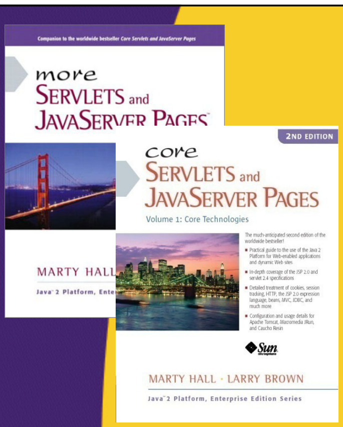
Layout Managers

Arranging Elements in Windows

Originals of Slides and Source Code for Examples:
http://courses.coreservlets.com/Course-Materials/java.html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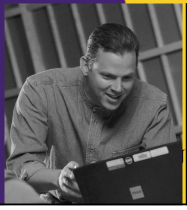


Topics in This Section

- **How layout managers simplify interface design**
- **Standard layout managers**
  - FlowLayout, BorderLayout, CardLayout, GridLayout, GridBagLayout, BoxLayout
- **Positioning components manually**
- **Strategies for using layout managers effectively**

Layout Managers

- **Assigned to each Container**
  - Give *sizes* and *positions* to components in the window
  - Helpful for windows whose size changes or that display on multiple operating systems
- **Relatively easy for simple layouts**
  - But, it is surprisingly hard to get complex layouts with a single layout manager
- **Controlling complex layouts**
  - Use nested containers (each with its own layout manager)
  - Use invisible components and layout manager options
  - Write your own layout manager
  - Turn some layout managers off and arrange some things manually

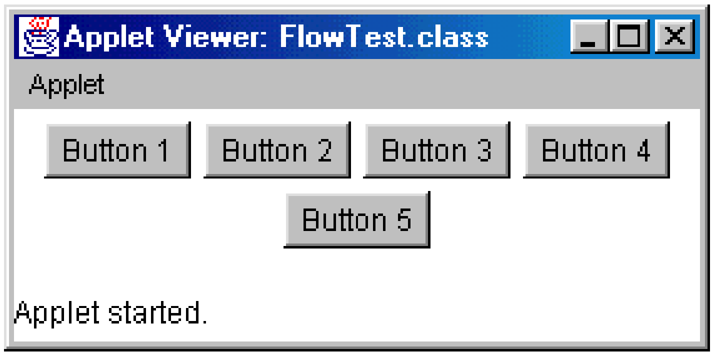
Simple Layout Managers

FlowLayout

- **Default layout for Panel, JPanel, and Applet**
- **Behavior**
  - Resizes components to their preferred size
  - Places components in rows left to right, top to bottom
    - Rows are centered by default
- **Constructors**
  - `FlowLayout()`
    - Centers each row and keeps 5 pixels between entries in a row and between rows
  - `FlowLayout(int alignment)`
    - Same 5 pixels spacing, but changes the alignment of the rows
    - `FlowLayout.LEFT, FlowLayout.RIGHT, FlowLayout.CENTER`
  - `FlowLayout(int alignment, int hGap, int vGap)`
    - Specify the alignment as well as the horizontal and vertical spacing between components (in pixels)

FlowLayout: Example

```
public class FlowTest extends Applet {
  public void init() {
    // setLayout(new FlowLayout()); [Default]
    for(int i=1; i<6; i++) {
      add(new Button("Button " + i));
    }
  }
}
```



BorderLayout

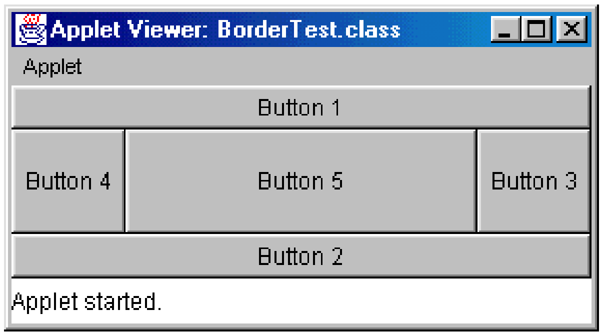
- **Default for Frame, JFrame, Dialog, JApplet**
- **Behavior**
  - Divides the `Container` into five regions
    - Each region is identified by a corresponding `BorderLayout` constant
      - `NORTH`, `SOUTH`, `EAST`, `WEST`, and `CENTER`
  - NORTH and SOUTH respect the preferred height of the component
  - EAST and WEST respect the preferred width of the component
  - CENTER is given the remaining space
- **Is allowing a maximum of five components too restrictive? Why not?**

