Graphic User Interfaces

GEEN163 Introduction to Computer Programming

"An ounce of practice is worth more than tons of preaching."

Mahatma Gandhi

Inherited Consistency

- Because many of the capabilities of a GUI object come from parent classes, you use the same methods to specify these capabilities for all objects
- An object of the class JButton or JTextField or any of the other GUI classes is also a member of the JComponent class
- Methods to set the color, font, size, position and many other properties are common for all components

Making a GUI

1. Create a class to extend JFrame
2. Create component objects
3. Specify the layout manager
4. Add the component objects to the container
5. Make the GUI visible and stoppable
6. Specify which objects respond to user input

Extending JFrame

- You can create a GUI by extending javax.swing.JFrame
- The class JFrame provides the “frame” where the GUI will be located

```
public class MyGUI extends
        javax.swing.JFrame {
}
```

Initializing

- GUIs should have a constructor method

```
public MyGUI(){
    // GUI initialization
}
```

- Your main method calls the constructor

```
public static void main(String[] rat){
    MyGUI prog = new MyGUI();
}
```

Creating a GUI

```
public class MyGUI extends javax.swing.JFrame {

    public MyGUI() {
        setSize(250, 200);
    }
   public static void main(String[] rat){
        MyGUI prog = new MyGUI();
  }
}
```

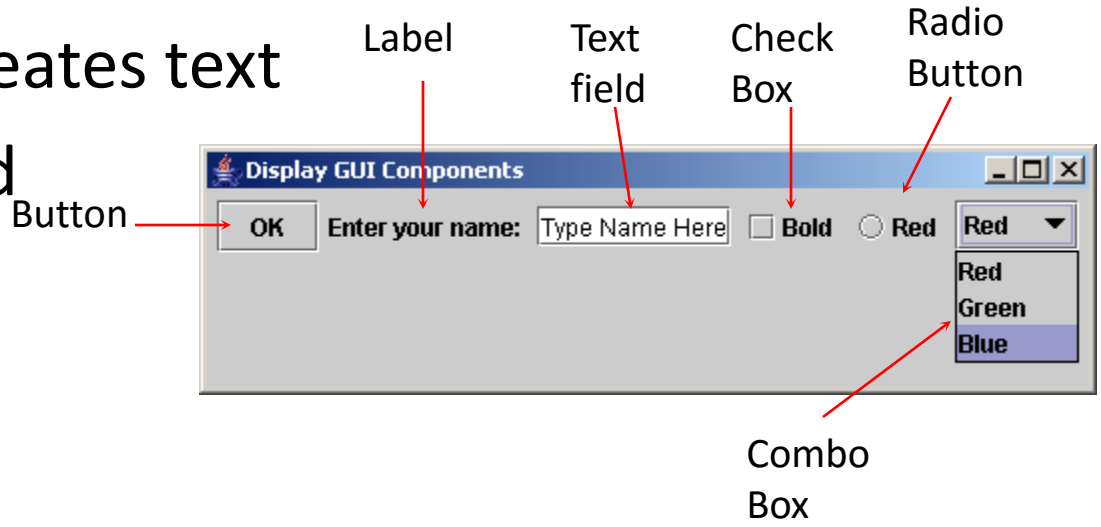
Setting the Frame Size

- You can specify how big the frame will be with the **`setSize( xSize, ySize )`** method
- The sizes are specified in pixels the same as the graphics methods used

Creating GUI Objects

All of the parts of a GUI are Java objects.

