

Beginning GUI Programming: More Adventures in Inheritance and Aggregation (and packages)

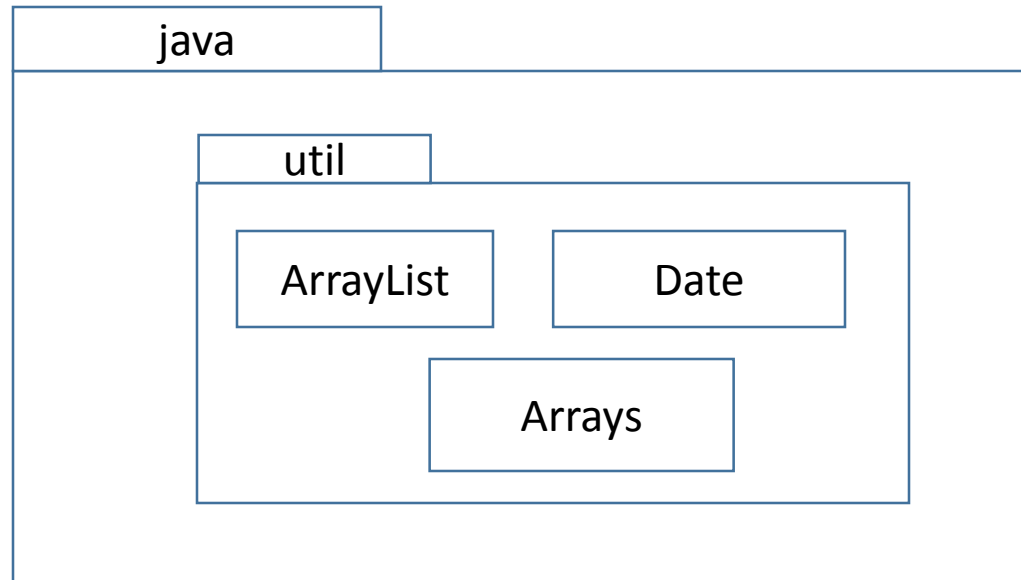
Slides derived from the work of
Dr. Amy McGovern and Dr. Deborah Trytten

Packages

- Packages are used to group classes together into meaningful units
- Examples
 - java.util
 - java.io
- Very simple to create a package
 - When creating a new class, enter the package name
 - Eclipse adds to top of file:
 - `package packageName;`

Packages in UML

Packages can nest



Package Naming Conventions

- Top level domain of organization first
 - Subdomains in reverse order
 - Then, name of package
- Done to preserve uniqueness of package names
- Example:
 - edu.ou.game

Access Modification and Packages

- Protected data is shared when classes share a package
- If you do not give methods and data an access modifier (public, protected, private) it will have package level access

Access Levels

Modifier	Class	Package	Subclass	World
public	Y	Y	Y	Y
protected	Y	Y	Y	N
<i>no modifier</i>	Y	Y	N	N
private	Y	N	N	N

Handy dandy chart:

<http://download.oracle.com/javase/tutorial/java/javaOO/accesscontrol.html>

Basic Elements of GUIs

- Components (sometimes called widgets)
 - Buttons, Checkboxes, etc.
- Containers collect Components together into a single unit

Basic Elements of GUIs II

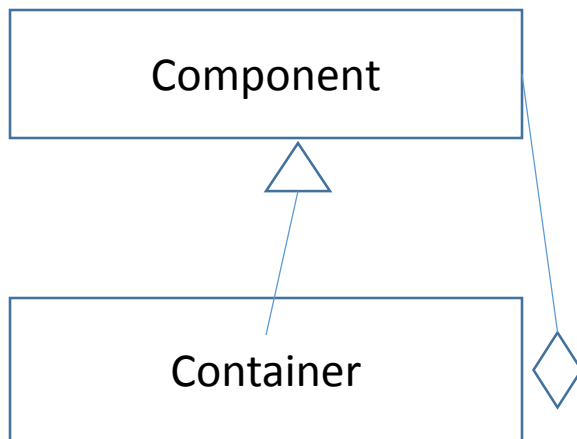
- Layout Managers
 - Determine how the components are organized in the container
- Look for examples in PowerPoint
 - Resizing can help identify layout management

Two Kinds of Components

- Abstract Windowing Toolkit (java.awt)
 - Designed to use components from platform
 - Good idea, but was problematic
 - Have to allow options for all platform options
 - Resulted in heavyweight components
- Swing (javax.swing)
 - Components start with J (e.g. JButton)
 - Only lowest level components are from platform

Container and Component?