BorderLayout (Continued)

- **Constructors**
  - BorderLayout()
    - Border layout with no gaps between components
  - BorderLayout(int hGap, int vGap)
    - Border layout with the specified empty pixels between regions
- **Adding Components**
  - add(component, BorderLayout.*REGION*)
  - Always specify the region in which to add the component
    - CENTER is the default, but specify it explicitly to avoid confusion with other layout managers

BorderLayout: Example

```
public class BorderTest extends Applet {
  public void init() {
    setLayout(new BorderLayout());
    add(new Button("Button 1"), BorderLayout.NORTH);
    add(new Button("Button 2"), BorderLayout.SOUTH);
    add(new Button("Button 3"), BorderLayout.EAST);
    add(new Button("Button 4"), BorderLayout.WEST);
    add(new Button("Button 5"), BorderLayout.CENTER);
  }
}
```



GridLayout

- **Behavior**
  - Divides window into equal-sized rectangles based upon the number of rows and columns specified
    - Items placed into cells left-to-right, top-to-bottom, based on the order added to the container
  - Ignores the preferred size of the component; each component is resized to fit into its grid cell
  - Too few components results in blank cells
  - Too many components results in extra columns

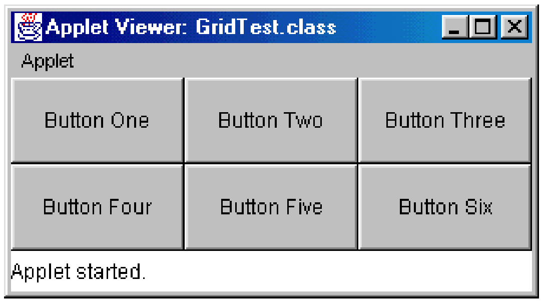
GridLayout (Continued)

- **Constructors**
  - `GridLayout()`
    - Creates a single row with one column allocated per component
  - `GridLayout(int rows, int cols)`
    - Divides the window into the specified number of rows and columns
    - Either rows or cols (but not both) can be zero

  -
    ```
    GridLayout(int rows, int cols,
               int hGap, int vGap)
    ```
    - Uses the specified gaps between cells

GridLayout, Example

```
public class GridTest extends Applet {
  public void init() {
    setLayout(new GridLayout(2,3)); // 2 rows, 3 cols
    add(new Button("Button One"));
    add(new Button("Button Two"));
    add(new Button("Button Three"));
    add(new Button("Button Four"));
    add(new Button("Button Five"));
    add(new Button("Button Six"));
  }
}
```

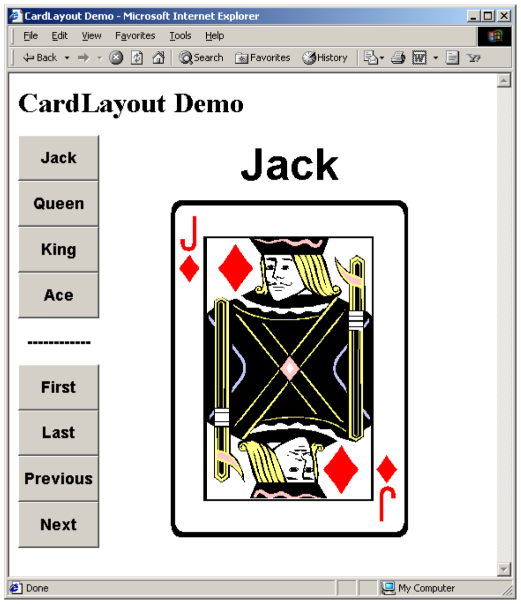


CardLayout

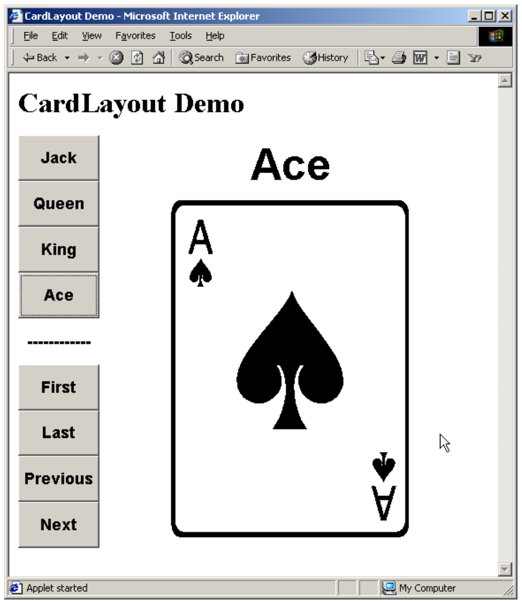
- **Behavior**
  - Stacks components on top of each other, displaying the top one
  - Associates a name with each component in window