- javax.swing.JButton creates buttons
- javax.swing.JLabel creates text
- javax.swing.JTextField creates input boxes



- javax.swing.JCheckBox creates check boxes
- javax.swing.JRadioButton creates radio buttons
- javax.swing.JComboBox creates menu boxes

Creating Components

- Most Swing components have a constructor that takes one String parameter specifying the text to be displayed in that component

```
javax.swing.JButton dog =
     new javax.swing.JButton( "OK" );
javax.swing.JLabel cat =
     new javax.swing.JLabel("Hi there");
```

Components as Instance Variables

- The GUI component variables should be defined in the class and **not** in the constructor method
- Calls to methods of the components are often put in the constructor method of a GUI class

Creating Components

```
public class MyGUI extends  javax.swing.JFrame {

   javax.swing.JButton dog = new javax.swing.JButton( "Go" );
   javax.swing.JLabel cat     = new javax.swing.JLabel("GEEN163");

 public MyGUI() {
      setSize(250, 200);
   }
 public static void main(String[] rat){
            MyGUI prog = new MyGUI();
   }
}
```

Content Pane

- A frame has a content pane that holds the visible components of the GUI, like buttons
- Programs need to get the content pane using the getContentPane() method of frame

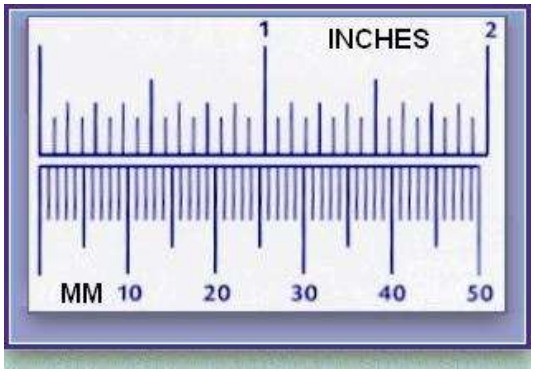
```
java.awt.Container   goat = getContentPane();
```

Creating Components

```
public class MyGUI extends  javax.swing.JFrame {
  javax.swing.JButton dog = new javax.swing.JButton( "Go" );
  javax.swing.JLabel cat     = new javax.swing.JLabel("GEEN163");


 public MyGUI() {
     setSize(250, 200);
     java.awt.Container goat = getContentPane();
  }
 public static void main(String[] rat){
          MyGUI prog = new MyGUI();
  }
}
```

The size of GUI components is measured in



A. inches
B. millimeters
C. pixels
D. pixies

Putting Them Where You Want Them

- The **Layout Manager** determines where components will appear in a GUI
- There are several ways to specify position and size
- Some are more portable than others
- Some are more frustrating than others

Layout Managers

- BoxLayout
- FlowLayout
- GridLayout
- BorderLayout
- Absolute Positioning

BoxLayout

- The BoxLayout is relatively simple
- It positions components as “boxes” either top to bottom (Y_AXIS) or left to right (X_AXIS)
- You must create a BoxLayout object

```
javax.swing.BoxLayout   whale =  new
javax.swing.BoxLayout(goat,javax.swing.BoxLayout.Y_AXIS);
```

or

```
import javax.swing.*;
BoxLayout   whale =
                        new BoxLayout(goat, BoxLayout.Y_AXIS);
```

Specifying the Layout Manager

- You must specify what layout manager your program will use with the **`setLayout`** method
- The parameter of the **`setLayout`** method is any layout manager object

```
javax.swing.BoxLayout   whale =  new
        javax.swing.BoxLayout(goat,javax.swing.BoxLayout.Y_AXIS);

setLayout( whale );
```

Adding Layout Manager

```
public class MyGUI extends javax.swing.JFrame {
   javax.swing.JButton dog = new javax.swing.JButton( "Go" );
   javax.swing.JLabel cat     = new javax.swing.JLabel("GEEN163");
   public MyGUI() {
      setSize(250, 200);
      java.awt.Container goat = getContentPane();
      javax.swing.BoxLayout   whale =  new
            javax.swing.BoxLayout(goat,javax.swing.BoxLayout.Y_AXIS);
      setLayout( whale );
    }
 public static void main(String[] rat){
         MyGUI prog = new MyGUI();
  }
}
```

GUI components should be

A. objects and not variables
B. local variables of constructor
C. local variables of main
D. instance variables of the class

Adding Components to a GUI

- To make them appear in a frame the components must be added to the content pane
- The add method links a component to a content pane object

```
goat.add( GUIthing );
```

