CMSC 132:
Object-Oriented Programming II

Java Support for GUIs

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Overview

- Java GUI Classes
- Creating a GUI
- Elements of a GUI
  - Component ⇒ items displayed (widgets)
  - Container ⇒ region containing components
  - Layout ⇒ arrangement of components
  - Event ⇒ interactions for GUI
Java GUI Classes

- AWT (Abstract Window Toolkit) (java.awt.*)
  - Old GUI framework for Java (Java 1.1)
  - Some reliance on native code counterparts
  - Platform independence problems

- Swing (javax.swing.*)
  - New GUI framework first introduced in Java 1.2
  - Includes AWT features plus many enhancements
  - Pure Java components (no reliance on native code)
  - Pluggable look and feel architecture

- SWT (Standard Widget Toolkit; from Eclipse)
Java GUI Classes

GUI classes can be organized in three groups

- **Component classes**
  - Items (widgets) displayed in GUI
    - JButton, JTextField, JDialog, JScrollBar…

- **Container classes**
  - Hold GUI Components
    - JFrame, JPanel, JApplet…

- **Helper classes**
  - Describe properties of other GUI components
    - Color, Graphics, Dimension…
How to Create a GUI

1. Define Frame or Applet to hold components
   - We’ll just use frames for now

2. Add GUI components to Frame
   - Use layout manager to determine position

3. Add actions to GUI
   - By adding event listeners to GUI components
GUI Elements – Container

Definition
- Abstractions occupying space in GUI

Properties
- Usually contain one or more widgets
- Can be nested in other containers

Example
- JFrame window containing
  - 1 menu (component)
  - 3 buttons (component)
  - 2 JInternalFrame windows (container)
Java Components

- JFrame
  - With three JButtons
JFrame Hierarchy

- Several super classes
  - As well as implemented interfaces
- Many, many member methods
  - Including inherited methods that allow
    - Resizing
    - Setting properties
    - Adding components,
    - Etc…
- Other top level containers
  - JDialog (dialog boxes)
  - JApplet (web applets)
  - JWindow (stripped down JFrame, no title bar or window buttons)
JFrame Structure

- Most things go into content pane
  - `getContentPane()`

- Use glassPane for pop up menus, some animations

- Methods
  - `getRootPane()`
  - `getLayeredPane()`
  - `getContentPane()`
  - `getGlassPane()`

- Can set...Pane explicitly

LayeredPane manages (optional) JMenuBar

LayeredPane contains contentPane
GUI Elements – Layout

- **Definition**
  - Arrangement of GUI components in container

- **Layout specification**
  - Logical terms (2\textsuperscript{nd} row, 1\textsuperscript{st} column, left)
    - Preferred approach
  - Actual coordinates (100 pixels, 5 inches)
    - Can be too rigid, limited to certain window sizes

- **Layout manager**
  - Entity translating layout specifications into actual coordinates at runtime, depending on conditions
Java Layout Managers

- **FlowLayout**
  - Lays out components from left to right

- **GridLayout**
  - Lays out components in a grid of user specified size

- **BorderLayout**
  - Designates portions of the container as North, South, East, West, and Center

- **CardLayout**
  - Adds components one on top of another

- **GridBagLayout**
  - Customizable manager that can use rows and columns of varying lengths
GUI Elements – Component

Definition
- Actual items (widgets) user sees in GUI

Examples
- Labels (fixed text)
- Text areas (for entering text)
- Buttons
- Checkboxes
- Tables
- Menus
- Toolbars
- Etc…
Java Components

- JPanel
Java Components

JTree

Creating a Simple JTree

javax.swing
- javax.swing.border
- javax.swing.colorchooser
- javax.swing.event
- javax.swing.filechooser
- javax.swing.plaf
- javax.swing.table
- javax.swing.text
- javax.swing.tree
- javax.swing.undo
Java Components

JTable

```
SELECT * from cisamdemo where account = '70000000009' and dollars > 1000
```

```
<table>
<thead>
<tr>
<th>DD</th>
<th>CONFIRM</th>
<th>PROCDATE</th>
<th>CONTROL</th>
<th>DOLLARS</th>
<th>DEALER</th>
<th>TERRITORY</th>
<th>CURRTRAN</th>
</tr>
</thead>
<tbody>
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<td>00161</td>
<td>06</td>
<td>210</td>
</tr>
</tbody>
</table>
```
Java Components

JTable

- Each JTable object
  - Gets its data from an object implementing TableModel interface
  - Displays contents of TableModel object
- DefaultTableModel class implements TableModel
- Many different ways to use JTable to display data
GUI Elements – Events

Definition

Action or condition occurring outside normal flow of control of program

Examples

- Mouse clicks
- Keyboard input
- Menu selections
- Window actions

In Java

- GUI events handled in event dispatching thread
Event Dispatching Thread

- Background thread to process events
  - From AWT graphical interface event queue
- These events are mainly updates that
  - Cause components to redraw themselves
  - Represent input events
- Swing uses a single-threaded painting model
  - Event Dispatching thread is the only valid thread for updating GUI components
  - Avoid updating GUI components from other threads
    - A source of common bugs
Event Dispatching Thread

Example code

- Allows current thread to execute GUI code in dispatching thread
- `createAndDisplayGUI`
  - Method that actually defines the GUI

```java
javax.swing.SwingUtilities.invokeLater(new Runnable() {
    public void run() {
        createAndDisplayGUI();
    }
});
```
Java Support For GUIs

- Several GUI code examples

Additional Resources

- Appendix C of textbook
- Javadoc for the JDK
- Swing tutorial
- Course slides and code handouts
- Java Ranch