```
        Panel cardPanel;
        CardLayout layout new CardLayout();
        cardPanel.setLayout(layout);
        ...
        cardPanel.add("Card 1", component1);
        cardPanel.add("Card 2", component2);
        ...
        layout.show(cardPanel, "Card 1");
        layout.first(cardPanel);
        layout.next(cardPanel);
```

CardLayout, Example


CardLayout Demo - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites History
CardLayout Demo
Jack
Queen
King
Ace

First
Last
Previous
Next
Jack
Done
My Computer


CardLayout Demo - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites History
CardLayout Demo
Jack
Queen
King
Ace

First
Last
Previous
Next
Ace
Applet started
My Computer

GridBagLayout

GridBagLayout

- **Behavior**
  - Divides the window into grids, without requiring the components to be the same size
    - About three times more flexible than the other standard layout managers, but *nine* times harder to use
  - Each component managed by a grid bag layout is associated with an instance of `GridBagConstraints`
    - The `GridBagConstraints` specifies:
      - How the component is laid out in the display area
      - In which cell the component starts and ends
      - How the component stretches when extra room is available
      - Alignment in cells
  - Java 5 introduced SpringLayout, with similar power but much less complexity

GridBagLayout: Basic Steps

- **Set the layout, saving a reference to it**
```
GridBagLayout layout = new GridBagLayout();
setLayout(layout);
```
- **Allocate a `GridBagConstraints` object**
```
GridBagConstraints constraints =
  new GridBagConstraints();
```
- **Set up the `GridBagConstraints` for component 1**
```
constraints.gridx = x1;
constraints.gridy = y1;
constraints.gridwidth = width1;
constraints.gridheight = height1;
```
- **Add component 1 to the window, including constraints**
```
add(component1, constraints);
```
- **Repeat the last two steps for each remaining component**

GridBagConstraints

- **Copied when component added to window**
  - Thus, can reuse the `GridBagConstraints`

```
GridBagConstraints constraints =
  new GridBagConstraints();
constraints.gridx = x1;
constraints.gridy = y1;
constraints.gridwidth = width1;
constraints.gridheight = height1;
add(component1, constraints);
constraints.gridx = x1;
constraints.gridy = y1;
add(component2, constraints);
```

GridBagConstraints Fields

- **`gridx, gridy`**
  - Specifies the top-left corner of the component
  - Upper left of grid is located at (gridx, gridy)=(0,0)
  - Set to **`GridBagConstraints.RELATIVE`** to auto-increment row/column

```
GridBagConstraints constraints =
   new GridBagConstraints();
constraints.gridx =
   GridBagConstraints.RELATIVE;
container.add(new Button("one"),
                    constraints);
container.add(new Button("two"),
                    constraints);
```

GridBagConstraints Fields (Continued)

- **`gridwidth`, `gridheight`**
  - Specifies the number of columns and rows the Component occupies

```
        constraints.gridwidth = 3;
```

  - **`GridBagConstraints.REMAINDER`** lets the component take up the remainder of the row/column
- **`weightx`, `weighty`**
  - Specifies how much the cell will stretch in the x or y direction if space is left over

