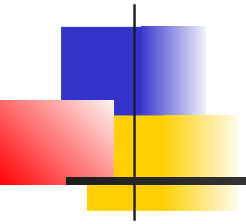


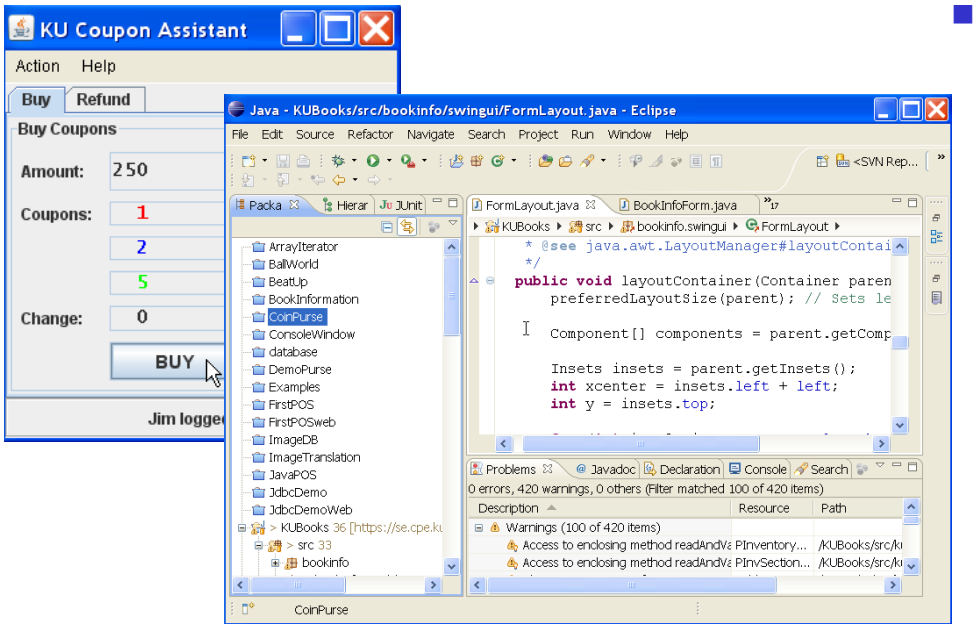
Introduction to Graphical Interface Programming in Java

Introduction to AWT and Swing

GUI versus Graphics Programming

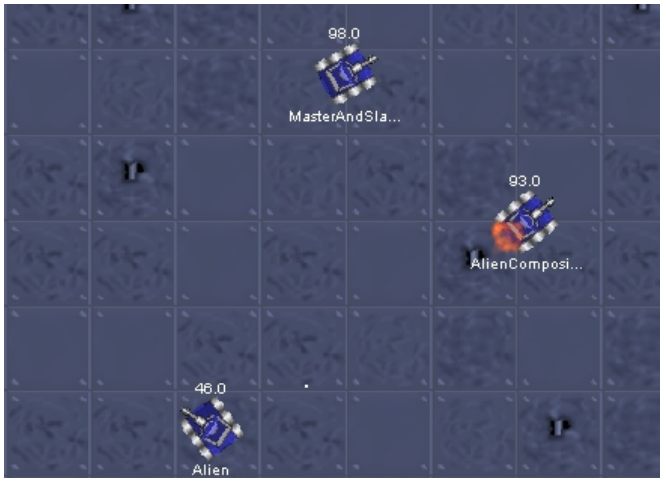
Graphical User Interface (GUI)

- Display info and accept user input
- Built using components
- "Forms" applications



Graphics Programming

- Manipulate graphical elements on a display
- points, lines, curves, shapes
- texture and lighting
- animation, 3D effect



Java Graphics Toolkits

Java provides frameworks for building graphical UIs.

AWT - Abstract Windowing Toolkit

- the first Java graphics framework

Swing - OS-independent framework.