- The order in which the components are added determines the order in which they will appear in the GUI

Adding Components

```
public class MyGUI extends javax.swing.JFrame {
   javax.swing.JButton dog = new javax.swing.JButton( "Go" );
   javax.swing.JLabel    cat  = new javax.swing.JLabel("GEEN163");
   public MyGUI() {
      setSize(150, 100);
      java.awt.Container goat = getContentPane();
      javax.swing.BoxLayout whale =  new
            javax.swing.BoxLayout(goat,javax.swing.BoxLayout.Y_AXIS);
      setLayout( whale );
     goat.add( cat );
     goat.add( dog );
   }
 public static void main(String[] rat){
         MyGUI prog = new MyGUI();
  }
}
```

Making It Start and Stop

- To make your program terminate if you press the red **X** in the upper right corner, include

```
setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
```

- Call `setVisible(true)` to make the frame appear onscreen

The Full GUI Initialization

```
public class MyGUI extends javax.swing.JFrame {
   javax.swing.JButton dog = new javax.swing.JButton( "Go" );
   javax.swing.JLabel    cat  = new javax.swing.JLabel("GEEN163");
   public MyGUI() {
      setSize(150, 100);
      java.awt.Container goat = getContentPane();
      javax.swing.BoxLayout whale =  new
            javax.swing.BoxLayout(goat,javax.swing.BoxLayout.Y_AXIS);
      setLayout( whale );
     goat.add( cat );
     goat.add( dog );
     setDefaultCloseOperation(javax.swing.JFrame.EXIT_ON_CLOSE);
     setVisible( true );
   }
 public static void main(String[] rat){
           MyGUI prog = new MyGUI();
  }
}
```

Jar Files

- A jar file is a collection of compiled Java classes

```
>jar tf BMPfile.jar  // display contents of jar
      META-INF/MANIFEST.MF
      BMPcomponent.class
      BMPfile.class
```

- The manifest file contains information about the files in the jar

Nothing Happens?

- When you press the button of our example GUI program, nothing happens
- You can specify a method to be called whenever a button is pressed or something is done to a component

Steps to Respond to Actions

To make an GUI respond in user input:

- Implement java.awt.event.ActionListener
- Add an action listener to the component
- Create an actionPerformed method

Implementing Interfaces

- Implementing an interface is similar to extending a class
- Interfaces are an advanced feature to be explained in detail in GEEN165

```
public class MyApplet
        extends javax.swing.JFrame
        implements java.awt.event.ActionListener {
```

Listeners

- Java has the concept of listeners
- Listener methods will be called when something happens
- There is a MouseListener, KeyListener, FocusListener, CellEditorListener and many more
- An ActionListener calls a method when the user takes some action with a component in the GUI

Adding a Listener

- The method **addActionListener** should be called on each GUI component that can do something
- Do not call addActionListener on components that do not do anything, like JLabel

```
javax.swing.JButton  kangaroo = new
                        javax.swing.JButton("Go");
        …
kangaroo.addActionListener( this );
```

Who Does It

- The parameter to the addActionListener method is the name of an object that implements ActionListener and has an actionPerformed method
- If the actionPerformed method is in the same class that call addActionListener, the usual parameter is **`this`**
- **`this`** is the name of ***this*** object

What Happens

- When a user clicks an object with an ActionListener, Java calls the method

```
public void actionPerformed(
                java.awt.event.ActionEvent  chicken) {
    // do something here
}
```

- This method should do what the user expects to happen when the button is pressed

GUI Structure

- Class extending JFrame and implementing ActionListener
- GUI component objects defined
- Constructor method
  - Initializes the GUI
  - Called only once at the beginning
- ActionPerformed method
  - Gets input and sets output
  - Called each time something is clicked

