls

James Tam

Components Effecting The State Of Other Components: The Driver Class

```
public class Driver
{
    public static final int WIDTH = 400;
    public static final int HEIGHT = 300;
    public static void main (String [] args)
    {
        MyFrame aFrame = new MyFrame ();
        aFrame.setSize(WIDTH,HEIGHT);
        aFrame.setVisible(true);
    }
}
```

James Tam

Components Effecting The State Of Other Components: Class MyFrame

```
public class MyFrame extends JFrame
{
    private JLabel aLabel;
    private GridBagLayout aLayout;
    private GridBagConstraints aConstraint;
    private JButton himButton;
    private JButton herButton;
    private MyButtonListener aButtonListener;
```

James Tam

Components Effecting The State Of Other Components: Class MyFrame (2)

```
public MyFrame ()
{
    MyWindowListener aWindowListener = new MyWindowListener ();
    addWindowListener(aWindowListener); // Calling method of super class.
    aConstraint = new GridBagConstraints();
    aButtonListener = new MyButtonListener();

    himButton = new JButton("HIM: Press her not me.");
    himButton.setActionCommand("him");
    himButton.setBackground(Color.lightGray);
    himButton.addActionListener(aButtonListener);

    herButton = new JButton("HER: Press him not me");
    herButton.setActionCommand("her");
    herButton.setBackground(Color.lightGray);
    herButton.addActionListener(aButtonListener);
```

James Tam

Components Effecting The State Of Other Components: Class MyFrame (3)

```
aLabel = new JLabel("Simple label");
aLayout = new GridBagLayout();
setLayout(aLayout);    // Calling method of super class.
addWidget(aLabel, 0, 0, 1, 1);
addWidget(himButton, 0, 1, 1, 1);
addWidget(herButton, 0, 2, 1, 1);
}
```

James Tam

Components Effecting The State Of Other Components: Class MyFrame (4)

```
public void addWidget (Component widget, int x, int y, int w, int h)
{
    aConstraint.gridx = x;
    aConstraint.gridy = y;
    aConstraint.gridwidth = w;
    aConstraint.gridheight = h;
    aLayout.setConstraints (widget, aConstraint);
    add(widget);    // Calling method of super class.
}
```

```
public JButton getHerButton () { return herButton; }
public JButton getHimButton () { return himButton; }
```

James Tam

Components Effecting The State Of Other Components: Class MyFrame (5)

```
private class MyWindowListener extends WindowAdapter
{
    public void windowClosing (WindowEvent e)
    {
        JFrame f = (JFrame) e.getWindow();
        f.setTitle("Closing window...");
        for (int i = 0; i < 500000000; i++);
        f.setVisible(false);
        f.dispose();
    }
}
}
```

James Tam

Components Effecting The State Of Other Components: Class ButtonListener

```
public class MyButtonListener implements ActionListener
{
    public static final int DELAY_TIME = 999999999;
    public void actionPerformed (ActionEvent e)
    {
        JButton aButton = (JButton) e.getSource();
        String s = e.getActionCommand();
        MyFrame aFrame = (MyFrame) aButton.getRootPane().getParent();
    }
}
```

James Tam

Components Effecting The State Of Other Components: Class ButtonListener (2)

```
if (s.equals("her"))
{
    JButton himButton = aFrame.getHimButton();
    String title = aFrame.getTitle();
    aFrame.setTitle(himButton.getText());
    himButton.setBackground(Color.green);
    aButton.setBackground(Color.lightGray);
    for (int i = 0; i < DELAY_TIME; i++);
    aFrame.setTitle(title);
}
```

James Tam

Components Effecting The State Of Other Components: Class ButtonListener (3)

```
else if (s.equals("him"))
{
    JButton herButton = aFrame.getHerButton();
    String title = aFrame.getTitle();
    aFrame.setTitle(herButton.getText());
    herButton.setBackground(Color.green);
    aButton.setBackground(Color.lightGray);
    for (int i = 0; i < DELAY_TIME; i++);
    aFrame.setTitle(title);
}
else
{
    :
    :
}
}
```