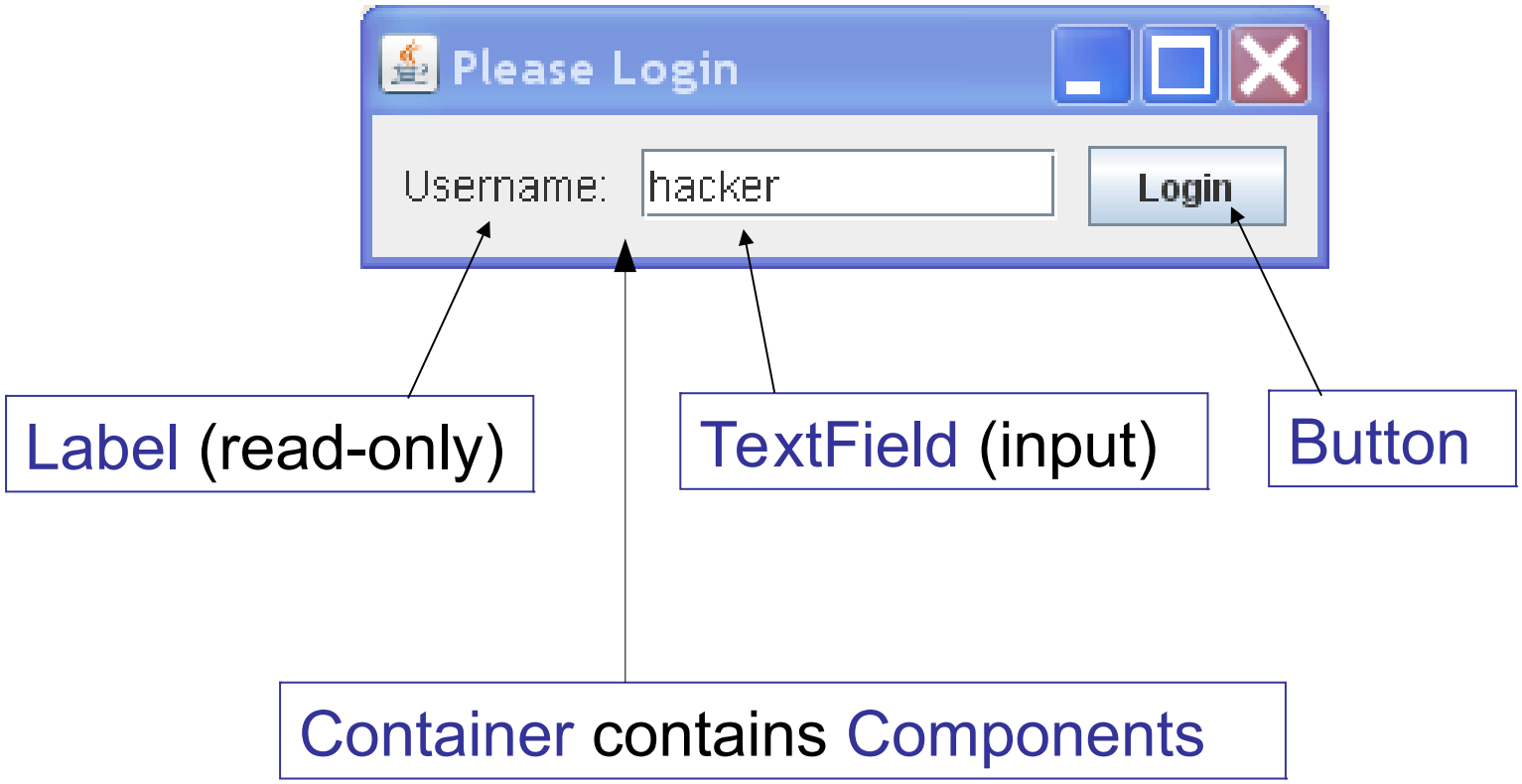
JavaFX - layout specified in XML (fxml), like Android

- use SceneBuilder to create a layout
- can also create layout in code (like Swing)

SWT - Standard Widget Toolkit used in Eclipse, Firefox.
Designed for efficiency. An Eclipse project.

Simple GUI Application

A graphical interface consists of components, containers, and layouts.



