

# CMSC 132: Object-Oriented Programming II

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## 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

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## 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)**

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## 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...

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## 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

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## GUI Elements – Container

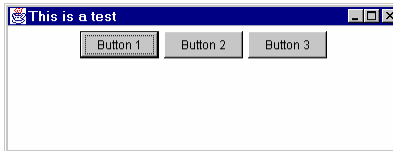
- **Definition**
  - Abstractions occupying space in GUI
- **Properties**
  - Usually contain one or more widgets
  - Can be nested in other containers
- **Example**
  - JFrame window containing
    - 1 menu (component)
    - 3 buttons (component)
    - 2 JInternalFrame windows (container)

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# Java Components

## ■ JFrame

- With three JButtons



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# JFrame Hierarchy

## ■ Several super classes

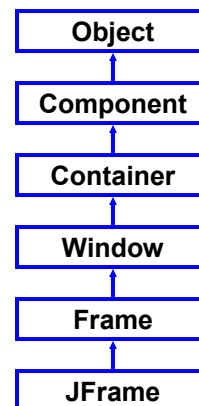
- As well as implemented interfaces

## ■ Many, many member methods

- Including inherited methods that allow
  - Resizing
  - Setting properties
  - Adding components,
  - Etc...

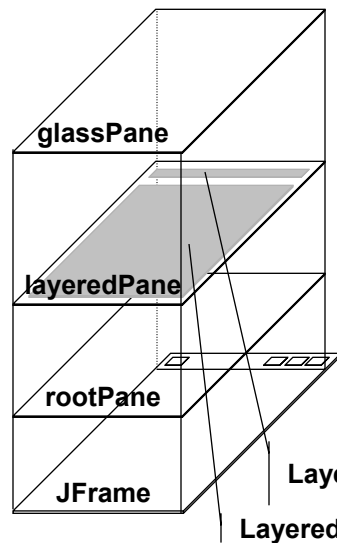
## ■ Other top level containers

- JDialog (dialog boxes)
- JApplet (web applets)
- JWindow (stripped down JFrame, no title bar or window buttons)



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## 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

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## GUI Elements – Layout

- Definition
  - Arrangement of GUI components in container
- Layout specification
  - Logical terms (2<sup>nd</sup> row, 1<sup>st</sup> 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

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## 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

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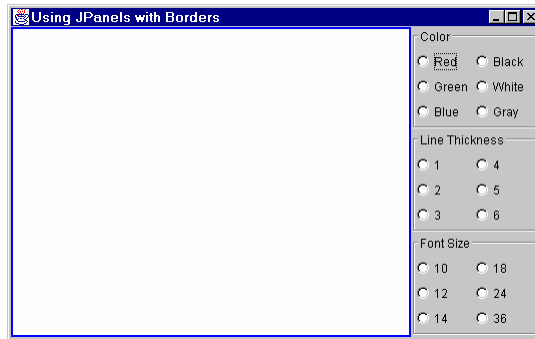
## GUI Elements – Component

- **Definition**
  - Actual items (**widgets**) user sees in GUI
- **Examples**
  - Labels (fixed text)
  - Text areas (for entering text)
  - Buttons
  - Checkboxes
  - Tables
  - Menus
  - Toolbars
  - Etc...

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# Java Components

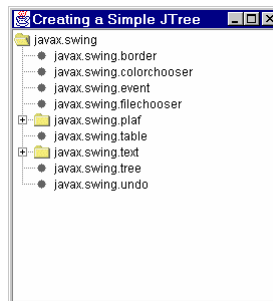
## ■ JPanel



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# Java Components

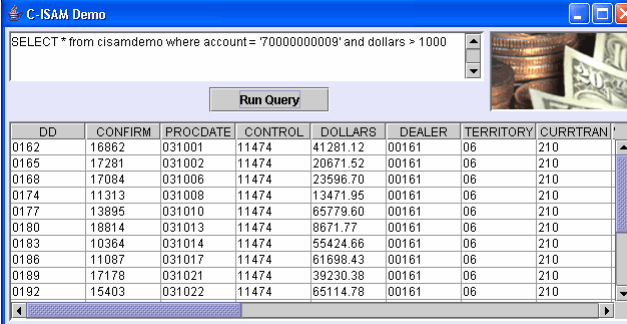
## ■ JTree



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# Java Components

## ■ JTable



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

Run Query

DD	CONFIRM	PROCDATE	CONTROL	DOLLARS	DEALER	TERRITORY	CURRTRAN
0162	16862	031001	11474	41281.12	00161	06	210
0165	17281	031002	11474	20671.52	00161	06	210
0168	17084	031006	11474	23596.70	00161	06	210
0174	11313	031008	11474	13471.95	00161	06	210
0177	13895	031010	11474	65779.60	00161	06	210
0180	18814	031013	11474	8671.77	00161	06	210
0183	10364	031014	11474	55424.66	00161	06	210
0186	11087	031017	11474	61698.43	00161	06	210
0189	17178	031021	11474	39230.38	00161	06	210
0192	15403	031022	11474	65114.78	00161	06	210

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# 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

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## 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

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## 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

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## Event Dispatching Thread

### ■ Example code

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

```
javax.swing.SwingUtilities.invokeLater(new Runnable() {  
    public void run() {  
        createAndDisplayGUI();  
    }  
});
```

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## 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

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