```
        constraints.weightx = 3.0;
```

  - Constraint affects the cell, not the component (use `fill`)
  - Use a value of 0.0 for no expansion in a direction
  - Values are relative, not absolute

GridBagConstraints Fields (Continued)

- **`fill`**
  - Specifies what to do to an element that is smaller than the cell size

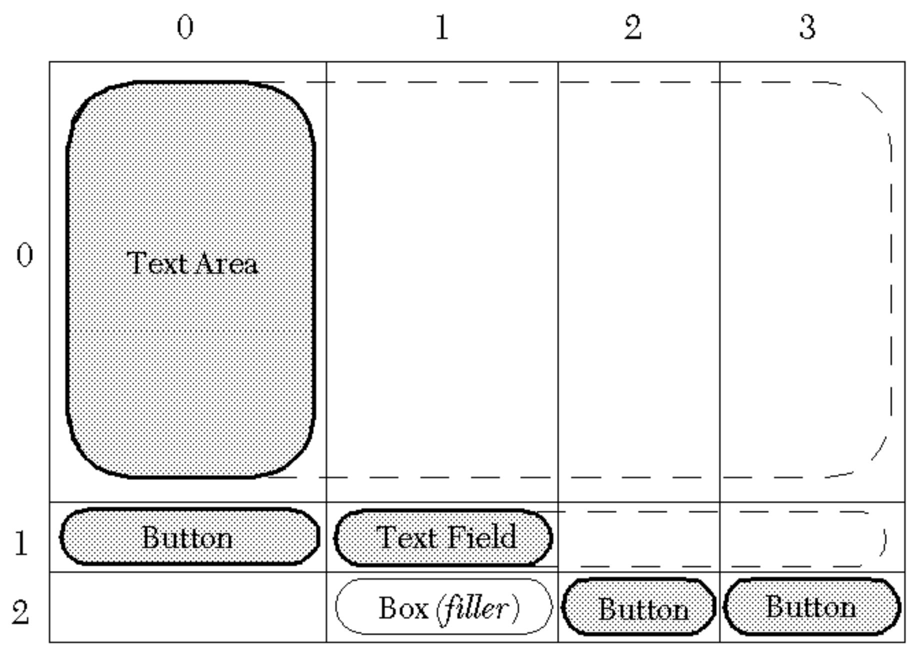
```
 constraints.fill = GridBagConstraints.VERTICAL;
```

  - The size of row/column is determined by the widest/tallest element in it
  - Can be `NONE`, `HORIZONTAL`, `VERTICAL`, or `BOTH`
- **anchor**
  - If the fill is set to `GridBagConstraints.NONE`, then the `anchor` field determines where the component is placed

```
 constraints.anchor = GridBagConstraints.NORTHEAST;
```

  - Can be `NORTH`, `EAST`, `SOUTH`, `WEST`, `NORTHEAST`, `NORTHWEST`, `SOUTHEAST`, or `SOUTHWEST`

GridBagLayout: Example



GridBagLayout: Example

```
public GridBagTest() {
    setLayout(new GridBagLayout());
    textArea = new JTextArea(12, 40);  // 12 rows, 40 cols
    bSaveAs = new JButton("Save As");
    fileField = new JTextField("C:\\Document.txt");
    bOk = new JButton("OK");
    bExit = new JButton("Exit");
    GridBagConstraints c = new GridBagConstraints();
    // Text Area.
    c.gridx      = 0;
    c.gridy      = 0;
    c.gridwidth  = GridBagConstraints.REMAINDER;
    c.gridheight = 1;
    c.weightx    = 1.0;
    c.weighty    = 1.0;
    c.fill       = GridBagConstraints.BOTH;
    c.insets     = new Insets(2,2,2,2); //t,l,b,r
    add(textArea, c);
    ...
```

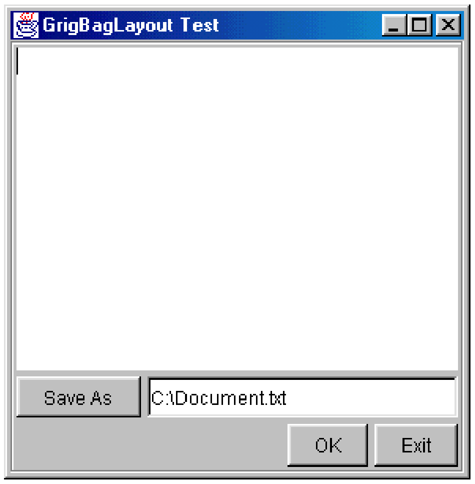
GridBagLayout: Example (Continued)