Designing a Simple GUI

1. create a window (a container)
2. create components

```
label = new Label("Username:");
input = new TextField( 12 ); // 12 = field width
button = new Button("Login");
```

3. layout components in a container

```
add( label );
add( input );
add( button );
```

4. display the container (frame is the container here):

```
frame.setVisible( true );
```

5. wait for user to do something

Graphics Toolkits

Java provides complete "frameworks" for building graphical applications.

A *framework* contains all the components and logic needed to manage a graphical interface.

You provide:

- select components and set their properties
- write application logic that controls how application responds to user actions
- you may extend (subclass) existing components to create custom components

AWT Graphics Toolkit - `java.awt`

- Java's first GUI toolkit
- uses graphical UI components of operating system, e.g. Windows, MacOS, X-windows.
- efficient, low overhead
- applications look different on each platform
- difficult to write and test good quality applications
- different bugs on each OS, hence the slogan . . .

"*Write once, debug everywhere*"

AWT Example

```
import java.awt.*;
public class AwtDemo {
 Frame frame;

 public AwtDemo( ) {
      frame = new Frame("Please Login");
    // create components
    Label label = new Label("Username:");
    TextField input = new TextField(12);
    Button button = new Button("Login");
    // layout components in the container
    frame.setLayout(new FlowLayout());
    frame.add(label);
    frame.add(input);
    frame.add(button);
    frame.pack();
 }
```

AWT Example (continued)

To display the window, call **`setVisible( true )`**

```
    public static void main(String [] args) {
        AwtDemo demo = new AwtDemo( );
        demo.frame.setVisible( true );
    }
}
```

