BreezySwing: A Lightweight Toolkit for the Construction of Easy, Realistic GUIs in CS1

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Problem Statement
Beginning students find it difficult to write realistic, event-driven programs with GUIs using just java.awt and javax.swing. One challenge is to find a solution that avoids distortions of GUI-based programming, such as the use of a series of simple modal dialogs for inputs. Another challenge is to provide an API that is lightweight enough that it both resembles “real Java” and can be easily trimmed away when students reach maturity.

Solution Overview
BreezySwing, like its predecessor, BreezyGUI [Lambert99, Lambert00], is a package of classes that allows students to construct easy, realistic GUIs. The package includes container classes that are extensions of JFrame, JDialog, and JApplet. Each container class encapsulates the details of a gridbag layout, allowing the student to place many types of standard components by specifying simple row and column positions, a width in columns, and a height in rows. In addition, each container class encapsulates the details of Java’s event handling mechanism by including single methods for responding to button clicks, menu item selections, and list box selections. The classes DoubleField and IntegerField are extensions of JTextField that hide the details of numeric I/O. Finally, the class GBPanel extends JPanel by including methods that simplify the handing of mouse events in graphics applications. The use of BreezySwing focuses students’ attention immediately on the idea that a user interface is built from a collection of objects that cooperate by sending messages. Students design an interface by choosing widget/objects of the appropriate types and quickly laying them out in a container. The rest of their time can then be focused on designing and implementing the algorithms that respond to events in the user interface and the code that manages the data in the application’s model.

Experience with the Solution
We have used BreezySwing in CS1 and CS2 classes for four years. We have published two editions of a CS1 college textbook that uses BreezySwing and has been adopted by many institutions around the world. We have also published a widely adopted AP textbook that uses BreezySwing. We have heard that the package has been used in classes where the textbooks were not adopted. Users’ reports of BreezySwing in the first course have been uniformly positive. We have heard some complaints from cognoscenti who are not users that the details of event handling (the listeners) should not be encapsulated, but no actual users in the first course have agreed with this criticism. We also included BreezySwing in the first edition of a CS2 book. Several users of this book complained that they had trouble weaning their students away from the package by the end of the course. To address this problem, we included a lighter weight version of BreezySwing, called iutil, in the second edition of the CS2 book.
API Documentation

Here is an example of an interactive counter applet with BreezySwing:

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

public class CounterApp extends GBApplet{
    private int counter = 0;
    private IntegerField counterField = addIntegerField(0, 1,1,2,1);
    private JButton incButton = addButton("Increment",   2,1,1,1);
    private JButton resetButton = addButton("Reset",       2,2,1,1);

    public void buttonClicked(JButton buttonObj){
        if (buttonObj == incButton)
            counter++;
        else
            counter = 0;
        counterField.setNumber(counter);
    }
}
```

To convert this code to a Java application, one just replaces GBApplet with GBFrame and includes an appropriate main method.

Method calls to add components to a container have the following form:

```
add<type>(<initial value>, <row>, <col>, <width>, <height>)
```

Menu items are added and returned by the following type of method call:

```
addMenuItem(<string name of menu>,  <string name of item>)
```

In addition to buttonClicked, the following single methods can be overridden to respond to user events:

```
public void menuItemSelected(JMenuItem mi)
public void listitemSelected(JList listObj)
public void listDoubleClicked(JList listObj, String itemClicked)
```

All of the standard MouseListener and MouseMotionListener methods are encapsulated in the GBPanel class, which essentially wraps their behavior in the more easily used methods

```
public void mouseClicked(int x, int y)
public void mouseMoved(int x, int y)
```

etc.

Complete documentation and downloads of BreezySwing are available at [www.cs.wwu.edu/martin](http://www.cs.wwu.edu/martin), scroll down to “Open source software packages.”