19. A Quick Java Swing Tutorial

Introduction

- Swing – A set of GUI classes
  - Part of the Java's standard library
  - Much better than the previous library: AWT
    - Abstract Window Toolkit
- Highlights
  - A rich set of widgets
    - Widget: Any GUI element (also called: components)
  - Contents and shape are separated (MVC support)
  - Fine-grained control over the behavior and look and feel
  - Platform independent
    - Isolates the programmer from the operating system's GUI

Swing Components

- Containers
  - Contain and manage other components.
  - Top Level/Internal
  - Examples: `JFrame` (Top Level), `JScrollPane`, `JPanel`.
- Basic controls
  - Atomic components
  - Used for showing output and/or getting some input
  - Inherits JComponent
  - Examples: `JButton`, `JLabel`, `JTextArea`, `JTable`, `JList`
- Usually every Swing class extends the corresponding AWT class
  - For backward-compatibility reasons

My First Swing Program

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

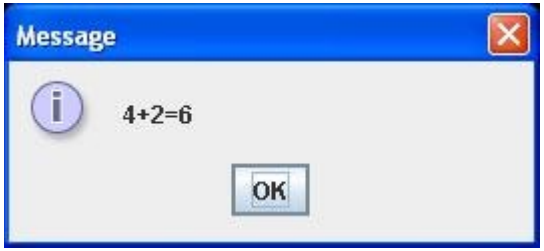
public class First {
  public static void main(String[] args) {
    JFrame frame = new JFrame("My First Frame");

    // operation to do when the window is closed.
    frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