- Container inherits from Component
 - Container is-a Component
- Container also aggregates Component

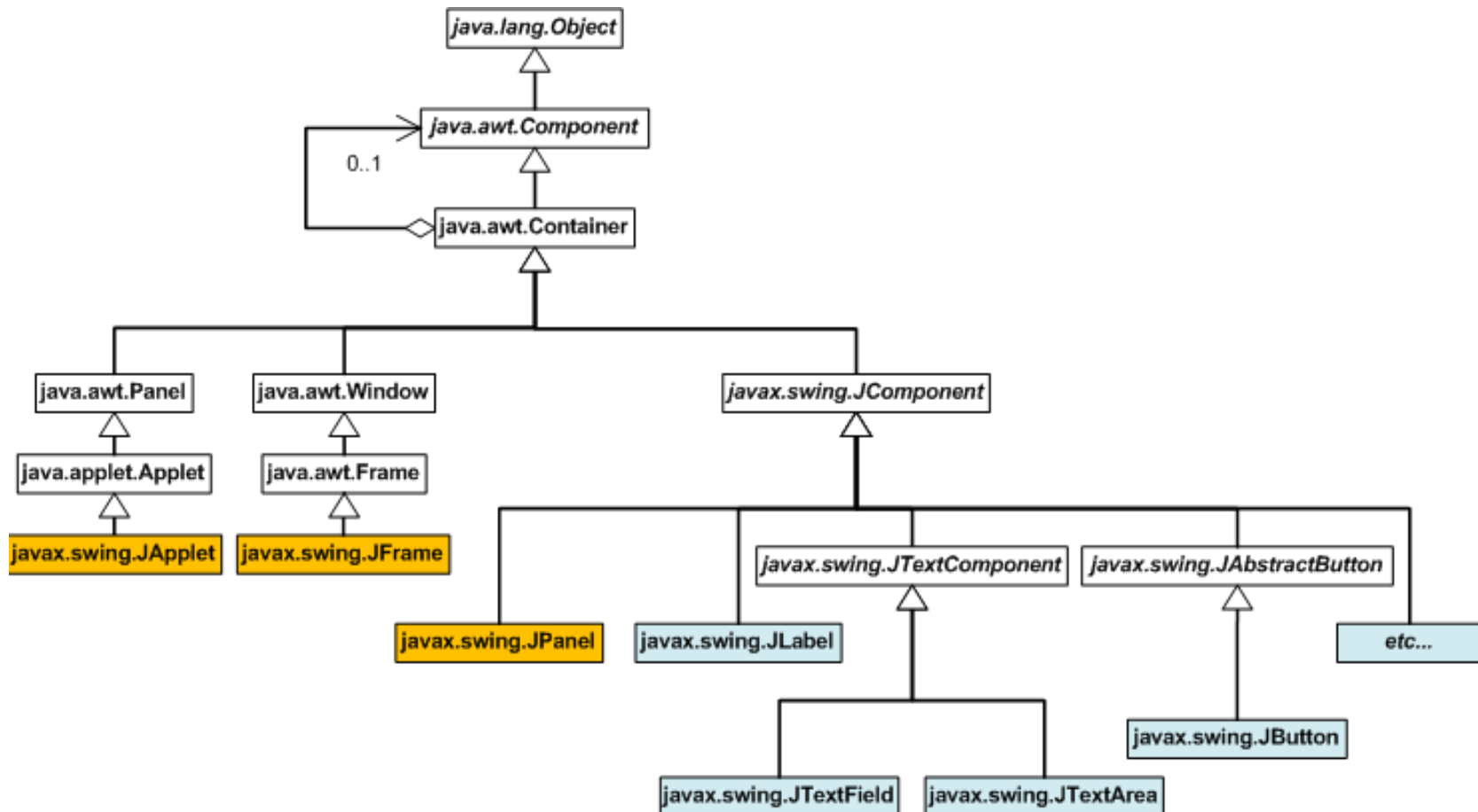


What we want: A hierarchy!

Compare folders (directories) and files

What would happen if roles switched?