When a button is pressed, Java calls

A. actionPerformed
B. add
C. actionEventChoice
D. init

Changing a Component's Text

- A useful method is setText It can be used to change the text of any object that has text, such as JButtons, JLabels and JTextfields

```
javax.swing.JLabel   trout   =
        new javax.swing.JLabel("Do something");

trout.setText("Don't do something");
```

GUI Output

- When a program with a GUI wants to display a result, it usually puts the value in a JLabel object.

```
JLabel aardvark = new JLabel();
                  …
double answer = some equation;
aardvark.setText("The answer is "+answer);
```

```
public class MyGUIaction extends javax.swing.JFrame implements
                                 java.awt.event.ActionListener {
   javax.swing.JButton dog = new javax.swing.JButton( "Go" );
   javax.swing.JLabel  cat = new javax.swing.JLabel("GEEN163");
   int  counter = 0;
   public MyGUIaction() {
      setSize(200, 100);
      java.awt.Container goat = getContentPane();
      javax.swing.BoxLayout whale =  new
        javax.swing.BoxLayout(goat,javax.swing.BoxLayout.Y_AXIS);
      setLayout( whale );
      goat.add( cat );
      goat.add( dog );
      dog.addActionListener( this );
       setDefaultCloseOperation(javax.swing.JFrame.EXIT_ON_CLOSE);
      setVisible( true );
   }
   public void actionPerformed(java.awt.event.ActionEvent thing) {
      counter = counter + 1;
      cat.setText("pressed " + counter   + " times");
   }
   public static void main(String[] rat){
      MyGUIaction prog = new MyGUIaction();
   }
}
```

Making a GUI

1. Create a class that extends JFrame and implements java.awt.event.ActionListener
2. Create component objects
3. Specify the layout manager
4. Add the component objects to the container
5. Add an action listener to the components that respond to user input
6. Create an actionPerformed method

Change of Thinking

- Applets do not have a main method
  - The init method is used to initialize the GUI
- Input is usually from JTextfield objects
  - java.util.Scanner is **not** used
- Output is usually to JLabel objects
  - System.out is **not** used

String and Numbers

- A String can contain any character on the keyboard, including the numbers

```
String myGrade = "4.0";
double myScore = 4.0;
```

- You cannot do arithmetic with Strings
- A string containing numerical characters must be converted to a double or an int for use in any calculations

Converting Strings to Numbers

- A String that contains numerical characters can be converted using

```
double cow = Double.parseDouble("2.25" );
String four = "4";
int goat = Integer.parseInt( four );
```

- These methods will throw an exception if the string does not contain a number

Inputting Numbers

- The getText() method returns a String
- If a number is entered in a JTextField, it will have to be converted to an int or double

```
JTextField gekko = new JTextField();
                    // in the actionPerformed method
String dragon = gekko.getText();
double lizard = Double.parseDouble( dragon );
```

getText and setText

- The getText and setText methods can be called on all of the GUI components
- The actionPerformed method of most programs
  - Call getText to get the input
  - Calculate a value
  - Call setText to display the result in the GUI

Example Numeric Input

```
import javax.swing.*;
public class GUImult extends JFrame implements
                                java.awt.event.ActionListener {
    JTextField inAmount = new JTextField();
    JLabel     answer   = new JLabel("Enter a number ");
public GUImult() {
    setSize(200, 70);
    java.awt.Container pane = getContentPane();
    BoxLayout where = new BoxLayout(pane, BoxLayout.X_AXIS);
    setLayout( where );
    pane.add( answer );
    pane.add( inAmount );
    inAmount.addActionListener( this );
    setDefaultCloseOperation(javax.swing.JFrame.EXIT_ON_CLOSE);
    setVisible( true );
}
public void actionPerformed(java.awt.event.ActionEvent thing) {
  String numStr = inAmount.getText();
  double amount = Double.parseDouble( numStr );
  answer.setText("Twice the number "+amount*2.0+"  ");
}
public static void main(String[] cow) {
  GUImult horse = new GUImult();
}
```

Homework

- The weekly programming assignment is posted on Blackboard
- Program is due by midnight on Friday