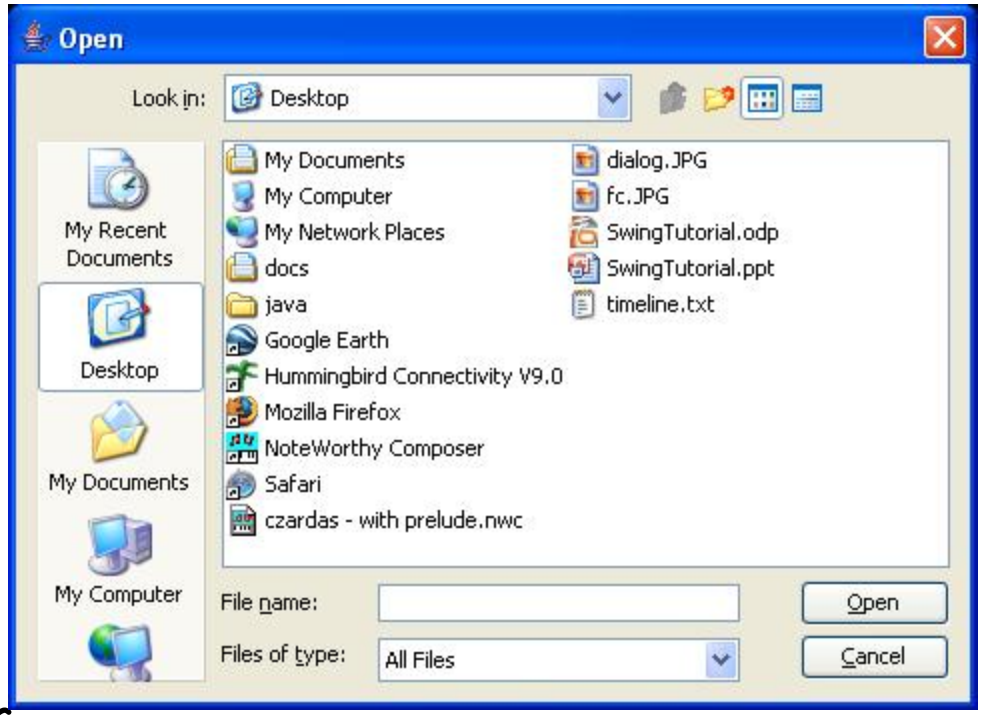
    frame.getContentPane().setLayout(new BorderLayout());
    frame.getContentPane().add(new JLabel("I Love Swing"),
       BorderLayout.CENTER);
    frame.pack();
    frame.setVisible(true);
  }
}
```

Top Level Containers: JDialog

- **`javax.swing.JDialog`**:
  - More simple and limited than frames
  - Typically used for showing a short message on the screen
  - Also has a border and a title bar
  - May have an owner
    - If the owner is invisible the dialog will also be invisible
  - Use the static method of JoptionPane to show standard dialog boxes:
    `JOptionPane.showMessageDialog(null, "4+2=6");`



Top Level Containers: JFileChooser



- **`javax.swing.JFileChooser`**:
  - Allows the the user to choose a file
  - Supports “open” and “save”: `showOpenDialog(),showSaveDialog()`

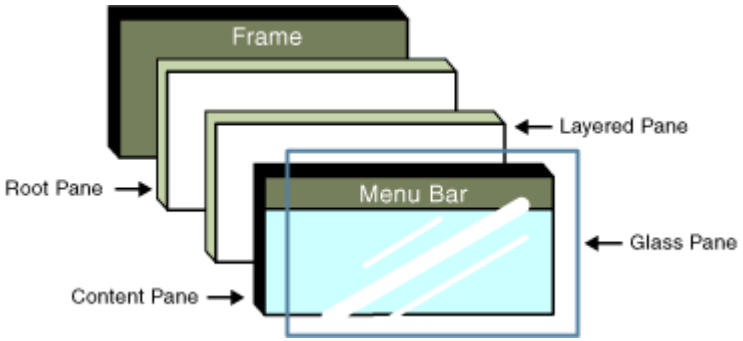
```
JFileChooser fc = new JFileChooser();
int returnVal = fc.showOpenDialog(null);
if(returnVal == JFileChooser.APPROVE_OPTION)