Java GUI Hierarchy UML



How to create a window

Key window pieces:

```
JFrame frame = new JFrame("Title");

// Default is to do nothing, so this is necessary
frame.setDefaultCloseOperation(
    JFrame.EXIT_ON_CLOSE);

// Default is upper left corner of screen
frame.setLocationRelativeTo(null); // centers window

// Default is size zero so only decorations will be shown
frame.setSize(100, 100);

// Won't see anything if you forget this
frame.setVisible(true);
```

Example

- Make a window titled “Foo Window”

Add Stuff (Components) to the Window

- Frames have a content pane which hold components
- `JButton ok = new JButton("OK");`
 - Construct new button
- `frame.add(ok);`
 - Put it in the frame's content pane
- What happens to the button when the window is resized?
- What happens if we try to put in a second button?
- Add a tooltip
 - `componentName.setTooltipText("Explanation")`

Example

- Make a window titled “Save Window”
- Add a button that says “Save first half”
- Can we add a button that says “Save second half”?

Additional Components

- JLabel – labels on the screen
- Fields for users to enter text
 - JTextField
 - JTextArea
- Binary choices
 - JRadioButton
 - JCheckBox
- Lots of other choices (see classes that start with J in API)

Layout Managers

- The configuration of components within a content pane is determined by the Layout Manager
 - Layout managers are in java.awt package
- Layout Management is rarely done with absolute pixel positions
 - Too many different monitors, platforms, window sizes

Layout Managers

To change layout managers

- Construct the new manager (e.g., use `FlowLayout`)
- Use `setLayout()` to pass the newly constructed manager
- Manager object is frequently ***anonymous***
 - What does this mean?

FlowLayout

Components are placed in the container from left to right, top to bottom

- Order of calls to `add()` determines placement
- Resizing rarely works well

Another Implementation Option

Allow class to inherit from JFrame directly, rather than having a JFrame as a component

- What does the code look like?
- Constructor calls other constructors, sets layouts, rather than doing this in main()

GridLayout

- Used for rectangular arrangements of widgets
- All components are equal size (limits use of layout)
- Components added left to right, top to bottom
 - These could be stored in an array
- Order of calls to add determines placement

GridLayout

- GridLayout constructor takes two parameters: number of rows and columns
- Weirdness with size = 0 for rows/cols:
 - Used to flag that the other dimension should dominate and this one should be as small as possible.
- More complicated layout manager available: GridBagLayout

BorderLayout

- Really nice layout manager
- Divides screen into five areas (constants)
 - Four compass directions
 - Center
 - Some areas can be left empty
- Resizing occurs at center
 - PowerPoint does this
- Adding: `add(component, placement)`
 - What happens when multiple components are added to the same placement?

Containers Revisited

- To add more than one component to the middle of a BorderLayout need another container
 - JPanel used to organize components
- Common for hierarchies to get deep
 - Necessitates careful design and documentation of components and containers
 - Resizing
- Can add borders to Jpanels:
 - TitledBorder (line around JPanel containing description)
 - LineBorder(line around Jpanel)

Color

- In java.awt
 - RGB: 0-255
 - Doesn't work like grade school paints (red + green = yellow)
- Can change background and foreground colors
 - setBackground()
 - setForeground()
- Lots of standard name constants available
 - BLACK, BLUE, CYAN, etc.
- Remember: artists are your friends

Font



- Problematic in commercial systems
 - Can be proprietary
 - Can be system dependent
- In java.awt
 - Names of families of font (mapped to fonts by local installation)
 - Serif (has little projections)
 - SanSerif (no little projections)
 - Monospaced (every character takes same space—can be UGLY)
 - Dialog (default)
 - DialogInput
 - Styles
 - PLAIN, BOLD, ITALIC
 - Size (in pixels)

ImageIcon

- Small image of fixed size
 - ImageIcon icon = new ImageIcon(filename);
 - Doesn't throw FileNotFoundException! Why?
- Formats
 - GIF
 - JPEG
 - PNG
- Can be placed on JLabel or JIcon by constructor
- Icons can be shared with multiple components

GUI Design

- Everyone thinks they can design GUIs perfectly
- Good GUI design requires
 - Artistic skill
 - Taste
 - Color sense
 - Usability considerations
 - Number of visible controls
 - Modes
 - Organization
 - Visibility
- CS 3053 Human Computer Interaction

Example

- Design an interface for a simple calculator
 - Windows calculator could be a model, but use no menus or memory
 - Implement it in Java
- We can't do the interactions
 - Yet!