```
 // Save As Button.
  c.gridx      = 0;
  c.gridy      = 1;
  c.gridwidth  = 1;
  c.gridheight = 1;
  c.weightx    = 0.0;
  c.weighty    = 0.0;
  c.fill       = GridBagConstraints.VERTICAL;
  add(bSaveAs,c);

  // Filename Input (Textfield).
  c.gridx      = 1;
  c.gridwidth  = GridBagConstraints.REMAINDER;
  c.gridheight = 1;
  c.weightx    = 1.0;
  c.weighty    = 0.0;
  c.fill       = GridBagConstraints.BOTH;
  add(fileField,c);
  ...
```

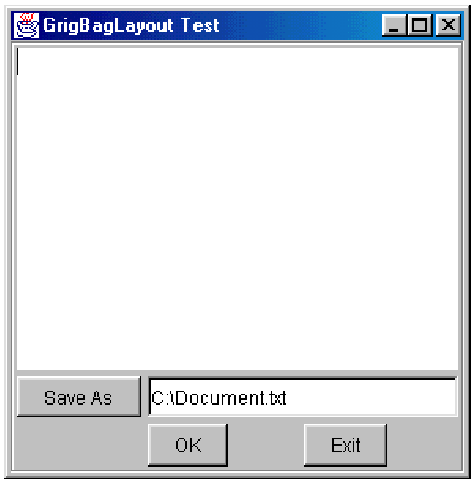
GridBagLayout: Example (Continued)

```
  // Exit Button.
  c.gridx      = 3;
  c.gridwidth  = 1;
  c.gridheight = 1;
  c.weightx    = 0.0;
  c.weighty    = 0.0;
  c.fill       = GridBagConstraints.NONE;
  add(bExit,c);

  // Filler so Column 1 has nonzero width.
  Component filler =
    Box.createRigidArea(new Dimension(1,1));
  c.gridx      = 1;
  c.weightx    = 1.0;
  add(filler,c);

  ...
}
```

GridBagLayout: Result



With Box filler at (2,1)



Without Box filler at (2,1)

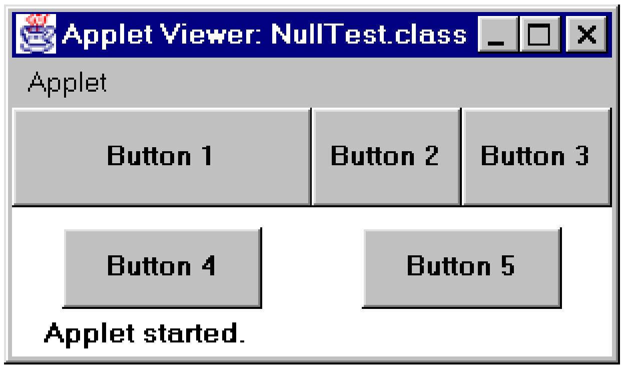
Strategies for Using Layout Managers

Disabling the Layout Manager

- **Behavior**