James Tam

The JList Class

- Used to provide a graphical and interactive control for a list.
 - This example will create a list of strings but the data is quite flexible.
- Scrollbars are NOT automatically included (you need to add a JList reference to the constructor of a class that provides scrolling capabilities).
- For the complete class refer to the url:
 - <http://java.sun.com/javase/7/docs/api/>
- For online tutorials (Sun):
 - <http://download.oracle.com/javase/tutorial/uiswing/components/list.html>

James Tam

Some Important Parts Of The List Class

```
class JList
{
    // The data for the list is stored by another class (some form of ListModel).
    // Returns a reference to the model (needed to add/remove elements).
    ListModel getModel ()

    // Creates a list whose data is an array of objects.
    public ListModel (Object [] listData)

    // Creates an empty list with the data managed by specified model
    public ListModel (ListModel dataModel1)

    // Passes an instance of a class that reacts to list events.
    addListSelectionListener(ListSelectionListener listener)
```

¹ The data model is what manipulates the list data. Common options *DefaultListModel*, *ListModel*

James Tam

Some Important Parts Of The List Class (2)

```
// Determines the number of rows that appear..  
setVisibleRowCount (int count)  
  
// Determine the index of the selected element  
int getSelectedIndex ()  
  
}
```

James Tam

Adding Scrolling Capability

- As you create an instance of the class that provides scrolling capabilities pass in a reference to the list in the scrolling classes' constructor.
 - E.g., JScrollPane (<reference to the List>)
- Then add an instance of this scrolling class to the Frame (or the appropriate container).
 - E.g., aFrame.add (<reference to the scrolling object>)

James Tam

Adding/Removing Elements

- As previously mentioned the ListModel (and not the list) is responsible for manipulating (adding/removing) the list data.
- In order to change the list's membership you need to first get a reference to the list model.
 - E.g., `aModel = aList.getModel ()`
- Then you can call the appropriate method of the ListModel.
 - Add: `aModel.addElement (<object>)`
 - Remove: `aModel.removeElementAt (<index or object>)`

James Tam

An Example Employing A List

- The complete code for this example can be found in UNIX under the path: `/home/219/examples/gui/eighth_JList`

James Tam

An Example Employing A List: The Driver Class

```
public class Driver
{
    public static final int WIDTH = 400;
    public static final int HEIGHT = 300;
    public static void main (String [] args)
    {
        MyFrame aFrame = new MyFrame ();
        aFrame.setSize(WIDTH,HEIGHT);
        aFrame.setVisible(true);
    }
}
```

James Tam

An Example Employing A List: Class MyFrame

```
public class MyFrame extends JFrame
{
    private JLabel listLabel;
    private JLabel textLabel;
    private JList aList;
    private GridBagLayout aLayout;
    private GridBagConstraints aConstraint;
    private JTextField aTextField;

    public static final int MAX_VISIBLE_ROWS = 3;
    public static final int MAX_ELEMENTS = 10;
```

James Tam

An Example Employing A List: Class MyFrame (2)

```
public MyFrame ()
{
    MyWindowListener aWindowListener = new MyWindowListener ();
    Object anObject;
    String aString;
    DefaultListModel aModel;
    int size;

    addWindowListener(aWindowListener);
    aConstraint = new GridBagConstraints();
    aList = new JList(new DefaultListModel ());
    initializeList();
    aList.setSelectedIndex(0);
    aTextField = new JTextField ();
    aModel = (DefaultListModel) aList.getModel();
    size = aModel.getSize();
    anObject = aModel.elementAt(0);
}
```

