1.00 Lecture 18

Swing Event Model

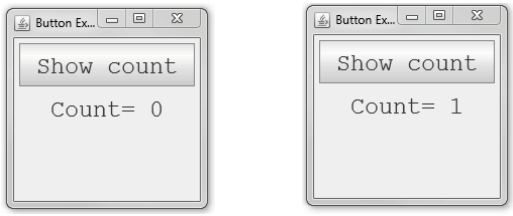
Reading for next time: Text 9.5, 18.3

GUI Event Model: Paradigm Shift

- **Operating system (Windows, JVM) runs the show:**
  - **Monitors keystroke, mouse, other I/O events from sources**
  - **Dispatches event messages to programs that need to know**
  - **Each program decides what to do when the event occurs**
- **This is the reverse of console-oriented programming, where the program runs the show, and asks the operating system (OS) to get input when it wants it**
- **Event sources: menus, buttons, scrollbars, etc.**
  - **Have methods allowing event listeners to register with them**
  - **When event occurs, source sends message (an event object) to all registered listener objects**
  - **`EventObject` is the superclass**
    - **`ActionEvent`, `MouseEvent`, etc. are subclasses that we use**
- **Event listeners: objects in your program that respond to events**

Exercise 1: Button Events

- Download ButtonFrame, ButtonTest, ButtonPanel
- We will build an application
  - User presses button
  - Application shows number of button presses
- Demo



Exercise 1 cont.

- Preliminaries:
  - Complete ButtonTest as shown on next page:
    - main():
      - Create new ButtonFrame object (inherits from JFrame, ButtonFrame class to be written next)
      - Sets default close operation
      - Sets frame visible
  - Complete ButtonFrame:
    - Set title
    - Set size
    - Get contentPane
    - Create ButtonPanel object (ButtonPanel written next)
    - Add the ButtonPanel object to the contentPane
  - Use last lecture's notes as a guide

Exercise 1: ButtonTest/Frame

```
import javax.swing.*;
public class ButtonTest {
   public static void main(String[] args) {
        // Create new frame (what class?)
        // Set default close option
        // Show frame (set visible)
   }
}      // main has 3 lines of SwingTest main (last lecture)
```

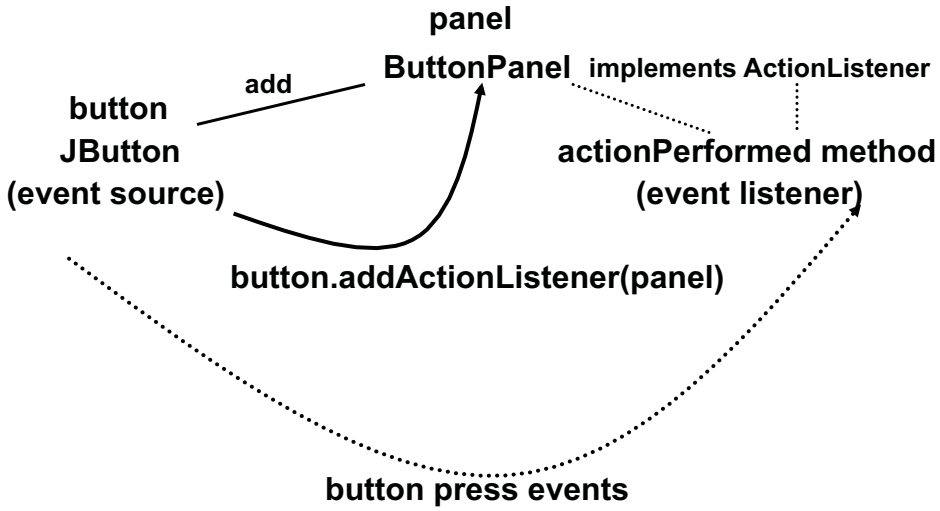
```
import java.awt.*;
import javax.swing.*;
public class ButtonFrame extends JFrame {
   public ButtonFrame() {
        // Call superclass constructor with "Button Example"
        // Set size of frame (200 by 200)
        // Get content pane
        // Create new panel (ButtonPanel, to be written next)
        // Add panel to content pane in BorderLayout.CENTER
   } }  // ButtonFrame has rest of SwingTest main(last lecture)
```

SwingTest from last lecture

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

public class SwingTest {
    public static void main(String args[]) {
        JFrame frame = new JFrame("Welcome to 1.00");
        frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
        frame.setSize(500,400);
        Container contentPane= frame.getContentPane(); // No J
        // We never draw on a JFrame. Instead we update
        // components that are added to its contentPane
        JPanel panel = new JPanel();
        panel.setBackground(Color.yellow);
        // Add panel to the contentPane of the JFrame
        contentPane.add(panel, BorderLayout.CENTER);
        frame.setVisible(true);
    }
}
```

ButtonPanel, Button



Exercise 2: ButtonPanel, p.1

- Complete ButtonPanel constructor on next slide:
  - Create `JButton`, `JLabel`, `Font` objects
  - Add the button and label objects to the `ButtonPanel`
  - Tell the `JButton` object to send an `ActionEvent` to the object (ButtonPanel) that is the `ActionListener`. If `panel` is the listener, and `button` is the `JButton` object

    ```
    button.addActionListener(panel);
    ```

    - In this example, since we are in the ButtonPanel constructor, and we need to refer to ButtonPanel itself, we use the keyword `this` as the argument
    - `this` is a reference to the current object; Java provides it automatically for every object
      - It's a hidden first argument in every method call
  - Last, read the `actionPerformed` method to understand what it does

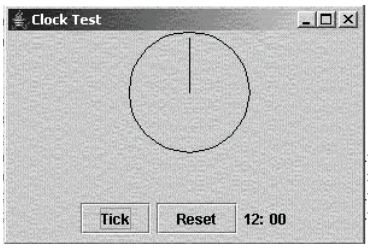
Exercise 2: Button, p.2

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
public class ButtonPanel extends JPanel implements ActionListener {
    private int i= 0;
    private JLabel countLabel;
    private JButton countButton;

    public ButtonPanel() {
        // Create new JButton with prompt: "Show count"
        // Create new JLabel (for output) with text:"Count= 0"
        // Create new Font font1: "Monospaced", Font.PLAIN, size 24
        countLabel.setFont(font1);
        countButton.setFont(font1);
        // Add your button to ButtonPanel (use add() method)
        // Add your label to ButtonPanel (use add() method)
        // Make the ButtonPanel object be the action listener
        // (We're in the ButtonPanel constructor, so use this)
    }
    public void actionPerformed(ActionEvent e) {
        i++;
        countLabel.setText("Count= " + i);
    }
}
```

