G51PRG: Introduction to Programming Second semester

Lecture 15: Graphical User Interfaces in Java

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Plan of today's lecture

- GUI packages in Java
- Comparison of java.awt and javax.swing
- Containers and components
- Creating new components
- Adding components to a container (layout managers)
  - Flow Layout
  - Grid Layout
  - Border Layout
- Containment hierarchies

After Easter...

- Event handling
- Basics of graphics
- Thread issues
- Applets

Java GUI Packages

- **`java.awt`**: Abstract Window Toolkit (AWT) Used in Java 1.0 and 1.1
- **`javax.swing`**: Swing is part of the Java Foundation Classes. Can be used in Java 1.1 (as an extension), Java 1.2 and above (where it is a core package)
- use one or the other–*never mix AWT and Swing components.*
- Sun recommends using Swing components.

Comparison of AWT and Swing

- AWT: simpler, more robust but less flexible than Swing. Uses native code to display GUI components (hence the look and feel depends on the platform, e.g, Motif/CDE, Windows, MacOS).
- Swing: lots of additional features (pluggable look and feel, assistive technologies, drag and drop). Does not use native code. More verbose. Not thread-safe.

Overview of libraries

- Components & Containers (windows, buttons, menus etc.) - use the ones from **`javax.swing`**
- Layout managers (arranging components relative to each other and the size of screen) –from **`java.awt`**
- Event handlers respond to user input (mouse clicks, text input etc.) –from **`java.awt`**
- Classes dealing with graphics (colours, shapes, fonts) and images; basic utilities are mostly in **`java.awt`** (**`java.awt.Graphics, java.awt.Color`** etc.)

Components and Containers

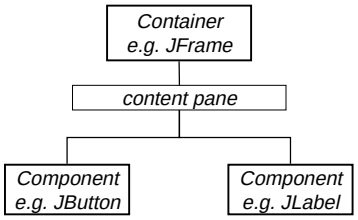
- ***Components*** are things like windows, menus, buttons, text labels, text fields etc.
- Some components are also ***Containers***: they can contain other components and are used for layout
- Some Components are ***atomic components***, e.g., buttons, text labels and text fields

Overview of the Swing Class Hierarchy

```
java.awt.Component
  └─java.awt.Container
      ├─java.awt.Window
      │   ├─java.awt.Frame
      │   │   └─javax.swing.JFrame
      │   └─java.awt.Dialog
      │       └─javax.swing.JDialog
      │
      └─javax.swing.JComponent
          ├─ javax.swing.JPanel,JLabel, JMenuBar etc ...
          └─javax.swing.AbstractButton
              └─ javax.swing.JButton, JMenuItem,etc ...
```


A Simple Swing Application

The simplest Swing application consists of a ***top-level Container*** and one or more Components



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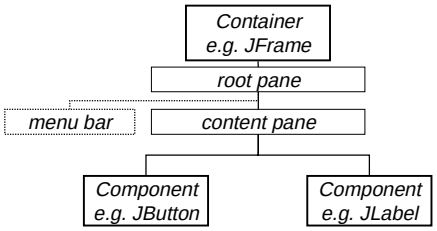


Creating a Single Window

There are two ways to make a window:

- in the **`main()`**, create an instance of a **`JFrame`** and make it visible;or
- extend **`JFrame`**, and in the **`main()`** create and make visible an instance of your new class.

Creating Components Inside a Window

Swing provides many classes for GUI components including buttons, labels and text fields, e.g.:

- to create a button with text *OK*, use

```
JButton okButton = new JButton("OK");
```

- to create a text label with text *Hi!*, use

```
JLabel label = new JLabel("Hi!");
```

Positioning Components in a Container

In Swing ***relative placement*** is used rather than ***absolute placement*:**

- components are placed and sized relative to other components
- how this is done depends on the choice of ***layout manager***

Layout Managers

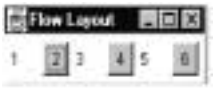
All layout mangers implement one of two interfaces:

- **`LayoutManager`**: interface for classes that know how to lay out containers, e.g., **`FlowLayout`**, **`GridLayout`** etc.
- `LayoutManager2` (extends **`LayoutManager`**): interface for classes that know how to layout containers based on constraint objects, e.g., **`BorderLayout`**, **`BoxLayout`**, **`GridBagLayout`**, etc.