James Tam

An Example Employing A List: Class MyFrame (3)

```
if (anObject instanceof String)
{
    aString = (String) anObject;
    aTextField.setText(aString);
}
aList.setVisibleRowCount(MAX_VISIBLE_ROWS);
aList.addListSelectionListener(new MyListListener());
listLabel = new JLabel(Integer.toString(size));
textLabel = new JLabel ("Currently selected item");

aLayout = new GridBagLayout();
setLayout(aLayout); // Calling method of super class.
addWidget(listLabel, 0, 0, 1, 1, GridBagConstraints.NONE);
addWidget(textLabel, 3, 0, 1, 1, GridBagConstraints.NONE);
addWidget(new JScrollPane(aList), 0, 1, 2, 3,
    GridBagConstraints.HORIZONTAL);
addWidget(aTextField, 3, 1, 1, 1, GridBagConstraints.HORIZONTAL);
}
```

James Tam

An Example Employing A List: **Class MyFrame (4)**

```
public void addWidget (Component widget, int x, int y, int w, int h, int fill)
{
    aConstraint.gridx = x;
    aConstraint.gridy = y;
    aConstraint.gridwidth = w;
    aConstraint.gridheight = h;
    aConstraint.fill = fill;
    aLayout.setConstraints (widget, aConstraint);
    add(widget);    // Calling method of super class.
}
```

James Tam

An Example Employing A List: **Class MyFrame (5)**

```
public void initializeList ()
{
    int i;
    DefaultListModel aModel = (DefaultListModel) aList.getModel ();
    for (i = 1; i <= MAX_ELEMENTS; i++)
        aModel.addElement(new String(Integer.toString(i * 10)));
}

public JTextField getTextField ()
{
    return aTextField;
}
```

James Tam

An Example Employing A List: Private Inner Class (MyListListener)

```
private class MyListListener implements ListSelectionListener
{
    public void valueChanged(ListSelectionEvent e) {
        JList aList = (JList)e.getSource();
        int index = aList.getSelectedIndex();
        DefaultListModel aModel = (DefaultListModel) aList.getModel();
        Object anObject = aModel.getElementAt(index);
        if (anObject instanceof String) {
            String aString = (String) anObject;
            MyFrame aFrame = (MyFrame) aList.getRootPane().getParent();
            JTextField aTextField = aFrame.getTextField();
            aTextField.setText(aString);
        }
    }
}
```

James Tam

Capturing TextField Events

- The complete code for this example can be found in UNIX under the path: /home/219/examples/gui/ninth_JTextField

James Tam

Capturing TextFieldEvents: Class MyFrame

```
public class MyFrame extends JFrame
{
    private JLabel instructions;
    private JTextField inputField;
    public MyFrame ()
    {
        setLayout(null);
        instructions = new JLabel("Enter some text below and hit return");
        instructions.setBounds(20,100,200,20);
        inputField = new JTextField();
        inputField.setBounds(20,150,200,20);
    }
}
```

James Tam

Capturing TextFieldEvents: Class MyFrame (2)

```
        inputField.addActionListener(new ActionListener() {
            public void actionPerformed (ActionEvent e) {
                JTextField aTextField = (JTextField) e.getSource ();
                MyFrame aFrame = (MyFrame)
                    aTextField.getRootPane().getParent ();
                aFrame.setTitle (aTextField.getText());
            }
        });
        add(instructions);
        add(inputField);
        setVisible(true);
    }
```

James Tam

References

- Books:

- “*Java Swing*” by Robert Eckstein, Marc Loy and Dave Wood (O’Reilly)
- “*Absolute Java*” (4th Edition) by Walter Savitch (Pearson)
- “*Java: How to Program*” (6th Edition) by H.M. Deitel and P.J. Deitel (Pearson)

- Websites:

- Java API specifications: <http://download.oracle.com/javase/7/docs/api/>
- Java tutorials: <http://download.oracle.com/javase/tutorial/uiswing/>

James Tam

You Should Now Know

- The difference between traditional and event driven software
- How event-driven software works (registering and notifying event listeners)
- How some basic Swing controls work
- How to layout components using layout managers and laying them out manually using a coordinate system

James Tam