  - If the layout is set to **`null`**, then components must be *sized* and *positioned* by hand
- **Positioning components**
    - `component.setSize(width, height)`
    - `component.setLocation(left, top)`
  - or
    - `component.setBounds(left, top, width, height)`

No Layout Manager: Example

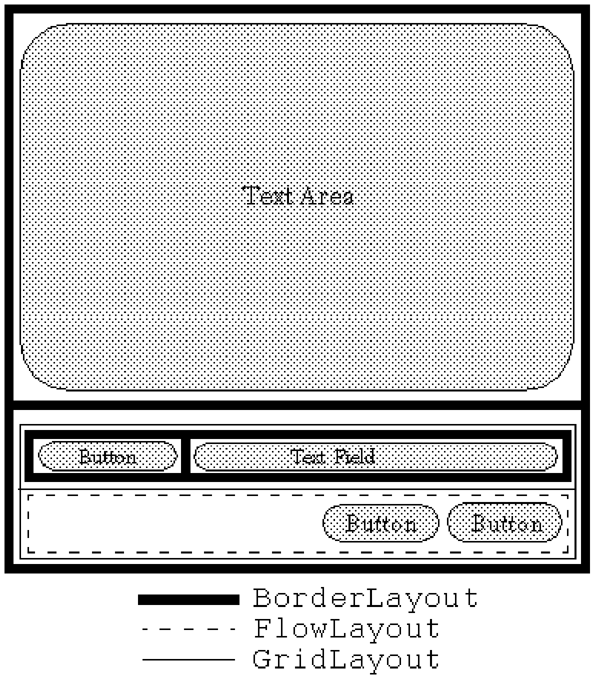
```
setLayout(null);
Button b1 = new Button("Button 1");
Button b2 = new Button("Button 2");
...
b1.setBounds(0, 0, 150, 50);
b2.setBounds(150, 0, 75, 50);
...
add(b1);
add(b2);
...
```



Using Layout Managers Effectively

- **Use nested containers**
  - Rather than struggling to fit your design in a single layout, try dividing the design into sections
  - Let each section be a panel with its own layout manager
- **Turn off the layout manager for *some* containers**
- **Adjust the empty space around components**
  - Change the space allocated by the layout manager
  - Override `insets` in the `Container`
  - Use a `Canvas` or a `Box` as an invisible spacer

Nested Containers: Example



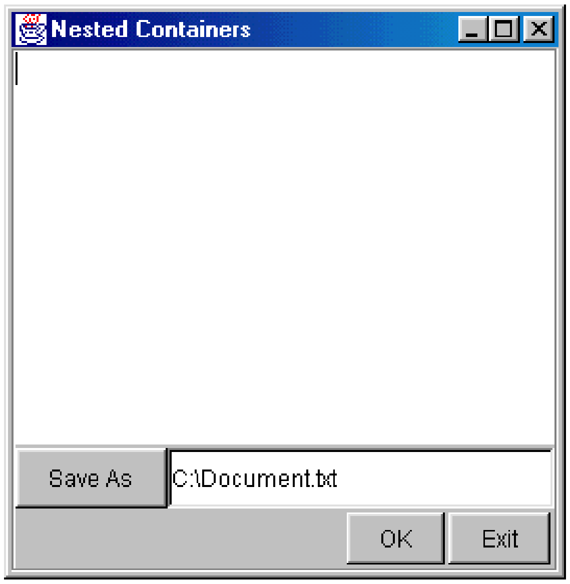
Nested Containers: Example