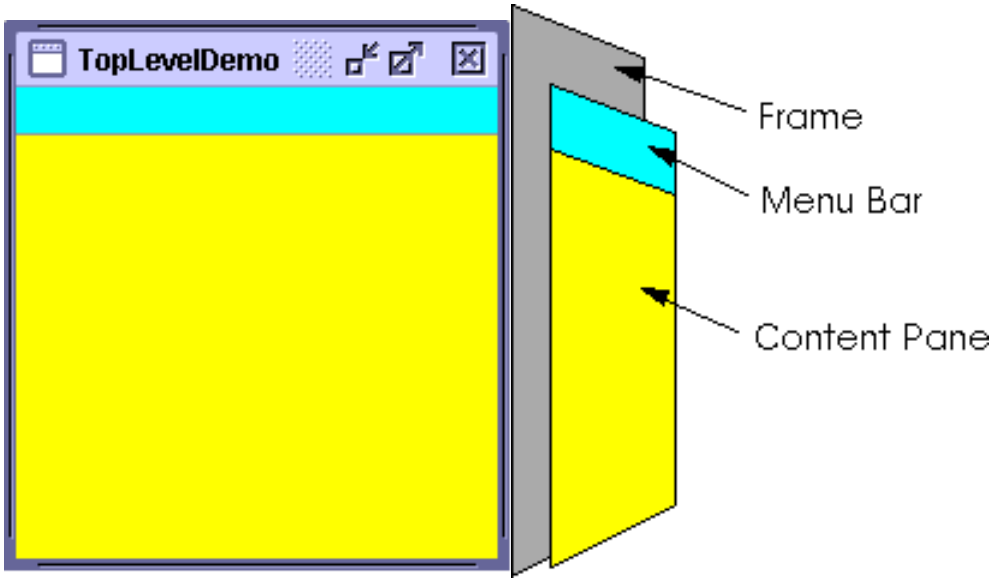
Swing Graphics Framework

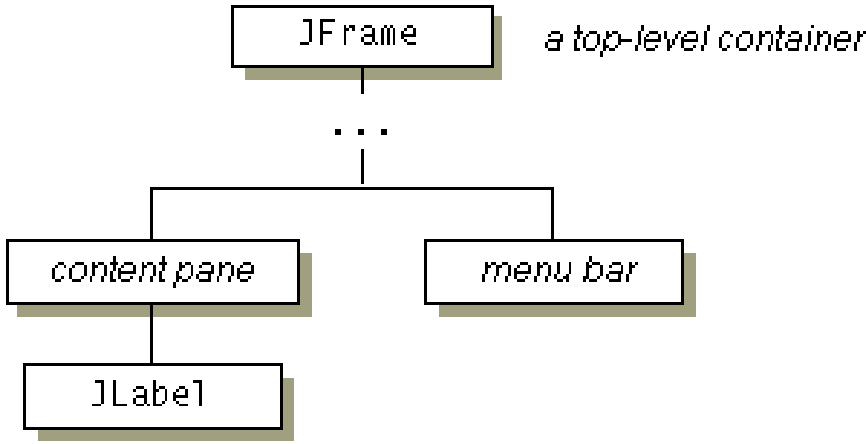
- Improved, OS-independent GUI framework
- classes in **`javax.swing`** and sub-packages
- Swing implements all components in software
- applications look & behave the same on all platforms
- applications *may not* look like native GUI apps (but you can change that by applying a LookAndFeel)
- part of the Java Foundation Classes (JFC).
  JFC also includes a 2D API and drag-and-drop API

Swing Containers

JFrame is the top level container for most applications

- has a title bar, menu bar, and content pane
- JFrame is a ***heavy weight*** component.





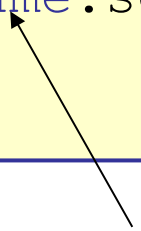
Swing Example

```
import javax.swing.*;
public class SwingDemo {
    JFrame frame;
    public SwingDemo( ) {
        frame = new JFrame("Please Login");
       // create components
       JTextField label = new JLabel("Username:");
       JTextField input = new JTextField(12);
       JButton button = new JButton("Login");
       // layout components in the container
       ContentPane pane = frame.getContentPane();
       pane.setLayout(new FlowLayout());
       pane.add(label);
       pane.add(input);
       pane.add(button);
       pane.pack();
    }
```

Swing Example (continued)

To display the window use **`setVisible( true )`**

```
    public static void main(String [] args) {
        SwingDemo demo = new SwingDemo( );
        demo.frame.setVisible( true );
    }
}
```



This is Bad Programming!

We should not directly access the private attributes of an object. We should invoke public behavior instead.

Demo

- Create the simple "Login" interface.

What is Running My Program?

In the main method, setVisible(true) returns immediately.

main() exits.

But, the application is still running!

What is in control? Where is the control of flow?

```
    public static void main(String [] args) {
        SwingDemo demo = new SwingDemo( );
        demo.frame.setVisible( true );
       System.out.println("UI started. Bye.");
    }
}
```

Swing creates its own Thread

Swing runs in a separate thread.

Or more than one thread.

One thread is special: the *Event Dispatcher Thread*

The Event Dispatcher Thread receives and "dispatches" all events involving the UI.

You should perform all UI updates in this thread.

Top Level Containers

A window that be displayed on screen:

- JFrame - title bar, menu, and content pane
- JWindow - no title bar or menu.
- JDialog - a dialog window, has title bar
- JApplet - for Applets (run in web browser).
  Deprecated now.

What's a Component?

- Also called "widgets".

Label

Textbox

Button

Slider

Checkbox

ComboBox

RadioButton

ProgressBar

xxx

Know your components

You need to know the available components

... and what they can do.

Visual Guide to Components

Sun's *Java Tutorial*

…/tutorial/ui/features/components.html

for Windows:

tutorial/ui/features/compWin.html

What Can a Component *Do*?

Common Behavior

setLocation(x, y)

setIcon(imageIcon)

setBackground(color)