Exercise 3: Clock

- You'll complete a clock:



- ClockFrame: written for you
  - Main: creates new ClockFrame
  - Constructor:
    - Gets contentPane, creates ClockPanel, adds to contentPane
- ClockPanel: complete two blocks of code
  - Constructor: Creates 2 buttons, 2 labels, adds to panel
  - Overrides paintComponent(), has actionPerformed()

Exercise 3: Clock

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

public class ClockFrame extends JFrame{
    public ClockFrame() {
        super("Clock Test");          // Or setTitle(…)
        setSize(300, 200);
        ClockPanel clock = new ClockPanel();
        Container contentPane= getContentPane();
        contentPane.add(clock, BorderLayout.CENTER);
    }

   public static void main(String[] args) {
        ClockFrame frame = new ClockFrame();
        frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
        frame.setVisible(true);
    }
}
```

Exercise 3: Clock

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

public class ClockPanel extends JPanel implements ActionListener {
    private JButton tickButton, resetButton;
    private JLabel hourLabel, minuteLabel;
    private int minutes = 720;              // 12 noon

    public ClockPanel(){
        JPanel bottomPanel = new JPanel();
        tickButton = new JButton("Tick");
        resetButton = new JButton("Reset");
        hourLabel = new JLabel("12:");
        minuteLabel = new JLabel("00");
        bottomPanel.add(tickButton);
        bottomPanel.add(resetButton);
        bottomPanel.add(hourLabel);
        bottomPanel.add(minuteLabel);
        setLayout(new BorderLayout());      // Next lecture
        add(bottomPanel, BorderLayout.SOUTH);
        // Who will listen to the button events? Your code here
    }
```

Exercise 3: Clock

```
public void paintComponent(Graphics g) {
     super.paintComponent(g);
     Graphics2D g2= (Graphics2D) g;

     Shape e= new Ellipse2D.Double(100, 0, 100, 100);
     g2.draw(e);

     double hourAngle = 2*Math.PI*(minutes- 3*60)/(12*60);
     double minuteAngle = 2*Math.PI * (minutes - 15) / 60;

     Line2D.Double hour= new Line2D.Double(150, 50,
            150 + (int) (30 * Math.cos(hourAngle)),
            50 + (int) (30 * Math.sin(hourAngle)));
     g2.draw(hour);

     Line2D.Double m= new Line2D.Double(150, 50,
            150 + (int) (45 * Math.cos(minuteAngle)),
            50 + (int) (45 * Math.sin(minuteAngle)));
     g2.draw(m);
}
```

Exercise 3: Clock

```
public void setLabels(){           // Doesn't handle midnight
      int hours = minutes/60;
      int min = minutes - hours*60;
      hourLabel.setText(hours+ ":");
      if (min < 10)                // Minutes should be two digits
          minuteLabel.setText("0" + min);
      else
          minuteLabel.setText("" + min);
}

public void actionPerformed(ActionEvent e) {
     if (e.getSource().equals(tickButton))
            // Complete this code: update clock and labels
      else   // Reset button
            // Complete this code: update clock and labels
}
}
```

Clock Exercise Methods

- **Methods**
  - **paintComponent(Graphics g):**
    - **This method draws the clock and the hours and minutes hands based on `minutes`**
  - `setLabels()`:
    - **This method sets the hour and minute labels to the correct values based on `minutes`. It is a helper method you can call when writing `actionPerformed()`**
  - `actionPerformed()`:
    - **If the event is from the tick button,**
      - **increment `minutes` by one and repaint the clock**
      - **repaint() will call the paintComponent() method which will redraw the clock with the clock hands adjusted to the new `minutes` value**
      - **We never call paintComponent() directly; always use repaint(). JVM manages the calls to paintComponent() –repaint() is a request to call paintComponent(). JVM must repaint when other apps obscure, etc.**
      - **Update the labels**
    - **If the event is from the reset button**
      - **Reset `minutes` to 720 (noon), repaint the clock and update the labels**

Clock Exercise 3

- **ClockFrame should compile and run after you've placed it in Eclipse**
  - **It won't, alas, do anything**
- **To make it do something:**
  - **Hook up the listener to the buttons in the ClockPanel constructor**
    - **The ClockPanel object is the listener that updates the display, so use the 'this' keyword**
  - **Complete the actionPerformed() method in class ClockPanel**
- **If you have time:**
  - **Move the clock figure away from the top of the frame**
  - **Make the clock circle, hour and minute hands be different colors and thicknesses**
  - **Handle midnight correctly**

1.00 / 1.001 / 1.002 Introduction to Computers and Engineering Problem Solving
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