   System.out.println("File: " + fc.getSelectedFile());
```

Top Level Containers: JFrame

- **`javax.swing.JFrame`**:
  - Top-level window with a title and a border.
  - Usually used as a program's main window

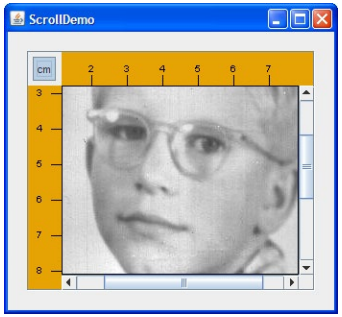
More on JFrame

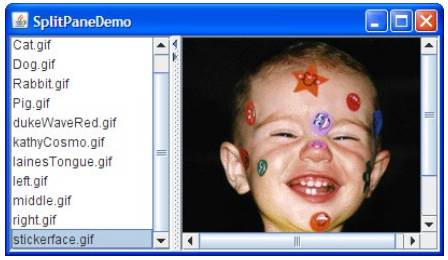
- Made of several layers
- Widgets are added to the Content Pane layer.
  - Use `getContentPane()` to obtain it
- Other layers are used for customizing the window's appearence

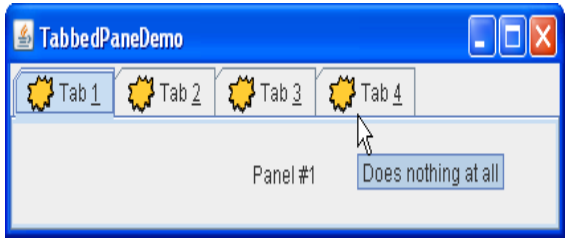


Internal Containers

- Not Top level containers
- Can contain other non-top level components
- Examples:
  - `JScrollPane`: Provides a scrollable view of its components
  - `JSplitPane`: Separates two components
  - `JTabbedPane`: User chooses which component to see



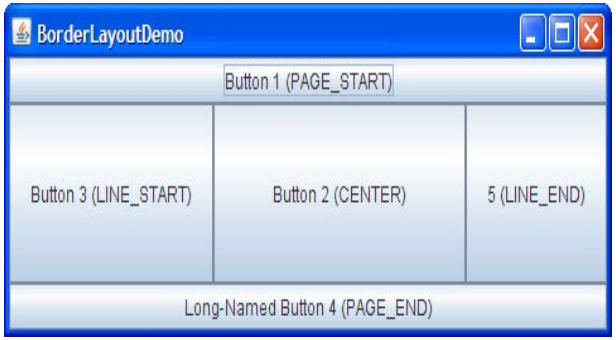


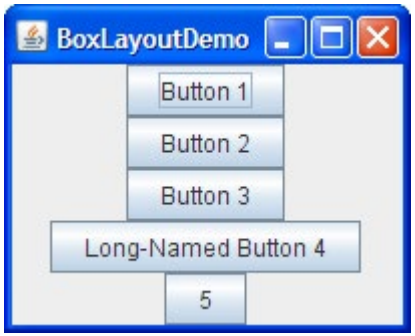


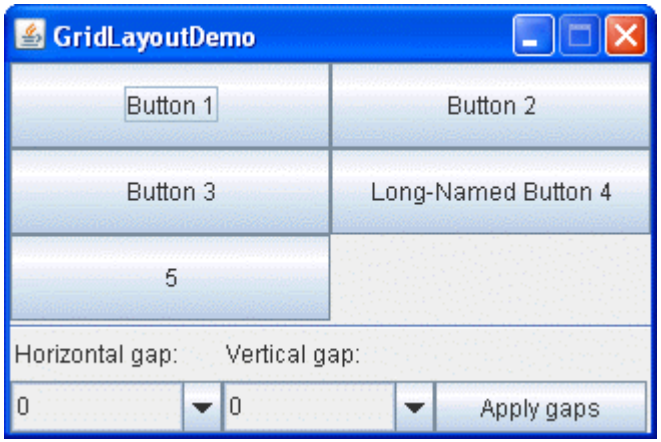
Containers - Layout

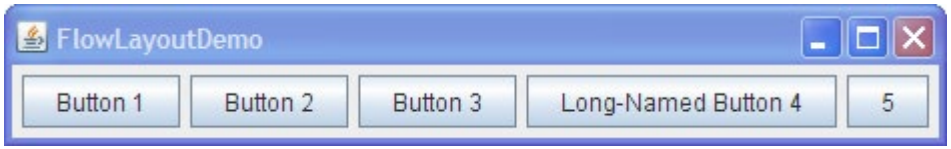