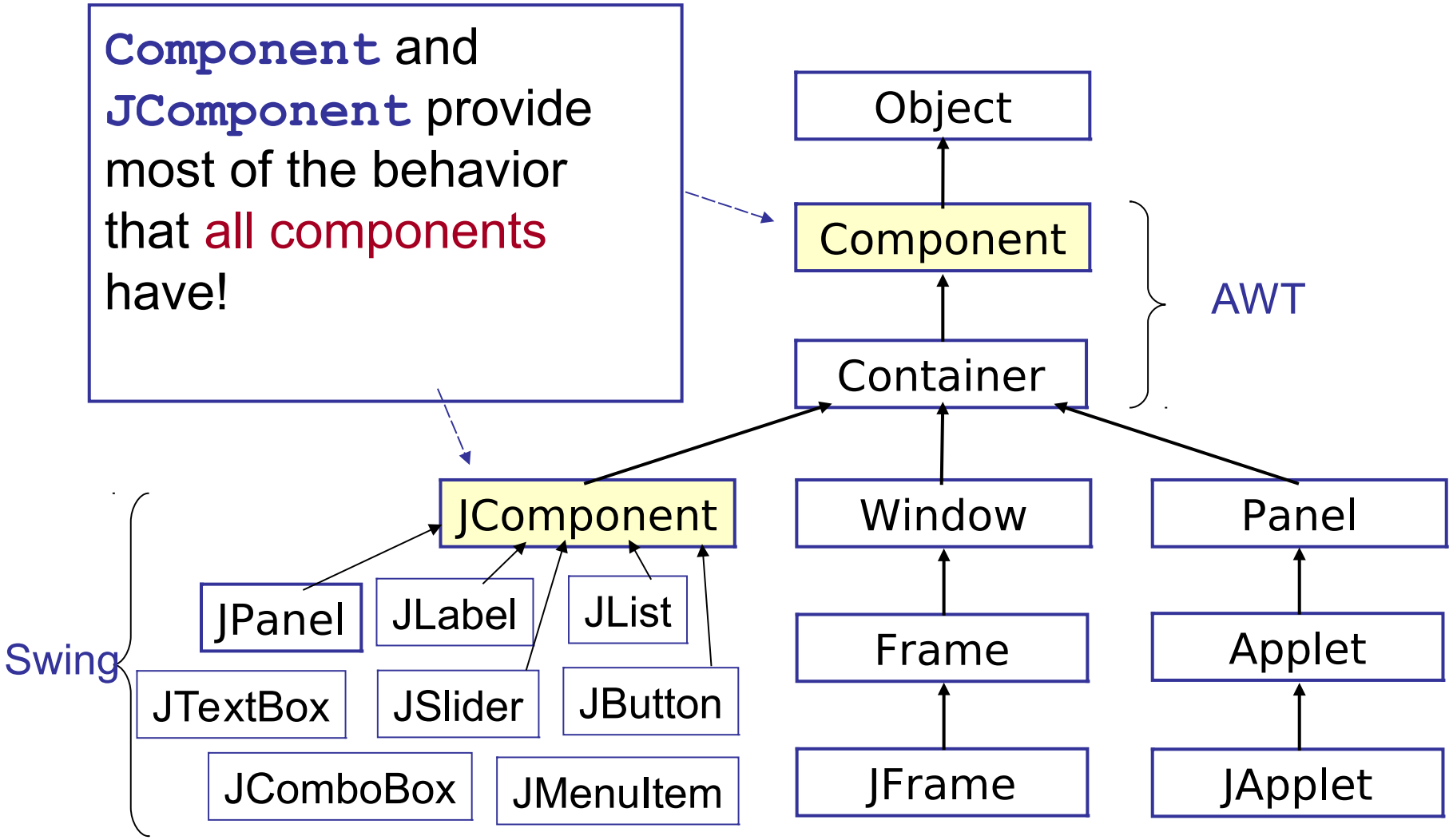
setForeground(color)

setEnabled(boolean)