Flow Layout

`FlowLayout` is the simplest way to fill in a window with components:

- start at the left upper corner and add the components one by one in a row
- when the right hand side of the container is reached start a new row



- default layout manager for **`JPanel`**s

Flow Layout Example

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

public class FlowExample extends JFrame {
  public FlowExample(){
    getContentPane().setLayout(new FlowLayout());
    getContentPane().add(new JLabel("1"));
    getContentPane().add(new JButton("2"));
    getContentPane().add(new JLabel("3"));
    getContentPane().add(new JButton("4"));
    getContentPane().add(new JLabel("5"));
    getContentPane().add(new JButton("6"));
}
```


Flow Layout Example continued

```
public static void main(String[] args) {
   FlowExample window = new FlowExample();
   window.setTitle("Flow Layout");
   window.pack();
   window.setVisible(true);
   }
}
```


Digression: Buttons with Icons

Adding a picture to the first button:

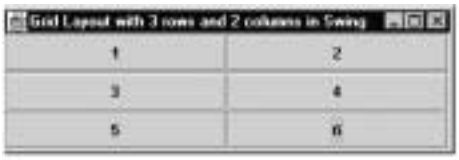
Buttons with Icons Example

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

public class ButtonExample extends JFrame {

 public ButtonExample(){
  ImageIcon icon = new ImageIcon("calvin.gif”);
  JButton calvin = new JButton(icon);
  getContentPane().setLayout(new FlowLayout());
  getContentPane().add(new JLabel(“1“));
  getContentPane().add(calvin);
      ...
}
```


Grid Layout

- The **`GridLayout`** class is a layout manager that lays out a container’s components in a rectangular grid.
- If the **`add()`** method is used without indicating row and column, the rows are filled from left to right and from top to bottom.

Grid Layout Example



Grid Layout Example

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

public class GridExample extends JFrame {
  public GridExample(){
      getContentPane().setLayout(new GridLayout(3,2));
      getContentPane().add(new JButton("1"));
      getContentPane().add(new JButton("2"));
      getContentPane().add(new JButton("3"));
      getContentPane().add(new JButton("4"));
      getContentPane().add(new JButton("5"));
      getContentPane().add(new JButton("6"));
  }
}
```


Border Layout

- The **`BorderLayout`** class is the default layout manager for **`JFrame`**, **`JDialog`** and **`JApplet`**
- In border layout, the container is divided into:
  - the `CENTER` area, which expands to take all available space
  - four borders: `NORTH` (top), `SOUTH` (bottom), `WEST` (left) and `EAST` (right)
- Often a container uses only one or two areas of the border layout, e.g., `CENTER` and `SOUTH`

Border Layout Example

Border Layout Example

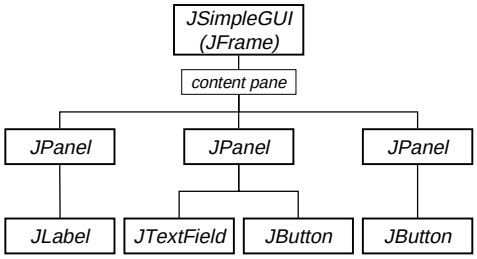
```
import javax.swing.*;
import java.awt.*;
public class BorderExample extends JFrame {
 public BorderExample(){
 // getContentPane().setLayout(new BorderLayout());
  getContentPane().add(new JButton("This is Center"),
                           BorderLayout.CENTER );
  getContentPane().add(new JButton("N"),
                           BorderLayout.NORTH);
  getContentPane().add(new JButton("S"),
                           BorderLayout.SOUTH);
  getContentPane().add(new JButton("E"),
                           BorderLayout.EAST);
  getContentPane().add(new JButton("W"),
                           BorderLayout.WEST);
 }
```


Containment Hierarchies

- For more control over layout, components are often grouped together in an ***intermediate container***, which is then added to another container, and so on.
- A **`JPanel`** is a container used for grouping components within a larger container, e.g., two buttons can be grouped on a **`JPanel`** to keep them together.

Intermediate Container Example

Intermediate Container Example



`JTextAreas` and **`JTextFields`**

A **`JTextField`** object is a text component that allows for the editing of a single line of text

- can be created with a specified width in columns and/or with a predefined line of text.

A **`JTextArea`** object is a multi-line region that displays text.

- can be editable or to be read-only
- can be created with scrollbars or without, with a given text, with a specified number of rows and columns, etc.

Intermediate Container Example

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

class JSimpleGUI1 extends JFrame {
  private JLabel label;
  private JTextField tf;
  private JButton okB, exitB;

  public JSimpleGUI1() {
    // Create the atomic components
    label = new JLabel("Enter your name");
    tf = new JTextField(20);
    okB = new JButton("Ok");
    exitB = new JButton("Exit");
```

Intermediate Container Example

```
// Create the intermediate containers
JPanel pane1 = new JPanel();  // default flow layout
pane1.add(label);
JPanel pane2 = new JPanel();  // default flow layout
pane2.add(tf);
pane2.add(okB);
JPanel pane3 = new JPanel(new
                      FlowLayout(FlowLayout.RIGHT));
pane3.add(exitB);
this.getContentPane().setLayout(new GridLayout(0, 1));
this.getContentPane().add(pane1);
this.getContentPane().add(pane2);
this.getContentPane().add(pane3);}
```


Intermediate Container Example

```
  public static void main(String args) {
    JSimpleGUI1 window = new JSimpleGUI1();
    window.setTitle("Simple GUI");
    window.pack();
    window.setVisible(true);
  }
}
```


Summary

- Classes from **`java.awt`** and **`javax.swing`** define various components of a graphical user interface
- Components are grouped together in containers
- Components are laid out relative to each other using layout managers
- For more control over layout, intermediate containers can be used

http://java.sun.com/docs/books/tutorial/uiswing/index.html