```
public NestedLayout() {

    setLayout(new BorderLayout(2,2));

    textArea = new JTextArea(12,40);  // 12 rows, 40 cols
    bSaveAs = new JButton("Save As");
    fileField = new JTextField("C:\\Document.txt");
    bOk = new JButton("OK");
    bExit = new JButton("Exit");

    add(textArea,BorderLayout.CENTER);

    // Set up buttons and textfield in bottom panel.
    JPanel bottomPanel = new JPanel();
    bottomPanel.setLayout(new GridLayout(2,1));
```

Nested Containers, Example

```
    JPanel subPanel1 = new JPanel();
    JPanel subPanel2 = new JPanel();
    subPanel1.setLayout(new BorderLayout());
    subPanel2.setLayout
            (new FlowLayout(FlowLayout.RIGHT,2,2));

    subPanel1.add(bSaveAs,BorderLayout.WEST);
    subPanel1.add(fileField,BorderLayout.CENTER);
    subPanel2.add(bOk);
    subPanel2.add(bExit);

    bottomPanel.add(subPanel1);
    bottomPanel.add(subPanel2);

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

Nested Containers: Result

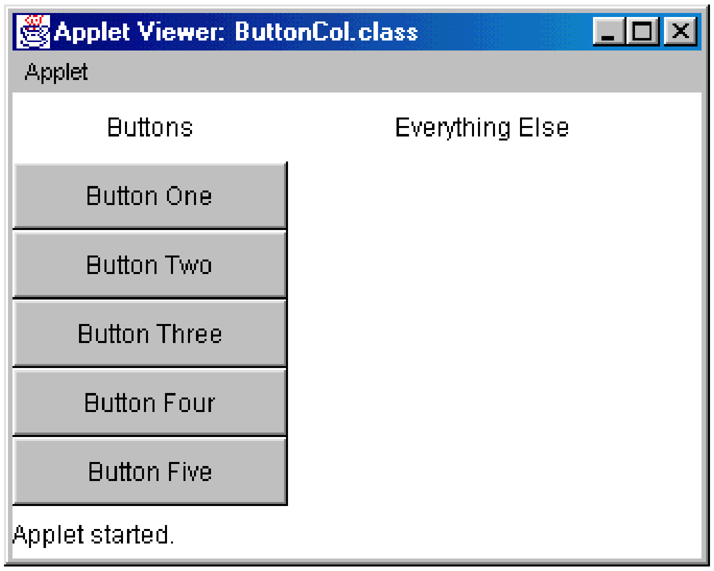


Turning Off Layout Manager for Some Containers: Example

- Suppose that you wanted to arrange a column of buttons (on the left) that take exactly 40% of the width of the container

```
setLayout(null);
int width1 = getSize().width*4/10;,
int height = getSize().height;
Panel buttonPanel = new Panel();
buttonPanel.setBounds(0, 0, width1, height);
buttonPanel.setLayout(new GridLayout(6, 1));
buttonPanel.add(new Label("Buttons", Label.CENTER));
buttonPanel.add(new Button("Button One"));
...
buttonPanel.add(new Button("Button Five"));
add(buttonPanel);
Panel everythingElse = new Panel();
int width2 = getSize().width - width1,
everythingElse.setBounds(width1+1, 0, width2, height);
```

Turning Off Layout Manager for Some Containers: Result



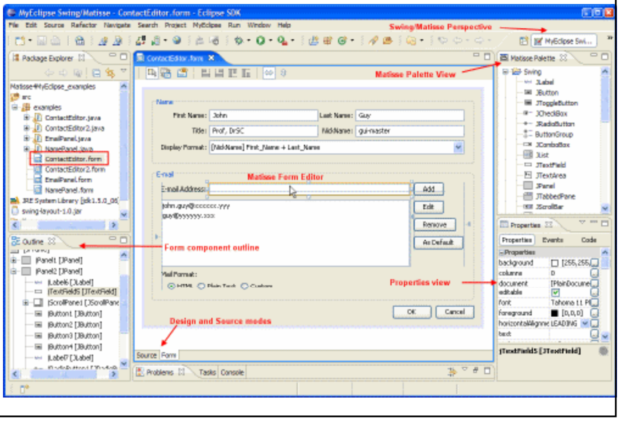
Adjusting Space Around Components

- **Change the space allocated by the layout manager**
  - Most `LayoutManagers` accept a horizontal spacing (`hGap`) and vertical spacing (`vGap`) argument
  - For `GridBagLayout`, change the insets
- **Use a `Canvas` or a `Box` as an invisible spacer**
  - For AWT layouts, use a `Canvas` that does not draw or handle mouse events as an "empty" component for spacing.
  - For Swing layouts, add a `Box` as an invisible spacer to improve positioning of components

Wrap-Up

Drag-and-Drop Swing GUI Builders

- **Free**
  - Matisse ("NetBeans GUI Builder") built into NetBeans
    - Also available in MyEclipse. *Not* in regular Eclipse.
  - WindowBuilder Pro
    - Originally a commercial product, then bought and released for free by Google. For Eclipse.
      - http://code.google.com/javadevtools/download-wbpro.html
- **Commercial**
  - JFormDesigner
    - jformdesigner.com
  - Jvider
    - jvider.com
  - SpeedJG
    - wsoftware.de
  - Jigloo
    - http://www.cloudgarden.com/jigloo/



Other Layout Managers

- **BoxLayout**
  – Lets you put components in horizontal or vertical rows and control the sizes and gaps. Simple, but useful.
- **GroupLayout**
  – Groups components into hierarchies, then positions each group. Mostly designed for use by GUI builders.
- **SpringLayout**
  – Alternative to GridBagLayout that lets you give complex constraints for each component. Almost exclusively designed for use by GUI builders.

Summary

- **Default layout managers**
  – Applet and Panel: FlowLayout
  – Frame and Dialog: BorderLayout
- **Preferred sizes**
  – FlowLayout: honors all
  – BorderLayout:
    - North/South honors preferred height
    - East/West honors preferred width
  – GridLayout: ignores preferred sizes
- **GridBagLayout**
  – The most complicated but most flexible manager
- **Design strategy**
  – Use nested containers, each with relatively simple layout

Questions?