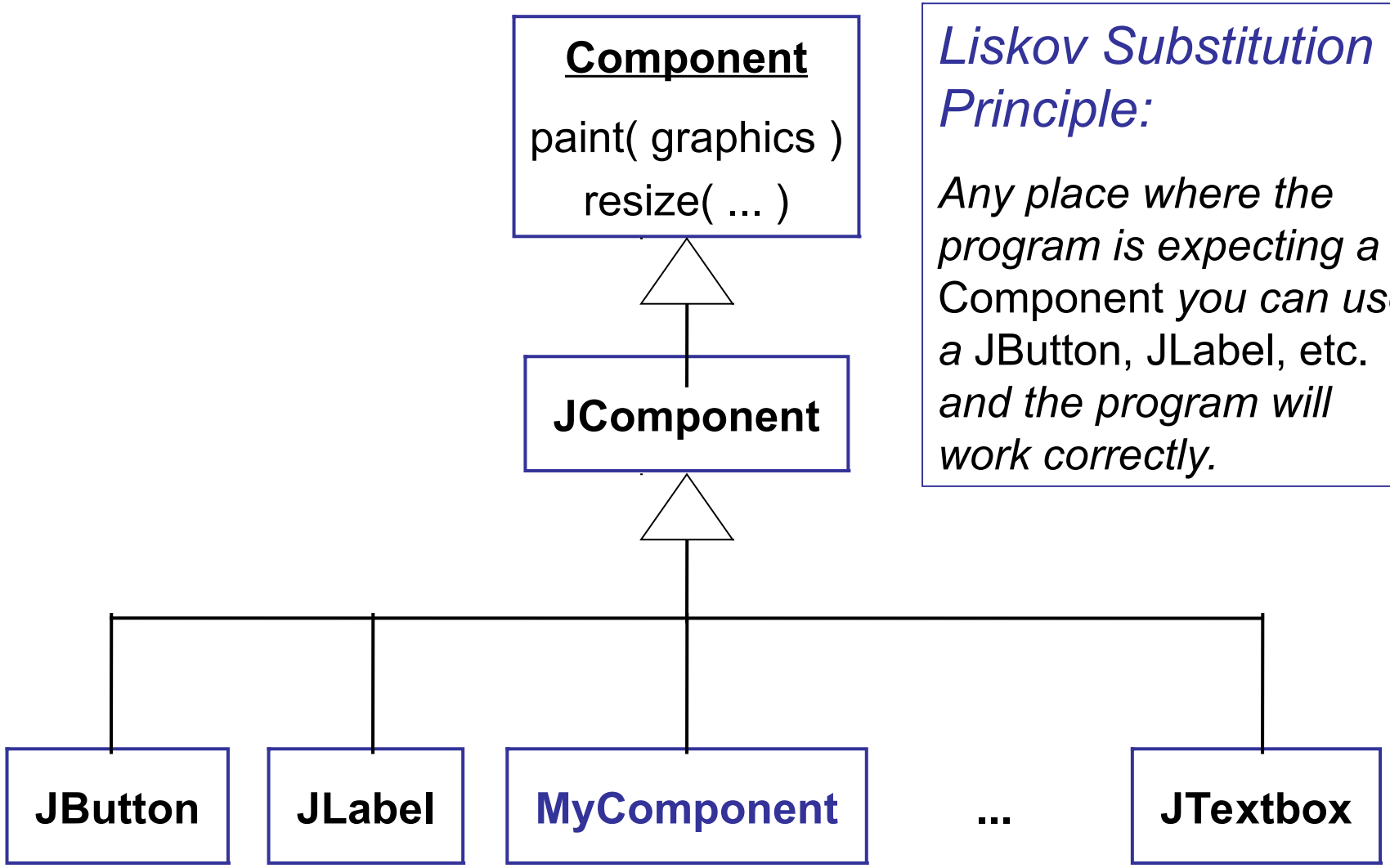
setVisible(boolean)

setToolTipText(string)

Important Components to Know



Hierarchy of Graphics Components



Liskov Substitution Principle:

Any place where the program is expecting a Component *you can use a* JButton, JLabel, etc. *and the program will work correctly.*

Playing with a JButton

```
import java.awt.*;
import javax.swing.*;
JButton button = new JButton( "Press Me" );
//TODO: add button to a frame and pack
button.setBackground( Color.YELLOW );
button.setForeground( Color.BLUE );
button.setToolTipText( "Make my day." );
button.setFont( new Font( "Arial", Font.BOLD, 24 ) );
button.setEnabled( true );
```