- Each container has a layout manager
  - Determines the size, location of contained widgets.
- Setting the current layout of a container:
  `void setLayout(LayoutManager lm)`
- *`LayoutManager`* implementing classes:
  - `BorderLayout`
  - `BoxLayout`
  - `FlowLayout`
  - `GridLayout`

Containers - Layout

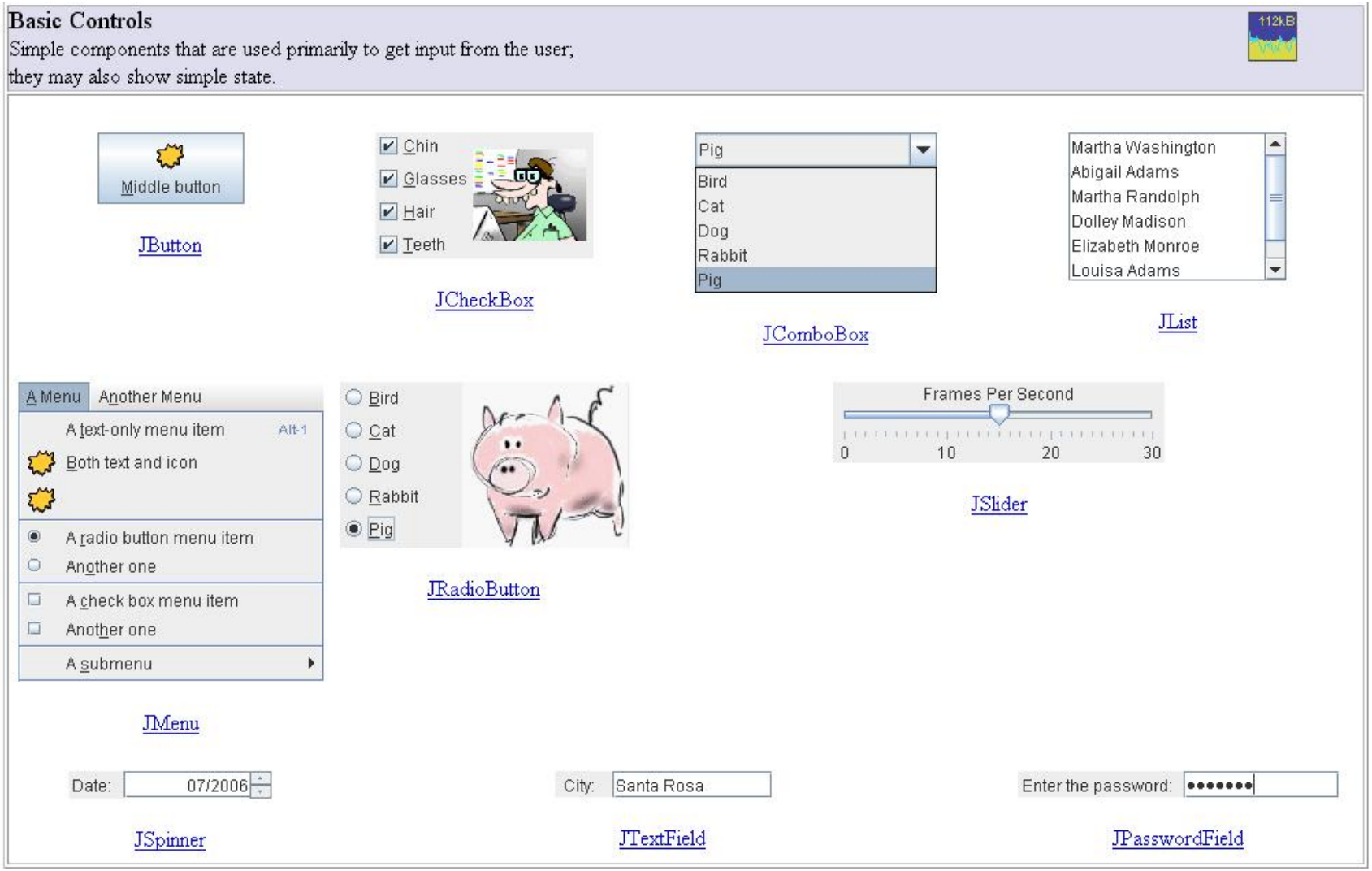




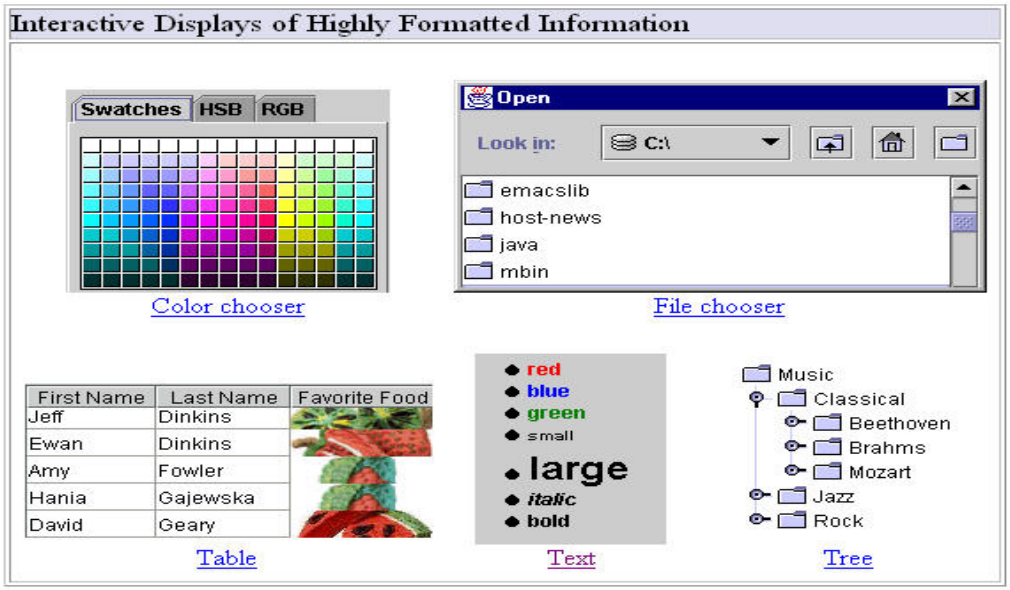


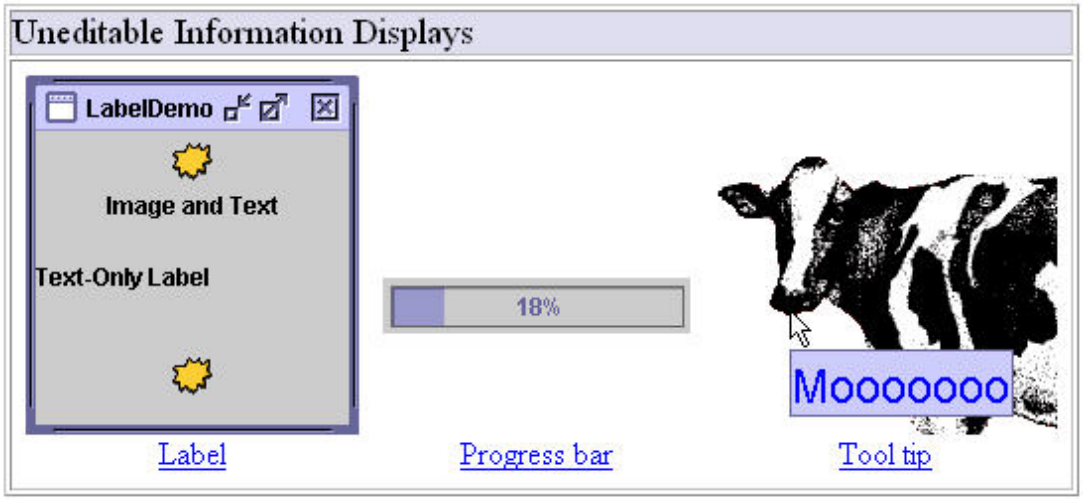


Swing Components



Swing Components





First Swing Program Revisited

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import java.awt.BorderLayout;

public class First {
  public static void main(String[] args) {
    JFrame frame = new JFrame("My First Fra

    // operation to do when the window is cl
    frame.setDefaultCloseOperation(JFrame      rr_ON_CLOSE);

    frame.getContentPane().setLayout(new BorderLayout());
    frame.getContentPane().add(new JLabel("I Love Swing"),
       BorderLayout.CENTER);
    frame.pa k();
    frame.s  isible(true);
  }
}
```