Components don't have to be boring

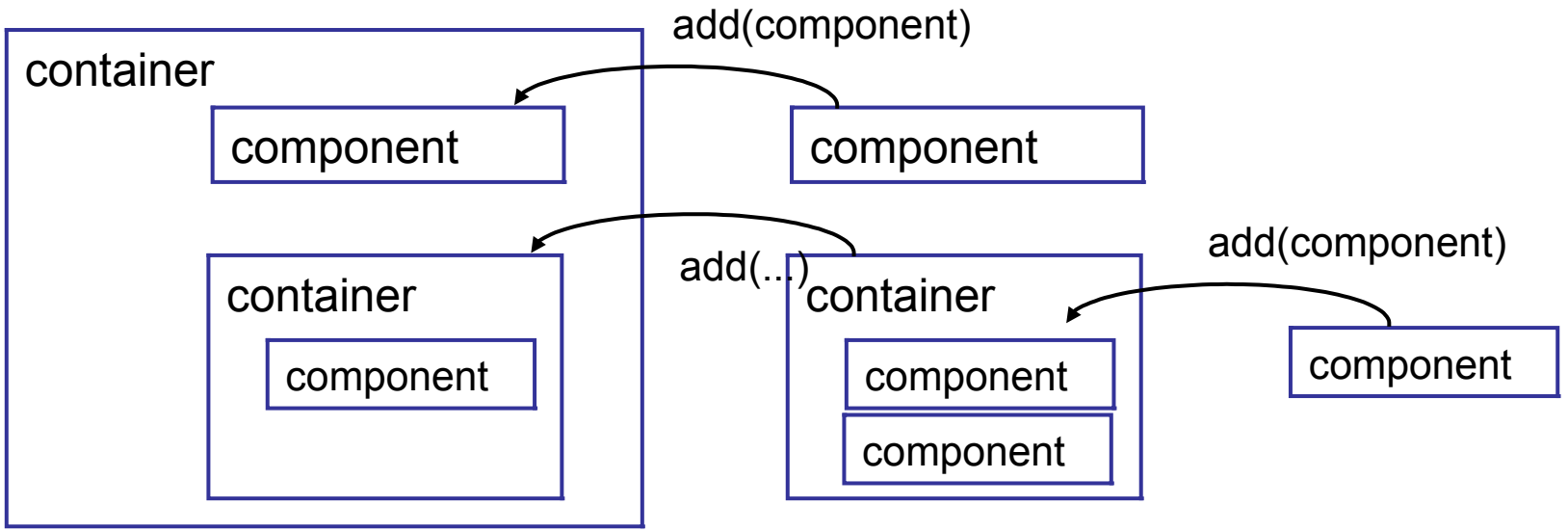
filename, URL, or InputStream.

Can by GIF, JPEG, PNG

```
ImageIcon icon = new ImageIcon("d:/images/fish.png");
button.setIcon(  icon );
```

Containers and Components

- A GUI has many **components** in **containers.**
- Use **add** to put component in a container.
- A container is also a component; so a container may *contain other containers*.



Lightweight Containers

A lightweight container is one that is not a window.

You must place it inside another container.

Cannot be drawn on screen by itself.

- JPanel simple rectangular area - most common
- JTabbedPane - multiple panels with a tab on top
- JSplitPane
- JInternalFrame - like a JFrame inside a JFrame

Learning Java Graphics

- Java Tutorial: *Creating a GUI with JFC/Swing*

  The section "*Using Swing Components*" contains "How To..." examples for many components.

  Good explanation and examples of Layout Managers.

- "JDK Demos and Samples"

  ***`jdk_dir`*`/demo/jfc/*`**

  Great demos with jar files (run) and source code. http://www.oracle.com/technetwork/java/javase/downloads/index.html

- *Big Java*, Chapter 19.

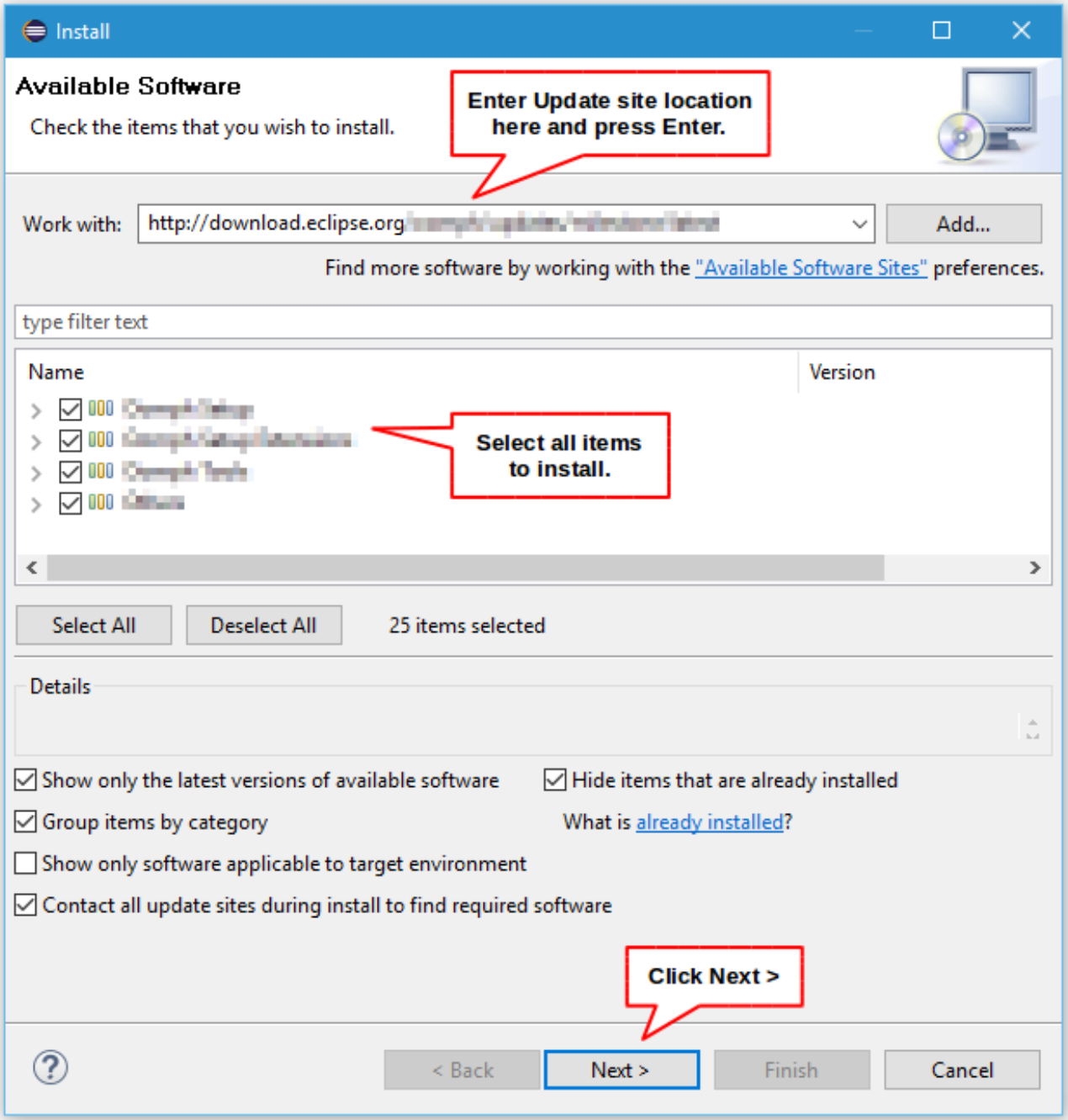
WindowBuilder for Eclipse

A graphical editor for creating UI with Swing or SWT.

Windowbuilder is included in Eclipse, but you *may* need to download & install extra components.

To find the Window Builder "Update Site" for your version of Eclipse, see:

http://www.eclipse.org/windowbuilder/download.php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Select All
Deselect All
25 items selected
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Group items by category
What is already installed?
Show only software applicable to target environment
Contact all update sites during install to find required software
Click Next >
< Back
Next >
Finish
Cancel