Create a frame

Choose the border layout

Create a text label

Add the label to the content pane

Specify CENTER as the layout position

Input

- So we now know how to present widgets on the screen
- A program also needs to react to the user's actions
- Examples:
  - When the user presses a button we want to save a file
  - When the user closes the program we want to ask “are you sure?”
  - ...
- Swing mechanism: Events and Listeners

Events, Listeners

- Swing defines all sorts of Listener interfaces
  - E.g.: `ActionListener, MouseMotionListener, WindowListener, ...`

```
public interface ActionListener extends EventListener {
  public void actionPerformed(ActionEvent e);
}

public interface MouseMotionListener extends EventListener {
  public void mouseDragged(MouseEvent e);
  public void mouseMoved(MouseEvent e);
}
```

- There are default (empty) implementations for many of the listeners
  - E.g.: `MouseMotionAdapter, WindowAdapter`

Events, Listeners (cont.)

- A listener is an object that implements a listener interface
- If we need to react to an event (on a certain widget) we register a listener object with that widget
- E.g.: `addActionListener()` registers an action listener with its receiver:

```
JButton button = new JButton();
ActionListener listener = ...;
button.addActionListener(listener);
```

- When an event occurs, all registered listeners are notified
  - The appropriate listener method (e.g: `actionPerformed()`) is invoked
  - An object describing the event is passed as a parameter

Event Handling Demo: GUI

Event Handling Demo: Code

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

public class Events implements ActionListener  {
   public Events() {
    JFrame frame = new JFrame("Events");
    frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

    frame.getContentPane().setLayout(new FlowLayout());
    JButton b = new JButton("Click me!");
    b.addActionListener(this);
    frame.getContentPane().add(b);

    frame.pack();
    frame.setVisible(true);
  }
  public void actionPerformed(ActionEvent e) {
    JOptionPane.showMessageDialog(null, "Thank you");
  }
  public static void main(String[] args)  { new Events(); }
}
```

Inner Classes

- Nested within another classes
- Instance specific:
  - Has access to methods & fields of the object that created it
  - => An inner class has TWO this variables
- Can be static
  - Can access only static members and methods only
  - A static method cannot create a non-static inner class

Local Classes

- Same as inner classes but defined inside a method
- Has access to local variables of the enclosing method
  - Only if the variable is defined as final
- Can be anonymous
  - Doesn’t have a name.

Event Handling Demo: Local Class

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

public class Events {
   public Events() {
     JFrame frame = new JFrame("Events");
     frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

     frame.getContentPane().setLayout(new FlowLayout());
     JButton b = new JButton("Click me!");
     b.addActionListener(new ActionListener() {
       public void actionPerformed(ActionEvent e) {
         JOptionPane.showMessageDialog(null, "Thank you");
       }
     });
     frame.getContentPane().add(b);

     frame.pack();
     frame.setVisible(true);
   }
   public static void main(String[] args)  { new Events(); }
}
```

Accessing Fields of Enclosing Object

```
public class A {
  int x = 0;
  public void f() {
    B b = new B();
    b.g();
    System.out.println(x);   // Output: 5
  }

  public class B {
    public void g() { x = 5; }
  }

  public static void main(String[] args) {
    new A().f();
  }
}
```

内部类

Using the Second this Variable

```
public class A {
  public void f() {
    B b = new B();
    System.out.println(b.g());   // Output: 1024
  }

  public int g() { return 512; }

  public class B {
    public int g() { return A.this.g() * 2; }
  }

  public static void main(String[] args) {
    new A().f();
  }
}
```